EUCHNER

**Operating Instructions
Installation and Use**

Modular Safety Control System MSC

Contents

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1. About this document

1.1. Scope

These operating instructions, the document *Safety information* and any available brief instructions form the complete user information for your device.

ⓘ	**Important!** Make sure to use the operating instructions valid for your product version. Please contact the EUCHNER service team if you have any questions.

1.2. Target group

Design engineers and installation planners for safety systems on machines, as well as setup and servicing staff possessing special expertise in handling safety components.

1.3. Key to symbols

Symbol/depiction	Meaning
📖	Printed document
(www)	Document is available for download at www.euchner.com
⚠️ **DANGER** **WARNING** **CAUTION**	Safety precautions **Danger** of death or severe injuries **Warning** about possible injuries **Caution** slight injuries possible
ⓘ **NOTICE** **Important!**	**Notice** about possible device damage **Important** information
Tip!	Useful information

1.4. Supplementary documents

The overall documentation for this device consists of the following documents:

Document title (document number)	Contents	
Safety information (2525460)	Basic safety information	📖
Operating Instructions Modular Safety Control System MSC (2121331)	(this document)	(www)
Possibly brief instructions enclosed	Take any associated additions to the operating instructions or data sheets into account	(www)

ⓘ	**Important!** Always read all documents to gain a complete overview of safe installation, setup and use of the device. The documents can be downloaded from www.euchner.com. For this purpose enter the doc. no. in the search box.

1.5. Exclusion of liability and warranty

In case of failure to comply with the conditions for correct use stated above, or if the safety regulations are not followed, or if any servicing is not performed as required, liability will be excluded and the warranty void.

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1.6. Notes on cybersecurity

EUCHNER components and systems must not be integrated into public networks. EUCHNER components are intended only for use in private networks. Use a VPN for remote access.

1.7. Notes about the EU Data Act

During information, this product produces data that are available to the user in accordance with EU Regulation 2023/2854 (Data Act). The corresponding chapters in these operating instructions explain what these data are and how you can access and use them.

2. Introduction

2.1. Contents of this manual

The use of the programmable safety system MSC and the related expansion modules ("SLAVES") is described in this manual.

It covers:
‣ System description
‣ Installation procedure
‣ Connections
‣ Signals
‣ Troubleshooting
‣ Use of the configuration software

2.2. Important safety precautions

⚠ **WARNING**

‣ MSC achieves the following safety levels: SIL 3, Maximum SIL 3, PL e, cat. 4, type 4 in accordance with the applicable standards.
However, the final SIL and PL safety categories for the application are dependent on the number of safety components, their parameters and the connections made, as per the risk analysis.

‣ Read the section "Applicable standards" carefully.

‣ Perform a comprehensive risk analysis to determine the corresponding safety level for the specific application based on all applicable standards.

‣ The programming/configuration of the MSC system is the sole responsibility of the installer or the user.

‣ This programming/configuration must correspond to the application-specific risk analysis and all applicable standards.

‣ After programming/configuration and installation of the MSC system and all related devices, a complete application safety check must be performed (see section *"Checking the system" on page 104*).

‣ After adding new safety components, the complete system must always be checked (see section *"Checking the system" on page 104*).

‣ EUCHNER is not liable for these processes or for the related risks.

‣ To ensure the correct use of the modules connected to the MSC system within the stated application, reference should be made to the operating instructions/manuals and the related product and/or application standards.

‣ The ambient temperature at the installation location for the system must match the operating temperatures stated on the product label and in the specifications.

‣ In the event of safety-related questions, if necessary contact the responsible safety authorities in your country or the responsible specialist association.

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2.3. Abbreviations and symbols

Abbreviations and symbols	
M-A1	Memory card for MSC basic module (accessory)
MSCB	Proprietary bus for expansion modules
EUCHNER Safety Designer (SWSD)	MSC configuration software for Windows
OSSD	Output signal switching device
MTTF$_D$	Mean Time to Dangerous Failure
PL	Performance Level (according to EN ISO 13849-1)
PFH	Probability of Dangerous Failure per Hour
SIL	Safety Integrity Level (according to EN IEC 61508)
Maximum SIL	Safety Integrity Level Claim Limit (according to EN IEC 62061:2021)
SW	Software

2.4. Applicable standards

MSC complies with the following European directives:
‣ 2006/42/EC   "Machinery Directive"
‣ 2014/30/EU   "EMC Directive"
‣ 2014/35/EU   "Low Voltage Directive"
‣ 2011/65/EU   RoHS "Restriction of the use of certain hazardous substances in electrical and electronic equipment"

It additionally corresponds to the following standards:
‣ EN IEC 61131-2
‣ EN ISO 13849-1
‣ EN IEC 61496-1
‣ EN IEC 61508-1
‣ EN IEC 61508-2
‣ EN IEC 61508-3
‣ EN IEC 63000
‣ EN IEC 62061
‣ EN 81-20
‣ EN 81-50

2.5. Combination options for the MSC system

Basic module	Expansion module	
	MSC-CE-...S	**MSC-CE-...**
MSC-CB-AC-FI8F04S	●	●
MSC-CB-AC-FI8F02	–	●

Key to symbols	●	Combination possible
	–	Combination not possible

3. Overview

MSC is a modular safety system and comprises a basic module (MSC-CB or MSC-CB-S), which can be configured using the graphic user interface EUCHNER Safety Designer, and various expansion modules that can be connected to the basic module via the proprietary MSCB bus.

Two basic modules that can be used as standalone devices are available.

‣ **MSC-CB** with 8 safety inputs, 2 programmable monitoring outputs and 2 separate, programmable 2-channel safety outputs (OSSD)

‣ **MSC-CB-S** with 8 safety inputs, up to 4 programmable monitoring outputs and 2 separate, programmable 2-channel or 4 separate, programmable 1-channel safety outputs (OSSD)

	Important!

ⓘ	The following expansion modules are available:
	‣ **FI8FO2**, **FI8FO4S** with inputs and outputs,
	‣ **FI8**, **FM4**, **FI16**, **SPM0**, **SPM1** and **SPM2** only with inputs,
	‣ **AC-FO2** and **AC-FO4** only with outputs,
	  - plus **O8**, **O16** and **AH-FO4SO8** with monitoring outputs,
	  - as well as **AZ-FO4** and **AZ-FO4O8** with positively driven safety relays.
	
	Expansion modules for connection to the most common industrial fieldbus systems for diagnostics are also available: **CE-PR** (PROFIBUS), **CE-CO** (CANopen), **CE-DN** (DeviceNet), **CE-EI** (EtherNet/IP-2Port), **CE-PN** (PROFINET), **CE-EC** (EtherCat), **CE-MR** (Modbus RTU), **CE-MT** (Modbus TCP/IP) and **CE-US** (USB interface).

MSC makes it possible to monitor the following safety sensors and command switches:

Optoelectronic sensors (safety light grids, scanners, safety light barriers), mechanical switches, safety mats, emergency stop buttons, two-hand controls, which are all managed via one single, flexible device that can be expanded.

The system is allowed to comprise only a single basic module MSC-CB or MSC-CB-S and a maximum of 14 expansion modules, of which not more than four are allowed to be of the same type.

With 14 expansion modules, the system can have up to 128 inputs, 30 dual-channel safety outputs and 48 monitoring outputs. The modules AZ-FO4/AZ-FO4O8 have four 1-channel outputs. The greater the number of AZ-FO4/AZ-FO4O8 modules used, the fewer dual-channel outputs are available. (More information about the maximum expansion stage of an MSC system is available in Tab. *8.1.2. General data on page 43*.)

The communication between the basic module (MASTER) and the expansion modules (SLAVES) is via the MSCB 5-way bus (proprietary bus from EUCHNER) on the rear side of every module.

The number of inputs in the system can be increased using the MSC expansion modules **FI8**, **FI16** and **FM4** such that more external devices can be connected. **FM4** also provides 8 outputs of type OUT_TEST.

With the expansion modules **AC-FO2** and **AC-FO4**, the MSC system has 2 or 4 OSSD pairs to control devices connected downstream of the MSC system.

AH-FO4SO8 is a safety module with 4 single-channel high-current safety outputs and 4 associated inputs for external device monitoring contacts (EDM). The module is also equipped with 8 programmable monitoring outputs.

FI8FO2 has 8 inputs, 2 programmable monitoring outputs and 2 dual-channel OSSD outputs.

FI8FO4S has 8 inputs, up to 4 programmable monitoring outputs and 4 OSSD outputs suitable for single-channel applications.

The expansion modules in the **CE** series make it possible to connect the most common industrial fieldbus systems for diagnostics and data transmission. **CE-EI**, **CE-PN**, **CE-MT** and **CE-EC** also have an Ethernet connection. **CE-US** makes it possible to connect devices with a USB port.

CE-CI1, **CE-CI2** are modules in the **MSC** family that make it possible to connect with expansion modules farther away (< 50 m). Two **CE-CI** modules are connected at the required distance using a screened cable (in accordance with the table for the technical cable data).

The following can be monitored (up to PL e) using the expansion modules for speed monitoring **SPM0**, **SPM1** and **SPM2**:

‣ Standstill, overspeed, speed range

‣ Direction of motion, rotary motion/linear motion

Up to 4 speed limits can be defined for each logical output (axis).

Each module has two logical outputs that can be configured via EUCHNER Safety Designer. In this way up to two independent axes can be monitored.

The expansion modules **AZ-FO4** and **AZ-FO4O8** have 4 separate safety relay outputs and the corresponding 4 inputs for the external device monitoring (EDM) contacts.

Two settings are available for the outputs (configuration via the EUCHNER Safety Designer software):

‣ 2 pairs of connection contacts (2 normally open contacts per output with 2 corresponding feedback loop inputs).

‣ 4 separate individual connection contacts (1 normally open contact per output with 1 corresponding feedback loop input).

Only the modules **AZ-FO4O8, AH-FO4SO8** and **O8** have 8 programmable monitoring outputs and the module **O16** has 16 programmable monitoring outputs.

With the EUCHNER Safety Designer software (SWSD), complex logic elements can be configured using logical operators and safety functions such as muting, timers and counters, etc.

All this is achieved using a straightforward, intuitive graphic user interface.

The configuration on the PC is sent via a USB connection to basic module **MSC-CB** or **MSC-CB-S**. The file is saved in **MSC-CB/MSC-CB-S** and can also be saved on the proprietary **M-A1** memory card (accessory). In this way, it is possible to copy the configuration to a different **basic module** quickly.

ⓘ   **Important!**

The MSC system is certified for the highest safety level included in the applicable industrial safety standards (SIL 3, Maximum SIL 3, PL e, cat. 4).

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4. Layout of the product

The scope of delivery of the MSC-CB or MSC-CB-S includes:

‣ Safety information

ℹ️	**Important!**
	The MSCB plug connector on the rear and the M-A1 memory card can be ordered separately.

The scope of delivery of the expansion modules includes:

‣ Safety information
‣ Rear MSCB plug connector

ℹ️	**Important!**
	The supplied MSCB plug connector and a further MSCB plug connector are required for the connection to the MSC-CB/MSC-CB-S to install an expansion module. This can be ordered separately as an accessory.

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5. Installation

5.1. Mechanical mounting

Mounting sequence of the MSC system on a 35 mm DIN rail:

1. Ensure a de-energized state.

2. Connect expansion plugs in accordance with the number of modules to be installed.

3. Mount the row of expansion plugs on the DIN rail. Hook on from top to bottom.

4. Mount the MSC module on the DIN rail. Hook on from top to bottom. Push module into place until it noticeably engages.

5. The module can be removed by pulling down the catch on the rear side.

2

3a

3b

4

5
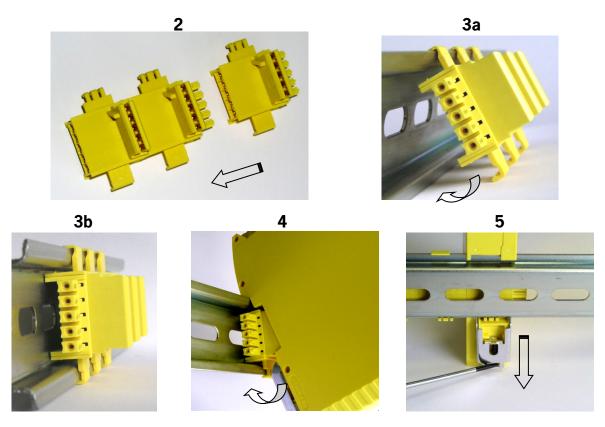
Fig. 1:   Fastening modules of the MSC system to a 35-mm DIN rail

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5.2. Calculation of the safety distance for an item of ESPE connected to the MSC system

All electro-sensitive protective equipment that is connected to the MSC system must be arranged at a distance that is at least the minimum safety distance **S** such that the danger zone can be reached only after the machine's hazardous movement has stopped.

⚠	**WARNING**
	‣ The European standard EN ISO 13855:2010- (EN 999:2008) *Safety of machinery. Positioning of protective equipment with respect to the approach speeds of parts of the human body** contains formulas for the calculation of the correct safety distance.
	‣ Specific information in relation to the correct arrangement can be found in the installation instructions for each item of protective equipment.
	‣ It is to be noted that the total reaction time is dependent on: Reaction time of MSC + reaction time of ESPE + reaction time of the machine in seconds (i.e. the time the machine requires to stop the hazardous movement from the moment when the stop signal is sent).
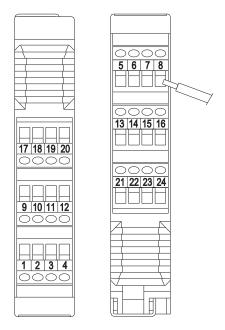
* A procedure is described that permits system planners to determine the minimum safety distance between protective equipment, in particular ESPE (e.g. light grids), safety mats or pressure-sensitive floors and two-hand controls, and a specific danger zone. It contains a rule for the arrangement of protective equipment based on the approach speed and time taken by the machine to stop, where corresponding extrapolation is possible, such that interlocking devices without guard locking are also included.

5.3. Electrical connections

The modules of the MSC system are equipped with plug-in connection terminals for the electrical connections. Each module can have 8, 16 or 24 connections. The connection terminals are designed as screw terminals and can be ordered as accessory sets.

Each module also has an MSCB plug connector on the rear. It is used for communication between the basic modules and expansion modules.

ⓘ	**Important!**
	Terminal tightening torque: 0.6 – 0.7 Nm

Fig. 2:   MSC terminal blocks

⚠	**WARNING**
	‣ Install safety modules in a housing that meets degree of protection IP54 as a minimum.
	‣ Connect module in electrically isolated state.
	‣ The power supply for the modules must be 24 V DC ±20% (PELV, in accordance with EN IEC 60204-1 (chapter 6.4)).
	‣ MSC is not allowed to be used to supply external devices.
	‣ The same ground connection (0 V DC) is to be used for all system components.

5.3.1. Notes in relation to connecting cables

ⓘ	**NOTICE**
	‣ Connection cross-section range: AWG 12 – 30 (single conductor/multiple conductor) (UL).
	‣ Use only copper conductors (Cu) with a temperature resistance of 60/75 °C.
	‣ It is recommended to use separate power supplies for the safety module and for other electrically powered devices (electric motors, inverters, frequency converters) or other sources of interference.
	‣ Cables for connections with a length of more than 50 m must have a cross-section of at least 1 mm² (AWG 16).

5.3.2. Notes about UL

Important!

‣ This device is intended to be used with a Class 2 power source.
As an alternative an LV/C (Limited Voltage/Current) power source with the following properties can be used:
This device shall be used with a suitable isolating source in conjunction with a fuse in accordance with UL248. The fuse shall be rated max. 3.3 A and be installed in the max. 30 V DC power supply to the device in order to limit the available current to comply with the UL requirements. Please note possibly lower connection ratings for your device (refer to the technical data).

‣ For use and application as per the requirements of UL [1] a connecting cable listed under the UL category code CYJV/7 must be used.

1) Note on the scope of the UL approval: the devices have been tested as per the requirements of UL508 and CSA/C22.2 no. 14 (protection against electric shock and fire).

The connections for each module in the MSC system are listed in the tables below:

5.3.2.1. Basic module MSC-CB

TERMINAL	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	MASTER_ENABLE1	Input	Basic module enable 1	Input (**"Type B"** in accordance with EN IEC 61131-2)
3	MASTER_ENABLE2	Input	Base unit enable 2	Input (**"Type B"** in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	OSSD1_A	Output	Safety output 1	PNP Active High
6	OSSD1_B	Output		PNP Active High
7	RESTART_FBK1	Input	Feedback loop/restart 1	Input in accordance with EN IEC 61131-2
8	OUT_STATUS1	Output	Programmable digital output	PNP Active High
9	OSSD2_A	Output	Safety output 2	PNP Active High
10	OSSD2_B	Output		PNP Active High
11	RESTART_FBK2	Input	Feedback loop/restart 2	Input in accordance with EN IEC 61131-2
12	OUT_STATUS2	Output	Programmable digital output	PNP Active High
13	OUT_TEST1	Output	Output for short circuit detection	PNP Active High
14	OUT_TEST2	Output	Output for short circuit detection	PNP Active High
15	OUT_TEST3	Output	Output for short circuit detection	PNP Active High
16	OUT_TEST4	Output	Output for short circuit detection	PNP Active High
17	INPUT1	Input	Digital input 1	Input in accordance with EN IEC 61131-2
18	INPUT2	Input	Digital input 2	Input in accordance with EN IEC 61131-2
19	INPUT3	Input	Digital input 3	Input in accordance with EN IEC 61131-2
20	INPUT4	Input	Digital input 4	Input in accordance with EN IEC 61131-2
21	INPUT5	Input	Digital input 5	Input in accordance with EN IEC 61131-2
22	INPUT6	Input	Digital input 6	Input in accordance with EN IEC 61131-2
23	INPUT7	Input	Digital input 7	Input in accordance with EN IEC 61131-2
24	INPUT8	Input	Digital input 8	Input in accordance with EN IEC 61131-2

Table 1:   Basic module MSC-CB

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5.3.2.2. Basic module MSC-CB-S

TERMINAL	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	n.c.	-	-	-
3	n.c.	-	-	-
4	GND	-	Power supply 0 V DC	-
5	OSSD1	Output	Safety output 1	PNP Active High
6	OSSD2	Output	Safety output 2	PNP Active High
7	RESTART_FBK1/ STATUS1	Input/ Output	Feedback loop/restart	Input in accordance with EN IEC 61131-2
			Programmable digital output	PNP Active High
8	RESTART_FBK2/ STATUS2	Input/ Output	Feedback loop/restart	Input in accordance with EN IEC 61131-2
			Programmable digital output	PNP Active High
9	OSSD3	Output	Safety output 3	PNP Active High
10	OSSD4	Output	Safety output 4	PNP Active High
11	RESTART_FBK3/ STATUS3	Input/ Output	Feedback loop/restart	Input in accordance with EN IEC 61131-2
			Programmable digital output	PNP Active High
12	RESTART_FBK4/ STATUS4	Input/ Output	Feedback loop/restart	Input in accordance with EN IEC 61131-2
			Programmable digital output	PNP Active High
13	OUT_TEST1	Output	Output for short circuit detection	PNP Active High
14	OUT_TEST2	Output	Output for short circuit detection	PNP Active High
15	OUT_TEST3	Output	Output for short circuit detection	PNP Active High
16	OUT_TEST4	Output	Output for short circuit detection	PNP Active High
17	INPUT1	Input	Digital input 1	Input in accordance with EN IEC 61131-2
18	INPUT2	Input	Digital input 2	Input in accordance with EN IEC 61131-2
19	INPUT3	Input	Digital input 3	Input in accordance with EN IEC 61131-2
20	INPUT4	Input	Digital input 4	Input in accordance with EN IEC 61131-2
21	INPUT5	Input	Digital input 5	Input in accordance with EN IEC 61131-2
22	INPUT6	Input	Digital input 6	Input in accordance with EN IEC 61131-2
23	INPUT7	Input	Digital input 7	Input in accordance with EN IEC 61131-2
24	INPUT8	Input	Digital input 8	Input in accordance with EN IEC 61131-2

Table 2:   Basic module MSC-CB-S

ⓘ   **NOTICE**

The terminals of the monitoring outputs (STATUSx) are shared with the control inputs (RESTART_FBK) of the OSSD outputs. In order to be able to use the monitoring output, the corresponding OSSD output must be used with an automatic restart without external feedback loop monitoring. In order to be able to use the STATUS1 output (terminal 7), automatic restart without feedback loop monitoring must be set for OSSD1 in EUCHNER Safety Designer.

5.3.3. USB connection

The MSC basic modules have a USB 2.0 port for connection to a PC on which the EUCHNER Safety Designer configuration software (see figure) is installed.

A USB cable of appropriate size is available as an accessory.

Fig. 3: Front USB-2.0 connection

5.3.4. MSC configuration memory (M-A1)

An optional backup memory card (called **M-A1**) can be installed in the MSC basic module for backing up the software configuration parameters.

Every new project transferred from the PC to MSC-CB/MSC-CB-S is written to the memory card M-A1.

➡ Always switch off MSC-CB/MSC-CB-S before logging onto or logging off from the M-A1.

Insert card into the **slot on the rear side of the MSC-CB/ MSC-CB-S** (direction as shown in *Fig. 4: M-A1*).

Label with technical data

M-A1 label
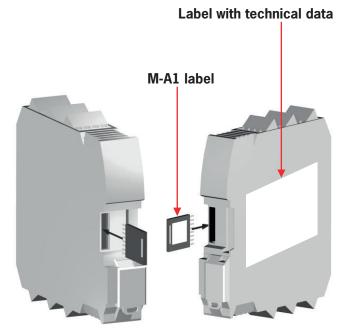
Fig. 4: M-A1

ⓘ **NOTICE**

‣ The basic module MSC-CB-S can read configurations from MSC-CB-S and MSC-CB.
‣ The basic module MSC-CB can read configurations only from MSC-CB.

5.3.4.1. MULTIPLE LOAD function

To configure several basic modules without using a PC and the USB port, the required configuration can be saved on an M-A1 memory card and then downloaded from there to the basic modules to be configured.

ⓘ **NOTICE**

If the file on the memory card is not identical to the file in the MSC-CB/MSC-CB-S, the configuration data in the MSC-CB/MSC-CB-S will be overwritten and therefore permanently deleted.

WARNING: ALL DATA THAT WERE IN THE MSC-CB/MSC-CB-S WILL BE LOST.

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5.3.4.2. RESTORE function

If the MSC-CB/MSC-CB-S module is faulty, it can be replaced with a new module. As the entire configuration is saved on the M-A1 memory card, all that is necessary is to insert this card in the new module and switch on the MSC system; the backed up configuration will then be loaded immediately. In this way interruptions in operation can be reduced to a minimum.

Compatibility of M-A1 memory cards and MSC-CB/MSC-CB-S basic modules

The MSC-CB-S can load the configurations from the M-A1 memory cards if these were written using an MSC-CB-S or an MSC-CB.

(i)	**Important!**
	A configuration written with MSC-CB-S cannot be read by MSC-CB.

(i)	**Important!**
	‣ The LOAD and RESTORE functions can be deactivated using the software (see *Fig. 51: EUCHNER Safety Designer, selecting expansion module on page 83*).
	‣ The expansion modules must be assigned addresses during installation before use (see NODE_SEL).

⚠	**WARNING**
	Each time M-A1 is used, it is to be carefully checked whether the configuration selected is the configuration prepared for this specific system. A complete function check must be performed on the system comprising the MSC and all devices connected to it (see section *"CHECKING the system" Page 104*).

5.3.5. Module FI8FO2

TERMINAL	SIGNAL	TYPE	DESCRIPTION	ACTION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	Input	Node selection	Input ("**Type B**" in accordance with EN IEC 61131-2)
3	NODE_SEL1	Input		Input ("**Type B**" in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	OSSD1_A	Output	Safety output 1	PNP Active High
6	OSSD1_B	Output		PNP Active High
7	RESTART_FBK1	Input	Feedback loop/restart 1	Input in accordance with EN IEC 61131-2
8	OUT_STATUS1	Output	Programmable digital output	PNP Active High
9	OSSD2_A	Output	Safety output 2	PNP Active High
10	OSSD2_B	Output		PNP Active High
11	RESTART_FBK2	Input	Feedback loop/restart 2	Input in accordance with EN IEC 61131-2
12	OUT_STATUS2	Output	Programmable digital output	PNP Active High
13	OUT_TEST1	Output	Output for short circuit detection	PNP Active High
14	OUT_TEST2	Output	Output for short circuit detection	PNP Active High
15	OUT_TEST3	Output	Output for short circuit detection	PNP Active High
16	OUT_TEST4	Output	Output for short circuit detection	PNP Active High
17	INPUT1	Input	Digital input 1	Input in accordance with EN IEC 61131-2
18	INPUT2	Input	Digital input 2	Input in accordance with EN IEC 61131-2
19	INPUT3	Input	Digital input 3	Input in accordance with EN IEC 61131-2
20	INPUT4	Input	Digital input 4	Input in accordance with EN IEC 61131-2
21	INPUT5	Input	Digital input 5	Input in accordance with EN IEC 61131-2
22	INPUT6	Input	Digital input 6	Input in accordance with EN IEC 61131-2
23	INPUT7	Input	Digital input 7	Input in accordance with EN IEC 61131-2
24	INPUT8	Input	Digital input 8	Input in accordance with EN IEC 61131-2

Table 3: Module FI8FO2

5.3.6. Module FI8FO4S

TERMINAL	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	-	Node selection	Input ("**Type B**" in accordance with EN IEC 61131-2)
3	NODE_SEL1	-	Node selection	Input ("**Type B**" in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	OSSD1	Output	Safety output 1	PNP Active High
6	OSSD2	Output	Safety output 2	PNP Active High
7	RESTART_FBK1/ STATUS1	Input/ Output	Feedback loop/restart	Input in accordance with EN IEC 61131-2
			Programmable digital output	PNP Active High
8	RESTART_FBK2/ STATUS2	Input/ Output	Feedback loop/restart	Input in accordance with EN IEC 61131-2
			Programmable digital output	PNP Active High
9	OSSD3	Output	Safety output 3	PNP Active High
10	OSSD4	Output	Safety output 4	PNP Active High
11	RESTART_FBK3/ STATUS3	Input/ Output	Feedback loop/restart	Input in accordance with EN IEC 61131-2
			Programmable digital output	PNP Active High
12	RESTART_FBK4/ STATUS4	Input/ Output	Feedback loop/restart	Input in accordance with EN IEC 61131-2
			Programmable digital output	PNP Active High
13	OUT_TEST1	Output	Output for short circuit detection	PNP Active High
14	OUT_TEST2	Output	Output for short circuit detection	PNP Active High
15	OUT_TEST3	Output	Output for short circuit detection	PNP Active High
16	OUT_TEST4	Output	Output for short circuit detection	PNP Active High
17	INPUT1	Input	Digital input 1	Input in accordance with EN IEC 61131-2
18	INPUT2	Input	Digital input 2	Input in accordance with EN IEC 61131-2
19	INPUT3	Input	Digital input 3	Input in accordance with EN IEC 61131-2
20	INPUT4	Input	Digital input 4	Input in accordance with EN IEC 61131-2
21	INPUT5	Input	Digital input 5	Input in accordance with EN IEC 61131-2
22	INPUT6	Input	Digital input 6	Input in accordance with EN IEC 61131-2
23	INPUT7	Input	Digital input 7	Input in accordance with EN IEC 61131-2
24	INPUT8	Input	Digital input 8	Input in accordance with EN IEC 61131-2

Table 4:   Module FI8FO4S

ℹ️ **NOTICE**

The terminals of the monitoring outputs (STATUSx) are shared with the control inputs (RESTART_FBK) of the OSSD outputs. In order to be able to use the monitoring output, the corresponding OSSD output must be used with an automatic restart without external feedback loop monitoring. In order to be able to use the STATUS1 output (terminal 7), automatic restart without feedback loop monitoring must be set for OSSD1 in EUCHNER Safety Designer.

5.3.7. Module FI8

TERMINAL	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	Input	Node selection	Input (**"Type B"** in accordance with EN IEC 61131-2)
3	NODE_SEL1	Input		Input (**"Type B"** in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	INPUT1	Input	Digital input 1	Input in accordance with EN IEC 61131-2
6	INPUT2	Input	Digital input 2	Input in accordance with EN IEC 61131-2
7	INPUT3	Input	Digital input 3	Input in accordance with EN IEC 61131-2
8	INPUT4	Input	Digital input 4	Input in accordance with EN IEC 61131-2
9	OUT_TEST1	Output	Output for short circuit detection	PNP Active High
10	OUT_TEST2	Output	Output for short circuit detection	PNP Active High
11	OUT_TEST3	Output	Output for short circuit detection	PNP Active High
12	OUT_TEST4	Output	Output for short circuit detection	PNP Active High
13	INPUT5	Input	Digital input 5	Input in accordance with EN IEC 61131-2
14	INPUT6	Input	Digital input 6	Input in accordance with EN IEC 61131-2
15	INPUT7	Input	Digital input 7	Input in accordance with EN IEC 61131-2
16	INPUT8	Input	Digital input 8	Input in accordance with EN IEC 61131-2

Table 5:   Module FI8

5.3.8. Module FM4

TERMINAL	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	Input	Node selection	Input (**"Type B"** in accordance with EN IEC 61131-2)
3	NODE_SEL1	Input		Input (**"Type B"** in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	INPUT1	Input	Digital input 1	Input in accordance with EN IEC 61131-2
6	INPUT2	Input	Digital input 2	Input in accordance with EN IEC 61131-2
7	INPUT3	Input	Digital input 3	Input in accordance with EN IEC 61131-2
8	INPUT4	Input	Digital input 4	Input in accordance with EN IEC 61131-2
9	OUT_TEST1	Output	Output for short circuit detection	PNP Active High
10	OUT_TEST2	Output	Output for short circuit detection	PNP Active High
11	OUT_TEST3	Output	Output for short circuit detection	PNP Active High
12	OUT_TEST4	Output	Output for short circuit detection	PNP Active High
13	INPUT5	Input	Digital input 5	Input in accordance with EN IEC 61131-2
14	INPUT6	Input	Digital input 6	Input in accordance with EN IEC 61131-2
15	INPUT7	Input	Digital input 7	Input in accordance with EN IEC 61131-2
16	INPUT8	Input	Digital input 8	Input in accordance with EN IEC 61131-2
17	OUT_TEST5	Output	Output for short circuit detection	PNP Active High
18	OUT_TEST6	Output	Output for short circuit detection	PNP Active High
19	OUT_TEST7	Output	Output for short circuit detection	PNP Active High
20	OUT_TEST8	Output	Output for short circuit detection	PNP Active High
21	INPUT9	Input	Digital input 9	Input in accordance with EN IEC 61131-2
22	INPUT10	Input	Digital input 10	Input in accordance with EN IEC 61131-2
23	INPUT11	Input	Digital input 11	Input in accordance with EN IEC 61131-2
24	INPUT12	Input	Digital input 12	Input in accordance with EN IEC 61131-2

Table 6:   Module FM4

EN

5.3.9. Module FI16

TERMINAL	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	Input	Node selection	Input ("**Type B**" in accordance with EN IEC 61131-2)
3	NODE_SEL1	Input		Input ("**Type B**" in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	INPUT1	Input	Digital input 1	Input in accordance with EN IEC 61131-2
6	INPUT2	Input	Digital input 2	Input in accordance with EN IEC 61131-2
7	INPUT3	Input	Digital input 3	Input in accordance with EN IEC 61131-2
8	INPUT4	Input	Digital input 4	Input in accordance with EN IEC 61131-2
9	OUT_TEST1	Output	Output for short circuit detection	PNP Active High
10	OUT_TEST2	Output	Output for short circuit detection	PNP Active High
11	OUT_TEST3	Output	Output for short circuit detection	PNP Active High
12	OUT_TEST4	Output	Output for short circuit detection	PNP Active High
13	INPUT5	Input	Digital input 5	Input in accordance with EN IEC 61131-2
14	INPUT6	Input	Digital input 6	Input in accordance with EN IEC 61131-2
15	INPUT7	Input	Digital input 7	Input in accordance with EN IEC 61131-2
16	INPUT8	Input	Digital input 8	Input in accordance with EN IEC 61131-2
17	INPUT9	Input	Digital input 9	Input in accordance with EN IEC 61131-2
18	INPUT10	Input	Digital input 10	Input in accordance with EN IEC 61131-2
19	INPUT11	Input	Digital input 11	Input in accordance with EN IEC 61131-2
20	INPUT12	Input	Digital input 12	Input in accordance with EN IEC 61131-2
21	INPUT13	Input	Digital input 13	Input in accordance with EN IEC 61131-2
22	INPUT14	Input	Digital input 14	Input in accordance with EN IEC 61131-2
23	INPUT15	Input	Digital input 15	Input in accordance with EN IEC 61131-2
24	INPUT16	Input	Digital input 16	Input in accordance with EN IEC 61131-2

Table 7: Module FI16

5.3.10. Module AC-FO4

TERMINAL	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	Input	Node selection	Input (**"Type B"** in accordance with EN IEC 61131-2)
3	NODE_SEL1	Input		Input (**"Type B"** in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	OSSD1_A	Output	Safety output 1	PNP Active High
6	OSSD1_B	Output		PNP Active High
7	RESTART_FBK1	Input	Feedback loop/restart 1	Input in accordance with EN IEC 61131-2
8	OUT_STATUS1	Output	Programmable digital output	PNP Active High
9	OSSD2_A	Output	Safety output 2	PNP Active High
10	OSSD2_B	Output		PNP Active High
11	RESTART_FBK2	Input	Feedback loop/restart 2	Input in accordance with EN IEC 61131-2
12	OUT_STATUS2	Output	Programmable digital output	PNP Active High
13	24 V DC	-	Power supply 24 V DC	24 V DC outputs, power supply*
14	24 V DC	-		
15	GND	-	Power supply 0 V DC	0 V DC outputs*
16	GND	-		
17	OSSD4_A	Output	Safety output 4	PNP Active High
18	OSSD4_B	Output		PNP Active High
19	RESTART_FBK4	Input	Feedback loop/restart 4	Input in accordance with EN IEC 61131-2
20	OUT_STATUS4	Output	Programmable digital output	PNP Active High
21	OSSD3_A	Output	Safety output 3	PNP Active High
22	OSSD3_B	Output		PNP Active High
23	RESTART_FBK3	Input	Feedback loop/restart 3	Input in accordance with EN IEC 61131-2
24	OUT_STATUS3	Output	Programmable digital output	PNP Active High

Table 8:   Module AC-FO4

5.3.11. Module AC-FO2

TERMINAL	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	Input	Node selection	Input (**"Type B"** in accordance with EN IEC 61131-2)
3	NODE_SEL1	Input		Input (**"Type B"** in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	OSSD1_A	Output	Safety output 1	PNP Active High
6	OSSD1_B	Output		PNP Active High
7	RESTART_FBK1	Input	Feedback loop/restart 1	Input in accordance with EN IEC 61131-2
8	OUT_STATUS1	Output	State of the outputs 1A/1B	PNP Active High
9	OSSD2_A	Output	Safety output 2	PNP Active High
10	OSSD2_B	Output		PNP Active High
11	RESTART_FBK2	Input	Feedback loop/restart 2	Input in accordance with EN IEC 61131-2
12	OUT_STATUS2	Output	State of the outputs 2A/2B	PNP Active High
13	24 V DC	-	Power supply 24 V DC	24 V DC output, power supply*
14	n.c.	-	-	-
15	GND	-	Power supply 0 V DC	0 V DC output*
16	n.c.	-	-	-

Table 9:   Module AC-FO2

*   This terminal must be connected to the power supply so that the module functions correctly.

EN
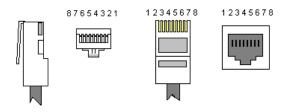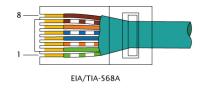
5.3.12. Modules SPM0 – SPM1 – SPM2

TERMINAL	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	Input	Node selection	Input ("**Type B**" in accordance with EN IEC 61131-2)
3	NODE_SEL1	Input		
4	GND	-	Power supply 0 V DC	-
5	PROXI1_24V	Output	Connections for the 1st proximity switch (see *Page 36*)	24 V DC power supply to PROXI1
6	PROXI1_REF	Output		0 V DC power supply to PROXI1
7	PROXI1 IN1 (3 WIRES)	Input		PROXI1 NO contact
8	PROXI1 IN2 (4 WIRES)	Input		PROXI1 NC contact
9	PROXI2_24 V	Output	Connections for the 2nd proximity switch (see *Page 36*)	24 V DC power supply to PROXI2
10	PROXI2_REF	Output		0 V DC power supply to PROXI2
11	PROXI2 IN1 (3 WIRES)	Input		PROXI2 NO contact
12	PROXI2 IN2 (4 WIRES)	Input		PROXI2 NC contact
13	n.c.	-	Not connected	-
14	n.c.	-		
15	n.c.	-		
16	n.c.	-		

Table 10:   Modules SPM0 – SPM1 – SPM2

5.3.12.1. Encoder connections with RJ45 plug connector (SPM1, SPM2)

EIA/TIA-568A
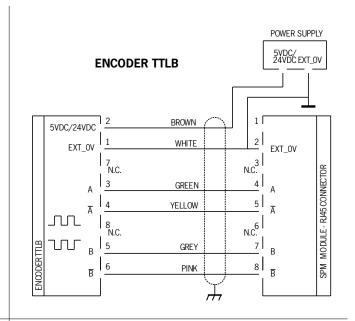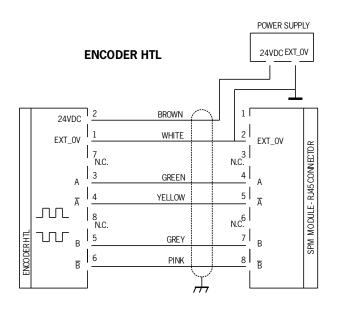
Pin			SPMTB	SPMH	SPMS
TWISTED *	1	INPUT	n.c.	n.c.	n.c.
	2		GND	GND	GND
	3		n.c.	n.c.	n.c.
TWISTED *	4		A	A	A
	5		$\overline{A}$	$\overline{A}$	$\overline{A}$
	6		n.c.	n.c.	n.c.
TWISTED *	7		B	B	B
	8		$\overline{B}$	$\overline{B}$	$\overline{B}$

* If twisted-pair cables are used.

Table 11:   Pin assignment
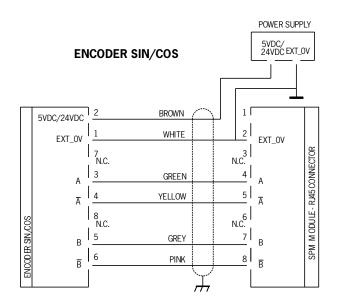
Fig. 5:   Connection examples

EN

5.3.13. Module AZ-FO4

TERMINAL	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	Input	Node selection	Input (**"Type B"** in accordance with EN IEC 61131-2)
3	NODE_SEL1	Input		Input (**"Type B"** in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	REST_FBK1	Input	Feedback loop/restart 1	Input in accordance with EN IEC 61131-2
6	REST_FBK2	Input	Feedback loop/restart 2	Input in accordance with EN IEC 61131-2
7	REST_FBK3	Input	Feedback loop/restart 3	Input in accordance with EN IEC 61131-2
8	REST_FBK4	Input	Feedback loop/restart 4	Input in accordance with EN IEC 61131-2
9	A_NO1	Output	Normally open contact, channel 1	
10	B_NO1	Output		
11	A_NO2	Output	Normally open contact, channel 2	
12	B_NO2	Output		
13	A_NO3	Output	Normally open contact, channel 3	
14	B_NO3	Output		
15	A_NO4	Output	Normally open contact, channel 4	
16	B_NO4	Output		

Table 12: Module AZ-FO4

5.3.14. Module AZ-FO4O8

TERMINAL	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	Input	Node selection	Input (**"Type B"** in accordance with EN IEC 61131-2)
3	NODE_SEL1	Input		Input (**"Type B"** in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	REST_FBK1	Input	Feedback loop/restart 1	Input in accordance with EN IEC 61131-2
6	REST_FBK2	Input	Feedback loop/restart 2	Input in accordance with EN IEC 61131-2
7	REST_FBK3	Input	Feedback loop/restart 3	Input in accordance with EN IEC 61131-2
8	REST_FBK4	Input	Feedback loop/restart 4	Input in accordance with EN IEC 61131-2
9	A_NO1	Output	Normally open contact, channel 1	
10	B_NO1	Output		
11	A_NO2	Output	Normally open contact, channel 2	
12	B_NO2	Output		
13	A_NO3	Output	Normally open contact, channel 3	
14	B_NO3	Output		
15	A_NO4	Output	Normally open contact, channel 4	
16	B_NO4	Output		
17	SYS_STATUS1	Output	Programmable digital output	PNP Active High
18	SYS_STATUS2	Output	Programmable digital output	PNP Active High
19	SYS_STATUS3	Output	Programmable digital output	PNP Active High
20	SYS_STATUS4	Output	Programmable digital output	PNP Active High
21	SYS_STATUS5	Output	Programmable digital output	PNP Active High
22	SYS_STATUS6	Output	Programmable digital output	PNP Active High
23	SYS_STATUS7	Output	Programmable digital output	PNP Active High
24	SYS_STATUS8	Output	Programmable digital output	PNP Active High

Table 13: Module AZ-FO4O8

5.3.15. Module O8

Pin	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	Input	Node selection	Input ("**Type B**" in accordance with EN IEC 61131-2)
3	NODE_SEL1	Input		Input ("**Type B**" in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	24 V DC STATUS 1-8	-	Power supply 24 V DC Monitoring outputs 1-8	-
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-
9	OUT_STATUS1	Output	Programmable digital output	PNP Active High
10	OUT_STATUS2	Output	Programmable digital output	PNP Active High
11	OUT_STATUS3	Output	Programmable digital output	PNP Active High
12	OUT_STATUS4	Output	Programmable digital output	PNP Active High
13	OUT_STATUS5	Output	Programmable digital output	PNP Active High
14	OUT_STATUS6	Output	Programmable digital output	PNP Active High
15	OUT_STATUS7	Output	Programmable digital output	PNP Active High
16	OUT_STATUS8	Output	Programmable digital output	PNP Active High

Table 14: Module O8

5.3.16. Module O16

Pin	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	Input	Node selection	Input ("**Type B**" in accordance with EN IEC 61131-2)
3	NODE_SEL1	Input		Input ("**Type B**" in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	24 V DC STATUS 1-8		Power supply 24 V DC Programmable digital output 1-8	
6	24 V DC STATUS 9-16		Power supply 24 V DC Programmable digital output 9-16	
7	-	-	-	-
8	-	-	-	-
9	OUT_STATUS1	Output	Programmable digital output	PNP Active High
10	OUT_STATUS2	Output	Programmable digital output	PNP Active High
11	OUT_STATUS3	Output	Programmable digital output	PNP Active High
12	OUT_STATUS4	Output	Programmable digital output	PNP Active High
13	OUT_STATUS5	Output	Programmable digital output	PNP Active High
14	OUT_STATUS6	Output	Programmable digital output	PNP Active High
15	OUT_STATUS7	Output	Programmable digital output	PNP Active High
16	OUT_STATUS8	Output	Programmable digital output	PNP Active High
17	OUT_STATUS9	Output	Programmable digital output	PNP Active High
18	OUT_STATUS10	Output	Programmable digital output	PNP Active High
19	OUT_STATUS11	Output	Programmable digital output	PNP Active High
20	OUT_STATUS12	Output	Programmable digital output	PNP Active High
21	OUT_STATUS13	Output	Programmable digital output	PNP Active High
22	OUT_STATUS14	Output	Programmable digital output	PNP Active High
23	OUT_STATUS15	Output	Programmable digital output	PNP Active High
24	OUT_STATUS16	Output	Programmable digital output	PNP Active High

Table 15: Module O16

EN

5.3.17. Module AH-FO4SO8

Pin	SIGNAL	TYPE	DESCRIPTION	VERSION
1	24 V DC	-	Power supply 24 V DC	-
2	NODE_SEL0	Input	Node selection	Input ("**Type B**" in accordance with EN IEC 61131-2)
3	NODE_SEL1	Input		Input ("**Type B**" in accordance with EN IEC 61131-2)
4	GND	-	Power supply 0 V DC	-
5	REST_FBK1	Input	Feedback loop/restart 1	Input in accordance with EN IEC 61131-2
6	REST_FBK2	Input	Feedback loop/restart 2	Input in accordance with EN IEC 61131-2
7	REST_FBK3	Input	Feedback loop/restart 3	Input in accordance with EN IEC 61131-2
8	REST_FBK4	Input	Feedback loop/restart 4	Input in accordance with EN IEC 61131-2
9	OSSD1	Output	Safety output 1	PNP Active High 4 single-channel (or 2 dual-channel)
10	OSSD2	Output	Safety output 2	
11	OSSD3	Output	Safety output 3	
12	OSSD4	Output	Safety output 4	
13	-	-	-	
14	24 V DC	-	Power supply 24 V DC	
15	-	-	-	
16	-	-	-	
17	OUT_STATUS1	Output	Programmable digital output	PNP Active High
18	OUT_STATUS2	Output	Programmable digital output	PNP Active High
19	OUT_STATUS3	Output	Programmable digital output	PNP Active High
20	OUT_STATUS4	Output	Programmable digital output	PNP Active High
21	OUT_STATUS5	Output	Programmable digital output	PNP Active High
22	OUT_STATUS6	Output	Programmable digital output	PNP Active High
23	OUT_STATUS7	Output	Programmable digital output	PNP Active High
24	OUT_STATUS8	Output	Programmable digital output	PNP Active High

Table 16:   Module AH-FO4SO8

5.3.18. CI1/CI2 bus communication expansion module

CI1   CI2

TERMINAL	CABLE CON-NECTION	SIGNAL NAME		DESCRIPTION
		CI1	CI2	
1		24 V DC	24 V DC	Power supply 24 V DC
2		n.c.	n.c.	-
3		Shielding, CH1	Shielding, CH1	-
4		0 V DC	0 V DC	Power supply 0 V DC
5		n.c.	n.c.	-
6		n.c.	n.c.	-
7		n.c.	Shielding, CH2	-
8		n.c.	n.c.	-
9	1. Cable pair	CH 1 – A	CH 1 – A	Ensure that the corresponding terminals of the additional CI module are connected: A <-> A B <-> B C <-> C D <-> D Shielding <-> shielding CH1 can also be connected to CH2 (CI2)
10		CH 1 – B	CH 1 – B	
11	2. Cable pair	CH 1 – C	CH 1 – C	
12		CH 1 – D	CH 1 – D	
13	1. Cable pair	n.c.	CH 1 – A	
14		n.c.	CH 1 – B	
15	2. Cable pair	n.c.	CH 1 – C	
16		n.c.	CH 1 – D	

5.3.19. Example for the connection of the MSC system to the machine control
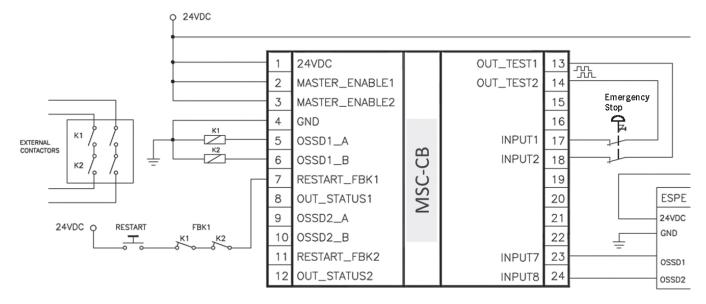
Fig. 6:   Example for the connection of the MSC system to the machine control

5.4. Checklist after installation

With the MSC system, faults can be detected in the individual modules. To ensure trouble-free operation of the system, the following checks are to be performed during setup and at least once a year:

1. Perform a complete system CHECK (see "CHECKING the system")

2. Check whether all cables are inserted correctly and the terminal blocks are tightened properly.

3. Check whether all LEDs (indicators) light up correctly.

4. Check whether all sensors connected to the MSC system are positioned correctly.

5. Check whether the MSC system is properly fastened to the DIN rail.

6. Check whether all external indicators (lamps) function correctly.

⚠ **WARNING**

After installation, maintenance or changing the configuration, perform the system CHECK as described in section "CHECKING the system" on page Page 104.

6. Flow chart


```
        ┌──────────────────────────────┐
        │      Mechanical mounting      │
        └──────────────────────────────┘
                      │
        ┌──────────────────────────────┐
        │    Electrical connections     │
        │  between the MSC modules and  │
        │       external sensors        │
        └──────────────────────────────┘
                      │
        ┌──────────────────────────────┐
        │   Preparation of the diagram  │
        └──────────────────────────────┘
                      │
     NO              ◇
                ╱ Validation  ╲
               ╱ software OK?   ╲
                ╲              ╱
                 ╲            ╱        YES
                      │
        ┌──────────────────────────────┐
        │          Connection           │
        │       via USB to base unit    │
        └──────────────────────────────┘
                      │
        ┌──────────────────────────────┐
        │           Download            │
        │    the diagram to base unit   │
        └──────────────────────────────┘
                      │
     NO              ◇
             ╱   Configuration check  ╲
            ╱  (incl. complete system   ╲
            ╲   CHECK see „Project       ╱
             ╲  validation") on base    ╱
              ╲   unit OK?             ╱      YES
                      │
        ┌──────────────────────────────┐
        │   Disconnect the connection   │
        │           via USB             │
        └──────────────────────────────┘
                      │
        ┌──────────────────────────────┐
        │      Switch on the system     │
        └──────────────────────────────┘
```

Fig. 7:   Flow chart
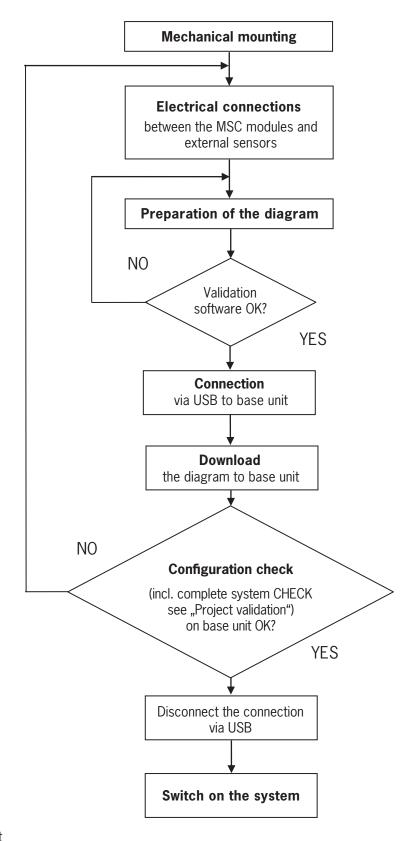
EN

7. Signals

7.1. CI1/CI2 bus communication expansion module

The CI module from the MSC family enables the connection of expansion modules that are at a greater distance from the MSC basic module **(< 50 m)**.

Two CI modules are connected at the required distance using a screened cable (see *Fig. 9: Technical data for cable)*. Each CI2 module has two independent connection channels.

Two CI2 modules can be connected as required. The CI1 module has only one channel and must be connected as the first or last module.

The figure shows a connection example.

➡ Using the CI modules does not change the system's response time.

Fig. 8:   Connection example, CI1/CI2 bus communication expansion module

Element	Description/value
Conductor	2 wisted, screened cable pairs
Rated impedance	120 Ω
Rated capacitance	<42 pF/m
Cable resistance	<95 mΩ/m
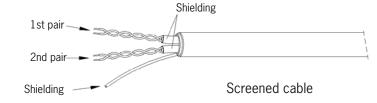
Fig. 9:   Technical data for cable

7.2. Inputs

7.2.1. MASTER_ENABLE

The basic module MSC-CB features two inputs: MASTER_ENABLE1 and MASTER_ENABLE2.

> **NOTICE**
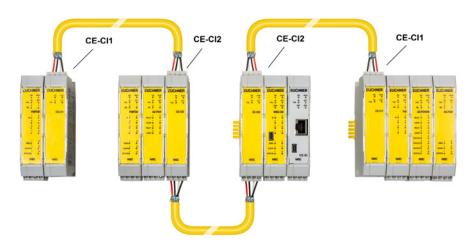> ‣ These signals must both be set permanently to logic level 1 (24 VDC) so that the MSC system functions correctly. If the user wants to deactivate the MSC system, these inputs can be simply set to logic level 0 (0 V DC).
> ‣ The MSC system is always active on MSC-CB-S. MASTER_ENABLE is not present.

7.2.2. NODE_SEL

The inputs NODE_SEL0 and NODE_SEL1 (on the expansion modules) are used to assign an address to the expansion modules using the connections given in *Table 17*:

	NODE_SEL1 (TERMINAL 3)	NODE_SEL0 (TERMINAL 2)
NODE 0	0 (or not connected)	0 (or not connected)
NODE 1	0 (or not connected)	24 V DC
NODE 2	24 V DC	0 (or not connected)
NODE 3	24 V DC	24 V DC

Table 17:   Node selection

A maximum of 4 addresses and therefore 4 modules of the same type are intended to be used in the same system.

> **NOTICE**
> Two modules of the same type are not allowed to be assigned the same physical address.

EN

7.2.3. Proximity switch input on speed monitoring modules SPM

⚠	**DANGER**
	Danger to life and risk of malfunctions as a result of incorrect connection
	‣ Improper mechanical installation of proximity switches can lead to dangerous operation. Pay particular attention to the size of the coding disks.
	‣ The SPM module must be capable of detecting the expected speed in any state. Perform a complete system test during installation and periodically during operation.
	‣ Using the MSC software and the sensor LEDs, ensure that the module never detects anomalies.

ⓘ	**NOTICE**
	‣ The coding disk must be dimensioned and the proximity sensors positioned according to the technical data for the proximity sensors and the corresponding manufacturer's guidelines.
	‣ Pay particular attention to frequent causes of faults that can affect both proximity sensors (cable short circuits, objects falling down from above, coding disk travel without operation, etc.)

Configuration with combined proximity switches on one axis *(Fig. 10)*

The SPM module can be configured in the "Combined proximity switch" mode for a measurement using two proximity switches on one axis.

The Performance Level PL e can be achieved under the following conditions:

➡ The proximity switches must be mounted such that the signals produced overlap.

➡ The proximity switches must be mounted such that at least one proximity switch is always actuated (active).
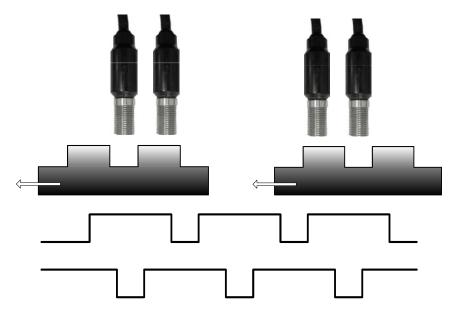

Fig. 10:   Proximity switches

The following must additionally apply:

➡ Proximity switches with a PNP output must be used.

➡ Proximity switches with a normally open output (NO; output active when switch is actuated).

➡ In the conditions stated above the DC value is 90%

➡ Both proximity switches must be of the same type, with a MTTF > 70 years.

7.2.4. RESTART_FBK

Using the RESTART_FBK signal, MSC can monitor a feedback loop signal (External Device Monitoring – EDM) from external contactors; both manual and automatic forms of starting can be programmed (see list of the possible connections in *Table 18*).

⚠	**WARNING**
	‣ If necessary, the response time of contactors must be checked using an additional device.
	‣ The command switch for starting (RESTART) must be installed outside the danger zone in a place from which there is a clear view of the danger zone and the entire working area affected.
	‣ It must not be possible to actuate the command switch from inside the danger zone.

Each OSSD pair or each single-channel OSSD output and each relay output have a corresponding RESTART_FBK input.

OPERATING MODE	EDM	RESTART_FBK
AUTOMATIC	With K1_K2 control	24V — K1 — K2 — ext_Restart_fbk
	Without K1_K2 control	24V ——————— ext_Restart_fbk
MANUAL	With K1_K2 control	24V — K1 — K2 — ⎵ — ext_Restart_fbk
	Without K1_K2 control	24V ———— ⎵ — ext_Restart_fbk

Table 18:   Restart_FBK configuration

EN

7.3. Outputs

7.3.1. OUT_STATUS

The signal OUT_STATUS / SYS_STATUS / STATUS is a programmable digital output for the indication of the state of:

‣ An input

‣ An output

‣ A node on the logic diagram designed with the aid of EUCHNER Safety Designer.
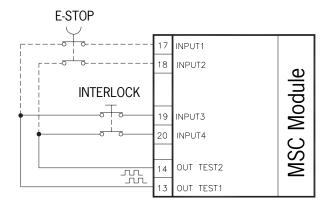
> ⓘ **NOTICE**
>
> OUT_STATUS, SYS_STATUS and STATUS are the same type of output; only the designations differ according to the module.

7.3.2. OUT_TEST

The inputs and the cables can be monitored for short circuits or overload states using the OUT_TEST signals *(Fig. 11)*.

SHORT CIRCUIT CONTROL

E-STOP

INTERLOCK

17	INPUT1
18	INPUT2
19	INPUT3
20	INPUT4
14	OUT TEST2
13	OUT TEST1

MSC Module

> ⓘ **NOTICE**
>
> ‣ The maximum number of controllable inputs for each OUT_TEST output is 4 INPUTS (parallel connection) **(MSC-CB, MSC-CB-S, FI8FO2, FI8FO4S, FI8, FM4, FI16)**
>
> ‣ The maximum permissible cable length on the OUT_TEST output is 100 m.

Fig. 11:   OUT_TEST

7.3.3. OSSD

ⓘ	**Important!** The safe OSSD outputs are periodically checked for short circuits or overload conditions. The voltage dip test method is selected for this check. In this test, each OSSD output is periodically (every 20 ms for MSC-CB, every 600 ms for MSC-CB-S) short-circuited to 0 V for a very short time (<120 μs). The control system can put the system into a safe state if the test results are inconsistent.

The MSC-CB, MSC-CB-S, FI8FO2, FI8FO4S, AC-FO2, AC-FO4 and AH-FO4SO8 modules have OSSD (output signal switching device) outputs. These outputs are short circuit-proof, monitored for short circuits, and supply:

‣ In the ON state: U_V **- 0.75 V** to U_V (with U_V = 24 V ±20%)
 - For AH-FO4SO8: U_V **- 0.6 V** to U_V (where U_V = 24 V ±20%)
‣ In the OFF state: **0** to **2 V rms.**

The maximum load of 400 mA at 24 V corresponds to a minimum ohmic load of 60 Ω.

MSC-CB, MSC-CE-121290, MSC-CE-FO2-121294, MSC-CE-FO4-121295:

‣ The maximum capacitive load is 0.68 μF and the maximum inductive load is 2 mH.

MSC-CB-S, MC-CE-S-166056, MSC-CE-AH, 122705:

‣ The maximum capacitive load is 0.82 μF and the maximum inductive load is 2 mH.

Each OSSD output can be configured as shown in *Table 19*:

Automatic	The output is activated, in accordance with the configuration defined by the EUCHNER Safety Designer software, only if 24 V DC is applied to the related RESTART_FBK input.
Manual	The output is activated, in accordance with the configuration defined by the EUCHNER Safety Designer software, only if there is the logical transition **0-->1** on the related RESTART_FBK input.
Monitored	The output is activated, in accordance with the configuration defined by the EUCHNER Safety Designer software, only if there is the logical transition **0-->1-->0** on the related RESTART_FBK input.

Table 19:   OSSD output configuration
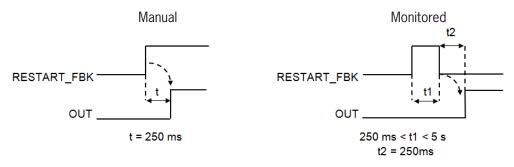

Fig. 12:   Manual/monitored restart

ⓘ	**NOTICE** It is not allowed to connect external devices to the outputs, except if this arrangement is intended in the configuration performed in the EUCHNER Safety Designer software.

EN

7.3.3.1. Single-channel OSSDs (MSC-CB-S, FI8FO4S, AH-FO4SO8)

The modules MSC-CB-S, FI8FO4S and AH-FO4SO8 have single-channel instead of dual-channel OSSD outputs. Three settings are available for the outputs (configuration via the EUCHNER Safety Designer software):

‣ 4 single-channel outputs (1 safety output per channel with corresponding RESTART_FBK input)
‣ 2 dual-channel outputs (2 safety outputs per channel with corresponding RESTART_FBK input)
‣ 1 dual-channel output and 2 single-channel outputs

Configuration of 2-channel double outputs
(safety category 4)

Configuration of 4-channel single outputs
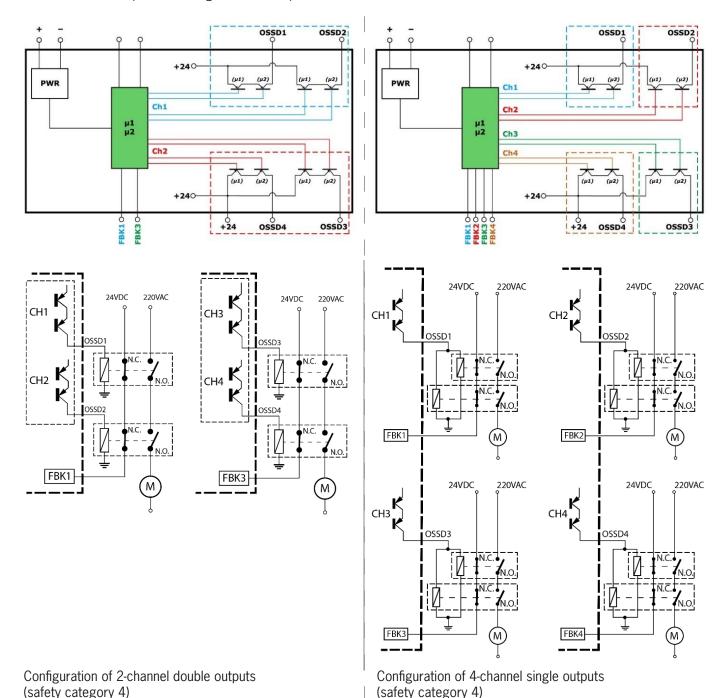(safety category 4)

Fig. 13:   AH-FO4SO8/MSC-CB-S/FI8FO4S

ⓘ **NOTICE**

In order to meet the requirements of Safety Integrity Level (SIL) 3 when the single-channel OSSD outputs are used, the OSSD outputs must be mutually independent.

$(\mathbf{i})$ | **NOTICE**
The most common causes of fault between the OSSD outputs must be ruled out by installing the cables properly (e.g. in separate cable paths).

7.3.3.2. High current OSSD (AH-FO4SO8)

The module AH-FO4SO8 has 4 high-current safety outputs (max. 2 A per channel).

➡ On the use of the module AH-FO4SO8 with output current > 5 A, the module must be separated from the neighboring modules by the connection of an MSC plug connector in between.

$(\mathbf{i})$ | **NOTICE**
Two OSSD configured as a single input cannot be interconnected to produce a dual-channel safety output. Dual-channel safety outputs must always be designed using the EUCHNER Safety Designer software

EN

7.3.4. Safety relays (AZ-FO4, AZ-FO4O8)

The modules AZ-FO4/AZ-FO4O8 have safety relays with positively driven contacts with 1 normally open contact and 1 normally closed feedback loop contact. The modules AZ-FO4/AZ-FO4O8 contain 4 safety relays.

> ℹ️ **Important!**
>
> You will find the possible operating modes for the modules AZ-FO4/AZ-FO4O8 that can be configured using the EUCHNER SAFETY DESIGNER software in the section "Relay [RELAY]."
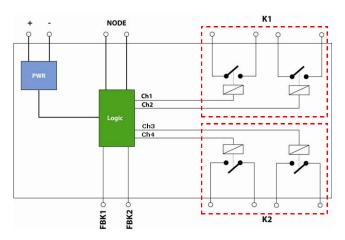
Excitation voltage	17–31 V DC
Switching voltage, min.,	10 V DC
Switching current, min.	20 mA
Switching voltage, max. (DC)	250 V DC
Switching voltage, max. (AC)	400 VAC
Switching current, max.	6 A
Response time	12 ms
Mechanical life of contacts	> 20 x 10^6

Table 20:   Technical data for AZ-FO4/AZ-FO4O8

> ℹ️ **NOTICE**
>
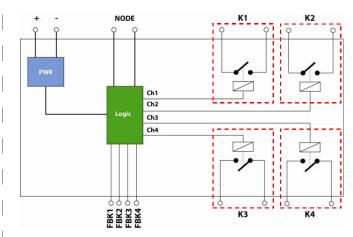> To ensure correct isolation and to prevent the risk of premature aging or damage to the relay, each output cable is to be protected using a 4 A quick-blow fuse. In addition, the load characteristics must correspond to the information in *Table 20*.

Configuration with 2 independent dual-channel outputs (safety category 4)

Configuration with 4 independent outputs (safety category 1 – 2)

Fig. 14:   AZ-FO4, AZ-FO4O8

8. Technical data

8.1. General system settings

8.1.1. Safety-related parameters

Parameters	Value	Standard
PFH	See tables with technical data for the related module	EN IEC 61508:2010
SIL	3 (safe outputs and relay outputs)	
SFF	See tables with technical data for the related module	
HFT	1	
Safety standard	Type B	
Maximum SIL	3	EN IEC 62061:2021
Type	4	EN IEC 61496-1:2021
PL	e (safe outputs and relay outputs)	EN ISO 13849-1 EN IEC 62061:2021
DC_{avg}	High	
$MTTF_D$ (years)	30–100	
Category	4	
Device mechanical life	20 years	
Degree of contamination	2	

8.1.2. General data

	MSC-CB	MSC-CB-S
Number of inputs, max.	128	
Number of safe dual-channel outputs, max.	16	30
Number of safe single-channel outputs, max.	12	32
Number of digital outputs, max.	32	48
Number of relay outputs, max.	12	28
OSSD (MSC-CB, MSC-CB-S, FI8FO2, FI8FO4S, AC-FO2, AC-FO4)	PNP Active High – 400 mA at 24 V DC max. (per OSSD)	
OSSD (AH-FO4SO8)	PNP Active High – 2 A at 24 V DC max. (per OSSD)	
Relay outputs (AZ-FO4, AZ-FO4O8)	6 A at 24 V DC max. (per relay)	
Digital output	PNP Active High – 100 mA at 24 V DC max. (per output)	
Response time **MSC-CB** (ms) This response time is dependent on the following parameters: 1) Number of expansion modules installed 2) Number of operators 3) Number of OSSD outputs The correct response time is calculated by the EUCHNER Safety Designer software (see project report). Fault reaction time **MSC-CB** (ms) The fault reaction time corresponds to the reaction time, except on SPM modules with an encoder/proximity switch interface. In this case, the fault reaction time is 2 s.	Basic module	10.6–12.6 + T_{Input_filter}
	MSC-CB + 1 expansion modules	11.8–26.5 + T_{Input_filter}
	MSC-CB + 2 expansion modules	12.8–28.7 + T_{Input_filter}
	MSC-CB + 3 expansion modules	13.9–30.8 + T_{Input_filter}
	MSC-CB + 4 expansion modules	15.0–33.0 + T_{Input_filter}
	MSC-CB + 5 expansion modules	16.0–35.0 + T_{Input_filter}
	MSC-CB + 6 expansion modules	17.0–37.3 + T_{Input_filter}
	MSC-CB + 7 expansion modules	18.2–39.5 + T_{Input_filter}
	MSC-CB + 8 expansion modules	19.3–41.7 + T_{Input_filter}
	MSC-CB + 9 expansion modules	20.4–43.8 + T_{Input_filter}
	MSC-CB + 10 expansion modules	21.5–46.0 + T_{Input_filter}
	MSC-CB + 11 expansion modules	22.5–48.1 + T_{Input_filter}
	MSC-CB + 12 expansion modules	23.6–50.3 + T_{Input_filter}
	MSC-CB + 13 expansion modules	24.7–52.5 + T_{Input_filter}
	MSC-CB + 14 expansion modules	25.8–54.6 + T_{Input_filter}

EN

Response time **MSC-CB-S** (ms) This response time is dependent on the following parameters: 1) Number of expansion modules installed 2) Number of operators 3) Number of OSSD outputs The correct response time is calculated by the EUCHNER Safety Designer software (see project report). Fault reaction time **MSC-CB-S** (ms) The fault reaction time corresponds to the reaction time, except on SPM modules with an encoder/proximity switch interface. In this case, the fault reaction time is 2 s.	Basic module	12.75–14.75	+ T_{Input_filter}
	MSC-CB-S + 1 expansion modules	13.83–37.84	+ T_{Input_filter}
	MSC-CB-S + 2 expansion modules	14.91–40.00	+ T_{Input_filter}
	MSC-CB-S + 3 expansion modules	15.99–42.16	+ T_{Input_filter}
	MSC-CB-S + 4 expansion modules	17.07–44.32	+ T_{Input_filter}
	MSC-CB-S + 5 expansion modules	18.15–46.48	+ T_{Input_filter}
	MSC-CB-S + 6 expansion modules	19.23–48.64	+ T_{Input_filter}
	MSC-CB-S + 7 expansion modules	20.31–50.80	+ T_{Input_filter}
	MSC-CB-S + 8 expansion modules	21.39–52.96	+ T_{Input_filter}
	MSC-CB-S + 9 expansion modules	22.47–55.12	+ T_{Input_filter}
	MSC-CB-S + 10 expansion modules	23.55–57.28	+ T_{Input_filter}
	MSC-CB-S + 11 expansion modules	24.63–59.44	+ T_{Input_filter}
	MSC-CB-S + 12 expansion modules	25.71–61.60	+ T_{Input_filter}
	MSC-CB-S + 13 expansion modules	26.79–63.76	+ T_{Input_filter}
	MSC-CB-S + 14 expansion modules	27.87–65.92	+ T_{Input_filter}

MSC-CB/MS-CB-S module connection	Proprietary 5-way bus (MSCB) from EUCHNER
Connecting cable cross-section	0.5–2.5 mm² / AWG 12 – 20 (single conductor/multiple conductor)
Connection length, max.	100 m
Operating temperature	-10–55 °C
Ambient temperature, max.	55 °C (UL)
Storage temperature	-20–85 °C
Relative humidity	10 %–95 %
Max. altitude (above sea level)	2000 m
Vibration resistance (EN IEC 61496-1/class 5M1)	±1.5 mm (9–200 Hz)
Shock resistance (EN IEC 61496-1/class 3M4)	15 g (6 ms half-sine)
Rated voltage	24 V DC ±20 %/PELV, Class III safety class UL: power supply from Class 2 (LVLE)
Overvoltage	II
Digital input	PNP Active High EN IEC 61131-2); max. permissible resistance 1.2 kΩ

➡ T_{Input_filter} = max. filter time related to the settings on the project inputs (see section "INPUTS").

8.1.3. Housing

Description	Electronics housing, 24-pin, max.
Material of housing	Polyamide
Degree of protection, housing	IP20
Degree of protection, terminal blocks	IP 2X
Mounting	Quick-release connection to rail in accordance with EN IEC 60715
Dimensions (H x W x D) in mm	108 x 22.5 x 114.5

8.1.4. Module MSC-CB

PFH (EN IEC 61508:2010)	6.85 E-9
SFF	99.8%
Operating voltage	24 V DC ±20%
Power dissipation	3 W max.
Module enable (no./description)	2/ PNP Active High "type B" as per EN IEC 61131-2
Digital INPUTS (no./description)	8/ PNP Active High as per EN IEC 61131-2
INPUT_FBK/RESTART (no./description)	2/ EDM control/automatic or manual operation possible using RESTART button
Test OUTPUTS (no./description)	4/ for checking for short circuits, overload states
Digital OUTPUTS (no./description)	2/ programmable – PNP Active High
OSSD (no./description)	2 pairs/semiconductor safety outputs – PNP Active High 400 mA at 24 V DC max.
Slot for the M-A1	Available
Connection to PC	USB 2.0 (Hi Speed) – cable length max.: 3 m
Connection to expansion module	Via proprietary 5-way MSCB from EUCHNER

8.1.5. Module MSC-CB-S

PFH (EN IEC 61508:2010)	1.35 E-8
SFF	99.7%
Operating voltage	24 V DC ±20%
Power dissipation	3 W max.
Digital INPUTS (no./description)	8/ PNP Active High as per EN IEC 61131-2
INPUT_FBK/RESTART (no./description)	≤ 4/ EDM control system/automatic or manual mode possible using RESTART pushbutton
Test OUTPUTS (no./description)	4/ for checking for short circuits, overload states
Digital OUTPUTS (no./description)	≤ 4/ programmable – PNP Active High
OSSD (no./description)	4 single/semiconductor safety outputs – PNP Active High 400 mA at 24 V DC max.
Slot for the M-A1	Available
Connection to PC	USB 2.0 (Hi Speed) – cable length max.: 3 m
Connection to expansion module	Via proprietary 5-way MSCB from EUCHNER

8.1.6. Module FI8FO2

PFH (EN IEC 61508:2010)	5.67 E-9
SFF	99.8%
Operating voltage	24 V DC ±20%
Power dissipation	3 W max.
Digital INPUTS (no./description)	8/ PNP Active High as per EN IEC 61131-2
INPUT_FBK/RESTART (no./description)	2/ EDM control/automatic or manual operation possible using RESTART button
Test OUTPUTS (no./description)	4/ for checking for short circuits, overload states
Digital OUTPUTS (no./description)	2/ programmable – PNP Active High
OSSD (no./description)	2 pairs/semiconductor safety outputs – PNP Active High 400 mA at 24 V DC max.
Connection to MSC-CB and MSC-CB-S	Via proprietary 5-way MSCB from EUCHNER

8.1.7. Module FI8FO4S

PFH (EN IEC 61508:2010)	1.32 E-8
SFF	99.7%
Operating voltage	24 V DC ±20%
Power dissipation	3 W max.
Digital INPUTS (no./description)	8/ PNP Active High as per EN IEC 61131-2
INPUT_FBK/RESTART (no./description)	≤ 4/ EDM control system/automatic or manual mode possible using RESTART pushbutton
Test OUTPUTS (no./description)	4/ for checking for short circuits, overload states
Digital OUTPUTS (no./description)	≤ 4/ programmable – PNP Active High
OSSD (no./description)	4 single/semiconductor safety outputs – PNP Active High 400 mA at 24 V DC max.
Connection to MSC-CB-S	Via proprietary 5-way MSCB from EUCHNER

8.1.8. Modules FI8 – FI16

Module	FI8	FI16
PFH (EN IEC 61508:2010)	4.46 E-9	4.93 E-9
SFF	99.7%	99.8%
Operating voltage	24 V DC ±20%	
Power dissipation	3 W max.	
Digital INPUTS (no./description)	8	16
	PNP Active High as per EN IEC 61131-2	
Test OUTPUTS (no./description)	4/ for checking for short circuits, overload states	
Connection to MSC-CB and MSC-CB-S	Via proprietary 5-way MSCB from EUCHNER	

EN

8.1.9. Module FM4

PFH (EN IEC 61508:2010)	5.60 E-9
SFF	99.7%
Operating voltage	24 V DC ±20%
Power dissipation	3 W max.
Digital INPUTS (no./description)	12/ PNP Active High as per EN IEC 61131-2
Test OUTPUTS (no./description)	8/ for checking for short circuits, overload states
Connection to MSC-CB and MSC-CB-S	Via proprietary 5-way MSCB from EUCHNER

8.1.10. Modules AC-FO2 – AC-FO4

Module	AC-FO2	AC-FO4
PFH (EN IEC 61508:2010)	4.08 E-9	5.83 E-9
SFF	99.8%	99.8%
Operating voltage	24 V DC ±20%	
Power dissipation	3 W max.	
INPUT_FBK/RESTART (no./description)	2/4/ EDM control system/automatic or manual mode possible using RESTART pushbutton	
Digital OUTPUTS (no./description)	2	4
	Programmable – PNP Active High	
OSSD (no./description)	2 pairs	4 pairs
	Semiconductor safety outputs: PNP Active High – 400 mA at 24 V DC max.	
Connection to MSC-CB and MSC-CB-S	Via proprietary 5-way bus MSCB from EUCHNER	

8.1.11. Module AH-FO4SO8

PFH (IEC 61508:2010)	8.56 E-09
SFF	99.7%
Operating voltage	24 V DC ± 20%
Power dissipation	4 W max.
INPUT_FBK/RESTART (no./description)	4/ EDM control / automatic or manual operation possible using RESTART button
Digital OUTPUTS (no./description)	8/ programmable outputs – PNP Active High
OSSD (no./description)	2 pairs (or 4 single) / semiconductor safety outputs – PNP Active High 2 A at 24 V DC max.
Response time	12 ms
Connection to MSC-CB and MSC-CB-S	Via proprietary 5-way bus MSCB from EUCHNER

8.1.12. Modules SPM0 – SPM1 – SPM2

Module	SPM0	SPM1	SPM2
PFH	7.48E-09	–	–
PFH (TTL/B)	–	9.32E-09 (SPM1TB)	1.12E-08 (SPM2TB)
PFH (sin/cos)	–	9.43E-09 (SPM1S)	1.14E-08 (SPM2S)
PFH (HTL24))	–	8.20E-09 (SPM1H)	8.92E-09 (SPM2H)
SFF	99.7%		
Operating voltage	24 V DC ±20%		
Power dissipation	3 W max.		
Encoder interface	–	TTL (models SPM1TB/SPM2TB) HTL (models SPM1H/SPM2H) sin/cos (models SPM1S/SPM2S)	
Encoder connections	–	RJ45	
Encoder input signals electrically isolated in accordance with EN 61800 5		Rated insulation voltage 250 V Overvoltage category II Rated impulse withstand voltage 4.00 kV	
Number of encoders, max.	–	1	2
Encoder frequency, max.	–	500 kHz (HTL: 300 kHz)	
Configurable encoder limit range	–	1 Hz – 450 kHz	
Proximity switch type	PNP/NPN – 3/4-wire		
Proximity switch connections	Plug-in terminals		
Configurable proximity switch limit ranges	1 Hz – 4 kHz		
Number of proximity switches, max.	2		
Max. frequency, proximity switch	5 kHz		
Max. number of axes	2		
Frequency spacing standstill/overspeed	> 10 Hz		
Threshold spacing	> 5%		
Connection to MSC-CB and MSC-CB-S	Via proprietary 5-way bus MSCB from EUCHNER		

8.1.13. Modules AZ-FO4 – AZ-FO4O8

| Module	AZ-FO4	AZ-FO4O8
PFH (EC IEC 61508:2010)	2.72 E-9	1.30 E-8
SFF	99.8%	99.7%
Operating voltage	24 V DC ±20%	
Power dissipation	3 W max.	
Switching voltage	240 VAC	
Switching current	6 A max.	
Normally open contacts	4	
INPUT FBK/RESTART (no./description)	4/ EDM control / automatic or manual operation possible using RESTART button	
Digital OUTPUTS (no./description)	–	8/ programmable outputs – PNP Active High
Response time	12 ms	
Mechanical life of contacts	> 40 x 10^6	
Connection	Terminal blocks	
Connection to MSC-CB and MSC-CB-S	Via proprietary 5-way bus MSCB from EUCHNER	

8.1.14. Modules O8 – O16
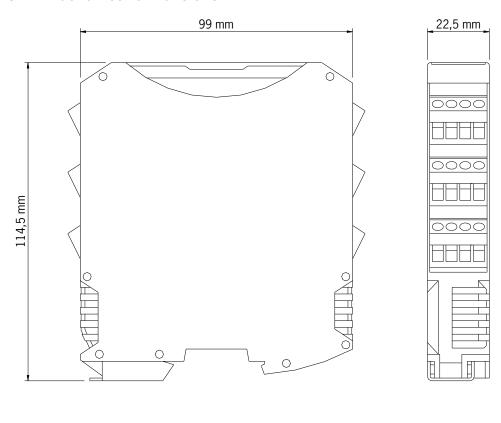
Module	O8	O16
PFH (EC IEC 61508:2010)	4.44 E-9	6.61 E-9
SFF	99.6%	99.6%
Operating voltage	24 V DC ±20%	
Power dissipation	3 W max.	
Digital OUTPUTS (no./description)	8	16
	Programmable outputs – PNP Active High	
Connection to MSC-CB and MSC-CB-S	Via proprietary 5-way bus MSCB from EUCHNER	

EN

8.1.15. Interface modules CI1 – CI2

Interface module	CI1	CI2
Number of connection channels	1	2
Connections	MSCB 5-pin communication plug connector (rear side), Plug-in connection terminals (CI1, 2 x 4-pin/CI2, 4 x 4-pin)	
Connectible modules	‣ Max. number of connectible CI modules = 6 ‣ Any bus module in the system can be connected only near the first additional CI module or directly on the MSC-CB.	
Max. connection length	<50 m (per section)	

8.2. Mechanical dimensions
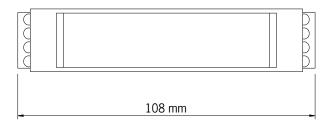
Fig. 15:   Module dimensions

8.3. Signals

8.3.1. Basic module MSC-CB *(Fig. 16)*

Table 21: Indication on starting

MEANING	RUN GREEN	IN FAIL RED	EXT FAIL RED	COM ORANGE	ENA BLUE	IN1–8 YELLOW	OSSD1/2 RED/GREEN	CLEAR1/2 YELLOW	STATUS1/2 YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	ON	ON	Red	ON	ON
MA1 detected	OFF	OFF	OFF	ON (max. 1 s)	ON (max. 1 s)	OFF	Red	OFF	ON
Writing/loading the diagram to/from MA1	OFF	OFF	OFF	Flashes 5 times	Flashes 5 times	OFF	Red	OFF	OFF
SWSD is requesting connection: no internal configuration	OFF	OFF	OFF	Flashing slowly	OFF	OFF	Red	OFF	OFF
SWSD is requesting connection: (expansion module or node number not correct) (see System layout)	OFF	OFF	OFF	Flashing quickly	OFF	OFF	Red	OFF	OFF
SWSD is requesting connection: (expansion module missing or not ready). (see System layout)	Flashing quickly	OFF	OFF	Flashing quickly	OFF	OFF	Red	OFF	OFF
SWSD connected, MSC-CB stopped	OFF	OFF	OFF	ON	OFF	OFF	Red	OFF	OFF

Table 22: Dynamic indication

MEANING	RUN GREEN	IN FAIL RED	EXT FAIL RED	COM ORANGE	IN1–8 YELLOW	ENA BLUE	OSSD1/2 RED/GREEN	CLEAR1/2 YELLOW	STATUS1/2 YELLOW
NORMAL OPERATION	ON	OFF	**OFF** Operation OK	**ON** = MSC-CB connected to PC **OFF** = Others	INPUT state	**ON** MASTER_ENABLE1 and MASTER_ENABLE2 Active **OFF** others	**RED** If output OFF **GREEN** If output ON	**ON** Waiting for RESTART **Flashing** NO feedback loop	OUTPUT state
EXTERNAL ERROR DETECTED	ON	OFF	**ON** Erroneous external connection detected	**ON** = MSC-CB connected to PC **OFF** = Others	Only the number of the INPUT with the erroneous connection **flashes**				

Fig. 16: MSC-CB

EN

8.3.2. Basic module MSC-CB-S *(Fig. 17)*

MEANING	LED							
	RUN GREEN	IN FAIL RED	EXT FAIL RED	COM ORANGE	ENA BLUE	IN1–8 YELLOW	OSSD1/4 RED/GREEN/YELLOW	STATUS1/4 YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	ON	ON	Red	ON
M-A1 detected	OFF	OFF	OFF	ON (max. 1 s)	ON (max. 1 s)	OFF	Red	OFF
Writing/loading the diagram to/from M-A1	OFF	OFF	OFF	Flashes 5 times	Flashes 5 times	OFF	Red	OFF
SWSD is requesting connection: no internal configuration	OFF	OFF	OFF	Flashing slowly	OFF	OFF	Red	OFF
SWSD is requesting connection: (expansion module or node number not correct) (see System layout)	OFF	OFF	OFF	Flashing quickly	OFF	OFF	Red	OFF
SWSD is requesting connection: (expansion module missing or not ready), (see System layout)	Flashing quickly	OFF	OFF	Flashing quickly	OFF	OFF	Red	OFF
SWSD connected, MSC-CB stopped	OFF	OFF	OFF	ON	OFF	OFF	Red	OFF

Table 23: Indication on starting

MEANING	LED							
	RUN GREEN	IN FAIL RED	EXT FAIL RED	COM ORANGE	IN1–8 YELLOW	ENA BLUE	OSSD1/4 RED/GREEN/YELLOW	STATUS1/4 YELLOW
NORMAL OPERATION	ON	OFF	**OFF** Operation OK	**ON** = MSC-CB-S connected to PC / **OFF** = Others	INPUT state	ON	**RED** If output OFF / **GREEN** If output ON / **YELLOW** Waiting for RESTART / **YELLOW FLASHING** NO feedback loop	OUTPUT state
EXTERNAL ERROR DETECTED	ON	OFF	**ON** Erroneous external connection detected	**ON** = MSC-CB-S connected to PC / **OFF** = Others	Only the number of the INPUT with the erroneous connection **flashes**			

Table 24: Dynamic indication

Fig. 17: MSC-CB-S

8.3.3. Module FI8FO2 *(Fig. 18)*

MEANING	LED							
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	IN1–8 YELLOW	OSSD1/2 RED/GREEN	CLEAR1/2 YELLOW	STATUS1/2 YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	ON	Red	ON	ON

Table 25:   Indication on starting

MEANING	LED							
	RUN GREEN	IN FAIL RED	EXT FAIL RED	IN1–8 YELLOW	SEL ORANGE	OSSD1/2 RED/GREEN	CLEAR1/2 YELLOW	STATUS1/2 YELLOW
NORMAL OPERATION	**OFF** If the module is waiting for the first message from the basic module **FLASHING** If no INPUT or OUTPUT is requested by the configuration **ON** If INPUT or OUTPUT is requested by the configuration	OFF	**OFF** **ON** Erroneous external connection detected	INPUT state Only the number of the INPUT with the erroneous connection **flashes**	Indicates the signal table NODE_SEL0/1	**RED** If output OFF **GREEN** If output ON	**ON** Waiting for RESTART **FLASHING** NO feedback loop	OUTPUT state

Table 26:   Dynamic indication

Fig. 18:
FI8FO2

8.3.4. Module FI8FO4S *(Fig. 19)*

MEANING	RUN GREEN	IN FAIL RED	EXT FAIL RED	LED			
				SEL0/1 ORANGE	IN1–8 YELLOW	OSSD1/4 RED/GREEN/YELLOW	STATUS1/4 YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	ON	Red	ON

Table 27: Indication on starting

MEANING	RUN GREEN	IN FAIL RED	EXT FAIL RED	LED			
				IN1–8 YELLOW	SEL0/1 ORANGE	OSSD1/4 RED/GREEN/YELLOW	STATUS1/2 YELLOW
NORMAL OPERATION	**OFF** If the module is waiting for the first message from the base unit / **FLASHING** If no INPUT or OUTPUT is requested by the configuration / **ON** If INPUT or OUTPUT is requested by the configuration	OFF	**OFF** / **ON** Erroneous external connection detected	INPUT state / Only the number of the INPUT with the erroneous connection **flashes**	Indicates the signal table NODE_SEL0/1	**RED** If output OFF / **GREEN** If output ON / **YELLOW** Waiting for RESTART / **YELLOW FLASHING** NO feedback loop	OUTPUT state

Table 28: Dynamic indication

Fig. 19:
FI8FO4S

8.3.5. Module FI8 *(Fig. 20)*

MEANING	LED				
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	IN1–8 YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	ON

Table 29: Indication on starting

MEANING	LED				
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	IN1–8 YELLOW
NORMAL OPERATION	**OFF** If the module is waiting for the first message from the base unit **FLASHING** If no INPUT or OUTPUT is requested by the configuration **ON** If INPUT or OUTPUT is requested by the configuration	**OFF**	**OFF** **ON** Erroneous external connection detected	Indicates the signal table NODE_SEL0/1	INPUT state Only the number of the INPUT with the erroneous connection **flashes**

Table 30: Dynamic indication
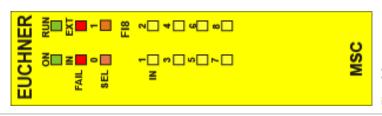
Fig. 20:
FI8

8.3.6. Module FM4 *(Fig. 21)*

Table 31: Indication on starting

MEANING	LED				
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	IN1–12 YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	ON

Table 32: Dynamic indication

MEANING	LED				
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	IN1–12 YELLOW
NORMAL OPERATION	**OFF** If the module is waiting for the first message from the basic module **FLASHING** If no INPUT or OUTPUT is requested by the configuration **ON** If INPUT or OUTPUT is requested by the configuration	OFF	OFF **ON** Erroneous external connection detected	Indicates the signal table NODE_SEL0/1	INPUT state Only the number of the INPUT with the erroneous connection **flashes**

Fig. 21:
FM4

8.3.7. Module FI16 *(Fig. 22)*

MEANING	LED				
	RUN GREEN	**IN FAIL RED**	**EXT FAIL RED**	**SEL ORANGE**	**IN1–16 YELLOW**
Switch on – initial CHECK	ON	ON	ON	ON	ON

Table 33: Indication on starting

MEANING	LED				
	RUN GREEN	**IN FAIL RED**	**EXT FAIL RED**	**SEL ORANGE**	**IN1–16 YELLOW**
NORMAL OPERATION	**OFF** If the module is waiting for the first message from the basic module **FLASHING** If no INPUT or OUTPUT is requested by the configuration **ON** If INPUT or OUTPUT is requested by the configuration	**OFF**	**OFF** / **ON** Erroneous external connection detected	Indicates the signal table NODE_SEL0/1	INPUT state / Only the number of the INPUT with the erroneous connection **flashes**

Table 34: Dynamic indication

Fig. 22:
FI16

EN
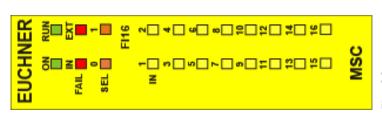
8.3.8. Module AC-FO2 *(Fig. 23)*

MEANING	RUN GREEN	IN FAIL RED	EXT FAIL RED	LED SEL ORANGE	OSSD1/2 RED/GREEN	CLEAR1/2 YELLOW	STATUS1/2 YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	Red	ON	ON

Table 35:   Indication on starting

MEANING	RUN GREEN	IN FAIL RED	EXT FAIL RED	LED SEL ORANGE	OSSD1/2 RED/GREEN	CLEAR1/2 YELLOW	STATUS1/2 YELLOW
NORMAL OPERATION	**OFF** If the module is waiting for the first message from the basic module / **FLASHING** If no INPUT or OUTPUT is requested by the configuration / **ON** If INPUT or OUTPUT is requested by the configuration	**OFF** Operation OK	**OFF** Operation OK	Indicates the signal table NODE_SEL0/1	**RED** If output OFF / **GREEN** If output ON	**ON** Waiting for RE-START / **Flashing** NO feedback loop	OUTPUT state

Table 36:   Dynamic indication

Fig. 23:
AC-FO2

8.3.9. Module AC-FO4 *(Fig. 24)*

MEANING	LED						
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	OSSD1/4 RED/GREEN	CLEAR1/4 YELLOW	STATUS1/4 YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	Red	ON	ON

Table 37:   Indication on starting

MEANING	LED						
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	OSSD1/4 RED/GREEN	CLEAR1/4 YELLOW	STATUS1/4 YELLOW
NORMAL OPERATION	**OFF** If the module is waiting for the first message from the basic module **FLASHING** If no INPUT or OUTPUT is requested by the configuration **ON** If INPUT or OUTPUT is requested by the configuration	**OFF** Operation OK	**OFF** Operation OK	Indicates the signal table NODE_SEL0/1	**RED** If output OFF **GREEN** If output ON	**ON** Waiting for RE-START **Flashing** NO feedback loop	OUTPUT state

Table 38:   Dynamic indication

Fig. 24:
AC-FO4

8.3.10. Module AZ-FO4 *(Fig. 25)*

MEANING	LED						
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL0/1 ORANGE	RELAY1/4 RED/GREEN	CLEAR1/4 YELLOW	
Switch on – initial CHECK	ON	ON	ON	ON	Red	ON	

Table 39:   Indication on starting

MEANING	LED					
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL0/1 ORANGE	RELAY1/4 RED/GREEN	CLEAR1/4 YELLOW
NORMAL OPERATION	**OFF** If the module is waiting for the first message from the basic module **FLASHING** If no INPUT or OUTPUT is requested by the configuration **ON** If INPUT or OUTPUT is requested by the configuration	**OFF** Operation OK	**OFF** Operation OK	Indicates the signal table NODE_SEL0/1	**RED** With open contact **GREEN** If contact closed	**ON** Waiting for RESTART **Flashing** Error feedback loop external switchgear

Table 40:   Dynamic indication

Fig. 25:
AZ-FO4

8.3.11. Module AZ-FO4FO8 *(Fig. 26)*

MEANING	LED						
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL0/1 ORANGE	RELAY1/4 RED/GREEN	CLEAR1/4 YELLOW	STATUS1/8 YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	Red	ON	ON

Table 41:   Indication on starting

MEANING	LED						
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL0/1 ORANGE	RELAY1/4 RED/GREEN	CLEAR1/4 YELLOW	STATUS1/8 YELLOW
NORMAL OPERATION	**OFF** If the module is waiting for the first message from the basic module **FLASHING** If no INPUT or OUTPUT is requested by the configuration **ON** If INPUT or OUTPUT is requested by the configuration	**OFF** Operation OK	**OFF** Operation OK	Indicates the signal table NODE_SEL0/1	**RED** With open contact **GREEN** If contact closed	**ON** Waiting for RE-START **FLASHING** Error feedback loop external switchgear	OUTPUT state

Table 42:   Dynamic indication

Fig. 26:
AZ-FO408

EN
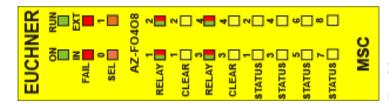
8.3.12. Module O8 *(Fig. 27)*

MEANING	LED				
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL0/1 ORANGE	STATUS1/8 YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	ON

Table 43: Indication on starting

MEANING	LED				
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL0/1 ORANGE	STATUS1/8 YELLOW
NORMAL OPERATION	**OFF** If the module is waiting for the first message from the basic module **FLASHING** If no INPUT or OUTPUT is requested by the configuration **ON** If INPUT or OUTPUT is requested by the configuration	**OFF** Operation OK	**OFF** Operation OK	Indicates the signal table NODE_SEL0/1	OUTPUT state

Table 44: Dynamic indication
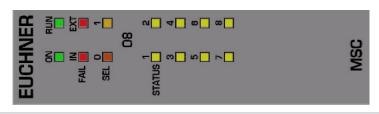
Fig. 27: O8

8.3.13. Module O16 *(Fig. 28)*

MEANING	LED				
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL0/1 ORANGE	STATUS1/16 YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	ON

Table 45: Indication on starting

MEANING	LED				
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL0/1 ORANGE	STATUS1/16 YELLOW
NORMAL OPERATION	**OFF** If the module is waiting for the first message from the basic module **FLASHING** If no INPUT or OUTPUT is requested by the configuration **ON** If INPUT or OUTPUT is requested by the configuration	**OFF** Operation OK	**OFF** Operation OK	Indicates the signal table NODE_SEL0/1	OUTPUT state

Table 46: Dynamic indication
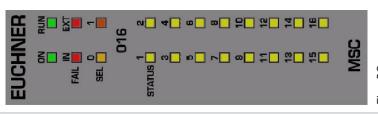
Fig. 28: O16

8.3.14. Modules SPM0 – SPM1 – SPM2 *(Fig. 29)*

Table 47:   Indication on starting

MEANING	LED						
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	ENC* YELLOW	PROX YELLOW	SH YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	Red	ON	ON

Table 48:   Dynamic indication

	LED						
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	ENC* YELLOW	PROX YELLOW	SH YELLOW
NORMAL OPERATION	**OFF** If the module is waiting for the first message from the basic module **FLASHING** If no INPUT or OUTPUT is requested by the configuration **ON** If INPUT or OUTPUT is requested by the configuration	**OFF** Operation OK	**OFF** Operation OK	Indicates the signal table NODE_SEL0/1	**ON** Encoder connected and operational **FLASHING** Encoder not connected but requested by the configuration	**ON** Proximity switch connected and operational **FLASHING 0.5 s** Proximity switch not connected but requested by the configuration **FLASHING 2 s** Fault on proximity switch	**OFF** Axis in normal speed range **FLASHING** Axis at elevated speed **ON** Axis at standstill

* IF SPM0 MODULE NOT FITTED

Fig. 29:
Speed monitoring modules SPM1, SPM2

8.3.15. Module AH-FO4SO8 *(Fig. 30)*

MEANING	LED						
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL0/1 ORANGE	RELAY1/4 RED/GREEN	CLEAR1/4 YELLOW	STATUS1/8 YELLOW
Switch on – initial CHECK	ON	ON	ON	ON	Red	ON	ON

Table 49: Indication on starting

MEANING	LED						
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL0/1 ORANGE	RELAY1/4 RED/GREEN	CLEAR1/4 YELLOW	STATUS1/8 YELLOW
	OFF If the module is waiting for the first message from the basic module **FLASHING** If no INPUT or OUTPUT is requested by the configuration **ON** If INPUT or OUTPUT is requested by the configuration						
NORMAL OPERATION		**OFF** Operation OK	**OFF** Operation OK	Indicates the signal table NODE_SEL0/1	**RED** If output is OFF **GREEN** If output is ON	**ON** Waiting for RE-START **FLASHING** Erroneous external feedback contactors	**ON** Assigned SYSTEM STATUS output is active **OFF** Assigned SYSTEM STATUS output is inactive

Table 50: Dynamic indication
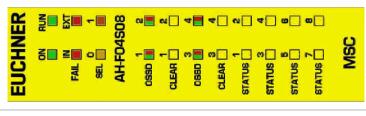
Fig. 30:
AH-FO4SO8
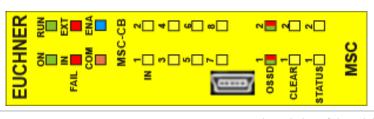
8.4. Fault diagnostics

8.4.1. Base unit MSC-CB *(Fig. 31)*

MEANING	RUN GREEN	LED								RECTIFICATION MEASURE
		IN FAIL RED	EXT FAIL RED	COM ORANGE	IN1–8 YELLOW	ENA BLUE	OSSD1/2 RED/GREEN	CLEAR1/2 YELLOW	STATUS1/2 YELLOW	
Internal fault	OFF	Flashes 2 or 3 times	OFF	OFF	OFF	OFF	Red	OFF	OFF	▸ Send module to EUCHNER for repair
OSSD output error	OFF	Flashes 4 times	OFF	OFF	OFF	OFF	Flashes 4 times (only the LED for the output in the error mode)	OFF	OFF	▸ Check OSSD1/2 connections ▸ If the problem persists, send MSC-CB to EUCHNER for repair.
Error during communication with expansion module	OFF	Flashes 5 times	OFF	OFF	OFF	OFF	OFF	OFF	OFF	▸ Restart system. ▸ If the problem persists, send MSC-CB to EUCHNER for repair.
Error in expansion module	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	▸ Restart system. ▸ Check which module is in the ERROR mode.
Error M-A1	OFF	Flashes 6 times	OFF	Flashes 6 times	OFF	OFF	OFF	OFF	OFF	▸ Replace M-A1

Table 51: Troubleshooting MSC-CB

Fig. 31: MSC-CB

8.4.2. Basic module MSC-CB-S *(Fig. 32)*

MEANING	LED								RECTIFICATION MEASURE
	RUN GREEN	IN FAIL RED	EXT FAIL RED	COM ORANGE	IN1–8 YELLOW	ENA BLUE	OSSD1/4 RED/GREEN/YELLOW	STATUS1/4 YELLOW	
Internal fault	OFF	Flashes 2 or 3 times	OFF	OFF	OFF	OFF	Red	OFF	▸ Send module to EUCHNER for repair
OSSD output error	OFF	Flashes 4 times	OFF	OFF	OFF	OFF	Flashes 4 times (only the LED for the output in the error mode)	OFF	▸ Check OSSD1/2 connections ▸ If the problem persists, send the MSC-CB-S to EUCHNER for repair.
Error during communication with expansion module	OFF	Flashes 5 times	OFF	OFF	OFF	OFF	OFF	OFF	▸ Restart system. ▸ If the problem persists, send the MSC-CB-S to EUCHNER for repair.
Error in expansion module	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	▸ Restart system. ▸ Check which module is in the ERROR mode.
Error M-A1	OFF	Flashes 6 times	OFF	Flashes 6 times	OFF	OFF	OFF	OFF	▸ Replace M-A1
OSSD overload or load connected to 24 V DC	ON	OFF	ON	OFF	INPUT state	ON	RED flashing (only the LED corresponding to the output in the error mode)	OUTPUT state	▸ Check OSSD output connections
Short circuit or overload on the status outputs	ON	OFF	ON	OFF	INPUT state	ON	OUTPUT state	Flashing	▸ Check status output connections

Table 52: Troubleshooting MSC-CB-S

Fig. 32:
MSC-CB-S

MSC

EN

8.4.3. Module FI8FO2 *(Fig. 33)*

MEANING	LED								RECTIFICATION MEASURE
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	IN1–8 YELLOW	OSSD1/2 RED/GREEN	CLEAR1/2 YELLOW	STATUS1/2 YELLOW	
Internal fault	OFF	Flashes 2 or 3 times	OFF		OFF	Red	OFF	OFF	▲ Send module to EUCHNER for repair
Compatibility error	OFF	Flashes 5 times	OFF		Flashes 5 times	Flashes 5 times	Flashes 5 times	Flashes 5 times	▲ Firmware version not compatible with basic module.
OSSD output error	OFF	Flashes 4 times	OFF	Indicates the physical address of the module	OFF	Flashes 4 times (only the LED for the output in the error mode)	OFF	OFF	▲ Check OSSD1/2 connections ▲ If the problem persists, send FI8FO2 to EUCHNER for repair.
Error during communication with basic module	OFF	Flashes 5 times	OFF		OFF	OFF	OFF	OFF	▲ Restart system. ▲ If the problem persists, send FI8FO2 to EUCHNER for repair.
Error in another expansion module or MSC-CB	OFF	ON	OFF		OFF	OFF	OFF	OFF	▲ Restart system. ▲ Check which module is in the ERROR mode.
Expansion module of the same type with the same address detected	OFF	Flashes 5 times	Flashes 5 times		OFF	OFF	OFF	OFF	▲ Change address of the module (see section NODE_SEL).
Internal node detection error	OFF	Flashes 3 times	OFF	RECTIFICATION MEASURE	OFF	OFF	OFF	OFF	▲ Send to EUCHNER for repair.

Table 53: Troubleshooting FI8FO2

Fig. 33: FI8FO2

8.4.4. Module FI8FO4S *(Fig. 34)*

MEANING	LED							RECTIFICATION MEASURE
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	IN1–8 YELLOW	OSSD1/4 RED/GREEN/YELLOW	STATUS1/4 YELLOW	
Internal fault	OFF	Flashes 2 or 3 times	OFF		OFF	Red	OFF	▸ Send module to EUCHNER for repair
Compatibility error	OFF	Flashes 5 times	OFF		Flashes 5 times	Flashes 5 times	Flashes 5 times	▸ Firmware version not compatible with basic module.
OSSD output error	OFF	Flashes 4 times	OFF		OFF	Flashes 4 times (only the LED for the output in the error mode)	OFF	▸ Check OSSD1/2 connections ▸ If the problem persists, send FI8FO4S to EUCHNER for repair.
Error during communication with basic module	OFF	Flashes 5 times	OFF	Indicates the physical address of the module	OFF	OFF	OFF	▸ Restart system. ▸ If the problem persists, send FI8FO4S to EUCHNER for repair.
Error in another expansion module or MSC-CB	OFF	ON	OFF		OFF	OFF	OFF	▸ Restart system. ▸ Check which module is in the ERROR mode.
Expansion module of the same type with the same address detected	OFF	Flashes 5 times	Flashes 5 times		OFF	OFF	OFF	▸ Change address of the module (see section NODE_SEL)
OSSD overload or load connected to 24 V DC	ON	OFF	ON		INPUT state	RED flashing (only the LED corresponding to the output in the error mode)	OUTPUT state	▸ Check OSSD output connections
Short circuit or overload on the status outputs	ON	OFF	ON		INPUT state	OUTPUT state	Flashing	▸ Check status output connections

Table 54: FI8FO4S troubleshooting

Fig. 34:
FI8FO4S

8.4.5. Module FI8 *(Fig. 35)*

MEANING	LED					RECTIFICATION MEASURE
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	IN1–8 YELLOW	
Internal fault	OFF	Flashes 2 or 3 times	OFF		OFF	▸ Send module to EUCHNER for repair.
Compatibility error	OFF	Flashes 5 times	OFF		Flashes 5 times	▸ Firmware version not compatible with basic module.
OSSD output error	OFF	Flashes 4 times	OFF		OFF	▸ Restart system. ▸ If the problem persists, send FI8 to EUCHNER for repair.
Error during communication with basic module	OFF	Flashes 5 times	OFF	Indicates the physical address of the module	OFF	▸ Restart system. ▸ If the problem persists, send FI8 to EUCHNER for repair.
Error in another expansion module or MSC-CB	OFF	ON	OFF		OFF	▸ Restart system. ▸ Check which module is in the ERROR mode.
Expansion module of the same type with the same address detected	OFF	Flashes 5 times	Flashes 5 times		OFF	▸ Change address of the module (see section NODE_SEL)
Internal node detection error	OFF	Flashes 3 times	OFF	Flashes 3 times	OFF	▸ Send to EUCHNER for repair.

Table 55: Troubleshooting FI8

Fig. 35:
FI8

8.4.6. Module FM4 *(Fig. 36)*

MEANING	LED RUN GREEN	LED IN FAIL RED	LED EXT FAIL RED	LED SEL ORANGE	LED IN1–8 YELLOW	RECTIFICATION MEASURE
Internal fault	OFF	Flashes 2 or 3 times	OFF		OFF	▸ Send module to EUCHNER for repair.
Compatibility error	OFF	Flashes 5 times	OFF		Flashes 5 times	▸ Firmware version not compatible with basic module.
OSSD output error	OFF	Flashes 4 times	OFF	Indicates the physical address of the module	OFF	▸ Restart system. ▸ If the problem persists, send FM4 to EUCHNER for repair.
Error during communication with basic module	OFF	Flashes 5 times	OFF		OFF	▸ Restart system. ▸ If the problem persists, send FM4 to EUCHNER for repair.
Error in another expansion module or MSC-CB	OFF	ON	OFF		OFF	▸ Restart system. ▸ Check which module is in the ERROR mode.
Expansion module of the same type with the same address detected	OFF	Flashes 5 times	Flashes 5 times		OFF	▸ Change address of the module (see section NODE_SEL)
Internal node detection error	OFF	Flashes 3 times	OFF	Flashes 3 times	OFF	▸ Send to EUCHNER for repair.

Table 56: Troubleshooting FM4

Fig. 36:
FM4

EN
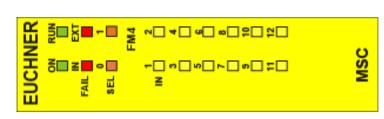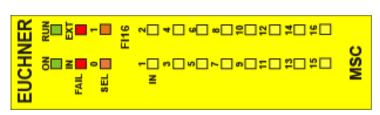
8.4.7. Module FI16 *(Fig. 37)*

MEANING	LED					RECTIFICATION MEASURE
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	IN1–16 YELLOW	
Internal fault	OFF	Flashes 2 or 3 times	OFF		OFF	▸ Send module to EUCHNER for repair.
Compatibility error	OFF	Flashes 5 times	OFF		Flashes 5 times	▸ Firmware version not compatible with basic module.
Error during communication with basic module	OFF	Flashes 5 times	OFF	Indicates the physical address of the module	OFF	▸ Restart system. ▸ If the problem persists, send FI16 to EUCHNER for repair.
Error in another expansion module or MSC-CB	OFF	ON	OFF		OFF	▸ Restart system. ▸ Check which module is in the ERROR mode.
Expansion module of the same type with the same address detected	OFF	Flashes 5 times	Flashes 5 times		OFF	▸ Change address of the module (see section NODE_SEL)
Internal node detection error	OFF	Flashes 3 times	OFF	Flashes 3 times	OFF	▸ Send to EUCHNER for repair.

Table 57:   Troubleshooting FI16

Fig. 37:
FI16

8.4.8. Modules AC-FO2/AC-FO4 *(Fig. 38)*

MEANING	LED							RECTIFICATION MEASURE
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	OSSD1/2 RED/GREEN	CLEAR1/2 YELLOW	STATUS1/4 YELLOW	
Internal fault	OFF	Flashes 2 or 3 times	OFF		Red	OFF	OFF	‣ Send module to EUCHNER for repair.
Compatibility error	OFF	Flashes 5 times	OFF		Flashes 5 times	Flashes 5 times	Flashes 5 times	‣ Firmware version not compatible with basic module.
OSSD output error	OFF	Flashes 4 times	OFF		Flashes 4 times (only the LED for the output in the error mode)	OFF		‣ Check OSSD1/2 connections. ‣ If the problem persists, send AC-FO2/AC-FO4 to EUCHNER for repair.
Error during communication with basic module	OFF	Flashes 5 times	OFF	Indicates the physical address of the module	OFF	OFF	OFF	‣ Restart system. ‣ If the problem persists, send AC-FO2/AC-FO4 to EUCHNER for repair.
Error in another expansion module or MSC-CB	OFF	ON	OFF		OFF	OFF	OFF	‣ Restart system. ‣ Check which module is in the ERROR mode.
Expansion module of the same type with the same address detected	OFF	Flashes 5 times	Flashes 5 times		OFF	OFF	OFF	‣ Change address of the module (see section NODE_SEL)
Power supply failed on OSSD3/4 (only AC-FO4)	ON	OFF	ON		Red flashing	Flashing	OUTPUT state	‣ Connect terminals 13 and 14 to power supply
STATUS output overload or short circuit	OFF	OFF	ON		OSSD state	CLEAR state	Flashing	‣ Check STATUS cable
Internal node detection error	OFF	Flashes 3 times	OFF	Flashes 3 times	OFF	OFF	OFF	‣ Send to EUCHNER for repair.

Table 58: Troubleshooting AC-FO2/AC-FO4

Fig. 38:
AC-FO2/AC-FO4

EN

8.4.9. Module AZ-FO4 *(Fig. 39)*

MEANING	RUN GREEN	IN FAIL RED	LED EXT FAIL RED	LED SEL0/1 ORANGE	LED RELAY1/4 RED/GREEN	LED CLEAR1/4 YELLOW	RECTIFICATION MEASURE
Internal fault	OFF	Flashes 2 or 3 times	OFF		RED	OFF	▸ Send module to EUCHNER for repair
Compatibility error	OFF	Flashes 5 times	OFF		Flashes 5 times	Flashes 5 times	▸ Firmware version not compatible with basic module.
Relay output error	OFF	Flashes 4 times	OFF		Flashes 4 times (only the LED corresponding to the output in the ERROR mode)	OFF	▸ If the problem persists, send module to EUCHNER for repair.
Error during communication with basic module	OFF	Flashes 5 times	OFF	Indicates the physical address of the module	OFF	OFF	▸ Restart system. ▸ If the problem persists, send module to EUCHNER for repair.
Error in another expansion module or MSC-CB	OFF	ON	OFF		OFF	OFF	▸ Restart system. ▸ Check which module is in the ERROR mode.
Expansion module of the same type with the same address detected	OFF	Flashes 5 times	Flashes 5 times		OFF	OFF	▸ Change address of the module (see section NODE_SEL)
External feedback loop error relay category 4	ON	OFF	Flashes 4 times		Flashes 4 times (only the LED corresponding to the output in the ERROR mode)		▸ Check terminals 5, 6, 7, 8
Internal node detection error	OFF	Flashes 3 times	OFF	Flashes 3 times	OFF	OFF	▸ Send module to EUCHNER for repair

Table 59:   Troubleshooting AZ-FO4

Fig. 39:
AZ-FO4

8.4.10. Module AZ-FO4O8 *(Fig. 40)*

MEANING	RUN GREEN	IN FAIL RED	EXT FAIL RED	SELO/1 ORANGE	RELAY1/4 RED/GREEN	CLEAR1/4 YELLOW	STATUS1/8 YELLOW	RECTIFICATION MEASURE
Internal fault	OFF	Flashes 2 or 3 times	OFF		RED	OFF	OFF	▸ Send module to EUCHNER for repair
Compatibility error	OFF	Flashes 5 times	OFF		Flashes 5 times	Flashes 5 times	Flashes 5 times	▸ Firmware version not compatible with basic module.
Relay output error	OFF	Flashes 4 times	OFF		Flashes 4 times (only the LED corresponding to the output in the ERROR mode)	OFF	OFF	▸ If the problem persists, send module to EUCHNER for repair.
Error during communication with basic module	OFF	Flashes 5 times	OFF	Indicates the physical address of the module	OFF	OFF	OFF	▸ Restart system. ▸ If the problem persists, send module to EUCHNER for repair.
Error in another expansion module or MSC-CB	OFF	ON	OFF		OFF	OFF	OFF	▸ Restart system. ▸ Check which module is in the ERROR mode.
Expansion module of the same type with the same address detected	OFF	Flashes 5 times	Flashes 5 times		OFF	OFF	OFF	▸ Change address of the module (see section NODE_SEL)
External feedback loop error relay category 4	ON	OFF	Flashes 4 times		Flashes 4 times (only the LED corresponding to the output in the ERROR mode)		OFF	▸ Check terminals 5, 6, 7, 8
Internal node detection error	OFF	Flashes 3 times	OFF	Flashes 3 times	OFF	OFF	OFF	▸ Send module to EUCHNER for repair
Short circuit or overload detected	OFF	OFF	ON	OFF	OSSD state	CLEAR state	Flashing	▸ Check output connections

Table 60: Troubleshooting AZ-FO4O8

Fig. 40:
AZ-FO4O8

8.4.11. Module O8 *(Fig. 41)*

MEANING	RUN GREEN	IN FAIL RED	EXT FAIL RED	SELO/1 ORANGE	STATUS1/8 YELLOW	RECTIFICATION MEASURE
Internal fault	OFF	Flashes 2 or 3 times	OFF		OFF	▸ Send module to EUCHNER for repair.
Compatibility error	OFF	Flashes 5 times	OFF		Flashes 5 times	▸ Firmware version not compatible with basic module.
Error during communication with basic module	OFF	Flashes 5 times	OFF	Indicates the physical address of the module	OFF	▸ Restart system. ▸ If the problem persists, send module to EUCHNER for repair.
Error in another expansion module or MSC-CB	OFF	ON	OFF	Indicates the physical address of the module	OFF	▸ Restart system. ▸ Check which module is in the ERROR mode.
Expansion module of the same type with the same address detected	OFF	Flashes 5 times	Flashes 5 times		OFF	▸ Change address of the module (see section NODE_SEL).
Internal node detection error	OFF	Flashes 3 times	OFF	Flashes 3 times	OFF	▸ Send to EUCHNER for repair.
Short circuit or overload on status outputs 1–8	OFF	OFF	ON	OFF	Flashing	▸ Check status output connections 1–8
No supply to the status outputs 1–8	OFF	OFF	ON	OFF	Alternately flashing	▸ Connect pin 5 to the supply

Table 61: Troubleshooting O8

Fig. 41: O8

8.4.12. Module O16 *(Fig. 42)*

MEANING	LED						RECTIFICATION MEASURE
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL 0/1 ORANGE	STATUS 1/8 YELLOW	STATUS 9/16 YELLOW	
Internal fault	OFF	Flashes 2 or 3 times	OFF		OFF	OFF	▸ Send module to EUCHNER for repair.
Compatibility error	OFF	Flashes 5 times	OFF		Flashes 5 times	Flashes 5 times	▸ Firmware version not compatible with basic module.
Error during communication with basic module	OFF	Flashes 5 times	OFF	Indicates the physical address of the module	OFF	OFF	▸ Restart system. ▸ If the problem persists, send module to EUCHNER for repair.
Error in another expansion module or MSC-CB	OFF	ON	OFF		OFF	OFF	▸ Restart system. ▸ Check which module is in the ERROR mode.
Expansion module of the same type with the same address detected	OFF	Flashes 5 times	Flashes 5 times		OFF	OFF	▸ Change address of the module (see section NODE_SEL)
Internal node detection error	OFF	Flashes 3 times	OFF	Flashes 3 times	OFF	OFF	▸ Send to EUCHNER for repair.
Short circuit or overload on status outputs 1–8	OFF	OFF	ON	OFF	Flashing	OFF	▸ Check status output connections 1–8
Short circuit or overload on status outputs 9–16	OFF	OFF	ON	OFF	OFF	Flashing	▸ Check status output connections 9–16
No supply to the status outputs 1–8	OFF	OFF	ON	OFF	Alternately flashing	OFF	▸ Connect pin 5 to the supply
No supply to the status outputs 9–16	OFF	OFF	ON	OFF	OFF	Alternately flashing	▸ Connect pin 6 to the supply

Table 62:   Troubleshooting O16
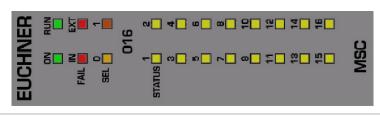
Fig. 42:
O16

8.4.13. Modules SPM0, SPM1, SPM2 *(Fig. 43)*

MEANING	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL ORANGE	ENC* YELLOW	PROX YELLOW	SH YELLOW	RECTIFICATION MEASURE
				LED				
Internal fault	OFF	Flashes 2 or 3 times	OFF	Indicates the physical address of the module	OFF	OFF	OFF	▲ Send module to EUCHNER for repair
Compatibility error	OFF	Flashes 5 times	OFF		Flashes 5 times	Flashes 5 times	Flashes 5 times	▲ Firmware version not compatible with basic module.
Internal fault Encoder	OFF	Flashes 3 times	OFF		Flashes 3 times	OFF	OFF	▲ Replace encoder ▲ Send to EUCHNER for repair
Internal fault Proximity switch	OFF	Flashes 3 times	OFF			Flashes 3 times		▲ Replace proximity switch ▲ Send to EUCHNER for repair
Internal fault Node detection	OFF	Flashes 3 times	OFF	Flashes 3 times	OFF	OFF	OFF	▲ Send module to EUCHNER for repair
Expansion module of the same type with the same address detected	OFF	Flashes 5 times	Flashes 5 times		OFF	OFF	OFF	▲ Change address of the module (see section NODE_SEL)
Encoder not connected, but requested by configuration	OFF	OFF	Flashes 3 times**		Flashes 3 times**	OFF	OFF	▲ Check connection and power supply for the encoder/proximity switch
Proximity switch not connected, but requested by configuration	OFF	OFF	Flashes 3 times**		OFF	Flashes 3 times**	OFF	▲ Check input frequency (in range)

* IF SPM0 MODULE NOT FITTED
** IF ERROR ON A SINGLE CHANNEL, THE FOLLOWING ERROR INFORMATION IS INDICATED IN SUCCESSION: FIRST THE ERROR, THEN THE ERRONEOUS CHANNEL.

Table 63: Troubleshooting SPM0, SPM1, SPM2

Fig. 43: SPM1, SPM2

8.4.14. Module AH-FO4SO8 *(Fig. 44)*

MEANING	LED							RECTIFICATION MEASURE
	RUN GREEN	IN FAIL RED	EXT FAIL RED	SEL 0/1 ORANGE	OSSD1/4 RED/GREEN	CLEAR1/4 YELLOW	STATUS 1/8 YELLOW	
Internal fault	OFF	Flashes 2 or 3 times	OFF		Red	OFF		▸ Send module to EUCHNER for repair.
Compatibility error	OFF	Flashes 5 times	OFF		Flashes 5 times	Flashes 5 times	Flashes 5 times	▸ Firmware version not compatible with basic module.
OSSD output error	OFF	Flashes 4 times	OFF		Flashes 4 times (only the LED corresponding to the output in the ERROR mode)	OFF	OFF	▸ If the problem persists, send module to EUCHNER for repair.
Error during communication with basic module	OFF	Flashes 5 times	OFF		OFF	OFF	OFF	▸ Restart system. ▸ If the problem persists, send module to EUCHNER for repair.
Error in another expansion module or MSC-CB	OFF	ON	OFF	Indicates the physical address of the module	OFF	OFF	OFF	▸ Restart system. ▸ Check which module is in the ERROR mode.
Expansion module of the same type with the same address detected	OFF	Flashes 5 times	Flashes 5 times		OFF	OFF	OFF	▸ Change address of the module (see section NODE_SEL)
STATUS output overload or short circuit	OFF	OFF	ON		OUTPUT state	CLEAR	Flashing	▸ Check status output connections
OSSD overload or load connected to 24 V DC	OFF	OFF	ON		Flashing (only the LED corresponding to the output in the ERROR mode)	OFF	OUTPUT state	▸ Check OSSD output connections
No voltage on OSSD3-OSSD4	OFF	OFF	ON		OSSD3/OSSD4 flashing	OSSD3/OSSD4 flashing	OUTPUT state	▸ Connect pin 14 to 24 V DC
Node detection error	OFF	Flashes 3 times	OFF	Flashes 3 times	OFF	OFF	OFF	▸ Send module to EUCHNER for repair

Table 64: Troubleshooting AH-FO4SO8
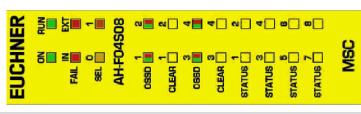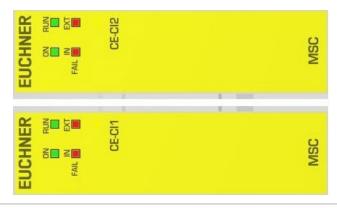
Fig. 44: AH-FO4SO8

8.4.15. CI1/CI2 bus communication expansion module *(Fig. 45)*

MEANING	LED				-
	ON GREEN	RUN GREEN	IN FAIL RED	EXT FAIL RED	
Switch-on: initial test	ON	ON	ON	ON	
Normal operation	ON	OFF > Flashing > ON	OFF Principle of operation OK	OFF Principle of operation OK	
Internal error (unre-coverable Restart system.)	ON	OFF	FLASHING after MSC-CB error coding (see operating instructions)	OFF	
Connection problem on terminals detected (can be restored)	ON	OFF	OFF	ON	

Table 65:   Light signals CI1/CI2

Fig. 45:
CI1/CI2

9. EUCHNER Safety Designer software

Using the **"EUCHNER Safety Designer"** (SWSD) application software, it is possible to design the logic for the safety components connected to the control system and the MSC system expansions.

The MSC basic module and the related expansion modules monitor and control the connected safety components.

EUCHNER Safety Designer is based on a graphical user interface using which the connections between the various components can be defined.

9.1. Installing the software

9.1.1. PC hardware system prerequisites

‣ RAM: > 2 GB

‣ Hard disk: > 500 MB free storage capacity

‣ USB connection: 2.0 or higher

9.1.2. PC software system prerequisites

Windows 7 with Service Pack 1 (or higher) installed.

ⓘ	**NOTICE**
	‣ Microsoft Framework 4.8 (or higher) must be installed on the PC.

9.1.3. EUCHNER Safety Designer is installed as follows

‣ Installation file available at www.euchner.com

‣ Double-click the file **SetupDesigner.exe**.

After the installation is complete, a window appears in which the user is prompted to close the installation program.

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9.1.4. General

If EUCHNER Safety Designer has been installed correctly, an icon is added to the desktop.

To start the program: double-click this icon. ➔

The following start screen is displayed:
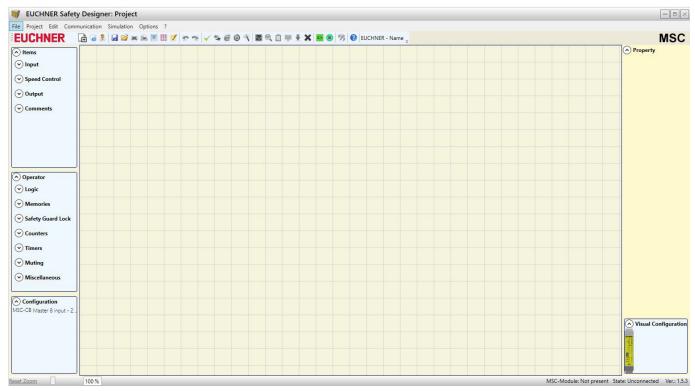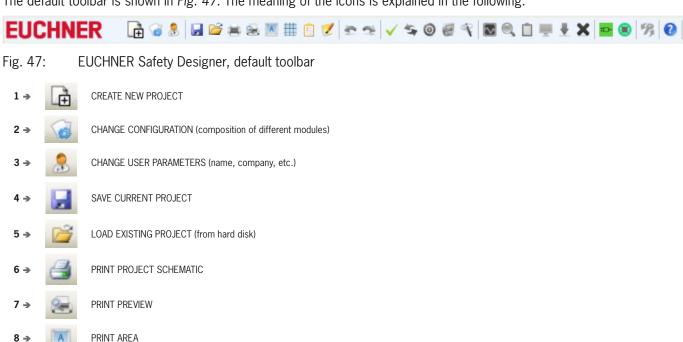
Fig. 46:   EUCHNER Safety Designer

You can now start to create projects.

9.1.5. Default toolbar

The default toolbar is shown in *Fig. 47*. The meaning of the icons is explained in the following:

Fig. 47:   EUCHNER Safety Designer, default toolbar

1 ➔   CREATE NEW PROJECT

2 ➔   CHANGE CONFIGURATION (composition of different modules)

3 ➔   CHANGE USER PARAMETERS (name, company, etc.)

4 ➔   SAVE CURRENT PROJECT

5 ➔   LOAD EXISTING PROJECT (from hard disk)

6 ➔   PRINT PROJECT SCHEMATIC

7 ➔   PRINT PREVIEW

8 ➔   PRINT AREA

9 ➔		CONNECT GRID
10 ➔		SHOW RESOURCES
11 ➔		PRINT PROJECT REPORT
12 ➔		UNDO (undo last command)
13 ➔		REDO (redo last action)
14 ➔		VALIDATE PROJECT
15 ➔		ESTABLISH CONNECTION TO MSCB
16 ➔		DISCONNECT FROM MSC
17 ➔		SEND PROJECT TO MSC
18 ➔		DOWNLOAD EXISTING PROJECT (from MSC)
19 ➔		MONITOR I/O – REALTIME STATUS – GRAPHIC
20 ➔		MONITOR I/O – REALTIME STATUS – TEXT
21 ➔		DOWNLOAD LOG FILE
22 ➔		DISPLAY SYSTEM CONFIGURATION
23 ➔		DOWNLOAD FAULT MEMORY
24 ➔		CLEAR FAULT MEMORY
25 ➔		SCHEMATIC SIMULATION
26 ➔		GRAPHIC SIMULATION
27 ➔		CHANGE PASSWORD
28 ➔		ONLINE HELP
29 ➔		RESTORE PASSWORD

Fig. 48:   EUCHNER Safety Designer, default icons

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9.1.6. Menu bar

The menu bar can be deactivated/activated.

Fig. 49: EUCHNER Safety Designer, menu bar

9.1.7. Creating a new project (configuring MSCB system)

To start a new project, select the icon on the default toolbar. The window with the project information is displayed (*Fig. 50*).
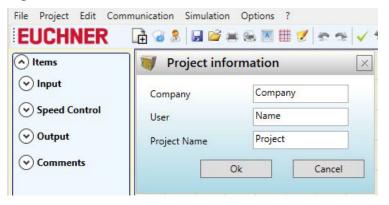
Fig. 50: EUCHNER Safety Designer, Project information

After opening, the MSC-CB-S module is shown. The basic module MSC-CB and the firmware versions of both base units can be selected from the drop-down menu. Multi-page selection: This tick can be used to activate distribution of the configuration over several pages. In this case, several pages of a fixed size are available for the user to place the components and connections.

The modules required for the system can be selected using the drop-down menus at the top of the screen (Select expansion module). The node can be selected using the list box at the bottom of the screen.

The insertion sequence of the modules is not important. Also, the physical position of the modules does not have to be the same as in the MSC configuration menu. For example, you can physically put the slave modules to the left of the master module.

For some slave modules, it is also necessary to select the type (MSC-CE-SPM) by means of a second drop-down menu located below the node selection menu.
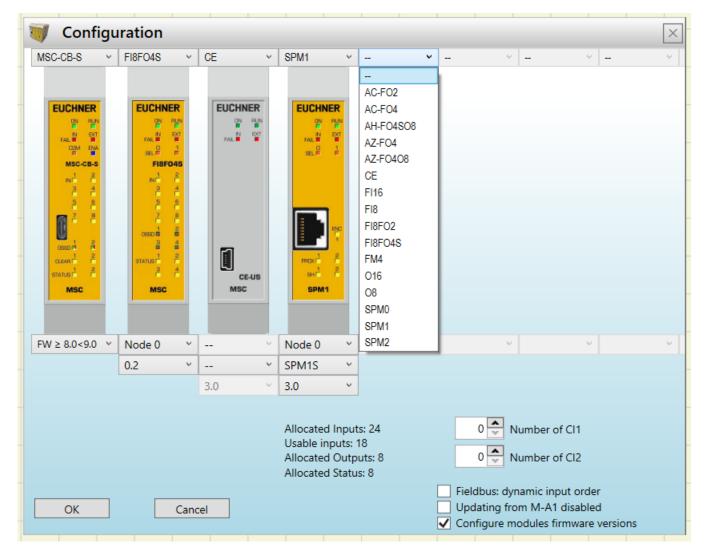
Fig. 51:   EUCHNER Safety Designer, selecting expansion module

9.1.7.1.   Page configuration/management

The size of the grid, the size of the page and its orientation can be configured in the Options menu.
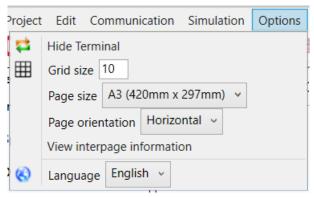
Fig. 52:   EUCHNER Safety Designer, Options menu

The pages are managed using a navigation menu or using the Page 1/Page 2/Page 3 tabs at the top, which display the names of the currently open pages.
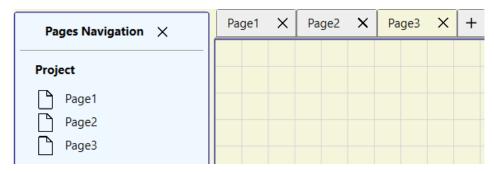
Fig. 53:   EUCHNER Safety Designer, Pages Navigation

A context menu is available with which the user can add, remove, rename or close pages.
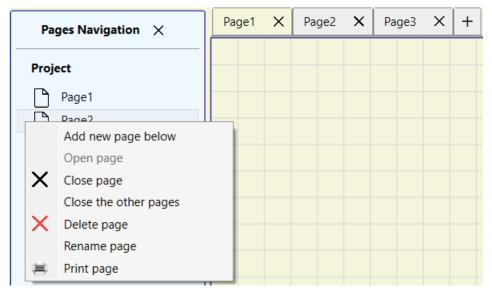
Fig. 54:   EUCHNER Safety Designer, Pages Navigation context menu

9.1.7.2.   Management of slave modules

The "Configure modules firmware versions" function is available. If selected, the user can manage the firmware version of the individual slave modules by entering the known firmware value of each available module.

➡ In this case, the project report does not indicate the minimum required versions of each slave module but instead the versions entered by the user during configuration.

9.1.7.3.   Fieldbus with dynamic input sequence

When activated, fieldbus input allocation (process data mapping) lists the input modules by their sequence in the user configuration (*Fig. 51*) and not by their hierarchical sequence; the following table shows the differences.

Hierarchical sequence of the I/O modules (default) Fieldbus with deactivated dynamic input sequence	Dynamic sequence of the I/O modules Fieldbus with activated dynamic input sequence
FI8FO2	FI16
FI16	FI8FO4S
FI8FO4S	FI8FO2

Table 66:   Allocation of process data

➡ The new tick is visible only if a fieldbus module (with firmware ≥ 3.0.0) exists in the configuration.

9.1.7.4. Changing configuration (layout of the various modules)

You can change the system configuration by selecting the [icon] icon. The Configuration window is displayed again (*Fig. 51*).

9.1.7.5. Editing user parameters

You can edit the project information by selecting the [icon] icon. The window with the project information appears (*Fig. 50*). It is not necessary to log off from ESWD for this action. As a rule, this feature is used when a new user needs to prepare a new project (also on the use of a project prepared previously).

9.1.8. Tool bars for ITEMS, OPERATOR, CONFIGURATION

Four large tool windows are displayed on the left and right side of the main window (*Fig. 55*):
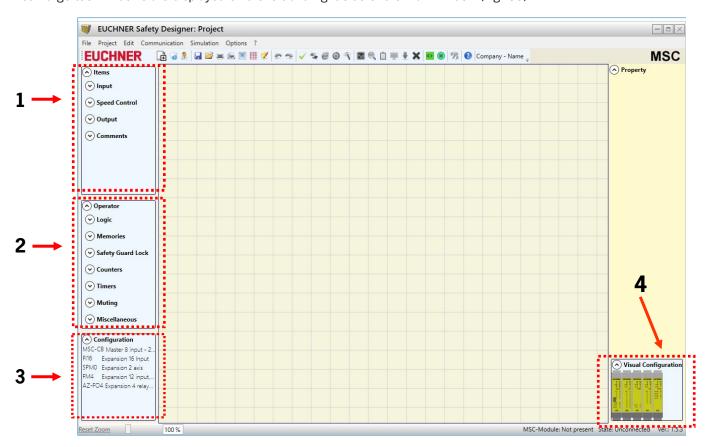
Fig. 55:   EUCHNER Safety Designer, tool windows

1. "tems" tool window

This window contains the various function blocks that make up the project. These blocks are divided into four different categories:
‣ Input
‣ Speed Control
‣ Output
‣ Comments

2. "Operator" tool window

This window contains the various function blocks for linking the items in point 1. These blocks are divided into seven different categories:
‣ Logic
‣ Memory
‣ Guard locking

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‣ Counter

‣ Timers

‣ Muting

‣ Miscellaneous

3. "Configuration" tool window

This window contains the description of the project layout.

4. "Visual configuration" tool window

This window contains the graphic illustration of the project layout.

In this window, it is possible to navigate between the I/Os of each module by right-clicking the module to be analyzed. When the master is connected to the network, all network parameters are additionally displayed in the top window.

9.1.9. Preparing the diagram

After the selection of the system layout, you can configure the project.

The logic diagram is prepared with the aid of the **DRAG & DROP** function:

‣ Select the item required from the windows described above (the individual items are described in more detail in the following) and drag to the design workspace.

‣ After the selection of an item, the **PROPERTY** window is activated where you must complete the fields as necessary.

‣ You can set a specific numeric value on a slider (e.g. Filter) using the left and right arrow keys on the keyboard, or by clicking the ends of the slider.

‣ Items can be linked together by selecting the required pin using the mouse and then dropping the link on the pin to be connected using drag & drop.

‣ You can make connections between elements a long way apart using the "Interpage In/Out" component under "Operator/Miscellaneous." A name must be assigned to the "Interpage Out" element; this name must correspond to the related "Interpage In" element to create the required connection.

Left part of the diagram

Right part of the diagram

Fig. 56:   Interpage In/Out

‣ If an item needs to be duplicated, first you must select it and then you can copy and paste it by pressing CTRL+C/CTRL+V on the keyboard.

‣ An item or a link is deleted by selecting the item or the link and then pressing DEL on the keyboard.

‣ The "Search" function (CRTL+F) permits searching within a plan for a search parameter. No distinction is made between upper-case and lower-case letters during the search.

9.1.9.1. Using the right mouse button

‣ On input/output blocks
  - Copy/paste
  - Delete
  - Delete all assigned connections
  - Alignment with other function blocks (with multiple selection)
  - Help
  - Monitor mode: show/hide the property window
  - Status block: activate/deactivate the logical negation on the input pin

‣ On operator blocks
  - Copy/paste
  - Delete
  - Alignment with other function blocks (with multiple selection)
  - Help
  - Activate/deactivate the logical negation
  - Monitor mode: show/hide the property window

‣ On terminals
  - Alignment with other function blocks (with multiple selection)

‣ On connections (wires)
  - Delete
  - Indication of the entire path for a connection (network)
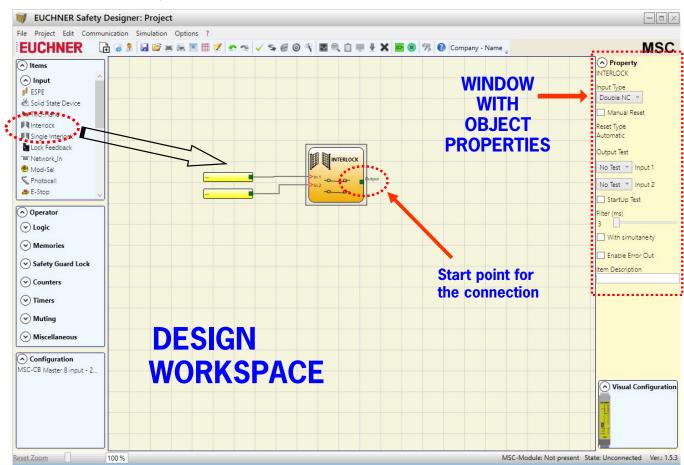
Fig. 57:   EUCHNER Safety Designer, design area

9.1.9.2. Several connections

The user can automatically insert multiple connection lines using the Connections command in the context menu.

‣ When a group of inputs and an operator is selected: All selected inputs will be connected to the free pins of the operator.
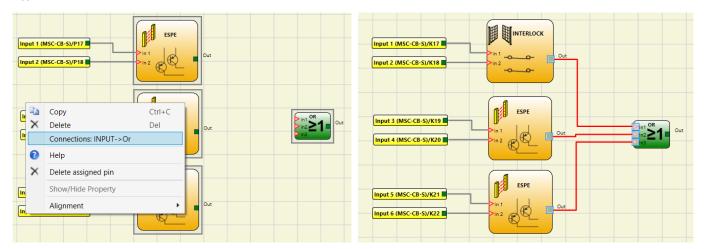
Fig. 58: Input group with operator

Fig. 59: Connection with operator established

‣ If an input and a group of operators/outputs are selected: The selected input will be connected to all operators/outputs.
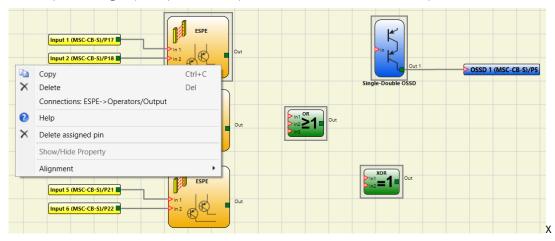
Fig. 60: Input with a group of operators and outputs

‣ When a group of operators/outputs is selected: The operator at the far left will be connected to all remaining operators/outputs.
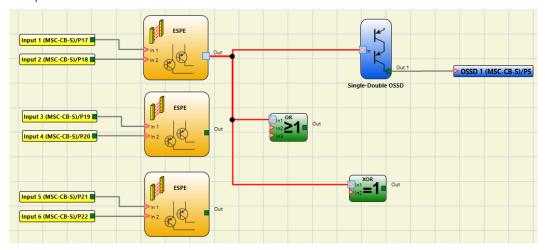
Fig. 61: Input: automatic connection to the operators established

9.1.9.3. Automatic numbering

FieldBus and Probes

The user can automatically number the bits of a selected group of FieldBus or Probes using the Automatic FieldBus (Probe) numbering command in the context menu.

If a numerical value is already assigned by another element of the same type in the scheme, this will be skipped during numbering.
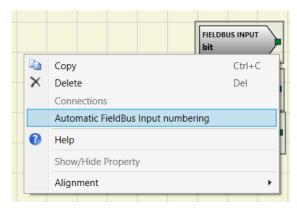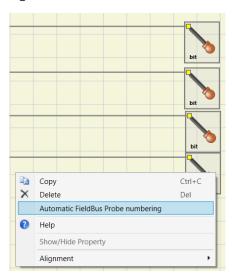
Fig. 62: Automatic fieldbus numbering

Fig. 63: Numbering OK (bit 1 already assigned)
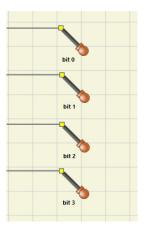
Fig. 64: Automatic numbering of fieldbus probe

Fig. 65: Automatic numbering OK

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Inputs/outputs

The user can automatically number the terminals of a selected group of inputs or outputs using the Automatic Input (Output) numbering command in the context menu.

This command offers a list of modules on which the assignment can be made. If a module does not have enough free pins or does not support the selected input type, it will be displayed in gray (not selectable) in the assignment list.
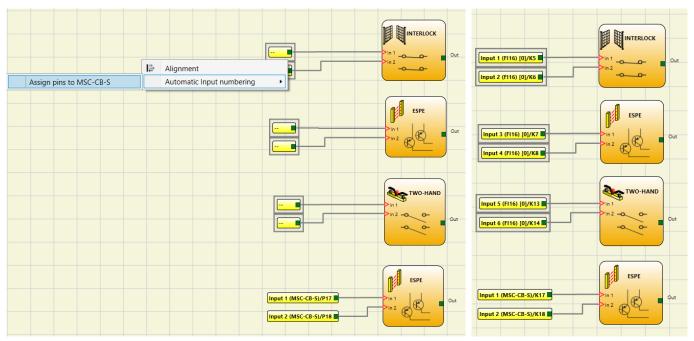
Fig. 66:   Automatic numbering of inputs

Fig. 67:   Automatic numbering completed (pin assigned to FI16)
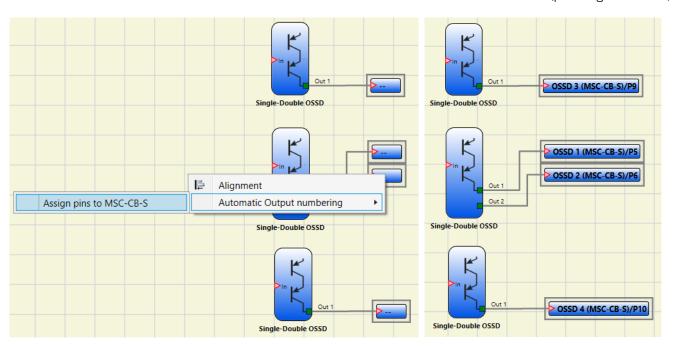
Fig. 68:   Automatic numbering of outputs

Fig. 69:   Automatic numbering completed

9.1.10. Example for a project

Fig. 70 shows an example of a project in which the module MSC-CB is connected to only two safety components (interlock and emergency stop).

The inputs (1, 2, 3) on the module MSC-CB for connecting the contacts on the safety components are highlighted in yellow on the left. The MSC outputs (from 1 to 4) are activated in accordance with the conditions that are defined in the interlock (INTERLOCK) and emergency stop (E-STOP) *(see Page 115 Emergency stop (E-STOP) and Page 116 Interlock (INTERLOCK)).*

Click a block to select it and activate the PROPERTY window on the right where you can configure the activation and test parameters for the block.
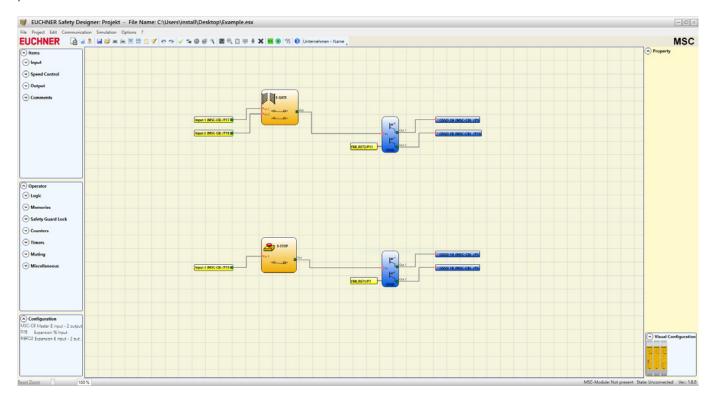
Fig. 70:   EUCHNER Safety Designer, project example

At the end of the project preparation phase (or during intermediate steps), you can save the current configuration using the

 icon on the default toolbar.

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9.1.10.1. Project validation

> **NOTICE**
>
> The completed project must now be validated.
>
> This check is made by running the VALIDATE command (✓ symbol on the default toolbar).
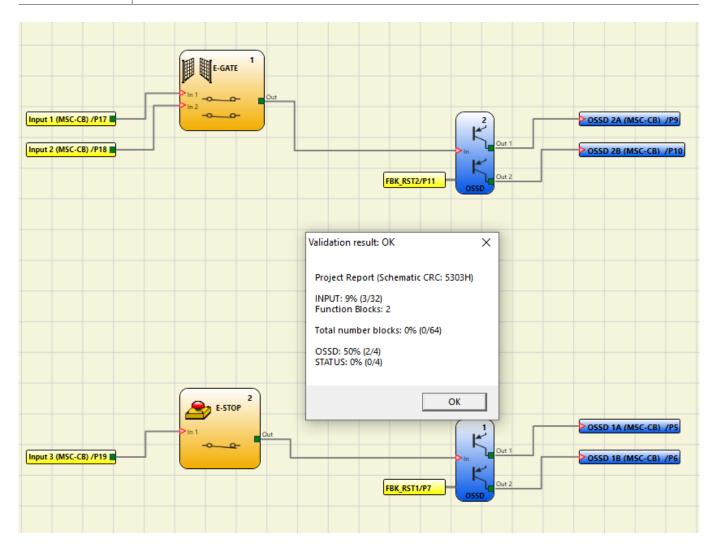
Fig. 71:   EUCHNER Safety Designer, project validation

If the validation is successful, a sequential number is assigned to the INPUT and OUTPUT on the diagram. This number then appears also in the REPORT and in the monitor in EUCHNER Safety Designer. The configuration can be transferred only after successful validation.

> ⚠ **WARNING**
>
> The validation function checks only whether the programming is appropriate for the properties of the MSC system. However, this check does not guarantee that the device has been programmed such that all safety requirements for the application are met.

9.1.10.2. Resources allocation

The resources allocation can be shown by selecting the [icon] icon. All elements used, such as inputs, outputs, status, fieldbus inputs and fieldbus outputs, are shown in the resources allocation.
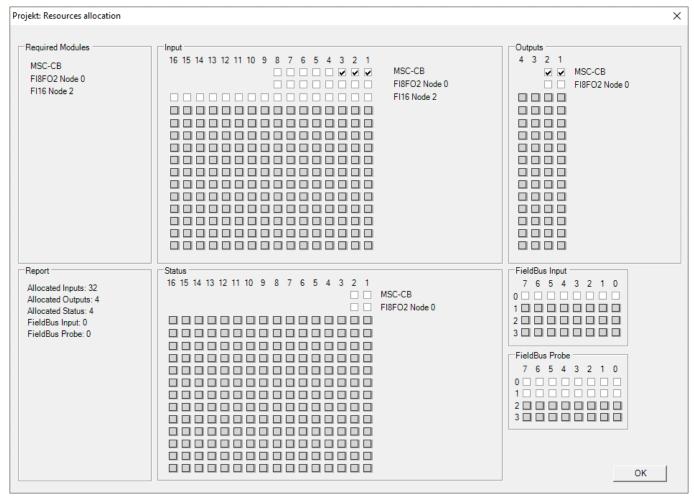
Fig. 72:   EUCHNER Safety Designer, resources allocation

9.1.10.3. Print report

The system layout can be printed together with the properties of the individual blocks ([icon] icon on the default toolbar).

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MSC

Project Report generated by EUCHNER Safety Designer Ver.: 1.9.4.1

MSC-Module: Project Report

Project Name:	Project
User:	User
Company:	EUCHNER
Date:	14.11.2025 07:51:56
Schematic CRC:	8296H

MSC-Module: Configuration

	MSC-CB-S	AZ-FO4O8	FI8FO4S
Module			
Node	Master	0	0
Configured Firmware version	FW >= 8.0 < 9.0	0.2	0.2

Updating from M-A1 disabled: False

Cycle Time (ms) = 4,151

MSC-Module: Safety Information

PFH$_d$ (according to IEC 61508):   2,99E-008 (1/h)
MTTF$_d$ (according to EN ISO 13849-1): 75 years
DC$_{avg}$ (according to EN ISO 13849-1): 99.00 %

The PFH$_d$ value shown takes into account the failure rate of all the components with exclusion of internal relays. For each Relay output a new value must be added to the previous PFH$_d$ depending on the switching frequency and the load on the Relay output. Moreover, the PL obtained for Relay output changes according to the customer configuration. See each Relay report for further details.

Attention!
This definition of PL and of the other related parameters as set forth in EN ISO 13849-1 only refers to the functions implemented in the MSC-Module system by the MSC configuration software, assuming configuration has been performed correctly. The actual PL of the entire application and the relative parameters must consider data for all the devices connected to the MSC-Module system within the scope of the application. This task and any other aspect of system configuration are the exclusive responsibility of the user/installer.
The final $MTTF_d$ value, taking in account data for all the devices connected to the system, must always be saturated to 100 years if over.

MSC-Module: Resources used

INPUT	3/16	19 %
Total number blocks	0/128	0 %
OSSD+Relay	2/12	17 %
STATUS	0/16	0 %

MSC-Module: Electrical diagram

Function Block 001 E-Gate

Items

	Function Block 001 E-Gate	Filter (ms): 3 / Double NC / Reset Type: Automatic / StartUp Test: False	Connections / In1: MSC-CB-S INPUT1/Terminal17 / In2: MSC-CB-S INPUT2/Terminal18
	Function Block 002 E-Stop	Filter (ms): 3 / Single / Reset Type: Automatic / StartUp Test: False	Connections / In1: MSC-CB-S INPUT3/Terminal19
	OUTPUT 01: Single-Double OSSD SIL3/PL e	Output Type = Single / Reset Type: Automatic / Response time: 19,588 ms / Dependence on inputs: 1	Connections / MSC-CB-S OSSD1/Terminal5
	OUTPUT 02: Single-Double OSSD SIL3/PL e	Output Type = Single / Reset Type: Automatic / Response time: 19,588 ms / Dependence on inputs: 2	Connections / MSC-CB-S OSSD2/Terminal9

Signature_____

Fig. 73:   EUCHNER Safety Designer, project report

> ⚠ **WARNING**
>
> ‣ This definition of the PL and the other related parameters in accordance with EN ISO 13849-1 relates only to the functions that have been implemented by EUCHNER Safety Designer in the MSC system; here it is assumed that the configuration has been performed correctly.
>
> ‣ The data for all devices connected to the MSCB in the application must be taken into account in the actual PL for the entire application and the related parameters.
>
> ‣ This task is allowed to be performed only by the design engineer or the installer.

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9.1.10.4. Connecting to MSC

> **(i)** **NOTICE**
>
> A remote connection is possible with a basic module firmware version from 3.0.1. To establish the connection to the MSC, the USB connection of the basic module is accessed via an Ethernet adapter.

Once the basic module has been connected to the PC via the USB cable, a connection must be established using the ↔ icon. A window with a password prompt appears. Type password (see "Password protection").
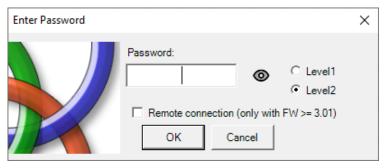
Fig. 74: EUCHNER Safety Designer, password prompt

9.1.10.5. Showing the parameters of the connected master

MSC-CB/MSC-CB-S connected via USB:

When MSC-CB/MSC-CB-S is connected via LAN in the "Module connected" textbox are displayed these parameters:

‣ MSC-CB/MSC-CB-S: firmware version

‣ S/N: serial number of the model
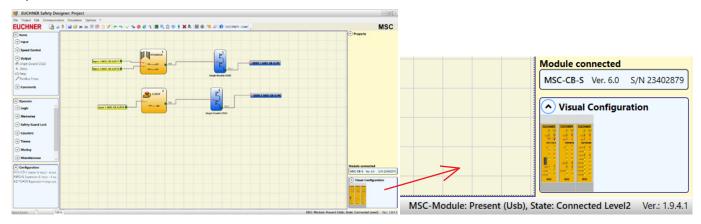
Fig. 75: USB parameter MSC-CB/MSC-CB-S

9.1.10.6. Sending the configuration to the MSC system

Click the 🖥 icon on the default toolbar to send the saved configuration from the PC to MSC-CB/MSC-CB-S after the related command is executed. In the MSC-CB/MSC-CB-S, the project is saved in the internal memory and (if fitted) on the M-A1 memory card (password required: level 2).

> **(i)** **NOTICE**
>
> This function is available only after the successful validation of the project.

9.1.10.7. Downloading a configuration file (project) from the basic module

Click the [icon] icon on the default toolbar to download a project from the basic module MSC-CB/MSC-CB-S to the EUCHNER Safety Designer configuration software. EUCHNER Safety Designer displays the project saved in MSC-CB/MSC-CB-S (required password: level 1).

> **NOTICE**
>
> ‣ If the project is to be used for other modules of type MSC-CB/MSC-CB-S, the components connected in each case are to be checked (see *"System layout" on page 98*).
> ‣ Then, "project validation" (*Page 92*) and "checking the system" (*Page 104*) are required.
> ‣ During this phase, EUCHNER Safety Designer (version 1.9.0 or higher) reads the original csx file, contained in MSC-CB-S, with the blocks and comments, etc. (as created by the planner).

9.1.10.8. Configuration log

> **NOTICE**
>
> ‣ The creation date and the CRC (four-digit hexadecimal code) for a project saved in the MSC-CB/MSC-CB-S are contained in the configuration file (project) (*Fig. 76*).
> ‣ If MSC-CB-S is used, it is also specified whether loading took place by means of EUCHNER Safety Designer or by means of an M-A1 memory card.
> ‣ Up to five sequential events can be recorded in this log. Then the results are overwritten starting with the oldest event.

The log file (LOG) can be displayed using the [icon] icon on the default toolbar (password required: level 1).
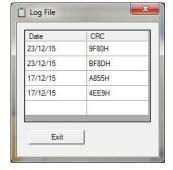
Fig. 76:   EUCHNER Safety Designer, log file

9.1.10.9. System layout

The current layout of the MSC system can be checked using the [icon] icon (password required: level 1). A table with the following content appears:

‣ Connected modules;

‣ Firmware version installed in the individual modules;

‣ Node number (physical address) of the individual modules.
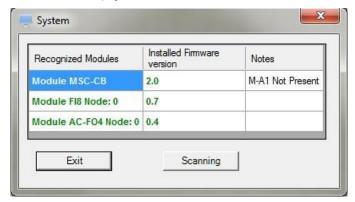
Fig. 77:   Overview of system layout

If there is an error in one of the modules detected, the following window appears. In the example below the node number of module FI8 is not correct (indicated by red text).
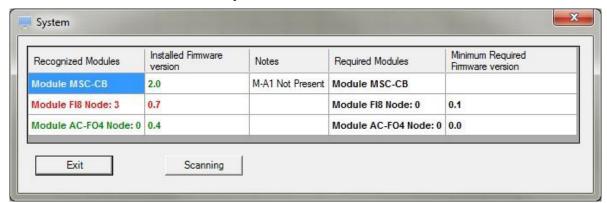
Fig. 78:   Erroneous system layout

9.1.10.10. Error log

The error log can be displayed using the [icon] icon on the default toolbar (password required: level 1).

The error log can be displayed using the [icon] icon on the default toolbar (password required: level 1).

➡ See *"Error log file" on page 224.*

9.1.10.11. Disconnecting the system

Click the [icon] icon to disconnect the PC from the basic module. After disconnection, the system is reset and restarted with the transferred project.

ℹ	**NOTICE**
	If the system does not comprise all the modules designated in the configuration, this discrepancy is indicated on the MSC-CB/MSC-CB-S module and the module is not started (see SIGNALS).

9.1.10.12. Monitor (real-time I/O status – text form)

Click the 🔍 icon to activate the monitor (password required: level 1). A pop-up window with the following content appears **(in real time)**:

‣ Status of the inputs (if the item has two or more input connections to MSC, only the first is indicated in the monitor as active; see example shown)
‣ Input diagnostics
‣ OSSD state
‣ OSSD diagnostics
‣ Status of the digital outputs

Module	block	Notes	INPUT	State	Input diagnostic	Module	OSSD	State	OSSD diagnostic	Module	Status	State	Diag Status
MSC-CB	1	Interlock	IN1	OFF		MSC-CB	OSSD1	OFF			X		
			IN2			MSC-CB	OSSD2	ON			X		
MSC-CB	2	E-Stop	IN3	ON			X				X		
			X				X				X		
			X				X				X		
			X				X						
			X										
			X										
			X										
			X										
			X										
			X										
			X										
			X										
			X										

Exit
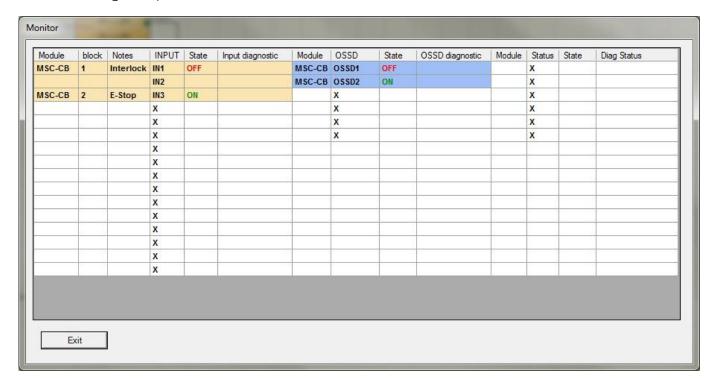
Fig. 79:   Monitor (text form)

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9.1.10.13. Monitor (real-time I/O status – text – graphic)

Click the [icon] icon to activate/deactivate the monitor (password required: level 1). Based on the color of the links (*Fig. 80*) the diagnostics can be read (in real time) as follows:

‣ **RED** = OFF
‣ **GREEN** = ON
‣ **DOTTED ORANGE** = Connection error
‣ **DOTTED RED** = ENABLE present (e.g. RESTART)

SPECIAL CASES

➡ "NETWORK" OPERATOR, "NETWORK IN" and "NETWORK OUT" signals:

‣ **THICK CONTINUOUS RED LINE** = STOP
‣ **THICK CONTINUOUS GREEN LINE** = RUN
‣ **THICK CONTINUOUS ORANGE LINE** = START

➡ "SERIAL OUTPUT" OPERATOR:

‣ **THICK CONTINUOUS BLACK LINE** = Data transmission

You can display the diagnostics by positioning the mouse pointer on the link.
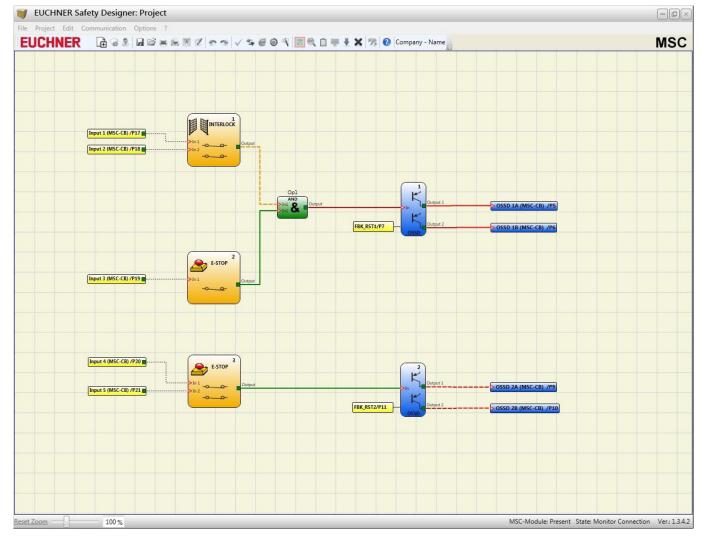
Fig. 80:   Monitor (graphic)

9.1.10.14. Monitor (I/O with diagnostics)

If diagnostics is active for the I/O, the numeric code of the diagnostics will be displayed together with the descriptive message.
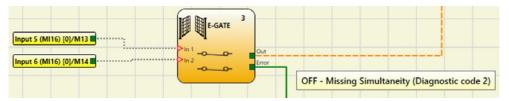
Fig. 81:   Monitor – input diagnostics (graphic)

#	block	Notes	Terminal	State	Diagnostic code	diagnostic
1	2	Single E-Gate	IN1	OFF		
2			X			
3			X			
4			X			
5	3	E-Gate	IN5	OFF	2	Missing Simultaneity
6			IN6			
7			X			
8			X			

Fig. 82:   Monitor – input diagnostics (text)
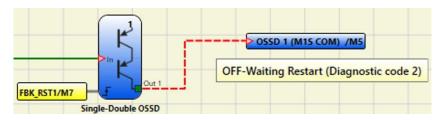
Fig. 83:   Monitor – output diagnostics (graphic)

#	Terminal	State	Diagnostic code	diagnostic
1	OSSD1	OFF	2	Waiting Restart
2	OSSD2	ON		
3	X			
4	X			

Fig. 84:   Monitor – output diagnostics (text)

9.1.10.15. Speed control monitor

Speed control

The monitor always displays the "Dir" field (if the encoder is used), even if the direction network is not used in the scheme.
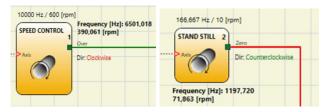
Fig. 85:   Speed control

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Speed Equality Check

The "Speed Equality Check" element displays the calculated speed difference as Δ (in percent) in addition to the two "Dir" fields.
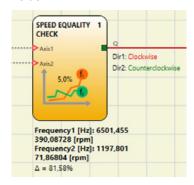
Fig. 86:   Speed Equality Check

9.1.10.16.Password protection

To upload and save the project, you must enter a password in EUCHNER Safety Designer.

ℹ	**NOTICE**
	The default password must be changed to prevent tampering (password level 2) or so that the configuration loaded in the MSC is not visible (password level 1).

9.1.10.17.Password level 1

All operators who use the MSC system must have a level 1 PASSWORD.

Using this password it is possible to display only the LOG file, the layout of the system, the real-time monitor and the upload processes.

On the initialization of the system for the first time, the operator must use the password "" (**ENTER key**). System planners who know the level 2 password can assign a new password for level 1 (alphanumeric, max. 8 characters).

ℹ	**NOTICE**
	Operators who know this password are **authorized** to upload the project (from MSC-CB/MSC-CB-S to PC), to edit it or to save it.

9.1.10.18.Password level 2

System planners who are authorized to work on the preparation of the project must know the level 2 PASSWORD. On the initialization of the system for the first time, the operator must use the password "**SAFEPASS**" (only upper case).

System planners who know the level 2 password can assign a new password for level 2 (alphanumeric, max. 8 characters).

ℹ	**NOTICE**
	‣ Using this password, the project **can** be uploaded (from PC to MSC-CB/MSC-CB-S), edited and saved. In other words, complete control of the PC => MSC system is possible using this password.
	‣ On UPLOADING a new project, you can change the level 2 password.
	‣ Should one of these passwords no longer be available, please contact EUCHNER to request an unlock file (if the unlock file is saved in the correct folder, the [icon] icon appears on the toolbar). Press the icon to reset the level 1 and 2 passwords to their original values. This password is provided only to the system planner and can be used only once.

9.1.10.19.MSC-CB-S maintenance password

The maintenance level is added during the connection (USB or Ethernet).

➡ This password enables all previous rights of level 2, except for the fact that the passwords and the network parameters cannot be changed.

➡ The default password is "**MAINTNCE**". The user can change it, see *"Password protection"*.

Fig. 87:   MSC-CB-S maintenance password

9.1.10.20.Password change

Click the [icon] icon to change the PASSWORD after the connection has been established using the level 2 password.

A window (*Fig. 88*) appears in which the new password can be selected. Type old and new password in the related fields (max. 8 characters). Click OK.

At the end of the process, disconnect to restart the system.

If an M-A1 memory card is fitted, the new password is also saved on this memory card.

Fig. 88:   Password change

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9.1.11. Checking the system

⚠	**WARNING**
	The system must be checked for correct operation after the project has been validated and uploaded to the MSC-CB/MSC-CB-S module and all safety components have been connected.

This check is made by forcing a status change for each safety component connected to MSC to check whether the status of the outputs also actually changes.

The following example is intended to explain the CHECK process.
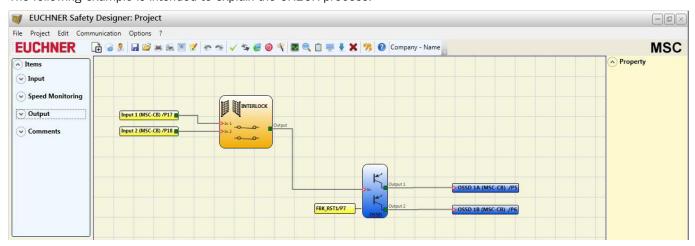
Fig. 89:   Checking the system

(t1)   In the normal operating status (interlock (INTERLOCK)), Input1 is closed, Input2 is open and the INTERLOCK output set to the "High" logic level. In this mode, the safety outputs (OSSD1/2) are active and a supply voltage of 24 V DC is present at the related terminals.

(t2)   If the interlock (INTERLOCK) is opened **physically**, the state of the inputs changes and therefore also the outputs of the INTERLOCK block: (OFF = 0 V DC –> 24 V DC); **the state of the safety outputs OSSD1/2 changes from 24 V DC to 0 V DC.** If this change is detected, the movable interlock (INTERLOCK) is connected correctly.
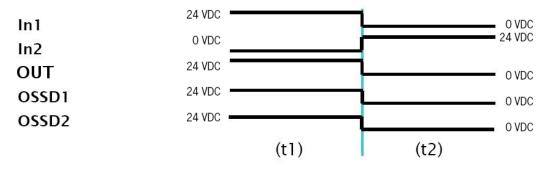
Fig. 90:   Change in the state of the system inputs/outputs

⚠	**WARNING**
	‣ You will find more detailed information on the correct installation of external sensors/components in the installation manual.
	‣ This check must be performed for each safety component in the project.

9.2. Item-specific function blocks

9.2.1. Output items

9.2.1.1. Safety outputs (OSSD)

The OSSD outputs do not require any maintenance. Output1 and Output2 supply 24 V DC with an input of "1" (TRUE) and 0 V DC with an input of "0" (FALSE).

➡ Each OSSD pair has a corresponding RESTART_FBK input. This input must always be connected as described in the paragraph RESTART_FBK.
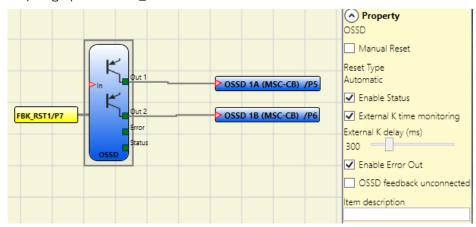
Fig. 91:   OSSD (safety outputs)

Parameters

Manual Reset: If selected, a reset can be requested on every change in the input signal. Otherwise, activation of the output will correspond directly to the input conditions.
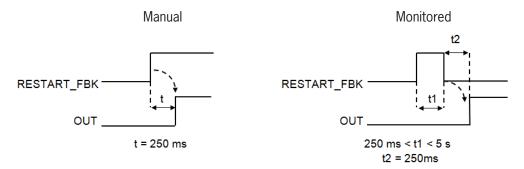
Fig. 92:   OSSD parameters

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.

Enable Status: If activated, the OSSD can be connected to a STATUS.

External K time monitoring: If activated, the time window for monitoring the external feedback signal (on the state of the output) can be set.

OUTPUT	FBK	ERROR	CLEAR LED MSC-CB/MSC-CB-S
1	0	0	0
0	1	1	flashing

If the OUTPUT is at logic level "High" (TRUE), the FBK signal must be at the logic level "Low" (FALSE) within the time set and vice versa.

Otherwise, the OUTPUT output changes to the Low level (FALSE) and the error is signaled on the basic module MSC-CB/MSC-CB-S by the flashing of the CLEAR LED for the OSSD in the error mode.

If not selected, the following checks are performed:

1. During power-up, the system checks whether the FBK signal is connected to 24 V DC.

2. In normal operation, the system checks whether 24 V DC is available via the NC contact set of K1/K2.

The FBK signal must fulfill the following conditions:

1. 24 V DC during power-up.

2. 24 V DC within 10 s from the TRUE/FALSE transition of the OSSD outputs.
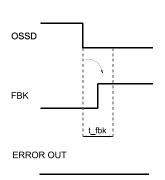
If one of these conditions is not met, the system detects an error that can be reset only by means of a switch-on cycle. The error is indicated by a flashing CLEAR LED corresponding to the affected OSSD output.
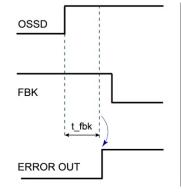
If the NC contacts of K1/K2 are not connected, connect the FBK input to 24 V DC.

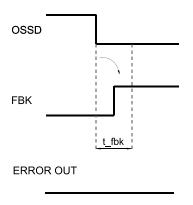*Enable Error Out:* If activated, the ERROR_OUT output is enabled. **If an error is detected on the external FBK signal, the output changes to the logic level "High" (TRUE).**

The **Error OUT** signal is reset if one of the following events occurs:
1. The system is switched off and on again.
2. Activation of the RESET operator.
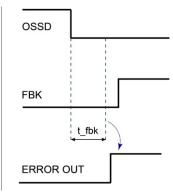
Fig. 93: Example for OSSD with correct feedback signal: in this case ERROR OUT=FALSE

Fig. 94: Example for OSSD with erroneous feedback signal (external switching time exceeded): In this case, ERROR OUT=TRUE

OSSD feedback unconnected: If selected, the RESTART_FBK input does not have to be connected. Otherwise, the feedback loop must be connected directly to 24 V DC or feedback must be provided via the positively driven contacts

This parameter can be used only on the following modules:
‣ MSC-CB with firmware version ≥ 4.1
‣ FI8FO2 with firmware version ≥ 0.11
‣ AC-FO4, AC-FO2 with firmware version ≥ 0.7
‣ AH-FO4SO8 with firmware version > 0.1

9.2.1.2. Safety output (single-double OSSD)

The OSSD safety output does not require any maintenance.

Output1 supplies 24 V DC with an input of "1" (TRUE) or 0 V DC with an input of "0" (FALSE).
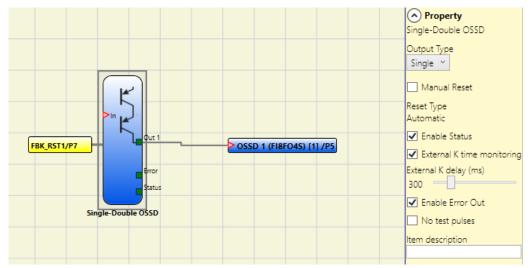
Fig. 95:   Single-double OSSD

➡ Each SINGLE_OSSD output has a corresponding RESTART_FBK input. The RESTART_FBK input appears for OSSD outputs of the MSC-CB-S and FI8FO4S modules only if manual reset or feedback loop monitoring is activated. The RESTART_FBK input is mandatory on the AH-FO4SO8 module and must be connected as described in the RESTART_FBK section.

➡ Several single-double OSSD outputs with active reset can share the same RESTART_FBK input.

➡ A NOT operator of the signal can be added by right-clicking directly on the input pin.

Parameters

Output type: two different output types are available:

‣ Single output
‣ Double output

The operator can choose from the following configurations using the MSC-CB-S, FI8FO4S and AH-F04S08 modules:

1. Four OSSD function blocks (single output)
2. Two OSSD function blocks (double output)
3. Two OSSD function blocks (single output) + one OSSD function block (double output)

ⓘ   **NOTICE**

When single-channel OSSDs are used, the OSSD outputs must be independent to meet the requirements of the Safety Integrity Level (SIL 3).

Failures with a common cause between the OSSD outputs must be ruled out by suitable cable installation (i.e. separate cable paths).

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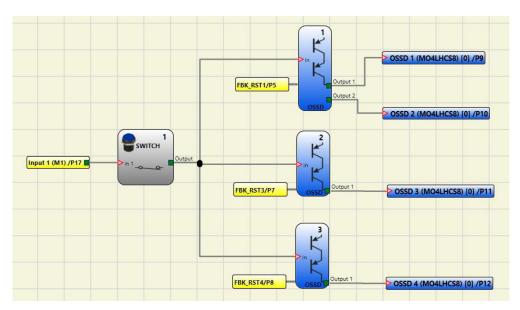
Fig. 96:   Example for a project: 2 blocks with single output + 1 block with double output

The possible configurations of the MSC-CB-S, FI8FO4S, AH-F04S08 (2 or 4 OSSD) modules are shown below:
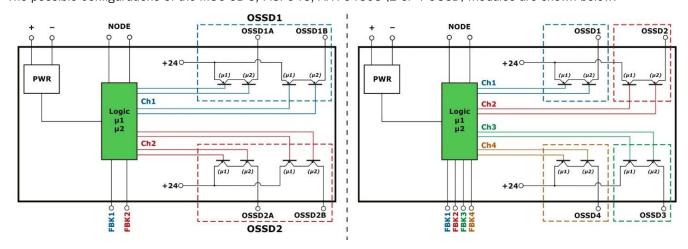
Fig. 97:   Configuration of 2-channel outputs (category 4)

Fig. 98:   Configuration of 4 single-channel outputs (category 4)

Manual Reset: If selected, a reset can be requested each time the IN input signal drops out. Otherwise, activation of the output follows the input conditions directly.
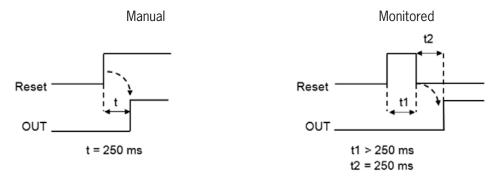
Fig. 99:   Manual/monitored reset

There are two types of reset: Manual and Monitored. On the selection of manual reset, only the signal transition from 0 to 1 is checked. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.

Enable Status: If activated, the current status of the OSSD can be connected to any point in the diagram.

External K time monitoring: If activated, the time window for monitoring the external feedback signal (on the state of the output) can be set.

OUTPUT	FBK	ERROR	CLEAR LED MSC-CB/MSC-CB-S
1	0	0	0
0	1	1	flashing

If the OUTPUT is at logic level "High" (TRUE), the FBK signal must be at the logic level "Low" (FALSE) within the time set and vice versa.
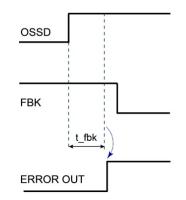
Otherwise, the OUTPUT output changes to the Low level (FALSE) and the error is signaled on the basic module by the flashing of the CLEAR LED for the OSSD in the error mode.

Enable Error Out: If activated, the ERROR_OUT output is enabled. **If an error of the external FBK signal is detected, the output changes to the logic level "High" (TRUE).**

The **Error OUT** signal is reset if one of the following events occurs:

1. The system is switched off and on again.

2. Activation of the RESET MSC-CB operator.
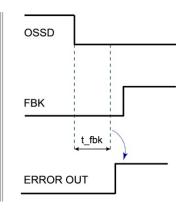
Fig. 100:   Example for OSSD with correct feedback signal: in this case ERROR OUT=FALSE

Fig. 101:   Example for OSSD with erroneous feedback signal (external switching time exceeded): In this case, ERROR OUT=TRUE

No test pulse: If activated, no test pulses will be transmitted via the output.

> **ⓘ   NOTICE**
>
> The SIL decreases when this parameter is activated.

OSSD feedback not connected: If selected, feedback must not be connected. If not selected, feedback must be connected directly to 24 V or via the row of NC contacts of K1/K2.

> **ⓘ   NOTICE**
>
> This parameter applies only to the module AH-FO4SO8, firmware version > 0.1.

Reset position: MSC-CB-S (firmware ≥ 7.0) or FI8FO4S (firmware ≥ 0.3) permits selection of the physical terminal of the module for issuing the reset command. The same terminal can also be used for various OSSD outputs.

➡ The unused Feedback/Restart pins can be used as individual inputs in the configuration.

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9.2.1.3. Signal output (STATUS)

Using the STATUS output, every point in the diagram can be monitored by connecting it to the In input. The output supplies 24 V DC with an input of "1" (TRUE) or 0 V DC with an input of "0" (FALSE).
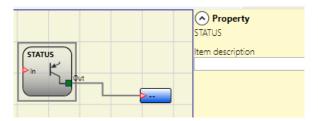
Fig. 102:   Status

9.2.1.4. Fieldbus output (FIELDBUS PROBE)

Using this element, the status of any point on the diagram can be indicated on the fieldbus.

The respective bit must be selected to perform changes on the output. The following table shows the max. number of sensors.

Basic module	Fieldbus module firmware	No. of sensors
MSC-CB-S	≥ 2.0	Max. 32
MSC-CB-S	< 2.0	Max. 16
MSC-CB	Independent	Max. 16

Table 67:   Max. number of sensors at the fieldbus output

The states are indicated on the fieldbus using four bytes. (Refer to the operating instructions for the fieldbus modules for more detailed information.)
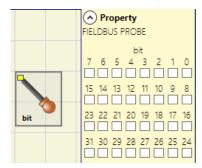
Fig. 103:   Fieldbus output

⚠	**Important!**
	The fieldbus output is **not** a safety output.

9.2.1.5. Relay [RELAY]

The output relay is a relay output with a normally open contact. The relay outputs are closed if the **IN** input is "1" (TRUE), otherwise the contacts are open (FALSE).

Parameters

Category: There are three categories of relay outputs:

Category 1. Outputs with a category 1 relay. Each AZ-FO4/AZ-FO4O8 module can have up to four outputs.

Properties:

‣ Internal relays are monitored.

‣ External device monitoring contacts (EDM, check on FBK 1-4) are not used (not required for category 1).

‣ Each output can be set to manual or automatic starting.
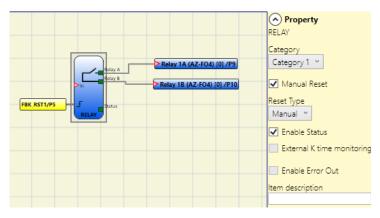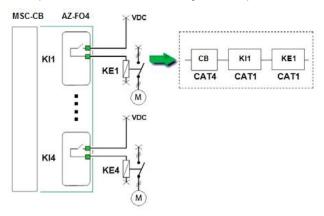
Fig. 104:   Relay output

Example of use with external relay   Example of use with only internal relay
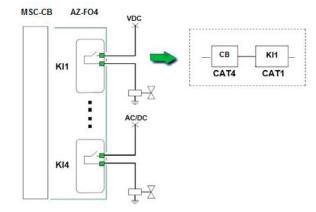
Fig. 105:   Examples of use

Category 2. Outputs with a category 2 relay with OTE (Output Test Equipment) outputs. Each AZ-FO4/AZFO4O8 module can have up to four outputs.

OTE: The OTE (Output Testing Equipment) output is normally "1" (TRUE), except if there is an internal error or a malfunction in conjunction with the feedback loop for external contactors (FALSE).

Properties:

‣ Internal relays are always monitored.

‣ Monitored external device monitoring contacts (EDM).

‣ The output can be configured for a manual or automatic restart. The external device monitoring (EDM) cannot be activated with a manual start, only with an automatic start. If, however, a manual start is required with external device monitoring, special logic must be used. (See information below)

EN
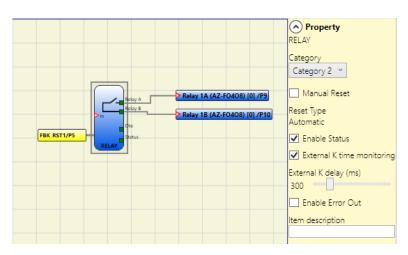
Fig. 106:   Relay output cat. 2

Output for the OTE (Output Test Equipment)

‣ Activation: This is necessary for category 2 configurations for signaling dangerous failures in accordance with EN ISO 13849-1: 2006/DAM1 (in preparation).

‣ OTE output: normally ON.
If there is a fault in the internal feedback or the external device monitoring (EDM) –> OFF.
This signal makes it possible to stop hazardous movements, or at least to indicate the fault to the operator.

Use of the automatic start (A) or manual start (B) (category 2)
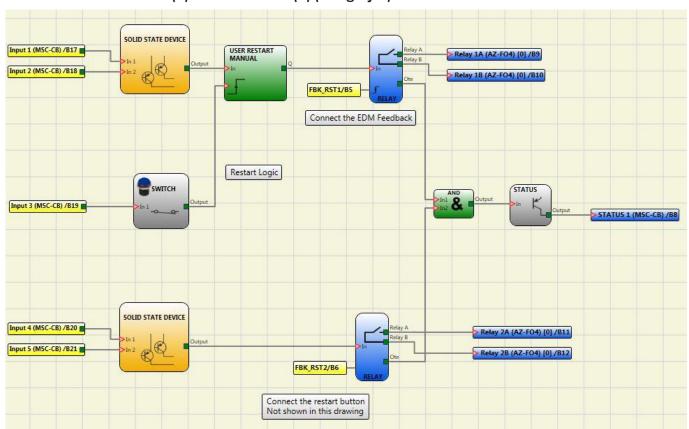
Fig. 107:   Use of the automatic or manual start

Category 4. Outputs with two category 4 relays. Each AZ-FO4/AZ-FO4O8 module can have up to two outputs of this type. The relays are operated in pairs for this output.

Properties:

‣ 2 dual-channel outputs.

‣ Double internal relays are monitored.

‣ The output can be configured for a manual or automatic restart.
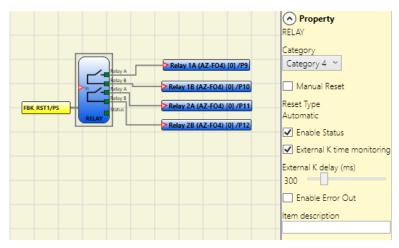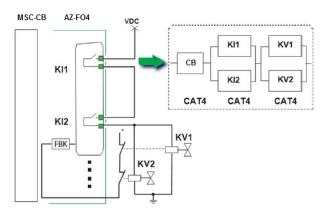
Fig. 108:   Relay output cat. 4

> **NOTICE**
>
> To avoid affecting the result of the calculation of the PL, the inputs (sensors or safety components) must correspond to the same or a higher category as the other devices in the chain.

Example of use with only the internal relay and monitored solenoid valves

Example of use with external contactors with feedback
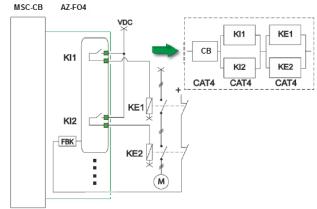
Fig. 109:   Examples of use

Manual Reset: If selected, a reset can be requested each time the IN input signal drops out. Otherwise, activation of the output follows the input conditions directly.

There are two types of reset: Manual and Monitored. On the selection of manual reset, only the signal transition from 0 to 1 is checked. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.

Enable Status: If activated, the current status of the relay outputs can be connected to a STATUS.

Enable external K reading: If activated, the switching times for external contactors can be read and checked:

‣ For category 1, it is not possible to enable the check of the external contactors.

‣ The check of the external contactors is always activated in category 4.
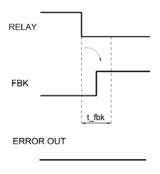
EN

External K time monitoring: If selected, the delay is monitored. This option is unavailable for category 1 and obligatory for category 4.
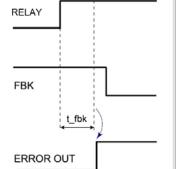
External K delay (ms): Maximum delay that can be caused by the external contactors. Using this value, the maximum delay between the switching of the internal relays and the switching of the external contacts (on activation and deactivation) can be checked.

Enable Error Out: If activated, the ERROR_OUT output is enabled. **If an error is detected on the external FBK signal, the output changes to the logic level "High" (TRUE).**

The **Error OUT** signal is reset if one of the following events occurs:

1. The system is switched off and on again.
2. Activation of the RESET MSC-CB operator.
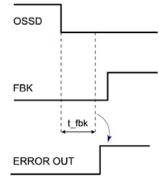
Fig. 110: Example for RELAY with correct feedback signal: ERROR OUT=FALSE in this case

Fig. 111: Example for RELAY with erroneous feedback signal (external switching time exceeded): ERROR OUT=TRUE in this case

9.2.2. Input items

9.2.2.1. Emergency stop (E-STOP)

Using the E-STOP function block, the input status of an emergency stop device can be checked. If the emergency stop button is pressed, the OUTPUT output is "0" (FALSE), otherwise the OUTPUT output is "1" (TRUE).
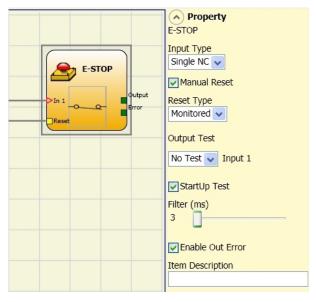

Fig. 112:   Emergency stop

Parameters

Input Type:

‣ Single NC – makes it possible to connect emergency stop devices with one normally closed contact
‣ Double NC – makes it possible to connect emergency stop devices with two normally closed contacts.

Manual Reset: If activated, a reset can be requested on every activation of the emergency stop. Otherwise, activation of the output will correspond directly to the input conditions.

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.
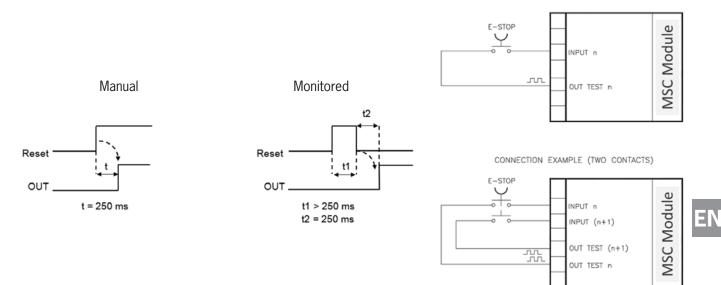

Fig. 113:   Emergency stop manual/monitored reset

Fig. 114:   Connection example, emergency stop

EN

⚠	**Important!**
	If Manual Reset is selected, the next input must be used. Example: If Input1 and Input2 are used for the function block, Input3 must be used for the reset input.

Output Test: This option can be used to select which test output signals are to be sent to the emergency stop device. Short circuits between the cables can be detected and rectified by means of this additional check. For this purpose it is necessary to configure the test output signals (from the test output signals available).

StartUp Test: If activated, the test is performed on switching on the external component (emergency stop). This test is performed by pressing and releasing the emergency stop to carry out a complete function test and to activate the output. This test is requested only on starting the machine (on switching on the module).

Filter (ms): Makes it possible to filter the signals that are received from the emergency stop. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

With Simultaneity: If activated, the simultaneous switching of the signals received from the emergency stop is checked.

Simultaneity (ms): This is active only if the previous parameter has been selected. Using this value you can define the maximum time (in ms) between the switching of the two signals that are received from the emergency stop.

Enable Error Out: If activated, an error detected by the function block is signaled.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

9.2.2.2. Interlock (INTERLOCK)

The input status of a movable guard or a safety door is checked by the INTERLOCK function block. If the movable guard or the safety door is open, the OUTPUT output is "0" (FALSE), otherwise the OUTPUT output is "1" (TRUE).
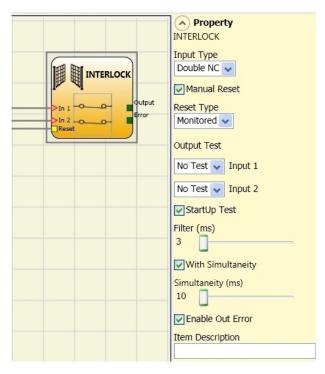

Fig. 115:   Interlocking

Parameters

Input Type:

‣ Double NC – makes it possible to connect components with two normally closed contacts.

‣ Double NC/NO – makes it possible to connect components with one normally closed contact and one normally open contact.

ⓘ | **Important!**

➡ If input is inactive (OUTPUT output is "0" (FALSE)), connect as follows:

‣ NO contact on terminal that has been assigned to input IN1.

‣ NC contact on terminal that has been assigned to input IN2.

Manual Reset: If activated, a reset can be requested on every activation of the movable guard or the safety door. Otherwise, activation of the output will correspond directly to the input conditions.

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.
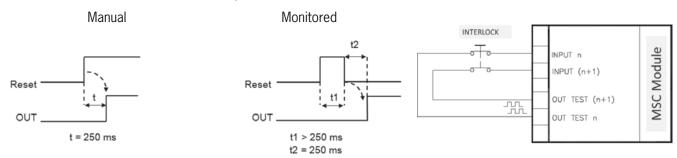

Fig. 116:   Interlock manual/monitored reset

Fig. 117:   Connection example, interlock

⚠ | **Important!**

If manual reset is selected, the next input after the inputs used by the function block must be used. Example: If Input1 and Input2 are used for the function block, Input3 must be used for the reset input.

Output Test: This option can be used to select which test output signals are to be sent to the component contacts. Short circuits between the cables can be detected and rectified by means of this additional check. For this purpose it is necessary to configure the test output signals (from the test output signals available).

StartUp Test: If activated, the test is performed on switching on the external component. This test is performed by opening the movable guard or the safety door to carry out a complete function test and to activate the output. This test is required only on starting the machine (switching on the module).

Filter (ms): This makes it possible to filter the signals that are received from the external contactors. The filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

With Simultaneity: If activated, the simultaneous switching of the signals received from the external contacts is checked.

Simultaneity (ms): This is active only if the previous parameter has been selected. Using this value you can specify the maximum time (in ms) between the switching of the two different signals from the external contacts.

Enable Error Out: If activated, an error detected by the function block is signaled.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

EN

9.2.2.3. Single-channel interlock (SINGLE INTERLOCK)

The input status of a movable guard or a safety door is checked by the SINGLE INTERLOCK function block. If the movable guard or the safety door is open, the OUTPUT output is "0" (FALSE), otherwise the OUTPUT output is "1" (TRUE).
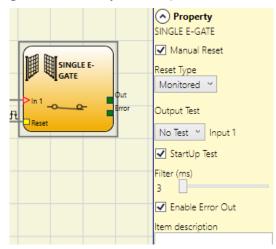

Fig. 118: Single-channel interlock

Parameters

Manual Reset: If activated, a reset can be requested on every activation of the movable guard or the safety door. Otherwise the activation of the output will correspond to the input conditions.

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.
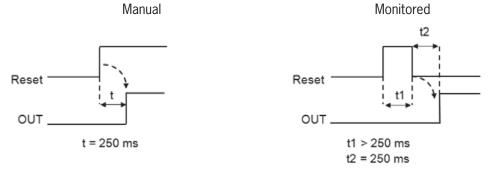

Fig. 119: Single-channel interlock manual/monitored reset

> ⚠️ **Important!**
>
> If manual reset is selected, the next input after the inputs used by the function block must be used. Example: If Input1 and Input2 are used for the function block, Input3 must be used for the reset input.

Output Test: This option can be used to select which test output signals are to be sent to the component contacts. Short circuits between the cables can be detected and rectified by means of this additional check. For this purpose it is necessary to configure the test output signals (from the test output signals available).

StartUp Test: If activated, the test is performed on switching on the external component. This test is performed by opening the movable guard or the safety door to carry out a complete function test and to activate the output. This test is required only on starting the machine (switching on the module).

Filter (ms): This makes it possible to filter the signals that are received from the external contactors. The filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

Enable Error Out: If activated, an error detected by the function block is signaled.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

9.2.2.4. Guard locking monitoring (LOCK FEEDBACK)

Using the LOCK FEEDBACK function block the state of the guard locking monitoring inputs for a movable guard or a safety door is checked. If the inputs signal that the guard locking is locked, the OUTPUT output is "0" (FALSE), otherwise the OUTPUT output is "1" (TRUE).
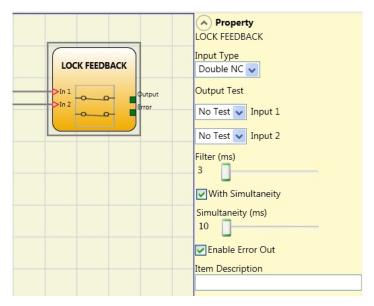

Fig. 120:   Guard lock monitoring

Parameters

Input Type:

‣ Single NC – makes it possible to connect components with one normally closed contact.

‣ Double NC – makes it possible to connect components with two normally closed contacts.

‣ Dual-channel NC/NO – makes it possible to connect components with one normally closed contact and one normally open contact.

ⓘ   **Important!**

➡ If input is inactive (guard locking unlocked, OUTPUT output is "0" (FALSE)), connect as follows:

‣ NO contact on terminal that has been assigned to input IN1.

‣ NC contact on terminal that has been assigned to input IN2.

Output Test: This option can be used to select which test output signals are to be sent to the component contacts. Short circuits between the cables can be detected and rectified by means of this additional check. For this purpose it is necessary to configure the test output signals (from the test output signals available).

Filter (ms): This makes it possible to filter the signals that are received from the external contacts. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

With Simultaneity: If activated (only on dual-channel NC or dual-channel NC/NO), the simultaneous switching of the signals received from the external contacts is checked.

Simultaneity (ms): only on dual-channel NC or on dual-channel NC/NO. This is active only if the previous parameter has been activated. Using this value you can define the maximum time (in ms) between the switching of the two different signals received from the external contacts.

Enable Error Out: If activated, an error detected by the function block is signaled.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

EN

9.2.2.5. Key-operated rotary switch (KEY LOCK SWITCH)

Using the KEY LOCK SWITCH function block, the input status of a manual key-operated rotary switch is checked. If the key is not turned, the OUTPUT output is "0" (FALSE), otherwise the OUTPUT output is "1" (TRUE).
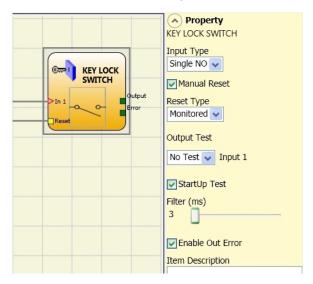

Fig. 121:   Key-operated rotary switch

Parameters

‣ Single NO – makes it possible to connect components with one normally open contact

‣ Double NO – makes it possible to connect components with two normally open contacts.

Manual Reset: If activated, a reset can be requested on every activation of the command. Otherwise, activation of the output will correspond directly to the input conditions.

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.
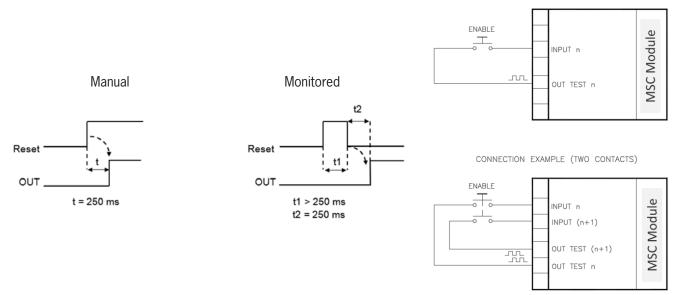

Fig. 122:   Key-operated rotary switch manual/monitored reset

Fig. 123:   Connection examples, key-operated rotary switch

⚠ **Important!**

If manual reset is selected, the next input after the inputs used by the function block must be used. Example: If Input1 and Input2 are used for the function block, Input3 must be used for the reset input.

Output Test: This option can be used to select which test output signals are to be sent to the component contacts. Short circuits between the cables can be detected and rectified by means of this additional check. For this purpose it is necessary to configure the test output signals (from the test output signals available).

StartUp Test: If activated, the test is performed on switching on the external component. This test is performed by opening and activating the key-operated rotary switch to carry out a complete function test and to activate the OUTPUT output. This test is required only on starting the machine (on switching on the module).

Filter (ms): This makes it possible to filter the signals that are received from the external contactors. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

With Simultaneity: If activated, the simultaneous switching of the signals received from the external contacts is checked.

Simultaneity (ms): This (only on dual-channel NO) is active only if the previous parameter has been selected. Using this value you can specify the maximum time (in ms) between the switching of the two different signals received from the external contacts.

Enable Error Out: If activated, an error detected by the function block is signaled.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

EN

9.2.2.6. Optoelectronic safety light grid or safety laser scanner (ESPE)

Using the ESPE function block the input status of an optoelectronic safety light grid (or safety light scanner) is checked. If the area protected by the light curtain is interrupted (outputs on the light grid FALSE), the OUTPUT output is "0" (FALSE). Conversely, if this area is clear and the outputs are "1" (TRUE), the OUTPUT output is "1" (TRUE).
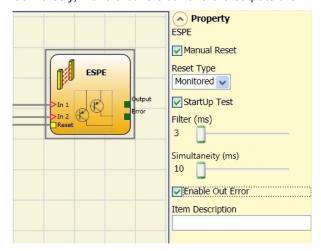

Fig. 124:   ESPE

Parameters

Manual Reset: If activated, a reset can be requested each time the area protected by the safety light grid is interrupted. Otherwise, activation of the output will correspond directly to the input conditions.

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.
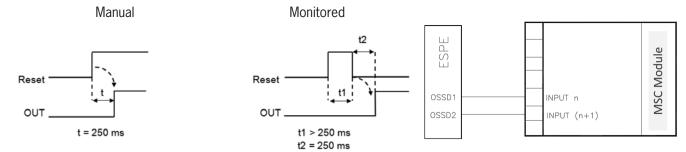

Fig. 125:   ESPE manual/monitored reset

Fig. 126:   Connection example, ESPE

⚠️   **Important!**

If manual reset is selected, the next input after the inputs used by the function block must be used. Example: If Input1 and Input2 are used for the function block, Input3 must be used for the reset input.

The OUT TEST signals cannot be used for the static safety output ESPE, as the test signals are generated by the ESPE.

StartUp Test: If activated, the test is performed on switching on the safety light grid. This test is performed by occupying and clearing the area protected by the safety light grid to carry out a complete function test and to activate the output. This test is required only on starting the machine (on switching on the module).

Filter (ms): Makes it possible to filter the signals that are received from the safety light grid. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

Simultaneity (ms): always active. Using this value you can define the maximum permissible time (in ms) between the switching of the two different signals received from the safety light grid.

Enable Error Out: If activated, an error detected by the function block is displayed.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

(translation of the original operating instructions) 2121331-09-07/25

9.2.2.7. Safety footswitch (FOOTSWITCH)

Using the FOOTSWITCH function block the input status of a safety footswitch is checked. If the footswitch is not pressed, the OUTPUT output is "0" (FALSE), otherwise the OUTPUT output is "1" (TRUE).
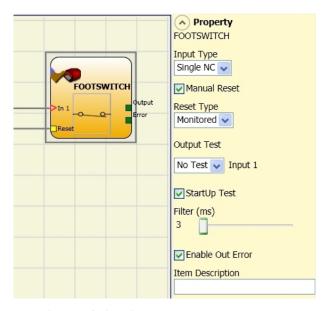

Fig. 127:   Safety footswitch

Parameters

Input Type:

‣ Single NC – makes it possible to connect components with one normally closed contact.

‣ Single NO – makes it possible to connect footswitches with one normally open contact.

‣ Double NC – makes it possible to connect footswitches with two normally closed contacts.

‣ Dual-channel NC/NO – makes it possible to connect footswitches with one normally closed contact and one normally open contact.

ⓘ   **Important!**

➡ If input is inactive (OUTPUT output is "0" (FALSE)), connect as follows:

‣ NO contact on terminal that has been assigned to input IN1.

‣ NC contact on terminal that has been assigned to input IN2.

Manual Reset: If activated, a reset can be requested on every activation of the safety footswitch. Otherwise, activation of the output will correspond directly to the input conditions.

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.
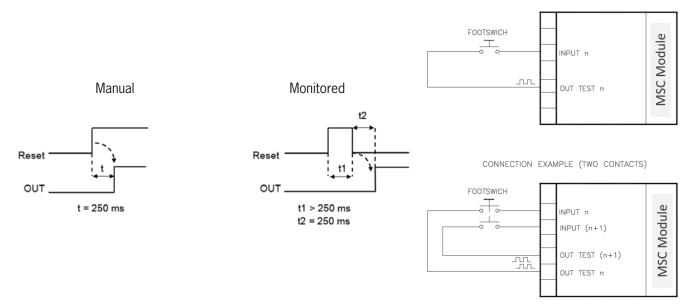

Fig. 128: Safety footswitch manual/monitored reset

Fig. 129: Connection examples, safety footswitch

⚠ **Important!**

If manual reset is selected, the next input after the inputs used by the function block must be used. Example: If Input1 and Input2 are used for the function block, Input3 must be used for the reset input.

Output Test: This option can be used to select which test output signals are to be sent to the component contacts. Short circuits between the cables can be detected and rectified by means of this additional check. For this purpose it is necessary to configure the test output signals (from the test output signals available).

StartUp Test: If activated, the test is performed on switching on the external component. This test is performed by pressing and releasing the footswitch to carry out a complete function test and to activate the output. This test is required only on starting the machine (on switching on the module).

Filter (ms): This makes it possible to filter the signals that are received from the external contactors. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

With Simultaneity: If activated (only on dual-channel NC or dual-channel NC/NO), the simultaneous switching of the signals received from the external contacts is checked.

Simultaneity (ms): only on dual-channel NC or dual-channel NC/NO. This is active only if the previous parameter has been activated. Using this value you can specify the maximum time (in ms) between the switching of the two different signals from the external contacts.

Enable Error Out: If activated, an error detected by the function block is displayed.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

9.2.2.8.   Operating mode selection (MOD-SEL)

Using the MOD-SEL function block the input status of an operating mode selector switch (up to 4 inputs) is checked. If only one of the IN inputs is "1" (TRUE), the corresponding OUTPUT output is also "1" (TRUE). In all other cases, i.e. if all IN inputs are "0" (FALSE) or more than one IN input is "1" (TRUE), all OUTPUT outputs are "0" (FALSE).
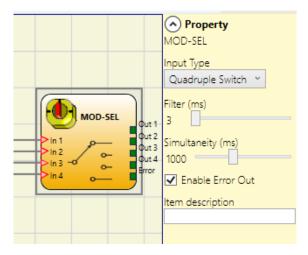

Fig. 130:   MOD-SEL

Parameters

Input Type:

‣ Double Switch – makes it possible to connect operating mode selector switches with two switch positions.

‣ Triple Switch – makes it possible to connect operating mode selector switches with three switch positions.

‣ Quadruple Switch – makes it possible to connect operating mode selector switches with four switch positions.

Filter (ms): Makes it possible to filter the signals that are received from the operating mode selector switch. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

Simultaneity (ms): Is always selected. Defines the maximum permissible time (ms) between the switching of the different signals received from the external contacts of the device.

Enable Error Out: If activated, an error detected by the function block is displayed.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

EN

9.2.2.9. Light barrier (PHOTOCELL)

Using the PHOTOCELL function block the input status of an optoelectronic safety light barrier is checked.

If the beam from the light barrier is obscured (output on the light barrier FALSE), the OUTPUT output is "0" (FALSE). If, conversely, the beam is not obscured (output on the light barrier TRUE), the OUTPUT output is "1" (TRUE).
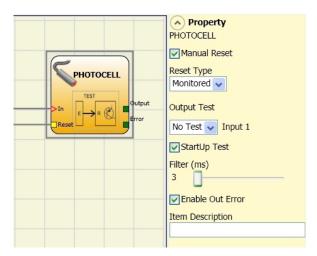
Fig. 131:   Light barrier

Parameters

Manual Reset: If activated, a reset can be requested on every activation of the safety light barrier. Otherwise, activation of the output will correspond directly to the input conditions.

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.
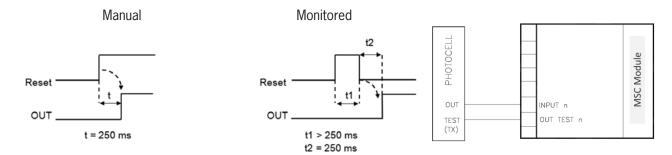
Fig. 132:   Light barrier manual/monitored reset

Fig. 133:   Connection example, light barrier

> **Important!**
> ‣ A test output is obligatory and can be selected using one of the 4 possible OUT_TEST outputs.
> ‣ Attention: If RESET is selected, the next input must be used for the reset. Example: If INPUT1 is used for the function block, INPUT2 must be used for the RESET.
> ‣ The reaction time of the light barrier must be > 2 ms and < 20 ms.

Output Test: This option can be used to select which test output signals are to be sent to the test input on the light barrier.

Short circuits between the cables can be detected and rectified by means of this additional check. For this purpose it is necessary to configure the test output signals (from the test output signals available).

StartUp Test: If activated, the test is performed on switching on the external component. This test is performed by covering and clearing the safety light barrier to carry out a complete function test and to activate the output. This test is required only on starting the machine (on switching on the module).

Filter (ms): This makes it possible to filter the signals that are received from the external contactors. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

Enable Error Out: If activated, an error detected by the function block is displayed.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

EN

9.2.2.10. Two-hand control (TWO-HAND)

Using the TWO-HAND function block the input status of a two-hand control switch is checked.

If both pushbuttons are pressed at the same time (within max. 500 ms), the OUTPUT output is "1" (TRUE); this status is retained until the pushbuttons are released. Otherwise, the OUTPUT output is "0" (FALSE).
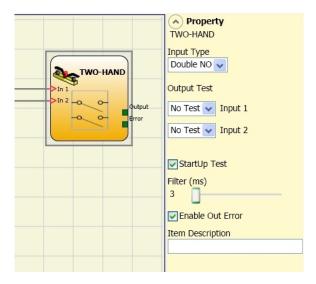
Fig. 134:   Two-hand control

Parameters

Input Type:

‣ Double NO – makes it possible to connect a two-hand switch with one normally open contact for each pushbutton (EN 574 III A).

‣ Quad NC-NO – makes it possible to connect a two-hand switch with a dual-channel normally closed/normally open contact for each pushbutton (EN 574 III C).

ⓘ   **Important!**

➡ If input is inactive (OUTPUT output is "0" (FALSE)), connect as follows:

‣ NO contact on terminal that has been assigned to input IN1.

‣ NC contact on terminal that has been assigned to input IN2.

Output Test: This option can be used to select which test output signals are to be sent to the component contacts. Short circuits between the cables can be detected and rectified by means of this additional check. For this purpose it is necessary to select the test output signals.

StartUp Test: If activated, the test is performed on switching on the external component (two-hand control). This test is performed by pressing at the same time (within max. 500 ms) and releasing both pushbuttons to carry out a complete function test and to activate the output. This test is required only on starting the machine (on switching on the module).

Filter (ms): Makes it possible to filter the input signals. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

Enable Error Out: If activated, an error detected by the function block is displayed.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

9.2.2.11. NETWORK_IN

This function block establishes the input interface of a network connection by producing a "1" (TRUE) in the OUTPUT output when the logic level is "High" – otherwise "0" (FALSE) will be set.
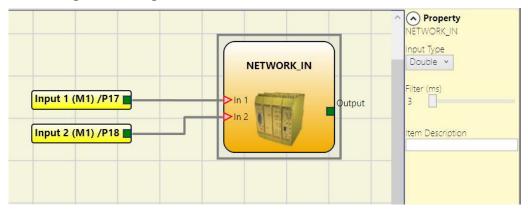

Fig. 135:   NETWORK_IN

Parameters

Input Type:

‣ Single-channel – makes it possible to connect the signal outputs from another MSC- basic module.

‣ Dual-channel – makes it possible to connect the OSSD outputs from another MSC- basic module.

Filter (ms): makes it possible to filter the signals that are received from another module.

This filter can be set to between 3 and 250 ms. The time set for the filter affects the calculation of the total response time of the module.

🛈	**Important!**
	➡ This input can be assigned only to the MSC basic module.
	➡ It must be used if the **OSSD** outputs on an MSC system are connected to the inputs on a downstream MSC system or together with the NETWORK operator.

9.2.2.12. SENSOR

Using the SENSOR function block the input status of a sensor (not a safety sensor) is checked. If the beam from the sensor is obscured (output on the light barrier FALSE), the OUTPUT output is "0" (FALSE). Conversely, if this beam is not occupied and the output on the sensor is "1" (TRUE), the OUTPUT output is "1" (TRUE).
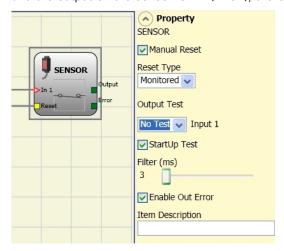
Fig. 136:   Sensor

Parameters

Manual Reset: If activated, a reset can be requested each time the area protected by the sensor is occupied. Otherwise, activation of the output will correspond directly to the input conditions.

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.

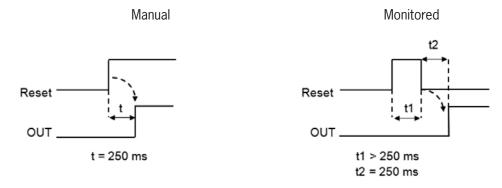| ⚠	**Important!**
	If manual reset is selected, the next input after the inputs used by the function block must be used. Example: If Input1 is used for the function block, Input2 must be used for the reset input.

Fig. 137:   Sensor manual/monitored reset

Output Test: This option can be used to select which test output signals are to be sent to the sensor. Short circuits between the cables can be detected and rectified by means of this additional check. For this purpose it is necessary to configure the test output signals (from the test output signals available).

StartUp Test: If activated, the test is performed on switching on the sensor. This test is performed by occupying and clearing the area protected by the sensor to carry out a complete function test and to activate the OUTPUT output. This test is required only on starting the machine (on switching on the module).

Filter (ms): This makes it possible to filter the signals that are received from the sensor. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

Enable Error Out: If activated, an error detected by the function block is displayed.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

EN

9.2.2.13. Pressure sensitive mat (S-MAT)

Using the pressure sensitive mat function block the input status of a pressure sensitive mat is checked. If there is a person on the footmat, the OUTPUT output is "0" (FALSE), otherwise, i.e. if the footmat is clear, the OUTPUT output is "1" (TRUE).
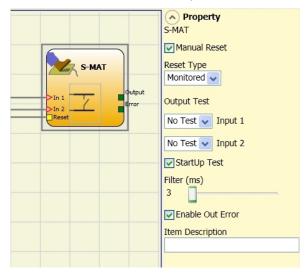

Fig. 138:   Pressure sensitive mat

Parameters

Manual Reset: If activated, a reset can be requested on every activation of the pressure sensitive mat. Otherwise, activation of the output follows the input conditions directly.

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.

ⓘ **Important!**

➡ If manual reset is selected, the next input after the inputs used by the function block must be used. Example: If Input1 and Input2 are used for the function block, Input3 must be used for the reset input.

➡ The use of two test outputs is obligatory. Each OUT TEST output be connected to only one pressure sensitive mat input (it is not allowed to connect two inputs in parallel).

➡ The pressure sensitive mat function block cannot be used for two-wire components or terminating resistors.
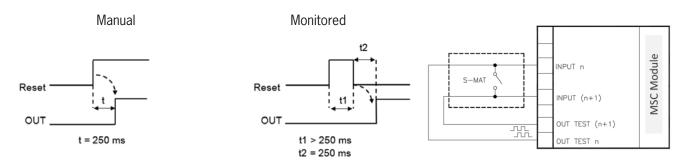

Fig. 139:   Pressure sensitive mat manual/monitored reset

Fig. 140:   Connection example, pressure sensitive mat

Output Test: This option can be used to select which test output signals are to be sent to the pressure sensitive mat contacts. Short circuits between the wires can be detected and rectified by means of this check. For this purpose it is necessary to configure the test output signals (from the test output signals available). The test signals are obligatory.

StartUp Test: If activated, the test is performed on switching on the external component. This test is performed by standing on and clearing the pressure sensitive mat to carry out a complete function test and to activate the output. This test is requested only on starting the machine (on switching on the module).

Filter (ms): This makes it possible to filter the signals that are received from the external contactors. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

Enable Error Out: If activated, an error detected by the function block is displayed.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

EN

9.2.2.14. Switch (SWITCH)

Using the SWITCH function block the input status of a pushbutton or switch (NOT A SAFETY SWITCH) is checked. If the pushbutton is pressed, the OUTPUT output is "1" (TRUE), otherwise the OUTPUT output is "0" (FALSE).
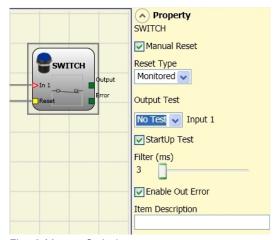

Fig. 141:   Switch

Parameters

Manual Reset: If activated, a reset can be requested on every activation of the device. Otherwise, activation of the output will correspond directly to the input conditions.

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.
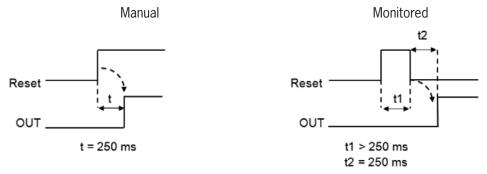
Fig. 142:   Switch manual/monitored reset

⚠	**Important!**
	If manual reset is selected, the next input after the inputs used by the function block must be used. Example: If Input1 is used for the function block, Input2 must be used for the reset input.

Output Test: This option can be used to select which test output signals are to be sent to the switch. Short circuits between the cables can be detected and rectified by means of this additional check. For this purpose it is necessary to configure the test output signals (from the test output signals available).

StartUp Test: If activated, the test is performed on switching on the switch. This test is performed by closing and opening the switch contact to carry out a complete function test and to activate the output. This test is required only on starting the machine (on switching on the module).

Filter (ms): Makes it possible to filter the signals that are received from the switch. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

Enable Error Out: If activated, an error detected by the function block is displayed.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

9.2.2.15. Enabling switch (ENABLING SWITCH)

Using the ENABLING SWITCH function block the input status of a 3-stage enabling switch is checked. If this switch is not pressed (position 1) or is fully pressed (position 3), the OUTPUT output is "0" (FALSE). In the middle position (position 2), the OUTPUT output is "1" (TRUE); see truth tables *Page 136*.

➡ For the ENABLING SWITCH function block, the module assigned must have the firmware version as shown in the table below, as a minimum:

MSC-CB	FI8FO2	FI8	FI16	FM4
1.0	0.4	0.4	0.4	0.0

Table 68: Firmware versions required
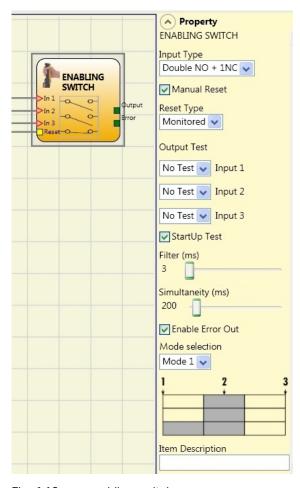
Fig. 143:   enabling switch

Parameters

Input Type:

‣ Double NO – makes it possible to connect an enabling switch with two normally open contacts.

‣ Double NO + 1NC – makes it possible to connect an enabling switch with two normally open contacts and one normally closed contact.

Output Test: Makes it possible to select the test output signals that are to be sent to the enabling switch. Short circuits between the cables can be detected and rectified by means of this additional check. For this purpose it is necessary to configure the test output signals (from the test output signals available).

StartUp Test: If activated, the test is performed on switching on the external component (enabling switch). This test is performed by pressing and releasing the switch to carry out a complete function test and to activate the output. This test is required only on starting the machine (switching on the module).
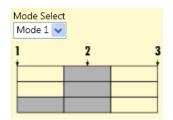
Simultaneity (ms): Is always selected. Defines the maximum permissible time (ms) between the switching of the different signals received from the external contacts of the device.

EN

Filter (ms): This parameter makes it possible to filter the signals from the device control system. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

Selection mode: Either of two modes can be selected if dual-channel NO + 1 NC is selected

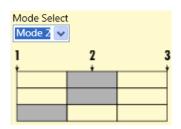## Mode 1 (device with 2 NO + 1 NC)

POSITION 1: Enabling switch fully released

POSITION 2: Enabling switch pressed to center position

POSITION 3: Enabling switch pressed all the way down

	Position		
Input	**1**	**2**	**3**
IN1	0	1	0
IN2	0	1	0
IN3	1	1	0
OUT	**0**	**1**	**0**

Table 69:   Only with 2 normally open contacts + 1 normally closed contact

Mode 2 (device with 2 NO + 1 NC)

POSITION 1: Enabling switch fully released

POSITION 2: Enabling switch pressed to center position

POSITION 3: Enabling switch pressed all the way down

	Position		
Input	**1**	**2**	**3**
IN1	0	1	0
IN2	0	1	0
IN3	1	0	0
OUT	**0**	**1**	**0**

Table 70:   Only with 2NO + 1NC

Enable Error Out: If activated, an error detected by the function block is displayed.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

9.2.2.16. Testable safety device (TESTABLE SAFETY DEVICE)

Using the TESTABLE SAFETY DEVICE function block the input status of a single-channel or a dual-channel safety sensor (both normally closed contacts and normally open contacts) is checked. Refer to the following tables for the sensor type and behavior:
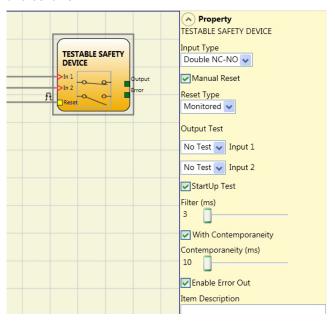
Fig. 144:   Testable safety device

Single normally closed contact

Fig. 145:   NC

IN	OUT
0	0
1	1

Table 71:   Status table NC

Single normally open contact

Fig. 146:   NO

IN	OUT
0	0
1	1

Table 72:   Status table NO

Dual-channel NC

Fig. 147:   Dual-channel NC

IN1	IN2	OUT	Simultaneity error *
0	0	**0**	-
0	1	**0**	X
1	0	**0**	X
1	1	**1**	-

Table 73:   Status table dual-channel NC

Dual-channel NC-NO

Fig. 148:   Dual-channel NC-NO

IN1	IN2	OUT	Simultaneity error *
0	0	**0**	X
0	1	**0**	-
1	0	**1**	-
1	1	**0**	X

Table 74:   Status table, dual-channel NC-NO

* Simultaneity error = max. time between the switching of the individual contacts has been exceeded.

EN

Parameters

Manual Reset: If activated, a reset can be requested on every activation of the device. Otherwise, activation of the output will correspond directly to the input conditions. There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.

⚠	**Important!**
	If manual reset is selected, the next input after the inputs used by the function block must be used. Example: If Input1 and Input2 are used for the function block, Input3 must be used for the reset input.

Output Test: This option can be used to select which test output signals are to be sent to the component contacts. Short circuits between the cables can be detected and rectified by means of this additional check. For this purpose it is necessary to configure the test output signals (from the test output signals available).

StartUp Test: If activated, the test is performed on switching on the device. This test requires the activation and deactivation of the device to carry out a complete function test and to activate the output. This test is required only on starting the machine (on switching on the module).

Filter (ms): Makes it possible to filter the signals that are received from the device. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

With Simultaneity: If selected, the check for simultaneous switching of the signals received from the device is enabled.

Simultaneity (ms): This is active only if the previous parameter has been selected. Defines the maximum permissible time (in ms) between the switching of the two different signals received from the sensor.

Enable Error Out: If activated, an error detected by the function block is displayed.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

9.2.2.17. Semiconductor output (SOLID STATE DEVICE)

Using the semiconductor output function block the input status is checked. If 24 V DC is present at the inputs, the OUTPUT output switches to "1" (TRUE), otherwise the OUTPUT output is "0" (FALSE).
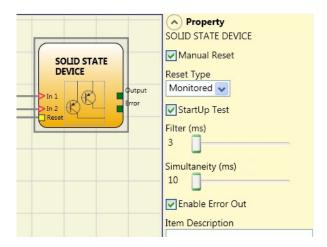

Fig. 149:   Semiconductor output

Parameters

Manual Reset: If activated, a reset can be requested on every activation of the safety function. Otherwise, activation of the output follows the input conditions directly.

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.
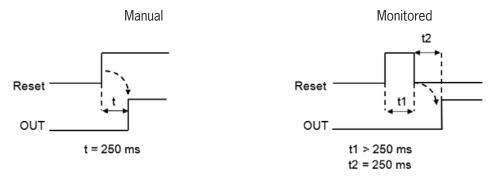
Fig. 150:   Semiconductor output manual/monitored reset

⚠ **Important!**

If manual reset is selected, the next input after the inputs used by the function block must be used. Example: If Input1 and Input2 are used for the function block, Input3 must be used for the reset input.

StartUp Test: If activated, the test is performed on switching on the safety system. This test requires the activation and deactivation of the device to carry out a complete function test and to activate the output. This test is required only on starting the machine (on switching on the module).

Filter (ms): Makes it possible to filter the signals from the safety device. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The time set for the filter affects the calculation of the total response time of the module.

Simultaneity (ms): Is always selected. Defines the maximum permissible time (in ms) between the switching of the two different signals received from the device.

Enable Error Out: If activated, an error detected by the function block is displayed.

Item Description: A functional description for the component can be entered here. This text is displayed in the upper part of the symbol.

EN

9.2.2.18. RESTART INPUT

The element can be used as a digital input (in addition to the 8 available on MSC-CB-S (firmware ≥ 7.0), FI8FO4S (firmware ≥ 0.3)) and can be connected to any external device. The usable inputs relate to the RESTART_FBK signals of MSC-CB-S (firmware ≥ 7.0), FI8FO4S (firmware ≥ 0.3).
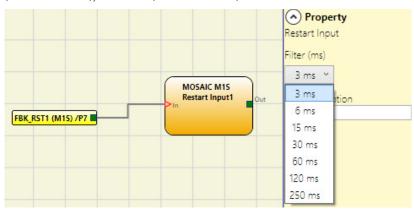
Fig. 151:   RESTART INPUT

Parameters

Filter (ms): enables filtering of signals coming from the external device. This filter can be set to between 3 and 250 ms and removes any contact bouncing. The filter duration influences the module's total reaction time.

9.2.2.19. Fieldbus input (FIELDBUS INPUT)

A conventional input can be provided using this element; the status of the input can be changed via the fieldbus.

The respective bit must be selected to perform changes on the input. The following table shows the max. number of virtual inputs.

Basic module	Fieldbus module firmware	Number of virtual inputs
MSC-CB-S	≥ 2.0	Max. 32
MSC-CB-S	< 2.0	Max. 8
MSC-CB	Independent	Max. 8

Table 75:   Max. number of sensors at the fieldbus input

The states are depicted on the fieldbus using four bytes. (Refer to the operating instructions for the fieldbus modules for more detailed information.)

Fig. 152:   Fieldbus input

⚠	**DANGER**
	The fieldbus input is **not** a safety input.
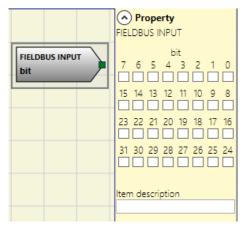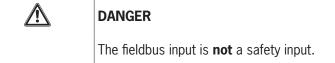
9.2.2.20. LL0 – LL1

A logic level can be supplied to the input of a component using these elements.

LL0 ➜ Logic level 0

LL1 ➜ Logic level 1

Fig. 153:   Logic level

ℹ **Important!**

LL0 and LL1 cannot be used to deactivate the logic connections in the program.

9.2.2.21. Notes

Starts input of a descriptive text that can be positioned at any point.

Fig. 154:   Notes

Parameters

Notes: field for entering the required comment.

Color: enables selection of the text color.

Height: enables selection of the text height (in pt).

9.2.2.22. Title

Automatically adds the name of the manufacturer, the system planner, the project name and the checksum (CRC).

Fig. 155:   Title

9.3. Function blocks for speed control

⚠️ **Important!**

▸ An external error or a malfunction on the encoder/proximity switch or on its connections does not necessarily result in a change in the safety status on the normal output of the function block (e.g. "zero"). Faults or malfunctions on the encoder/proximity switch or in the cabling are, however, detected by the module and managed and specified via the diagnostics bit (error output (Error)) that can be activated on each function block.

▸ To ensure safety, the diagnostics bit must be used in the configuration program to initiate possible deactivation of the outputs if the axis is in operation. If there are no external problems on the encoder/proximity switch, the "Error" output is 0 (zero).

▸ If there are the following external problems on the encoder/proximity switch, the "Error" output is 1 (one):
- Encoder or proximity switch missing.
- One or more connections on the encoder or proximity switch missing.
- No encoder supply (only TTL model with external supply).
- Frequency discrepancy between the signals on the encoder/proximity switch.
- Phase error on the encoder signals or cycle error on an individual phase.

Fig. 156:   Example for the speed control function block with "Error Out" enabled and a graphical 3-threshold diagram on the right. (The continuous line represents the threshold, while the dashed line represents the applied hysteresis.)

ℹ️ **NOTICE**

From EUCHNER Safety Designer software version 1.8.0, the speed control function blocks feature a graphic illustration of the configured thresholds.

9.3.1. Speed monitoring (SPEED CONTROL)

The speed monitoring function block checks the speed of a device. If the measured speed exceeds a previously set limit, the OVER output switches to "0" (FALSE). If the speed is below the previously set limit, the OVER output is "1" (TRUE).
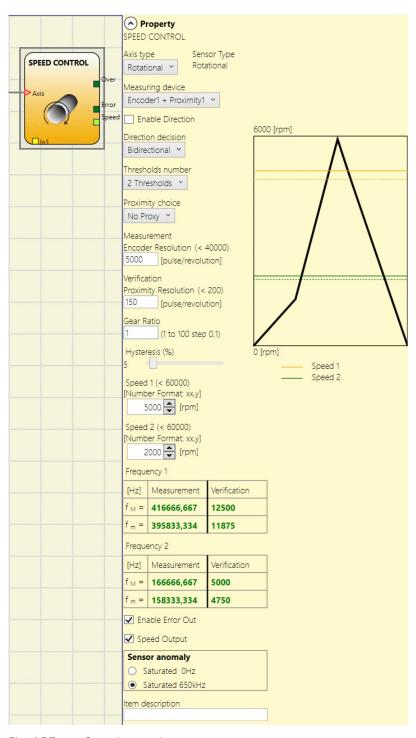

Fig. 157: Speed control

Parameters

Axis type: Defines the type of axis that is monitored by the device. "Linear" if the movement is linear or "Rotational" if the movement is rotary.

Sensor Type: If "Linear" is selected for the previous parameter, the sensor type connected to the inputs of the module is defined here. "Rotational" (e.g. encoder on a toothed rack) or "Linear" (e.g. optical linear sensor). This selection defines the other parameters.

Measuring device: Defines the type of measuring device/sensors used. The following can be selected:

‣ Encoder
‣ Proximity switch
‣ Encoder + proximity switch
‣ Proximity 1 + Proximity 2
‣ Encoder 1 + Encoder 2

Sin/cos: deactivates the analog control system: (Available only if at least one sin/sos encoder input is present.) The sin20 + cos20 analog control system can be deactivated, simplifying the reliability check of the encoder signals.

‣ The diagnostic coverage decreases when the analog control system is deactivated.
‣ The project's safety level decreases from:
SIL 3 -> SIL 2, PLe -> PLd.
Please observe the chapter *"Important safety precautions"*.

Enable Direction: Select this parameter to activate the DIR output of the function block. This output is "1" (TRUE) if the axis is rotating counterclockwise and "0" (FALSE) if the axis is rotating clockwise (see adjacent figure).

Direction decision: Defines the direction of rotation for which the entered limits are activated. The following can be selected:

‣ Bidirectional
‣ Clockwise
‣ Counterclockwise

If "Bidirectional" is selected, the measurement is made on exceeding the limit entered, both clockwise and counterclockwise. If "Clockwise" or "Counterclockwise" is selected, the measurement is made only if the axis is rotating in the selected direction.

Thresholds number: This enables you to enter the number of thresholds in relation to the maximum speed value.

Changing this value increases or decreases the number of thresholds that can be inserted from at least 1 to at most 8 on MSC-CB (firmware ≥ 4.0) and MSC-CE-SPM (firmware ≥ 2.0) and from at most 4 on MSC-CB/MSC-CB-S (firmware < 4.0) or MSC-CE-SPM (firmware < 2.0).

In case of thresholds greater than 1, the access pins for selection of the specific threshold appear in the lower part of the function block. The user can use these pins to select the threshold to activate.
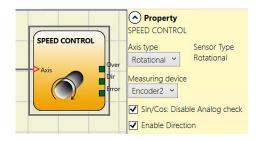

Fig. 158:   Sin/Cos

Fig. 159:   Example for the rotation of the axis clockwise

In1	Thresholds number
0	Speed 1
1	Speed 2

Table 76:   Settings up to 2 thresholds

In2	In1	Thresholds number
0	0	Speed 1
0	1	Speed 2
1	0	Speed 3
1	1	Speed 4

Table 77:   Settings up to 4 thresholds

In3	In2	In1	Thresholds number
0	0	0	Speed 1
0	0	1	Speed 2
0	1	0	Speed 3
0	1	1	Speed 4
1	0	0	Speed 5
1	0	1	Speed 6
1	1	0	Speed 7
1	1	1	Speed 8

Table 78:   Settings up to 8 thresholds

Pitch: If the axis type "Linear" and the sensor type "Rotational" are selected, this field enables you to enter the pitch for converting the rotation of the sensor into the distance covered.
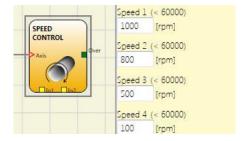

Fig. 160:   Pitch

Proximity choice: Selecting the proximity switch enables you to select between PNP, NPN, NO contact, NC contact, 3-wire or 4-wire.

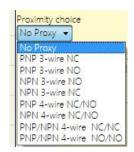(To ensure Performance Level = Pl e, a PNP NO must be used (see *7.2.3. Proximity switch input on speed monitoring modules SPM on page 36*).

Fig. 161:   Proximity choice

Encoder Resolution: Entry for the number of pulses/revolution (for a rotary sensor) or µm/pulse (for a linear sensor) in relation to the 1st measuring device.

Verification: In this field, you can enter the number of pulses/revolution (for a rotary sensor) or µm/pulse (for a linear sensor) in relation to the 2nd measuring device.

Gear Ratio: This parameter is active if there are two sensors on the selected axis. This parameter enables you to enter the gear ratio between the two sensors. If the two sensors are on the same moving object, the ratio is 1. Otherwise, the number must be entered regarding the ratio. Example: There is an encoder and a proximity switch, and the latter is on the moving object that (due to a gear ratio) moves at twice the speed of the encoder. For this reason, this value must be set to 2.

Hysteresis (%): Corresponds to the hysteresis (in percent) below which a speed change is filtered out. A value other than 1 must be entered here to prevent constant switching when the input is changed.

Fig. 162:   Hysteresis

Speed 1 – 8: Enter the maximum speed value above which the output of the OVER function block is "0" (FALSE). Conversely, if the speed measured is below the value entered, the OVER output on the function block is "1" (TRUE). On MSC-CB (firmware ≥ 4.0), MSC-CB-S (firmware ≥ 5.1) and MSC-CE-SPM (firmware ≥ 2.0), the value can be entered with a decimal point.
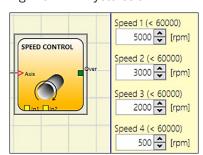

Fig. 163:   Speed 1 – 8

EN

Frequency: Indicates the maximum calculated frequency values *fM* and *fm* (reduced by the entered hysteresis).

▸ If the indicated value is GREEN, the calculated frequency is in the correct range.

▸ If the indicated value is RED, the parameters given in the following formulas must be changed.

1. Rotary axis, rotary sensor. The calculated frequency is:

$$f[Hz] = \frac{rpm[\text{rev/min}]}{60} * Resolution[\text{pulses/rev}]$$

2. Linear axis, rotary sensor. The calculated frequency is:

$$f[Hz] = \frac{speed[\text{m/min}] * 1000}{60 * pitch[\text{mm/rev}]} * Resolution[\text{pulses/rev}]$$

3. Linear axis, linear sensor. The calculated frequency is:

$$f[Hz] = \frac{speed[\text{mm/s}] * 1000}{Resolution[\text{µm/pulse}]}$$

4. Hysteresis. To be changed only if: *fM* = green; *fm* = red

KEY:
f = Frequency
rpm = Rotary speed
Resolution = Measurement
speed = Linear speed
pitch = Pitch

Enable Error Out: If activated, an error detected by the function block is signaled.

Speed Output: If this option is activated, it provides the measured frequency via the *Speed* Output, which can be connected to a speed, threshold or window comparator. Using this function, one or more thresholds can be set independent of the measured frequency.

Sensor anomaly: This parameter can be used to configure the saturation of the measured frequency if the measuring device is not available (sensor not connected, for example).

For the saturation, it is possible to select between the maximum value (default=650 kHz, OVERSPEED) and the minimum value (0 Hz).
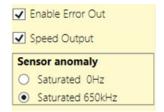

Fig. 164:   *Sensor anomaly*

9.3.2. Speed range monitoring (WINDOW SPEED CONTROL)

The speed range monitoring function block checks the speed of a device; the WINDOW output is "1" (TRUE) if the measured speed is within the previously defined speed window.
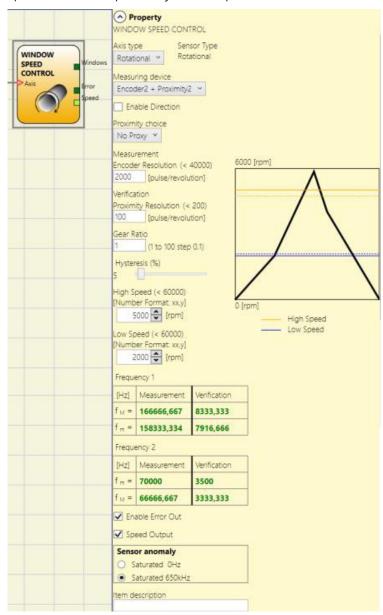
Fig. 165:   Speed range monitoring

Parameters

Axis type: Defines the type of axis that is monitored by the device. "Linear" if the movement is linear or "Rotational" if the movement is rotary.

Sensor Type: If "Linear" is selected for the previous parameter, the sensor type connected to the inputs of the module is defined here. This can be "Rotational" (e.g. encoder on a toothed rack) or "Linear" (e.g. optical linear sensor). This selection defines the other parameters.

Measuring device: This option specifies the type of measuring devices/sensors used. The following can be selected:

‣ Encoder
‣ Proximity switch
‣ Encoder + proximity switch
‣ Proximity 1 + Proximity 2
‣ Encoder 1 + Encoder 2

Pitch: If the axis type "Linear" and the sensor type "Rotational" are selected, this field becomes active. Enter here the distance that is covered during one sensor revolution.

Sin/cos: deactivates the analog control system: (Available only if at least one sin/sos encoder input is present.) The sin20 + cos20 analog control system can be deactivated, simplifying the reliability check of the encoder signals.

‣ The diagnostic coverage decreases when the analog control system is deactivated.

‣ The project's safety level decreases from:
 SIL 3 -> SIL 2, PLe -> PLd.
 Please observe the chapter *"Important safety precautions"*.

Fig. 166:   Sin/Cos

Enable Direction: (Available only if at least one encoder input is present.) Select this parameter to activate the DIR output on the function block. This output is "1" (TRUE) if the axis is rotating counterclockwise and "0" (FALSE) if the axis is rotating clockwise (see adjacent figure).

Fig. 167:   Example for the rotation of the axis clockwise

Proximity choice: Selecting the proximity switch enables you to select between PNP, NPN, NO contact, NC contact, 3-wire or 4-wire.

To ensure Performance Level = Pl e, a PNP NO must be used (see *"Proximity switch input on speed monitoring modules SPM" on page 36*).

Encoder Resolution: Entry for the number of pulses/revolution (for a rotary sensor) or µm/pulse (for a linear sensor) in relation to the 1st measuring device.

Verification: In this field, you can enter the number of pulses/revolution (for a rotary sensor) or µm/pulse (for a linear sensor) in relation to the 2nd measuring device.
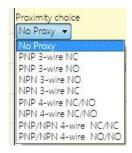

Fig. 168:   Proximity choice

Gear Ratio: This parameter is active if there are two sensors on the selected axis. This parameter enables you to enter the gear ratio between the two sensors. If the two sensors are on the same moving object, the ratio is 1; otherwise the figure for the ratio must be entered. Example: There is an encoder and a proximity switch, and the latter is on the moving object that (due to a gear ratio) moves at twice the speed of the encoder. For this reason, this value must be set to 2.

Hysteresis (%): Corresponds to the hysteresis (in percent) below which a speed change is filtered out. A value other than 1 must be entered here to prevent constant switching when the input is changed.

Fig. 169:   Hysteresis

High Speed: In this field, enter the highest speed value above which the output of the WINDOW function block is "0" (FALSE). Conversely, if the speed measured is below the value entered, the WINDOW output of the function block is "1" (TRUE). On MSC-CB (firmware ≥4.0), MSC-CB-S (firmware ≥5.1) and MSC-CE-SPM (firmware ≥2.0), the value can be entered with a decimal point.

Low Speed: In this field, enter the lowest speed value below which the output of the WINDOW function block is "0" (FALSE). Conversely, if the speed measured is above the value entered, the WINDOW output of the function block is "1" (TRUE). On MSC-CB (firmware ≥4.0), MSC-CB-S (firmware ≥5.1) and MSC-CE-SPM (firmware ≥2.0), the value can be entered with a decimal point.

Frequency: Indicates the maximum calculated frequency values *fM* and *fm* (reduced by the entered hysteresis).

‣ If the indicated value is GREEN, the calculated frequency is in the correct range.

‣ If the indicated value is RED, the parameters given in the following formulas must be changed.

1. Rotary axis, rotary sensor. The calculated frequency is:

$$f[Hz] = \frac{rpm[\text{rev}/\text{min}]}{60} * Resolution[\text{pulses}/\text{rev}]$$

2. Linear axis, rotary sensor. The calculated frequency is:

$$f[Hz] = \frac{speed[\text{m}/\text{min}] * 1000}{60 * pitch[\text{mm}/\text{rev}]} * Resolution[\text{pulses}/\text{rev}]$$

3. Linear axis, linear sensor. The calculated frequency is:

$$f[Hz] = \frac{speed[\text{mm}/\text{s}] * 1000}{Resolution[\text{µm}/\text{pulse}]}$$

4. Hysteresis. To be changed only if: *fM* = green; *fm* = red

KEY:
f = Frequency
rpm = Rotary speed
Resolution = Measurement
speed = Linear speed
pitch = Pitch

Enable Error Out: If activated, an error detected by the function block is signaled.

Speed Output: If this option is activated, it provides the measured frequency via the *Speed* Output, which can be connected to a speed, threshold or window comparator. Using this function, one or more thresholds can be set independent of the measured frequency.

Sensor anomaly: This parameter can be used to configure the saturation of the measured frequency if the measuring device is not available (sensor not connected, for example).

For the saturation, it is possible to select between the maximum value (default=650 kHz, OVERSPEED) and the minimum value (0 Hz).
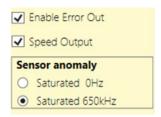

Fig. 170: *Sensor anomaly*

9.3.3. Standstill monitoring (STAND STILL)

The standstill monitoring function block checks the speed of a device; the ZERO output is "1" (TRUE) if the speed is 0. If the speed is not 0, the ZERO output is "0" (FALSE).
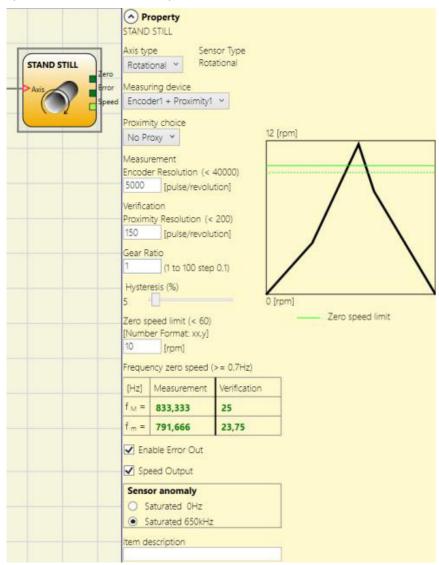

Fig. 171:   Standstill monitoring

Parameters

Axis type: Defines the type of axis that is monitored by the device. "Linear" if the movement is linear or "Rotational" if the movement is rotary.

Sensor Type: If "Linear" is selected for the previous parameter, the sensor type connected to the inputs of the module is defined here. This can be "Rotational" (e.g. encoder on a toothed rack) or "Linear" (e.g. optical linear sensor). This selection defines the other parameters.

Measuring device: This option specifies the type of measuring devices/sensors used. The following can be selected:
‣ Encoder
‣ Proximity switch
‣ Encoder + proximity switch
‣ Proximity 1 + Proximity 2
‣ Encoder 1 + Encoder 2

Pitch: If the axis type "Linear" and the sensor type "Rotational" are selected, this field becomes active. Enter here the distance that is covered during one sensor revolution.

Sin/cos: deactivates the analog control system: (Available only if at least one sin/sos encoder input is present.) The sin20 + cos20 analog control system can be deactivated, simplifying the reliability check of the encoder signals.

▸ The diagnostic coverage decreases when the analog control system is deactivated.

▸ The project's safety level decreases from:
SIL 3 -> SIL 2, PLe -> PLd.
Please observe the chapter *"Important safety precautions"*.

Enable Direction: (Available only if at least one encoder input is present.) Select this parameter to activate the DIR output on the function block. This output is "1" (TRUE) if the axis is rotating counterclockwise and "0" (FALSE) if the axis is rotating clockwise (see adjacent figure).

Fig. 172:   Sin/Cos

Fig. 173:   Example for the rotation of the axis clockwise

Proximity choice: Selecting the proximity switch enables you to select between PNP, NPN, NO contact, NC contact, 3-wire or 4-wire.

(To ensure Performance Level = Pl e, a PNP NO must be used (see *"Proximity switch input on speed monitoring modules SPM" on page 36*).

Encoder Resolution: Entry for the number of pulses/revolution (for a rotary sensor) or μm/pulse (for a linear sensor) in relation to the 1st measuring device.
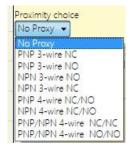

Fig. 174:   Proximity choice

Verification: In this field, you can enter the number of pulses/revolution (for a rotary sensor) or μm/pulse (for a linear sensor) in relation to the 2nd measuring device.

Gear Ratio: This parameter is active if there are two sensors on the selected axis. This parameter enables you to enter the gear ratio between the two sensors. If the two sensors are on the same moving object, the ratio is 1; otherwise the figure for the ratio must be entered. Example: There is an encoder and a proximity switch, and the latter is on the moving object that (due to a gear ratio) moves at twice the speed of the encoder. For this reason, this value must be set to 2.

Hysteresis (%): Corresponds to the hysteresis (in percent) below which a speed change is filtered out. A value other than 1 must be entered here to prevent constant switching when the input is changed.
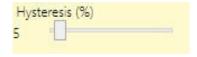

Fig. 175:   Hysteresis

Zero speed limit: Enter the highest speed that still corresponds to standstill in this field. Above this limit, the ZERO output of the function block is "0" (FALSE). If the measured speed is below the entered value, the ZERO output of the function block is "1" (TRUE).

EN

Frequency zero speed: Indicates the maximum calculated frequency values *fM* and *fm* (reduced by the entered hysteresis).

‣ If the indicated value is GREEN, the calculated frequency is in the correct range.

‣ If the indicated value is RED, the parameters given in the following formulas must be changed.

1. Rotary axis, rotary sensor. The calculated frequency is:

$$f[Hz] = \frac{rpm[\text{rev}/\text{min}]}{60} * Resolution[\text{pulses}/\text{rev}]$$

2. Linear axis, rotary sensor. The calculated frequency is:

$$f[Hz] = \frac{speed[\text{m}/\text{min}] * 1000}{60 * pitch[\text{mm}/\text{rev}]} * Resolution[\text{pulses}/\text{rev}]$$

3. Linear axis, linear sensor. The calculated frequency is:

$$f[Hz] = \frac{speed[\text{mm}/\text{s}] * 1000}{Resolution[\text{µm}/\text{pulse}]}$$

4. Hysteresis. To be changed only if: *fM* = green; *fm* = red

KEY:
f = Frequency
rpm = Rotary speed
Resolution = Measurement
speed = Linear speed
pitch = Pitch

Enable Error Out: If activated, an error detected by the function block is signaled.

Speed Output: If this option is activated, it provides the measured frequency via the *Speed* Output, which can be connected to a speed, threshold or window comparator. Using this function, one or more thresholds can be set independent of the measured frequency.

Sensor anomaly: This parameter can be used to configure the saturation of the measured frequency if the measuring device is not available (sensor not connected, for example).

For the saturation, it is possible to select between the maximum value (default=650 kHz, OVERSPEED) and the minimum value (0 Hz).
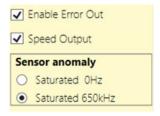

Fig. 176:   *Sensor anomaly*

9.3.4. Speed/standstill monitoring (STAND STILL AND SPEED CONTROL)

The speed/standstill monitoring function block checks the speed of a device; the ZERO output is "1" if the speed is 0. In addition, the OVER output is "0" (FALSE) if the measured speed exceeds a previously defined limit.
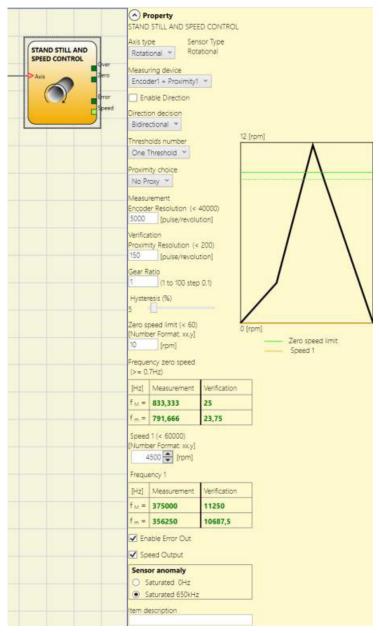

Fig. 177:   Speed/standstill monitoring

Parameters

Axis type: Defines the type of axis that is monitored by the device. "Linear" if the movement is linear or "Rotational" if the movement is rotary.

Sensor Type: If "Linear" is selected for the previous parameter, the sensor type connected to the inputs of the module is defined here. This can be "Rotational" (e.g. encoder on a toothed rack) or "Linear" (e.g. optical linear sensor). This selection defines the other parameters.

Measuring device: Defines the type of measuring device/sensors used. The following can be selected:

‣ Encoder
‣ Proximity switch
‣ Encoder + proximity switch
‣ Proximity 1 + Proximity 2
‣ Encoder 1 + Encoder 2

Sin/cos: deactivates the analog control system: (Available only if at least one sin/sos encoder input is present.) The sin20 + cos20 analog control system can be deactivated, simplifying the reliability check of the encoder signals.

‣ The diagnostic coverage decreases when the analog control system is deactivated.

‣ The project's safety level decreases from:
SIL 3 -> SIL 2, PLe -> PLd.
Please observe the chapter *"Important safety precautions"*.

Fig. 178:   Sin/Cos

Enable Direction: Select this parameter to activate the DIR output of the function block. This output is "1" (TRUE) if the axis is rotating counterclockwise and "0" (FALSE) if the axis is rotating clockwise (see adjacent figure).

Direction decision: Defines the direction of rotation for which the entered limits are activated. The following can be selected:

‣ Bidirectional
‣ Clockwise
‣ Counterclockwise

➡ If "Bidirectional" is selected, the measurement is made on exceeding the limit entered, both clockwise and counterclockwise. If "Clockwise" or "Counterclockwise" is selected, the measurement is made only if the axis is rotating in the selected direction.

Fig. 179:   Example for the rotation of the axis clockwise

Thresholds number: This enables you to enter the number of thresholds in relation to the maximum speed value.

Changing this value increases or decreases the number of thresholds that can be inserted from at least 1 to at most 8 on MSC-CB (firmware ≥ 4.0) and MSC-CE-SPM (firmware ≥ 2.0) and from at most 4 on MSC-CB/MSC-CB-S (firmware < 4.0) or MSC-CE-SPM (firmware < 2.0).

In case of thresholds greater than 1, the access pins for selection of the specific threshold appear in the lower part of the function block. The user can use these pins to select the threshold to activate.
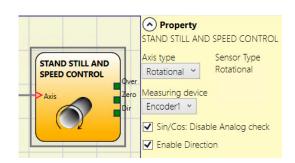
In1	Thresholds number
0	Speed 1
1	Speed 2

Table 79:   Settings up to 2 thresholds

In2	In1	Thresholds number
0	0	Speed 1
0	1	Speed 2
1	0	Speed 3
1	1	Speed 4

Table 80:   Settings up to 4 thresholds

In3	In2	In1	Thresholds number
0	0	0	Speed 1
0	0	1	Speed 2
0	1	0	Speed 3
0	1	1	Speed 4
1	0	0	Speed 5
1	0	1	Speed 6
1	1	0	Speed 7
1	1	1	Speed 8

Table 81:   Settings up to 8 thresholds

Pitch: If the axis type "Linear" and the sensor type "Rotational" are selected, this field enables you to enter the pitch for converting the rotation of the sensor into the distance covered.

Proximity choice: Selecting the proximity switch enables you to select between PNP, NPN, NO contact, NC contact, 3-wire or 4-wire.

To ensure Performance Level = Pl e, a PNP NO must be used (see *"Proximity switch input on speed monitoring modules SPM" on page 36*).

Frequency zero speed / Frequency1 / Frequency2: Indicates the maximum calculated frequency values *fM* and *fm* (reduced by the entered hysteresis).

‣ If the indicated value is GREEN, the calculated frequency is in the correct range.

‣ If the indicated value is RED, the parameters given in the following formulas must be changed.

1. Rotary axis, rotary sensor. The calculated frequency is:

$$f[Hz] = \frac{rpm[rev/min]}{60} * Resolution[pulses/rev]$$

2. Linear axis, rotary sensor. The calculated frequency is:

$$f[Hz] = \frac{speed[m/min] * 1000}{60 * pitch[mm/rev]} * Resolution[pulses/rev]$$

3. Linear axis, linear sensor. The calculated frequency is:

$$f[Hz] = \frac{speed[mm/s] * 1000}{Resolution[\mu m/pulse]}$$

4. Hysteresis. To be changed only if: *fM* = green; *fm* = red

KEY:
f = Frequency
rpm = Rotary speed
Resolution = Measurement
speed = Linear speed
pitch = Pitch

Encoder Resolution: Entry for the number of pulses/revolution (for a rotary sensor) or μm/pulse (for a linear sensor) in relation to the 1st measuring device.

Verification: In this field, you can enter the number of pulses/revolution (for a rotary sensor) or μm/pulse (for a linear sensor) in relation to the 2nd measuring device.

Gear Ratio: This parameter is active if there are two sensors on the selected axis. This parameter enables you to enter the gear ratio between the two sensors. If the two sensors are on the same moving object, the ratio is 1; otherwise the figure for the ratio must be entered. Example: There is an encoder and a proximity switch, and the latter is on the moving object that (due to a gear ratio) moves at twice the speed of the encoder. For this reason, this value must be set to 2.

Hysteresis (%): Corresponds to the hysteresis (in percent) below which a speed change is filtered out. A value other than 1 must be entered here to prevent constant switching when the input is changed.
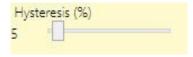

Fig. 180:   Hysteresis

Zero speed limit: In this field, enter the highest speed above which the output of the function block ZERO is "0" (FALSE). If the measured speed is below the entered value, the ZERO output of the function block is "1" (TRUE).

Speed 1, 2, 3, 4: Enter the highest speed in this field. If the speed is exceeded, the OVER output of the function block is "0" (FALSE). If the measured speed is below the entered value, the OVER output of the function block is "1" (TRUE).

Enable Error Out: If activated, an error detected by the function block is signaled.

EN

Speed 1 – 8: Enter the maximum speed value above which the output of the OVER function block is "0" (FALSE). Conversely, if the speed measured is below the value entered, the OVER output on the function block is "1" (TRUE). On MSC-CB (firmware ≥ 4.0), MSC-CB-S (firmware ≥ 5.1) and MSC-CE-SPM (firmware ≥ 2.0), the value can be entered with a decimal point.

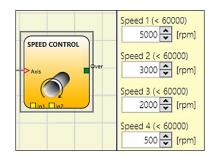Fig. 181:   Speed 1 – 8

Frequency zero speed / Frequency1 / Frequency2: Indicates the maximum calculated frequency values *fM* and *fm* (reduced by the entered hysteresis).

‣ If the indicated value is GREEN, the calculated frequency is in the correct range.

‣ If the indicated value is RED, the parameters given in the following formulas must be changed.

1. Rotary axis, rotary sensor. The calculated frequency is:

$$f[Hz] = \frac{rpm[\text{rev/min}]}{60} * Resolution[\text{pulses/rev}]$$

2. Linear axis, rotary sensor. The calculated frequency is:

$$f[Hz] = \frac{speed[\text{m/min}] * 1000}{60 * pitch[\text{mm/rev}]} * Resolution[\text{pulses/rev}]$$

3. Linear axis, linear sensor. The calculated frequency is:

$$f[Hz] = \frac{speed[\text{mm/s}] * 1000}{Resolution[\text{µm/pulse}]}$$

4. Hysteresis. To be changed only if: *fM* = green; *fm* = red

KEY:
f = Frequency
rpm = Rotary speed
Resolution = Measurement
speed = Linear speed
pitch = Pitch

Enable Error Out: If activated, an error detected by the function block is signaled.

Speed Output: If this option is activated, it provides the measured frequency via the *Speed* Output, which can be connected to a speed, threshold or window comparator. Using this function, one or more thresholds can be set independent of the measured frequency.

Sensor anomaly: This parameter can be used to configure the saturation of the measured frequency if the measuring device is not available (sensor not connected, for example).

For the saturation, it is possible to select between the maximum value (default=650 kHz, OVERSPEED) and the minimum value (0 Hz).
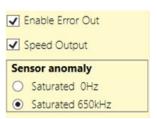

Fig. 182:   Sensor anomaly

9.3.5. Speed comparison (SPEED EQUALITY CHECK)

The SPEED EQUALITY CHECK function block monitors the input frequency values (Axis1, Axis2) from two encoders and checks whether they deviate. The user can set the resolutions of the two encoders, the maximum deviation threshold (in percent) and the threshold timeout. The Q output is set to 1 (TRUE) if the deviation is within the permissible values.
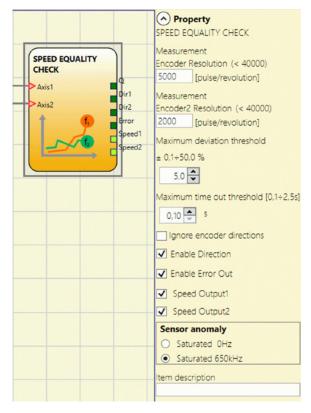

Fig. 183: Speed comparison

Parameters

Encoder Resolution: Entry for the number of pulses/revolution (for a rotary sensor) or µm/pulse (for a linear sensor) in relation to the 1st measuring device.

Maximaler Schwellenwert für die Abweichung (maximum deviation threshold): The user sets the maximum permissible threshold within which output Q returns the value 1.

Maximale Zeit außerhalb des Schwellenwertbereichs (maximum time outside the threshold range): The user sets the time (in seconds) within which the measurement lies outside the threshold range. Output Q returns the value 1 if the deviation remains within the designated time; output Q changes to 0 if the deviation exceeds the time limit.

Geber-Richtungen ignorieren (ignore encoder directions): If this option is selected, the direction of rotation of the Axis1 and Axis2 inputs is not taken into account. Only the absolute value is considered.

Enable Direction: (Available only if at least one encoder input is present.) When this parameter is activated, the DIR output on the function block is activated. This output is 1 (TRUE) if the axis rotates counterclockwise and 0 (FALSE) if the axis rotates clockwise.

Enable Error Out: If activated, an error detected by the function block is signaled.

Ausgang Geschwindigkeit1/Ausgang Geschwindigkeit2 (Speed1 output/Speed2 output): If this option is activated, it provides the measured frequency via the Speed1/Speed2 outputs, which can be connected to a speed, threshold or window comparator. Using this function, one or more thresholds can be set independent of the measured frequency.

Fig. 184: Example for the rotation of the axis clockwise

EN

9.4. Function blocks in the "OPERATOR" window

All inputs on these operators can be inverted (logical NOT). To invert, click the input that is to be inverted using the right mouse button. A small circle then appears on the inverted input. To clear the inversion, simply click the same input again.

> **(i)**   **Important!**
>
> The maximum permissible number of function blocks is 64 with MSC-CB or 128 with MSC-CB-S.

9.4.1. Logical operators

9.4.1.1. AND

The logical operator AND produces an output of "1" (TRUE) if all inputs are "1" (TRUE).

IN$_1$	IN$_2$	IN$_x$	OUT
0	0	0	0
1	0	0	0
0	1	0	0
1	1	0	0
0	0	1	0
1	0	1	0
0	1	1	0
1	1	1	1
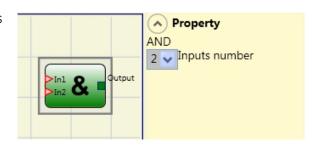
Fig. 185:   AND

Parameters

Inputs number: Use this option to set 2 to 8 inputs.

9.4.1.2. NAND

The logical operator NAND produces an output of "0" (FALSE) if all inputs are "1" (TRUE).

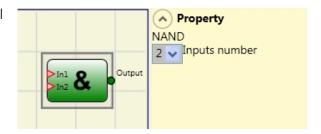| IN$_1$	IN$_2$	IN$_x$	OUT
0	0	0	1
1	0	0	1
0	1	0	1
1	1	0	1
0	0	1	1
1	0	1	1
0	1	1	1
1	1	1	0

Fig. 186:   NAND

Parameters

Inputs number: Use this option to set 2 to 8 inputs.

9.4.1.3. NOT

The logical status of the input is inverted using the logical NOT operator.

IN$_1$	OUT
0	1
1	0

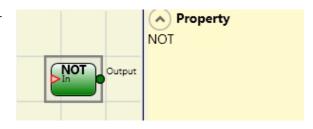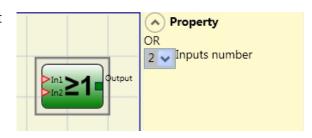
Fig. 187:   NOT

9.4.1.4. OR

The logical operator OR produces an output of "1" (TRUE) if at least one of the inputs is "1" (TRUE).

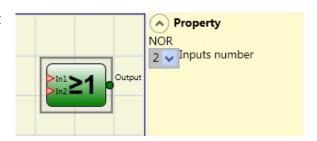| IN$_1$	IN$_2$	IN$_x$	OUT
0	0	0	0
1	0	0	1
0	1	0	1
1	1	0	1
0	0	1	1
1	0	1	1
0	1	1	1
1	1	1	1

Fig. 188:   OR

Parameters

Inputs number: Use this option to set 2 to 8 inputs.

9.4.1.5. NOR

The logical operator NOR produces an output of "0" (FALSE) if at least one of the inputs is "1" (TRUE).

IN$_1$	IN$_2$	IN$_x$	OUT
0	0	0	1
1	0	0	0
0	1	0	0
1	1	0	0
0	0	1	0
1	0	1	0
0	1	1	0
1	1	1	1

Fig. 189:   NOR

Parameters

Inputs number: Use this option to set 2 to 8 inputs.

9.4.1.6. XOR

The logical operator XOR produces an output of "0" (FALSE) if the number of inputs that are "1" (TRUE) is even or if all inputs are "0" (FALSE).

IN$_1$	IN$_2$	IN$_x$	OUT
0	0	0	0
1	0	0	1
0	1	0	1
1	1	0	0
0	0	1	1
1	0	1	0
0	1	1	0
1	1	1	1

Fig. 190:   XOR

Parameters

Inputs number: Use this option to set 2 to 8 inputs.

EN

9.4.1.7. XNOR

The logical operator XNOR produces an output of "0" (FALSE) if the number of inputs that are "1" (TRUE) is even or if all inputs are "0" (FALSE).

IN$_1$	IN$_2$	IN$_x$	OUT
0	0	0	1
1	0	0	0
0	1	0	0
1	1	0	1
0	0	1	0
1	0	1	1
0	1	1	1
1	1	1	0
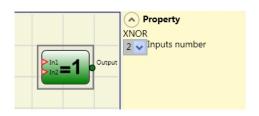
Fig. 191:   XNOR

Parameters

Inputs number: Use this option to set 2 to 8 inputs.

9.4.1.8. Logical macro (LOGICAL MACRO)

This operator permits the grouping of two or three logic blocks.

A maximum of 8 inputs are available.

The result of the first two operators flows into a third operator; the result of this operator is output on the OUTPUT output.
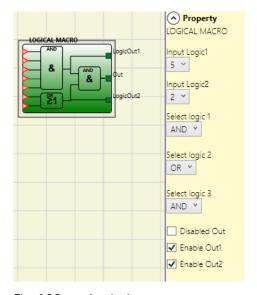
Fig. 192:   Logical macro

Parameters

Input Logic 1, 2: Use this option to set the number of logic inputs (1 to 7).

If one of the two logic inputs has only one input, the corresponding logic is deactivated and the input is assigned directly to the final logic (example in the adjacent figure).

Select logic 1, 2, 3: This enables the operator type to be selected from the following options: AND, NAND, OR, NOR, XOR, XNOR.

Deactivate main output: If this option is selected, the main output OUT is deactivated.

Activation of Output1, Output2: Select this option to display intermediate results. (see *Fig. 192*)
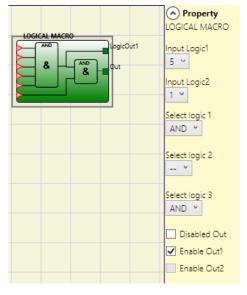

Fig. 193:   Logical macro parameter

9.4.1.9. MULTIPLEXER

Using the MULTIPLEXER logical operator, the input signal sent to the output depends on the SEL selection. If only one bit is set for Sel1–Sel4, the selected input is connected to the output. If:

‣ More than one SEL input = "1" (TRUE) or

‣ No SEL input = "1" (TRUE),

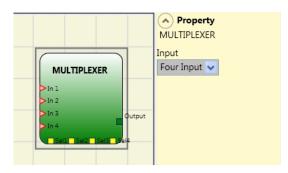Then the output switches to "0" (FALSE), and that independent of the input values.

Fig. 194:   Multiplexer

Parameters

Inputs number: Use this option to set 2 to 4 inputs.

9.4.1.10. Digital comparator (DIGITAL COMPARATOR) (only on MSC-CB-S)

The DIGITAL COMPARATOR operator can compare a signal group in binary format with a constant or with a second signal group.

Comparison with a constant

The signal comparison must not be selected for the comparison with a constant. The DIGITAL COMPARATOR operator compares a signal group with an integer constant. Inputs In1 to In8 produce a binary value. In1 is the LSB (least significant bit) and In8 the MSB (most significant bit).

Example for 8 inputs:

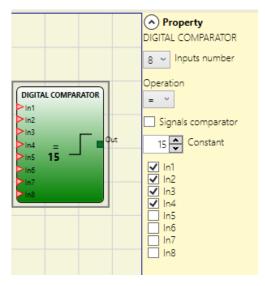| Input	Value
In1	0
In2	1
In3	1
In4	0
In5	1
In6	0
In7	0
In8	1

Fig. 195:   Digital comparator, comparison with a constant

➡ This results in the binary number 01101001, which represents the decimal value 150.

Example for 5 inputs:

Input	Value
In1	0
In2	1
In3	0
In4	1
In5	1

➡ This results in the binary number 01011, which represents the decimal value 26.

Parameters

Inputs number: Setting 2 to 8 inputs

Logical operator: Choice between equal to (=), unequal to (!=), greater than (>), greater than or equal to (>=), less than (<) and less than or equal to (<=) (refer to the table for an exact description)

Constant: Setting value from 0 to 255

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Operator	Description
Equal to (=)	The OUTPUT output is "1" (TRUE) if the value combined from the inputs is equal to the constant. If the two values are not equal, the OUTPUT output = "0" (FALSE).
Unequal to (!=)	The OUTPUT output is "1" (TRUE) if the value combined from the inputs is not equal to the constant. If the values are equal, the OUTPUT output = "0" (FALSE).
Greater than (>)	The OUTPUT output is "1" (TRUE) if the value combined from the inputs is larger than the value of the constant. If the constant is the same or larger, the OUTPUT output = "0" (FALSE).
Greater than or equal to (>=)	The OUTPUT output is "1" (TRUE) if the value combined from the inputs is larger than or the same as the value of the constant. If the constant is larger, the OUTPUT output = "0" (FALSE).
Less than (<)	The OUTPUT output is "1" (TRUE) if the value combined from the inputs is smaller than the value of the constant. If the constant is the same or smaller, the OUTPUT output = "0" (FALSE).
Less than or equal to (<=)	The OUTPUT output is "1" (TRUE) if the value combined from the inputs is smaller than or the same as the value of the constant. If the constant smaller, the OUTPUT output = "0" (FALSE).

Comparison with a second signal group

The signal comparison must be selected for the comparison with a second signal group. Inputs In1_A to In4_A produce the value A. In1_A is the LSB and In4_A the MSB of the binary value. Inputs In1_B to In4_B produce the value B. In1_B is the LSB and In4_B the MSB of the binary value.
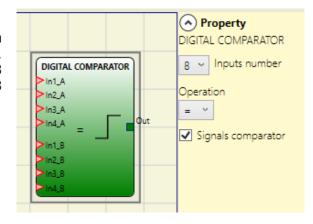

Fig. 196:   Digital comparator, signal comparison

Parameters

Logical operator: Choice between equal to (=), unequal to (!=), greater than (>), greater than or equal to (>=), less than (<) and less than or equal to (<=) (refer to the table for an exact description)

Operator	Description
Equal to (=)	The OUTPUT output is "1" (TRUE) if value A is equal to value B. If the two values are not equal, the OUTPUT output = "0" (FALSE).
Unequal to (!=)	The OUTPUT output is "1" (TRUE) if value A is not equal to value B. If the values are equal, the OUTPUT output = "0" (FALSE).
Greater than (>)	The OUTPUT output is "1" (TRUE) if value A is larger than value B. If value B is the same or larger, the OUTPUT output = "0" (FALSE).
Greater than or equal to (>=)	The OUTPUT output is "1" (TRUE) if value A is larger than or the same as value B. If the value B is larger, the OUTPUT output = "0" (FALSE).
Less than (<)	The OUTPUT output is "1" (TRUE) if value A is smaller than value B. If value B is the same or smaller, the OUTPUT output = "0" (FALSE).
Less than or equal to (<=)	The OUTPUT output is "1" (TRUE) if value A is smaller than or the same as value B. If value B is smaller, the OUTPUT output = "0" (FALSE).

9.4.2. Memory operators

Operators of the type MEMORY make it possible to save data (TRUE or FALSE) that come from other project components.

Status changes are performed according to the truth tables given for each operator.

9.4.2.1. D FLIP FLOP (max. number = 16 with MSC-CB)

Using the D FLIP-FLOP operator the status set previously on the Q output is saved according to the following truth table.

Preset	Clear	Ck	D	Q
1	0	X	X	1
0	1	X	X	0
1	1	X	X	0
0	0	L	X	Retain memory
0	0	Rising edge	1	1
0	0	Rising edge	0	0
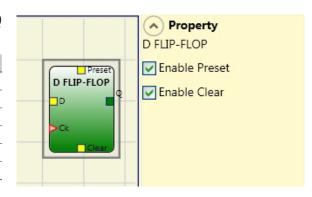
Fig. 197:   D Flip-Flop

Parameters

Enable Preset: If activated, the Q output can be set to "1" (TRUE).

Enable Clear: If activated, the memory process can be reset.

9.4.2.2. T FLIP FLOP (max. number = 16 with MSC-CB)

This operator toggles the Q output on each rising edge on the T (Toggle) input .

Parameters

Enable Clear: If activated, the memory process can be reset.

Fig. 198:   T Flip-Flop

9.4.2.3. SR FLIP-FLOP

Using the SR FLIP-FLOP operator, the Q output is set to "1" with Set and to "0" with Reset.

See truth table below:

SET	RESET	Q
0	0	Retain memory
0	1	0
1	0	1
1	1	0

Fig. 199:   SR Flip-Flop

Parameters

Save output status: If this is selected, the output status of the flip-flop is saved in the non-volatile memory on every change. The most recently saved value is restored with the MSC system is switched on. Up to 8 flip-flops with storage of the output status are possible. They are distinguished by an "M."

NOTICE

‣ The user must bear a few limitations in mind when using this memory type. The maximum required time for a single saving operation is estimated at 50 ms, and the maximum number of possible saving operations is fixed at 100,000.

‣ The total number of storage operations must not exceed the limit, otherwise this will shorten the product's mechanical life. Furthermore, the frequency of storage operations must be low enough to permit them under safe conditions.

9.4.2.4. Manual restart (USER RESTART MANUAL) (max. number = 16 with MSC-CB, max. number = 32 with MSC-CB-S including other RESTART operators)

Using the USER RESTART MANUAL operator the restart signal is saved as per the following truth table.

Fig. 200:   Manual restart

Clear	Restart ⌐	IN	Q	Restart request type 1	Restart request type 2
1	X	X	0	0	1
X	X	0	0	0	1
0	0	1	Retain memory	1	Flashing at 1 Hz
0	Rising edge	1	1	0	0

Parameters

Enable Clear: If activated, the memory process can be reset.

Reset Request: If activated, this can indicate that restarting is possible. The behavior can correspond to that of type 1 or type 2.

Important!

In case of request output type 2, a system timer is used.

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9.4.2.5. Monitored restart (USER RESTART MONITORED) (max. number = 16 with MSC-CB, max. number = 32 with MSC-CB-S including other RESTART operators)

Using the USER RESTART MONITORED operator the restart signal is saved as per the following truth table.
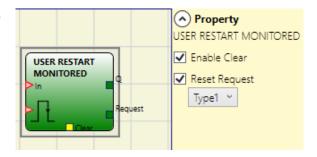

Fig. 201: Monitored restart

Clear	Restart ⎍	IN	Q	Restart request type 1	Restart request type 2
1	X	X	0	0	1
X	X	0	0	0	1
0	0	1	Retain memory	1	Flashing at 1 Hz
0	⎍	1	1	0	0

Parameters

Enable Clear: If activated, the memory process can be reset.

Reset Request: If activated, this can indicate that restarting is possible. The behavior can correspond to that of type 1 or type 2.

> **ⓘ Important!**
>
> In case of request output type 2, a system timer is used.

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9.4.2.6. **Manual restart macro (MACRO RESTART MANUAL) (max. number = 16 with MSC-CB, max. num-ber = 32 with MSC-CB-S including other RESTART operators)**

Using the MACRO RESTART MANUAL operator, a logic block selected by the user can be combined with the manual restart function block ("USER RESTART MANUAL") as per the following truth table:
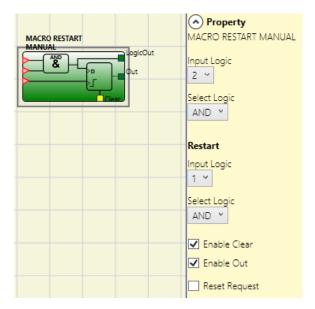

Fig. 202:   Macro manual restart

Clear	Restart ⌐	Input	Output	Restart request
1	X	X	0	0
X	X	0	0	0
0	0	1	Retain memory	1
0	Rising edge	1	1	0

Parameters

Input Logic: Use this option to set the number of logic inputs used (2 to 7).

Select Logic: This enables the operator type to be selected from the following options: AND, NAND, OR, NOR, XOR, XNOR.

Enable Clear: The memory process can be reset if this option is selected.

Enable Out: Select this option to display intermediate result of the logic.

Reset Request: If activated, this can indicate that restarting is possible.

Restart Input Logic (only MSC-CB-S): Use this option to set the number of reset logic inputs used (1 to 7. If 1 is selected, the logic is not taken into account.

Restart Select Logic (only MSC-CB-S): Permits selection of the operator type for the start logic from the following options: AND, NAND, OR, NOR, XOR, XNOR.

9.4.2.7.   Macro monitored restart (MACRO RESTART MONITORED) (max. number = 16 with MSC-CB, max. number = 32 with MSC-CB-S including other RESTART operators)

Using the MACRO RESTART MONITORED operator, a logic block selected by the user can be combined with the monitored restart function block ("USER RESTART MONITORED") as per the following truth table:
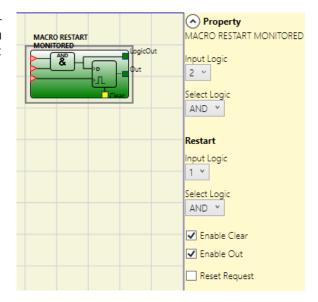

Fig. 203:   Macro-monitored restart

Clear	Restart ⎍	Input	Output	Restart request
1	X	X	0	0
X	X	0	0	0
0	0	1	Retain memory	1
0	⎍	1	1	0

Parameters

Input Logic: Use this option to set the number of logic inputs used (2 to 7).

Select Logic: This enables the operator type to be selected from the following options: AND, NAND, OR, NOR, XOR, XNOR.

Enable Clear: If activated, the memory process can be reset.

Enable Out: Select this option to display intermediate result of the logic.

Reset Request: If activated, this can indicate that restarting is possible.

Restart Input Logic (only MSC-CB-S): Use this option to set the number of reset logic inputs used (1 to 7. If 1 is selected, the logic is not taken into account.

Restart Select Logic (only MSC-CB-S): Permits selection of the operator type for the start logic from the following options: AND, NAND, OR, NOR, XOR, XNOR.

9.4.2.8. PRE-RESET (only MSC-CB-S, max. number = 32 including other restart operators)

The PRE-RESET operator can be used if several reset buttons must be used. For example, it may be necessary to locate a restart switch (pre-reset) in the danger zone (at a point from which the entire zone is visible) and a restart switch (reset) outside the danger zone.

The 0-1-0 transitions must occur in sequence for the pre-reset and the reset. The reset transitions must occur within 500 ms to 5 s after the pre-reset transitions.
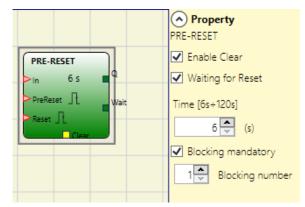
Fig. 204: Pre-reset

Parameters

Enable Clear: If activated, the memory process can be reset.

Waiting for Reset: If activated, another output will become available. This becomes "1" (TRUE) when the pre-reset completes the 0-1-0 transition and becomes "0" (FALSE) when the operator is reset or the time between the transitions of the two inputs elapses.

Time: Maximum duration of the transition 0 - 1 - 0 (6 - 120 s can be set).

Signal interruptions: If activated, a number of interruptions in the signal (max. 7) can be specified. Output Q is set if the signal had fewer interruptions (1 - 0 - 1 transitions) than the specified number of interruptions but had at least one interruption.

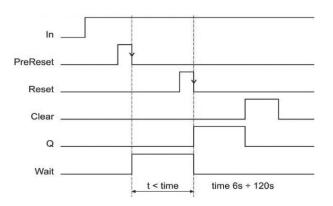The behavior of the operator is shown in the following time sequences:

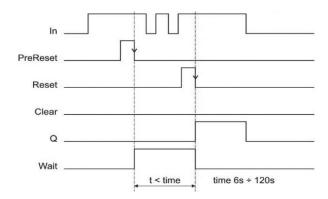Fig. 205: Pre-reset without signal interruptions

Fig. 206: Pre-reset with signal interruptions (number of activations = 2)

9.4.3. Guard locking operators

9.4.3.1. Guard locking logic (GUARD LOCK) (max. number with MSC-CB = 4, max. number with MSC-CB-S = 8)

The GUARD LOCK operator is used to monitor the guard locking state of ELECTROMECHANICAL GUARD LOCKING. For this purpose, it is checked whether the guard locking command and the status of an INTERLOCK and FEEDBACK match. The OUTPUT main output is "1" (TRUE) if guard locking is active.
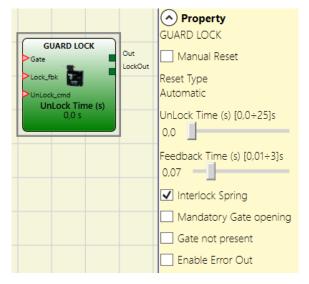

Fig. 207:   Guard lock logic

Description of the inputs/outputs

LOCK_FBK input: The LOCK_FBK input indicates the status of the solenoid (feedback) that activates/deactivates guard locking. Electromechanical guard locking is activated/deactivated by a command on the solenoid. For example, the solenoid status can be evaluated by an NO contact, which is connected through as shown when the solenoid is energized.
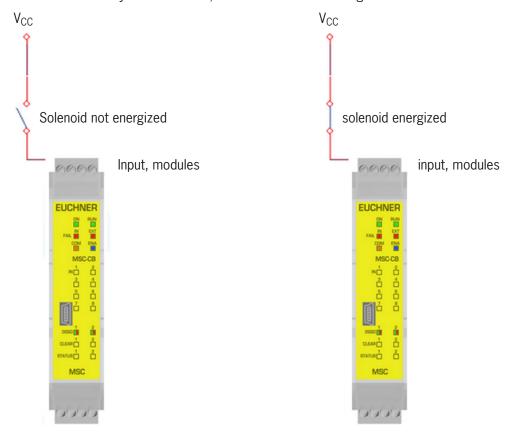

Fig. 208:   Example of detection of the guard locking solenoid status. The GUARD LOCK operator processes the signal arriving at the module.

GATE input: The GATE input detects the door position status. The position of the door (GATE) is monitored using suitable contacts. For example, the door status can be evaluated by an NO contact, which is activated as shown when the door is closed.
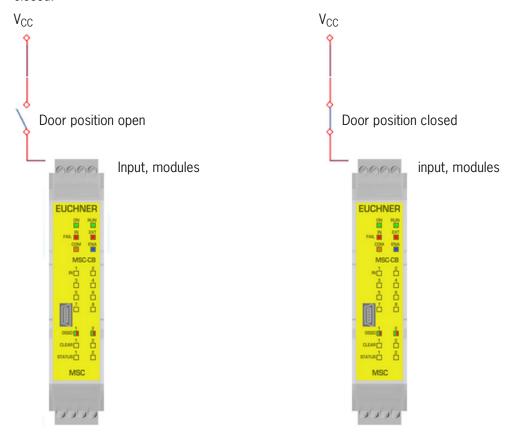
V_{CC} V_{CC}

Door position open   Door position closed

Input, modules   input, modules

Fig. 209:   Example of door position detection of electromechanical guard locking. The GUARD LOCK operator processes the signal arriving at the module.

UNLOCK_CMD input: The UNLOCK_CMD input detects the command of the user evaluating activation/deactivation of guard locking. Particularly:

‣ Deactivating guard locking: the UNLOCK_CMD control signal must assume the value "1" (TRUE)

‣ Activating guard locking: the UNLOCK_CMD control signal must assume the value "0" (FALSE)

The control signal can originate from a pushbutton, for example.

OUTPUT output: Depending on the value assumed, this signal indicates the information specified in the table below.

	VALUE	Meaning
Output	"1" (TRUE)	‣ Door closed ‣ Guard locking active
Output	"0" (FALSE)	‣ Deactivation of guard locking is requested ‣ There is an error

LOCKOUT output: This signal controls the guard locking solenoid and can output the values "0" (FALSE) and "1" (TRUE).

ERROROUT output: This signal indicates a guard locking control error if the value "1" (TRUE) is output. The value "0" (FALSE) is output if there are no errors.

Operating modes

The GUARD LOCK operator checks the agreement between the control status of UNLOCK_CMD, the door position (INTER-LOCK) via the GATE input and the solenoid status via the LOCK_FBK input. The OUTPUT main output assumes the value "1" (TRUE) if the door is closed and locked.

Operating mode without gate: In this case, the user selects the "Gate nicht vorhanden" ("Gate not present") parameter.

The LOCK_FBK input must be connected to an input element of the LOCK FEEDBACK type that detects the status of the solenoid or the guard locking.

The UNLOCK_CMD input can be connected as required in the circuit diagram and determines control of guard locking.

The OUTPUT signal is "1" (TRUE) when the safety door is closed and guard locking is active. If a release command is applied to the UNLOCK_CMD input, OUTPUT will become "0" (FALSE) and guard locking will be released by LOCKOUT.

The OUTPUT signal is also "0" (FALSE) if error conditions exist (e.g., door open with blocked guard locking, feedback time exceeds the maximum permissible value, etc.).

From the moment when the UNLOCK_CMD release command is detected, the LOCKOUT output releases guard locking after a us-er-defined unlock time.
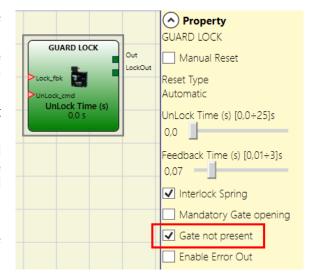

Fig. 210:   Guard lock logic / Gate not present

The solenoid's activation time is closely tied to its technical and physical properties and therefore depends on the guard locking used. When LOCKOUT is activated, the LOCK_FBK signal changes its status at different times. The user can change the value of the "Rückführkreis Zeit" ("feedback loop time") parameter to remedy this variability. This defines the maximum time for the status change of the LOCK_FBK input. The GUARD LOCK operator expects this status change after activation of the solenoid. The following condition must apply: **feedback time ≥ solenoid activation time**.

This will now be explained using an application example.

Example of operating mode without gate: In this example, the user releases the guard locking using the "SWITCH" function block formed by a pushbutton. The LOCKOUT signal controls the "STATUS" monitoring output. This command controls guard locking control (the solenoid). The status of the solenoid and the guard locking is detected by the "Lock_fbk" input via the "LOCK FEEDBACK" input block. The "Output1" output indicates the guard locking status.

The guard locking used in the example remains locked if the solenoid is not energized. The "Federverriegelung" ("spring interlock") option must be selected.
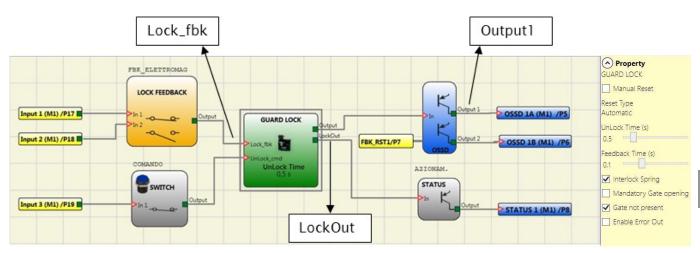

Fig. 211:   Example of operating mode without gate

Tip!	The GUARD LOCK operator's parameters are displayed on the right side. An application example is displayed on the left side. It can be recognized that the solenoid's feedback consists of two contacts, an NC contact and an NO contact. The two contacts change the status when current is supplied to the solenoid.

The figure below shows the procedures with regard to operation:

1. The user issues the command to deactivate guard locking. The "UNLOCK CMD" signal changes from LL0 to LL1 while the "Output1" signal changes from LL1 to LL0.

2. Solenoid deactivation is entered with an "unlock time" delay of 0.5 second compared to the control system. The "LOCK OUT" signal changes from LL0 to LL1.

3. The solenoid is actually deactivated with a delay of 95 ms in relation to actuation. This is necessary due to the solenoid's technical properties. The 95 ms value is less than 100 ms ("feedback time"). There are therefore no errors.

4. The user requests activation of guard locking. The "UNLOCK_CMD" signal therefore changes from LL1 to LL0, as does the actuation signal to "LOCK OUT".

5. The solenoid is actually activated with a delay of approx. 95 ms compared to the actuation time. Guard locking is now actually activated.

6. The "Output1" signal is applied to LL1 as soon as the GUARD LOCK operator detects that guard locking is activated and the door is closed.
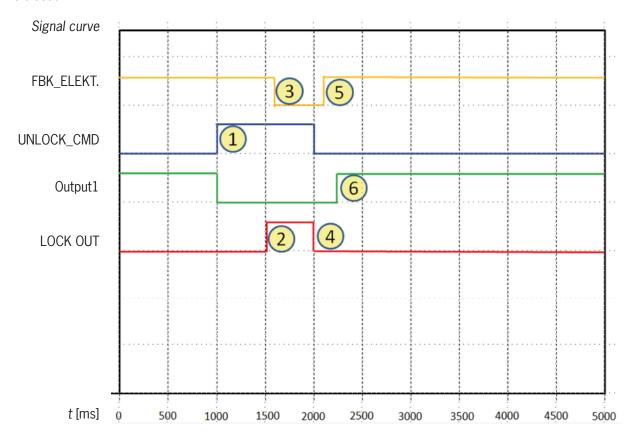

Fig. 212:   Signal curves in relation to the function of the GUARD LOCK block in the operating mode without gate

Operating mode with gate: In this case, the "Gate nicht vorhanden" ("Gate not present") parameter must **not** be selected.

The Gate input must be connected to an input function block of the INTERLOCK type that detects the door status. The LOCK_FBK input must be connected to an input function block of the LOCK FEEDBACK type. This signal detects the status of the solenoid and the guard locking.

The UNLOCK_FBK input can be connected as required in the circuit diagram and determines the request to deactivate guard locking (if set to "1" [TRUE]).

The OUTPUT output is "1" (TRUE) when the safety door is closed and guard locking is active. As the result of a release command on the UNLOCK_CMD input, the OUTPUT output will become "0" (FALSE) and guard locking will be deactivated by LOCKOUT.

The OUTPUT output is also "0" (FALSE) if error conditions exist (e.g., door open with activated guard locking, feedback time exceeds the maximum permissible value, etc.).
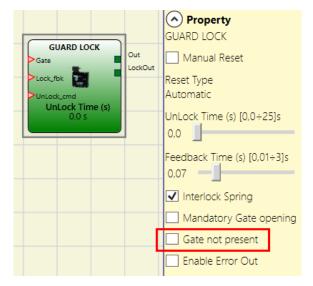

Fig. 213: Guard lock logic / Gate present

From the moment when the UNLOCK_CMD release command is detected, the LOCKOUT output releases guard locking after a user-defined time. This parameter corresponds to the adjustable "unlock time". The solenoid's activation time is closely tied to its technical and physical properties and therefore depends on the guard locking used. When LOCKOUT is activated, the LOCK_FBK signal changes its status at different times. The user can change the value of the "Rückführkreis Zeit" ("feedback loop time") parameter to remedy this variability. This defines the maximum time for the status change of the LOCK_FBK input. The GUARD LOCK operator expects this status change after activation of the solenoid. The following condition must apply: **feedback time ≥ solenoid activation time**.

This will now be explained using an application example.

Example of operating mode with gate: In this example, the user releases the guard locking using the "SWITCH" function block formed by a pushbutton. The LOCKOUT signal controls the "STATUS" monitoring output. This command controls guard locking control (the solenoid).

The status of the guard locking is detected by the "Lock_fbk" input via the "LOCK FEEDBACK" input block. The "Output1" output indicates the guard locking status.

The "INTERLOCK" input monitors the door position.

The guard locking used in the example remains active when current is not supplied to the solenoid, which is why the "Federverriegelung" ("spring interlock") option must be selected.
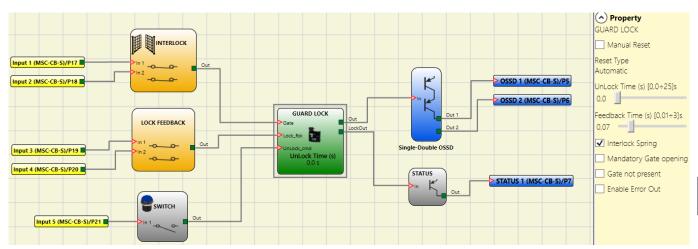

Fig. 214: Example of operating mode with gate

Tip!	The GUARD LOCK operator's parameters are displayed on the right side. An application example is displayed on the left side. It can be recognized that the solenoid's feedback consists of two contacts, an NC contact and an NO contact. The two contacts change the status when current is supplied to the solenoid. By contrast, two NC contacts are used for the door position.

The figure below shows the procedures with regard to operation:

1. The user issues the command to deactivate guard locking. The "UNLOCK CMD" signal changes from LL0 to LL1 while the "Output1" signal changes from LL1 to LL0.

2. Solenoid deactivation is entered with an "unlock time" delay of 0.5 second compared to the control system. The LOCK OUT signal changes from LL0 to LL1.

3. The solenoid is actually deactivated with a delay of 95 ms in relation to actuation. This is necessary due to the solenoid's technical properties. The 95 ms value is less than 100 ms ("feedback time"). There are therefore no errors.

4. Guard locking is deactivated, and the operator opens the door. The FBK_GATE signal changes from LL1 to LL0.

5. The user closes the door, and the FBK_GATE signal changes from LL0 to LL1.

6. The user requests guard locking activation via the UNLOCK CMD signal. The GUARD LOCK operator detects that the door is closed via FBK GATE and controls guard locking via LOCK OUT. The LOCK OUT signal changes from LL1 to LL0.

7. The solenoid is actually activated with a delay of approx. 95 ms after the LOCK OUT signal was applied to the solenoid. Guard locking is now actually activated.

8. The "Output1" signal is applied to LL1 as soon as the GUARD LOCK operator detects that guard locking is activated and the door is closed.
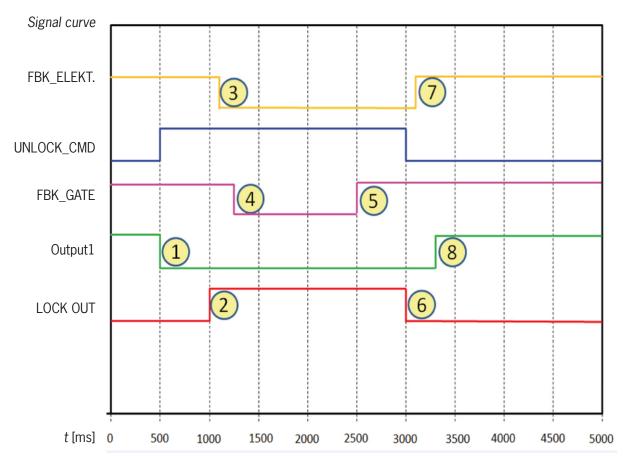

Fig. 215:   Signal curves in relation to the function of the GUARD LOCK block in the operating mode with gate

Operating mode with mandatory door opening: In this case, the "Gate nicht vorhanden" ("Gate not present") parameter must **not** be selected. The "Schutztür zwingend öffnen" ("mandatory safety door opening") parameter must be selected instead. The GATE input must be connected to a signal of the INTERLOCK type that detects the door position status. The GATE input must confirm door opening. The LOCK_FBK input must be connected to a signal of the LOCK FEEDBACK type that detects the status of the solenoid and the guard locking. The UNLOCK_CMD input can be connected as required in the circuit diagram and determines the request to deactivate guard locking (if set to "1" (TRUE)).

The OUTPUT output is "1" (TRUE) when the safety door is closed and guard locking is active. If a release command is applied to the UNLOCK_CMD input, the output signal will be set to "0" (FALSE) and guard locking will be released by LOCKOUT.

The OUTPUT output is also "0" (FALSE) if error conditions exist (e.g., door open with activated guard locking, feedback time exceeds the maximum permissible value, etc.).
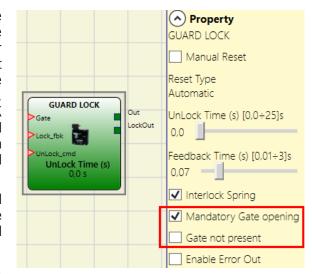
Fig. 216: Guard lock logic / Mandatory Gate opening

From the moment when the UNLOCK_CMD release command is detected, the LOCKOUT output releases guard locking after a user-defined time. This parameter corresponds to the adjustable "unlock time".

The solenoid's activation time is closely tied to its technical and physical properties and is therefore different, depending on the guard locking used. When LOCKOUT is activated, the LOCK_FBK signal changes its status at different times. The user can change the value of the "Rückführkreis Zeit" ("feedback loop time") parameter to remedy this variability. This defines the maximum time for the status change of the LOCK_FBK input. The GUARD LOCK operator expects this status change after activation of the solenoid. The following condition must apply: **feedback time ≥ solenoid activation time**.

This will now be explained using an application example.

Example of operating mode with mandatory door opening: In this example, the user releases the guard locking using the "SWITCH" function block formed by a pushbutton. The LOCKOUT signal controls the "STATUS" monitoring output. This command controls guard locking control (the solenoid). The status of the guard locking is detected by the "Lock_fbk" input via the "LOCK FEEDBACK" input block. The "Output1" output indicates the guard locking status.

The door position is monitored by the "Gate" input via the "FBK_GATE" input block.

The guard locking used in the example remains active when current is not supplied to the solenoid, which is why the "Federverriegelung" ("spring interlock") option must be selected.
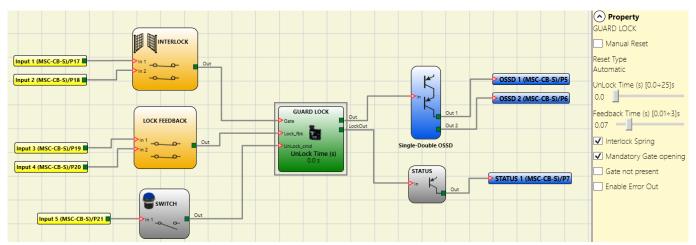
Fig. 217: Example of operating mode with mandatory gate opening

Tip!	The GUARD LOCK operator's parameters are displayed on the right side. An application example is displayed on the left side. It can be recognized that the solenoid's feedback consists of two contacts, an NC contact and an NO contact. The two contacts change the status when current is supplied to the solenoid. By contrast, two NC contacts are used for the door position.

The figure below shows the procedures with regard to operation:

1. The user issues the command to deactivate guard locking. The "UNLOCK CMD" signal changes from LL0 to LL1 while the "Output1" signal changes from LL1 to LL0.

2. The solenoid or the guard locking is deactivated with an "unlock time" delay of 0.5 second. The "LOCK OUT" signal changes from LL0 to LL1.

3. The solenoid is actually deactivated with a delay of 95 ms in relation to actuation. This is necessary due to the solenoid's technical properties. The 95 ms value is less than 100 ms ("feedback time"). There are therefore no errors.

4. Guard locking is deactivated, and the operator opens the door. The FBK_GATE signal changes from LL1 to LL0.

5. The user closes the door, and the FBK_GATE signal changes from LL0 to LL1.

6. The user requests guard locking activation via the UNLOCK CMD signal. The GUARD LOCK operator detects that the door is closed via FBK GATE and controls guard locking via LOCK OUT. The LOCK OUT signal changes from LL1 to LL0.

7. The solenoid is actually activated with a delay of approx. 95 ms after the LOCK OUT signal was applied to the solenoid. Guard locking is now actually activated.

8. The "Output1" signal is applied to LL1 as soon as the GUARD LOCK operator detects that guard locking is activated and the door is closed.

Fig. 218: Signal curves in relation to the function of the GUARD LOCK block in the operating mode with mandatory gate opening.

In the "mandatory gate opening" operating mode, the GUARD LOCK operator indicates an error if it does not detect opening of the door after a request to deactivate the guard locking. This concept is emphasized in the figure in the following (see figure). In this case, the "Aktivierung Error out" ("error out activation") option in the plan from Figure 61 was selected to show the fault in the graph.

The operator requests deactivation of guard locking, but the door is never opened. The "FBK_GATE" signal indicates this state by remaining fixed at LL1. Consequently, the GUARD LOCK operator indicates an error (change from LL0 to LL1) when the guard locking control cycle has ended (moment E).
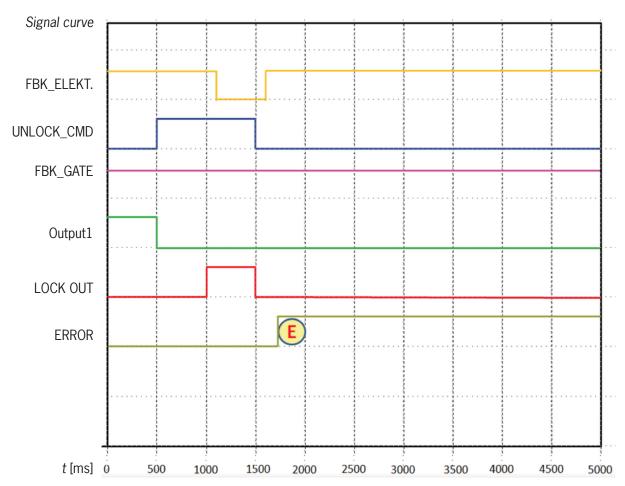

Fig. 219:   Example of a possible fault in "mandatory gate opening" mode. In this case, the error is generated because the door is never opened even though a request for releasing/blocking the locking has been issued.

Parameters

Manueller Reset (manual reset): Two types of reset are possible: "Manuell" ("manual") and "Überwacht" ("monitored"). On the selection of manual reset, only the signal transition from 0 to 1 is checked. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.
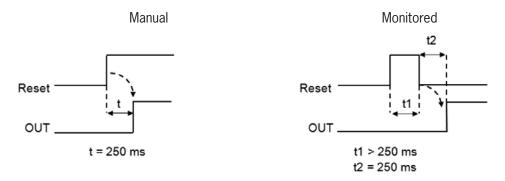

Fig. 220:   Guard lock logic manual/monitored reset

⚠	**WARNING**
	If manual reset is activated, the next input after the inputs used by the function block must be used.
	Example: If Input1 and Input2 are used for the function block, Input3 must be used for the reset input.

Unlock Time (s): The time that elapses between the activation of the Unlock_cmd input and the actual release of the locking.

‣ 0 ms – 1 s: 100 ms step
‣ 1.5 s – 10 s: 0.5 s step
‣ 15 s – 25 s: 5 s step

Rückführkreis Zeit (s) (feedback loop time (s)): Maximum time delay between the LockOut output and the Lock_fbk input (as stated on the data sheet for the guard locking, with required delay).

‣ 10 ms – 100 s: 10 ms step
‣ 150 ms – 1 s: 50 ms step
‣ 1.5 s – 3 s: 0.5 s step

Mechanically locked (closed-circuit current): The guard lock is locked passively and released actively, i.e. it is locked by the mechanical force in the spring. The guard locking therefore remains locked after interruption of the power supply.

Safety door must be opened once: The cycle is resumed only after the door is opened and this is then confirmed on the GATE input.

No door: If selected, the GATE input will be deactivated.

Enable Error Out: This is selected to enable a signal (Error OUT) for signaling a guard locking malfunction. If Error OUT = "1" (TRUE), there is a guard locking error.
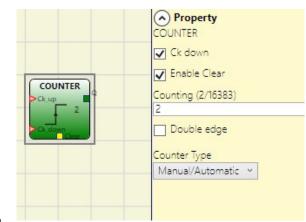
9.4.4. COUNTER operators

The operators of type COUNTER enable the user to generate a signal (TRUE) as soon as the count entered is reached.

9.4.4.1. Counter (COUNTER) (max. number = 16)

The COUNTER operator is a pulse counter.

There are three operating modes:

1. AUTOMATIC
2. MANUAL
3. MANUAL+AUTOMATIC

In the following examples the counter value is 6:

1. The counter generates a pulse with the length of two internal cycles as soon as the entered counter value is reached. This is the default mode if the CLEAR pin is not activated.
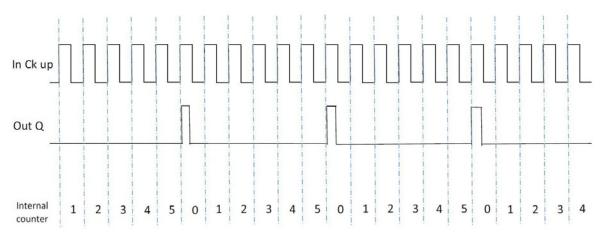
Fig. 221:   Counter

Fig. 222:   Use of the counter without reset input

2. The counter sets the Q output to "1" (TRUE) as soon as the entered counter value is reached. The Q output changes to "0" (FALSE) if the CLEAR signal is activated.
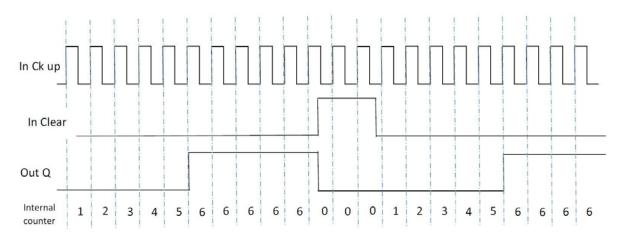

Fig. 223:   Use of the counter with CLEAR signal for resetting the output

3. The counter generates a pulse length that corresponds to the reaction time as soon as the count entered is reached. If the CLEAR signal is activated, the internal counter returns to 0.
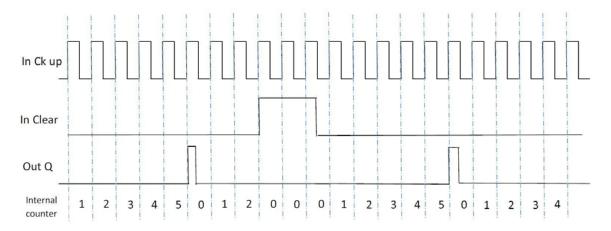

Fig. 224:   Use of the counter with CLEAR signal for resetting the counter input

Parameters

Enable Clear: If this option is selected, the clear request is activated to restart the count by setting the Q output to "0" again (FALSE). It is also possible to activate the automatic function (Automatic Enable) using manual reset.

If not selected, the operating mode is then automatic and, on reaching the entered count, the output changes to "1" (TRUE) and remains there for two internal cycles. It is then reset.

Ck down: Selects counting down.

Double edge: If activated, rising and falling edges are counted.

Counter status: If selected, the current counter value can be forwarded via the COUNTER output to the COUNTER COMPARATOR block.

9.4.4.2.   Timer value comparison (COUNTER COMPARATOR) (only MSC-CB-S and MSC-CB ≥ 4.0)

The COUNTER COMPARATOR operator enables the Counter output of the COUNTER operator to be compared with a threshold.

If the counter value of the COUNTER operator is less than the threshold, the output is "0" (FALSE).

If the counter value is greater than or equal to the threshold, the output is "1" (TRUE).
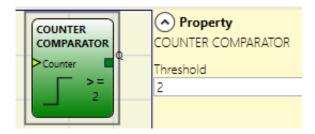

Fig. 225:   Counter value comparison

> ⓘ   **Important!**
>
> The operator can be connected only to the COUNTER output of a COUNTER operator.

Parameters

Threshold: Counter value from which the output is set to "1" (TRUE)

9.4.5. TIMER operators (max. number = 32 with MSC-CB, max. number = 48 with MSC-CB-S)

Using the operators of type TIMER a signal (TRUE or FALSE) can be generated for a user-defined time.

9.4.5.1. MONOSTABLE

Using the MONOSTABLE operator, an output of "1" (TRUE) is generated by the rising/falling edge of the input. This state is retained for the time set.

Parameters

Time: The delay can be set to a value between 10 ms and 1,098.3 s.

Rising Edge: If selected, the output is set to "1" (TRUE) by a rising edge on the input signal and remains in this state for the time set. However, this state can be extended as long as the input remains at "1" (TRUE).

Fig. 226:   Monostable

Fig. 227:   State change on use with rising edge

If not selected, the logic is reversed, i.e. the output is set to "0" (FALSE) by a falling edge on the input signal and remains in this state for the time set. However, this state can be extended as long as the input remains at "0" (FALSE).

Fig. 228:   State change on use with falling edge

Retriggerable: If selected, the time is reset on each status change on the input.

EN

9.4.5.2. MONOSTABLE_B

Using this operator, an output of "1" (TRUE) is generated by the rising/falling edge of the input. This state is retained for the time *t* set.

Parameters

Time: The delay can be set to a value between 10 ms and 1,098.3 s.

Rising Edge: If selected, the output is set to "1" (TRUE) by a rising edge on the input signal and remains in this state for the time set.
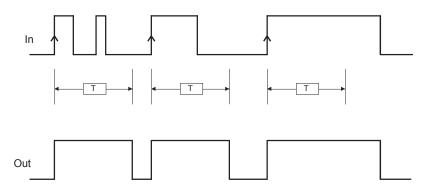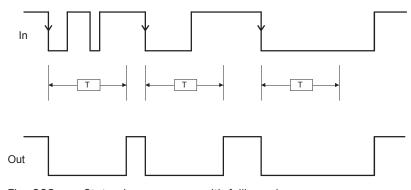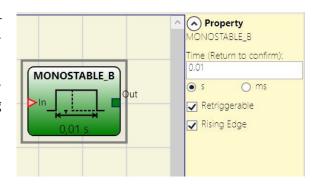

Fig. 229:   Monostable_B

Fig. 230:   State change on use with rising edge

If not selected, the logic is reversed, i.e. the output is set to "0" (FALSE) by a falling edge on the input signal and remains in this state for the time set.
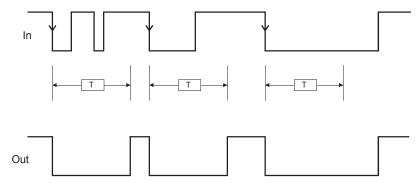
Fig. 231:   State change on use with falling edge
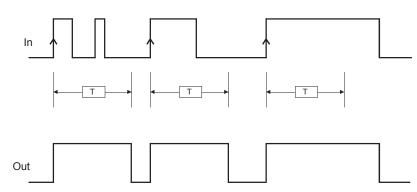
➡ Unlike the MONOSTABLE operator, the OUT output on the MONOSTABLE_B is not kept at "1" (TRUE) beyond the maximum set time *t*.

Retriggerable: If selected, the time is reset on each status change on the input.

9.4.5.3. Passing make contact (PASSING MAKE CONTACT)

The PASSING MAKE CONTACT operator provides the signal present on the input as a pulse on the output. If this signal is "1" (TRUE) longer than the set time, the pulse is limited to the set time. The pulse is truncated with a falling edge.

Parameters

Time: The delay can be set to a value between 10 ms and 1,098.3 s.
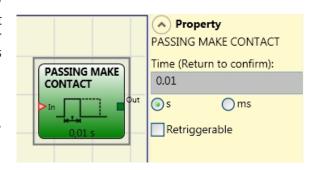
Fig. 232:   Passing make contact
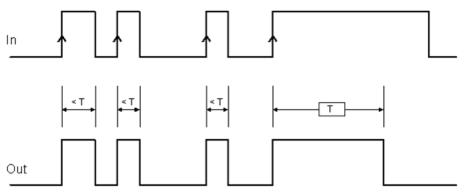
Fig. 233:   State change of the passing make contact without "Retriggerable" set

Retriggerable: If activated, the time is not reset on a falling input edge. The output remains at "1" (TRUE) for the entire time set. The timer is restarted if there is a new rising edge.
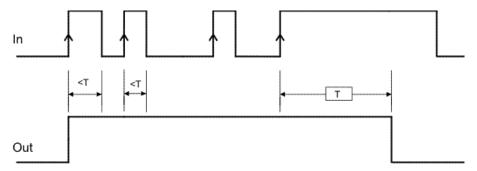
Fig. 234:   State change of the passing make contact with "Retriggerable"

9.4.5.4. Delay (DELAY)

The DELAY operator makes it possible to use a signal delay and switches the output to "1" (TRUE) after the time set if the status of the signal on the input changes.

Parameters

Time: The delay can be set to a value between 10 ms and 1,098.3 s.

Rising Edge: A switch-on delay is selected with this setting. If selected, the delay starts with the rising edge on the input signal. The output is then set to "1" (TRUE) and remains in this state for the time set, as long as the input remains at "1" (TRUE).

Fig. 235:   Delay

Fig. 236:   Switch-on delay

If nothing is selected, the logic is reversed. An OFF time is selected with this setting. The output is set to "1" (TRUE) by a rising edge on the input, and the delay starts on the falling edge on the input. At the end of the time set the output is set to "0" (FALSE), provided "0" (FALSE) is present on the input; otherwise it remains at "1" (TRUE).
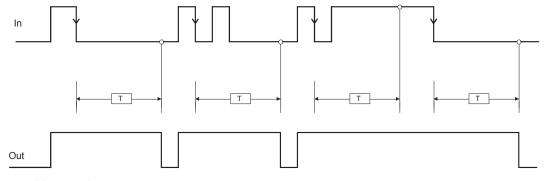
Fig. 237:   OFF time

Retriggerable: If selected, the delay is reset on each status change on the input.

9.4.5.5. Long-term delay (LONG DELAY) (only MSC-CB-S and MSC-CB ≥ 4.0)

The LONG DELAY operator makes it possible to use a signal delay of up to 15 hours and switches the output to "1" (TRUE) after the time set if the status of the signal at the input changes.

Fig. 238:   Long-term delay

Parameters

Time: The delay can be set to a value between 0.5 s and 54,915 s.

Rising Edge: A switch-on delay is selected with this setting. If selected, the delay starts with the rising edge on the input signal. The output is then set to "1" (TRUE) and remains in this state for the time set, as long as the input remains at "1" (TRUE).
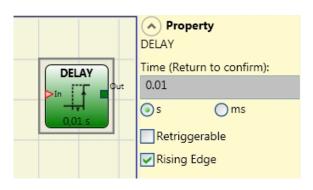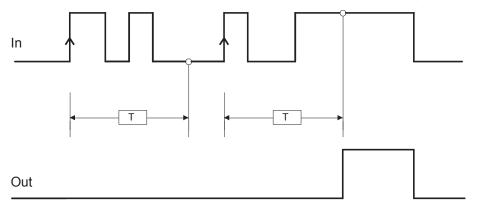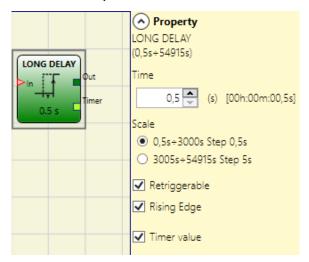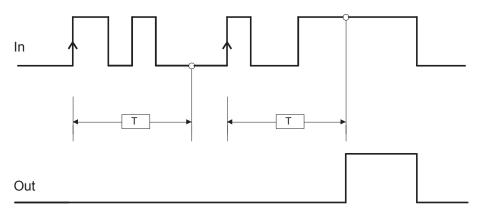

Fig. 239:   Switch-on delay

If nothing is selected, the logic is reversed. An OFF time is selected with this setting. The output is set to "1" (TRUE) by a rising edge on the input, and the delay starts on the falling edge on the input. At the end of the time set the output is set to "0" (FALSE), provided "0" (FALSE) is present on the input; otherwise it remains at "1" (TRUE).
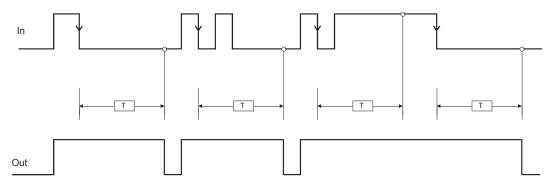
Fig. 240:   OFF time

Retriggerable: If selected, the delay is reset on each status change on the input.

Timer value: If selected, the current value of the timer will be output. This output can be transferred in the input to a DELAY COMPARATOR operator.

9.4.5.6. Timer value comparison (DELAY COMPARATOR) (only MSC-CB-S and MSC-CB ≥ 4.0)

The DELAY COMPARATOR operator enables the Timer output of the Timer operators to be compared with a threshold. If the timer value of the Timer operator is less than the threshold, the output is "0" (FALSE). If the timer value is greater than or equal to the threshold, the output is "1" (TRUE).
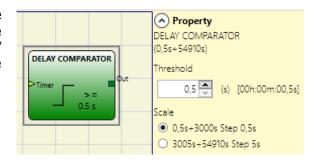
Fig. 241:   Timer value comparison

	Important!
ⓘ	The operator can be connected only to the Timer output of a Timer operator.

Parameters

Threshold: Counter value from which the output is set to "1" (TRUE).

Scale: The user can select two different scales for the time *T* to be set.

‣ 0,5 s – 3,000 s: 0.5 s step

‣ 3,005 s – 54,915 s: 5 s step
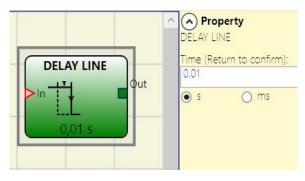
9.4.5.7. Delay line (DELAY LINE)

This operator makes it possible to apply a signal delay and switches the output to "0" after the time set if there is no signal on the input.

If the input returns to "1" before the entered time elapses, the OUT output always produces an LL0 (FALSE) pulse. The duration of this pulse corresponds to around twice the response time, and the pulse LL0 is delayed by the time set.

Parameters

Time: The delay can be set to a value between 10 ms and 1,098.3 s.

Fig. 242:   Delay line
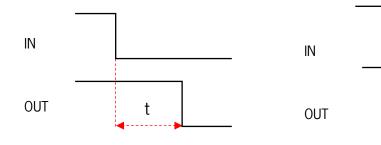
Fig. 243:   OFF time without filtering short interruptions

➡ Unlike the DELAY operator, the DELAY LINE operator does not filter out any interruptions on the input shorter than the time set.

➡ This operator is displayed on the use of delayed OSSDs (OSSD must be programmed with RESTART MANUAL).

Scale: The user can select two different scales for the time *T* to be set.

‣ 10 ms – 60 s: 10 ms step
‣ 60.1 s – 1,098.3 s: 100 ms step

9.4.5.8. Long-term delay line (LONG DELAY LINE) (only MSC-CB-S and MSC-CB ≥ 4.0)

The operator makes it possible to use a signal delay and switches the output to "0" (FALSE) after a time set (up to 15 hours) if there is no signal at the input. If the input returns to "1" (TRUE) before the entered time elapses, the OUT output always produces an LL0 (FALSE) pulse. The duration of this pulse corresponds to around twice the response time, and the pulse LL0 is delayed by the time set.

Parameters

Time: The delay can be set to a value between 0.5 s and 54,915 s.

Fig. 244:   Long-term delay line

Scale: The user can select two different scales for the time *T* to be set.

‣ 0,5 s – 3,000 s: 0.5 s step
‣ 3,005 s – 54,915 s: 5 s step

➡ Unlike the DELAY operator, the DELAY LINE operator does not filter out any interruptions on the input shorter than the time set.

➡ This operator is displayed on the use of delayed OSSDs (OSSD must be programmed with RESTART MANUAL).

9.4.5.9. Clock generation (CLOCKING)

Using the CLOCKING operator a clock signal output with the required duration is generated if the input is "1" (TRUE).

Up to 7 inputs are available on the Clocking operator to control the duty cycle on the output.

Parameters

Time: The delay can be set to a value between 10 ms and 1,098.3 s.

Duty cycle choice: Up to 7 inputs for 7 different duty cycles on the output signal can be selected.

The clock signal on OUT has the corresponding duty cycle depending on the input activated.

The EN input must always be set to high (TRUE).

You will find information on how the operator functions in the following table.
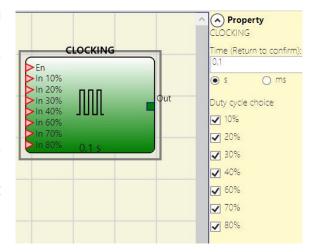
Fig. 245:   Clock generation

EN	10%	20%	30%	40%	60%	70%	80%	OUT
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	50%
1	1	0	0	0	0	0	0	10%
1	0	1	0	0	0	0	0	20%
1	0	0	1	0	0	0	0	30%
1	0	0	0	1	0	0	0	40%
1	0	0	0	0	1	0	0	60%
1	0	0	0	0	0	1	0	70%
1	0	0	0	0	0	0	1	80%
1	1	0	0	0	0	0	1	90%

Table 82:   Duty cycle choice

➡ The upstream circuit of the CLOCKING operator must ensure that, in addition to the EN release, only one input signal is present (except for duty cycle 10%, 80%).

➡ The simultaneous presence of the EN input and a number of inputs > 1 at High level (TRUE) generates an output signal with a duty cycle of 50%.
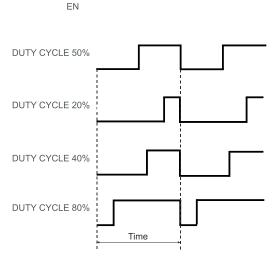
Fig. 246:   Different duty cycles

9.4.6. The MUTING function

The muting function provides a temporary, automatic interruption of a safety device to enable a normal material flow through a protected opening.

In other words, when the system detects the material and differentiates it from a person (in a potentially hazardous situation), it bypasses the safety device temporarily to permit the material to pass through the opening.

9.4.7. MUTING operators (max. number = 4 with MSC-CB, max. number = 8 with MSC-CB-S)

9.4.7.1. Simultaneous muting (MUTING "Con")

The muting function is activated after the interruption of the sensors S1 and S2 (the sequence is irrelevant) within the period defined by the operator of between 2 s and 5 s (or S4 and S3 for material that is moving in the opposite direction).

The MUTING "Con" operator with "simultaneous" logic makes it possible to mute the input signal via the sensor inputs S1, S2, S3 and S4.

➡ Prerequisite: The muting cycle can start only if all sensors S1 – S4 are "0" (FALSE) and the INPUT input is "1" (TRUE).

Parameters

Timeout (s): Sets the time within which the muting cycle is to be ended from 10 s to infinite. If the cycle is not complete at the end of this time, the muting is interrupted immediately.

With Enable: If selected, it is possible to enable or not enable the muting function. Otherwise, the muting function is always enabled.
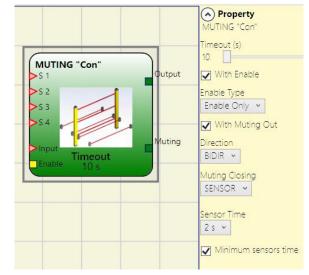
Fig. 247:   Simultaneous muting

There are two enable modes: "Enable/Disable" and "Enable Only." On the selection of "Enable/Disable" the muting cycle cannot be started if "Enable" is set to "1" (TRUE) or "0" (FALSE). Instead, it is activated only with a rising edge.

To deactivate the muting, set "Enable" to "0" (FALSE). In this mode, the muting is deactivated on a falling edge, irrespective of the state. On the selection of "Enable Only" the muting cannot be deactivated. "Enable" must be set to "0" (FALSE) to enable a new rising edge for the next muting cycle.

Direction: The sequence in which the sensors are activated can be defined. If BIDIR (bidirectional) is set, activation is possible in both directions (from S1&S2 to S3&S4 and from S3&S4 to S1&S2). With UP, activation is possible from S1&S2 to S3&S4, and with DOWN from S3&S4 to S1&S2.

Muting Closing: There are two types: CURTAIN and SENSOR. If CURTAIN is selected, the muting is ended on a rising input signal. With SENSOR the muting is ended when the third sensor has been cleared.

EN

CURTAIN selected						
S1	**S2**	**Input**	**S3**	**S4**	**Muting**	
0	0	1	0	0	0	
1	0	1	0	0	0	
1	1	1	0	0	1	Muting activated
1	1	X	0	0	1	
1	1	X	1	1	1	
0	0	0	1	1	1	
0	0	1	1	1	0	
0	0	1	0	0	0	

Table 83:   Status table simultaneous muting with CURTAIN selected

SENSOR selected						
S1	**S2**	**Input**	**S3**	**S4**	**Muting**	
0	0	1	0	0	0	
1	0	1	0	0	0	
1	1	1	0	0	1	Muting activated
1	1	X	0	0	1	
1	1	X	1	1	1	
0	0	0	1	1	1	
0	0	1	1	1	1	
0	0	1	0	1	0	
0	0	1	0	0	0	

Table 84:   Status table simultaneous muting with SENSOR selected

Blind Time: **Only with "Muting Closing = Curtain":** Should be selected if, for instance, it is known that after the end of the muting, objects may protrude beyond the pallet and may occupy the light grid, as a result the INPUT input is set to "0" (FALSE). During the blind time the INPUT input remains "1" (TRUE). The blind time can be between 250 ms and 1 s.

Sensor Time: The **maximum time** (between 2 s and 5 s) between the activation of two muting sensors can be set.

Minimum sensors time: If selected, muting can be activated only if a time **>150 ms** has elapsed between the activation of sensor 1 and sensor 2 (or sensor 4 and sensor 3).

9.4.7.2. MUTING "L"

The muting function is activated after the interruption of the sensors S1 and S2 (the sequence is irrelevant) within the period defined by the operator of between 2 s and 5 s.

The muting status ends after the opening has been cleared.

The MUTING operator with "L" logic makes it possible to mute the input signal via the sensor inputs S1 and S2.

➡ Prerequisite: The muting cycle can start only if S1 and S2 are "0" (FALSE) and the input is "1" (TRUE).

Parameters

Timeout (s): Sets the time within which the muting cycle is to be ended from 10 s to infinite. If the cycle is not complete at the end of this time, the muting is interrupted immediately.

With Enable: If selected, it is possible to enable or not enable the muting function. Otherwise, the muting function is always enabled.

Fig. 248:   L muting

There are two enable modes: "Enable/Disable" and "Enable Only." On the selection of "Enable/Disable" the muting cycle cannot be started if "Enable" is set to "1" (TRUE) or "0" (FALSE). Instead, it is activated only with a rising edge. To deactivate the muting, set "Enable" to "0" (FALSE). In this mode, the muting is deactivated on a falling edge, irrespective of the state. On the selection of "Enable Only" the muting cannot be deactivated. "Enable" must be set to "0" (FALSE) to enable a new rising edge for the next muting cycle.

Sensor Time: The **maximum time** (between 2 s and 5 s) between the activation of two muting sensors can be set.

End Muting Time: Specification of the **maximum time** (between 2.5 and 6 s) that must elapse between enabling of the first sensor and enabling of the hazardous opening.

After this time has elapsed, the muting function is at an end.

Blind Time: Should be selected if, for instance, it is known that after the end of the muting, objects may protrude beyond the pallet and may occupy the light grid and thereby set the INPUT input to "0" (FALSE). During the blind time the input remains "1" (TRUE). The blind time can be between 250 ms and 1 s.

EN

9.4.7.3. "Sequential" MUTING

The muting function is activated after the sequential interruption of the sensors S1 and S2, followed by sensors S3 and S4 (without any time limit). If the pallet moves in the opposite direction, the correct sequence is: S4, S3, S2, S1.

The MUTING operator with "sequential" logic makes it possible to mute the input signal via the sensor inputs S1, S2, S3 and S4.

➡ Prerequisite: The muting cycle can start only if all sensors S1 – S4 are "0" (FALSE) and the INPUT input is "1" (TRUE).

Parameters

Timeout (s): Sets the time within which the muting cycle is to be ended from 10 s to infinite. If the cycle is not complete at the end of this time, the muting is interrupted immediately.

With Enable: If selected, it is possible to enable or not enable the muting function. Otherwise, the muting function is always enabled.
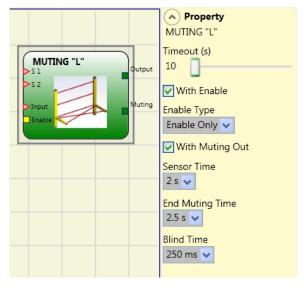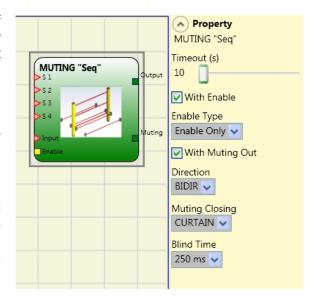

Fig. 249:   "Sequential" MUTING

There are two enable modes: "Enable/Disable" and "Enable Only." On the selection of "Enable/Disable" the muting cycle cannot be started if "Enable" is set to "1" (TRUE) or "0" (FALSE). Instead, it is activated only with a rising edge. To deactivate the muting, set "Enable" to "0" (FALSE). In this mode, the muting is deactivated on a falling edge, irrespective of the state. On the selection of "Enable Only" the muting cannot be deactivated. "Enable" must be set to "0" (FALSE) to enable a new rising edge for the next muting cycle.

Direction: The sequence in which the sensors are activated can be defined. If BIDIRECTIONAL is set, activation is possible in both directions (from S1 to S4 and from S4 to S1). With UP, activation is possible from S1 to S4 and with DOWN, from S4 to S1.

Muting Closing: There are two types: CURTAIN and SENSOR. If CURTAIN is selected, the muting is ended on a rising input signal. With SENSOR the muting is ended when the penultimate sensor has been cleared.

CURTAIN selected						
S1	**S2**	**Input**	**S3**	**S4**	**Muting**	
0	0	1	0	0	0	
1	0	1	0	0	0	
1	1	1	0	0	1	Muting activated
1	1	X	0	0	1	
1	1	X	1	0	1	
1	1	X	1	1	1	
0	1	X	1	1	1	
0	0	0	1	1	1	
0	0	1	1	1	0	
0	0	1	0	1	0	
0	0	1	0	0	0	

Table 85:   Status table sequential muting with CURTAIN selected

SENSOR selected						
S1	**S2**	**Input**	**S3**	**S4**	**Muting**	
0	0	1	0	0	0	
1	0	1	0	0	0	
1	1	1	0	0	1	Muting activated
1	1	X	0	0	1	
1	1	X	1	0	1	
1	1	X	1	1	1	
0	1	X	1	1	1	
0	0	0	1	1	1	
0	0	1	1	1	1	
0	0	1	0	1	0	
0	0	1	0	0	0	

Table 86:   Status table sequential muting with SENSOR selected

Blind Time: **Only with "Muting Closing = Curtain":** Should be selected if, for instance, it is known that after the end of the muting, objects may protrude beyond the pallet and may occupy the light grid, as a result the INPUT input is set to "0" (FALSE). During the blind time the input remains "1" (TRUE). The blind time can be between 250 ms and 1 s.

EN

9.4.7.4. MUTING "T"

The muting function is activated after the interruption of the sensors S1 and S2 (the sequence is irrelevant) within the period defined by the operator of between 2 s and 5 s.

The muting status ends after both sensors have been cleared.

The MUTING operator with "T" logic makes it possible to mute the INPUT input signal via the sensor inputs S1 and S2.

➡ Prerequisite: The muting cycle can start only if S1 and S2 are "0" (FALSE) and the input is "1" (TRUE).

Parameters

Timeout (s): Sets the time within which the muting cycle is to be ended from 10 s to infinite. If the cycle is not complete at the end of this time, the muting is interrupted immediately.
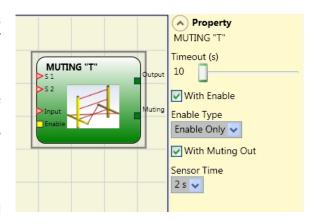
Fig. 250:   T muting

With Enable: If selected, it is possible to enable or not enable the muting function. Otherwise, the muting function is always enabled.

There are two enable modes: "Enable/Disable" and "Enable Only." On the selection of "Enable/Disable" the muting cycle cannot be started if "Enable" is set to "1" (TRUE) or "0" (FALSE). Instead, it is activated only with a rising edge. To deactivate the muting, set "Enable" to "0" (FALSE). In this mode, the muting is deactivated on a falling edge, irrespective of the state. On the selection of "Enable Only" the muting cannot be deactivated. "Enable" must be set to "0" (FALSE) to enable a new rising edge for the next muting cycle.

Sensor Time: The **maximum time** (between 2 s and 5 s) between the activation of two muting sensors can be set.

9.4.7.5. MUTING OVERRIDE

The OVERRIDE function is necessary if the machine stops after erroneous sequences of the muting activation and material is occupying the hazardous opening.

This process activates the OUTPUT output and in this way makes it possible to remove the material that is blocking the opening.

The Muting Override operator must be connected after the Muting operator ("T," "L," "SEQ," "Con") (OUTPUT output on the MUTING ("T," "L," "SEQ," "Con") connected directly to the INPUT input on the Muting Override).

The operator make it possible to override the directly connected muting input.

The "Override" operator can be activated only if muting is not active (INPUT = "0") and at least one muting sensor (or the light grid) is occupied.

Fig. 251:   Muting override

The override function ends as soon as the light grid and the muting sensors are clear again. The OUTPUT output switches to logical "0" (FALSE).
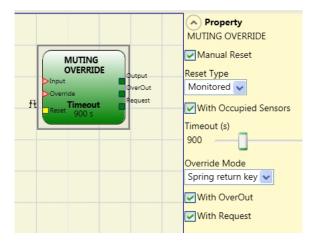
The override function can be started either by state control or edge control.

Start of the override with state: This function is used if the override command (OVERRIDE = 1) is to be active during all subsequent processes. However, a further override function can be activated only if the command is deactivated and is then activated again.

If the light grid and the sensors are cleared (not occupied) or if the time is exceeded, the override is ended without the need for further commands.

Start of the override with edge: The override function is activated by the rising edge on the Override input (OVERRIDE = 1).

The override function is ended if the light grid and the sensors are cleared (not occupied) or on timeout.

The override function can be restarted only if the override enable is activated again (OVERRIDE = 1).

Parameters

i	**NOTICE**
	With Occupied Sensors: **Must** be selected for sequential muting, "T" muting and simultaneous muting.
	With "L" muting, this option is **not** allowed to be selected.
	➡ Otherwise, a warning will be output during the compiler phase and in the report.
	➡ The user must take additional safety measures while the override is active.

Conditions to be checked on activating the override function					
"With Occupied Sensors" selected	Sensor occupied	Light grid occupied	Input	Override	Output
X	X	–	0	1	1
	–	X	0	1	1
–	X	–	0	1	1
	X	X	0	1	1

Table 87:   Status table on use of the override function

EN

Timeout (s): Permits the setting of the time within which the override function must be ended from 10 s to infinite.

Override Mode: Makes it possible to configure the start of the override function (pulsed or state triggered).
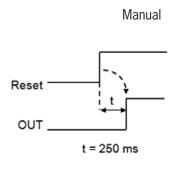
With OverOut: Makes it possible to activate an active override signal output (active if High).

With Request: Makes it possible to activate a signal output (active if High) to indicate that the override function can be activated.

Manual Reset:

‣ If the RESET input is active (TRUE), the OUTPUT output of the function block is enabled.

‣ If the RESET input is not active (FALSE), the OUTPUT output of the function block follows the override request.

There are two types of reset: "Manual" and "Monitored." On the selection of manual reset, the system checks only the signal transition from 0 to 1. With monitored reset, the double transition from 0 to 1 and then back to 0 is checked.
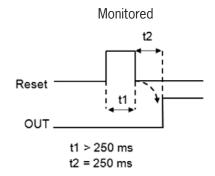
Fig. 252:   Muting override reset

9.5. Other function blocks

9.5.1. Serial output (SERIAL OUTPUT) (max. number = 4)

Using the SERIAL OUTPUT operator the status of up to 8 sensors is output; the data are output in series.

Principle of operation

Using this operator the status of all inputs connected is output in two different ways:

Asynchronous serial output:

1. The status on the cable when not in use is "1" (TRUE).

2. The start data transfer signal is 1 bit = "0" (FALSE).

3. Transfer of n bits, where the status of the inputs connected is *Manchester* coded:

‣ Status 0: rising signal edge in the middle of the bit

‣ Status 1: falling signal edge in the middle of the bit

4. Intercharacter interval is "1" (TRUE) to make it possible to synchronize an external device.

For this reason the Clock output is not available with the asynchronous method.

Synchronous serial output

1. Output and Clock are "0" (FALSE) when not in use.

2. Transfer of n bits, where the input status is coded with OUTPUT as data and CLOCK as timebase.

3. Intercharacter interval is "0" (FALSE) to make it possible to synchronize an external device.
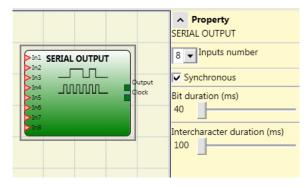
Fig. 253:   Serial output
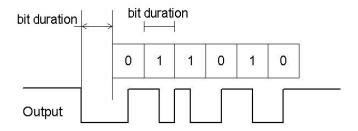
Fig. 254:   Asynchronous serial output
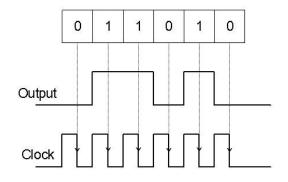
Fig. 255:   Synchronous serial output

Parameters

Inputs number: Defines the number of inputs of the function block. These can be 2 to 8 (asynchronous) or 3 to 8 (synchronous).

Mode selection: Choice between synchronous and asynchronous serialization

Bit duration (ms): In this field, you can enter the value that corresponds to the duration of the individual bits (input n) in the pulse sequence that comprises the transmission.

‣ 40 ms – 200 ms: 10 ms step

‣ 250 ms – 0.95 s: 50 ms step

Intercharacter duration (ms): Enter in this field the time that must elapse between the transmission of one pulse sequence and the next.

‣ 100 ms – 2,5 s : 100 ms step

‣ 3 s – 6 s: 500 ms step

EN

9.5.2. OSSD EDM (only MSC-CB-S) (max. number = 32)

The OSSD EDM (External Device Monitoring) block enables 1 to 4 EDM feedback items to be monitored with regard to a safety output using a generic MSC input.

If the In input is at "1" (TRUE), the FBK_K signal must be at "0" (FALSE) and must then change to "1" (TRUE) within the specified time. If the FBK_K signal does not change within the specified time, the OUTPUT output will be set to "0" and the corresponding CLEAR LED on the MSC will flash to indicate the error. The ERROR OUT output is also set to "1" (TRUE).
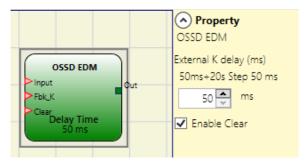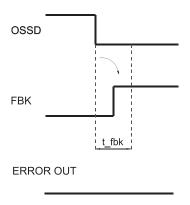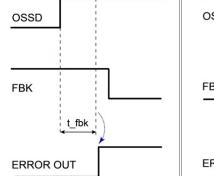
Fig. 256:   OSSD EDM

If the error signal is activated for the safety output, the error signal is set to "1" (TRUE) if an error was detected in the external feedback loop:
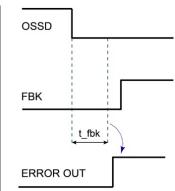
Fig. 257:   Example for OSSD with correct feedback signal: in this case ERROR OUT=FALSE

Fig. 258:   Example for OSSD with erroneous feedback signal (external switching time exceeded): In this case, ERROR OUT=TRUE

Parameters

Feedback number: number of feedback connections selectable (1 – 4).

External K delay (ms): Time window for monitoring the external feedback signal (on the state of the output).

Enable Clear: If activated, the error can be cleared without having to restart the MSC.

9.5.3. TERMINATOR

The TERMINATOR operator makes it possible to add an input that is not used in the program.

The input connected with the TERMINATOR appears in the input structure, and its status is sent via the bus.
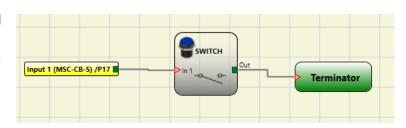
Fig. 259:   TERMINATOR

9.5.4. Network (NETWORK) (max. number = 1)

Using the NETWORK operator, STOP and RESET commands are distributed via a local network. Using NETWORK_In and NETWORK_Out, it is possible to exchange START, STOP and RUN signals between the various nodes.

Principle of operation

Using this operator you can straightforwardly distribute STOP and RESET commands via a local MSC network.
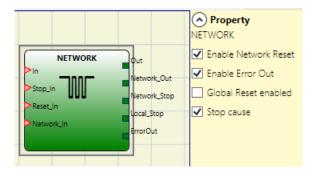
Fig. 260:   Network

The following conditions must be met for the "NETWORK" operator:

1. The *NETWORK_In* input connected to a single or double input must be connected to the NETWORK_Out output on the previous module in the network.

2. The NETWORK_Out output connected to a STATUS output or an OSSD output must be connected to the NETWORK_In input on the following module in the local network.

3. The Stop_In and Reset_In inputs must be connected to input devices that act as stop (e.g. E-STOP) or reset (e.g. SWITCH) devices.

4. The IN input can be connected in the logic as required (e.g. input function blocks or results of logical combinations).

5. The Output output can be connected in the logic as required. The output is "1" (TRUE) if the IN input is "1" (TRUE) and the function block has been restarted.

Parameters

Enable Network Reset: If activated, the function block can be reset via the network. If not activated, the function block can be reset only via the local Reset_In input.

Enable Error Out: If activated, the STATUS output Error_OUT is available.

Global Reset enabled (MSC-CB firmware ≥ 4.0, MSC-CB-S firmware ≥ 5.2): If activated, the entire system can be restarted with a reset button from any node in the network. If this is not activated, all nodes can be restarted except for the node that caused the stop (this node must be restarted using a separate reset).

Stop cause (only MSC-CB-S): If activated, the NETWORK_STOP and LOCAL_STOP outputs will be activated and indicate the cause for the STOP status. These outputs are normally "0" (FALSE) when the system is in RUN mode and OUTPUT is at "1" (TRUE). If a stop is requested from the network, the NETWORK_STOP output changes to "1" (TRUE). If the OUTPUT output changes to "0" (FALSE) due to the IN and STOP_In inputs, the LOCAL_STOP output becomes "1" (TRUE). The outputs stay under these conditions until the next network reset.

⚠	WARNING
	The RESET command switches must be installed outside the danger zones for the network in places at which there is a clear view of the entire work areas affected.

ⓘ	NOTICE
	‣ A maximum of 10 base units can be connected in the network configuration.
	‣ A maximum of 9 expansion modules can be connected to each basic module.

Condition 1: During switch-on, see *Fig. 263* and *Fig. 264:*

The Net_out outputs on the various nodes are in the state "0" (FALSE).

2. The STOP signal is sent via the Net_out cable.

3. If the RESET command switch on a node is actuated, all existing nodes are started when the START signal is sent.

4. As the final result, the Net_out output on all nodes connected has the state "1" (TRUE) if the various Net_in inputs have the state "1" (TRUE).

5. The RUN signal is transmitted via the network to the four nodes.

Condition 2: If the emergency stop button is pressed on one of the four nodes, see *Fig. 263* and *Fig. 264:*

The Net_out output changes to the state "0" (FALSE).

2. The STOP signal is sent via the Net_out cable.

3. The next node receives the STOP code and deactivates the output.

4. The STOP command generates the STOP code for all lines of type Net_in and Net_out.

5. As the final result, the Net_out output on all nodes connected is in the state "0" (FALSE).

6. If the emergency stop is switched back to the normal position, all nodes can be restarted with a single reset by transmitting the START signal again. The latter condition does not occur if ENABLE RESET NETWORK is not selected. In this event, the local reset method must be used. The system needs approx. 4 seconds to restore all outputs on the blocks that form the network.

(i) | **Important!**
Perform a local reset of the module that caused the loss of the power supply to restore the safety output.
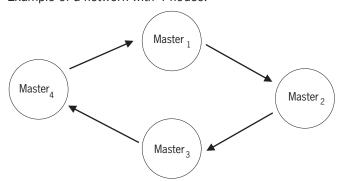
Reaction time: The maximum reaction time of the network beginning from the emergency stop is calculated according to the formula:

$$\text{(Master MSC-CB) } t_r = 11.3 \text{ ms} + [175.3 \text{ ms} \cdot \text{(number of masters} - 1)]$$

$$\text{(Master MSC-CB-S) } t_r = 12.7 \text{ ms} + [232.7 \text{ ms} \cdot \text{(number of masters} - 1)]$$

➡ The network can be implemented only with masters of the same type: only MSC-CB or only MSC-CB-S.

Example of a network with 4 nodes:

Actuation of emergency stop	Master 1	Master 2	Master 3	Master 4
	t_r Master 1	t_r Master 2	t_r Master 3	t_r Master 4
Master MSC-CB	11.3 ms	186.6 ms	362 ms	537.2 ms
Master MSC-CB-S	12.7 ms	245.4 ms	478.1 ms	710.8 ms

Table 88: Reaction time of a network with 4 nodes

Condition 3: If the IN input on the network function block on one of the 4 nodes switches to the state "0" (FALSE), see *Fig. 261* and *Fig. 262:*

1. The local output changes to the state "0" (FALSE).

2. The RUN signal continues to be sent via the Network_Out lines.

3. The states of the other nodes remain unchanged.

4. In this event, the local reset method must be used. The Reset_In LED flashes to indicate this state. The related node can be restarted using its reset.

The Network_In input and the Network_Out output can be represented only on the I/O terminals of the basic module.

		Network_In		Network_Out (OSSD)	Network_Out (STATUS)	Reset_In
	LED	**FAIL EXT**	**IN** (1)	**OSSD** (2)	**STATUS**	**IN** (3)
STATE	**STOP**	OFF	OFF	RED	OFF	OFF
	CLEAR	OFF	FLASHING	RED/GREEN (FLASHING)	FLASHING	FLASHING
	RUN	OFF	ON	GREEN	ON	ON
	FAIL	ON	FLASHING	–	–	–

(1) Corresponds to the input that is connected to Network_In.
(2) Corresponds to the input that is connected to Network_Out.
(3) Corresponds to the input that is connected Reset_In.

Table 89:   Signals of the NETWORK function block
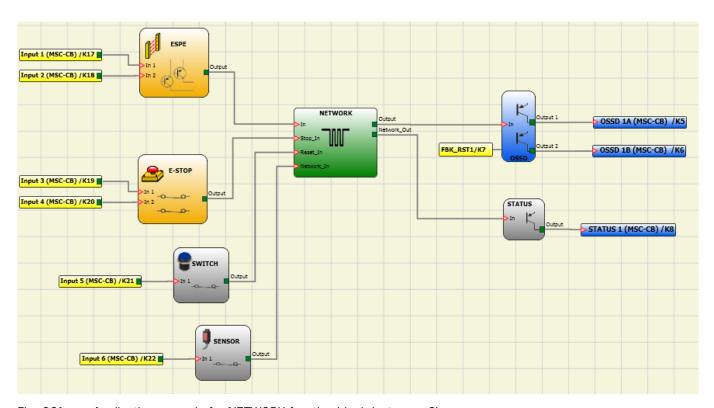
Fig. 261:   Application example for NETWORK function block (category 2)
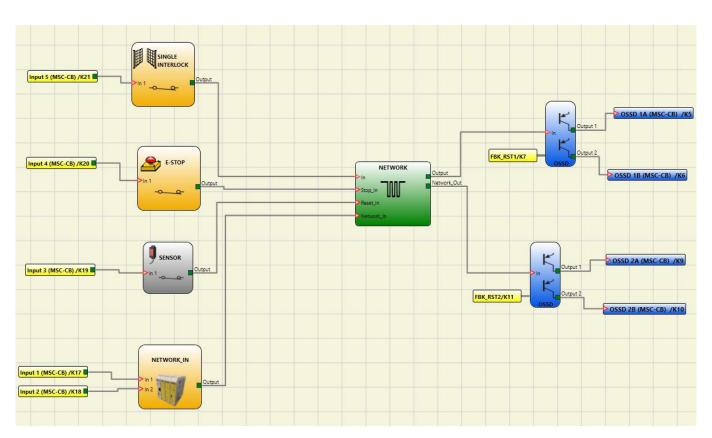
Fig. 262:   Application example for NETWORK function block (category 4)

Application example in category 2 (EN ISO 13849-1):
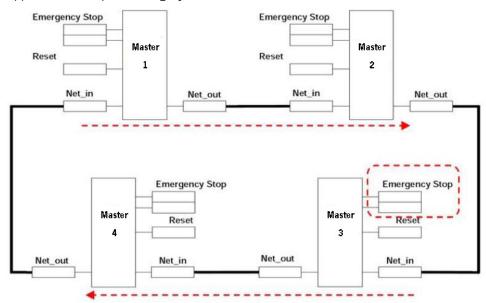
Fig. 263:   Network data flow

Network parameters for calculation of the PL		Network logic			
Architecture	Cat. 2				
Diagnostic coverage	DC = 90%				
Reliability of modules	$MTTF_d$ = 437 (years)				

Application example in category 4 (EN ISO 13849-1):
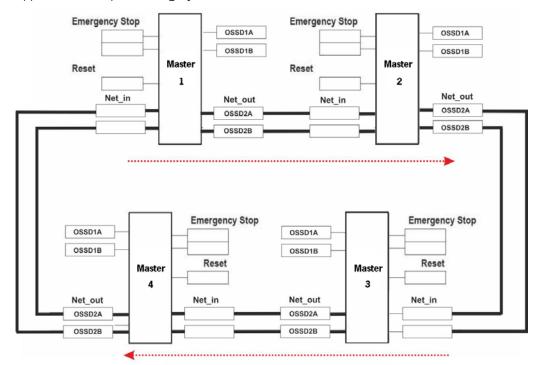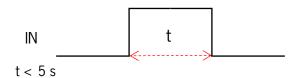
Fig. 264: Network data flow

Network parameters for calculation of the PL		Logical block diagram of a safety function that uses the network
Architecture	Cat. 4	
Diagnostic coverage	DC = 99%	
Reliability of modules	$PFH_d = 6.86E\text{-}09$ (hour^{-1})	

9.5.5. Reset (RESET)

This operator generates a system reset if there is an OFF-ON-OFF transition with a duration of less than 5 s on the corresponding input.

Fig. 265:   Reset duration

Fig. 266:   Reset

	NOTICE
(i)	‣ If the duration is > 5 s, there is no RESET.
	‣ Reset (RESET) can be used to reset malfunctions without interrupting the power supply to the system.

9.5.6. Interpage In/Out

If the circuit diagram is very comprehensive and a connection between two elements that are a long way apart is necessary, the component "Interpage In/Out" can be used.

INTERPAGE OUT

[OUTPUT CONNECTION]

INTERPAGE IN

[INPUT CONNECTION]

Left part of the diagram

Right part of the diagram
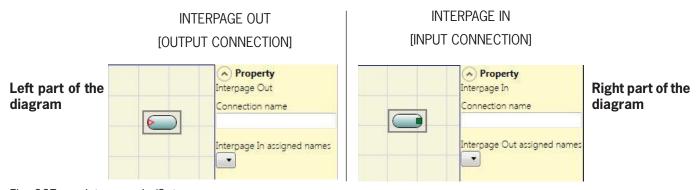
Fig. 267:   Interpage In/Out

In order to establish a connection, "Connection: input" and "Connection: output" must have the same name.

9.5.7. Input/output for internal feedback (max. number = 8, only MSC-CB-S ≥ 6.0)

The IntFbk In/Out operators can be used to create logical loops or to connect the output of a function block with the input of another function block.

After a logic cycle delay of the basic module, each IntFbk_In assumes the same logic value of the corresponding IntFbk_Out.
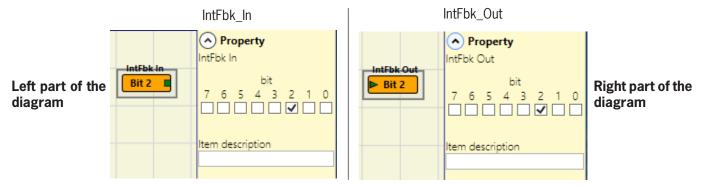
Fig. 268: Input/output for internal feedback
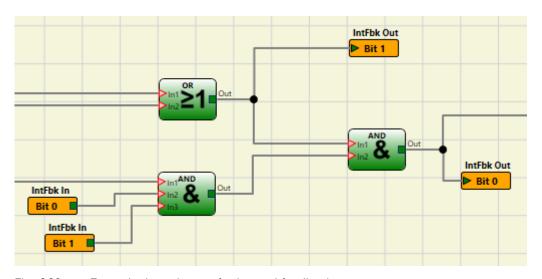
Fig. 269: Example: input/output for internal feedback

Parameters

Bit: Specification of the internal bit at which IntFbk_Out links the value to IntFbk_In.

⚠ **WARNING**

The feedback loops can produce dangerous system oscillations and make the system unstable if this is not designed carefully. An unstable system can have serious consequences for the user, e.g. severe injuries or death.

EN

9.6. Special applications

9.6.1. Output delay with manual operating mode

If two OSSD outputs are required and one output is to be delayed (in the MANUAL operating mode), the following diagram is to be used:
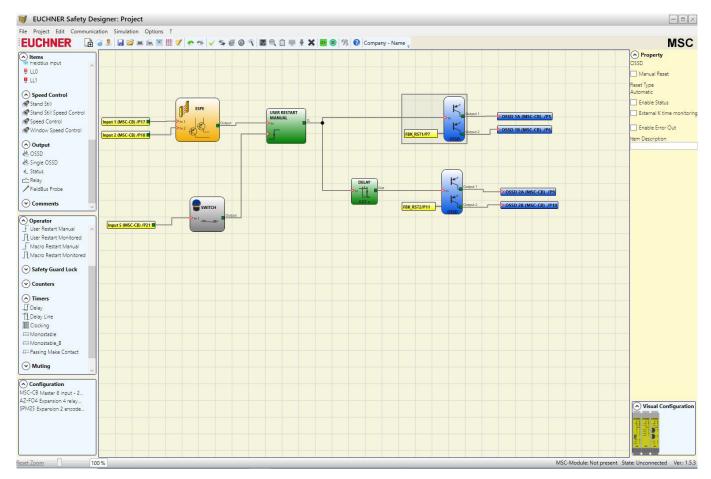
Fig. 270:   Two outputs, of these one output delayed (MANUAL operating mode)

➡ If the Delay operator is used, the application must be as follows:
   - The two outputs must be programmed via the USER RESTART MANUAL function with automatic reset.

9.7. Simulator

	Important!
ℹ️	‣ This simulator has been designed purely as a planning aid during the design of the safety function.
	‣ The result of the simulation must not be considered confirmation of the suitability of the project.
	‣ The hardware and software for the resulting safety function must be validated in real situations according to the applicable standards, e.g. ISO/EN 13849-2 for validation or IEC/EN 62061: chapter 8 for the validation of safety-related electrical control systems.
	‣ You will find the safety parameters for MSC configuration in the report from the EUCHNER SAFETY DESIGNER software.

In the toolbar at the top there are two new green icons (from firmware MSC-CB version 3.0 or higher):
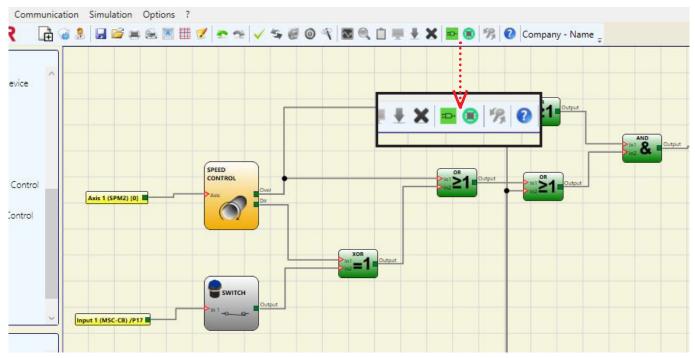
Fig. 271:   The icons for the simulator function

These icons relate to the new simulator function.

‣ The first icon 🔲 displays the "Schematic Simulation." It activates the schematic simulator (both statically or dynamically) in which the user can activate the INPUT to check the loaded plan.

‣ The second icon 🔘 is for the "Graphic Simulation." It activates the simulator controlled via the file with stimuli; this simulator permits the display of the required traces in a specific diagram.

➡ THE SIMULATION ICONS ARE AVAILABLE ONLY IF THE BASIC MODULE IS NOT CONNECTED.

EN

9.7.1. Schematic simulation

Activate the schematic simulation by clicking the ▣ icon.

The schematic simulation permits the checking/controlling of the signal on the output from the various function blocks in real time, i.e. during the actual simulation. The user can select as required which outputs on the blocks are to be operated and check the reaction of the different elements of the schematic diagram based on the color of the different lines.

As for the Monitor function, the color of the line (or the same button) indicates the signal state: green signifies signal LL1, red LL0.

During the "Schematic Simulation" various new buttons appear on the toolbar. The simulation can be administered using these buttons. They can be used to start the simulation ("Play" button), stop the simulation ("Stop" button), run the simulation step-by-step ("PlayStep" button) or reset the simulation ("Reset" button). If the simulation is reset, the time is reset to 0 ms.

On starting the simulation by pressing the "Play" button, the sequence over time can be monitored in the "Time" field. The time elapses in accordance with the "Step" time unit, which is multiplied by the "KT" factor selected by the user.
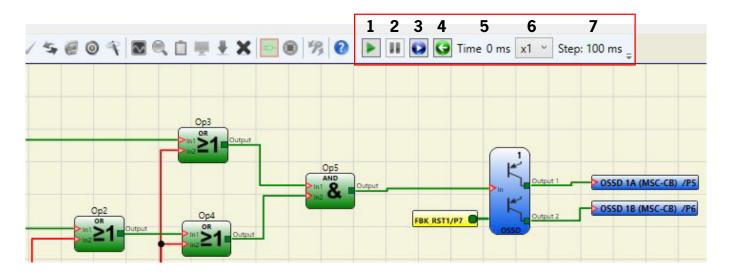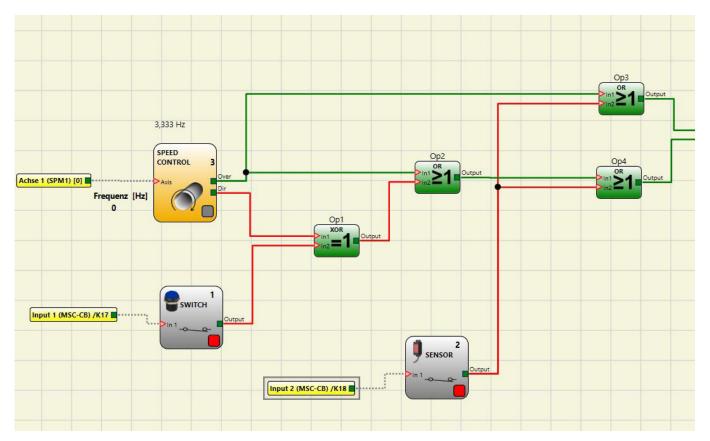
Fig. 272:   Circuit diagram simulation

Number	Symbol	Description
1	▶	Play button
2	❚❚	Stop button
3	⏭	Play Step button
4	⏮	Reset button
5	Zeit 0 ms	Time
6	x1 ⌄	KT
7	Schritt: 100 ms	Simulation step

Table 90:   Key

By clicking the button at the bottom right corner of each input block, the related output status can be activated (also if the simulation is interrupted, i.e. if the time is not running – the simulation is then "static"). If the button is red after clicking it, the output is "0" ("LOW") and, conversely, if the button is green, the output is "1" ("HIGH").

In some function blocks, for example "Speed control" or "Lock feedback," the button is gray. This color indicates that the value is entered manually using a corresponding pop-up window and the type of value to be entered changes depending on the type of function block (for example, it is necessary to enter a frequency in the "Speed control" block).
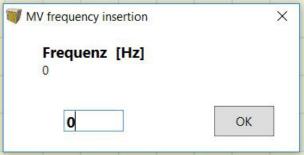
Fig. 273:   The buttons for activating the block outputs are at the top; there is a pop-up example below. In this case, it is necessary to enter the frequency for the "Speed control" function block.

EN

9.7.2. Administration of the graphic simulation

Activate the graphic simulation by clicking the ⬤ icon.

The graphic simulation makes it possible to show the change in the signals graphically. The user must first specify in a text file the stimuli, i.e. the waveforms over time, that are used as inputs (stimuli). The simulator converts the stimuli file prepared into a diagram and displays the required traces at the end of the simulation.

As soon as the simulation is finished, a diagram as shown below appears automatically. From the diagram it is possible to print the traces displayed ("Print" button), to save the results, to load them again ("Save" button), and to display other traces ("Change visibility"). The identifiers for the traces are the same as in the function block description.

Click the "Close" button ("X" button at top right) to close the graphic simulation environment.
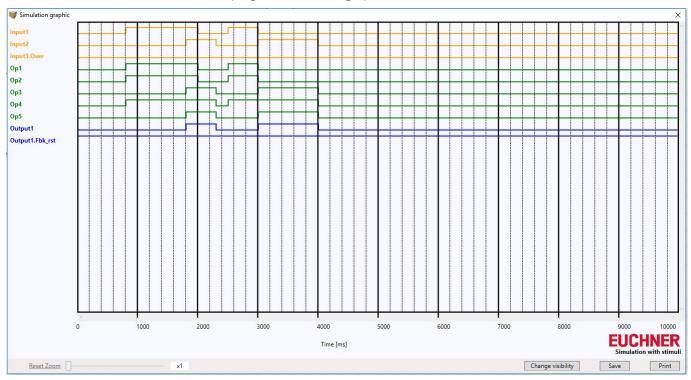
Fig. 274:   Example for a result from the graphic simulation: The traces can be seen on the screen along with the three buttons at the bottom right; these buttons can be used to select the traces, save and print them.

To perform the simulation, as a minimum the following process steps are necessary:

1. Prepare a stimuli file as required
2. Load the stimuli file and wait until the simulation is finished

After you click the ⬛ icon, the following screen appears:
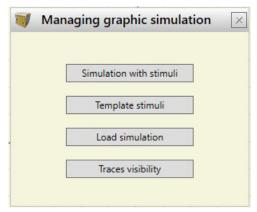
Fig. 275:   Selection menu for the graphic simulation mode

The individual buttons on the menu are described in detail in the following (see *Fig. 49*):

Template Stimuli button: Makes it possible to save the template file with the required name in the required storage location on the hard disk. This file contains the signal identifiers as per the diagram (see *Fig. 276*). Here, with the aid of a text editor, the operator can enter the status of the input signals at a specific time as well as the duration of the simulation and the time step to be used (see *Fig. 277*).
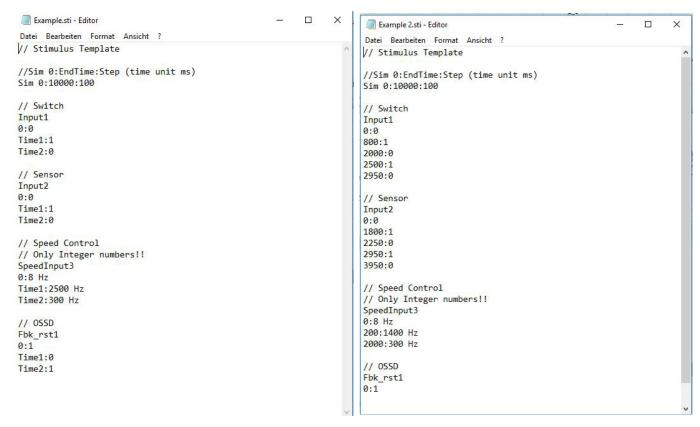
Fig. 276:   Template file immediately after saving

Fig. 277:   Example of a completed template file

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Simulation with stimuli button: Makes it possible to upload a (completed) template file. The simulation can be started immediately after uploading.

A diagram with the resulting signals is displayed at the end of the simulation.

Load simulation: button: Makes it possible to load a simulation completed earlier, provided at least one simulation has been saved.

Traces visibility button: Makes it possible to display graphically the traces selected (in the form of signal waveforms) as a diagram. As soon as it is clicked, the button opens a pop-up window as shown in *Fig. 278*. The traces can be removed from the diagram or added to the diagram in this window.
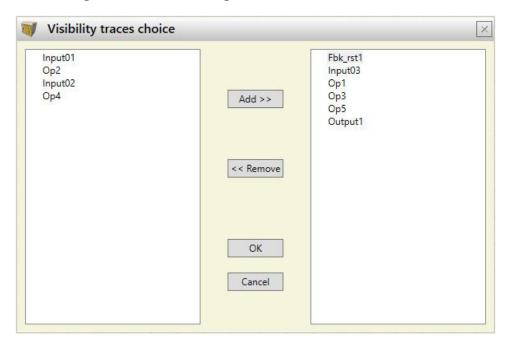
Fig. 278: Displaying the traces. The traces that can be added to the diagram are shown in the pane on the left. The traces currently shown in the diagram are displayed in the pane on the right; these traces can also be removed from the diagram.

9.7.2.1. Application example for the graphic simulation

The following example relates to the use of a press that has been installed inside a safety zone. The motor of the press can be operated only if two conditions are met at the same time: the gate of the safe area is closed and the motor activation command has been issued. The drive is to start with a delay of two seconds after the start signal.

Diagram

The input elements are represented in the diagram by the door for the safe zone and by the control system for the motor drive. These two signals are used as inputs for the AND logical operator; the result from this operator is delayed by two seconds by a delay block. The relay is then operated by the delayed signal; in turn the relay makes it possible to operate the press motor.
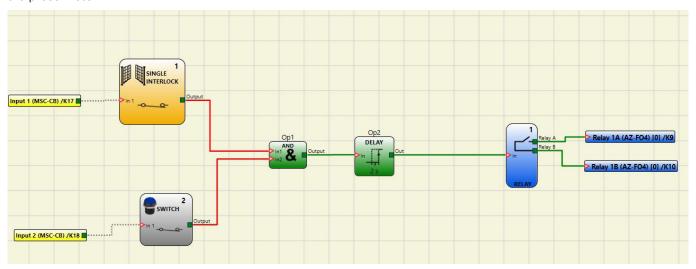
Fig. 279: Diagram for the application example

Stimuli file

The stimuli file provides for the closing of the gate after 2,000 ms (signal at LL1) and the activation command from the operator at 3,000 ms (signal at LL1).

```
// Stimulus Template

//Sim 0:EndTime:Step (time unit ms)
Sim 0:10000:100

// Single Interlock
Input1
0:0
2000:1
10000:0

// Switch
Input2
0:0
3000:1
10000:0
```

Fig. 280: Stimuli file for the application example

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Result of the simulation

The signals from the simulation are shown in the diagram. In this case:

‣ At 2,000 ms, the "Safe Zone" signal changes to logic level 1. It indicates the closing of the gate.

‣ At 3,000 ms, the "Start_Press" signal changes to logic level 1. It indicates the request for activation by the operator.

‣ The output signal of the AND operator „Op1" increases to logic level 1 at 3,000 ms. This occurs when the two inputs "Safe Zone" and "Start_Press" change to logic level 1.

‣ The signal on the output of the AND operator is delayed by 2000 ms by the Delay operator.

‣ The signal at the output of delay block "Op2" issues the command to close the relay at 5,000 ms. At this point, the re-lay "M_Press" is activated.
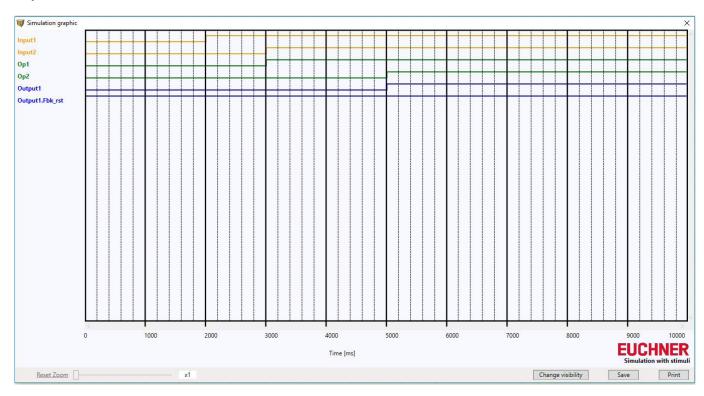
Fig. 281:   Diagram resulting from the simulation of the application example

9.7.3. MSC error codes

If there is a malfunction, the MSC system sends a code that corresponds to the error detected by the basic module to the EUCHNER Safety Designer software.

The code can be read as follows:

‣ Connect the basic module (indicates ERROR via LED) to the PC using the USB cable.

‣ Start EUCHNER SAFETY DESIGNER software.

‣ Establish the connection using the [icon]; a window appears with the password prompt; type the password; a window appears with the error code acquired.

All possible errors with the corresponding solution are listed in the following table.

All other codes relate to an internal malfunction. Please check any malfunctions against this table and state on returning to EUCHNER.

9.7.3.1. GENERIC ERRORS

Microcontroller failures

DECIMAL	HEX	ERROR	CORRECTIVE ACTION
0	0	MICROCONTROLLER ERROR	Restart the system / Replace module for repair
0	0	INITIAL RAM TEST FAILED = 0	
1	1	REDUNDANT MICROCONTROLLER FAILURE	
2	2	FUSE TEST FAILED	
3	3	INITIAL WD TEST FAILED	
4	4	REGISTERS TEST FAILED	
5	5	INSTRUCTIONS TEST FAILED	
6	6	ROM TEST FAILED	
7	7	OFF LINE TESTS NOT IN SEQUENCE	
8	8	OFF LINE TESTS NOT EXECUTED	
9	9	MEMORY CORRUPTED	
10	A	END OF CODE MEM REACHED	
11	B	TIMERS TEST FAILED	
12	C	INTERRUPT TEST FAILED	
13	D	INITIAL COMMUNICATION TIMEOUT	
14	E	COMMUNICATION MISSING	
15	F	RAM TEST FAILED	
16	10	SEQUENCE FAILED	
17	11	EEROM CORRUPTED	
18	12	EEROM STUCKED	
19	13	EXCHANGE FAILURE	Check backplane and MSC-CB connection / Restart the system
20	14	SERIAL PERIPHERAL INTERFACE TIMEOUT EXPIRED	Restart the system / Replace module for repair
21	15	ASYNCHRONOUS SERIAL DATA FAILURE	
22	16	CLOCK FAILURE	
23	17	AD CONVERTER FAIL	
24	18	BAND-GAP VOLTAGE REFERENCE FAIL	
25	19	HW STACK OVERFLOW	
26	1A	SW STACK OVERFLOW	

EN

Board failures

DECIMAL	HEX	ERROR	CORRECTIVE ACTION
32	20	ERROR BOARD	Restart the system / Replace module for repair
32	20	REDUNDANT MICROCONTROLLER FAILURE	
33	21	INITIAL UNDERVOLTAGE TEST FAILED	
34	22	INITIAL START INCONGRUENCY	
35	23	INTERNAL BUS FAILED	
36	24	INPUT FEEDBACK CHANNEL TEST FAILED	
37	25	INPUT TEST FAILED	
38	26	MICROCONTROLLER ID FAILURE	
39	27	PROFET FAILURE	
40	28	NODE NUMBER ACQUISITION FAILURE	
41	29	NETWORK CONTROLLER HW FAILURE	
42	2A	NETWORK CONTROLLER SW FAILURE	
43	2B	NETWORK CONTROLLER CORE FAILURE	
44	2C	NODE INPUT TEST FAILED	
45	2D	STATUS REGISTER FAIL	
46	2E	NETWORK CONTROLLER MISSING	
47	2F	NETWORK CONTROLLER WRONG	
48	30	NETWORK CONTROLLER CONFIG ERROR	
49	31	SERIAL PERIPHERAL INTERFACE FLASH FAILURE	
50	32	SERIAL PERIPHERAL INTERFACE FLASH CORRUPTED	
51	33	MOSFET FAILURE	

Backplane communication failures

DECIMAL	HEX	ERROR	CORRECTIVE ACTION
64	40	BACKPLANE ERROR	Check backplane connection
64	40	REDUNDANT BACKPLANE ERROR	
65	40	NO BACKPLANE SELECTION	
66	41	DOUBLE NODE SELECTION	Check node selection
67	42	WRONG ANSWER	Restart the system / Replace module for repair
68	43	TOO MUCH SLAVE MODULES	Check number of slaves
69	44	SLAVE ERROR	Check/replace slave in fail
70	45	NODE SELECTION ERROR	Check node selection
71	46	COMMAND NOT EXECUTED	Check backplane connection / Restart the system
72	47	CONFIGURATION ERROR	Verify connections and project
73	48	SLAVE ERROR	Check / Replace slave in fail
74	49	INTERNAL ERROR	Restart the system / Replace module for repair
75	4A	INTERNAL ERROR	
76	4B	BUS GENERIC ERROR	Check backplane connection

MSC Configuration Memory (M-A1) failures

DECIMAL	HEX	ERROR	CORRECTIVE ACTION
96	60	M-A1 ERROR	Replace M-A1
96	60	REDUNDANT M-A1 FAILURE	
97	61	M-A1 FAILURE	
98	62	M-A1 NOT COMPATIBILE	
99	63	M-A1 NOT RESPONDING	
100	64	M-A1 NOT WRITING	
101	65	M-A1 NOT WORKING	

9.7.3.2. SPECIFIC ERRORS

MSC-CB-S, FI8FO4S, AH-FO4SO8 OSSD failures

DECIMAL	HEX	ERROR		CORRECTIVE ACTION
128	80	FBK_COMANDI_FAILURE		Restart the system / Replace module for repair
129	81	CORRENTE_OFF_FAIL1	OSSD1	Restart the system / Replace module for repair
130	82	INI_OSSDS_FOUND_ON1	OSSD1	Check OSSD1 connection
131	83	INT_FBK_INCONGRUENCY1	OSSD1	Restart the system / Replace module for repair
132	84	INI_OSSD_FAILURE1	OSSD1	
133	85	DYN_OSSD_FBK_OUT_FAILURE1	OSSD1	
134	86	DYN_OSSD_FBK_OUT_H_FAILURE1	OSSD1	
135	87	DYN_SLAVE_OSSDS_SEQUENCE1	OSSD1	
136	88	DYN_TEST_ON_MASTER_FAILED1	OSSD1	Check OSSD1 connection
137	89	DYN_TEST_ON_INTERFERENCE_FAILURE1	OSSD1	Restart the system / Replace module for repair
138	8A	DYN_TEST_ON_SLAVE_FAILED1	OSSD1	Check OSSD1 connection
139	8B	DYN_TEST_OFF_MASTER_FAILED1	OSSD1	
140	8C	DYN_TEST_OFF_INTERFERENCE_FAILURE1	OSSD1	Restart the system / Replace module for repair
141	8D	DYN_TEST_OFF_SLAVE_FAILED1	OSSD1	Check OSSD1 connection
142	8E	DYN_OVERCURRENT_FAILURE1	OSSD1	Check OSSD1 connection: overload
143	8F	SECOND_OSSDS_FAILURE1	OSSD1	Restart the system / Replace module for repair
144	90	CORRENTE_OFF_FAIL2	OSSD2	Restart the system / Replace module for repair
145	91	INI_OSSDS_FOUND_ON2	OSSD2	Check OSSD2 connection
146	92	INT_FBK_INCONGRUENCY2	OSSD2	Restart the system / Replace module for repair
147	93	INI_OSSD_FAILURE2	OSSD2	
148	94	DYN_OSSD_FBK_OUT_FAILURE2	OSSD2	
149	95	DYN_OSSD_FBK_OUT_H_FAILURE2	OSSD2	
150	96	DYN_SLAVE_OSSDS_SEQUENCE2	OSSD2	
151	97	DYN_TEST_ON_MASTER_FAILED2	OSSD2	Check OSSD2 connection
152	98	DYN_TEST_ON_INTERFERENCE_FAILURE2	OSSD2	Restart the system / Replace module for repair
153	99	DYN_TEST_ON_SLAVE_FAILED2	OSSD2	Check OSSD2 connection
154	9A	DYN_TEST_OFF_MASTER_FAILED2	OSSD2	
155	9B	DYN_TEST_OFF_INTERFERENCE_FAILURE2	OSSD2	Restart the system / Replace module for repair
156	9C	DYN_TEST_OFF_SLAVE_FAILED2	OSSD2	Check OSSD2 connection
157	9D	DYN_OVERCURRENT_FAILURE2	OSSD2	Check OSSD2 connection: overload
158	9E	SECOND_OSSDS_FAILURE2	OSSD2	Restart the system / Replace module for repair
159	9F	CORRENTE_OFF_FAIL3	OSSD3	Restart the system / Replace module for repair
160	A0	INI_OSSDS_FOUND_ON3	OSSD3	Check OSSD3 connection
161	A1	INT_FBK_INCONGRUENCY3	OSSD3	Restart the system / Replace module for repair
162	A2	INI_OSSD_FAILURE3	OSSD3	
163	A3	DYN_OSSD_FBK_OUT_FAILURE3	OSSD3	
164	A4	DYN_OSSD_FBK_OUT_H_FAILURE3	OSSD3	
165	A5	DYN_SLAVE_OSSDS_SEQUENCE3	OSSD3	
166	A6	DYN_TEST_ON_MASTER_FAILED3	OSSD3	Check OSSD3 connection
167	A7	DYN_TEST_ON_INTERFERENCE_FAILURE3	OSSD3	Restart the system / Replace module for repair
168	A8	DYN_TEST_ON_SLAVE_FAILED3	OSSD3	Check OSSD3 connection
169	A9	DYN_TEST_OFF_MASTER_FAILED3	OSSD3	
170	AA	DYN_TEST_OFF_INTERFERENCE_FAILURE3	OSSD3	Restart the system / Replace module for repair
171	AB	DYN_TEST_OFF_SLAVE_FAILED3	OSSD3	Check OSSD3 connection
172	AC	DYN_OVERCURRENT_FAILURE3	OSSD3	Check OSSD3 connection: overload
173	AD	SECOND_OSSDS_FAILURE3	OSSD3	Restart the system / Replace module for repair

EN

DECIMAL	HEX	ERROR		CORRECTIVE ACTION
174	AE	CORRENTE_OFF_FAIL4	OSSD4	Restart the system / Replace module for repair
175	AF	INI_OSSDS_FOUND_ON4	OSSD4	Check OSSD4 connection
176	B0	INT_FBK_INCONGRUENCY4	OSSD4	Restart the system / Replace module for repair
177	B1	INI_OSSD_FAILURE4	OSSD4	
178	B2	DYN_OSSD_FBK_OUT_FAILURE4	OSSD4	
179	B3	DYN_OSSD_FBK_OUT_H_FAILURE4	OSSD4	
180	B4	DYN_SLAVE_OSSDS_SEQUENCE4	OSSD4	
181	B5	DYN_TEST_ON_MASTER_FAILED4	OSSD4	Check OSSD4 connection
182	B6	DYN_TEST_ON_INTERFERENCE_FAILURE4	OSSD4	Restart the system / Replace module for repair
183	B7	DYN_TEST_ON_SLAVE_FAILED4	OSSD4	Check OSSD4 connection
184	B8	DYN_TEST_OFF_MASTER_FAILED4	OSSD4	
185	B9	DYN_TEST_OFF_INTERFERENCE_FAILURE4	OSSD4	Restart the system / Replace module for repair
186	BA	DYN_TEST_OFF_SLAVE_FAILED4	OSSD4	Check OSSD4 connection
187	BB	DYN_OVERCURRENT_FAILURE4	OSSD4	Check OSSD4 connection: overload
188	BC	SECOND_OSSDS_FAILURE4	OSSD4	Restart the system / Replace module for repair

MSC-CB, FI8FO2, AC-FO2, AC-FO4 OSSD failures

DECIMAL	HEX	ERROR		CORRECTIVE ACTION
192	C0	INI_OSSD_FEEDBACK_TEST_FAILED	OSSD1	Restart the system / Replace module for repair
193	C1	INI_MONOSTABLE_CHECK_FAILED	OSSD1	
194	C2	INI_OSSD_FOUND_ON	OSSD1	Check OSSD1 connection
195	C3	INI_FBK_P_CHECK_FAILED	OSSD1	Restart the system / Replace module for repair
196	C4	DYN_FBK_P_CHECK_FAILED	OSSD1	
197	C5	DYN_MASTER_OSSD_ON_TEST_FAILED	OSSD1	Check OSSD1 connection
198	C6	DYN_OSSD_SHORTED	OSSD1	
199	C7	DYN_SLAVE_OSSD_ON_TEST_FAILED	OSSD1	
200	C8	DYN_SLAVE_OSSD_ON_SEQUENCE	OSSD1	Restart the system / Replace module for repair
201	C9	DYN_OSSD_OFF_TEST_FAILED	OSSD1	Check OSSD1 connection
202	CA	DYN_OSSD_ON_TEST_FAILED	OSSD1	
203	CB	DYN_OSSD_NOT_ALIGNED	OSSD1	Restart the system / Replace module for repair
204	CC	DYN_MONO_CHECK_FAILED	OSSD1	
205	CD	SECOND_OSSD_FAILURE	OSSD1	
206	CE	INI_OSSD_FEEDBACK_TEST_FAILED2	OSSD2	
207	CF	INI_MONOSTABLE_CHECK_FAILED2	OSSD2	
208	D0	INI_OSSD_FOUND_ON2	OSSD2	Check OSSD2 connection
209	D1	INI_FBK_P_CHECK_FAILED2	OSSD2	Restart the system / Replace module for repair
210	D2	DYN_FBK_P_CHECK_FAILED2	OSSD2	
211	D3	DYN_MASTER_OSSD_ON_TEST_FAILED2	OSSD2	Check OSSD2 connection
212	D4	DYN_OSSD_SHORTED2	OSSD2	
213	D5	DYN_SLAVE_OSSD_ON_TEST_FAILED2	OSSD2	
214	D6	DYN_SLAVE_OSSD_ON_SEQUENCE2	OSSD2	Restart the system / Replace module for repair
215	D7	DYN_OSSD_OFF_TEST_FAILED2	OSSD2	Check OSSD2 connection
216	D8	DYN_OSSD_ON_TEST_FAILED2	OSSD2	
217	D9	DYN_OSSD_NOT_ALIGNED2	OSSD2	Restart the system / Replace module for repair
218	DA	DYN_MONO_CHECK_FAILED2	OSSD2	
219	DB	SECOND_OSSD_FAILURE2	OSSD2	
220	DC	INI_OSSD_FEEDBACK_TEST_FAILED3	OSSD3	
221	DD	INI_MONOSTABLE_CHECK_FAILED3	OSSD3	
222	DE	INI_OSSD_FOUND_ON3	OSSD3	Check OSSD3 connection
223	DF	INI_FBK_P_CHECK_FAILED3	OSSD3	Restart the system / Replace module for repair
224	E0	DYN_FBK_P_CHECK_FAILED3	OSSD3	

DECIMAL	HEX	ERROR		CORRECTIVE ACTION
225	E1	DYN_MASTER_OSSD_ON_TEST_FAILED3	OSSD3	Check OSSD3 connection
226	E2	DYN_OSSD_SHORTED3	OSSD3	
227	E3	DYN_SLAVE_OSSD_ON_TEST_FAILED3	OSSD3	
228	E4	DYN_SLAVE_OSSD_ON_SEQUENCE3	OSSD3	Restart the system / Replace module for repair
229	E5	DYN_OSSD_OFF_TEST_FAILED3	OSSD3	Check OSSD3 connection
230	E6	DYN_OSSD_ON_TEST_FAILED3	OSSD3	
231	E7	DYN_OSSD_NOT_ALIGNED3	OSSD3	Restart the system / Replace module for repair
232	E8	DYN_MONO_CHECK_FAILED3	OSSD3	
233	E9	SECOND_OSSD_FAILURE3	OSSD3	
234	EA	INI_OSSD_FEEDBACK_TEST_FAILED4	OSSD4	
235	EB	INI_MONOSTABLE_CHECK_FAILED4	OSSD4	
236	EC	INI_OSSD_FOUND_ON4	OSSD4	Check OSSD4 connection
237	ED	INI_FBK_P_CHECK_FAILED4	OSSD4	Restart the system / Replace module for repair
238	EE	DYN_FBK_P_CHECK_FAILED4	OSSD4	
239	EF	DYN_MASTER_OSSD_ON_TEST_FAILED4	OSSD4	Check OSSD4 connection
240	F0	DYN_OSSD_SHORTED4	OSSD4	
241	F1	DYN_SLAVE_OSSD_ON_TEST_FAILED4	OSSD4	
242	F2	DYN_SLAVE_OSSD_ON_SEQUENCE4	OSSD4	Restart the system / Replace module for repair
243	F3	DYN_OSSD_OFF_TEST_FAILED4	OSSD4	Check OSSD4 connection
244	F4	DYN_OSSD_ON_TEST_FAILED4	OSSD4	
245	F5	DYN_OSSD_NOT_ALIGNED4	OSSD4	Restart the system / Replace module for repair
246	F6	DYN_MONO_CHECK_FAILED4	OSSD4	
247	F7	SECOND_OSSD_FAILURE4	OSSD4	

Fieldbus modules failures

DECIMAL	HEX	ERROR	CORRECTIVE ACTION
128	80	FIELDBUS RESTART	Restart the system / Replace module for repair
129	81	MISSING FIELDBUS	
130	82	FIELDBUS CONFIGURATION ERROR	Check fieldbus configuration
131	83	FIELDBUS WRONG MODULE	Restart the system / Replace module for repair
132	84	COMMUNICATION ERROR	
133	85	DUMMY ERROR	
134	86	BACKWARD CONFIG. IS NOT POSSIBLE	Check BUS firmware version / configuration
135	87	FIELDBUS TIMEOUT	Restart the system / Replace module for repair
136	88	FIELDBUS CET (TIME ZONE) CONFIG. ERROR	
137	89	ERROR MANAGEMENT	
138	8A	FIELDBUS FACTORY RESET ERROR	
139	8B	REPROGRAMMING NOT CORRECT	
140	8C	MICRON CONFIGURATION ERROR	Check MICRON configuration

SPM0 / SPM1 / SPM2 errors

DECIMAL	HEX	ERROR	CORRECTIVE ACTION
128	80	COMMON TEST ENCODER ERROR	Restart the system / Replace module for repair
129	81	PROXY COMMON TEST ERROR	
130	82	ERROR EXCHANGED MEASURES	
131	83	DIRECT MEMORY ACCESS FAILURE	
132	84	PROXY1 TEST ERROR	
133	85	PROXY1 DISCARDED MEASURE	Check proxy signals
134	86	INITIAL IDENTIFICATION MODULE1 INCORRECT	Restart the system / Replace module for repair
135	87	ERROR TEST ENCODER1 INTERFACE	
136	88	ENCODER1 INTEGRITY TEST ERROR	Check ENCODER signals

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DECIMAL	HEX	ERROR	CORRECTIVE ACTION
137	89	REDUNDANT ENCODER1 FAILURE	Restart the system / Replace module for repair
138	8A	ENCODER1 DISCARDED MEASURE	Check ENCODER signals
139	8B	PROXY2 TEST ERROR	Restart the system / Replace module for repair
140	8C	PROXY2 DISCARDED MEASURE	Check proxy signals
141	8D	INITIAL IDENTIFICATION MODULE2 INCORRECT	Restart the system / Replace module for repair
142	8E	ERROR TEST ENCODER2 INTERFACE	
143	8F	ENCODER2 INTEGRITY TEST ERROR	Check ENCODER signals
144	90	REDUNDANT ENCODER2 FAILURE	Restart the system / Replace module for repair
145	91	ENCODER2 DISCARDED MEASURE	Check ENCODER signals
146	92	ERROR EXCHANGED MEASURES	Restart the system / Replace module for repair
147	93	UNDERVOLTAGE POWER SUPPLY ERROR PROXY1	Check power supply
148	94	UNDERVOLTAGE POWER SUPPLY ERROR PROXY2	
149	95	OVERLOAD PROXY1	Check proxy signals
150	96	OVERLOAD PROXY2	

AZ-FO4 / AZ-FO4O8 errors

DECIMAL	HEX	ERROR	CORRECTIVE ACTION
128	80	RELAY1 SUPPLY FAIL	Check module power supply
129	81	RELAY1 FEEDBACK WRONG	Restart the system / Replace module for repair
130	82	INTERNAL CONTACT FEEDBACK WRONG	
131	83	RELAY1 OFF TEST FAILED	
132	84	RELAY1 ON TEST FAILED	
133	85	RELAY1 OFF TEST FAILED	
134	86	RELAY1 ON TEST FAILED	
135	87	RELAY1 OFF SEQUENCE	
136	88	RELAY1 ON SEQUENCE	
137	89	SPARE FAULT	
138	8A	REDUNDANT RELAY1 FAILURE	
139	8B	RELAY2 FEEDBACK WRONG	
140	8C	INTERNAL CONTACT FEEDBACK2 WRONG	
141	8D	RELAY2 OFF TEST FAILED	
142	8E	RELAY2 ON TEST FAILED	
143	8F	RELAY2 OFF TEST FAILED	
144	90	RELAY2 ON TEST FAILED	
145	91	RELAY2 OFF SEQUENCE FAILED	
146	92	RELAY2 ON SEQUENCE FAILED	
147	93	SPARE FAULT2	
148	94	REDUNDANT RELAY2 FAILURE	
149	95	RELAY3 FEEDBACK WRONG	
150	96	INTERNAL CONTACT FEEDBACK3 WRONG	
151	97	RELAY3 OFF TEST FAILED	
152	98	RELAY3 ON TEST FAILED	
153	99	RELAY3 OFF TEST FAILED	
154	9A	RELAY3 ON TEST FAILED	
155	9B	RELAY3 OFF SEQUENCE	
156	9C	SPARE FAULT3	
157	9D	REDUNDANT RELAY3 FAILURE	
158	9E	RELAY4 FEEDBACK WRONG	
159	9F	INTERNAL CONTACT FEEDBACK4 WRONG	
160	A0	RELAY4 OFF TEST FAILED	

O8 / O16 errors

DECIMAL	HEX	ERROR	CORRECTIVE ACTION
128	80	FAILURE PROFET 1…8	Restart the system / Replace module for repair
129	81	FAILURE PROFET 9…16	
130	82	REDUNDANT PROFET FAILURE	

AH-FO4SO8 errors

DECIMAL	HEX	ERROR	CORRECTIVE ACTION
128	80	LOG FEEDBACK COMMANDS FAILURE	Restart the system / Replace module for repair
129	81	OSSD1 / STATUS OFF CURRENT FAIL	
130	82	OSSD1 FOUND ON AT STARTUP	Check OSSD1 connection
131	83	OSSD1 FEEDBACK SIGNALS INCONGRUENT	Restart the system / Replace module for repair
132	84	OSSD1 FEEDBACK OUT FAILURE	
133	85	OSSD1 FEEDBACK OUT FAILURE	
134	86	OSSD1 ON SEQUENCE	
135	87	OSSD1 TEST ON FAILED	Check OSSD1 connection
136	88	OSSD1 TEST ON INTERFERENCE FAILURE	Restart the system / Replace module for repair
137	89	OSSD1 TEST ON FAILED	Check OSSD1 connection
138	8A	OSSD1 TEST OFF FAILED	
139	8B	OSSD1 TEST OFF INTERFERENCE FAILURE	Restart the system / Replace module for repair
140	8C	OSSD1 TEST OFF FAILED	Check OSSD1 connection
141	8D	OSSD1 OVERCURRENT FAILURE	Check OSSD1 overload
142	8E	REDUNDANT OSSD4 FAILURE	Restart the system / Replace module for repair
143	8F	OSSD2 / STATUS OFF CURRENT FAIL	
144	90	OSSD2 FOUND ON AT STARTUP	Check OSSD2 connection
145	91	OSSD2 FEEDBACK SIGNALS INCONGRUENT	Restart the system / Replace module for repair
146	92	OSSD2 FEEDBACK OUT FAILURE	
147	93	OSSD2 FEEDBACK OUT FAILURE	
148	94	OSSD2 ON SEQUENCE FAILURE	
149	95	OSSD2 TEST ON FAILED	Check OSSD2 connection
150	96	OSSD2 TEST ON INTERFERENCE FAILURE	Restart the system / Replace module for repair
151	97	OSSD2 TEST ON FAILED	Check OSSD2 connection
152	98	OSSD2 TEST OFF FAILED2	
153	99	OSSD2 TEST OFF INTERFERENCE FAILURE	Restart the system / Replace module for repair
154	9A	OSSD2 TEST OFF FAILED	Check OSSD2 connection
155	9B	OSSD2 OVERCURRENT FAILURE	Check OSSD2 overload
156	9C	REDUNDANT OSSD2 OSSDs FAILURE	Restart the system / Replace module for repair
157	9D	OSSD3 / STATUS OFF CURRENT FAIL	
158	9E	OSSD3 FOUND ON AT STARTUP	Check OSSD3 connection
159	9F	OSSD3 FEEDBACK SIGNALS INCONGRUENT	Restart the system / Replace module for repair
160	A0	OSSD3 FEEDBACK OUT FAILURE	
161	A1	OSSD3 FEEDBACK OUT FAILURE	
162	A2	OSSD3 SLAVE OSSDs ON SEQUENCE	
163	A3	OSSD3 TEST ON MASTER FAILED	Check OSSD3 connection
164	A4	OSSD3 TEST ON INTERFERENCE FAILURE	Restart the system / Replace module for repair
165	A5	OSSD3 TEST ON SLAVE FAILED	Check OSSD3 connection
166	A6	OSSD3 TEST OFF MASTER FAILED	
167	A7	OSSD3 TEST OFF INTERFERENCE FAILURE	Restart the system / Replace module for repair
168	A8	OSSD3 TEST OFF SLAVE FAILED	Check OSSD3 connection
169	A9	OSSD3 OVERCURRENT FAILURE	Check OSSD3 overload
170	AA	REDUNDANT OSSD3 FAILURE	Restart the system / Replace module for repair
171	AB	OSSD4 / STATUS OFF CURRENT FAIL	

DECIMAL	HEX	ERROR	CORRECTIVE ACTION
172	AC	OSSD4 FOUND ON AT STARTUP	Check OSSD4 connection
173	AD	OSSD4 FEEDBACK SIGNALS INCONGRUENT	Restart the system / Replace module for repair
174	AE	OSSD4 FEEDBACK OUT FAILURE	
175	AF	OSSD4 FEEDBACK OUT FAILURE	
176	B0	OSSD4 OSSDS ON SEQUENCE	
177	B1	OSSD4 TEST ON MASTER FAILED	Check OSSD4 connection
178	B2	OSSD4 TEST ON INTERFERENCE FAILURE	Restart the system / Replace module for repair
179	B3	OSSD4 TEST ON SLAVE FAILED	Check OSSD3 connection
180	B4	OSSD4 TEST OFF MASTER FAILED	
181	B5	OSSD4 TEST OFF INTERFERENCE FAILURE	Restart the system / Replace module for repair
182	B6	OSSD4 TEST OFF SLAVE FAILED	Check OSSD4 connection
183	B7	OSSD4 OVERCURRENT FAILURE	Check OSSD4 overload
184	B8	REDUNDANT OSSD4 FAILURE	Restart the system / Replace module for repair

9.7.3.3. DIAGNOSTIC CODES

INPUT diagnostics

Code		MEANING
DECIMAL	HEX	
1	1	Input not restored
2	2	Missing Simultaneity
3	3	Missing Simultaneity
4	4	Missing Simultaneity
7	7	MOD-SEL incoherent
8	8	MOD-SEL disconnected
10	A	OutTest Error
11	B	Detected input fault
13	D	OutTest connected to other inputs
14	E	OutTest OK but input to 24V
15	F	Photocell short circuit
16	10	Photocell is not responding
17	11	Short between Photocell
18	12	S-MAT disconnected
19	13	OutTest shorted
20	14	Wrong OutTest connection
21	15	OutTest shorted to 24V
22	16	Detected Test output fault
23	17	Configured Proximity missing
24	18	Configured Encoder missing
25	19	Encoder (or Proximity) missing
26	1A	One or both Proximity missing
27	1B	One or both Encoders missing
28	1C	Wrong frequency ratio detected
29	1D	Wrong Encoder supply
30	1E	Detected Encoder signals anomaly
31	1F	The selected threshold does not exist
32	20	Over-frequency detected on Encoder1 input
33	21	Over-frequency detected on Encoder2 input
34	22	Over-frequency detected on Proximity1 input
35	23	Over-frequency detected on Proximity2 input
36	24	Detected inconsistency of 4-wires Proximity inputs
37	25	Detected inconsistency of 4-wires Proximity2 inputs

Code		MEANING
DECIMAL	HEX	
38	26	Configured Proximity2 missing
39	27	Detected interleaved Proximity inputs inconsistency
40	28	Sensor current below the minimum allowed value
41	29	Sensor current exceeds the maximum allowed value
42	2A	Unconnected sensor
43	2B	Sensor supply overload
44	2C	Current value at sensor input too high
53	35	Mismatch between redundant channels readings
54	36	Sensor current below the minimum allowed value
55	37	Sensor current exceeds the maximum allowed value
56	38	Sensor1 current exceeds the maximum allowed value
57	39	Sensor2 current exceeds the maximum allowed value
58	3A	Unconnected sensor1
59	3B	Unconnected sensor2
60	3C	Sensor1 supply overload
61	3D	Sensor2 supply overload
62	3E	Current value at sensor1 input too high
63	3F	Current value at sensor2 input too high
72	48	Configured Encoder2 missing
73	49	Detected Encoder2 signals anomaly
74	4A	Wrong Encoder2 supply
128	80	Diagnostic input OK
133	85	Two hands are not contemporaneous
134	86	Missing StartUp Test
137	89	Waiting for Restart

OUTPUT STATUS diagnostics

Code		MEANING
DECIMAL	HEX	
0	0	DIAGNOSTICS STATUS OK
1	1	PROFET OVERLOAD
2	2	PROFET POWER SUPPLY MISSING
3	3	STATUS ENABLE MISSING

OSSD OUTPUT diagnostics

Code		MEANING
DECIMAL	HEX	
0	0	DIAGNOSTICS OSSD OK
1	1	ENABLE MISSING
2	2	WAITING RESTART
3	3	FBK K1-K2 MISSING
4	4	EVALUATION OUTPUT STATE
5	5	OSSD SUPPLY MISSING
6	6	RESTART POSITIVE PULSE DURATION EXCEEDS THE MAXIMUM ALLOWED VALUE
7	7	EXTERNAL K1_K2 FEEDBACK NOT CONGRUENT WITH THE COMMANDED STATE
8	8	FB K1-K2 MISSING
9	9	OSSD OVERLOAD
10	A	OSSD WITH LOAD CONNECTED TO 24V!

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9.7.4. Error log file

The error log file can be displayed using the [icon] icon on the default toolbar (password required: level 1).

A table is displayed with the last 5 errors that have occurred since the scheme was last sent to the MSC or the last time
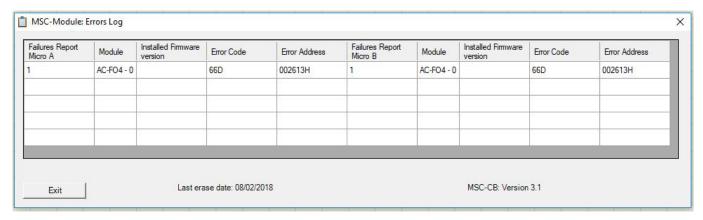
the error log was deleted (icon: [icon]).

Failures Report Micro A	Module	Installed Firmware version	Error Code	Error Address	Failures Report Micro B	Module	Installed Firmware version	Error Code	Error Address
1	AC-FO4 - 0		66D	002613H	1	AC-FO4 - 0		66D	002613H

Exit   Last erase date: 08/02/2018   MSC-CB: Version 3.1

Fig. 282:   Error log file

10. Ordering information and accessories

> **(i) Tip!**
>
> Suitable accessories, e.g. cables or assembly material, can be found at www.euchner.com. To order, enter the order number of your item in the search box and open the item view. Accessories that can be combined with the item are listed in *Accessories*.

11. Inspection and service

> **⚠ WARNING**
>
> Danger of severe injuries due to the loss of the safety function.
>
> ‣ If damage or wear is found, the respective MSC module must be completely replaced. Replacement of individual parts or assemblies is not permitted.
>
> ‣ Check the device for proper function at regular intervals and after every fault. For information about possible time intervals, refer to EN ISO 14119:2024, section 9.2.1.

No servicing is required. Repairs to the device are only allowed to be made by the manufacturer.

12. Service

If servicing is required, please contact:

EUCHNER GmbH + Co. KG

Kohlhammerstraße 16

70771 Leinfelden-Echterdingen

Service telephone:

+49 711 7597-500

E-mail:

support@euchner.de

Internet:

www.euchner.com

13. Declaration of conformity

The product complies with the requirements according to
‣ Machinery Directive 2006/42/EC (until January 19, 2027)
‣ Machinery Regulation (EU) 2023/1230 (from January 20, 2027)

The EU declaration of conformity can be found at www.euchner.com. Enter the order number of your device in the search box. The document is available under *Downloads*.

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