FF-SRM200P2 muting module

FF-SRM Series

FEATURES

- Category 4 muting module as per the EN 954-1, IEC 61508 and EN 61496-1 European standards
- Meets the applicable parts of the US & Canadian regulations and standards ANSI/RIA/OSHA
- Multi-functional module programmable through internal selectors : muting functions, mutual exclusion mode
- Compatible with many types of safety devices (safety light curtains, laser scanners, safety mats, safety switches) and muting sensors
- Works with safety devices with static or relay outputs
- Inputs for 1 mutable safety device and 1 non-mutable safety device or up to 2 mutable safety devices
- Inputs for 2 or 4 sensors to start and end the muting sequence
- Uni-directional or bi-directional muting
- Max. muting time programmable in wide ranges (10 s to unlimited)
- Safety relay outputs: 3 NO
- Auxiliary static outputs for the muting lamp, diagnostic information and output relay status
- Response time : 25 ms
- Integrated start and restart interlock capability
- Monitored start push-button
- Test output for safety device testing
- External Device Monitoring (EDM) loop for the control of external contactors
- 45 mm / 1.77 in slim housing
- Detailed diagnostic information for easy troubleshooting via external and internal indicators
- LED indicators for relay status and diagnostic information

TYPICAL APPLICATIONS

- Conveyor lines, palletizers and depalletizers, automotive transfer lines
- Packaging and wrapping machines
- Machines where manual operations must be carried out outside of hazardous phases of the machine cycle: mechanical or hydraulic presses, press-brakes, welding robots, double transfer lines
- Hazardous areas being mutually accessed by material handling robots or operators carrying out manual operations (mutual exclusion mode)

(pending)

Suitable interfaces up to **Category 4** per EN 954-1

The **FF-SRM200P2** is a programmable safety control module offering **various muting modes** and an **mutual exclusion mode** in one device.

The FF-SRM200P2 is permanently self-checked and complies with the requirements of the EN 954-1 European standard for **Category 4** safety devices, IEC 61508 and EN 61496-1. Any internal failure is detected and leads to the de-energisation of its safety relay outputs.

Mode depending, **up to two safety devices** (e.g. light curtains, laser scanners, safety mats, safety switches etc.) protecting a hazardous area and **up to four sensors** (e.g. for starting or ending a muting sequence) can be connected to this module. If needed, the correct functioning of the connected safety devices may be monitored by the module through its **test output**.

The FF-SRM200P2 module offers an **extensive diagnostic** through indicators, which allow for an easy troubleshooting in muting applications.

In the **muting mode**, the module is an interface between one or two safety devices (i.e. light curtains, laser scanners, safety mats, safety switches, etc.) and the control circuitry of a hazardous machine for which it is necessary to mute the safety device(s) at certain steps of the process.

In the **mutual exclusion mode**, the module can monitor up to two safety devices (typically light curtains, switches) protecting hazardous areas accessible by operators and machines. The operators access to the area is only allowed during the safe period of the machine cycle without stopping the hazardous movement.

⚠ WARNING

MISUSE OF DOCUMENTATION

- The information presented in this product sheet (or catalogue) is for reference only. DO NOT USE this document as system installation information.
- Complete installation, operation and maintenance information is to be referenced for each product.

Failure to comply with these instructions could result in death or serious injury.

Applications

Muting means that the safety outputs of a mutable safety device are "muted" **during the non-hazardous portion of a machine cycle**. In a conveyor fed machine area, for example, an object is allowed to enter the machine area even when intruding the sensing field of the mutable safety device. However, the machine must stop when an operator is intruding the sensing field of the safety device. In order to distinguish an operator from an object the muting module evaluates the validity of a muting sequence via auxiliary start and end muting sensors.

Common applications:

- Palletisers / depalletisers,
- Handling, wrapping and packaging machines,
- Robotic zones on automotive transfer lines,
- Automotive paint-shops.

Muting may also be used on workstations manually loaded or unloaded by an operator. The intrusion of an operator in the sensing field of the safety device is not taken into account **during the non-hazardous portion** of the machine cycle (e.g. the opening stroke of a press).

Common applications:

- Mechanical or hydraulic presses,
- Press brakes,
- Dual work stations where the operator loads parts on one station while a robot works on the other station.

Mutual exclusion may be used in hazardous areas that can be accessed by a machine (e.g. a handling robot) and an operator carrying out operations. The mutual exclusion principle consists in **avoiding that the operator and the machine are entering or are located together inside the hazardous area at the same time**. Every time the operator is leaving the hazardous area, he needs to acknowledge his exit with a push-button, allowing the handling robot to enter the area again.

Common applications:

- Palletisers
- Handling / Welding robots

Product description

The **muting** sequence is controlled by two or four sensors (like photoelectric sensors, limit switches or proximity sensors) and the muting module. The sensors must be installed so that only an object is able to validate a muting sequence but not a person.

When a start muting sequence is valid, the output relay contacts of the FF-SRM200P2 remain energised even if the protection field of the muted safety devices is intruded by an object. An external white muting lamp indicates that the safety device is actually muted. Correct operation of this lamp is monitored by the module in accordance with the IEC/EN 61496-1 European standard.

The following **muting modes** can be programmed using internal selectors of the FF-SRM200P2:

- Bi-directional or uni-directional muting,
- With 2 start muting sensors and up to 2 muted safety devices,
- With 4 start / end muting sensors and 1 muted safety device.

When a program for one muted and one non-muted safety device is selected, intruding the non-muted safety device will always de-energise the module's safety relay outputs.

The **maximum time for muting** the connected safety devices is programmable in a wide range (10 s to unlimited) and can therefore be adapted to the application.

External indicators provide information on the relay output status, restart status, muting phase status and on diagnostics.

After power up of the module or after the intrusion of the safety device outside a valid muting sequence, the module can be restarted manually via a **restart push-button**.

When necessary, the connected safety devices can be tested using the **test** output of the FF-SRM200P2.

The **inputs** of the safety devices and the auxiliary sensors are floating allowing the connection of devices with static outputs (PNP or NPN) or relay outputs.

An **External Device monitoring (EDM)** loop is available in order to monitor external safety contactors driven by the safety relay outputs of the module.

Trouble shooting an application using the FF-SRM200P2 muting module is easy through internal and external diagnostic indicators. The connected muting lamp starts to flicker when an error has been detected.

FF-SRM200P2 Muting module

SPECIFICATIONS

Suitable interfaces up to Category 4 per EN 954-1

(pending)

Dimensions in millimeters / inches, meters / feet, weights in kg / lbs

	Nominal supply voltage (A1(+), A2(-))	24 Vdc (±15 %, power line disturbance: max. 5 ms)
	Nominal power consumption	4,1 W
	Fuse protection	Internal PTC
Inputs	**Safety devices**	1 or 2 redundant floating inputs with optocoupler (S11/S12, S13/S14) and (S21/S22, S23/S24)
	Auxiliary sensors	2 or 4 floating inputs with optocoupler (S21/S22, S23/S24, S31/S32, S33/S34)
	Restart input type (S43/S44)	Normally open (restart on push-button release within max. 3 s)
	Restart loop and External Device Monitoring (EDM)	Modes 20 to 79 (muting modes): 1 common input (S43/S44)
		Modes 90 to 93 (mutual exclusion modes): 2 separate inputs (restart: S43/S44, EDM: S41/S42)
	Restart delay time	Manual start mode: 65 ms
	Input voltage at S12,S14,S22,S24,S32,S34	23 Vdc at nominal voltage
	Switching on min. voltage / off max. voltage	
	at S12,S14,S22,S24,S32,S34,S44	16 Vdc / 7 Vdc
	Input current at S12,S14,S22,S24,S32,S34,S44	4,5 mA at nominal voltage
	Coincidence time between safety device inputs S12/S14	
	and S22/S24 (if muting with 2 sensors is selected)	max. 2,5 s
	Coincidence time between start muting inputs S32/S34	max. 10 s
	Max. muting time (selector programmable)	10 s, 20 s , 30 s, 1 mn, 5 mn, 10 mn, 30 mn, 1 h, 3 h, unlimited (> 3 days)
Safety outputs	**Contact type**	Internally redundant positive guided safety relay contacts
	Contact complement	3 NO (13/14, 23/24, 33/34)
	Response time	25 ms (between safety device input and module relay outputs)
	Switching capability	Power factor = 1 (see Note 1 and Figure 1)
	Output Current (min. to max.)	1 mA to 5 A (see Note 1)
	Output Voltage (min. to max.)	0,1 to 230 Vac/dc
	Typical Electrical Life Expectancy	Power factor = 1 at 230 Vac (see Note 2 and Figure 1)
		1 A: 2 000 000 operations; 2 A: 1 000 000 operations; 5 A: 300 000 operations; 6 A: 200 000 operations
	Typical Power Factor (cos φ)	Limitation Factor (see Note 3 and Figure 2)
	0,3	0,45
	0,5	0,70
	0,7	0,85
	1	1
	Operating frequency	1200 switching cycles/h (max.)
	Fuse rating	6 A time delayed (max.)
	Mechanical life	Ten million switching operations
Auxiliary outputs	**Relay status / test output**	PNP static output (58) (23 Vdc / max. 100 mA / min. 10 mA)
	Test output	Normally closed characteristics (test active: 0 Vdc, test inactive: 24 Vdc)
		response of safety device on test signal < 200 ms
	Muting lamp / diagnostic output	PNP static output (48) (23 Vdc / max. 100 mA)
General	**Temperature range**	0 °C to +55 °C / 32 °F to 131 °F
	Sealing	Housing IP 40; Terminals IP 20
	Housing material	Thermoplastic
	Vibration resistance	Amplitude 0,35 mm; Frequency 10 to 55 Hz
	Connector connection (max.)	1 x 4 mm^2 solid [12 AWG], 1 x 2,5 mm^2 [14 AWG], 2 x 1,5 mm^2 [16 AWG] stranded wire with sleeve DIN 46288
	Connector attachment	Removable block terminals with M3,5 screws; wire contacts are enclosed to prevent electrical shock
	Mounting	Quick install rail mounting EN 50022-35, 35 mm x 15 mm / 1.38 in x 0.59 in. size
	Weight	320 g / 0.70 lb

ORDERING INFORMATION

FF-SRM200P2

Note 1: Contact damage: To ensure the 1 mA capability during the lifetime of the contact, never exceed 300 mA or 60 V.

Note 2: Install arc suppression devices across load to avoid module contact arcing and ensure specified relay life expectancy.

Note 3: Total operations = operations at power factor 1 multiplied by the limitation factor.
Example: U = 230 Vac, I = 2 A, power factor cos φ = 0,7
Switching power P = U x I = 460 Vac
Contact life (cos φ = 1, P = 460 Vac) = 1 000 000 operations (see Figure 1)
Limitation factor F (cos φ = 0,5) = 0,7 (see Figure 2)
Contact life (cos φ = 0,5, P = 460 Vac) = F x contact life (cos φ = 1, P = 460 Vac) = 700 000 operations.

FIG. 1 CONTACT LIFE FOR 100% RESISTIVE LOAD (TYPICAL)

Power factor = 1 (cos φ)(see Note 3)

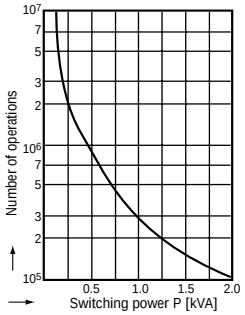
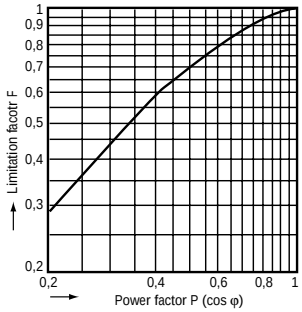


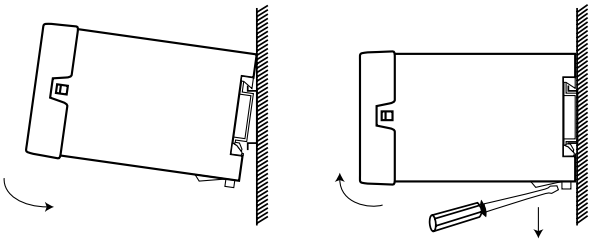
FIG. 2 LIMITATION FACTOR FOR INDUCTIVE LOADS

Power factor < 1 (cos φ)(see Note 3)



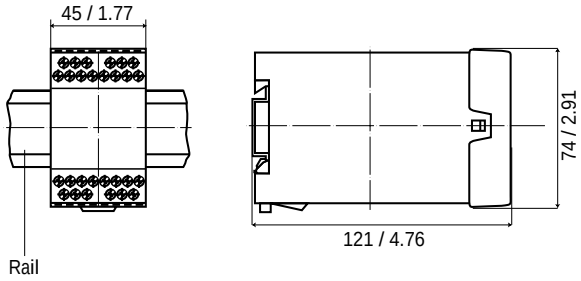
FF-SRM

Installation diagram

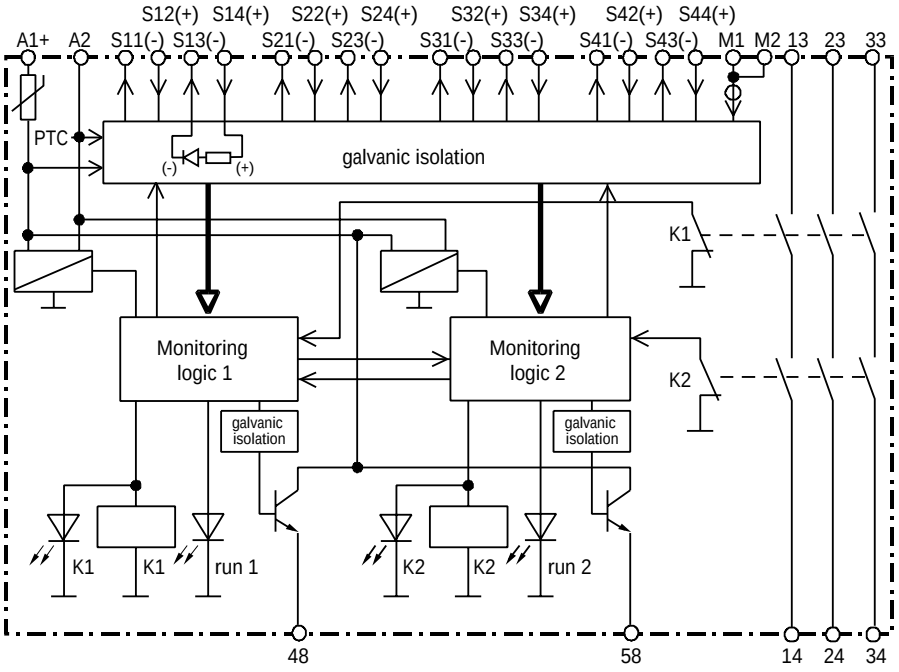


Mounting Dimensions

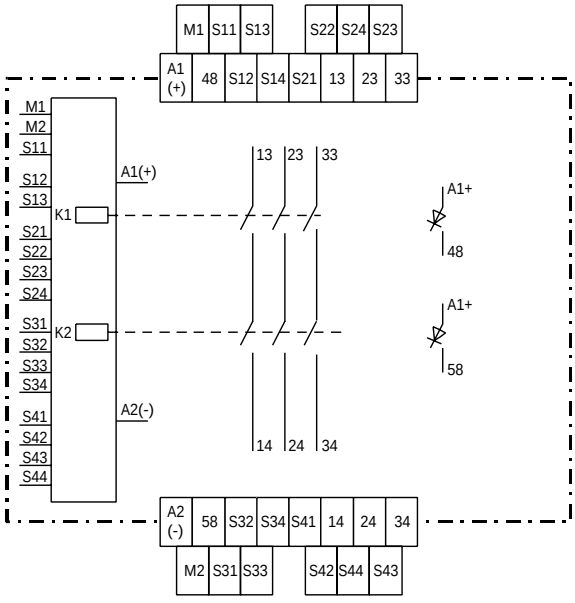
Width: 45 mm / 1.77 in ; Height: 74 mm / 2.91 in;
Depth: 121 mm / 4.76 in



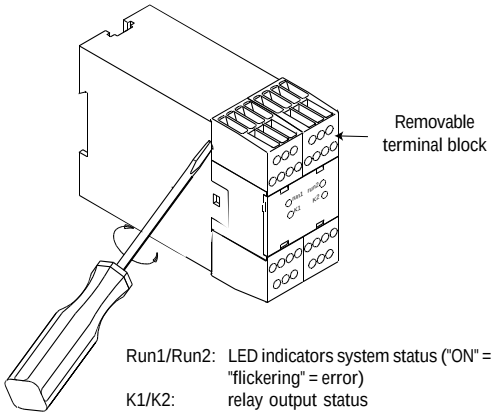
Internal circuitry



Front panel



Removable terminal blocks



Run1/Run2: LED indicators system status ("ON" = ON, "flickering" = error)
K1/K2: relay output status

FF-SRM

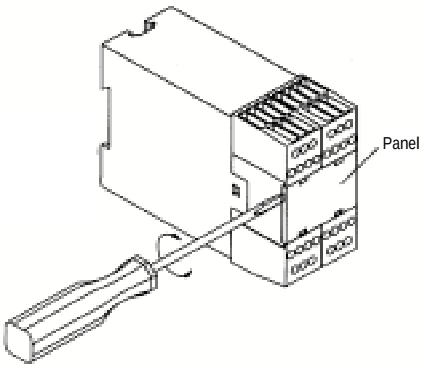
Mode setting

The operating modes of the FF-SRM200P2 module are set using 4 selectors located behind the removable front panel. 60 different programs are available allowing to adapt the muting mode and the max. muting time to the application.

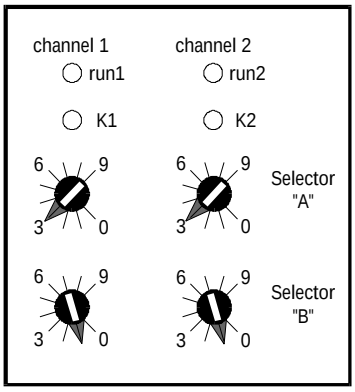
The FF-SRM200P2 module has two redundant microprocessor channels. The mode setting of each channel is done by two selectors "A" and "B".

The position of the corresponding selector "A" or "B" for channel 1 and channel 2 must be identical (see example).

Front panel removal



Mode selector "A" and "B" for channel 1 and channel 2



Internal view

example "31"

Example: Selecting mode **"31"**

Selector	Channel 1	Channel 2	Description
"A"	3	3	Muting with 2 auxiliary sensors
"B"	1	1	Maximum muting time: 20 s

MUTING MODES

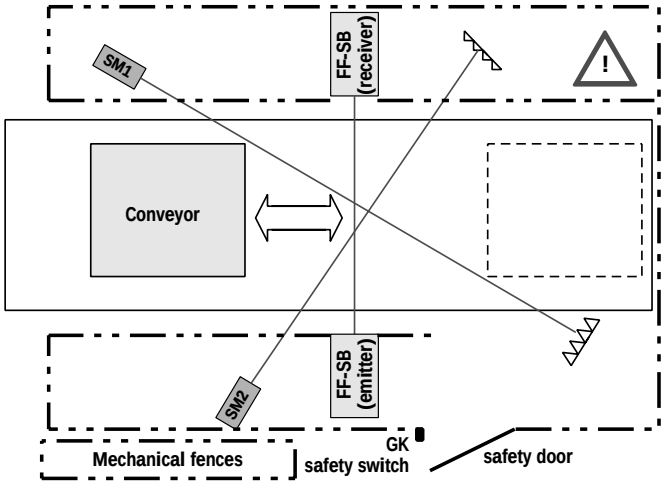
				Inputs	Selector "B": Max. muting time									
					0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
		1	Not valid (*Note (3)*)		Not valid									
Selector "A": Muting modes	**Safety device without test input**	**2**	- 2 muting sensors SM1, SM2 - 1 mutable safety device - No or 1 non-mutable safety device *Note: (1)* *Application examples: 1A, 1B, 3B*	(S31/S32) (S33/S34) (S11/S12, S13/S14) (S21/S22, S23/S24)	10 s	20 s	30 s	1 mn	5 mn	10 mn	30 mn	1 h	3 h	> 3 days
		3	- 2 muting sensors SM1, SM2 - 1 or 2 mutable safety devices *Notes: (1), (4)* *Application examples: 3A*	(S31/S32) (S33/S34) (S11/S12, S13/S14) (S21/S22, S23/S24)										
		4	- 2 start muting sensors SM1, SM2 - 2 end muting sensors EM1, EM2 - 1 mutable safety device *Note: (1)* *Application examples: 2, 5*	(S31/S32) (S33/S34) (S21/S22) (S23/S24) (S11/S12, S13/S14)										
	Safety device with test input	**5**	- 2 muting sensors SM1, SM2 - 1 mutable safety device - No or 1 non-mutable safety device *Note: (2)* *Test Input example*	(S31/S32) (S33/S34) (S11/S12, S13/S14) (S21/S22, S23/S24)										
		6	- 2 muting sensors SM1, SM2 - 1 or 2 mutable safety devices *Notes: (1), (4)* *Test Input example*	(S31/S32) (S33/S34) (S11/S12, S13/S14) (S21/S22, S23/S24)										
		7	- 2 start muting sensors SM1, SM2 - 2 end muting sensors EM1, EM2 - 1 mutable safety device *Note: (1)* *Test Input example*	(S31/S32) (S33/S34) (S21/S22) (S23/S24) (S11/S12, S13/S14)										

Note (1): Activation of the mutable safety device(s) is (are) NOT necessary during muting sequence.
Note (2): Activation of the mutable safety device is necessary during muting sequence.
Note (3): If a not valid mode has been selected, fatal error 5 is displayed (see "Diagnostic Information" for details).
Note (4): The 2 mutable safety devices are muted simultaneously.

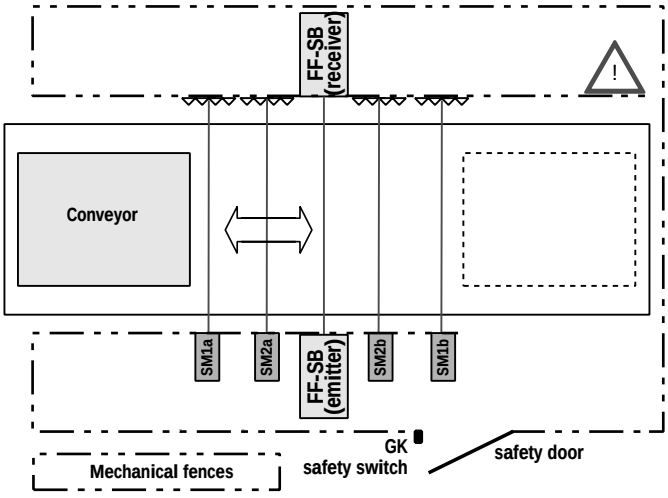
MUTUAL EXCLUSION MODES		Inputs			Selector "B": Test input and External Device Monitoring (EDM) functions									
		Robot detection	Operator detection	Position sensor	Safety device without test input		Safety device with test input							
					0	1	2	3	4	5	6	7	8	9
Selector "A": Mutual exclusion	9	(S11/S12, S13/S14)	(S21/S22, S23/S24)	(S31/S32)	With EDM	Without EDM	With EDM	Without EDM	Not valid					

Application example 1: Bi-directional muting on a conveyor

1A - Bi-directional muting with 2 muting sensors, 1 mutable and 1 non-mutable safety device



1B - Bi-directional muting with 4 muting sensors, 1 mutable and 1 non-mutable safety device



Description

A conveyor is loading and unloading a hazardous zone protected by one or two safety devices (e.g. safety light curtain, safety key interlock switch). As the conveyor enters and exits the zone passing by the same point, the movement is bi-directional.

The muting system is composed of the following elements:

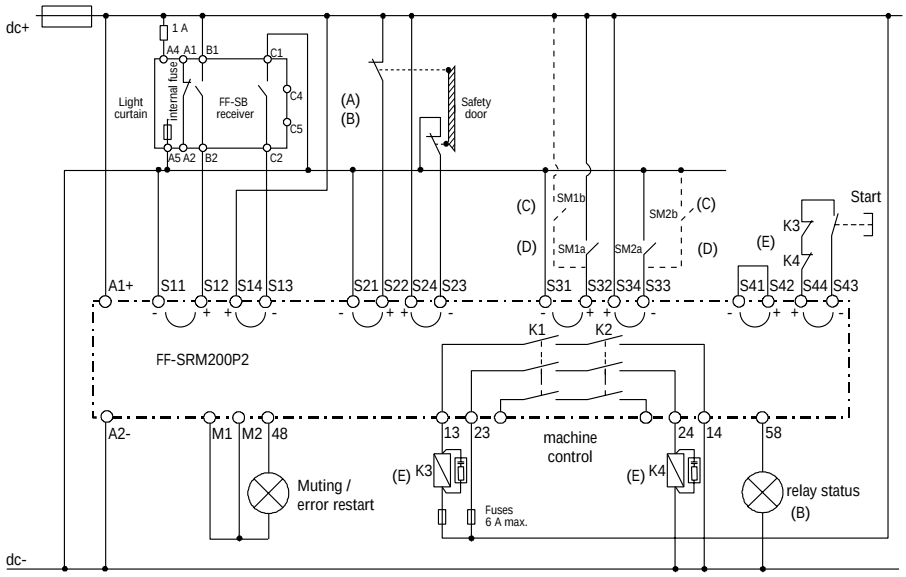
- the FF-SRM200P2 muting module,
- 1 mutable safety device (e.g. FF-SB safety light curtain) detecting access through the opening for the conveyor,
- 1 non-mutable safety device (e.g. GK safety key interlock) to monitor the safety door ("guard only"),
- example 1A: 2 auxiliary muting sensors SM1 and SM2 to start and end the muting sequence (crossed through scan or retro-reflective-polarised photoelectric sensors),
- example 1B: 4 auxiliary muting sensors SM1a, SM2a, SM1b and SM2b to start and end the muting sequence (e.g. limit switches, proximity sensors, through scan or retro-reflective-polarised photoelectric sensors).

The use of the second non-mutable safety device connectable to the same FF-SRM200P2 module is optional.

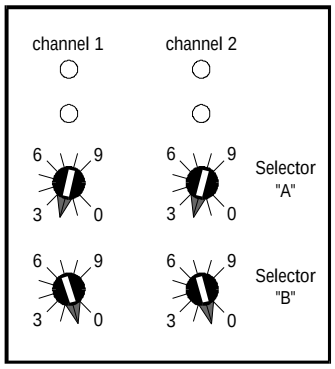
In order to start a **muting sequence**, the muting sensors SM1 and SM2 must be activated within a time frame of maximum 10 s. The muting sequence is stopped after de-activating the first of the two muting sensors.

In any case, the muting sequence will be interrupted after the **maximum selected muting time** has elapsed. If an object remains accidentally in the detection field of the muted safety device and the muting time has elapsed, an external Temporary Manual Muting (TMM, customer supplied) may be used to evacuate the detection field.

Wiring diagram



Mode selector



Internal view

Mode 20 to 29: muting with 2 muting sensors, 1 mutable and 1 non-mutable safety device (not tested).
Example: mode 21: max. muting time: 20 s.

Note (A): Connect mutable safety device to S11/S12 and S13/S14. Connect non-mutable safety device to S21/S22 and S23/S24.
Signals between redundant safety device inputs S11 to S14 or S21 to S24 must be applied within a max. time of 2,5 s.
Modes 20 to 39: muting using safety devices without test input: unused safety device inputs must be connected to power: S21 and S23 to (dc-); S22 and S24 to (dc+).

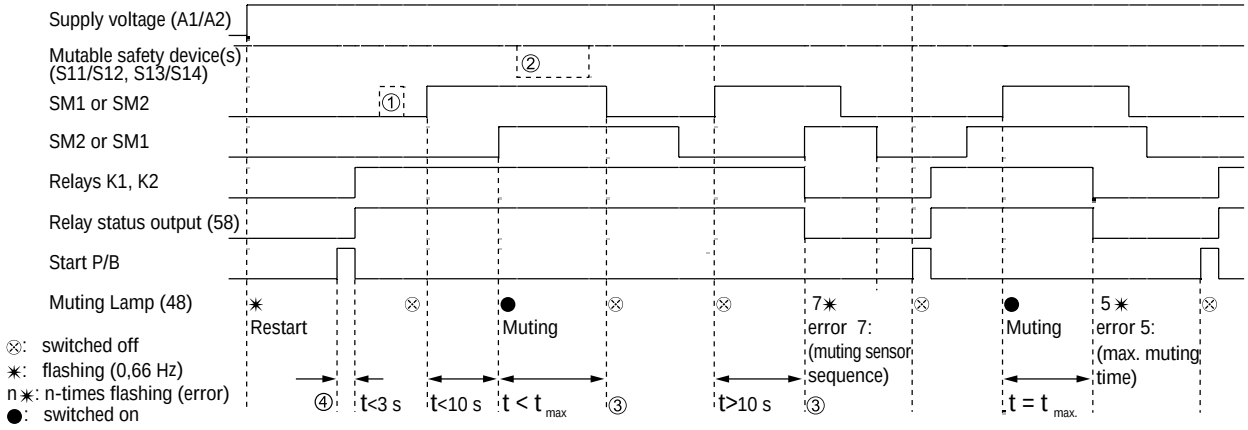
Note (B): Modes 50 to 69: muting using safety devices with test input: terminal 58 is used as test output that must be connected to the test input of each safety device. Unused safety device inputs must be connected to power and to the test output: S21 and S23 to (dc-); S22 and S24 to 58 (refer to Chapter "Test input").
Modes 50 to 59 (only): 1 non-mutable and 1 mutable safety device AND safety devices with test input: the mutable safety device needs to be activated during the muting sequence.

Note (C): Bi-directional muting with 4 SM muting sensors (example 1B): connect SM1b and SM2b as shown in parallel to SM1a and SM2a.

Note (D): Sensors contact type: this can be voltage free dry contacts or static outputs. When using sensors with static outputs, use 1 PNP and 1 NPN sensor to allow cross fault detection between the input channels.

Note (E): External contactors: when external contactors are used, connect one normally closed contact of each contactor (or the normally closed contact of the FF-SRE extension module) in series into the combined restart loop and External Device Monitoring (EDM) loop S43/S44. Install arc suppressors across the coils of external safety relays.

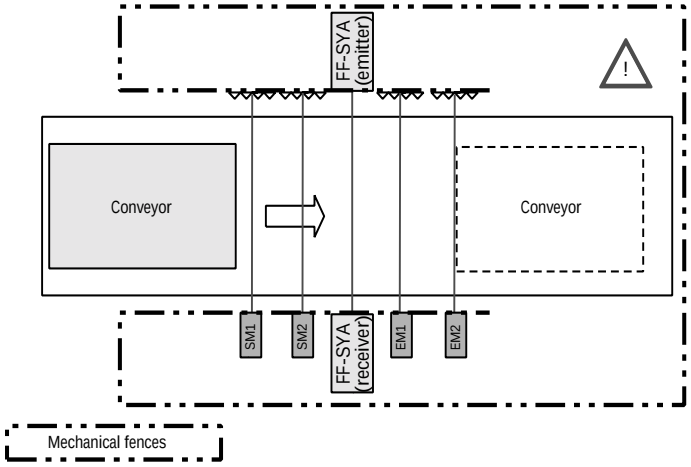
Functional diagram



Notes:

- Maximum coïncidence time between activation of muting sensors SM1 / SM2: 10 s (only the raising signal edge is taken into account).
- Muting sensors can be activated in any order (SM1 then SM2 or SM2 then SM1).
- All muting sensors SM1 and SM2 must remain activated during a muting sequence. In the case of 2 pairs of muting sensors at least one of each parallel sensor (SM1a or SM1b, SM2a or SM2b) must remain activated.
- The de-activation of the first muting sensor SM1 or SM2 will stop the muting sequence (only the falling signal edge is taken into account). In the case of 2 pairs of muting sensors, the de-activation of the first muting sensor group (SM1a / SM1b or SM2a / SM2b) will stop the muting sequence.
- tmax.: max. muting time programmable with the internal selector "B".
- The activation of only one sensor SM is ignored (see ①).
- The activation of the mutable safety device is not necessary during a muting sequence (except modes 50 to 59) (see ②).
- Muting sensors SM1 and SM2 must be inactive before starting a new muting sequence (see ③).
- The restart push-button must be pushed AND released within 3 s to start the module (see ④).
- Activating the non mutable safety device leads to the de-energisation of the safety relay outputs of the module).

Application example 2: Uni-directional muting with 1 mutable safety device and 4 muting sensors



Description

A conveyor is loading and unloading a hazardous zone protected by one mutable safety device (e.g. safety light curtain). As the conveyor enters and exits the zone at two different points, the movement is uni-directional.

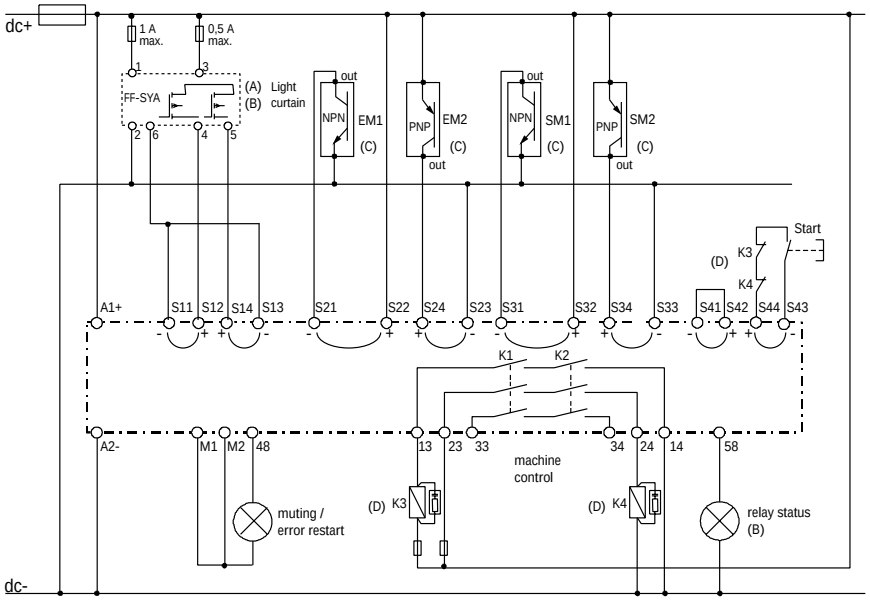
The muting system is composed of the following elements:

- the FF-SRM200P2 muting module,
- 1 mutable safety device (e.g. FF-SYA safety light curtain) detecting access through the opening for the conveyor,
- 2 start muting sensors SM1, SM2 and 2 end muting sensors EM1, EM2 (e.g. limit switches, proximity sensors, through scan or retro-reflective-polarised photoelectric sensors).

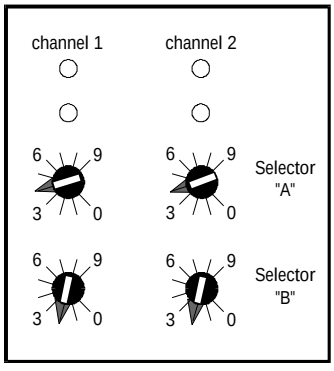
In order to start a **muting sequence**, the muting sensors SM1 and SM2 must be activated within a time frame of maximum 10 s. The muting sequence is stopped after de-activating the first of the two end muting sensors EM1 or EM2.

In any case, the muting sequence will be interrupted after the **maximum selected muting time** has elapsed. If an object remains accidentally in the detection field of the muted safety device and the muting time has elapsed an external Temporary Manual Muting (TMM, customer supplied) may be used to evacuate the detection field.

Wiring diagram



Mode selector



Modes 40 to 49: muting with 2 start muting sensors SM1, SM2, 2 end muting sensors EM1, EM2 and 1 mutable safety device without test input. Example: mode 42: max. muting time 30 s.

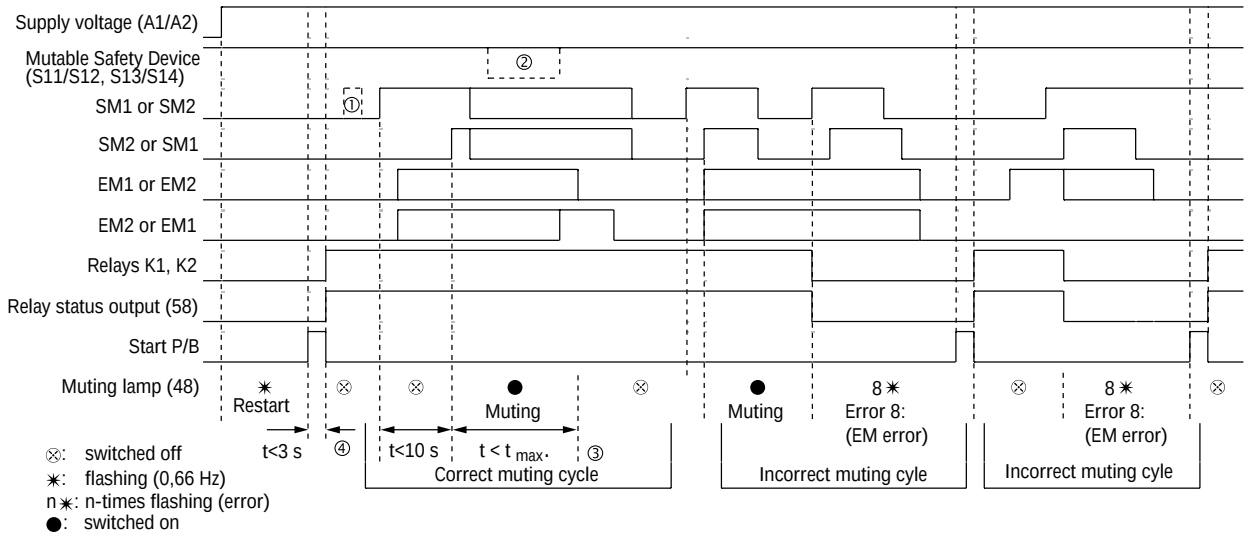
Note (A): Signals between redundant safety device inputs S11 to S14 must be applied within a max. time of 2.5 s.

Note (B): Modes 70 to 79: muting using safety devices with test input: Terminal 58 is used as test output that must be connected to the test input of the safety device (refer to chapter "Test input").

Note (C): Sensors contact type: this could be voltage free dry contacts or static contacts. When using sensors with static outputs, use 1 PNP and 1 NPN sensor to allow cross fault detection between the input channels. Use sensors with open outputs when no object is detected.

Note (D): External contactors: When external contactors are used, connect one normally closed contact of each contactor (or the normally closed contact of the FF-SRE extension module) in series into the combined restart loop and External Device Monitoring (EDM) loop S43/S44. Install arc suppressors across the coils of external safety relays.

Functional diagram

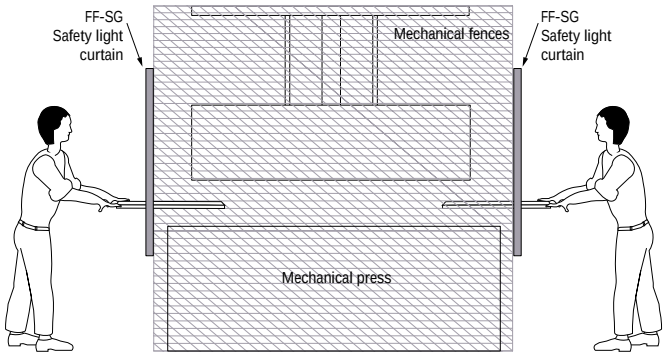


Notes:

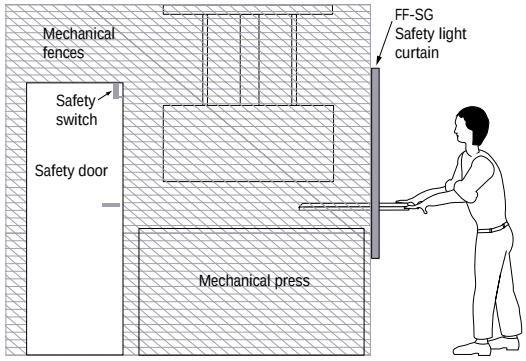
- Maximum coïncidence time between activation of muting sensors SM1 / SM2: 10 s (only the raising signal edge is taken into account).
- No timing constraints between EM1 / EM2.
- Muting sensors can be activated in any order within the pair (SM1 then SM2 or vice-versa, EM1 then EM2 or vice-versa).
- Once a valid muting sequence is started, both muting sensors SM1 and SM2 may be de-activated the muting sequence without stopping the muting sequence in progress.
- The de-activation of the first end muting sensor EM1 or EM2 will stop the muting sequence (only the falling signal edge is taking into account).
- tmax.: max. muting time programmable with the internal selector "B".
- The activation of only one sensor SM is ignored (see ①).
- The activation of the mutable safety device is not necessary during a muting sequence (except modes 50 to 59) (see ②).
- All SM and EM sensors must be inactive before starting a new muting sequence (see ③).
- The restart push-button must be pushed AND released within 3 s to start the module (see ④).
- Activating the not mutable safety device leads to the de-energisation of the safety relay output of the module.

Application example 3: Muting on a mechanical press

3A - Muting on a mechanical press with 2 muting sensors and 2 mutable safety devices



3B - Muting on a mechanical press with 2 muting sensors,1 mutable and 1 non-mutable safety device



Description

On a mechanical press, the mutable safety device(s) (e.g. safety light curtain) can be muted as soon as the press tool reaches the bottom dead centre (BDC), allowing the operator to unload the press during the opening stroke without stopping the press movement.

As soon as the press tool reaches the BDC, muting sensors SM1 and SM2 are activated by the rotating disk cam. A **muting sequence** will be started, when muting sensors SM1 and SM2 are activated within a time frame of 10 s.

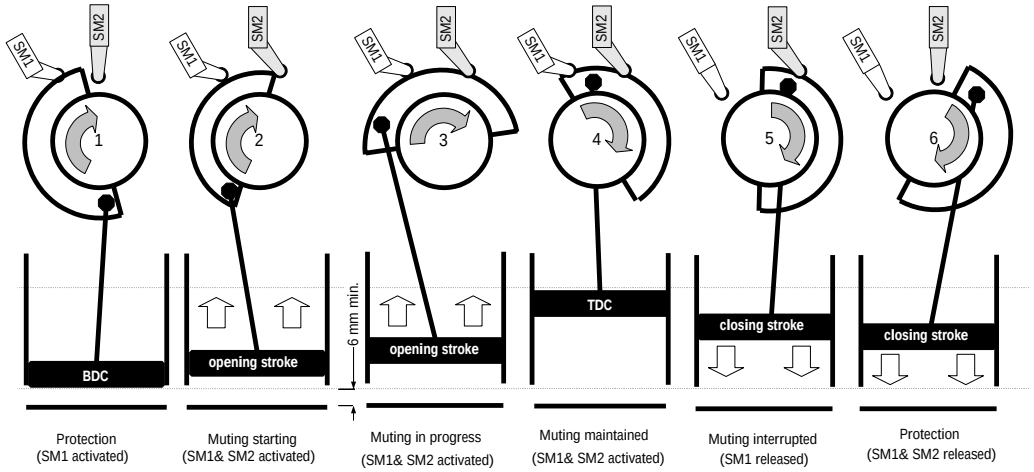
The muting sensors must remain activated till the press tool initiates its closing stroke. When the first of the two muting sensors is de-activated by the rotating disk cam, the muting sequence will be stopped.

The muting system is composed of the following elements:

- the FF-SRM200P2 muting module,
- example 3A: up to 2 mutable safety devices (e.g. FF-SG safety light curtains),
- example 3B: 1 mutable (e.g. FF-SG safety light curtain) and up to 1 non-mutable safety device (e.g. GK safety key interlock) to monitor the safety door ("guard only"),
- 2 muting sensors SM1 and SM2 to start and end the muting sequence.

The use of the second mutable or non-mutable safety device connectable to the same FF-SRM200P2 module is optional.

In any case, the muting sequence will be interrupted after the **maximum selected muting time** has elapsed. If an object remains accidentally in the detection field of the muted safety device and the muting time has elapsed, an external Temporary Manual Muting (TMM, customer supplied) must be used to evacuate the detection field.



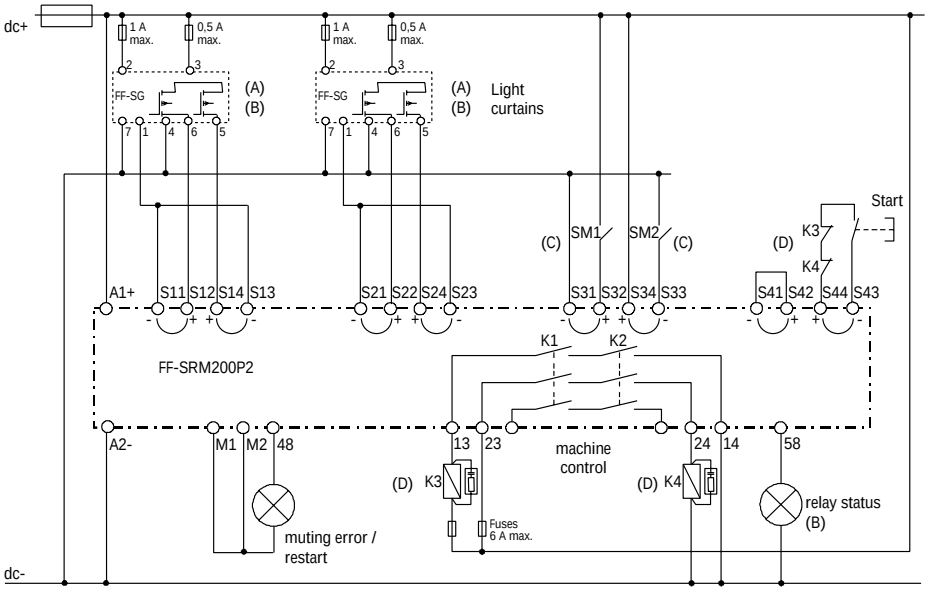
SM1: muting sensor 1

SM2: muting sensor 2

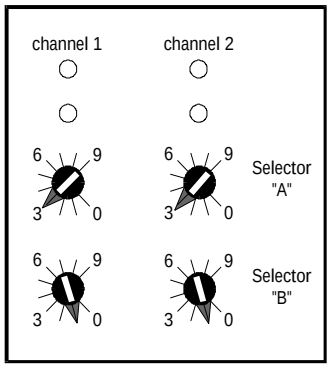
BDC (Bottom Dead Center): point at which the tool is closest to the die.

TDC (Top Dead Center): point at which the tool is furthest to the die.

Typical wiring diagram application example 3A



Mode selector



Internal view

Modes 30 to 39: muting with 2 muting sensors and 2 mutable safety devices.

Example: mode 31: max. muting time 20 s.

Note (A): Signals between redundant safety device inputs S11 to S14 or S21 to S24 must be applied within a max. time of 2.5 s.

Modes 20 to 39: muting using safety devices without test input: Unused safety device inputs must be connected to power: S21 and S23 to (dc-); S22 and S24 to (dc+).

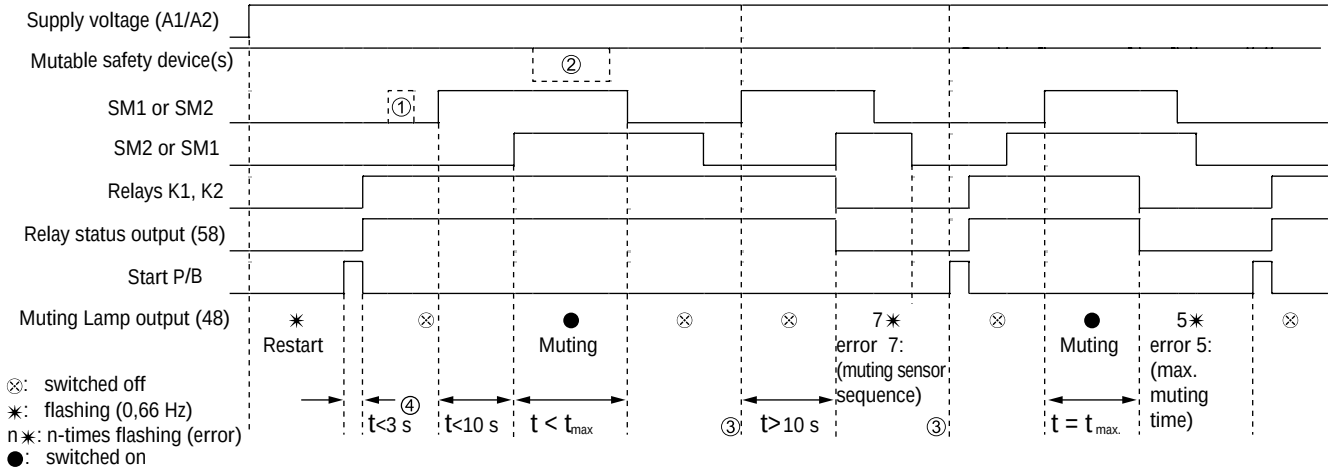
Note (B): Modes 50 to 69: muting using safety devices with test input: Terminal 58 is used as test output that must be connected to the test input of each safety device (refer to chapter "Test input").

Modes 50 to 59 (only): 1 non-mutable and 1 mutable safety device AND safety devices with test input: the mutable safety device needs to be activated during the muting sequence.

Note (C): Sensors contact type: Safety switch contacts are preferred for press applications.

Note (D): External contactors: when external contactors are used, connect one normally closed contact of each contactor (or the normally closed contact of the FF-SRE extension module) in series into the combined restart loop and External Device Monitoring (EDM) loop S43/S44. Install arc suppressors across the coils of external safety relays.

Functional diagram

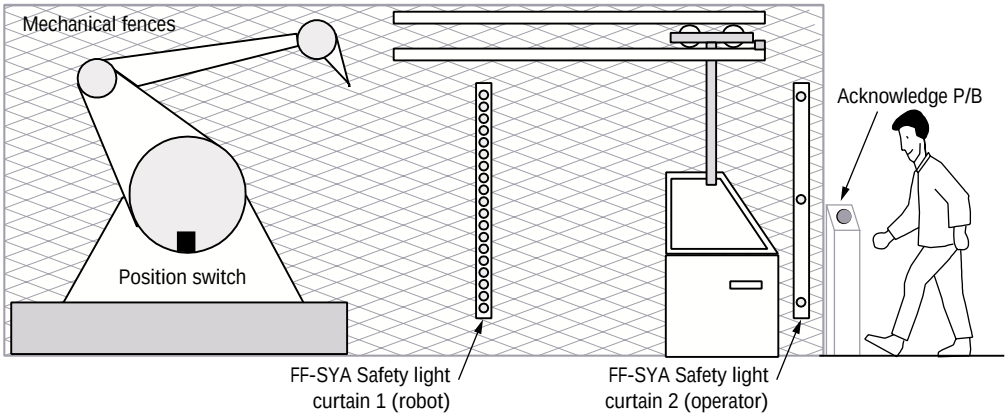


Notes:

- Maximum coïncidence time between activation of muting sensors SM1 / SM2: 10 s (only the raising signal edge is taken into account).
- Muting sensors can be activated in any order (SM1 then SM2 or SM2 then SM1).
- All muting sensors SM1 and SM2 must remain activated during a muting sequence.
- The de-activation of the first muting sensor SM1 or SM2 will stop the muting sequence (only the falling signal edge is taking into account).
- tmax.: max. muting time programmable with the internal selector "B".
- The activation of only one sensor SM is ignored (see ①).
- The activation of the mutable safety device is not necessary during a muting sequence (except for modes 50 to 59) (see ②).
- Muting sensors SM1 and SM2 must be inactive before starting a new muting sequence (see ③).
- The restart push-button must be pushed AND released within 3 s to start the module (see ④).
- Activating the not mutable safety device leads to the de-energisation of the safety relay output of the module.

Application example 4: Mutual exclusion function in a robot area

Mutual exclusion function with 2 safety devices and an enabling contact



Description

A robot and an operator regularly access the same hazardous area in order to carry out operations.

The mutual exclusion principle consists in:

- allowing the operator access to the hazardous area only when the robot is outside of it,
- allowing the robot access to the hazardous area only when the operator is outside of it and has acknowledged exiting the area.

The mutual exclusion system is composed of the following elements:

- the FF-SRM200P2 muting module,
- safety device 1 (e.g. FF-SYA safety light curtain 1) monitoring the access of the robot into the area,
- safety device 2 (e.g. FF-SYA safety light curtain 2) monitoring the access of the operator into the area,
- an optional safety device (e.g. safety switch) monitoring the robot position, before it is detected by safety light curtain 1,
- an acknowledge push-button located outside of the area.

The functional principle of the mutual exclusion consists in not allowing the activation of the safety devices for the operator and the robot at the same time. When the operator is entering the area activating safety light curtain 2, the access is memorised in the module. After leaving the area the operator needs to push the acknowledge push-button to confirm his exit. This push-button must be located outside the area with a clear view to the hazard.

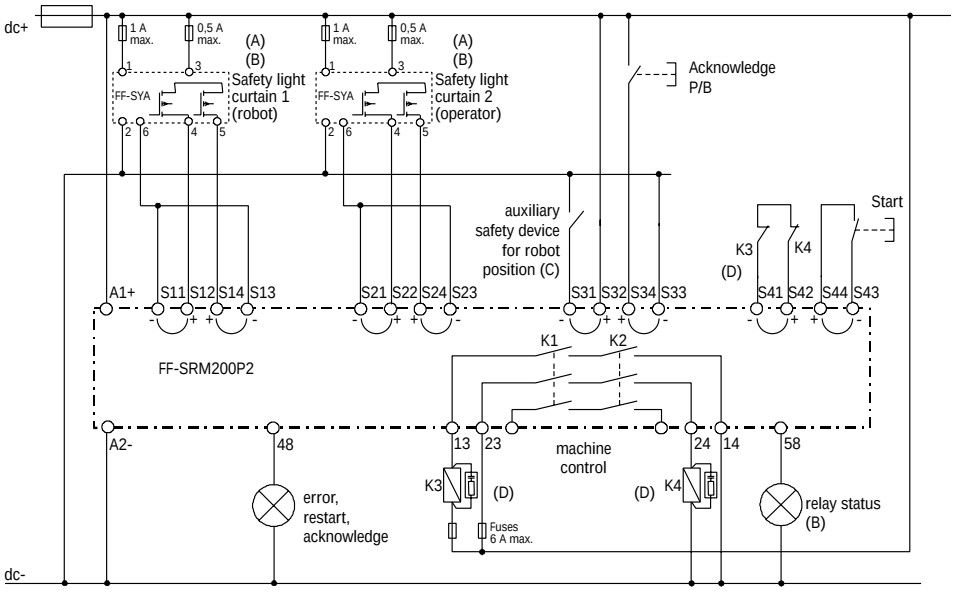
If the robot activates safety light curtain 1 before the operator has pushed the acknowledge push-button, the hazard will be stopped through the safety relay outputs of the FF-SRM200P2 muting module.

The hazard will also be stopped if safety light curtain 1 is activated and the operator attempts to enter the area actuating safety light curtain 2.

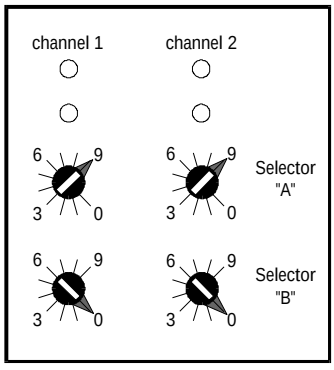
In order to increase safety (especially when the operator is likely to work close to safety light curtain 1 (robot) without keeping the required safety distance), safety may be increased by installing an additional safety sensor (e.g. safety switch) to monitor and anticipate the robot position.

If used, both the auxiliary safety device AND the safety light curtain 1 must have their sensing fields free (= voltage is applied to the module inputs S11 to S14, S31 and S32), in order to allow the operator to enter the hazardous area. As soon as the robot is detected by AT LEAST ONE of the robots safety devices (light curtain 1 or additional safety switch), the operator is not allowed to enter the hazardous area without stopping the hazard.

Typical wiring diagram



Mode selector



Internal view

Modes 90 to 93: mutual exclusion.

Example: mode 90 (safety device without test input and with EDM).

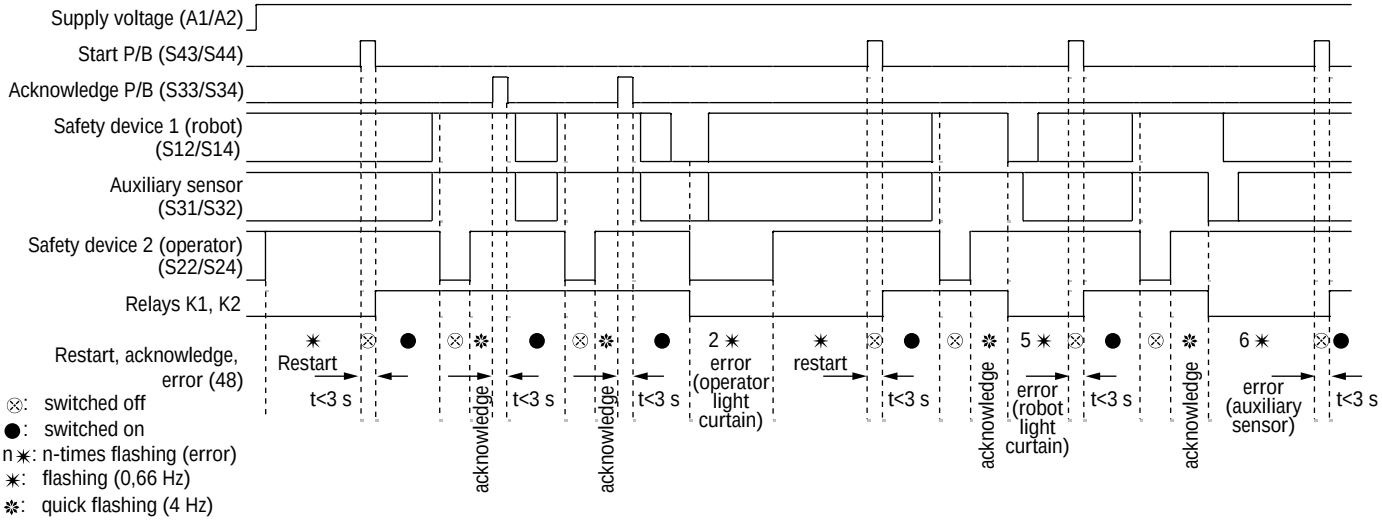
Note (A): Signals between redundant safety device inputs S11 to S14 or S21 to S24 must be applied within a max. time of 2.5 s.

Note (B): **Modes 92 and 93: mutual exclusion using safety devices with test input:** Terminal 58 is used as test output that must be connected to the test input of each safety device (included auxiliary safety device, see chapter "Test input").

Note (C): Auxiliary safety device for robot position (use is application depending and optional):
Modes 90 to 91: mutual exclusion using safety devices without test input: if used, connect the auxiliary safety device between (dc-) and S31 and S32 to (dc+). Unused robot position inputs must be connected to power: S31 to (dc-) and S32 to (dc+).
Modes 92 to 93: mutual exclusion using safety devices with test input: terminal 58 is used as test output that must be connected to the test input of each safety device (including the auxiliary safety device, see chapter "Test input").

Note (D): **External contactors:** when external contactors are used, connect one normally closed contact of each contact (or the normally closed contact of the FF-SRE extension module) in series into the External Device Monitoring (EDM) loop S41/S42 and select the modes with EDM (modes 90 or 92). In these modes, the muting module also checks, whether the normally closed contacts of the external safety relays have opened max. 250 ms after energising the internal safety relays K1 and K2. Install arc suppressors across the coils of external safety relays.

Functional diagram



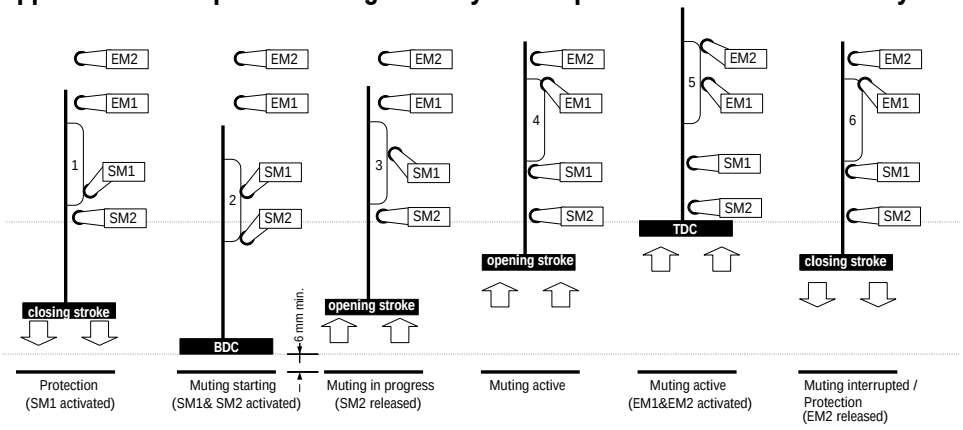
Notes:

- Safety device 1 (robot) and the auxiliary safety device for the robot position are permanently muted (allowing the robot to enter the hazardous area):
  1. If safety device 2 (operator) is not activated
  OR
  2. If safety device 2 has been activated, but the operator has pushed the acknowledge push-button, to confirm that he has left the hazardous area.
- The start push-button must be pushed AND released within 3 s, to energise the safety output contact of the module.
- The acknowledge push-button must be pushed for acknowlegment during less than 3 s.The module de-energises its safety output contacts, when the push-button is pushed longer than 3 s.
- Pushing the start push-button with one or both of the robot's safety devices activated leads to the energisation of the module output contacts:
  1. If safety device 2 (operator) is not activated
  OR
  2. If safety device 2 has been activated, but the operator has pushed the acknowledge push-button, to confirm that he has left the hazardous area.

OTHER EXAMPLES

The following application examples are detailed in the installation manual of the FF-SRM200P2 muting module.

Application example 5: Muting on a hydraulic press with 1 mutable safety device and 4 muting sensors



SM1 Start muting sensor 1
SM2 Start muting sensor 2
EM1 End muting sensor 1
EM2 End muting sensor 2

BDC (Bottom Dead Center): point at which the tool is closest to the die.

TDC (Top Dead Center): point at which the tool is furthest to the die.

Description

On a hydraulic press, the safety device (e.g. safety light curtain) can be muted as soon as the press tool reaches the bottom dead centre (BDC), allowing the operator to unload the press during the opening stroke without stopping the movement of the press.

The muting system is composed of the following elements:

- the FF-SRM200P2 muting module,
- 1 mutable safety device (e.g. a safety light curtain)
- 2 start muting sensors and 2 end muting sensors (e.g. cam operated safety switches)

As soon as the press tool reaches the BDC, the start muting sensors SM1 and SM2 are activated. When activated within a time frame of maximum 10 s, a new muting sequence will be started. The end muting sensors EM1 and EM2 must get de-activated when the press tool starts its closing stroke. The muting sequence gets terminated as soon as the first of the end muting sensors is de-activated.

In any case, the muting sequence will be interrupted after the maximum selected muting time has elapsed. If an object remains accidentally in the detection field of the muted safety device and the muting time has elapsed, an external Temporary Manual Muting (TMM, customer supplied) may be used to evacuate the detection field.

TEST INPUT EXAMPLE

Muting using one FF-SLG18/FF-SLG30 type 2 safety light curtain with test input (modes 50 to 69)

When a type 3 or type 4 safety device is not often actuated, it may be useful to test the connected emergency stop chain from time to time. For this purpose, the FF-SRM200P2 muting module is equipped with a test output allowing to test the correct functioning of the connected emergency stop chain (i.e. safety device incl. external contactors, safety control modules, etc.) at certain steps of the process.
When connecting type 2 safety devices to the FF-SRM200P2 muting module, the test function must be used to check the safety integrity of the safety device.

Safety devices compatible with the FF-SRM200P2 test output

- FF-SLG18 and FF-SLG30 type 2 safety light curtains (all models with the exception of FF-SLG18147B2 and FF-SLG30147B2)
- Safety switches (e.g. for safety door monitoring).

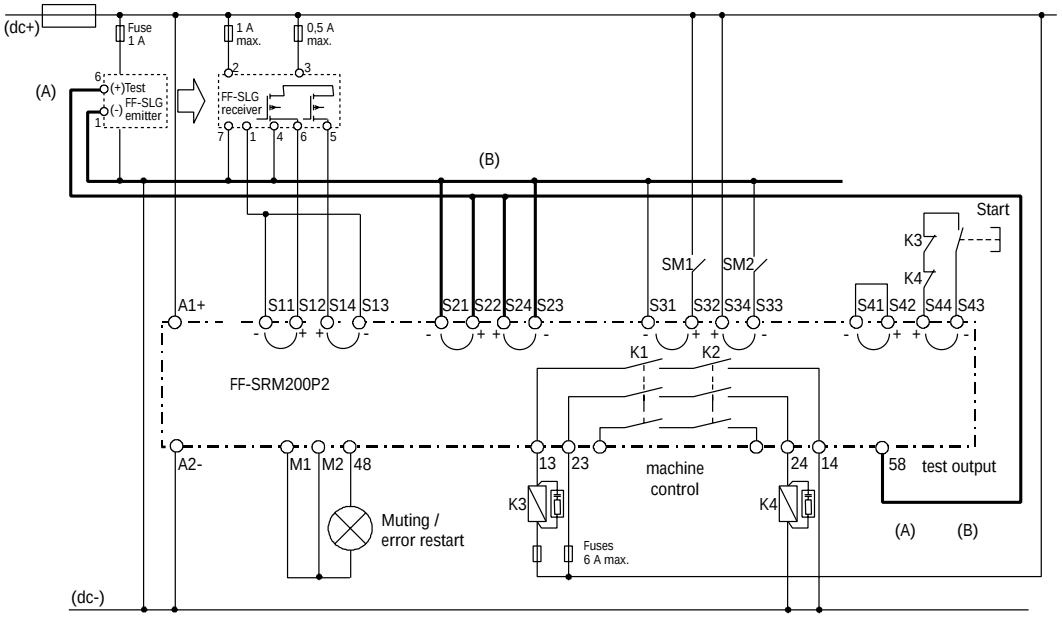
Modes with test

- Muting modes 50 to 79
- Mutual exclusion modes 92 to 93.

In these modes the output terminal 58 is used as test output and it must be connected to the test inputs of **all** connected safety devices, that are tested simultaneously.

A test signal is generated

- At each activation of the start push-button and each activation of the acknowledge push-button
- At each new and valid muting sequence (muting lamp light on).



Note (A): The FF-SLG18/FF-SLG30 emitter and receiver needs to be powered AFTER the FF-SRM200P2 muting module. Otherwise, the test sequence at power up may not work. Connect test output terminal 58 to the test input of each FF-SLG18/FF-SLG30 emitter as shown in the wiring diagram above while respecting the polarity of the test input terminals (test input (+) = terminal 6, test input (-) = terminal 1).

Note (B): Unused safety device inputs must be connected to power and to the test output: S21 and S23 to (dc-); S22 and S24 to 58.
Modes 50 to 59 (only): 1 non-mutable and 1 mutable safety device AND safety devices with test input: the mutable safety device needs to be activated during the muting sequence.

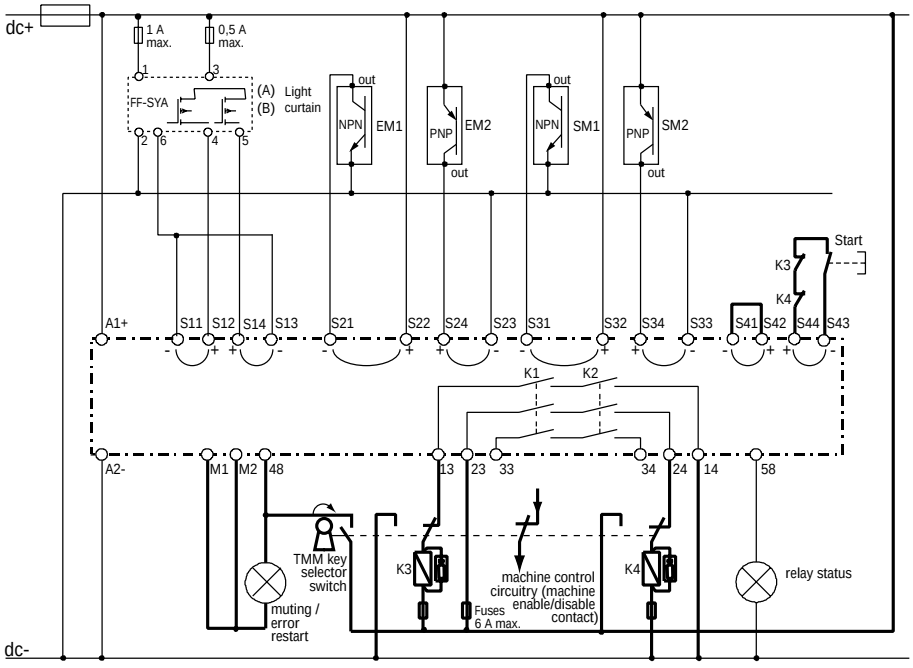
TEMPORARY MANUAL MUTING EXAMPLE

Uni-directional muting with 1 mutable safety device and 4 muting sensors

An external Temporary Manual Muting (TMM) may be necessary, in order to evacuate an object (e.g. a palette with goods in a conveyor application) accidentally remaining in the detection field of a safety device.

The use of a TMM may be necessary in the following cases:
- An object remains in the detection field of a safety device.
- The selected maximum muting time has elapsed.
- Loss of power.
- An application error or a fatal error occured on the module (e.g. muting lamp failure).

The external TMM system shall be composed by the following components (customer supplied):
- One dual contact key selector switch with two positions or two separate key selector switches with two positions (alternative: two-hand control).
- Two external safety contactors (with mechanically guided contacts and a normally closed EDM monitoring contact).
- The muting lamp (already connected to terminal 48 of the module).



Diagnostic informations

Detailed diagnostic information for an easy troubleshooting of your muting application is available using the following indicators:

- internal indicators: LED "RUN1" and "RUN2" located on the module front panel,
- external indicators: muting lamp connected to terminals 48.

In the case of a failure the indicators are indicating a flashing code. There exist two types of errors:

- **FATAL ERRORS** are only indicated by flashing internal LED's "RUN1" and /or "RUN2". The muting lamp connected to terminal 48 remains permanently off.
  The normally open safety contacts (13/14, 23/24, 33/34) are de-energised and the module needs to be reset by taking the power off and on after resolving the error cause.
- **APPLICATION AND INSTALLATION ERRORS** are indicated by flashing internal LED "RUN1" and the muting lamp connected to terminal 48. LED "RUN2" is permanently on.
  The normally open safety contacts (13/14, 23/24, 33/34) are de-energised, but the module can be restarted pushing the start push-button after resolving the error cause.

FATAL ERRORS				
Error code	**LED RUN 1**	**LED RUN 2**	**Muting lamp (48)**	**Error type**
0	⊗	⊗	⊗	Internal module error
5	5 ✳ (1)	5 ✳ (1)	⊗	Mode selector error
6	6 ✳	⊗	⊗	Under-voltage error
	⊗	6 ✳	⊗	Over-voltage error
7	7 ✳ (1)	7 ✳ (1)	⊗	Input error
8	8 ✳ (1)	8 ✳ (1)	⊗	Relay contact error
9 10 11 12 13	9-13 ✳ (1)	9-13 ✳ (1)	⊗	Internal module error

Note (1): It is possible that
- LED "RUN1" and "RUN2" are indicating different error codes or,
- only one LED "RUN1" or "RUN2" is indicating an error code and the second LED "RUN1" or "RUN2" is switched off.

APPLICATION AND INSTALLATION ERRORS				
Error code	**LED RUN 1**	**LED RUN 2**	**Muting lamp (48)**	**Error type**
1	1 ✳	●	1 ✳	Safety device error
2	2 ✳	●	2 ✳	Safety device activated (e.g. beam interruption of a safety device light curtain)
3	3 ✳	●	3 ✳	Restart P/B error
4	4 ✳	●	4 ✳	External device monitoring (EDM) error
5	5 ✳	●	5 ✳	Max. muting time error (muting modes)
				Safety device 1 (robot) error (mutual exclusion modes)
6	6 ✳	●	6 ✳	Muting lamp error (muting modes)
				Robot position sensor error (mutual exclusion modes)
7	7 ✳	●	7 ✳	Start muting sensor (SM) error
8	8 ✳	●	8 ✳	End muting sensor (EM) error

⊗: switched off n ✳: n-times flashing ●: switched on

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