Modicon MCM

Standalone Safety Controller XPSMCMCB1604SA(G)

User Guide

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www.se.com

Legal Information

The information provided in this document contains general descriptions, technical characteristics and/or recommendations related to products/solutions.

This document is not intended as a substitute for a detailed study or operational and site-specific development or schematic plan. It is not to be used for determining suitability or reliability of the products/solutions for specific user applications. It is the duty of any such user to perform or have any professional expert of its choice (integrator, specifier or the like) perform the appropriate and comprehensive risk analysis, evaluation and testing of the products/solutions with respect to the relevant specific application or use thereof.

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Safety Information

Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

Please Note

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

Before You Begin

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

⚠WARNING

UNGUARDED EQUIPMENT

- Do not use this software and related automation equipment on equipment which does not have point-of-operation protection.
- Do not reach into machinery during operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This automation equipment and related software is used to control a variety of industrial processes. The type or model of automation equipment suitable for each application will vary depending on factors such as the control function required, degree of protection required, production methods, unusual conditions, government regulations, etc. In some applications, more than one processor may be required, as when backup redundancy is needed.

Only you, the user, machine builder or system integrator can be aware of all the conditions and factors present during setup, operation, and maintenance of the machine and, therefore, can determine the automation equipment and the related safeties and interlocks which can be properly used. When selecting automation and control equipment and related software for a particular application, you should refer to the applicable local and national standards and regulations. The National Safety Council's Accident Prevention Manual (nationally recognized in the United States of America) also provides much useful information.

In some applications, such as packaging machinery, additional operator protection such as point-of-operation guarding must be provided. This is necessary if the operator's hands and other parts of the body are free to enter the pinch points or other hazardous areas and serious injury can occur. Software products alone cannot protect an operator from injury. For this reason the software cannot be substituted for or take the place of point-of-operation protection.

Ensure that appropriate safeties and mechanical/electrical interlocks related to point-of-operation protection have been installed and are operational before placing the equipment into service. All interlocks and safeties related to point-of-operation protection must be coordinated with the related automation equipment and software programming.

NOTE: Coordination of safeties and mechanical/electrical interlocks for point-of-operation protection is outside the scope of the Function Block Library, System User Guide, or other implementation referenced in this documentation.

Start-up and Test

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check are made and that enough time is allowed to perform complete and satisfactory testing.

⚠WARNING

EQUIPMENT OPERATION HAZARD

- Verify that all installation and set up procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.
- Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and temporary grounds that are not installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove all temporary grounds from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

Operation and Adjustments

The following precautions are from the NEMA Standards Publication ICS 7.1-1995:

(In case of divergence or contradiction between any translation and the English original, the original text in the English language will prevail.)

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer’s instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer’s instructions and the machinery used with the electrical equipment.
- Only those operational adjustments required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

About the Document

Document Scope

The present document describes how to use the Standalone Safety Controller XPSMCMCB1604SA(G), which can be configured using the SoSafe MCM Basic software.

Validity Note

This document has been updated for the release of SoSafe MCM Basic V1.0.3.

The characteristics of the products described in this document are intended to match the characteristics that are available on www.se.com. As part of our corporate strategy for constant improvement, we may revise the content over time to enhance clarity and accuracy. If you see a difference between the characteristics in this document and the characteristics on www.se.com, consider www.se.com to contain the latest information.

Product Related Information

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to this equipment.
- Use only the specified voltage when operating this equipment and any associated equipment.

Failure to follow these instructions will result in death or serious injury.

⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Do not use the equipment described herein to supply external equipment.
- Do not make contact with terminals until the power has been confirmed removed.
- Follow all electrical safety regulations and standards (for example, lockout/tag-out, phase grounding, barriers) to reduce the possibility of contact with hazardous voltages in the work area.
- Complete thorough hardware tests and system commissioning to verify that line voltages are not present on the control circuits before using your hardware operationally.

Failure to follow these instructions will result in death or serious injury.

⚠DANGER

LOSS OF DESIGNATED SAFETY FUNCTION

- Install the equipment in an enclosure with a degree of protection of at least IP 54.
- Use the same ground connection (0 Vdc) for all system components.
- Use a Protective Extra Low Voltage (PELV) power supply to isolate the equipment from line voltage.
- Do not directly connect the equipment to line voltage.

Failure to follow these instructions will result in death or serious injury.

⚠DANGER

POTENTIAL FOR EXPLOSION

Install and use the equipment in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

The Standalone Safety Controller XPSMCMCB1604SA(G) can reach a maximum Safety Integrity Level (SIL) 3 as per IEC 61508 and IEC 62061, and a maximum Performance Level (PL) e, category 4, as per ISO 13849-1. However, the definitive SIL and PL of the application depends on a number of safety-related components, their parameters, and the connections that are made, as per the risk analysis.

For details and exceptions, refer to the Standalone Safety Controller XPSMCMCB1604SA(G) key safety-related values, page 19.

The module must be configured in accordance with the application-specific risk analysis and all the applicable standards.

Ensure to conform to any safety information, different electrical requirements, and normative standards that would apply to your adaptation.

⚠WARNING

INSUFFICIENT SAFETY-RELATED FUNCTIONS

- Perform a risk assessment as per ISO 12100 and/or other equivalent assessment and appropriately consider all applicable regulations and standards that apply to your machine/process before using this software.
- In your risk assessment, determine all requirements regarding the Safety Integrity Level (SIL), the Performance Level (PL), and any other safety-related requirements and capabilities applicable to your machine/process.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

⚠WARNING

UNAUTHENTICATED ACCESS AND SUBSEQUENT UNAUTHORIZED MACHINE OPERATION

- Evaluate whether your environment or your machines are connected to your critical infrastructure and, if so, take appropriate steps in terms of prevention, based on Defense-in-Depth, before connecting the automation system to any network.
- Limit the number of devices connected to a network to the minimum necessary.
- Isolate your industrial network from other networks inside your company.
- Protect any network against unintended access by using firewalls, VPN, or other, proven security measures.
- Monitor activities within your systems.
- Prevent subject devices from direct access or direct link by unauthorized parties or unauthenticated actions.
- Prepare a recovery plan including backup of your system and process information.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For more information on organizational measures and rules covering access to infrastructures, refer to ISO/IEC 27000 series, Common Criteria for Information Technology Security Evaluation, ISO/IEC 15408, IEC 62351, ISA/IEC 62443, NIST Cybersecurity Framework, Information Security Forum - Standard of Good Practice for Information Security and refer to Cybersecurity Guidelines for EcoStruxure Machine Expert, Modicon and PacDrive Controllers and Associated Equipment.

⚠WARNING

LOSS OF CONTROL

- Perform a Failure Mode and Effects Analysis (FMEA), or equivalent risk analysis, of your application, and apply preventive and detective controls before implementation.
- Provide a fallback state for undesired control events or sequences.
- Provide separate or redundant control paths wherever required.
- Supply appropriate parameters, particularly for limits.
- Review the implications of transmission delays and take actions to mitigate them.
- Review the implications of communication link interruptions and take actions to mitigate them.
- Provide independent paths for control functions (for example, emergency stop, over-limit conditions, and error conditions) according to your risk assessment, and applicable codes and regulations.
- Apply local accident prevention and safety regulations and guidelines.[1]
- Test each implementation of a system for proper operation before placing it into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), *Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control* and to NEMA ICS 7.1 (latest edition), *Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems* or their equivalent governing your particular location.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The observation of operating limits and duty cycles is of particular importance for equipment designed to perform a safety-related function. If this module has been subjected to electrical, mechanical, or environmental conditions beyond its stated limits, do not use it.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Do not exceed any of the rated operating limits for the equipment specified in the present document.
- Immediately cease using and replace any equipment that has or might have been subjected to conditions beyond its rated operating limits.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

There are no user-serviceable parts in this equipment. For reasons of safety and compliance, only the manufacturer should perform repairs to this equipment.

⚠WARNING

LOSS OF SAFETY-RELATED FUNCTION

Do not attempt to repair or alter this equipment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

General Cybersecurity Information

In recent years, the growing number of networked machines and production plants has seen a corresponding increase in the potential for cyber threats, such as unauthorized access, data breaches, and operational disruptions. You must, therefore, consider all possible cybersecurity measures to help protect assets and systems against such threats.

To help keep your Schneider Electric products secure and protected, it is in your best interest to implement the cybersecurity best practices as described in the Cybersecurity Best Practices document.

Schneider Electric provides additional information and assistance:

- Subscribe to the Schneider Electric security newsletter.
- Visit the Cybersecurity Support Portal web page to:
  - Find Security Notifications.
  - Report vulnerabilities and incidents.
- Visit the Schneider Electric Cybersecurity and Data Protection Posture web page to:
  - Access the cybersecurity posture.
  - Learn more about cybersecurity in the cybersecurity academy.
  - Explore the cybersecurity services from Schneider Electric.

Product Related Cybersecurity Information

Refer to Cybersecurity Guidelines for EcoStruxure Machine Expert, Modicon and PacDrive Controllers and Associated Equipment User Guide.

Environmental Data

For product compliance and environmental information, refer to the Schneider Electric Environmental Data Program.

Available Languages of the Document

The document is available in these languages:

- English (EIO0000005307)
- French (EIO0000005308)
- German (EIO0000005309)
- Spanish (EIO0000005310)
- Italian (EIO0000005311)
- Portuguese (EIO0000005312)
- Chinese (EIO0000005313)

Related Documents

Title of documentation	Reference number
Cybersecurity Best Practices	CS-Best-Practices-2019-340
Cybersecurity Guidelines for EcoStruxure Machine Expert, Modicon and PacDrive Controllers and Associated Equipment User Guide	EIO0000004242

To find documents online, visit the Schneider Electric download center (www.se.com/ww/en/download/).

Information on Non-Inclusive or Insensitive Terminology

As a responsible, inclusive company, Schneider Electric is constantly updating its communications and products that contain non-inclusive or insensitive terminology. However, despite these efforts, our content may still contain terms that are deemed inappropriate by some customers.

Terminology Derived from Standards

The technical terms, terminology, symbols and the corresponding descriptions in the information contained herein, or that appear in or on the products themselves, are generally derived from the terms or definitions of international standards.

In the area of functional safety systems, drives and general automation, this may include, but is not limited to, terms such as *safety*, *safety function*, *safe state*, *fault*, *fault reset*, *malfunction*, *failure*, *error*, *error message*, *dangerous*, etc.

Among others, these standards include:

Standard	Description
IEC 61131-2:2007	Programmable controllers, part 2: Equipment requirements and tests.
ISO 13849-1:2023	Safety of machinery: Safety related parts of control systems. General principles for design.
EN 61496-1:2020	Safety of machinery: Electro-sensitive protective equipment. Part 1: General requirements and tests.
ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ISO 14119:2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
ISO 13850:2015	Safety of machinery - Emergency stop - Principles for design
IEC 62061:2021	Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: General requirements.
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Requirements for electrical/electronic/programmable electronic safety-related systems.
IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Software requirements.
IEC 61784-3:2021	Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions.

Standard	Description
2006/42/EC	Machinery Directive
2014/30/EU	Electromagnetic Compatibility Directive
2014/35/EU	Low Voltage Directive

In addition, terms used in the present document may tangentially be used as they are derived from other standards such as:

Standard	Description
IEC 60034 series	Rotating electrical machines
IEC 61800 series	Adjustable speed electrical power drive systems
IEC 61158 series	Digital data communications for measurement and control – Fieldbus for use in industrial control systems

Finally, the term *zone of operation* may be used in conjunction with the description of specific hazards, and is defined as it is for a *hazard zone* or *danger zone* in the *Machinery Directive* (*2006/42/EC*) and *ISO 12100:2010*.

NOTE: The aforementioned standards may or may not apply to the specific products cited in the present documentation. For more information concerning the individual standards applicable to the products described herein, see the characteristics tables for those product references.

Standards Relating to the Standalone Safety Controller XPSMCMCB1604SA(G)

The following list provides an overview of the standards that relate to the Standalone Safety Controller XPSMCMCB1604SA(G):

Standard	Description
ISO 13849-1:2023	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
ISO 13855:2010	Safety of machinery - Positioning of safeguards with respect to the approach speeds of parts of the human body
IEC 61131-2:2007	Industrial-process measurement and control - Programmable controllers – Part 2: Equipment requirements and tests
EN 61496-1:2013	Safety of machinery - Electro-sensitive protective equipment - Part 1: General requirements and tests
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/ electronic/programmable electronic safety-related systems
IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 3: Software requirements
IEC 61508-4:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems- Part 4: Definitions and abbreviations
IEC 61800-5-2:2016	Adjustable speed electrical power drive systems - Part 5-2: Safety requirements – Functional
IEC 62061:2021	Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems
2011/65/EU	Restriction of the use of certain hazardous substances in Electrical and Electronic Equipment

The list of standards relating to the Standalone Safety Controller XPSMCMCB1604SA(G) is not intended to be exhaustive relative to your specific application. Further, there may be additional functional safety standards that may apply to your particular application. Visit the Schneider Electric website at www.se.com for product certifications which detail compliance with specific standards, regulations, and directives.

Dual Dimensions

Dimensions are indicated in metric system and U.S. customary units system. The U.S. dimensions are given in parentheses, for example 8.4 mm (0.33 in).

NOTE: The given values in parentheses are rounded and for reference only.

Hardware Information

What's in This Part

General Information

What's in This Chapter

Standalone Safety Controller XPSMCMCB1604SA(G)

Hardware Overview

The Standalone Safety Controller XPSMCMCB1604SA(G) can be configured using the SoSafe MCM Basic software.

The controller provides the following inputs and outputs:

- 16 safety-related inputs
- 4 independent configurable restart/EDM (External Device Monitoring) inputs
- 4 independent dual-channel solid-state safety-related outputs (OSSD)
- 4 SIL 1/PL c status outputs
- 4 test outputs

The Standalone Safety Controller XPSMCMCB1604SA(G) is capable of monitoring the following safety-related sensors and command devices:

- Optoelectronic sensors (safety-related light curtains, scanners, safety-related photo cells)
- Mechanical switches
- Safety-related pressure-sensitive mats
- Emergency stops
- Two-hand controls
- Enabling devices
- Magnetic switches
- Proximity switches

Optional external relay modules

The following external relay modules are available:

Input and output expansion unit	Type	Description
XPSMCMER0002	ER02	• 2 forcibly guided contact safety-related relay outputs (2 NO and 1 NC each).
XPSMCMER0004	ER04	• 4 forcibly guided contact safety-related relay outputs (2 NO and 1 NC each).
XPSMCMER0008	ER08	• 8 forcibly guided contact safety-related relay outputs (2 NO and 1 NC each).

NOTE: For more information on the external relay units, refer to the corresponding instruction sheet.

Software Overview

SoSafe MCM Basic is used to create configurations with a combination of safety-related functions and logic, for example, the combination of a muting function with timers or counters.

The configuration created on the PC is sent to the controller through a USB connection.

The configuration resides in the Standalone Safety Controller XPSMCMCB1604SA(G).

Scope of Delivery

The Standalone Safety Controller XPSMCMCB1604SA(G) is provided with an instruction sheet in English. The instruction sheet contains a link (QR code) to the present User Guide, translated guides and supplemental documents.

NOTE: For the controller, you can purchase the following items separately as optional accessories:

- USB (computer) to Mini B USB (controller) cable, page 154 for connection to PC

Key Safety-Related Values of XPSMCMCB1604SA(G)

Key safety-related values	Value	Standard
Probability of a dangerous failure per hour (PFH_D)	1.50E-8	IEC 61508
Safety Integrity Level (SIL)(1)	3	
Safe Failure Fraction (SFF)	99.7 %	
Hardware Fault Tolerance (HFT)	1 (type B)	
Defined “Safe state”(2)	Outputs off	
Maximum Safety Integrity Level (SIL)(1)	3	IEC 62061
Type	4	IEC 61496-1
Performance Level (PL)(1)	e	ISO 13849-1
Diagnostic Coverage (DC_{avg})	High 98.9%	IEC 62061
Mean Time to Dangerous Failure ($MTTF_D$)	160.81 years	
Category(1)	4	
Maximum service life	20 years	

(1) The SIL, PL and Category of the overall system depend on the components used, the wiring and the configuration.

(2) The Standalone Safety Controller XPSMCMCB1604SA(G) is in the defined safe state when the safety-related outputs are deactivated. To exit the defined safe state condition, a valid combination of hardware inputs is required.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- You must carry out a risk assessment in accordance with ISO 12100.
- Validate the entire system/machine in accordance with the required performance level and risk assessment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Regular proof test intervals as defined by safety standards are required. Observe the required test cycles according to your application.

Technical Data

What's in This Chapter

General Controller Characteristics

Housing Characteristics

Housing characteristics	
General description	Electronic housing 40 poles, with locking latch mounting
Housing material	Polyamide
Housing degree of protection	IP20
Terminal blocks degree of protection	IP2x
Mounting	Quick coupling to rail according to EN/IEC 60715
Dimensions (h x l x d)	• with screw terminals: 108 x 45 x 114.5 mm (4.25 x 1.77 x 4.5 in) • with spring terminals: 118 x 45 x 114.5 mm (4.67 x 1.77 x 4.5 in)
Weight	0.25 kg (8.8 oz)

Ambient Characteristics

Ambient characteristics	
Maximum surrounding air temperature	+55 °C (131 °F)
Ambient operating temperature	-10...+55 °C (14...131 °F)
Relative humidity	10...95%
Maximum operation altitude	2000 m (6562 ft)
Pollution degree	2
Vibration, sinusoidal, displacement amplitude 5 ... 9 Hz (IEC 61496-1)	1.5 mm (class 5M1)
Vibration, sinusoidal, acceleration amplitude 9 ... 200 Hz (IEC 61496-1)	5 m/s^2 (class 5M1)
Vibration, random, power spectral density 5 ... 200 Hz (IEC 61496-1)	0.5 m^2/s^3 (class 5M1)
Vibration, random, power spectral density 200 ... 500 Hz (IEC 61496-1)	0.1 m^2/s^3 (class 5M1)
Shock, half-sine, 11 ms, peak acceleration (IEC 61496-1)	50 m/s^2 (class 5M1)
Shock, half-sine, 6 ms, acceleration (IEC 61496-1)	150 m/s^2 (class 3M4)

Electrical characteristics

Electrical characteristics	
Rated voltage	24 Vdc ± 20 % (PELV supply) Protective Class III; UL: Supply from class 2 (LVLE)
Dissipated power	6 W maximum
Overvoltage category	II
Response time	22...24 ms (1)
Digital inputs (No./description)	16 / PNP active high according to IEC 61131-2 (type 3)
FBK/Restart inputs (No./description)	4 / PNP active high according to IEC 61131-2 (type 2)
Test outputs (No./description)	4 / to test for cross circuits/short circuits and overloads
SIL 1/PL c outputs (No./description)	4 / configurable, PNP active high
Solid-state safety-related outputs (OSSD) (No./description)	4 pairs / solid-state safety-related outputs, PNP active high Maximum load current of 400 mA Interface type C class 3 (ZVEI CB24I)
Connection to PC	USB 2.0 or greater Maximum cable length: 3 m (9.84 ft)
Maximum length of connections	Maximum cable length: 100 m (328,08 ft)
Connection cable cross-section	0.5...2.5 mm^2 / AWG 12...30 (solid/stranded).
(1) The value depends on the number of operators in a configuration and can be found in the project report (see Project Report, page 50).	

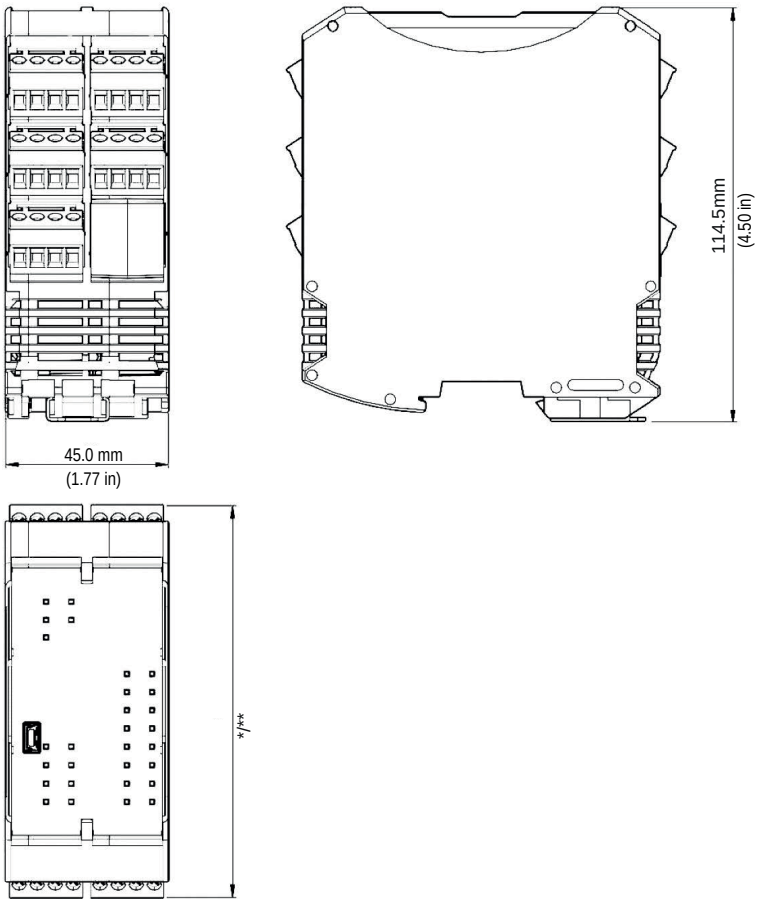
Mechanical Dimensions

Overview

Mount the modules (Standalone Safety Controller XPSMCMCB1604SA(G) and any relay modules) in an electric cabinet with an IP54 degree of protection. The minimum clearance below and above the controller is 40 mm (1.57 in). Allow at least 100 mm (3.93 in) distance between the cabinet door and the front face of the module(s). There are no clearances required on the left or right side of the module (s); however, other equipment in proximity may require larger distances and those clearances must also be taken into account.

Dimensions of the Controller

The graphic indicates the dimensions of the Standalone Safety Controller XPSMCMCB1604SA(G):

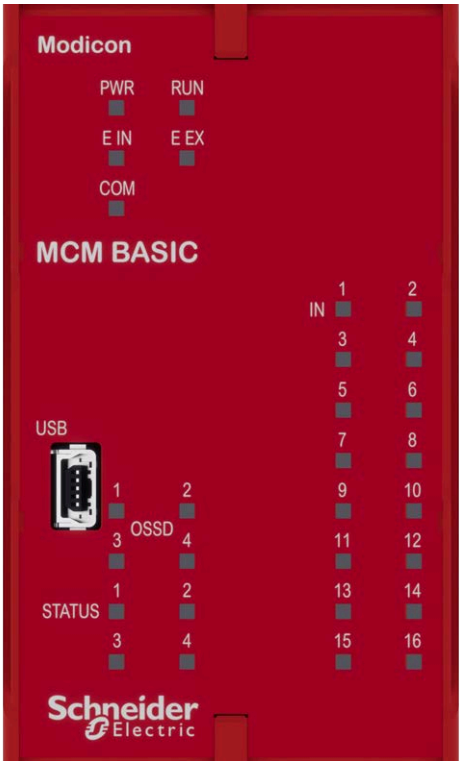


* Screw terminals 108 mm (4.25 in)

** Spring terminals 118 mm (4.67 in)

LED Indicators

Front-Face View



Operation States

The following table describes the indication of the operation states of the Standalone Safety Controller XPSMCMCB1604SA(G) by means of the LEDs. The description assumes that the power LED (**PWR**) is ON:

RUN **green**	**E IN** **red**	**E EX** **red**	**COM** **orange**	**IN 1...16** **yellow**	**OSSD 1...4** **red/green/ yellow**	**STATUS 1...4** **yellow**	**Meaning**
ON	ON	ON	ON	ON	red	ON	Power on - initial test
OFF	OFF	OFF	Flashing	OFF	red	OFF	Configuration software not connected, controller configuration not present
OFF	OFF	OFF	ON	OFF	red	OFF	Configuration software connected, controller stopped
ON	OFF	OFF	ON = configuration software connected OFF= other states	Input state	red = output OFF green = output ON yellow = waiting for restart flashing yellow = inconsistent feedback	Status output state	Normal operation

Troubleshooting

The following table describes the indication of detected errors of the Standalone Safety Controller XPSMCMCB1604SA(G) by means of the LEDs. The description assumes that the power LED (**PWR**) is ON:

Detected error	**RUN** **green**	**E IN** **red**	**E EX** **red**	**COM** **orange**	**IN 1...16** **yellow**	**OSSD 1...4** **red/green**	**STATUS 1...4** **yellow**	**Solution**
External error detected	ON	OFF	ON	ON = configuration software connected OFF= other states	The LED that corresponds to the input with the incorrect connection flashes.	red = output OFF green = output ON yellow = waiting for restart flashing yellow = inconsistent feedback	Status output state	Verify external components and wiring.
Internal error detected	OFF	2 or 3 flashes	OFF	OFF	OFF	red	OFF	Product non serviceable (1).
OSSD output error	OFF	4 flashes	OFF	OFF	OFF	4 flashes	OFF	Verify solid-state safety-related output (*OSSD*)1/2 connections(1).
(1) If the condition persists, contact your local Schneider Electric representative.								

Inputs and Outputs

Digital Inputs

The Standalone Safety Controller XPSMCMCB1604SA(G) provides 16 active high PNP digital inputs (terminals 25...40) that allow connection to project hardware components. These inputs are designed according to IEC 61131-2, type 3.

In addition to the 16 digital inputs, the Standalone Safety Controller XPSMCMCB1604SA(G) can also use the four *RESTART_FBK* inputs (terminals 7, 11, 15, 19) as individual digital inputs. These inputs do not have all the possible configurations of the 16 digital inputs; they can only be used with the *RESTART INPUT* function block, page 96.

Input RESTART_FBK

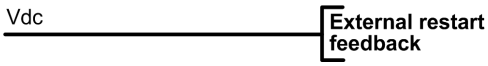
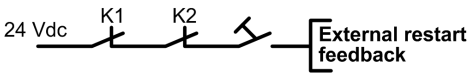
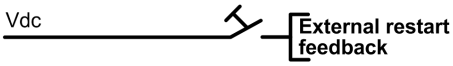
The RESTART_FBK signal inputs (IEC 61131-2, type 2) allow the Standalone Safety Controller XPSMCMCB1604SA(G) to verify an EDM (External Device Monitoring) feedback signal (series of contacts) from external contactors, and to monitor manual or automatic operation.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- If required, the response time of the external contactors must be verified by an additional device.
- The *RESTART* command device must be installed outside the zone of operation in a position where the zone of operation and the entire work area concerned are clearly visible.
- It must not be possible to operate the *RESTART* command device from inside the zone of operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Operation mode	EDM	`Restart_fbk`
Automatic	With `K1_K2` control	
	Without `K1_K2` control	
Manual	With `K1_K2` control	
	Without `K1_K2` control	

NOTE: *RESTART_FBK* inputs can also be used as digital inputs when not used in `Restart_fbk` mode.

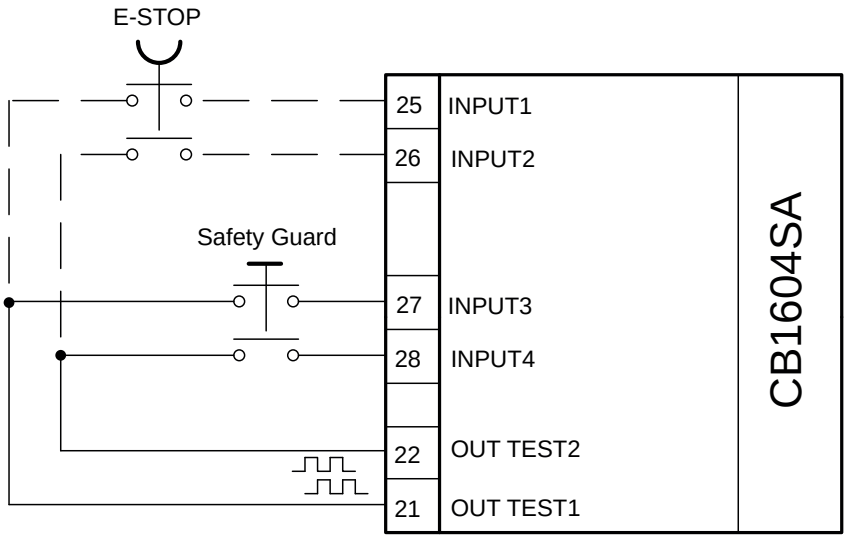
Output `TEST`

The `TEST` outputs must be used to monitor the presence of cross circuits or short circuits on the inputs. Connecting the test outputs helps to reach PL e in accordance with ISO 13849-1 and SIL 3 in accordance with IEC 62061.

NOTE: These safety levels can also be obtained by applying other means of fault exclusion as described in ISO 13849-2.

NOTE: The maximum number of controllable inputs for each test output is four inputs (parallel connection).

NOTE: The maximum allowed length for test output signal connections is 100 m.



Solid-State Safety-Related Output (OSSD)

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect any equipment to an OSSD unless the OSSD is appropriately configured with SoSafe MCM Basic software.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The *OSSD* safety-related outputs of the Standalone Safety Controller XPSMCMCB1604SA(G) are short-circuit protected and cross-circuit monitored.

The outputs are able to supply:

- In the ON condition: Uv - 1.2 V...Uv
  where Uv = 24 Vdc ± 20%
- In the OFF condition: 0...2 V r.m.s.

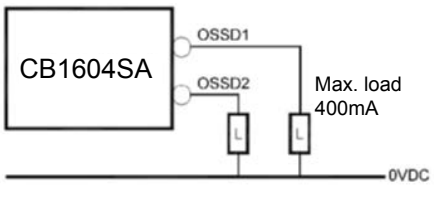
The maximum load current is 400 mA (per OSSD). The minimum resistive load is 60 Ω.

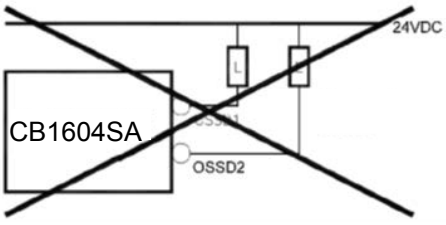
The maximum capacitive load is 0.68 µF.

The outputs are tested every 120 ms and comply with Type C, class 3 according to ZVEI CB24I Ed.2 with a maximum test pulse duration of 120 µs.

The maximum inductive load is 2 mH.

The load must be connected between the OSSD output terminals and 0 Vdc.



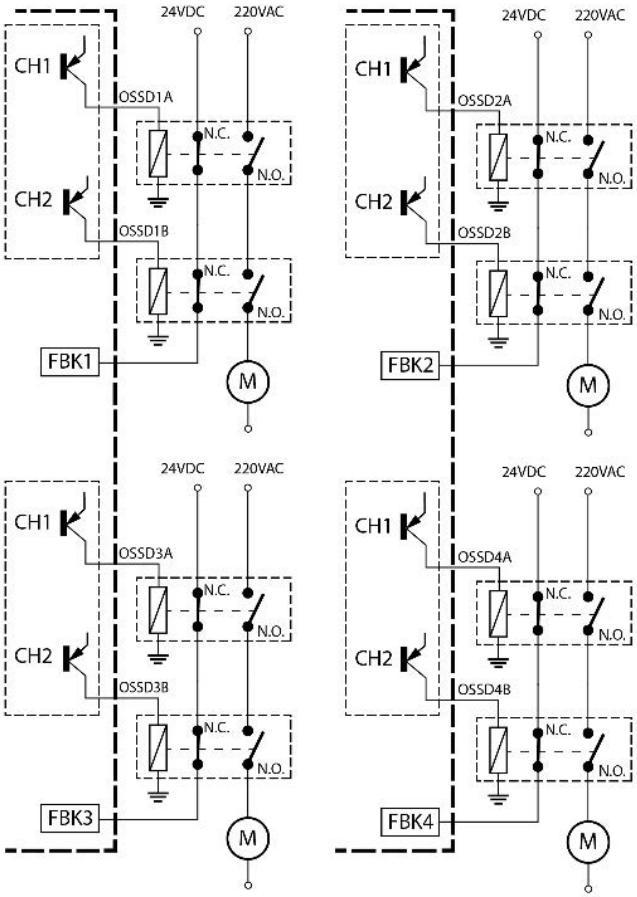


⚠WARNING

UNINTENDED EQUIPMENT OPERATION

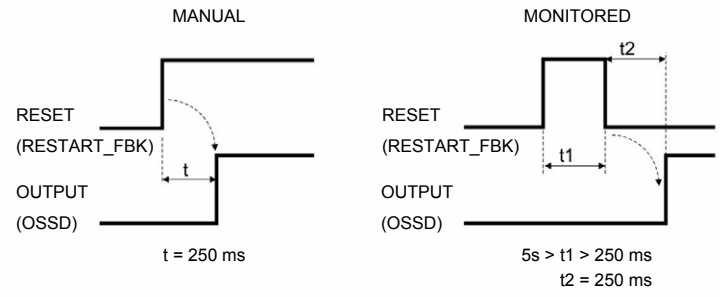
Use appropriate wiring between OSSD outputs (separate cable paths for example).

Failure to follow these instructions can result in death, serious injury, or equipment damage.



The following table indicates how each *OSSD* output can be configured:

Automatic	The output is activated according to the configurations set by the SoSafe MCM Basic software, only if the corresponding *RESTART_FBK* input is connected to Uv (24 Vdc ± 20%).
Manual	The output is activated according to the configurations set by the SoSafe MCM Basic software, only if the level at the corresponding *RESTART_FBK* input changes from 0 Vdc to Uv (24 Vdc ± 20%).
Monitored	The output is activated according to the configurations set by the SoSafe MCM Basic software, only if the level at the corresponding *RESTART_FBK* input changes from 0 Vdc to Uv (24 Vdc ± 20%) and back to 0 Vdc.



Output STATUS (SIL 1/PL c in Accordance with Standard IEC 61508)

The status outputs are configurable digital diagnostic outputs that indicate the status of

- a safety-related input or
- a safety-related output or
- a node of the logic diagram configured using the SoSafe MCM Basic software

⚠WARNING

INSUFFICIENT SAFETY-RELATED FUNCTIONS

Do not use status outputs for safety-related purposes greater than SIL 1/PL c (IEC 61508).

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Installation

What's in This Chapter

Mechanical Installation

Presentation

For installing the Standalone Safety Controller XPSMCMCB1604SA(G) on a 35 mm DIN rail, proceed as follows:

Step	Action
1	Attach the Standalone Safety Controller XPSMCMCB1604SA(G) to the rail at the top.
2	Press the controller until it snaps into place.

For removing the Standalone Safety Controller XPSMCMCB1604SA(G) from the rail, proceed as follows

Step	Action
1	Use a screwdriver to pull down the locking latch on the back of the controller; then lift the controller upwards and pull.

Electrical Installation

Wiring Best Practices

Overview

This section describes the wiring guidelines and associated best practices to be respected when using the Standalone Safety Controller XPSMCMCB1604SA(G).

⚠⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to this equipment.
- Use only the specified voltage when operating this equipment and any associated equipment.

Failure to follow these instructions will result in death or serious injury.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Do not use the equipment described herein to supply external equipment.
- Do not make contact with terminals until the power has been confirmed removed.
- Follow all electrical safety regulations and standards (for example, lockout/tag-out, phase grounding, barriers) to reduce the possibility of contact with hazardous voltages in the work area.
- Complete thorough hardware tests and system commissioning to verify that line voltages are not present on the control circuits before using your hardware operationally.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- Perform a Failure Mode and Effects Analysis (FMEA), or equivalent risk analysis, of your application, and apply preventive and detective controls before implementation.
- Provide a fallback state for undesired control events or sequences.
- Provide separate or redundant control paths wherever required.
- Supply appropriate parameters, particularly for limits.
- Review the implications of transmission delays and take actions to mitigate them.
- Review the implications of communication link interruptions and take actions to mitigate them.
- Provide independent paths for control functions (for example, emergency stop, over-limit conditions, and error conditions) according to your risk assessment, and applicable codes and regulations.
- Apply local accident prevention and safety regulations and guidelines.[1]
- Test each implementation of a system for proper operation before placing it into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), *Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control* and to NEMA ICS 7.1 (latest edition), *Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems* or their equivalent governing your particular location.

Wiring Guidelines

The following rules must be applied when wiring a Standalone Safety Controller XPSMCMCB1604SA(G):

- I/O wiring must be separate from the power wiring. Route these two types of wiring in separate cable ducting.
- Verify that the operating conditions and environment are within the specification values found in the technical characteristics.
- Use proper wire sizes to meet voltage and current requirements.
- Use copper conductors (required).
- The maximum length of cables connected to inputs is 100 m (328 ft). There are other limiting factors related to resistance and capacitance of the cable.

To help minimize the effects of electromagnetic interference, use shielded, properly grounded cables for all I/O susceptible to electrical noise. If you do not

use shielded cable for these connections, electromagnetic interference can cause signal degradation. Degraded signals can cause the controller or attached modules and equipment to perform in an unintended manner.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Use shielded cables for any I/O that may be susceptible to electromagnetic radiation.
- Ground cable shield at a single point(1).
- Route I/O cables separately from power cables.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1]Multipoint grounding is permissible (and in some cases inevitable) if connections are made to an equipotential ground plane dimensioned to help avoid cable shield damage in the event of power system short-circuit currents.

The use of shielded cables requires compliance with the following wiring rules:

- For protective ground connections (PE), metal conduit or ducting can be used for part of the shielding length, provided there is no break in the continuity of the ground connections. For functional ground (FE), the shielding is intended to attenuate electromagnetic interference and the shielding must be continuous for the length of the cable. If the purpose is both functional and protective, as is often the case for communication cables, the cable must have continuous shielding.
- Wherever possible, keep cables carrying one type of signal separate from the cables carrying other types of signals or power.

If necessary, decouple any electrical power equipment (for example, electric motors, inverters or frequency converters) or other sources of disturbance from the safety controller using separate power supplies. Obtain a common grounding point.

Protective Ground (PE)

The protective ground (PE) of the Standalone Safety Controller XPSMCMCB1604SA(G) is connected to the DIN rail.

Shielded Cables Connections

Shielded I/O cables must be securely connected to ground. The I/O shields may be connected either to the functional ground (FE) or to the protective ground (PE) of your installation.

⚠DANGER

HAZARD OF ELECTRIC SHOCK

Ensure that a proper ground exists between the integrated ground clamp of the equipment and the mounting rail to which it is attached.

Failure to follow these instructions will result in death or serious injury.

Cable Types and Wire Sizes

Cable types and wire sizes

for a 5.08 pitch removable **screw** terminal block

mm / in. 7 / 0.28								
mm²	0.2…2.5	0.2…2.5	0.25…2.5	0.25…1.5	2 x 0.2…1	2 x 0.2…1.5	2 x 0.25…1	2 x 0.5...1.5
AWG	*24…14*	*24…14*	*23...14*	*23...16*	*2 x 24…18*	*2 x 24…16*	*2 x 23…18*	*2 x 20...16*

Ø 3,5 mm (*0.14 in.*)	C	N•m	0.5
		lb-in	*4.42*

for a 5.08 pitch removable **spring** terminal block (used by XPSMCM•••G).

mm / in. 10 / 0.39					
mm²	0.2…2.5	0.2…2.5	0.25…2.5	0.25…2.5	2 x 0.5...1
AWG	*24…14*	*24…14*	*23...14*	*23...14*	*2 x 20...18*

The following instructions concerning connection cables must be observed:

- Use 60/75 °C copper (Cu) conductor only. Maximum cable length 100 m (328 ft).
- Cables used for connections of longer than 50 m (164 ft) must have a cross-section of at least 1 mm² (AWG 16).

Spring cage clamp connectors have the added advantage of requiring little maintenance in order to retain the tension on the wire. However, screw connectors do require tightening maintenance on a regular schedule.

⚠⚠DANGER

LOOSE WIRING CAUSES ELECTRIC SHOCK

Tighten connections in conformance with the torque specifications.

Failure to follow these instructions will result in death or serious injury.

⚠DANGER

FIRE HAZARD

Use only the correct wire sizes for the maximum current capacity of the I/O channels and power supplies.

Failure to follow these instructions will result in death or serious injury.

The spring clamp connectors of the terminal block are designed for only one wire or one cable end. Two wires to the same connector must be installed with a double wire cable end to help prevent loosening.

⚠⚠DANGER

LOOSE WIRING CAUSES ELECTRIC SHOCK

Do not insert more than one wire per connector of the spring terminal blocks unless using a double wire cable end (ferrule).

Failure to follow these instructions will result in death or serious injury.

Protecting Outputs from Inductive Load Damage

Depending on the load, a protection circuit may be needed for the outputs of the controller. Inductive loads using DC voltages may create voltage reflections resulting in overshoot that will damage or shorten the life of output devices.

⚠CAUTION

OUTPUT CIRCUIT DAMAGE DUE TO INDUCTIVE LOADS

Use an appropriate external protective circuit or device to reduce the risk of inductive direct current load damage.

Failure to follow these instructions can result in injury or equipment damage.

If you use modules with relay outputs or external relays with the controller, inductive loads can result in welded contacts and loss of control. Each inductive load must include a protection device such as a peak limiter, RC circuit or flyback diode. Capacitive loads are not supported by these relays.

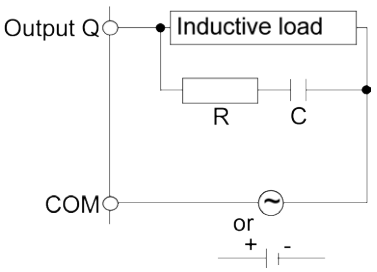
⚠WARNING

RELAY OUTPUTS WELDED CLOSED

- Always protect relay outputs from inductive alternating current load damage using an appropriate external protective circuit or device.
- Do not connect relay outputs to capacitive loads.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

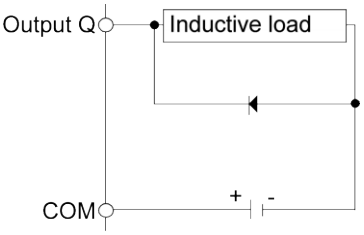
Protective circuit A for relay outputs: this protection circuit can be used for both AC and DC load power circuits.



C 0.1 to 0.82 µF (including capacitance of cables)

R Resistor of approximately the same resistance value as the load

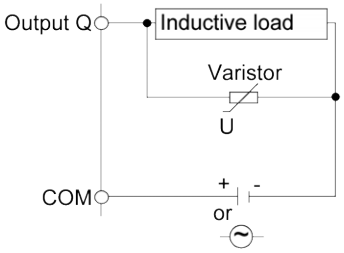
Protective circuit B for relay outputs: this protection circuit can be used for DC load power circuits.



Use a diode with the following ratings:

- Reverse withstand voltage: power voltage of the load circuit x 10.
- Forward current: more than the load current.

Protective circuit C: this protection circuit can be used for both AC and DC load power circuits.



In applications where the inductive load is switched on and off frequently and/or rapidly, ensure that the continuous energy rating (J) of the varistor exceeds the peak load energy by 20 % or more.

The guidelines for component ratings are the same as for the relay output protection above.

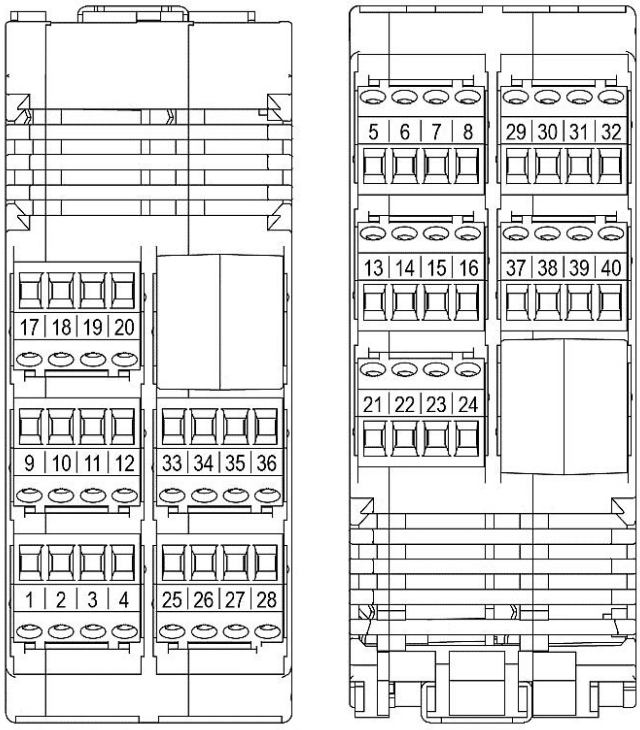
Terminal Blocks

Presentation

The Standalone Safety Controller XPSMCMCB1604SA(G) is provided with removable terminal blocks for the electrical connections with 40 terminals in total.

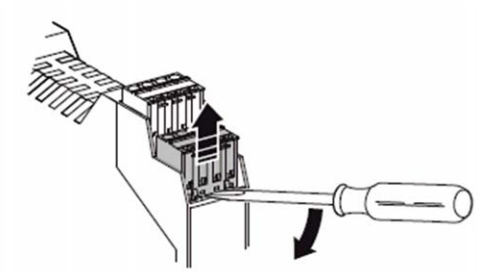
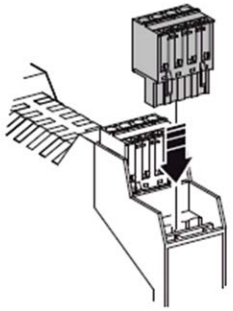
The following graphic shows an example with the maximum number of terminals:

Terminal numbers



Removing and Inserting the I/O Terminal Block

To remove a terminal block, use a flat, insulated or non-conductive screwdriver as described in the following table:

Step	Action
1	Slide the tip of the screwdriver into the slit located between the front of the terminal block and the module to lift the terminal block up.  **NOTE:** You can remove the terminal block to wire it.
2	To put a terminal block in the module, slide it in the proper location until you hear it click into place. 

Connector Designations

Terminal	Signal	LED	Type	Description	Operation
1	24 VDC	PWR	-	24 Vdc power supply	-
2	24 VDC		-	24 Vdc power supply	-
3	NC	-	-	Not Connected	-
4	0 VDC	PWR	-	0 Vdc power supply	-
5	OSSD1_A	OSSD 1	Output	Safety-related output 1	PNP active at Uv (24 Vdc ± 20%).
6	OSSD1_B				
7	RESTART_FBK1	-	Input	Feedback/Restart 1	Input type 2 according to IEC 61131-2
8	OUT_STATUS 1	STATUS 1	Output	SIL 1/PL c output	Configurable output (SIL 1/PL c in accordance with IEC 61508)
9	OSSD2_A	OSSD 2		Safety-related output 2	PNP active at Uv (24 Vdc ± 20%).
10	OSSD2_B				
11	RESTART_FBK2	-	Input	Feedback/Restart 2	Input type 2 according to IEC 61131-2
12	OUT_STATUS 2	STATUS 2	Output	SIL 1/PL c output	Configurable output (SIL 1/PL c in accordance with IEC 61508)
13	OSSD3_A	OSSD 3		Safety-related output 1	PNP active at 24 Vdc.
14	OSSD3_B				

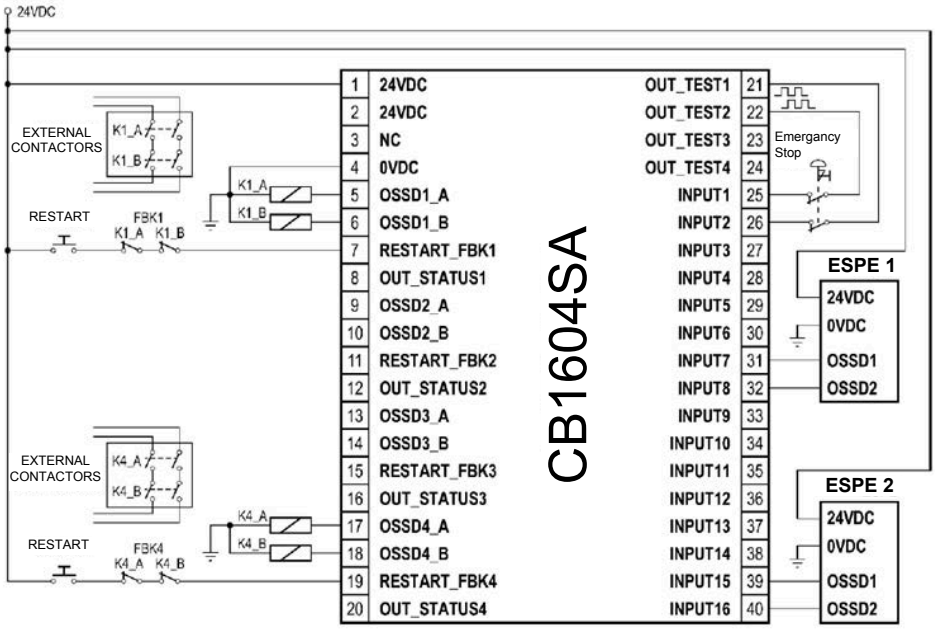
Terminal	Signal	LED	Type	Description	Operation
15	RESTART_FBK3	-	Input	Feedback/Restart 1	Input type 2 according to IEC 61131-2
16	OUT_STATUS 3	STATUS 3	Output	SIL 1/PL c output	Configurable output (SIL 1/PL c in accordance with IEC 61508)
17	OSSD4_A	OSSD 4		Safety-related output 2	PNP active at 24 Vdc.
18	OSSD4_B				
19	RESTART_FBK4	-	Input	Feedback/Restart 2	Input type 2 according to IEC 61131-2
20	OUT_STATUS 4	STATUS 4	Output	SIL 1/PL c output	Configurable output (SIL 1/PL c in accordance with IEC 61508)
21	OUT_TEST1	-		Short-circuit detection output	PNP active at 24 Vdc.
22	OUT_TEST2	-		Short-circuit detection output	PNP active at 24 Vdc.
23	OUT_TEST3	-		Short-circuit detection output	PNP active at 24 Vdc.
24	OUT_TEST4	-		Short-circuit detection output	PNP active at 24 Vdc.
25	INPUT1	IN 1	Input	Safety-related input 1	Input type 3 according to IEC 61131-2
26	INPUT2	IN 2		Safety-related input 2	
27	INPUT3	IN 3		Safety-related input 3	
28	INPUT4	IN 4		Safety-related input 4	
29	INPUT5	IN 5		Safety-related input 5	
30	INPUT6	IN 6		Safety-related input 6	
31	INPUT7	IN 7		Safety-related input 7	
32	INPUT8	IN 8		Safety-related input 8	
33	INPUT9	IN 9		Safety-related input 9	
34	INPUT10	IN 10		Safety-related input 10	
35	INPUT11	IN 11		Safety-related input 11	
36	INPUT12	IN 12		Safety-related input 12	
37	INPUT13	IN 13		Safety-related input 13	
38	INPUT14	IN 14		Safety-related input 14	
39	INPUT15	IN 15		Safety-related input 15	
40	INPUT16	IN 16		Safety-related input 16	

USB Input

The Standalone Safety Controller XPSMCMCB1604SA(G) includes a Mini B USB connector for connection to a PC with SoSafe MCM Basic software installed.
A compatible USB cable is available as an accessory, page 154

Wiring Example

The following graphic shows an example for the connection of the Standalone Safety Controller XPSMCMCB1604SA(G) to a machine control system:



NOTE: Best practice dictates the use of fusing on the incoming 24 Vdc power, and sized appropriately for the requirements of the module.

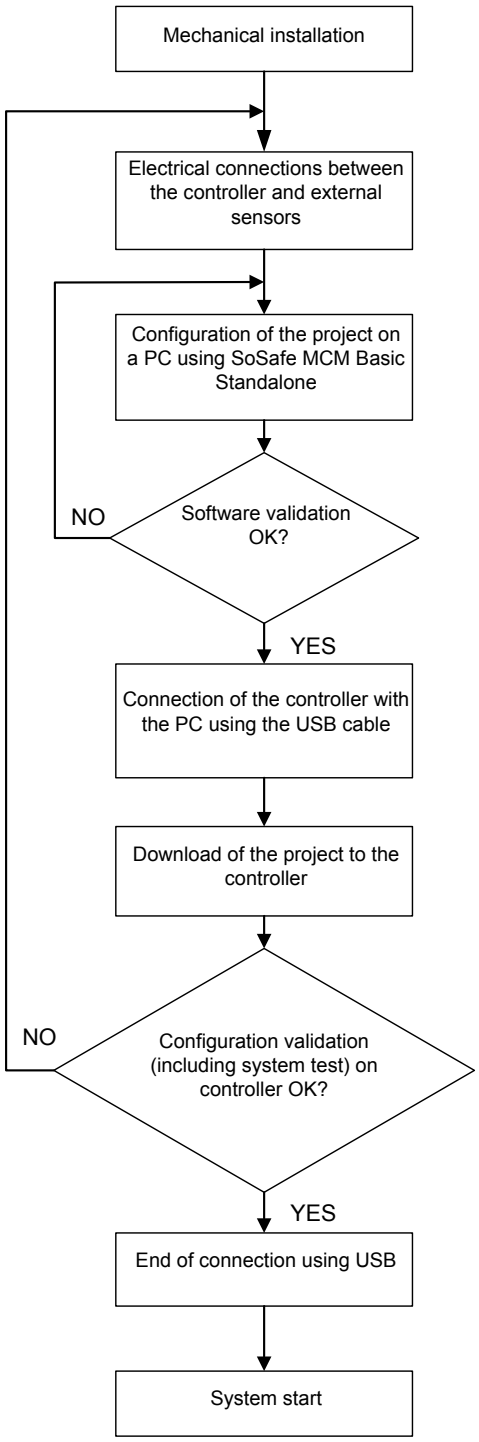
⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as "No Connection (N.C.)" or Not Connected.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Installation Process Diagram



SoSafe MCM Basic

What’s in This Part

General Information

What's in This Chapter

SoSafe MCM Basic

Overview

The software used to operate the Standalone Safety Controller XPSMCMCB1604SA(G) is SoSafe MCM Basic.

SoSafe MCM Basic is used to configure a logic connection between the inputs and outputs of the Standalone Safety Controller XPSMCMCB1604SA(G) and the components of the application being developed. The Standalone Safety Controller XPSMCMCB1604SA(G) is used to monitor and control the connected safety-related components.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

PC Hardware Requirements

- RAM: ≥ 2 GB
- Hard disk: ≥ 1 GB free space
- USB port: 2.0 or greater

PC Software Requirements

- Windows 7 with Service Pack 1 (or greater), Windows 10 or 11, 32 bit or 64 bit
- Microsoft .NET Framework 4.8 (or greater) must be installed on the PC.

Installation of SoSafe MCM Basic

Installation

1. Download SoSafe MCM Basic from www.se.com and install the Schneider Electric Software Installer (SESI) from the zip file. If the Schneider Electric Software Installer (SESI) is already installed on your PC, you can skip this step.
2. Run the installer and follow the procedure on the screen. Select SoSafe MCM Basic from the list of products to be installed
3. Wait until the installation procedure is complete.

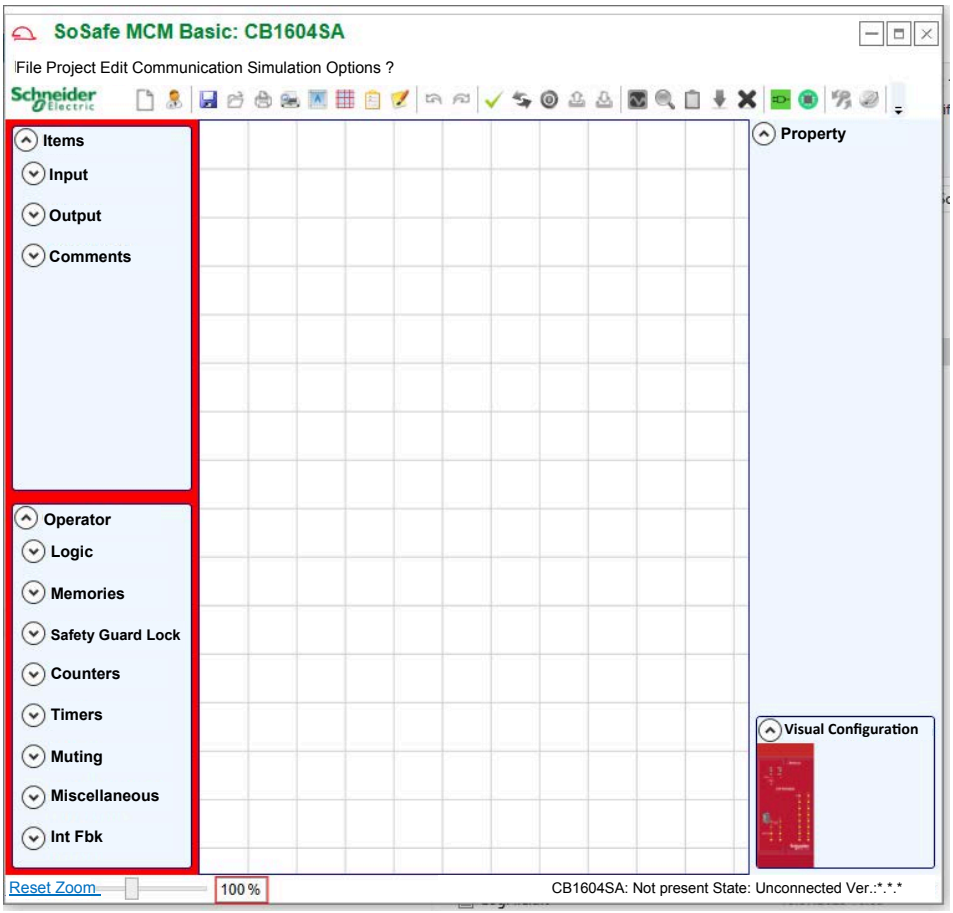
Presentation of SoSafe MCM Basic

Opening Screen

When the SoSafe MCM Basic software is installed, an icon is created on the desktop.

To launch the program, double-click the icon .

The following screen is displayed:



Toolbar

The following graphic shows the toolbar:

Icon	Description
	Create a new project.
	Modify project information (for example name, company)
	Save the project
	Load an existing project from the PC
	Print the project
	Print preview
	Display printing area
	Snap to grid
	Resources allocation
	Print the project report
	Undo (cancel the last command)
	Redo (restore the last cancelled command)
	Validate the project
	Connect to Standalone Safety Controller XPSMCMCB1604SA(G)
	Send a project to the Standalone Safety Controller XPSMCMCB1604SA(G)
	Disconnect and reboot the Standalone Safety Controller XPSMCMCB1604SA(G)

Icon	Description
	Load a project from the Standalone Safety Controller XPSMCMCB1604SA(G)
	Graphical monitor (online I/O state - graphic)
	Monitor (online I/O state - textual)
	Upload log file
	Display system configuration
	Error log
	Erase errors log
	Start **Schematic Simulation**
	Start **Automatic Simulation**
	Modify password
	Online help
	Password recovery (only with unlock file, see Password Levels, page 53)

Menu bar

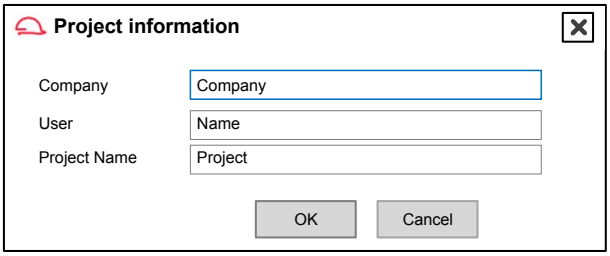
The commands accessible through the toolbar are also accessible through the menus (**File**, **Project**, **Edit**, **Communication**, **Simulation** and **Options**) on the menu bar.

Creating a Project

What's in This Chapter

Creating a New Project

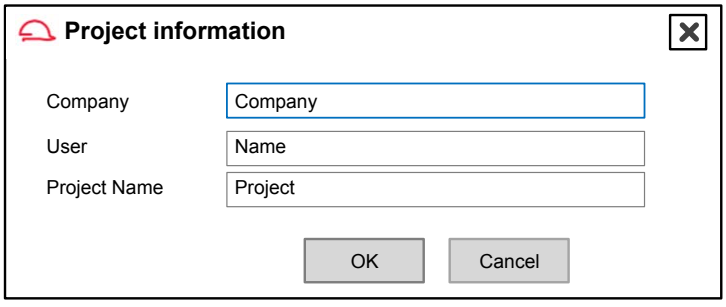
Creating and Configuring a Project

Step	Action	Result
1	Go to **Project** -> **New Project**, or select the  icon from the toolbar to create a new project.	The **Project information** window is displayed: 
2	Enter the **Company** information, **User**, and **Project Name**. Click **OK**.	The **Project information** is stored and you are ready to start the configuration.

Modifying the Project Information

Procedure

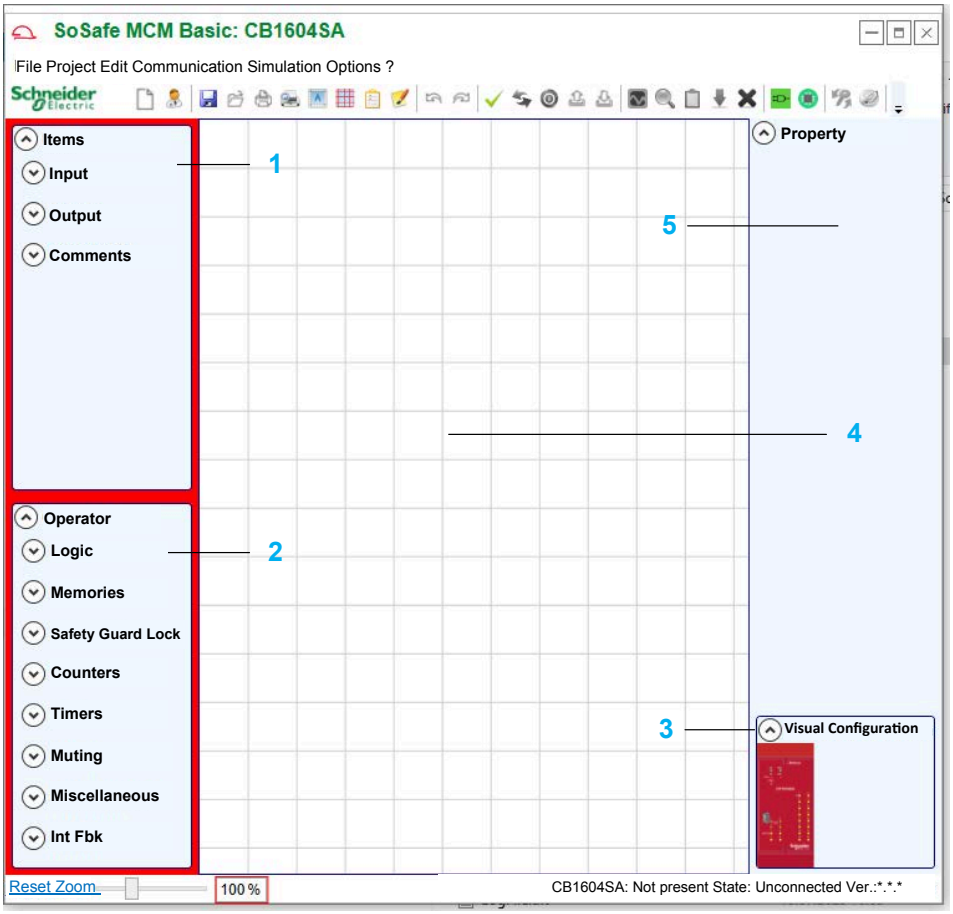
To modify the project information, proceed as follows:

Step	Action	Result
1	Click the icon  or use the menu **Project > Change Project Info**.	The **Project information** window appears: 
2	Enter the **Company** information, **User**, and **Project Name**. Click **OK**.	The project information is updated.

Presentation of the Tool Windows

Description

Four tool windows are displayed to the left and right of the design area:

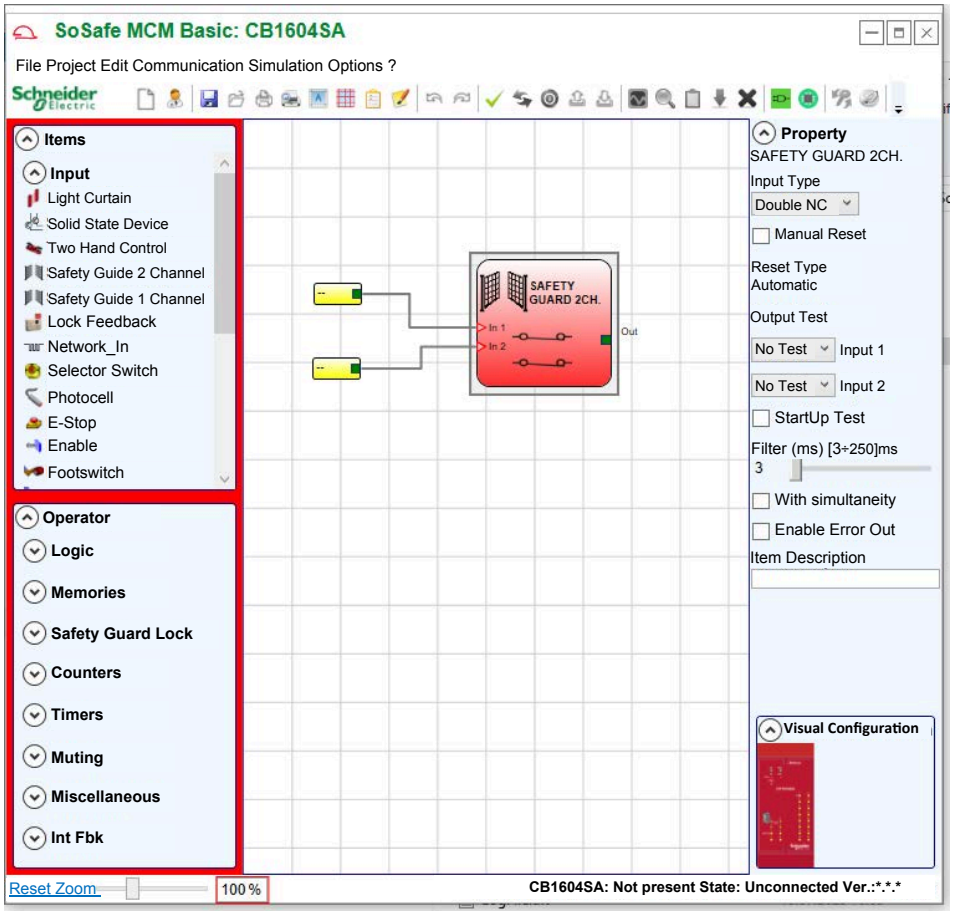


Nb	Tool window	Description
1	**Items**	This window provides access to the types of function blocks: • **Input** • **Output** • **Comments**
2	**Operator**	This window provides access to the types of operator function blocks, page 100 used to link the function blocks: • **Logic** • **Memories** • **Safety Guard Lock** • **Counters** • **Timers** • **Muting** • **Miscellaneous** • **Int Fbk** (internal function block)
3	**Visual configurations**	This window contains the graphic representation of the hardware configuration. In this window you can navigate through the I/Os of the module by right-clicking the module to be analyzed.
4	**Design area**	This window contains a graphical representation of your configuration.
5	**Property**	This window displays the properties and parameters of the selected object.

Project Configuration

Procedure

For configuring the project, proceed as follows:



Step	Action
1	Drag the function block from the **Items** or **Operator** tool windows, and drop it into the design area. **NOTE:** For details about each function block, refer to Function Blocks, page 69.
2	Click the function block in the design area to display the **Property** side window and define specific attributes of the function block.
3	Connect the objects by dragging the pin to connect and dropping it onto the pin to be connected.
4	To use the panning function for moving the working area in the window, select the object to move and use the arrow keys on your keyboard.
5	If the configuration is very complex and requires a connection between two elements that are far from each other, use the *Interpage Out* and *Interpage In* operators. For connecting the two elements, use the same unique connection name for *Interpage Out* and *Interpage In*. For more information on the *Interpage* operators, refer to *Interpage In* and *Interpage Out* Operator, page 148.
6	To duplicate a function, you can select a function block and press **Ctrl+C** / **Ctrl+V**, or right-click and select **Copy** from the contextual menu, and then **Paste**.
7	For a better graphic visibility of the schematic plan, you can move the wires. Place the mouse pointer on a wire and click and hold the wire to be moved, then drag it to the desired location.
8	To delete a function or a link, select it and press the **Delete** key or right-click and select **Delete** from the contextual menu.
9	To perform a search within the schematic plan based on a search parameter, press **Ctrl+F**. The search is not case-sensitive.

Options Available with a Right Click

Block input/output

- Copy/paste
- Delete
- Delete all assigned pins
- Alignment with other functional blocks (multiple selection)
- Online help
- **Monitor** mode: Show/hide the **Property** window
- Input pin of output blocks: Activate/deactivate logical negation

Block operators

- Copy/paste
- Delete
- Alignment with other functional blocks (multiple selection)
- Online help
- Input pin: Activate/deactivate logical negation
- **Monitor** mode: Show/hide the **Property** window

Terminals

- Alignment with other blocks

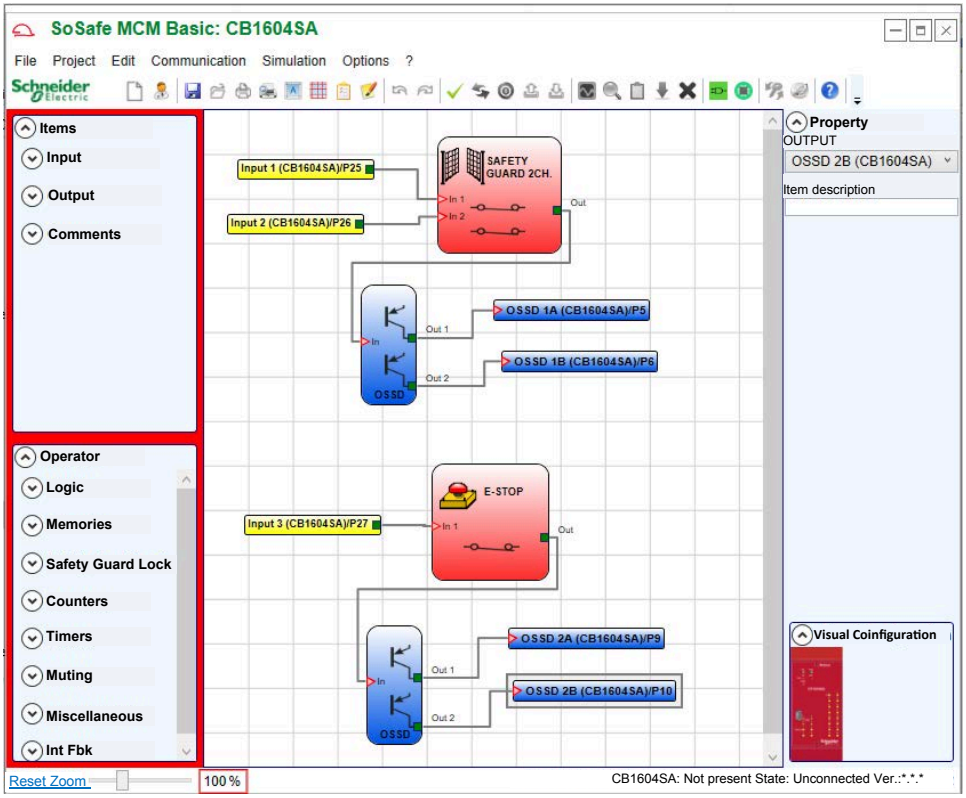
Connections (wires)

- Delete
- Display the full path of the connection (network)

Project Example

Presentation

The following graphic presents a project example in which the Standalone Safety Controller XPSMCMCB1604SA(G) is connected with two safety-related function blocks: SAFETY GUARD 2 CH and E-STOP (Emergency-Stop).



The physical inputs (terminal numbers) are displayed in the design area, for instance **Input 3 (CB1604SA) / P27** means that terminal 27 of CB1604SA is used as physical input for the E-STOP function block.

The safety-related outputs are activated according to the conditions defined by functions SAFETY GUARD 2 CH and E-STOP.

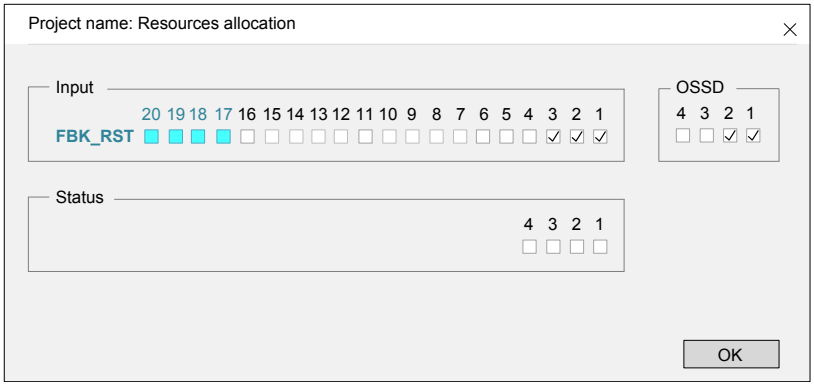
Step	Action
1	Click the function block in the design area to display the **Property** side window.
2	Configure the function block. For more information, refer to Function Blocks, page 69.
3	Save the configuration using the icon from the toolbar or through the menu **File > Save/ Save as...**.

Resources Allocation

Presentation

You can activate the **Resources Allocation** function using the icon  .

After executing this function, the used elements among **Inputs**, **OSSD** Outputs and **Status** are visible, for example:



Project Validation

Presentation

When the software configuration is complete, the project must be verified. Execute the validation command by clicking the icon in the toolbar.

If the validation is successful, a sequential number is assigned to the input and output of the project. This number is listed in the report and in the monitor of SoSafe MCM Basic. It is then possible to transfer the configuration to the Standalone Safety Controller XPSMCMCB1604SA(G).

NOTE: The validation function verifies the consistency of the configuration with respect to the characteristics of the Standalone Safety Controller XPSMCMCB1604SA(G). It does not verify whether the device has been configured to meet all the safety-related requirements for the application. Each safety-related function and set of functions must be validated according to ISO 13849-1 to help ensure correct operation.

For more information on the validation of projects, refer to Validating the Project, page 58.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Empirically validate each safety-related function of your functional safety system before placing your application into service.
- Thoroughly validate the functionality of your safety-related system in the context of your application.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Project Report

Presentation

Click the icon in the toolbar to print out a project report of the hardware and software configurations (with properties for each function block) as depicted in the following example:

Stand Alone
Programmable Safety
Controller

Project Report generated by SoSafe MCM Basic Ver .: 1.0.3.4

CB1604SA: Project Report

Project Name: Project
User: Name
Company: Schneider Electric
Date: 11/02/2022 15:51:23
Schematic CRC: 9DE2H
File Name: C:\MCM Basic Example.szx

CB1604SA: Cycle Time

Cycle Time (ms) = 4.72

CB1604SA: Safety Information

PFH_d (according to IEC 61508): 1,53E-008 (1/h)
$MTTF_d$ (according to EN ISO 13849-1): 154,51 years
DC_{avg} (according to EN ISO 13849-1): 98.90 %

Attention!

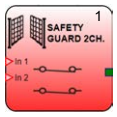
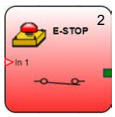
This definition of PL and of the other related parameters as set forth in EN ISO 13849-1 only refers to the functions implemented in the CB1604SA system by the SoSafe MCM Basic configuration software, assuming configuration has been performed correctly. The actual PL of the entire application and the relative parameters must consider data for all the devices connected to the CB1604SA 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.

CB1604SA: Resources used

INPUT	3/16	19 %
Total number blocks	0/64	0 %
OSSD	2/4	50 %
STATUS	0/4	0 %

CB1604SA: Electrical diagram

Items

	Function Block 001 Safety Guard 2 Channel	Filter (ms): 3 Double NC Reset Type: Automatic StartUp Test: False	Connections In1: CB1604SA/Terminal25 In2: CB1604SA/Terminal26
	Function Block 002 E-Stop	Filter (ms): 3 Single Reset Type: Automatic StartUp Test: False	Connections In1: CB1604SA/Terminal27
	OUTPUT 01 OSSD SIL3/PL e	Reset Type: Manual Response time: 21,34 ms Dependance on inputs: 1	Connections CB1604SA OSSD1A/Terminal5 CB1604SA OSSD1B/Terminal6 CB1604SA Restart_Fbk: Terminal7
	OUTPUT 02 OSSD SIL3/PL e	Reset Type: Manual Response time: N.A. (Rete?)	Connections CB1604SA OSSD2A/Terminal9 CB1604SA OSSD2B/Terminal10 CB1604SA Restart_Fbk: Terminal11

Signature _____

NOTE: The Performance Level (PL) and other safety-related data such as Probability of Dangerous Failure per hour (PFHd), Mean Time to Dangerous Failure (MTTFd), or Average Diagnostic Coverage (DCavg) as per ISO 13849-1 specified in the SoSafe MCM Basic only relate to the components of the Standalone Safety Controller XPSMCMCB1604SA(G). The safety-related data for the overall safety-related function to be implemented depends on the safety-related data of all components constituting the control system. In addition to the logic (typically represented by the Standalone Safety Controller XPSMCMCB1604SA(G)), this also comprises the input devices such as sensors, and the output devices such as motor contactors, motor starters, and variable speed drives.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Calculate the safety-related data for the overall safety-related function according to ISO 13849-1 to determine whether your application meets the safety-related requirements and capabilities defined in your risk assessment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

You can, for example, use SISTEMA/VDMA, the Safety Integrity Software Tool for the Evaluation of Machine Applications.

Transferring the Project

What's in This Chapter

Password Levels

Overview

SoSafe MCM Basic requires a password to transfer (upload or download) the configuration. Passwords are only required for operations while connected to the controller.

The password can be composed of upper and lower case letters and numerical characters with a maximum length of eight characters.

Two levels of passwords are used:

- **Level1 Password**: operating and maintenance tasks
- **Level2 Password**: complete access to the configuration possibilities in the software.

⚠WARNING

UNAUTHORIZED DATA ACCESS, PASSWORD CHANGE

- Immediately change the default password to a new, secure password.
- Do not distribute the password to unauthorized or otherwise unqualified personnel.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: When you connect a controller for the first time, use the password SAFEPASS (case sensitive), to be able to create a new, secure password (refer to Modifying the Password, page 54).

NOTE: A secure password is one that has not been shared or distributed to any unauthorized personnel and does not contain any personal or otherwise obvious information. Further, a mix of upper and lower case letters and numbers offer a higher security with SoSafe MCM Basic. Choose a password of at least seven characters.

NOTE: You can reset a forgotten password only once. Ensure to implement a suitable password management to help avoid the non-availability of your equipment. For more information, refer to Forgotten Password, page 54.

Level1 Password

Everyone using the Standalone Safety Controller XPSMCMCB1604SA(G) must have a **Level1 Password**. This password allows access to display the log file, monitoring of the system, and upload operations.

NOTE:

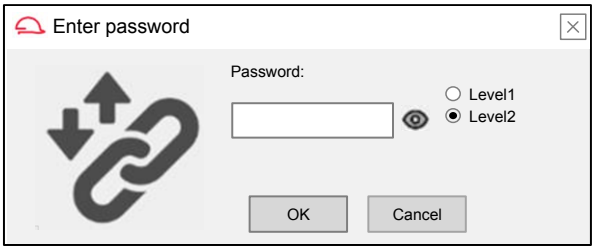
- Before modifying the **Level1 Password**, you must enter the **Level2 Password**.
- By default, the **Level1 Password** is not set, that is to say empty.

Level2 Password

To enable download to the Standalone Safety Controller XPSMCMCB1604SA(G), the **Level2 Password** is required. In addition, the features enabled by **Level1 Password** are available.

NOTE:

- When a controller is connected for the first time, use the password SAFEPASS (case sensitive).
- Before modifying **Level2 Password**, you must enter the existing **Level2 Password**.



Forgotten Password

If a password has been forgotten, contact Schneider Electric technical support.

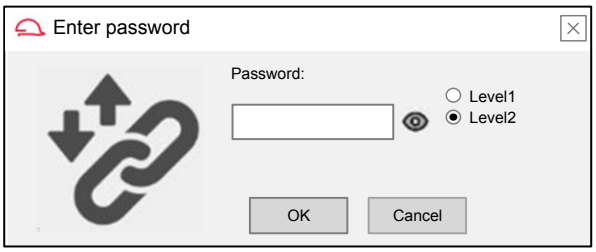
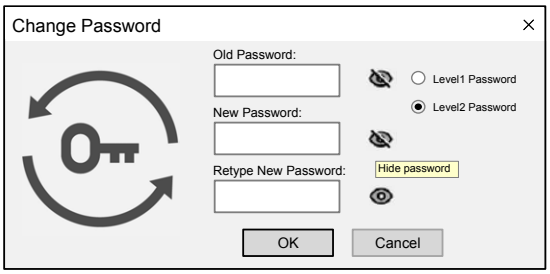
For resetting the password, you need to provide the serial number of the controller to the technical support representative. You can find the serial number on the product labelling.

NOTE: You can reset a forgotten password only once. Ensure to implement a suitable password management to help avoid the non-availability of your equipment.

Modifying the Password

Procedure

The following table describes how to modify your password:

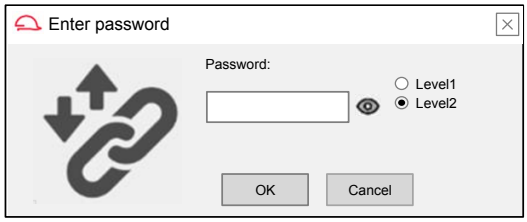
Step	Action	Result
1	Click the icon  or use the menu **Communication > Change password**.	A popup window appears requesting the password of the controller:  **NOTE:** You must enter the **Level2 Password** in order to modify the password level. The default password is SAFEPASS (case sensitive). **⚠WARNING** **UNAUTHORIZED DATA ACCESS, PASSWORD CHANGE** • Immediately change the default password to a new, secure password. • Do not distribute the password to unauthorized or otherwise unqualified personnel. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**
2	Enter the **Level2 Password** and click **OK**.	A popup window requests the **Level2 Password** as well as the new one. 
3	Enter the **Old Password**, **New Password** and confirm in **Retype New Password**. Click **OK**.	The new password is stored within the controller memory.

NOTE: The password can be composed of upper and lower case letters and numerical characters with a maximum length of eight characters.

NOTE: You can reset a forgotten password only once. Ensure to implement a suitable password management to help avoid the non-availability of your equipment.

Connecting to the Standalone Safety Controller XPSMCMCB1604SA(G)

Procedure

Step	Action	Result
1	Connect the Standalone Safety Controller XPSMCMCB1604SA(G) with the required USB cable with Mini B USB connector to the PC through an USB port.	–
2	Click the icon  or use the menu **Communication > Connection** to log on to the controller.	A popup window appears requesting the password of the controller: 
3	Enter the password, page 53 and click **OK**.	A connection is established to the Standalone Safety Controller XPSMCMCB1604SA(G).

Transferring the Configuration

Sending the Configuration

To send the saved configuration from a PC to the Standalone Safety Controller XPSMCMCB1604SA(G), click the icon  in the toolbar and wait for the execution. The Standalone Safety Controller XPSMCMCB1604SA(G) saves the project in its internal memory.

The **Level2 Password** is required for sending the configuration.

NOTE: This function is possible only after a successful project validation.

Loading a Configuration

To load the configuration from the Standalone Safety Controller XPSMCMCB1604SA(G) to SoSafe MCM Basic, click the icon  or use the menu **Communication > Schematic reading**.

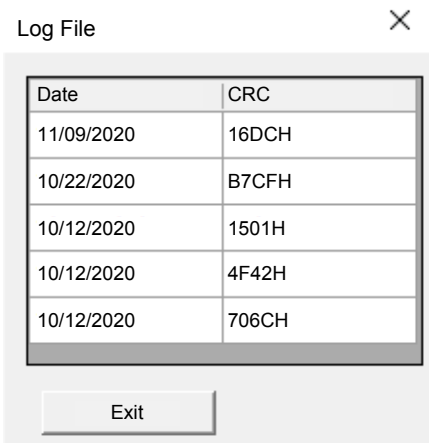
SoSafe MCM Basic displays the project residing in the controller. The **Level1 Password** is sufficient for loading the configuration.

If a loaded configuration is to be used by another Standalone Safety Controller XPSMCMCB1604SA(G), validate the configuration as described in Project Validation, page 50, and validate the new installation as described in Validating the Project, page 58.

Log File

The transfer date and CRC (4-digit hexadecimal identification) of the five latest configurations downloaded are stored in the Standalone Safety Controller XPSMCMCB1604SA(G). The sixth downloaded event overwrites the oldest of the previous data.

The configuration **Log File** can be displayed using the icon  in the toolbar or using the menu **Communication > Log file**. The **Level1 Password** is sufficient.



Disconnecting and Rebooting the Controller

To disconnect the computer from the Standalone Safety Controller XPSMCMCB1604SA(G), use the  icon. When the controller is disconnected while logged with **Level2 Password**, it automatically reboots and restarts the last transferred configuration.

Validating the Project

What's in This Chapter

Validation

Presentation

After verifying and sending the project to the Standalone Safety Controller XPSMCMCB1604SA(G) and connecting all physical input and output automation equipment, a functional validation must be carried out to validate the operation.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Empirically validate each safety-related function of your functional safety system before placing your application into service.
- Thoroughly validate the functionality of your safety-related system in the context of your application.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

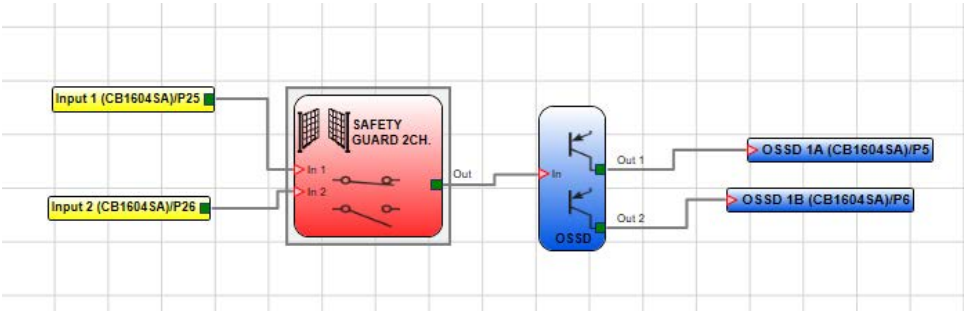
Software and Hardware Validation

For software and hardware validation, the standard ISO 13849-1 provides a basis for thoroughly testing your application with your Standalone Safety Controller XPSMCMCB1604SA(G). A validation test plan must be created to minimize the risk and cross-verify that all requirements as part of the risk assessment are adequately covered such that any risks have been minimized to an acceptable level.

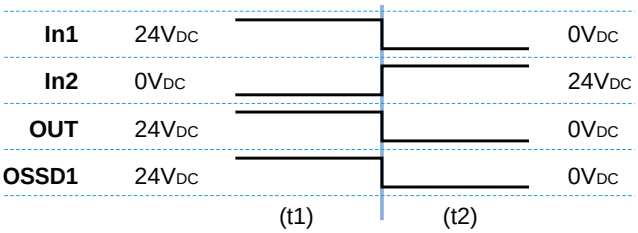
Functional Validation

For functional validation, each safety-related function must be tested before a machine is put into operation. The functional validation is managed by activating each input device and monitoring that the response of the system is what is expected. The validation must contain normal scenarios and must cover scenarios which combine multiple functions together to help ensure that the configuration has been done correctly.

The following is an example to help understanding a typical test procedure.



Validating the project with SoSafe MCM Basic:



(t1) In the normal operating condition, a safety-related guard (`SAFETY GUARD 2CH`) is closed. Input 1 is closed, Input 2 is open and the output of the safety-related guard block is set to TRUE. In this mode, the safety-related outputs (`OSSD_1A`, `OSSD_1B`) are active and the power supply to the relative terminals is 24 Vdc.

(t2) When the safety-related guard is physically open, the inputs are set to FALSE which must set the outputs of the `SAFETY GUARD 2CH` function block to FALSE. Therefore, the physical output changes from 24 to 0 Vdc. If this change occurs, then the safety-related guard safety chain is functioning according to requirements.

NOTE:

- The installation of each external input sensor or actuator must be validated by referring to the device-specific installation manual.
- The validation must be performed for each safety-chain component in the project.

Checklist After Installation

Presentation

The following must be verified at start up and at least once every year:

Step	Action
1	Conduct a full functional test of the system, as described in the Validation, page 58 section.
2	Verify that all the cables are correctly inserted and that all screw terminals are tightened with the specified tightening torque.
3	Verify that all the LED indicators are correctly illuminating.
4	Verify the positioning and function of all input and output sensors and actuators used with the Standalone Safety Controller XPSMCMCB1604SA(G).
5	Verify the correct mounting of the Standalone Safety Controller XPSMCMCB1604SA(G) to the DIN rail.
6	Verify that all the external indicators (lamps/beacons/sirens) are functioning as you intended.

Monitoring

What's in This Chapter

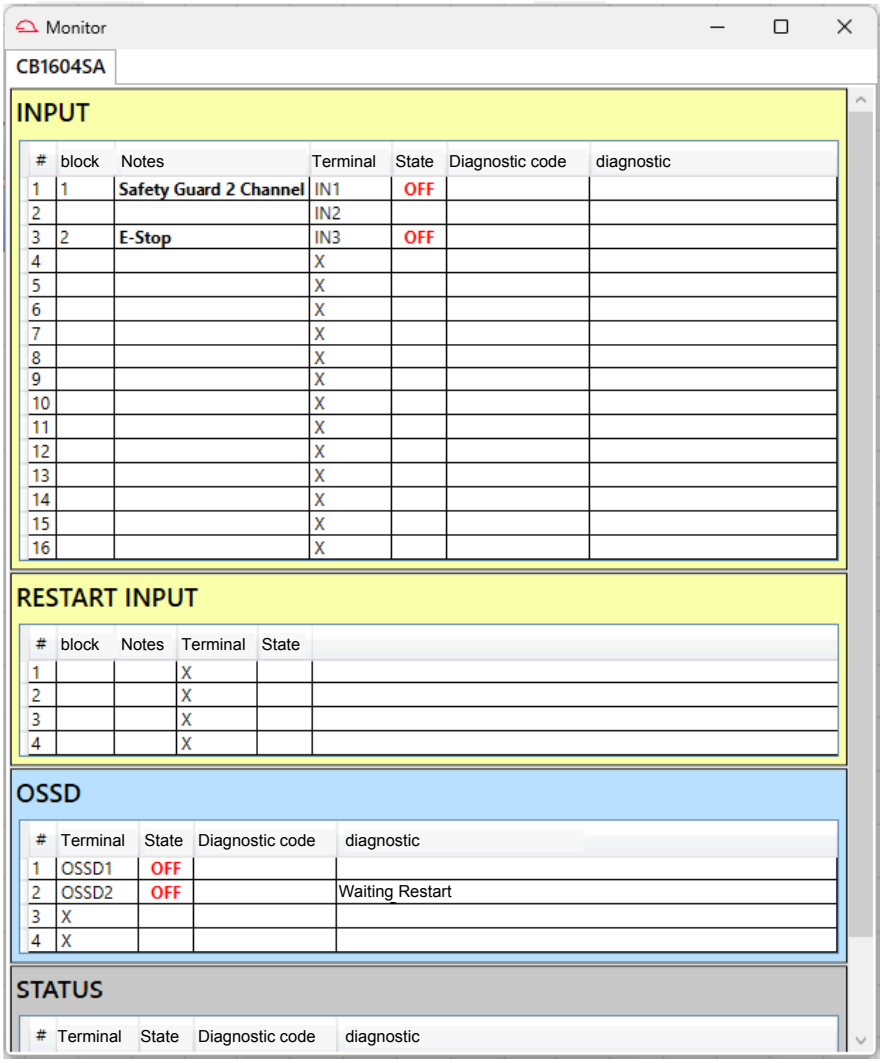
Monitoring the I/O State

State Monitor

To activate the monitoring, use the icon  . The **Level1 Password** is sufficient. A pop-up window appears with the following information:

- input state (when the object has two or more input connections to the controller, the monitor shows only the first connection as active);
- Input/Out_test Diagnostics
- OSSD State
- OSSD Diagnostics
- Signaling OUTPUT state

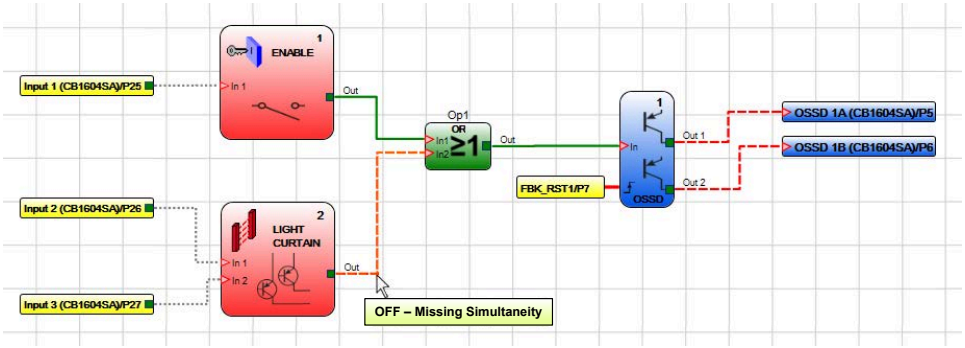
The following graphic presents the state monitor:



Graphical Monitor

To activate/deactivate the monitor use the icon  . (The **Level1 Password** is sufficient).

The following graphic presents the graphical monitor:



The following features are available with the graphical monitor:

- Hover the mouse pointer over a connection line to display diagnostics information.
- Right-click an item and select **Show/Hide Properties** to display its properties.

The diagnostics are indicated by color coding the lines:

- Red: OFF
- Green: ON
- Dashed orange: Connection error detected.
- Dashed red: Pending enable (for example restart).

Specific indications for the lines of the function block *NETWORK*:

- Red: STOP
- Green: RUN
- Orange: START

Specific indications for the lines of the function block *SERIAL OUTPUT*:

- Black: Data is being transmitted

NOTE: The project cannot be modified as long as the graphical monitor mode is active.

Simulation

What's in This Chapter

General Information

Overview

The Simulation function of SoSafe MCM Basic is intended to support you in developing your configuration by simulating the behavior of the function blocks. The Simulation function is not intended to substitute for, but to complement, the processes of risk assessment, risk evaluation, validation, and commissioning as well as any ancillary processes, tasks, and obligations according to the applicable regulations and standards such as ISO 13849-1 and IEC 62061. The Simulation function only simulates the behavior of the function blocks in the configuration. It neither simulates nor tests the hardware in your application.

⚠WARNING

INSUFFICIENT PERFORMANCE LEVEL/SAFETY INTEGRITY LEVEL

Do not use the Simulation function as the sole means for risk assessment, risk evaluation, validation, and commissioning as well as any ancillary processes, tasks, and obligations according to the applicable regulations and standards such as, but not limited to, ISO 13849-1 and IEC 62061.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Refer to Validating the Project , page 58 for additional information on the validation of your project.

SoSafe MCM Basic provides two types of simulation: **Schematic Simulation** and **Automatic Simulation**:

- **Schematic Simulation**, page 62 can be used to perform a simulation of a configuration or toggle the logical state of individual function blocks manually to observe the behavior of the function blocks in the configuration.
- **Automatic Simulation**, page 64 can be used to automatically verify the behavior of a configuration over time. **Automatic Simulation** is based on a user-configured **Triggers File** (*.sti files). The result of **Automatic Simulation** is a list of selected signal traces that can be saved as a file.

  NOTE: The Simulation function is available only if the Standalone Safety Controller XPSMCMCB1604SA(G) is disconnected.

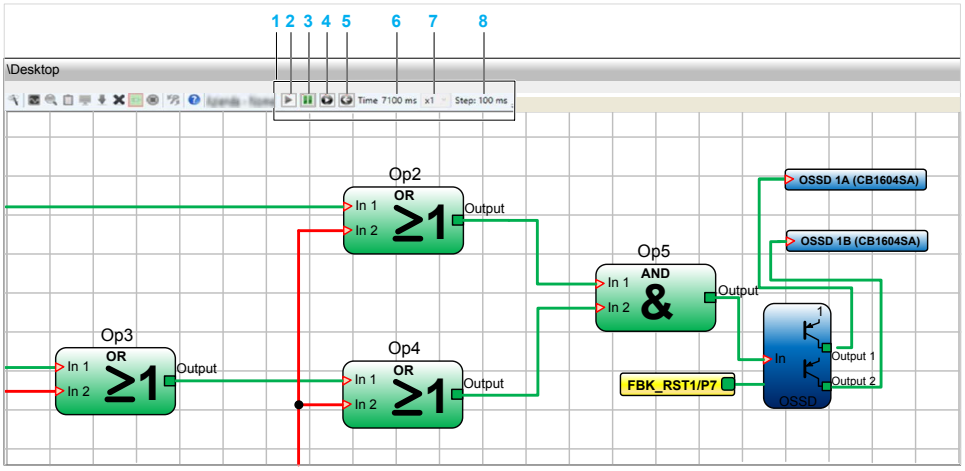
Schematic Simulation

Click the icon  to start the **Schematic Simulation**. You can use **Schematic Simulation** to monitor/guide the output signals of the various function blocks. You can choose the block outputs you want to control and verify the response of the various elements of the schematic model according to the color of the different lines.

With the monitor function, the color of the line (or of the key) indicates the signal status: green means the signal is set to TRUE (logic level 1), red means the signal is set to FALSE (logic level 0).

With **Schematic Simulation**, keys appear in the toolbar and can be used to control the simulation: the **Play** and **Stop** keys to start and stop the simulation, the **PlayStep** key for step-by-step operation and the **Reset** key. When the simulation is reset, the time value is reset to 0 ms.

When you press **Play** to start the simulation, the amount of time that has elapsed is displayed next to the word **Time**. This time is measured in **Step** units of time multiplied by the user-defined **KT** factor.



1: **Schematic Simulation** keys

2: **Play** key

3: **Stop** key

4: **PlayStep** key

5: **Reset** key

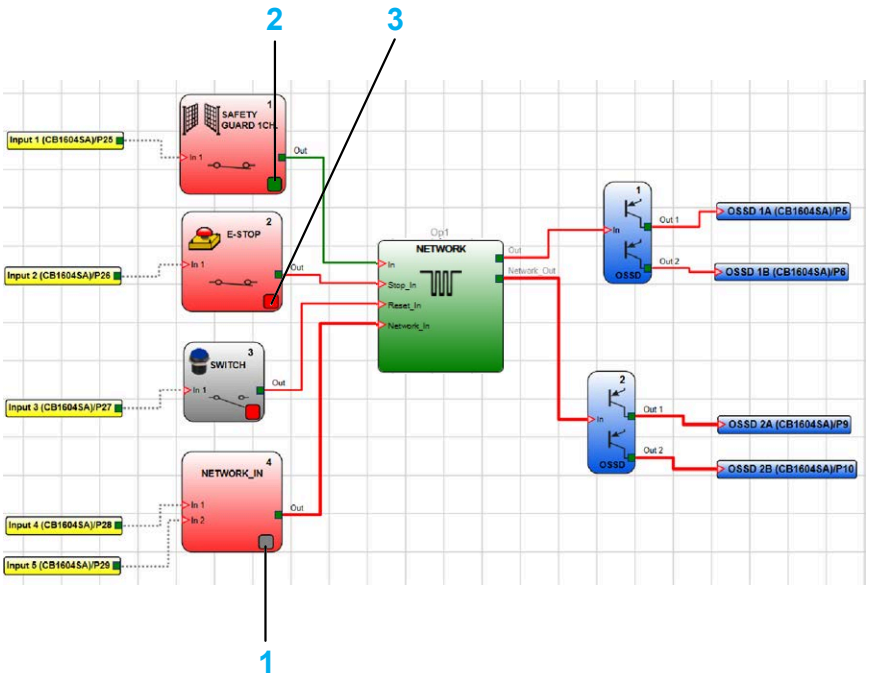
6: **Time** value

7: **KT** factor

8: Step units

Click the bottom right key of each input block (see graphic hereafter) to activate the respective output status (even when the simulator is not running, that is, when the time is not elapsing: in this case the simulation is **static**). If the key turns red when you click on it, the output is FALSE (logic level 0 or *LL0*). If the key turns green, the output is TRUE (logic level 1 or *LL1*).

In the **NETWORK_IN** operator, the key is gray. This indicates that the value must be entered manually in a specific pop-up window.

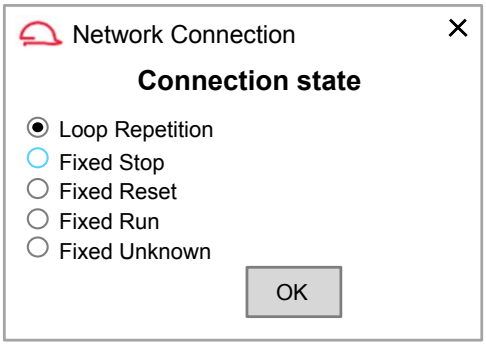


1: Select the value for the state of **NETWORK_IN**

2: TRUE (Logic level 1)

2: FALSE (Logic level 0)

The following graphic presents the pop-up window for entering the **Connection state** of the network:

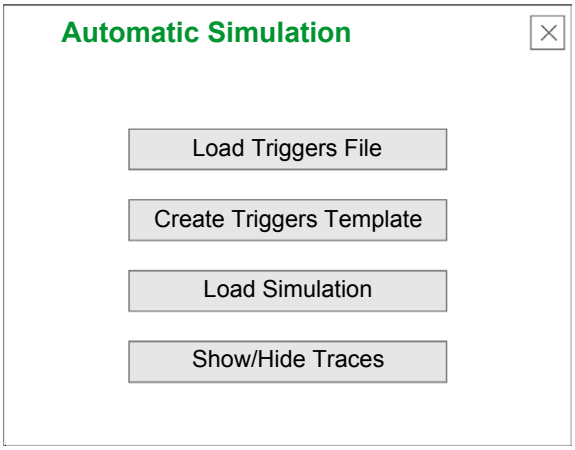


Automatic Simulation

You can use **Automatic Simulation** to display the signal pattern over time in a diagram.

As opposed to the **Schematic Simulation**, it runs through a full simulation of your SoSafe MCM Basic configuration without user interaction. **Automatic Simulation** is based on an *.sti file with simulation trigger events. A trigger event is a transition of the logical state of a function block at a given point in time. The template for this **Triggers File** is created by SoSafe MCM Basic and can be edited. The resulting simulation **Triggers File** is then used to perform the simulation.

Click the icon button in the toolbar or use the menu **Simulation > Automatic Simulation** to activate (or deactivate) the **Automatic Simulation**. When selected, the following dialog box is displayed:



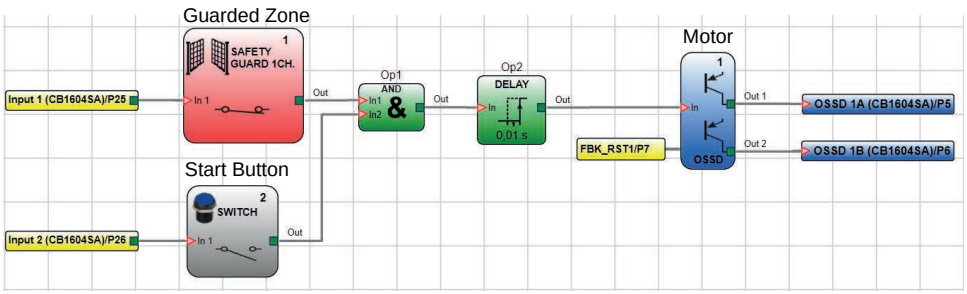
Button	Function
Load Triggers File	Lets you load a file containing simulation triggers. If the triggers are valid, **Automatic Simulation** starts immediately after you have loaded the **Triggers File**. If the triggers are invalid, SoSafe MCM Basic displays an error message and you have to correct the simulation triggers.
Create Triggers Template	Click this button to create a template file for the triggers. You can then edit the simulation triggers as required.
Load Simulation	Lets you load a simulation result previously saved and perform the simulation again.
Show/Hide Traces	Lets you select the signal traces to be displayed in the simulation result.

Performing **Automatic Simulation** requires a simulation **Triggers File**. A simulation **Triggers File** is created in two steps:

Step	Action
1	Create the triggers template file. For details, refer to Creating a Triggers Template for a Triggers File for an Automatic Simulation, page 65.
2	Edit the simulation triggers in the template file to create the simulation **Triggers File**. For details, refer to Editing the Simulation Triggers in the Template File for an Automatic Simulation, page 66.

Creating a Triggers Template for a Triggers File for an Automatic Simulation

The following descriptions use this sample configuration to explain the procedure:



To activate the safety-related output, the two input function blocks *SAFETY GUARD* and *SWITCH* must be set to TRUE (logic level 1). When both input function blocks are set to TRUE, the output of the AND function block becomes TRUE and then a *DELAY* function block (rising edge) adds a wait time until the outputs of the output function block *OSSD* are set to TRUE triggering a motor start.

In the dialog box displayed after you have selected **Automatic Simulation**, click **Create Triggers Template**. SoSafe MCM Basic prompts you for a name and a location of the template to be saved (file extension *.STI).

The template is a text file. Open the template with a text editor such as Notepad. Content of the template:

```
// Simulation Triggers Template
//Sim 0:EndTime:Step (time unit ms)
Sim 0:10000:100
// Safety Guard 1 Channel
Input1
0:0
Time1:1
Time2:0
// Switch
Input2
0:0
Time1:1
Time2:0
// OSSD
Fbk_rst1
0:0
Time1:1
Time2:0
```

At the top, the template contains a section for the timing of the simulation (first section). The timing section is followed by one section for each input function block and output function block. These sections specify the simulation triggers.

Editing the Simulation Triggers in the Template File for an Automatic Simulation

In the text editor, edit the individual sections to meet your simulation requirements.

In the timing section at the top of the file, you can modify the end time of the simulation and the time increments. The unit is milliseconds for both time values.

Following the timing section, the template provides a section for each function block. Modify the values in these sections to adapt the behavior of the function blocks to your simulation requirement. Example of a section prior to editing:

```
// Safety Guard 1 Channel
Input1
0:0
Time1:1
Time2:0
```

`Input1` identifies the input. Do not modify this value.

`0:0` represents the logical state of the input at time 0 (start) of the simulation. If you want the simulation to start with the input set to FALSE (logical 0), enter `0:0`. If you want the simulation to start with the input set to TRUE (logical 1), enter `0:1`.

`Time1:1` represents the logical state of the input at a specified point in time. For example, if, after a period of 2000 ms, you want the input to switch from FALSE (0) to TRUE (1), enter `2000:1`.

`Time2:0` represents the next transition of the logical state. For example, if, after a period of 8000 ms, you want the input to switch back from TRUE (1) to FALSE (0), enter `8000:0`.

Example of section after editing for simulation **Triggers File**:

```
// Safety Guard 1 Channel
Input1
0:0
2000:1
8000:0
```

You may enter additional `time:state` combinations if you want the simulation to include multiple state transitions at different times.

It is possible to add comments to the simulation **Triggers File**. Comments are not interpreted by the simulation function. A line starting with two slashes is a comment. Example:

```
// Switch
// This is the pushbutton the user has to press to start the
motor
Input2
0:0
// Switch to TRUE after 3 seconds
3000:1
// Switch to FALSE after 9 seconds
9000:0
```

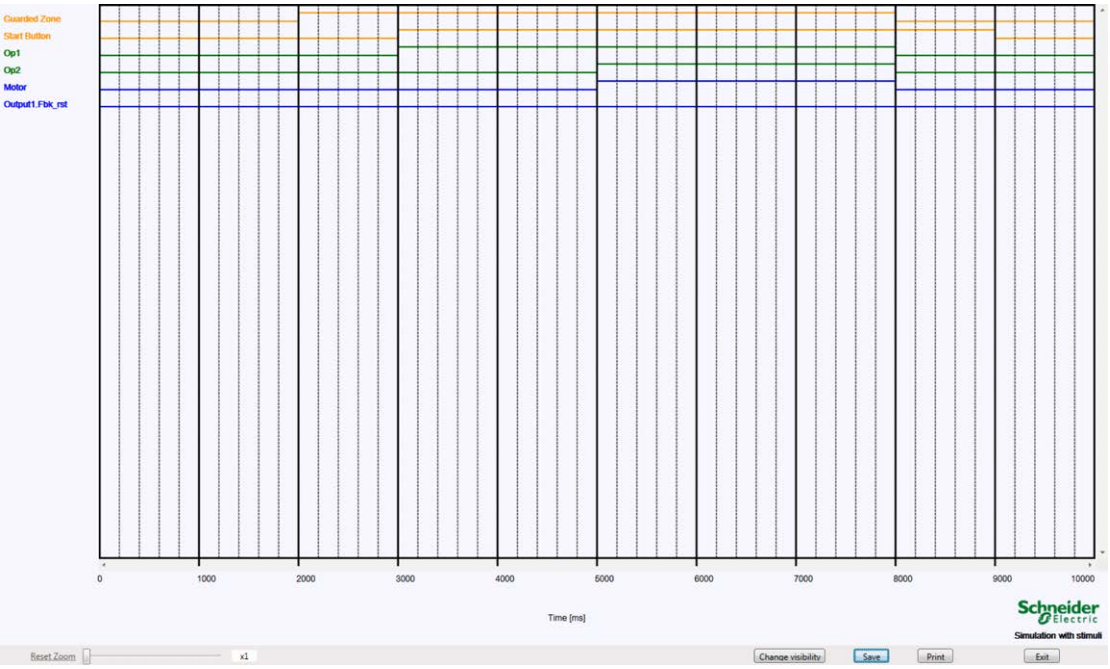
After you have modified the values in the triggers template file, save the file with the extension *.STI. This edited file is the simulation **Triggers File**.

Running an Automatic Simulation

After you have saved a simulation **Triggers File**, you can start the **Automatic Simulation**.

In the dialog box displayed after you have selected **Automatic Simulation**, click **Load Triggers File**. SoSafe MCM Basic prompts you for the name and location of the simulation **Triggers File** to be used for the simulation (file extension *.STI). After you have selected a valid file, the **Automatic Simulation** starts to run.

The simulation is displayed on screen. At the end of the simulation, SoSafe MCM Basic displays the results of the simulation in the form of a graphical representation of the traces (waveforms) of the function blocks.



The chart displays the signal traces over time. A trace is identified by the description you have assigned to the corresponding item in the diagram (for example, `GUARDED ZONE`). If you have not entered a description, the chart shows the name of the function block.

In the example, the logical state of the input function block `SAFETY GUARD` with the description Guarded Zone changes from FALSE (0) to TRUE (1) after 2000 ms. The logical state of the input function block `SWITCH` with the description Start Button changes from FALSE (0) to TRUE (1) after 3000 ms. This meets the condition defined by means of the operator function block `AND` (`Op1`). The time of 2 s defined by means of the timer function block `DELAY` (`Op2`) starts to run. After

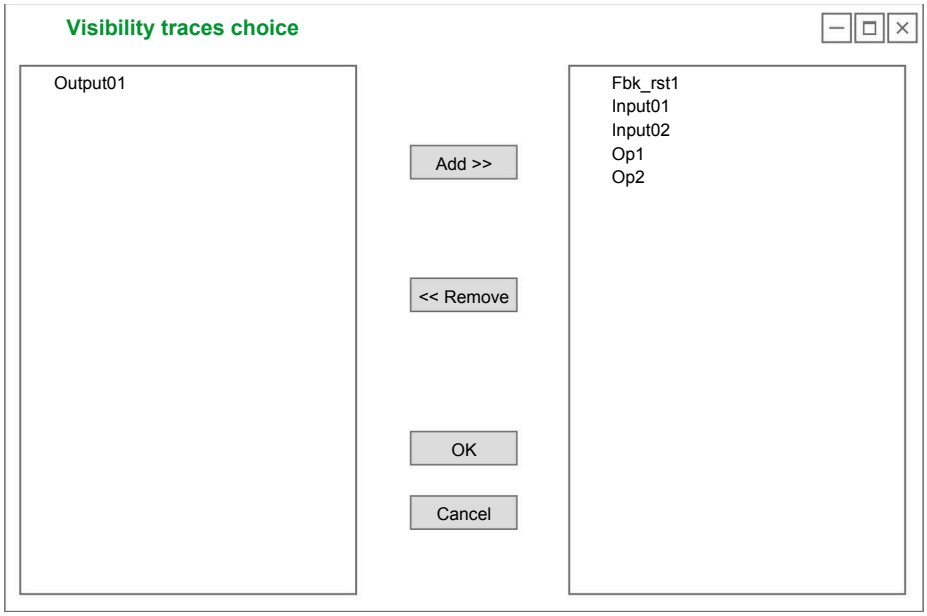
5000 ms, the delay time has elapsed and output function block OSSD with the description Motor is set to TRUE (1).

After 8000 ms, the logical states of the function blocks with the exception of `SWITCH` (Start Button) change to FALSE. The logical state of the function block `SWITCH` (`Start Button`) changes to FALSE after 9000 ms.

You can print and/or save the results to a file (the file extension is *.DAT) using the appropriate buttons at the bottom of the chart window. You can load again the saved simulation in the dialog box displayed with **Automatic Simulation > Load Simulation**.

Showing/Hiding Traces of an Automatic Simulation

In the dialog box displayed after you have selected **Automatic Simulation**, click the button **Show/Hide Traces**. SoSafe MCM Basic displays a dialog box that allows you to add or remove traces in the chart to be displayed at the end of the simulation:



In the chart with the simulation results, you can also use the button **Change Visibility** to show/hide traces.

Function Blocks

What's in This Part

Object Function Blocks

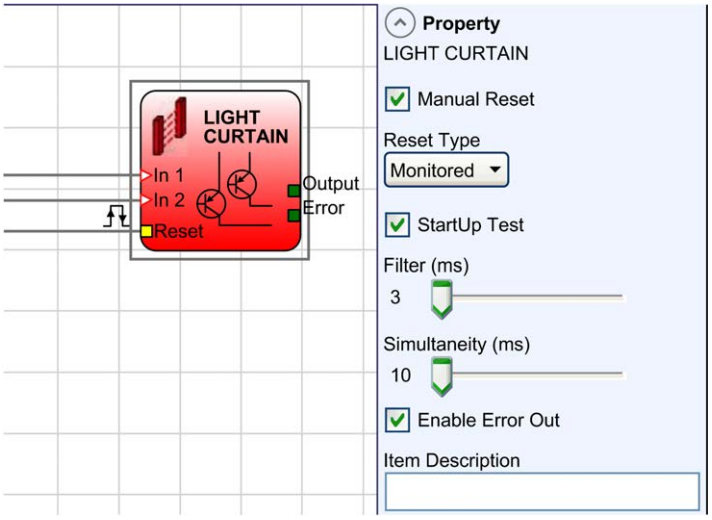
What's in This Chapter

Input Function Blocks

LIGHT CURTAIN Function Block

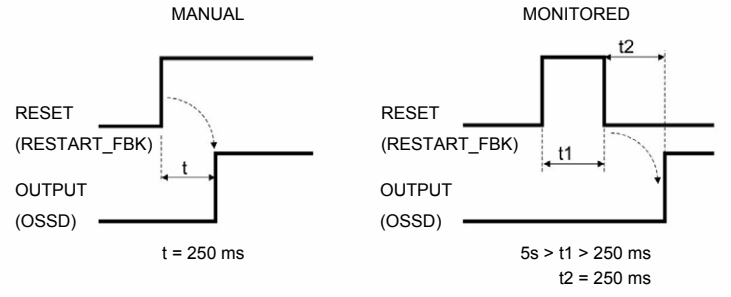
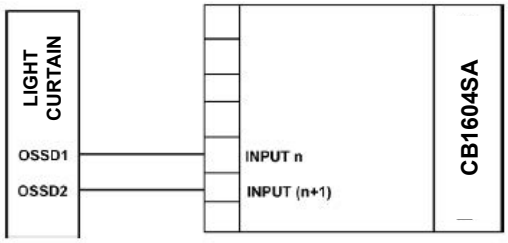
Presentation

The light curtain function block *LIGHT CURTAIN* monitors an optoelectronic safety-related light curtain (or laser scanner) state (Electro-Sensitive Protective Equipment, *ESPE*). When the optoelectronic device detects an object, the output is set to FALSE. If there is no object detected by the optoelectronic device, the output is set to TRUE.



Parameters

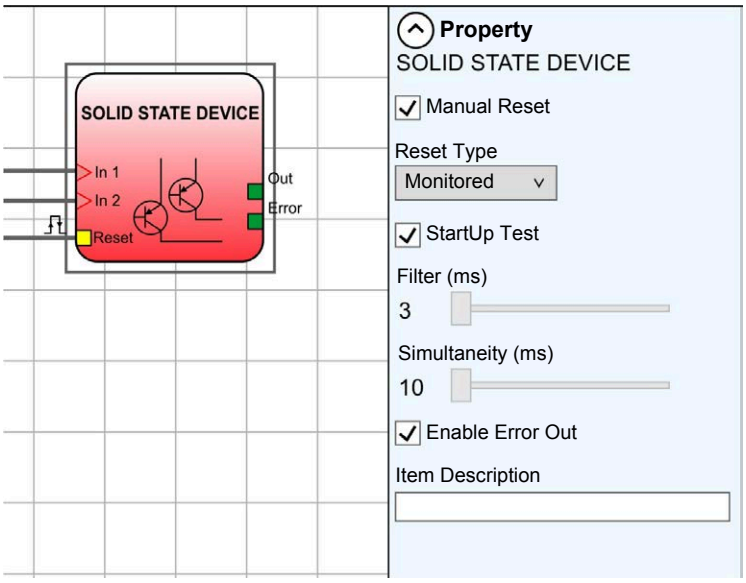
The following table presents the parameters displayed in the **Property** pane:

Parameter	Description
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0.  Connection example: **CONNECTION SAMPLE**  **NOTE:** If **Manual Reset** is selected, use the input immediately after those used by the function block: for example, if inputs 1 and 2 are used for the function block, use input 3 for *Reset*. **NOTE:** OUT TEST signals cannot be used with light curtains or similar devices with OSSD outputs as the tests are carried out by the devices themselves.
StartUp Test	When selected, the function requires, on power-up, the light curtain to be tested. This test is performed by interrupting the detection field of the optoelectronic device and then removing the interruption.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
Simultaneity (ms)	The function monitors for synchronized switching of the two channels. If both channels switch within the synchronization (simultaneity) time, the value remains TRUE. The synchronization time can be set to values from 10 to 7000 ms.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

SOLID STATE DEVICE Function Block

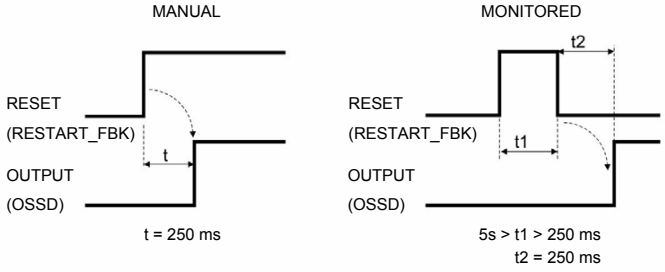
Presentation

The *SOLID STATE DEVICE* function block monitors the inputs of a solid-state device. If the inputs are set to TRUE, the output is set to TRUE. If one or both inputs are set to FALSE, the output is set to FALSE.



Parameters

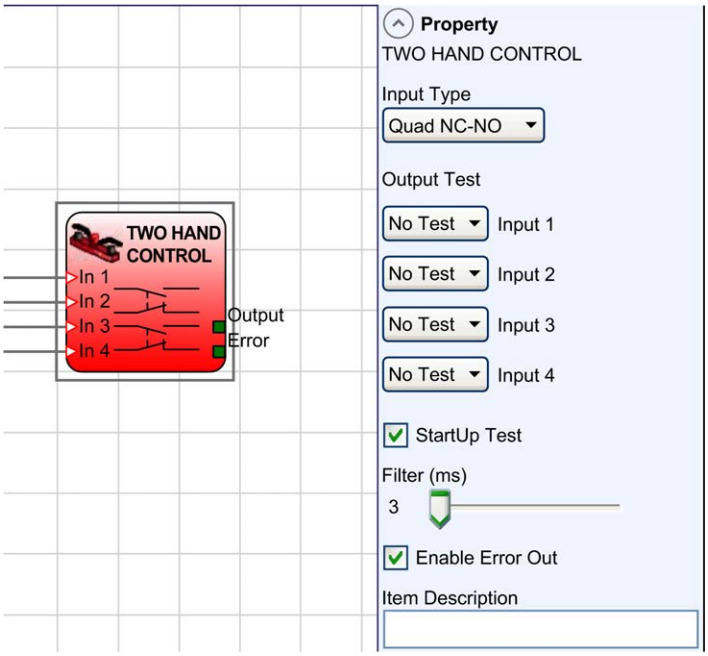
The following table presents the parameters displayed in the **Property** pane:

Parameter	Description
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0.  **NOTE:** If *Reset* is enabled, use the input immediately after those used by the function block: for example, if inputs 1 and 2 are used for the function block, use input 3 for *Reset*.
StartUp Test	When selected, the function requires, on power-up, the solid-state device to be tested. This test is performed by activating and deactivating the inputs of the *SOLID STATE DEVICE* function block.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
Simultaneity (ms)	Is always active. The function monitors for synchronized switching of the two channels. If both channels switch within the synchronization (simultaneity) time, the value remains TRUE. The synchronization time can be set to values from 10 to 7000 ms
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

TWO HAND CONTROL Function Block

Presentation

The *TWO HAND CONTROL* function block monitors the two-hand control devices. Both of the push-button switches must be activated within 500 ms to set the output to TRUE. If the push-button switches are not activated simultaneously, then the output is set to FALSE.



Parameters

The following table presents the parameters displayed in the **Property** pane:

Parameter	Description
Input Type	• **Double NO** (Dual channel NO): Use with a two-hand control device type III A as per ISO 13851 (with one NO per push-button). • **Quad NC-NO** : Use with a two-hand control device type III C as per ISO 13851 (with one NO and one NC contact block per push-button). **NOTE:** Correct connection of **Quad NC-NO**: • Contacts NO to terminal corresponding to IN1, IN3 • Contacts NC to terminal corresponding to IN2, IN4
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs.
StartUp Test	When selected, the function requires, on power-up, the two-hand control to be tested. This test is performed by pressing simultaneously within 500 ms and releasing the two-hand control push-buttons.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.

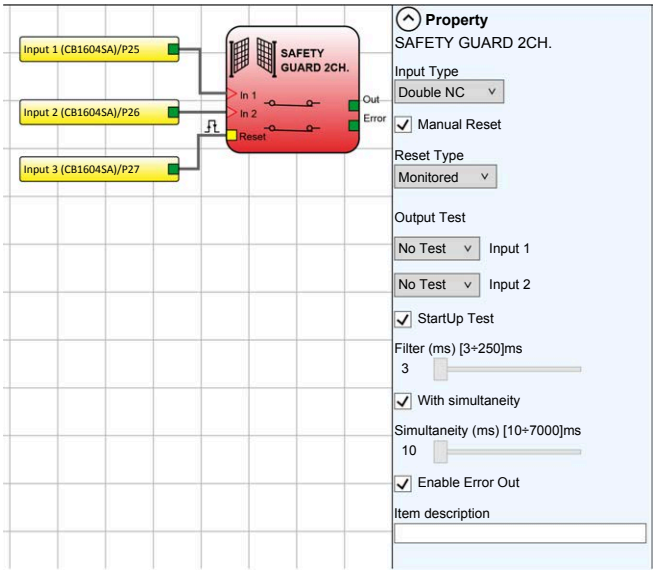
Parameter	Description
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

SAFETY GUARD 2 CH Function Block

Presentation

The *SAFETY GUARD 2 CH* function block monitors the state of a movable guard.

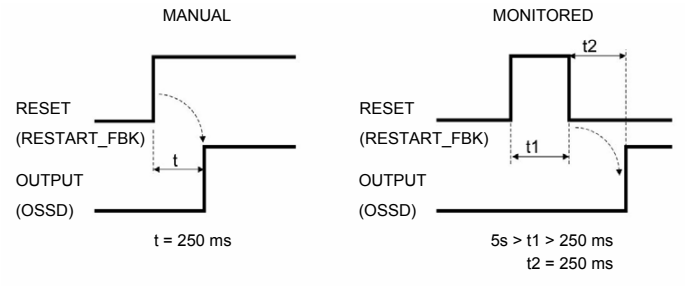
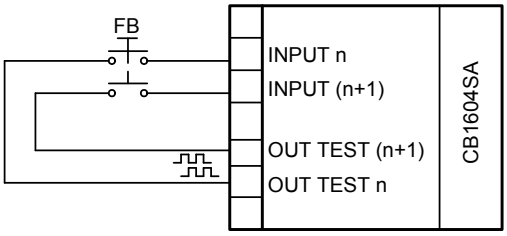
When the guard is closed, the inputs to the function are set to TRUE and the output is set to TRUE. When the guard is opened, one or both of the inputs to the function are set to FALSE and the output is set to FALSE.



Parameters

The following table presents the parameters displayed in the **Property** pane:

Parameter	Description
Input Type	• **Double NC**: allows connection of dual-channel guards with two normally closed output contacts. • **Double NC/NO**: allows connection of dual-channel guards with one normally closed output contact and one normally open output contact.
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.

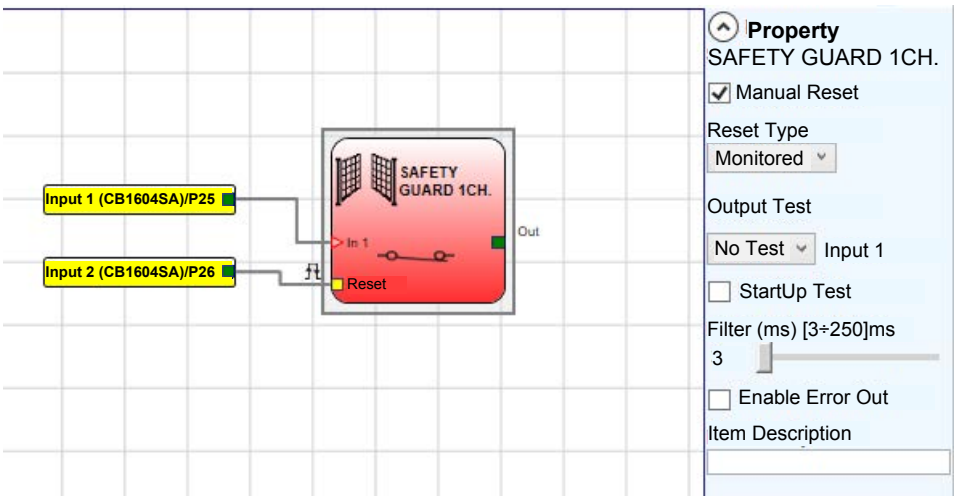
Parameter	Description
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0.  **NOTE:** If **Manual Reset** is selected, use the input immediately after those used by the function block: for example, if inputs 1 and 2 are used for the function block, use input 3 for *Reset*.
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs. Connection example with two contacts: 
StartUp Test	When selected, the function requires, on power-up, the movable guard to be tested. This test is performed by opening and closing the guard.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
With simultaneity	Is only available when dual-channel inputs are used. When selected, the function monitors for synchronized switching of the two channels. If both channels switch within the synchronization (simultaneity) time, the value remains TRUE.
Simultaneity (ms)	Specifies the maximum time (10...7000 ms) between the switching of the contacts of the safety guard.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

SAFETY GUARD 1 CH Function Block

Presentation

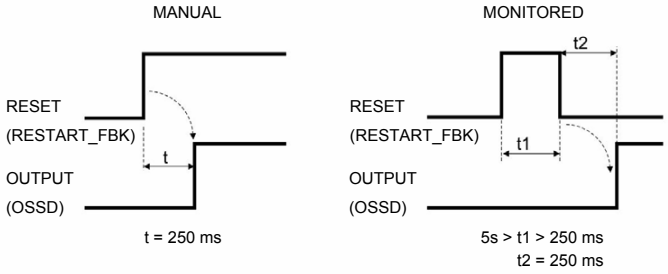
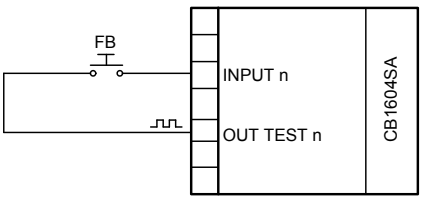
The *SAFETY GUARD 1 CH* function block monitors the state of a movable guard.

When the guard is closed, the input to the function is set to TRUE and the output is set to TRUE. When the guard is opened, the input to the function is set to FALSE and the output is set to FALSE.



Parameters

The following table presents the parameters displayed in the **Property** pane:

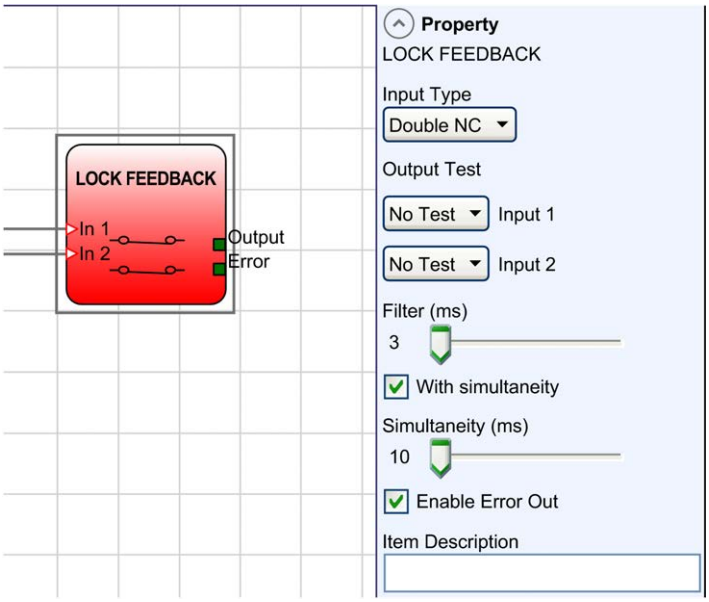
Parameter	Description
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0.  **NOTE:** If **Manual Reset** is selected, use the input immediately after those used by the function block: for example, if inputs 1 and 2 are used for the function block, use input 3 for *Reset*.
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs. Connection example with one contact: 
StartUp Test	When selected, the function requires, on power-up, the movable guard to be tested. This test is performed by opening and closing the guard.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.

Parameter	Description
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

LOCK FEEDBACK Function Block

Presentation

The *LOCK FEEDBACK* function block monitors the lock status of an interlocking device for a guard. In the case where the inputs indicate that the lock is locked, the output is set to TRUE, otherwise, the output is set to FALSE.



Parameters

The following table presents the parameters displayed in the **Property** pane:

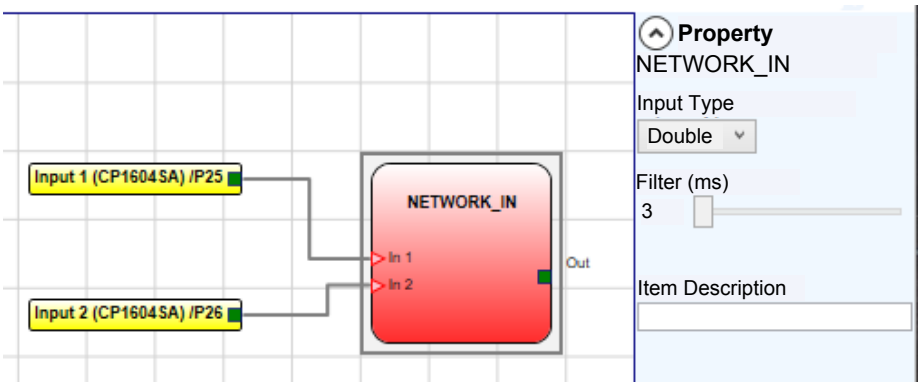
Parameter	Description
Input Type	• **Single NC**: For guard with one normally closed output contact. • **Double NC**: For guards with two normally closed output contacts. • **Double NC/NO**: For guards with one normally closed output contact and one normally open output contact. Connect the contact that is open when the guard is unlocked (NO) to IN1, the closed contact (NC) to IN2.
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.

Parameter	Description
With simultaneity	Is only available when dual-channel inputs are used. When selected, the function monitors for synchronized switching of the two channels. If both channels switch within the synchronization (simultaneity) time, the value remains TRUE.
Simultaneity (ms)	Specifies the maximum time (10...7000 ms) between the switching of the contacts of the safety-related device.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

NETWORK_IN Function Block

Presentation

The *NETWORK_IN* function block is used together with the *NETWORK* operator to connect the inputs, which are used to build the network. It can be configured for one or two inputs. When the inputs are set to TRUE, the associated output is set to TRUE.



For details, refer to *NETWORK* Operator, page 141.

Parameters

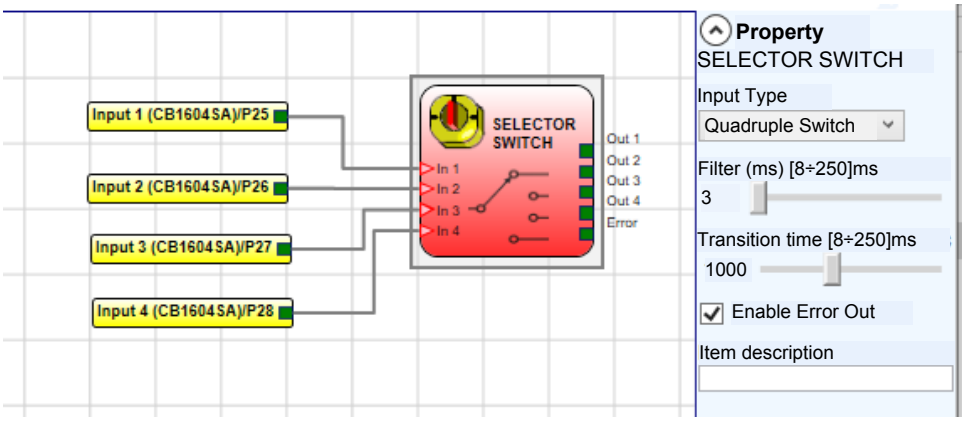
Parameter	Description
Input Type	• **Single**: enables the connection of status outputs of another Standalone Safety Controller XPSMCMCB1604SA(G). • **Double**: enables the connection of OSSD outputs of another Standalone Safety Controller XPSMCMCB1604SA(G).
Filter (ms)	• When selected, enables the filtering of signals from another Standalone Safety Controller XPSMCMCB1604SA(G). • The filter can be configured to 3...250 ms. • The filter time is added to the response time of the device represented by the function block to determine the total response time.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

SELECTOR SWITCH Function Block

Presentation

The *SELECTOR SWITCH* function block monitors the inputs from a selector switch with two to four channels. If only one input is set to TRUE, the

corresponding output is also set to TRUE. If all inputs are set to FALSE or more than one input is set to TRUE, the outputs are set to FALSE.



Parameters

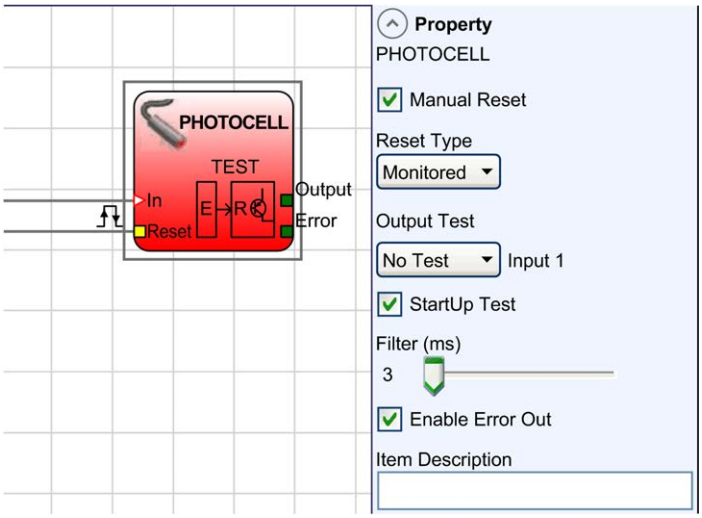
The following table presents the parameters displayed in **Property** pane:

Parameter	Description
Input Type	• **Double switch**: allows connection of a two-way selector switch. • **Triple switch**: allows connection of a three-way selector switch. • **Quadruple switch**: allows connection of a four-way selector switch.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
Simultaneity (ms)	Specifies the maximum time (10...7000 ms) between the switching of the contacts of the selector switch.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

PHOTOCELL Function Block

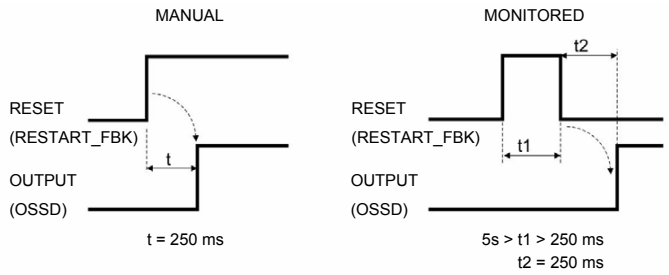
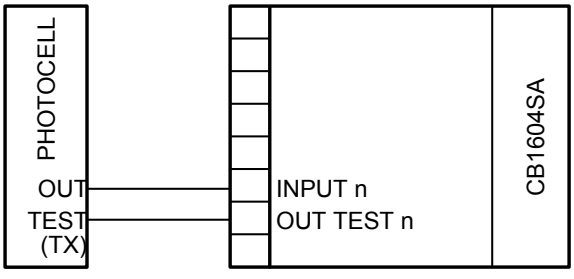
Presentation

The *PHOTOCELL* function block monitors the inputs of an optoelectronic photo cell. If the beam of the photo cell is clear, the output is set to TRUE. If the beam of the photo cell is occupied, the output is set to FALSE.



Parameters

The following table presents the parameters displayed in the **Property** pane:

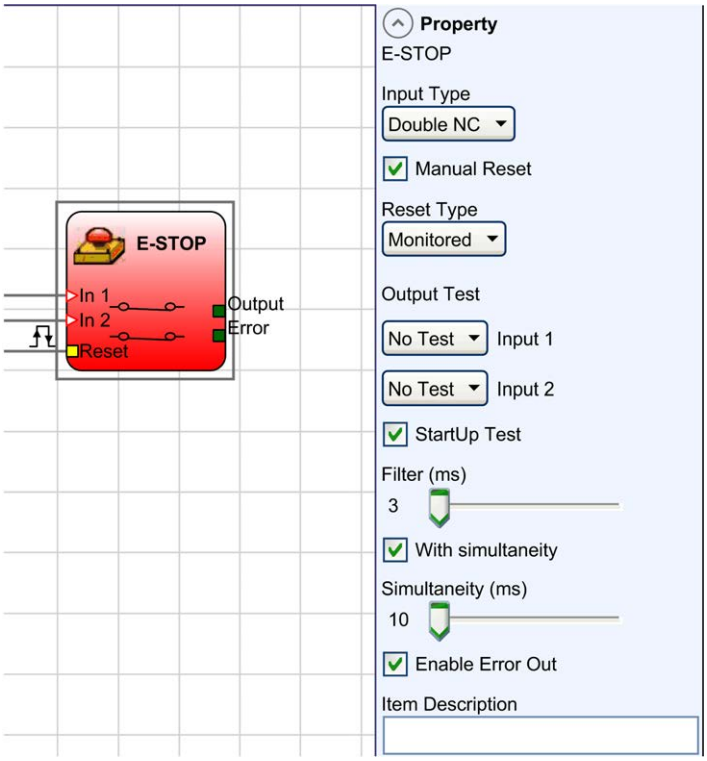
Parameter	Description
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0. 
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs. An output test signal is mandatory and can be selected from the 4 possible Test Output 1...4. If **Manual Reset** is selected, a consecutive input has to be used. For example, Input 1 is used for the functional block, then Input 2 has to be used for the Reset input. The response time of the photocell must be greater than 2 ms and less than 20 ms. Connection example: 

Parameter	Description
StartUp Test	When selected, the function requires, on power-up, the photocell to be tested. This test is performed by triggering a rising and falling edge on the photocell.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

E-STOP Function Block

Presentation

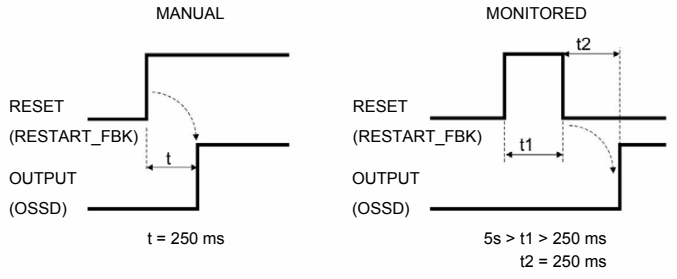
The *E-STOP* function block (emergency stop) monitors an emergency stop push-button state. The output of the *E-STOP* function block is TRUE when the inputs are TRUE (emergency stop push-button not pressed).



Parameters

The following table presents the parameters displayed in the **Property** pane:

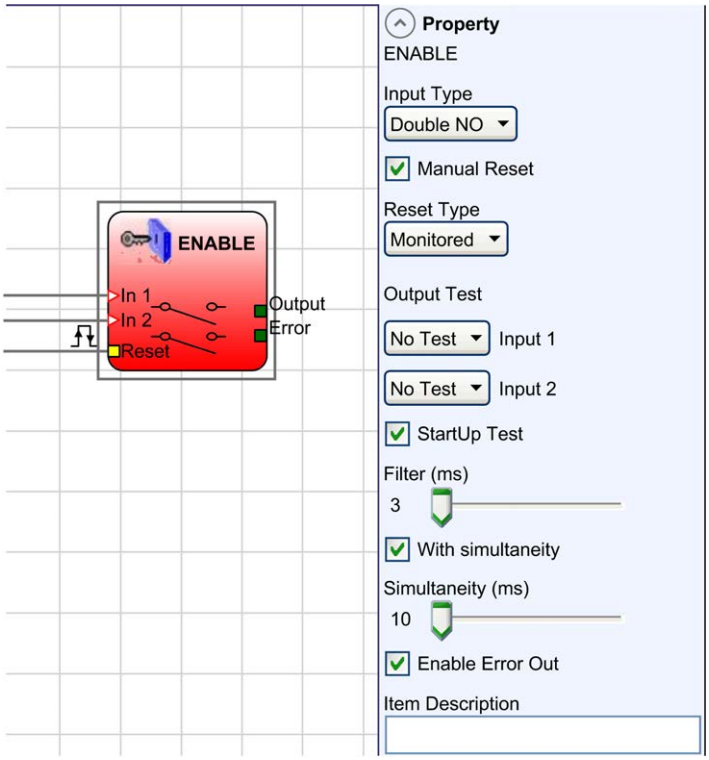
Parameter	Description
Input Type	• **Single NC**: allows connection of single-channel emergency stop push-button. • **Double NC**: allows connection of dual-channel emergency stop push-button.
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.

Parameter	Description
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0.  **NOTE:** If **Manual Reset** is selected, use the input immediately after those used by the function block: for example, if inputs 1 and 2 are used for the function block, use input 3 for *Reset*.
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs.
StartUp Test	When selected, the function requires, on power-up, the emergency stop to be tested. This test is performed by pressing and releasing the push-button.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
With simultaneity	Is only available when dual-channel inputs are used. When selected, the function monitors for synchronized switching of the two channels. If both channels switch within the synchronization (simultaneity) time, the value remains TRUE.
Simultaneity (ms)	Specifies the maximum time (10...7000 ms) between the switching of the contacts of the e-stop.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

ENABLE Function Block

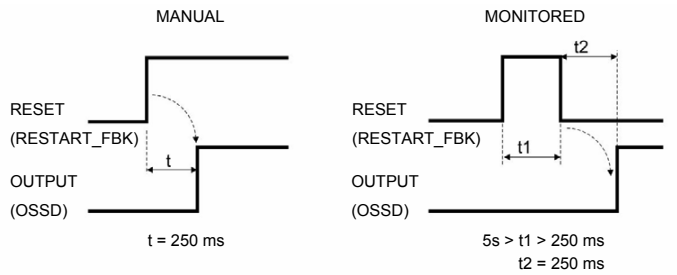
Presentation

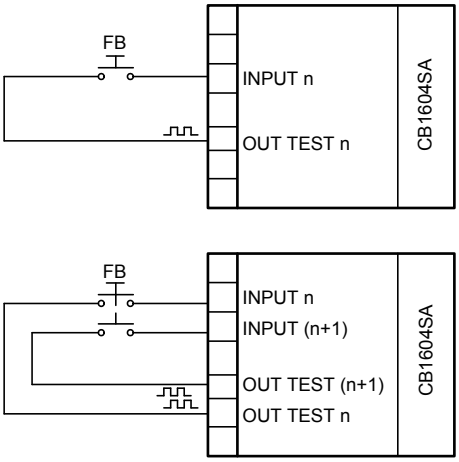
The ENABLE function block monitors a manual key device. When the key is inserted and turned in the closed position, the output is set to TRUE. When the key is not inserted or inserted but not turned to the closed position, the output is set to FALSE.



Parameters

The following table presents the parameters displayed in the **Property** pane:

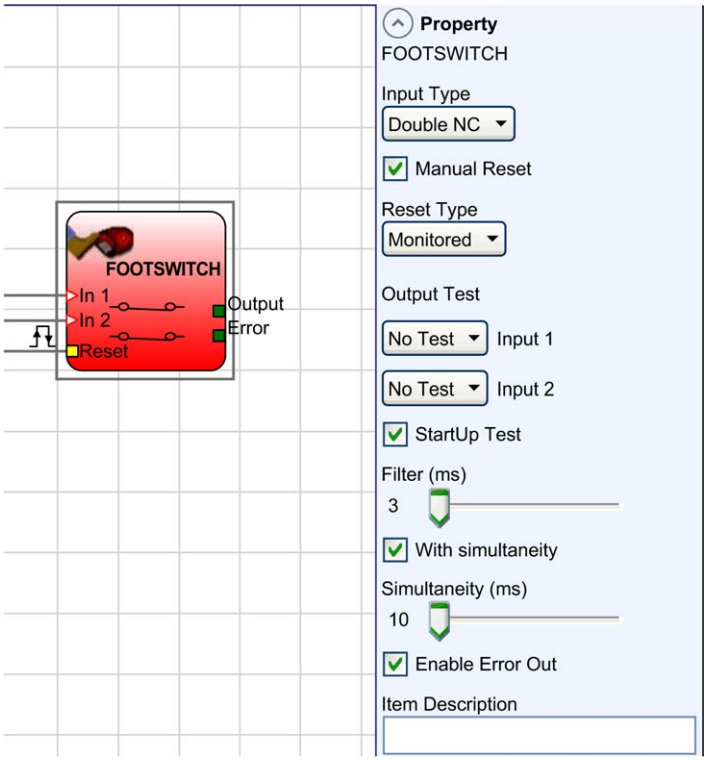
Parameter	Description
Input Type	• **Single NO**: allows connection of single-channel normally open contact. • **Double NO**: allows connection of dual-channel normally open contacts.
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0.  **NOTE:** If **Manual Reset** is selected, use the input immediately after those used by the function block: for example, if inputs 1 and 2 are used for the function block, use input 3 for *Reset*.

Parameter	Description
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs. Connection examples with one/ two contacts: 
StartUp Test	When selected, the function requires, on power-up, the enable switch to be tested. This test is performed by opening and activating the enable key.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
With simultaneity	Is only available when dual-channel inputs are used. When selected, the function monitors for synchronized switching of the two channels. If both channels switch within the synchronization (simultaneity) time, the value remains TRUE.
Simultaneity ms	Specifies the maximum time (10...7000 ms) between the switching of the contacts of the enable.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

FOOTSWITCH Function Block

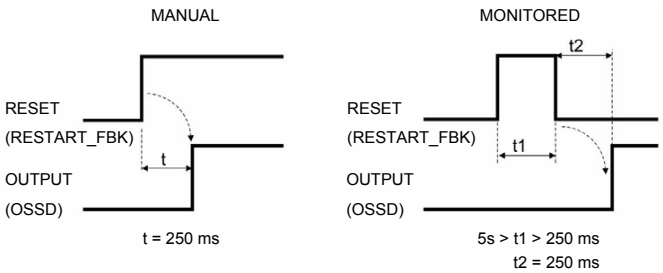
Presentation

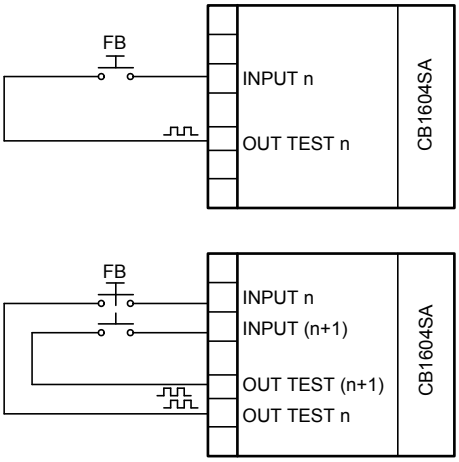
The *FOOTSWITCH* function block monitors the footswitch. If the footswitch is pressed, the output is set to TRUE. When it is not pressed, the output is set to FALSE.



Parameters

The following table presents the parameters displayed in the **Property** pane:

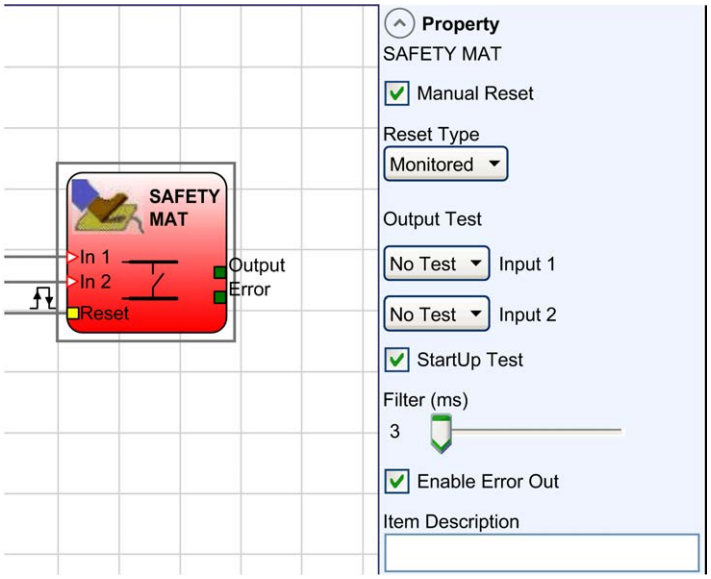
Parameter	Description
Input Type	• **Single NC**: For footswitches with one normally closed output contact. • **Single NO**: For footswitches with one normally open output contact. • **Double NC**: For footswitches with two normally closed output contacts. • **Double NC/NO**: For footswitches with one normally closed output contact and one normally open output contact. Connect the NC contact to IN1, the NO contact to IN2.
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0. 

Parameter	Description
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs. Connection example with one / two contacts: 
StartUp Test	When selected, the function requires, on power-up, the footswitch to be tested. This test is performed by pressing and releasing the footswitch.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
With simultaneity	Is only available when dual-channel inputs are used. When selected, the function monitors for synchronized switching of the two channels. If both channels switch within the synchronization (simultaneity) time, the value remains TRUE.
Simultaneity (ms)	Specifies the maximum time (10...7000 ms) between the switching of the contacts of the footswitch.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

SAFETY MAT Function Block

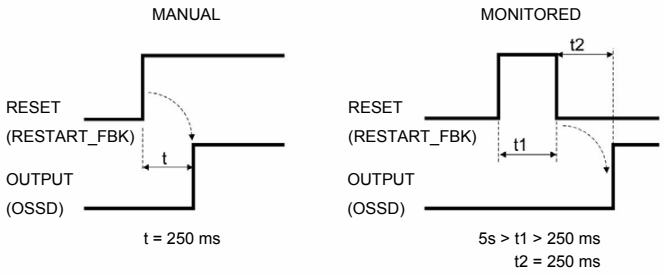
Presentation

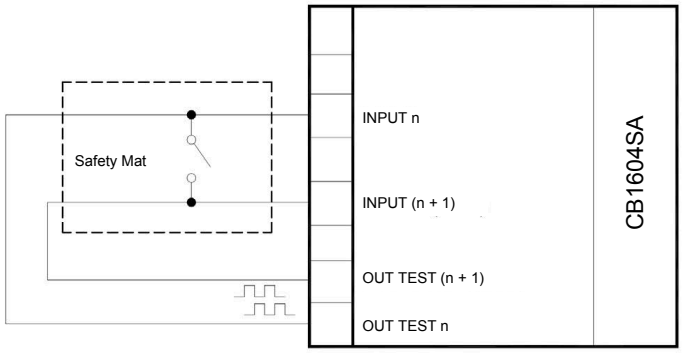
The *SAFETY MAT* function monitors the safety-related pressure-sensitive mat. If the safety-related mat is not activated, the output is set to TRUE. If the safety-related mat is activated, the output is set to FALSE.



Parameters

The following table presents the parameters displayed in the **Property** pane:

Parameter	Description
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0. 

Parameter	Description
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs. For the *SAFETY MAT* function, two output test signals are mandatory. Connection example:  **NOTE:** If **Manual Reset** is selected, use the input immediately after those used by the function block: for example, if inputs 1 and 2 are used for the function block, use input 3 for *Reset*. **NOTE:** • Each test output can be connected to only one *SAFETY MAT* input (parallel connection of 2 inputs not allowed). • The function block *SAFETY MAT* cannot be used with 2-wire components and termination resistance.
Start-up Test	When selected, the function requires on power-up of machine the safety-related mat to be activated. This test is performed by disengaging and engaging the safety-related mat.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

SENSOR Function Block

Presentation

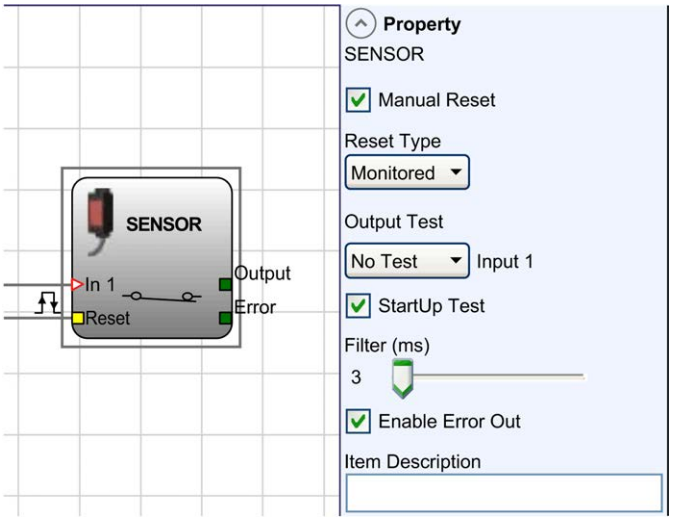
The *SENSOR* function monitors the input of a non-safety-related sensor. If the signal of the sensor is not interrupted, the output is set to TRUE. If the signal of the sensor is interrupted, the output is set to FALSE.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

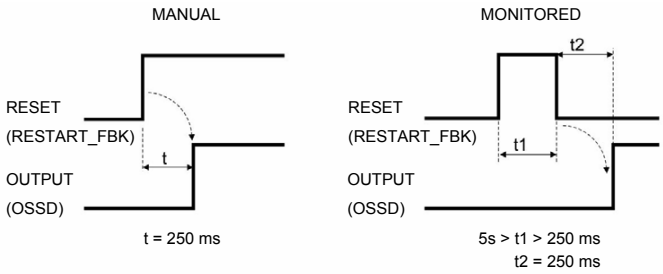
Do not use the *SENSOR* function as a safety-related input.

Failure to follow these instructions can result in death, serious injury, or equipment damage.



Parameters

The following table presents the parameters displayed in the **Property** pane:

Parameter	Description
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0.  **NOTE:** If **Manual Reset** is selected, use the input immediately after the one used by the function block: for example, if input 1 is used for the function block, use input 2 for *Reset*.
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs.
StartUp Test	When selected, the function requires, on power-up, the sensor to be tested. This test is performed by interrupting the beam(s) of the sensor and then removing the interruption.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

SWITCH Function Block

Presentation

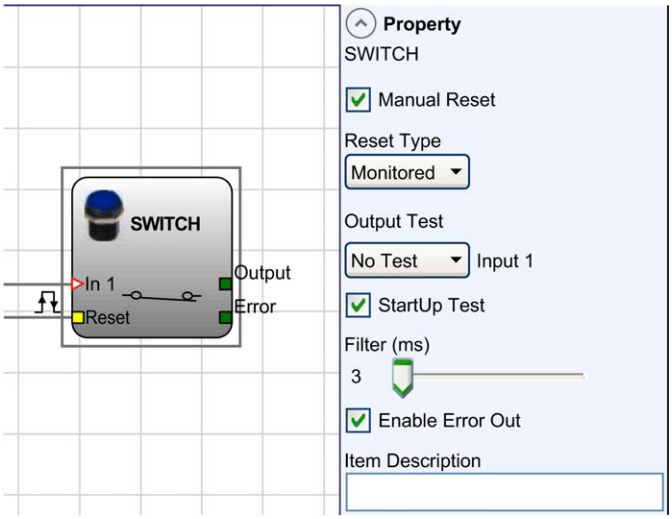
The *SWITCH* function block monitors the input of a non-safety-related push-button or switch. While the push-button is pressed or when the switch is ON, the output is set to TRUE; otherwise, the output is set to FALSE.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

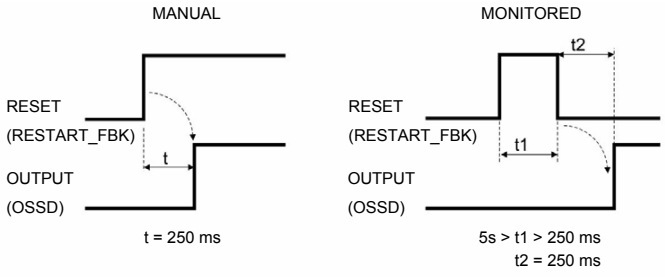
Do not use the *SWITCH* function as a safety-related input.

Failure to follow these instructions can result in death, serious injury, or equipment damage.



Parameters

The following table presents the parameters displayed in **Property** pane:

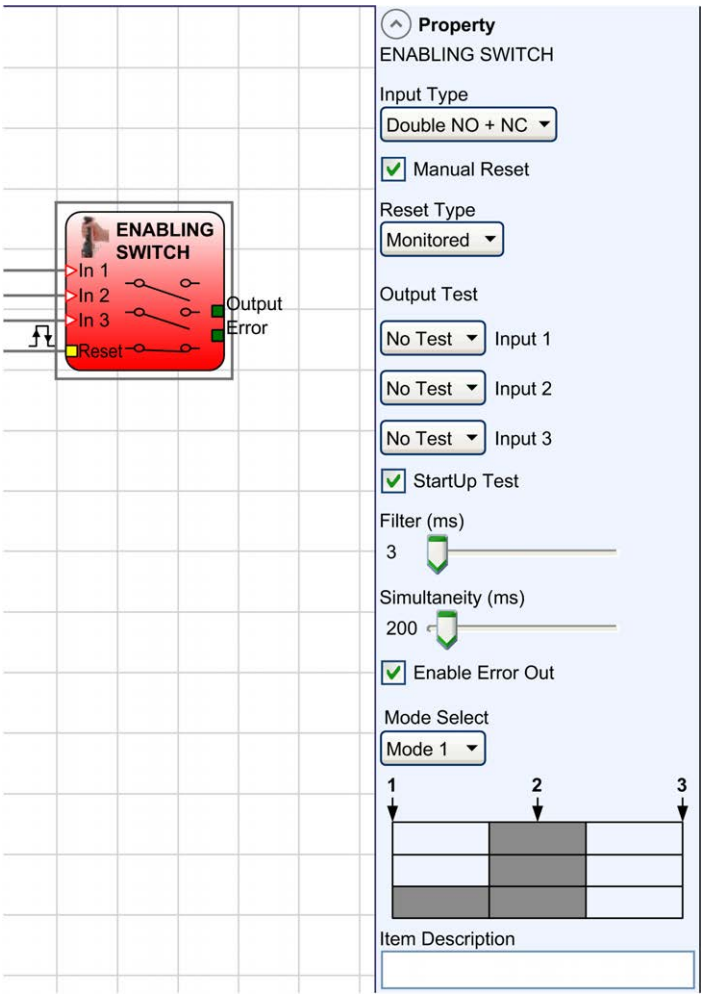
Parameter	Description
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0.  **NOTE:** If **Manual Reset** is selected, use the input immediately after the one used by the function block: for example, if input 1 is used for the function block, use input 2 for *Reset*.

Parameter	Description
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs.
StartUp Test	When selected, the function requires, on power-up, the switch to be tested. This test is performed by activating and deactivating the switch.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

ENABLING SWITCH Function Block

Presentation

The *ENABLING SWITCH* function block monitors the inputs of an enabling switch. When the enabling switch is in the middle position (position 2), the output is set to TRUE. If the enabling switch is not pressed (position 1) or if it is pressed completely (position 3), the output is set to FALSE.



Parameters

The following table presents the parameters displayed in the **Property** pane:

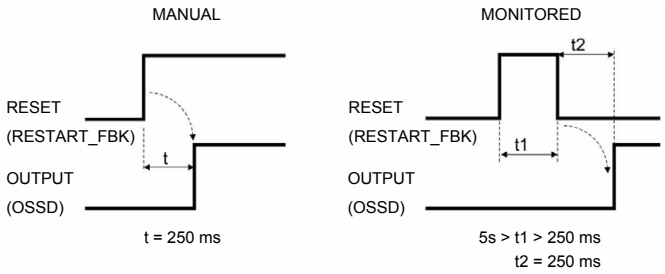
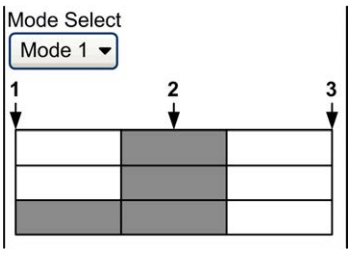
Parameter	Description
Input Type	• **Double NO**: allows connection of an enabling switch with 2 normally open contacts. • **Double NO + NC**: allows connection of an enabling switch with 2 normally open and 1 normally closed contacts.
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0. 
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs.
StartUp Test	When selected, the function requires, on power-up, the enabling switch to be tested. This test is performed by pressing and releasing the enabling switch.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
Simultaneity (ms)	Is always active. When selected, the function monitors for synchronized switching of the two channels. If both channels switch within the synchronization (simultaneity) time, the value remains TRUE. The synchronization time (ms) can be set to values from 10 to 7000 ms.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Mode Select	**Mode 1** and **Mode 2** are described hereafter.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

Table Mode 1 (2NO + 1 NC)



Position 1: enable switch fully released

Position 2: enable switch pressed to middle position

Position 3: enable switch fully pressed

	Position		
Input	1	2	3
IN1	0	1	0
IN2	0	1	0
IN3(1)	1	1	0
OUT	0	1	0
(1) only for input type 2NO + 1NC			

Table Mode 2 (2NO + 1 NC)

Position 1: enable switch fully released

Position 2: enable switch pressed to middle position

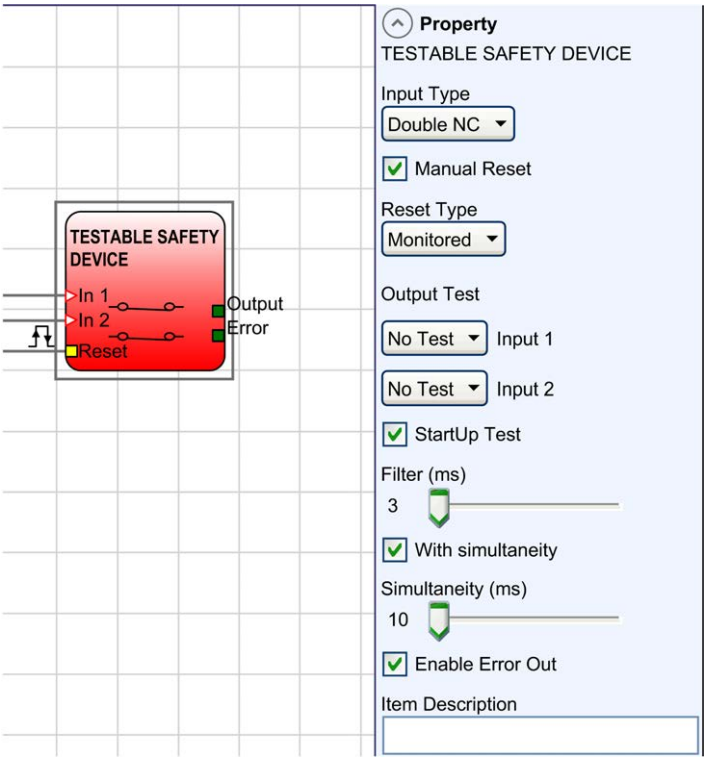
Position 3: enable switch fully pressed

	Position		
Input	1	2	3
IN1	0	1	0
IN2	0	1	0
IN3(1)	1	0	0
OUT	0	1	0
(1) only for input type 2NO + 1NC			

TESTABLE SAFETY DEVICE Function Block

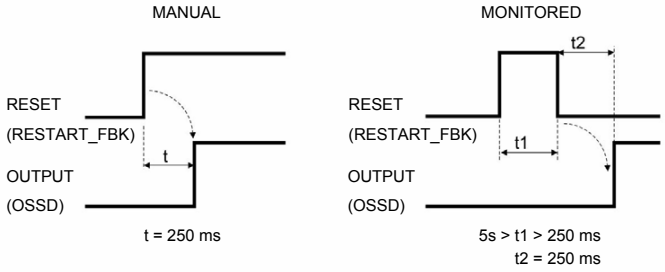
Presentation

The *TESTABLE SAFETY DEVICE* function block monitors the inputs of a single-channel or dual-channel safety-related sensor.



Parameters

The following table presents the parameters displayed in the **Property** pane:

Parameter	Description
Input Type	• **Single NC**: allows connection of single normally closed contacts. • **Single NO**: allows connection of single normally open contacts. • **Double NC**: allows connection of dual-channel normally closed contacts. • **Double NC/NO**: allows connection of two channels with one normally open and one normally closed contacts
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0.  **NOTE:** If **Manual Reset** is selected, use the input immediately after those used by the function block: for example, if inputs 1 and 2 are used for the function block, use input 3 for *Reset*.

Parameter	Description
Output Test	Output tests are used for short circuit and cross circuit detection at the inputs. The test outputs provide 24 Vdc test pulses with a test pulse duration of 100 µs. The switch off test pulse interval is every 5.5 ms. The inputs for which the test is set, expect this test pulse pattern from the test output. If the test pulse is not received or a different test pulse pattern is received, the outputs of the function block are set to FALSE After physical hardware inputs have been selected for the function, the appropriate test outputs can be assigned which supply the test pulses to the associated inputs.
StartUp Test	When selected, the function requires, on power-up, the safety-related device to be tested. This test is performed by activating and deactivating the device represented by this function block.
Filter (ms)	Used to filter the input signals from the function block. The filter can be configured between 3 and 250 ms and is used to help suppress contact bounce. The filter time is added to the response time of the device represented by the function block to determine the total response time.
With simultaneity	Is only available when dual-channel inputs are used. When selected, the function monitors for synchronized switching of the two channels. If both channels switch within the synchronization (simultaneity) time, the value remains TRUE.
Simultaneity (ms)	Specifies the maximum time (10...7000 ms) between the switching of the contacts of the testable safety-related device.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

Single NC and Single NO

IN1	OUT
0	0
1	1

Double NC and double NO

IN1	IN2	OUT	Synchronization error detected
0	0	0	No
0	1	0	Yes
1	0	0	Yes
1	1	1	No

Double NC / NO

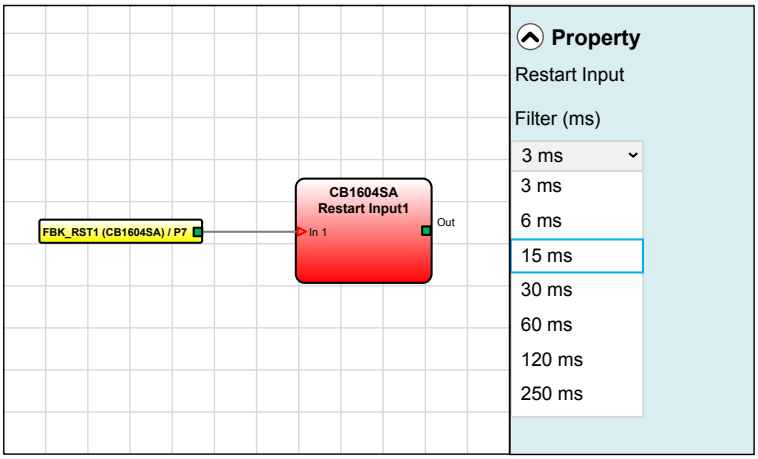
IN1 (NC)	IN2 (NO)	OUT	Synchronization error detected
0	0	0	Yes
0	1	0	No
1	0	1	No
1	1	0	Yes

RESTART INPUT Function

The *RESTART INPUT* function allows you to use feedback inputs not used for feedback as digital inputs (in addition to the 16 available inputs on the Standalone Safety Controller XPSMCMCB1604SA(G)).

The usable *RESTART_FBK* inputs of the Standalone Safety Controller XPSMCMCB1604SA(G) are available on terminals 7, 11, 15 and 19.

Parameter	Description
Filter (ms)	Used to filter the signals from the external device. This filter can be set to between 3 and 250 ms, helping to suppress rebounds on the contacts. The duration of the filter affects the calculation of module total response time.



LL0 and *LL1* Functions

Presentation

The *LL0* 

and *LL1* 

functions allow a predefined logical level (binary constants) to be entered on a function block input.

- *LL0*: logical level 0 (FALSE)
- *LL1*: logical level 1 (TRUE)

NOTE: *LL0* and *LL1* cannot be used to disable the logical operators in the project.

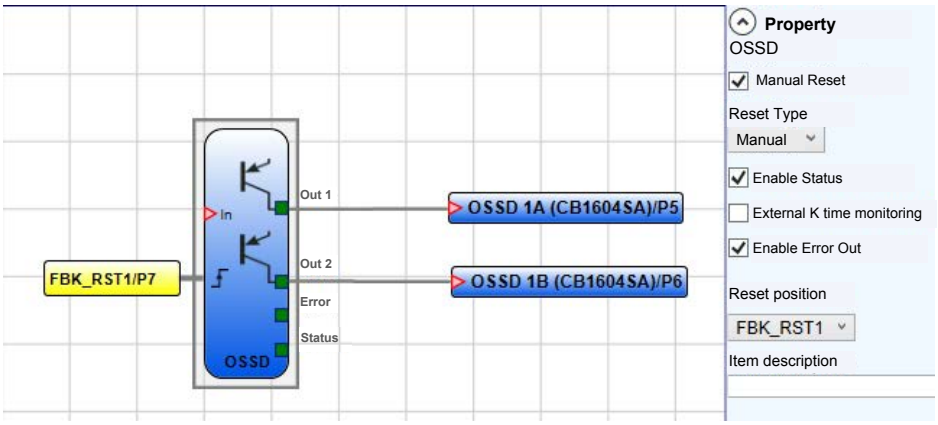
Output Function Blocks

OSSD Function Block

Presentation

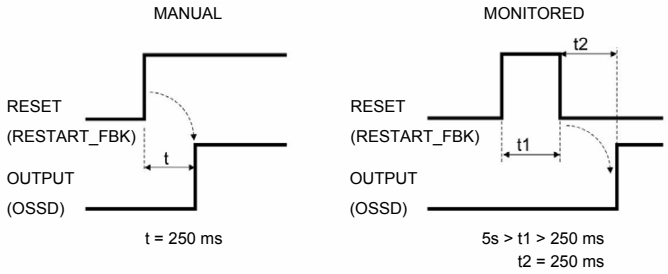
The *OSSD* (Output Signal Switching Device) semiconductor safety-related outputs *Out1* and *Out2* supply 24 Vdc if the input is set to TRUE, whereas they supply 0 Vdc if the input is set to FALSE.

NOTE: Each pair of solid-state safety-related output (*OSSD*) has a *RESTART_FBK* input. This input must be connected as described in Input RESTART_FBK, page 25.

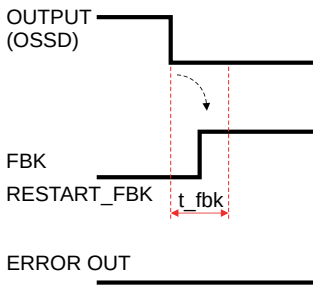
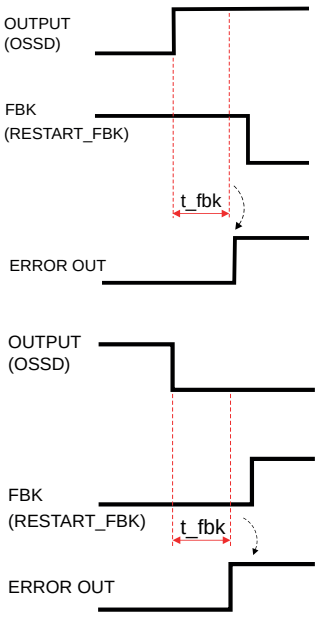


Parameters

The following table presents the parameters displayed in **Property** pane:

Parameter	Description
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the system verifies the signal transition from 0 to 1. When **Monitored** is selected, the system verifies the double transition from 0 to 1 and then back to 0. 
Enable Status	Provides the state of the function block at its corresponding output.
External K time monitoring / **External K delay**	Selecting this option enables the time *t_fbk* to be set to monitor the timing of the external feedback signal.. • The feedback signal (*FBK_RST*) must be TRUE before the output (OSSD) can be activated. When the output is activated, the feedback signal must transition from TRUE to FALSE within the specified time. • When the output is deactivated (transitioning to FALSE), the feedback signal must turn TRUE again within the specified time *t_fbk*. Otherwise, the output is deactivated and the detected error is indicated on the Standalone Safety Controller XPSMCMCB1604SA (G) by the flashing of the LED corresponding to the OSSD (see LED Indicators, page 24).
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block. **NOTE:** The `Error Out` signal is reset in the following cases: • Power cycle of the system. • Activation of the RESET function.
Reset position	Allows to select the physical terminal of Standalone Safety Controller XPSMCMCB1604SA(G) to give the reset command. You can use the same terminal for different *OSSD* outputs.
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

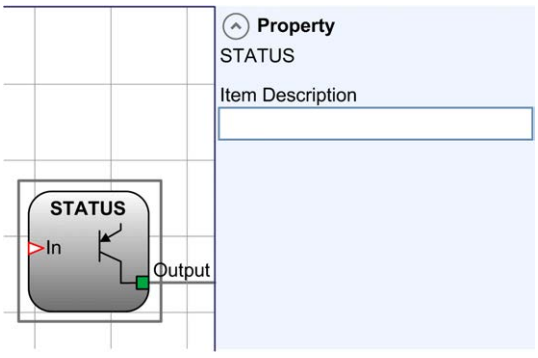
Example of Output Timing

Example with feedback time from external contactor K not exceeded.	*Error Out* set to FALSE: 
Example with feedback time from external contactor K exceeded.	*Error Out* set to TRUE: 

STATUS Function Block (SIL 1/PL c output)

Presentation

The *STATUS* function block can be used to monitor any point within the configuration by connecting it to the input of the *STATUS* function block. The output returns 24 Vdc if the input is set to TRUE, or 0 Vdc if the input is set to FALSE.



⚠WARNING

INSUFFICIENT AND/OR INEFFECTIVE SAFETY-RELATED FUNCTIONS

Do not use the `STATUS` function block for safety-related purposes higher than SIL 1/PL c.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

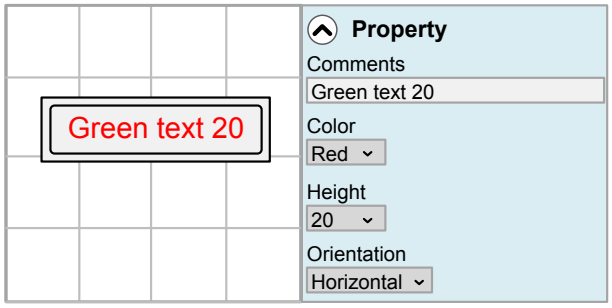
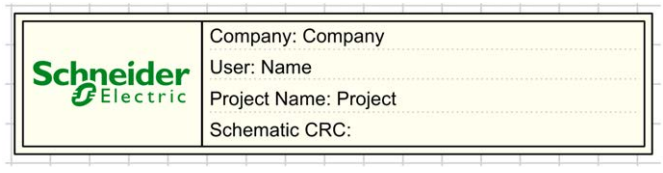
Parameters

The following table presents the parameters displayed in the **Property** pane:

Parameter	Description
Item Description	25-character text description of component function or name can be entered. The text is displayed above the function block.

COMMENTS and *TITLE* Objects

The objects *COMMENTS* and *TITLE* allow you to create titles for configurations and annotate them with comments to provide additional information as described in the following table:

Object	Description
Comments	This object allows a description to be entered and placed in any point of the diagram.  **Properties** • **Comments**: Enter the desired comment. • **Color**: Select the color of the comment text. • **Height:** Select the size of the comment text. • **Orientation:** Select the orientation of the comment text.
Title	This object can be used to add title information to a configuration diagram. 

Operator Function Blocks

What's in This Chapter

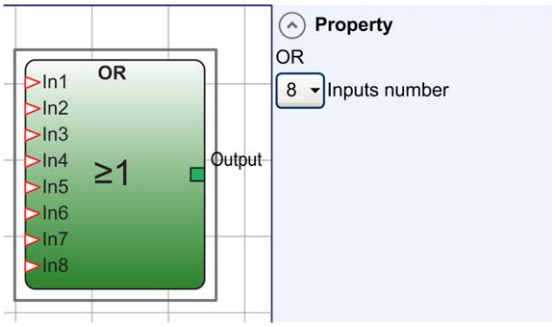
Logical Operators

The total number of operator function blocks which can be used within an application is 64.

The inputs of the logical operators can be inverted (logical NOT) by right-clicking the input pin to be inverted. A little circle is shown on the inverted input. To cancel the inversion, click the input pin.

OR

Presentation

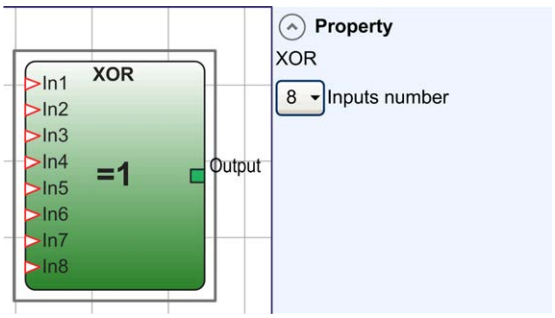


Logical *OR* returns an output TRUE if at least one of the inputs is set to TRUE.

The **Inputs number** (count of inputs) can be set from 2 to 8.

XOR

Presentation

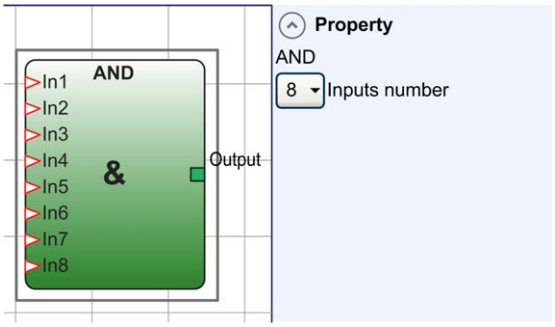


Logical *XOR* returns an output FALSE if the number of inputs set to TRUE is even or the inputs are all set to FALSE.

The **Inputs number** (count of inputs) can be set from 2 to 8.

AND

Presentation

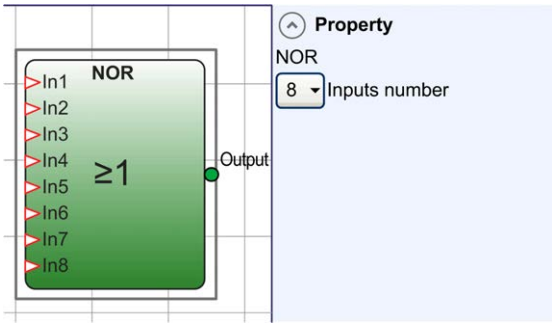


Logical *AND* returns an output TRUE if all the inputs are set to TRUE.

The **Inputs number** (count of inputs) can be set from 2 to 8.

NOR

Presentation

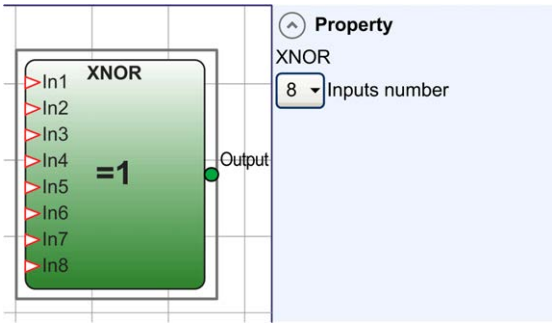


Logical *NOR* returns an output FALSE if at least one of the inputs is set to TRUE.

The **Inputs number** (count of inputs) can be set from 2 to 8.

XNOR

Presentation

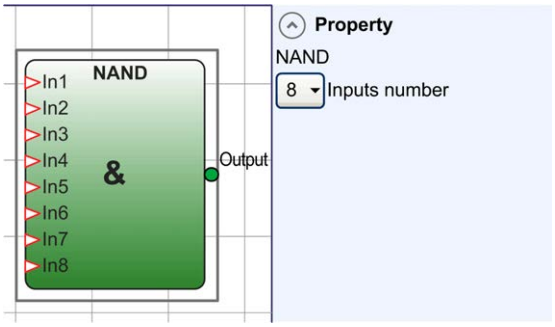


Logical *XNOR* returns an output TRUE if the number of inputs set to TRUE is even or the inputs are all set to FALSE.

The **Inputs number** (count of inputs) can be set from 2 to 8.

NAND

Presentation

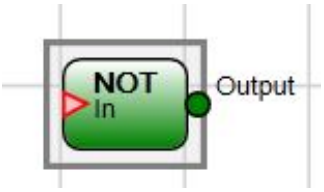


Logical *NAND* returns an output FALSE if all the inputs are set to TRUE.

The **Inputs number** (count of inputs) can be set from 2 to 8.

NOT

Presentation

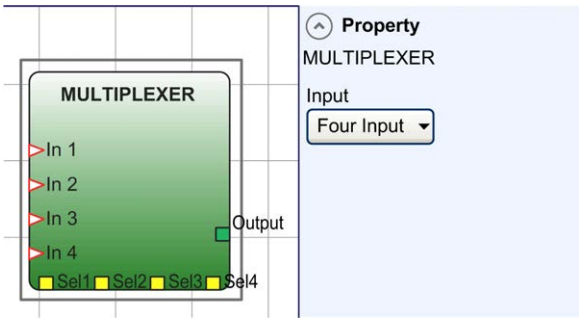


Logical *NOT* inverts the logical state of the input.

In	Output
0	1
1	0

MULTIPLEXER

Presentation



Logical *MULTIPLEXER* forwards the signal of the inputs to the output according to the *Sel* selection.

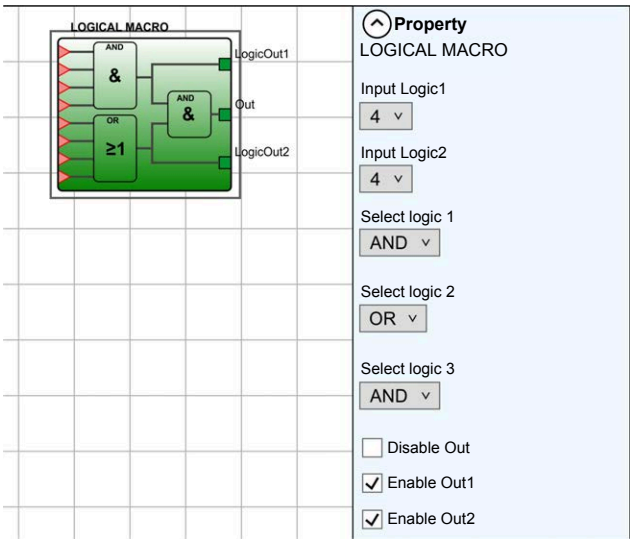
If the *Sel1* to *Sel4* have only 1 bit set to TRUE, the selected *In n* is connected to the output.

If more than one *Sel* input is set to TRUE, or if no *Sel* inputs are set to TRUE, the output is set to FALSE regardless of the values presented at the *In n*.

The number of inputs can be set from 2 to 4.

LOGICAL MACRO

Presentation



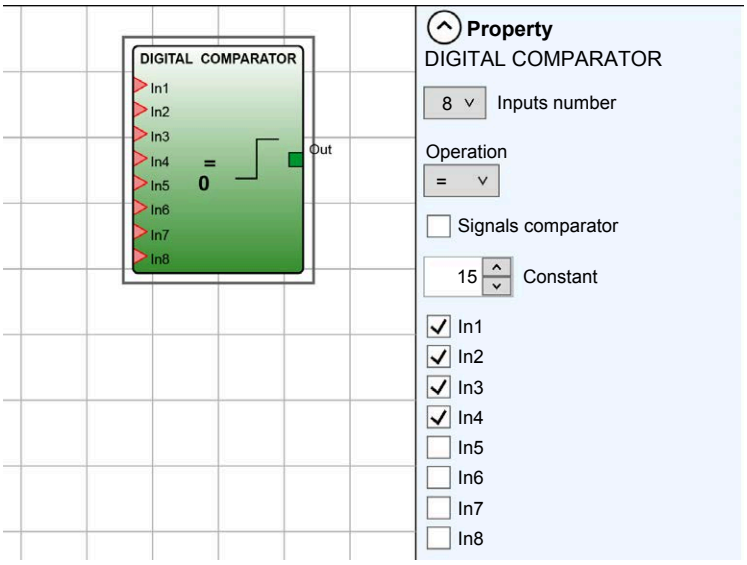
The *LOGICAL MACRO* operator enables the grouping of two or three logic gates. A maximum of eight inputs are available. The result of the first two logic gates converges into a third logic gate. The result of the third logic gate is provided at the *Output*.

Parameters

Parameters	Description
Input Logic1	Select the number of logic inputs (**1**...**7**) for each of the input logic gates. If 1 is selected from the drop down list, it results in removing the logic gate, and the output of this logic gate is directly connected to the third (end) logic.
Input Logic2	
Select Logic1	Select the operator type: • **AND** • **NAND** • **OR** • **NOR** • **XOR** • **XNOR** • **SR Flip-Flop (only for logic 3)**
Select Logic2	
Select Logic3	
Disable Out	When selected, the output `OUT` is deactivated. The outputs `LogicOut1` and `LogicOut2` remain activated.
Enable Out1	When selected, activates an output with the result of the logic gate 1 and/or 2.
Enable Out2	

DIGITAL COMPARATOR

Presentation



The *DIGITAL COMPARATOR* allows to compare (in binary format) a group of signals with a constant or two groups of signals to each other.

Comparison with Constant

The *DIGITAL COMPARATOR* allows to compare a group of input signals (from 2 to a maximum of 8) with an integer **Constant** that can vary from 0 to 255. To select this mode, the **Signals Comparator** check box must be cleared. The constant can be entered bit-wise or as a decimal figure.

For the bit-wise input of the constant, the following rule applies: Input **In1** is the LSB (least significant bit) while input **In8** (or lower if the number of inputs selected is lower than 8) is the MSB (most significant bit).

- Example of an operator with 8 inputs:

  In1 →0

  In2 →1

  In3 →1

  In4 →0

  In5 →1

  In6 →0

  In7 →0

  In8 →1

  The binary value corresponds to a decimal value of 150.
- Example of an operator with 5 inputs:

  In1 →0

  In2 →1

  In3 →0

  In4 →1

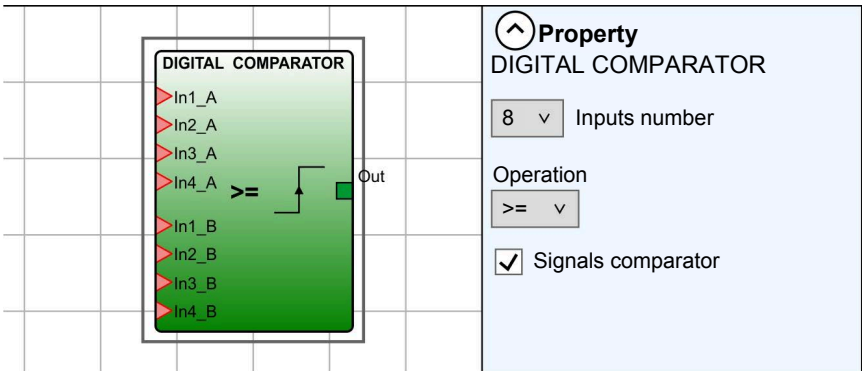
  In5 →1

  The binary value corresponds to a decimal value of 26.

Parameter	Description
Operation	The operations that can be used are: • < Lower The OUT output is set to TRUE as long as the input value is less than the value of the constant. The OUT output is set to FALSE when the input value is higher than or equal to the value of the constant. • ≥ Higher or equal The OUT output is set to TRUE as long as the input value is higher than or equal to the value of the constant. The OUT output is set to FALSE when the input value is lower than the value of the constant. • > Higher The OUT output is set to TRUE as long as the input value is higher than the value of the constant. The OUT output is set to FALSE when the input value is lower than or equal to the value of the constant. • ≤ Lower or equal The OUT output is set to TRUE as long as the input value is lower than or equal to the value of the constant. The OUT output is set to FALSE when the input value is higher than the value of the constant. • = Equal The OUT output is set to TRUE as long as the input value is equal to the value of the constant. The OUT output is set to FALSE when the input value is different from the value of the constant. • != Different The OUT output is set to TRUE as long as the input value is different from the value of the constant. The OUT output is set to FALSE when the input value is equal to the value of the constant.
Signals comparator	To perform a comparison with constant, this check box must be cleared.
In1...**In8**	Input **In1** is the LSB (least significant bit) while input **In8** (or lower if the number of inputs selected is lower than 8) is the MSB (most significant bit).

Signal Comparison

The *DIGITAL COMPARATOR* allows to compare (in binary format) two groups of signals to each other. To select this mode, the **Signal Comparator** check box must be selected:



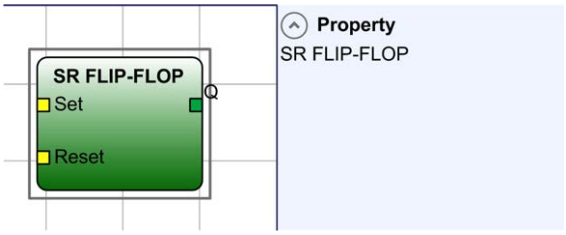
Parameter	Description
Operation	The operations that can be used are: • < Lower The OUT output is set to TRUE as long as the value of the group of inputs A is less than the value of the group of inputs B. The OUT output is set to FALSE when the value of the group of inputs A is higher than or equal to the value of the group of inputs B. • ≥ Higher or equal The OUT output is set to TRUE as long as the value of the group of inputs A is higher than or equal to the value of the group of inputs B. The OUT output is set to FALSE when the value of the group of inputs A is lower than the value of the group of inputs B. • > Higher The OUT output is set to TRUE as long as the value of the group of inputs A is higher than the value of the group of inputs B. The OUT output is set to FALSE when the value of the group of inputs A is lower than or equal to the value of the group of inputs B. • ≤ Lower or equal The OUT output is set to TRUE as long as the value of the group of inputs A is lower than or equal to the value of the group of inputs B. The OUT output is set to FALSE when the value of the group of inputs A is higher than the value of the group of inputs B. • = Equal The OUT output is set to TRUE as long as the value of the group of inputs A is equal to the value of the group of inputs B. The OUT output is set to FALSE when the value of the group of inputs A is different from the value of the group of inputs B. • != Different The OUT output is set to TRUE as long as the value of the group of inputs A is different from the value of the group of inputs B. The OUT output is set to FALSE when the value of the group of inputs A is equal to the value of the group of inputs B.
In1_A...**In4_B**	Binary signals to be compared, group of inputs A to group of inputs B.
Signals comparator	To perform a signal comparison, this check box must be selected.

Memory Operators

Memory operators can be used to save data from other project components. State changes are performed according to the truth tables shown for each memory operator.

SR FLIP-FLOP

Presentation



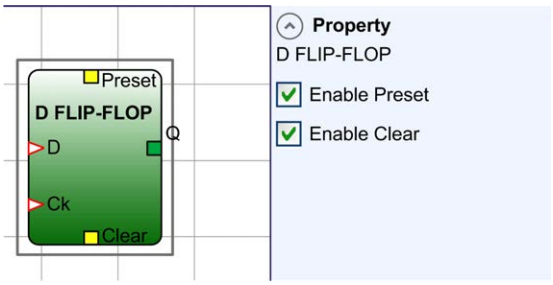
The *SR FLIP-FLOP* operator sets output *Q* to TRUE (1) with *Set*, FALSE (0) with *Reset*:

Set	Reset	Q
0	0	Retain output value
0	1	0
1	0	1
1	1	0

D FLIP-FLOP

Presentation

You can configure a maximum of 16 *D FLIP-FLOP* operators (altogether with *T FLIP-FLOP*, page 107 operators).



The *D FLIP-FLOP* operator saves the previously set state on output *Q* according to the following truth table:

Preset	Clear	Ck	D	Q
1	0	0/1	0/1	1
0	1	0/1	0/1	0
1	1	0/1	0/1	0
0	0	0	0/1	Retain output value
0	0	Rising edge	1	1
0	0	Rising edge	0	0

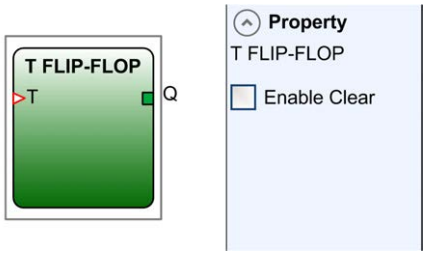
Parameters

Parameters	Description
Enable Preset	When selected, enables the asynchronous **Preset** signal to be used.
Enable Clear	When selected, enables the asynchronous **Clear** signal to be used.

T FLIP-FLOP

Presentation

You can configure a maximum of 16 *T FLIP-FLOP* operators (altogether with *D FLIP-FLOP*, page 107 operators).



The *T FLIP-FLOP* operator changes the state of the *Q* output at each rising edge of the *T* input (toggle).

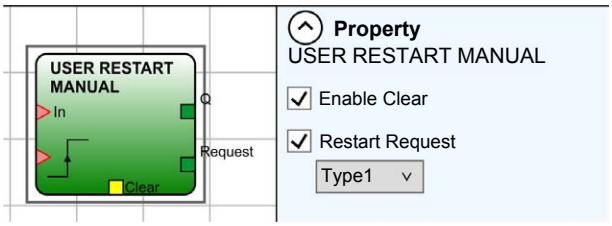
Parameters

Parameter	Description
Enable Clear	When selected, enables the asynchronous **Clear** signal to be used.

USER RESTART MANUAL

Presentation

You can configure a maximum of 16 *USER RESTART MANUAL* operators (altogether with other *RESTART* operators).



The *USER RESTART MANUAL* operator is used to manage the restart signal according to the following truth table:

Clear	Restart	In	Q	Restart Request Type 1	Restart Request Type 2(1)
1	0/1	0/1	0	0	1
0/1	0/1	0	0	0	1
0	0	1	Retain output value	1	Toggling (1 Hz)
0	Rising edge	1	1	0	0
(1) This output uses a system timer.					

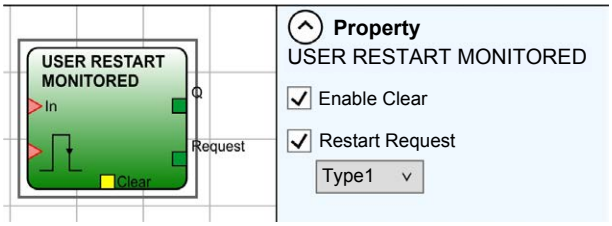
Parameters

Parameter	Description
Enable Clear	When selected, enables the asynchronous **Clear** signal to be used.
Restart Request	When selected, it enables an output that can be used to indicate the possibility of performing the restart. The behavior can be of type 1 or type 2 as represented in the truth table.

USER RESTART MONITORED

Presentation

You can configure a maximum to 16 *USER RESTART MONITORED* operator (altogether with other *RESTART* operators).



The *USER RESTART MONITORED* operator is used to manage the restart signal according to the following truth table:

Clear	Restart	In	Q	Restart Request Type 1	Restart Request Type 2(1)
1	0/1	0/1	0	0	1
0/1	0/1	0	0	0	1
0	0	1	Retain output value	1	Toggling (1 Hz)
0	 (2)	1	1	0	0

(1) This output uses a system timer.

(2) 250 ms < t < 5s

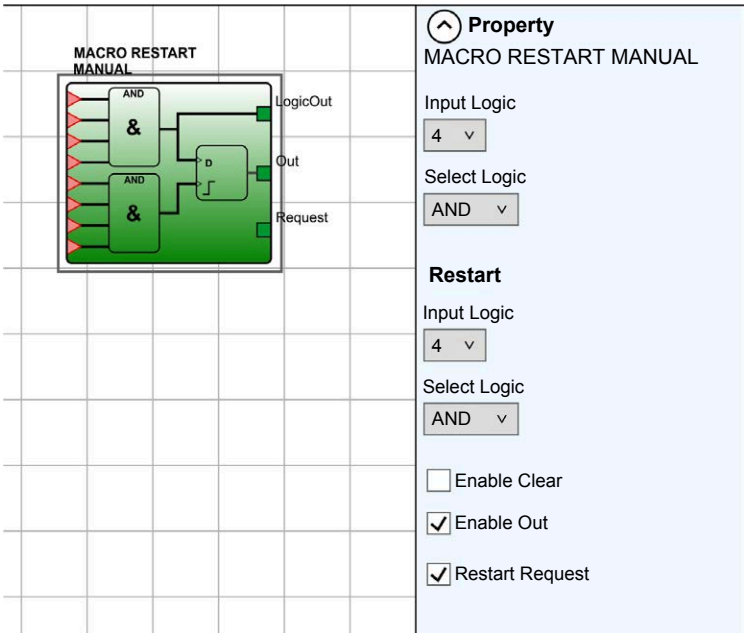
Parameters

Parameter	Description
Enable Clear	When selected, enables the asynchronous **Clear** signal to be used.
Restart Request	When selected, it enables an output that can be used to indicate the possibility of performing the restart. The behavior can be of type 1 or type 2 as represented in the truth table.

MACRO RESTART MANUAL

Presentation

You can configure up to 16 *MACRO RESTART MANUAL* operators (altogether with other *RESTART* operators).



The *MACRO RESTART MANUAL* operator is used to select logic gates of your choice to act as inputs to the *USER RESTART MANUAL* function block according to the following truth table:

Clear	Restart Logic Out	Input Logic Out	Output	Restart Request
1	0/1	0/1	0	0
0/1	0/1	0	0	0
0	0	1	Retain output value	1
0	Rising edge	1	1	0

Parameters

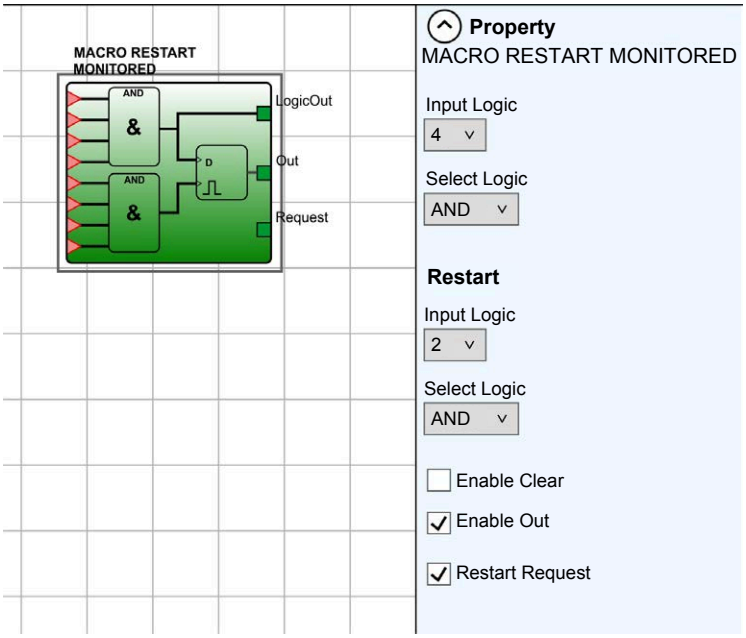
Parameters	Description
Input Logic	Select the number of logic inputs (**1**...**7**). If you select 1, the logic is not considered.
Select Logic	Select the operator type: • **AND** • **NAND** • **OR** • **NOR** • **XOR** • **XNOR**
Restart > Input Logic	Select the number of logic inputs (from 1 to 7). If you select 1, the logic is not considered.
Restart > Select Logic	Select the operator type: • **AND** • **NAND** • **OR** • **NOR** • **XOR** • **XNOR**
Enable Clear	When selected, enables the asynchronous **Clear** signal to be used.

Parameters	Description
Enable Out	When selected, activates an output with the result of the calculation performed by the logic gate.
Restart Request	When selected, enables an output that can be used to indicate the possibility of performing the restart. The behavior is represented in the truth table.

MACRO RESTART MONITORED

Presentation

You can configure a maximum to 16 *MACRO RESTART MONITORED* operators (altogether with other *RESTART* operators).



The *MACRO RESTART MONITORED* operator is used to select logic gates of your choice to act as inputs to the *USER RESTART MONITORED* function block according to the following truth table:

Clear	Restart Logic Out	Input Logic Out	Output	Restart Request
1	0/1	0/1	0	0
0/1	0/1	0	0	0
0	0	1	Retain output value	1
0	(1)	1	1	0
(1) 250 ms < t < 5s				

Parameters

Parameters	Description
Input Logic	Select the number of logic inputs (**1**...**7**). If you select 1, the logic is not considered.
Select Logic	Select the operator type: • **AND** • **NAND** • **OR** • **NOR** • **XOR** • **XNOR**
Restart > Input Logic	Select the number of logic inputs (from 1 to 7). If you select 1, the logic is not considered.
Restart > Select Logic	Select the operator type: • **AND** • **NAND** • **OR** • **NOR** • **XOR** • **XNOR**
Enable Clear	When selected, enables the asynchronous **Clear** signal to be used.
Enable Out	When selected, activates an output with the result of the calculation performed by the logic gate.
Restart Request	When selected, enables an output that can be used to indicate the possibility of performing the restart. The behavior is represented in the truth table.

PRE-RESET

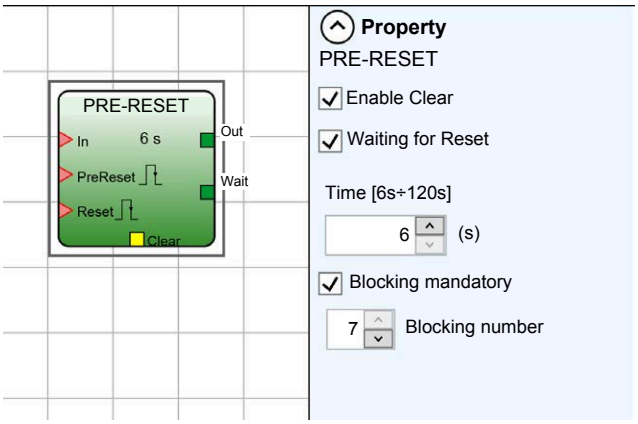
Presentation

You can configure a maximum of 16 *PRE-RESET* operators (altogether with other *RESTART* operators).

The *PRE-RESET* operator can be used if there is no position for a single reset device that allows for complete visibility of the zone of operation.

In this case, it is necessary to use a *PRE-RESET* button inside the zone of operation (with complete visibility of the zone of operation) and a second button for *RESET* outside the zone of operation to activate the `Q` output.

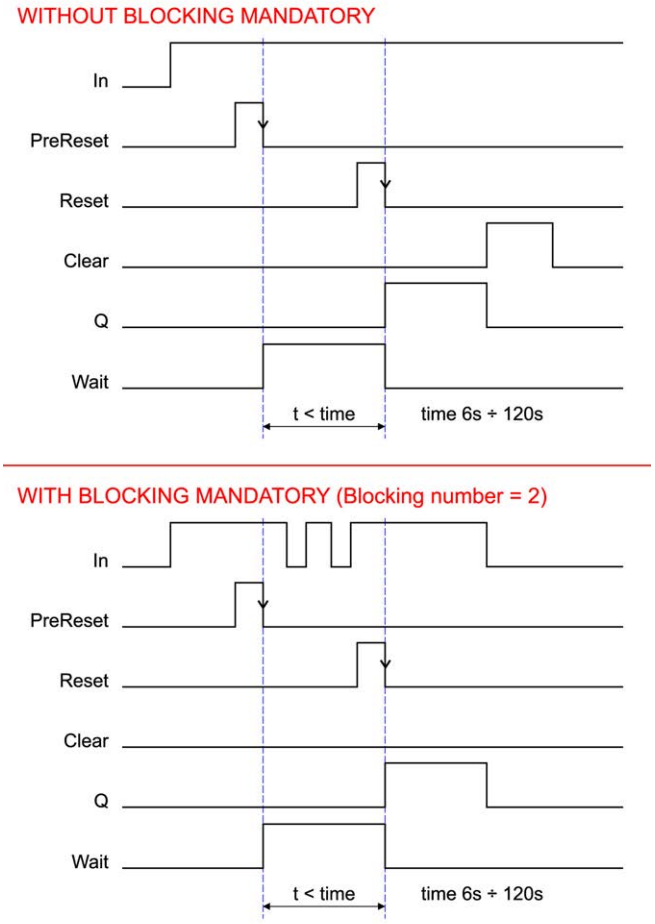
For each of the two `PreReset` and `Reset` inputs, the transition 0→1→0 is considered to be a valid signal. It is mandatory that the transition 0→1→0 has a duration between 500 ms and 5 s.



Parameters	Description
Enable Clear	When selected, enables the asynchronous **Clear** signal to be used.
Waiting for Reset	When selected, enables an output `Wait`. This signal is 1 from the `PRE-RESET` signal transition to the end of the permissible time or to the next `RESET` signal transition.
Time	The external reset is operative if pressed within a duration configurable by you in the range 6...120 s
Blocking mandatory	When selected, the minimum number of interruptions (of the light curtain or similar) is 1 before the `RESET` signal can be activated. If you specify a `BLOCKING NUMBER` other than 1, this number corresponds to the maximum permissible number of interruptions.
Blocking number	Blocking number has the range from 1 to 7.

The behavior of the `PRE-RESET` operator is illustrated in the following timing charts:

- The first without `Blocking Mandatory`
- The second with `Blocking Mandatory` active and `Blocking number` = 2.



Safety Guard Lock Operators

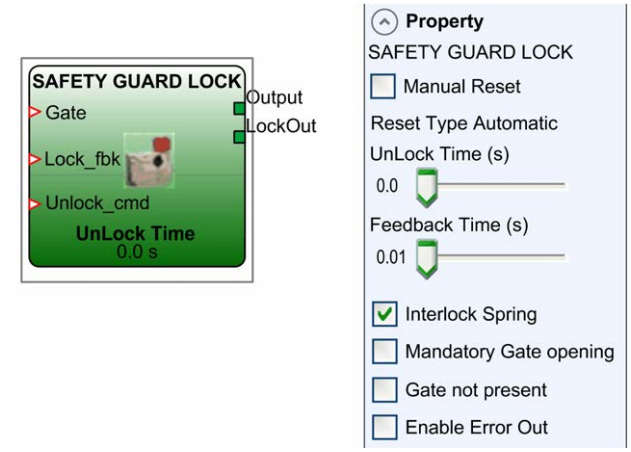
SAFETY GUARD LOCK

Presentation

The *SAFETY GUARD LOCK* operator monitors the consistency between the status of the `UnLock_cmd` signal, the status of the *SAFETY GUARD 1 CH* /

SAFETY GUARD 2 CH (`Gate` signal) and the status of the locking electromagnet (`Lock_fbk` signal).

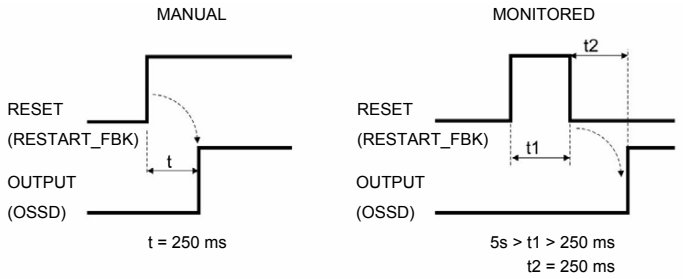
You can configure a maximum of four *SAFETY GUARD LOCK* operators.



Inputs and Outputs

Input / Output	Description
`Gate`	When the `Gate` input is present, it detects the status (feedback) of the door/gate connected to the guard lock. The status of the door/gate (`Gate`) is detected using specific contacts. For example, the status of the door/gate can be indicated by a normally open contact that is closed when the door/gate is closed.
`Lock_fbk`	The `Lock_fbk` input is used to detect the status (feedback) of the electromagnet that unlocks/locks the guard lock. Electromechanical guard locks are unlocked/locked through an electric control that energizes/de-energizes an electromagnet. Its status (energized/de-energized) is indicated by appropriate contacts. For example, the status of the electromagnet can be indicated by a normally open contact that is closed when the electromagnet is energized.
`UnLock_cmd`	The `UnLock_cmd` input detects the user-defined command sent to lock or unlock the guard lock. • Request to unlock: the `UnLock_cmd` signal must be set to TRUE. • Request to lock: the `UnLock_cmd` signal must be set to FALSE. The command signal can be sent by using a key, for example.
`Output`	The `Output` signal indicates the information shown in the following table: **Value** / **Meaning** TRUE: • Door/Gate closed • Guard lock locked FALSE: • Request to unlock the guard lock • Error condition
`LockOut`	The `LockOut` output signal controls the guard lock electromagnet and can assume the value FALSE or TRUE.
`ErrorOut`	If enabled, when the output signal `ErrorOut` is set to TRUE, it indicates a detected error in the control of the guard lock. It is set to FALSE when no errors have been detected.

Parameters

Parameter	Description
Manual Reset	When selected, the parameter enables manual request to reset after the safety-related device is triggered. When not selected, the enabling of the output of the function directly follows the input conditions.
Reset Type	When **Manual** is selected, the function block verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0.  **NOTE:** For **Manual Reset**, use the input immediately after those used by the function block: for example, if inputs 1 and 2 are used for the function block, use input 3 for *Reset*.
Unlock Time (s)	Delay time after a rising edge on the *UnLock_cmd* input while the guard unlock output is set to TRUE (*Lockout* output). • 0 ms to 1 s, increments of 100 ms • 1.5 s to 10 s, increments of 0.5 s • 15...25 s, increments of 5 s
Feedback Time (s)	Maximum delay time accepted between *LockOut* output and *Lock_fbk* input. • 10 ms to 100 s, increments of 10 ms • 150 ms to 1 s, increments of 50 ms • 1.5 s to 3 s, increments of 0.5 s **NOTE:** The time after which the electromagnet is activated depends on the technical/physical characteristics of the specific device and can therefore vary according to the type of guard lock used. Thus, since the *LockOut* signal controls the activation of the device, the status of the `Lock_fbk` feedback signal changes at different times, depending on the type of guard lock. This variability can be avoided by changing the value of the **Feedback Time (s)**. The following condition must be met: **Feedback Time (s)** ≥ Electromagnet activation time
Interlock Spring	The guard is locked passively and released actively, that is, the mechanical force of the spring keeps it locked. The guard thus continues to be locked even when the power supply is disconnected.
Mandatory Gate opening	When selected, the guard must be tested by opening and closing the guard before the function is enabled.
Gate not present	When selected, allows the function block to be used for only a lock feedback without the *Guard* function block.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block. When *Error Out* is set to TRUE, an error is detected.

Operating Principles

The *SAFETY GUARD LOCK* operator supports the following operating principles:

A	The function block is used to monitor a lock and a guard. An interlock guard switch is not available (parameter **Gate not present** is selected). For more details, refer to Operating Principle A, page 116.
B	The function block is used to monitor a lock and a guard. An interlock guard switch is available. The status of the guard is provided by the *SAFETY GUARD 1 CH* or *SAFETY GUARD 2 CH* function block to the *Gate* input. For more details, refer to Operating Principle B, page 117.
C	The function block is used to monitor a lock and a guard with a guard test. An interlock guard switch is available (parameter **Mandatory Gate opening** is selected). The status of the guard is provided by the *SAFETY GUARD 1 CH* or *SAFETY GUARD 2 CH* function block to the *Gate* input on the function block (feedback of the guard). For more details, refer to Operating Principle C, page 119.

Operating Principle A: Interlock Guard Switch Is Not Available

To operate the function without an interlock guard switch, select the parameter **Gate not present**.

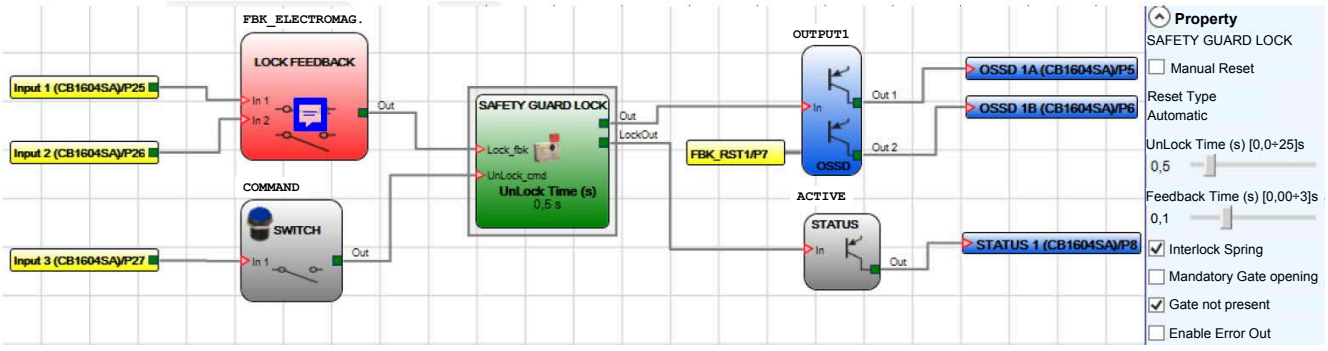
1. The `Lock_fbk` input must be connected to a *LOCK FEEDBACK*, page 77 (feedback coil lock) input element that verifies the status of the guard lock electromagnet.
2. The `UnLock_cmd` input can be connected freely in the diagram and determines the request to unlock at a rising edge.
3. The *Out* signal of this element is set to TRUE if the guard is closed and locked. When an unlock command is applied to the `UnLock_cmd` input, the *Out* signal is set to 0 and the lock is released through the *LockOut* signal. The output is set to FALSE even if an error has been detected (for example, open guard with lock locked, maximum **Feedback Time** was exceeded).
4. The *LockOut* signal controls the activation of the lock, depending on the `UnLock_cmd` command and the user-defined **Unlock Time (s)**.
5. The selected **Feedback Time** must be at least as long as the activation time of the electromagnet of the lock used.

Example of Operating Principle A:

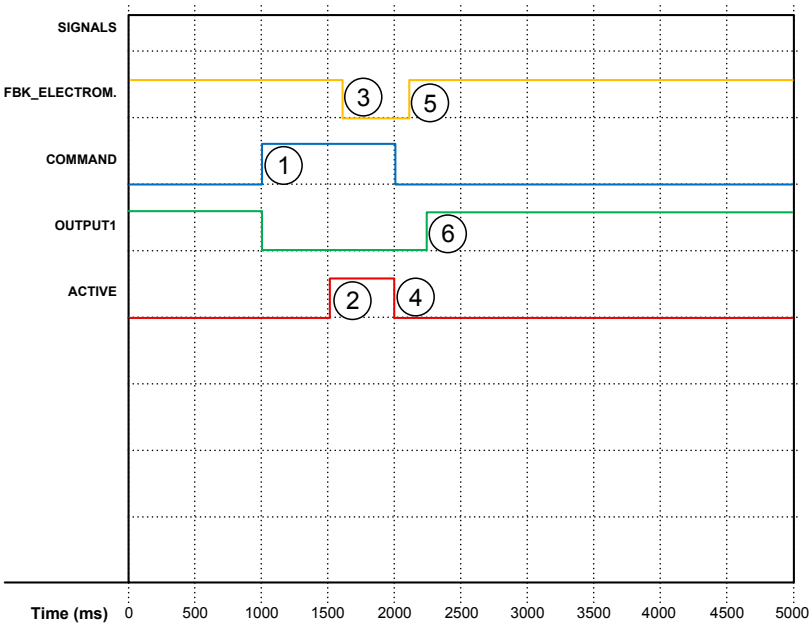
The guard lock used in the following example continues to be locked when the electromagnet is not energized. Therefore, the **Interlock Spring** option must be selected.

You unlock the guard lock with the *SWITCH* block. The `LockOut` signal controls a *STATUS* SIL 1/PL c output that controls the guard lock electromagnet, the status of which is detected by the `Lock_fbk` input through the *LOCK FEEDBACK* input block. `OUTPUT1` indicates the status of the operations.

NOTE: The electromagnet feedback consists of two contacts, one normally closed and one normally open. When the electromagnet is energized, the two contacts switch status.



The following trace graphic displays the traces for the operation:



Step	Operation
1	You request the unlocking of the guard lock. The `COMMAND` signal switches from FALSE to TRUE, and the `OUTPUT1` signal switches from TRUE to FALSE.
2	The electromagnet is activated with a delay of the **Unlock Time (s)**, after the command is sent. The delay has been set to 0.5 seconds. The `ACTIVE` signal switches from FALSE to TRUE.
3	The electromagnet is activated, 95 ms after the command. This delay is due to the technical characteristics of the electromagnet. In any case, the value of 95 ms is lower than the 100 ms of the **Feedback Time** and therefore, no errors are detected.
4	You release the unlock gate command. The `COMMAND` signal and the `ACTIVE` signal switch from TRUE to FALSE.
5	The electromagnet is deactivated, approximately 95 ms after the command was sent. This delay is due to the technical characteristics of the device. The guard lock is locked.
6	As soon as the *SAFETY GUARD LOCK* operator detects that the guard lock is locked, the `OUTPUT1` signal switches to TRUE.

Operating Principle B: Interlock Guard Switch Is Available

The function block is used to monitor a lock and a guard.

1. The `Gate` input must be connected to a *SAFETY GUARD 1 CH* or *SAFETY GUARD 2 CH* function block that verifies the status of the door/gate.

   NOTE: In this operating mode, the `Gate` input must confirm the opening of the gate.

2. The `Lock_fbk` input must be connected to a *LOCK FEEDBACK*, page 77 (feedback coil lock) input element that verifies the status of the guard lock electromagnet.
3. The `UnLock_cmd` input can be connected freely in the diagram and determines the request to unlock at a rising edge.
4. The *Out* signal of this element is set to TRUE if the guard is closed and locked. When an unlock command is applied to the `UnLock_cmd` input, the *Out* signal is set to 0 and the lock is released through the *LockOut* signal. The output is set to FALSE even if an error has been detected (for example, open guard with lock locked, maximum **Feedback Time** was exceeded).
5. The *LockOut* signal controls the activation of the lock, depending on the `UnLock_cmd` command and the user-defined **Unlock Time (s)**.
6. The selected **Feedback Time** must be at least as long as the activation time of the electromagnet of the lock used.

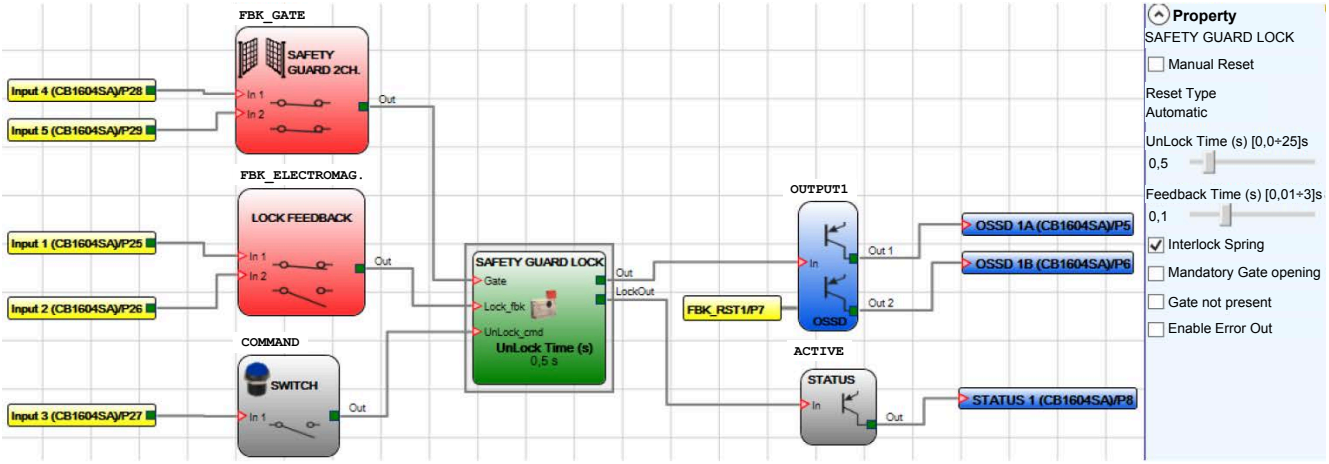
Example of Operating Principle B:

You unlock the guard lock with the *SWITCH* block. The `LockOut` signal controls a *STATUS* SIL 1/PL c output that controls the guard lock electromagnet, the status of which is detected by the `Lock_fbk` input through the *LOCK FEEDBACK* input block. `OUTPUT1` indicates the status of the operations.

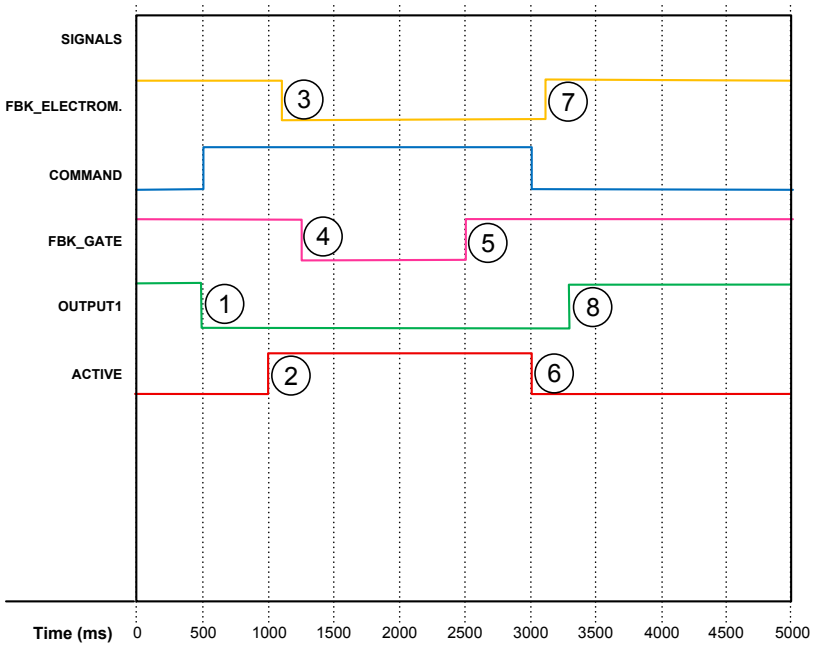
The status of the safety gate is monitored by the `Gate` input through the *SAFETY GUARD 2 CH* input.

The guard lock used in the following example continues to be locked when the electromagnet is not energized. Therefore, the **Interlock Spring** option must be selected.

NOTE: The electromagnet feedback consists of two contacts, one normally closed and one normally open. When the electromagnet is energized, the two contacts switch status. The gate feedback consists of two normally closed contacts.



The following trace graphic displays the traces for the operation:



Step	Operation
1	You request the unlocking of the guard lock. The COMMAND signal switches from FALSE to TRUE, and the OUTPUT1 signal switches from TRUE to FALSE.
2	The electromagnet is activated with a delay of the **Unlock Time (s)**, after the command is sent. The delay has been set to 0.5 seconds. The ACTIVE signal switches from FALSE to TRUE.
3	The electromagnet is activated, 95 ms after the command. This delay is due to the technical characteristics of the electromagnet. In any case, the value of 95 ms is lower than the 100 ms of the **Feedback Time** and therefore, no errors are detected.
4	The guard lock is unlocked and you open the gate. The FBK_GATE signal switches from TRUE to FALSE.
5	You close the gate and the FBK_GATE signal switches from FALSE to TRUE.
6	You release the unlock gate command. The *SAFETY GUARD LOCK* detects the gate closed condition, through the FBK_GATE signal, and sends a command to lock the guard lock. The ACTIVE signal switches from TRUE to FALSE.
7	The electromagnet is deactivated, approximately 95 ms after the command was sent. This delay is due to the technical characteristics of the device. The guard lock is locked.
8	As soon as the *SAFETY GUARD LOCK* operator detects that the guard lock is locked and the gate is closed, the OUTPUT1 signal switches to TRUE.

Operating Principle C: Interlock Guard Switch Is Available, Parameter Mandatory Gate opening Is Selected

To operate the function as a guard safety-related lock taking into account the feedback of the guard, select the parameter **Mandatory Gate opening**.

1. The Gate input must be connected to a *SAFETY GUARD 1 CH* or *SAFETY GUARD 2 CH* function block (feedback of the guard) that verifies the status of the door/gate.

   NOTE: In this mode, the Gate input must confirm the opening of the guard.
2. The Lock_fbk input must be connected to a *LOCK FEEDBACK*, page 77 (feedback coil lock) input element that verifies the status of the guard lock electromagnet.
3. The UnLock_cmd input can be connected freely in the diagram and determines the request to unlock at a rising edge.
4. The *Out* signal of this element is set to TRUE if the guard is closed and locked. When an unlock command is applied to the UnLock_cmd input, the *Out* signal is set to 0 and the lock is released through the *LockOut* signal. The output is set to FALSE even if an error has been detected (for example, open guard with lock locked, maximum **Feedback Time** was exceeded).
5. The *LockOut* signal controls the activation of the lock, depending on the UnLock_cmd command and the user-defined **Unlock Time (s)**.
6. The selected **Feedback Time** must be at least as long as the activation time of the electromagnet of the lock used.

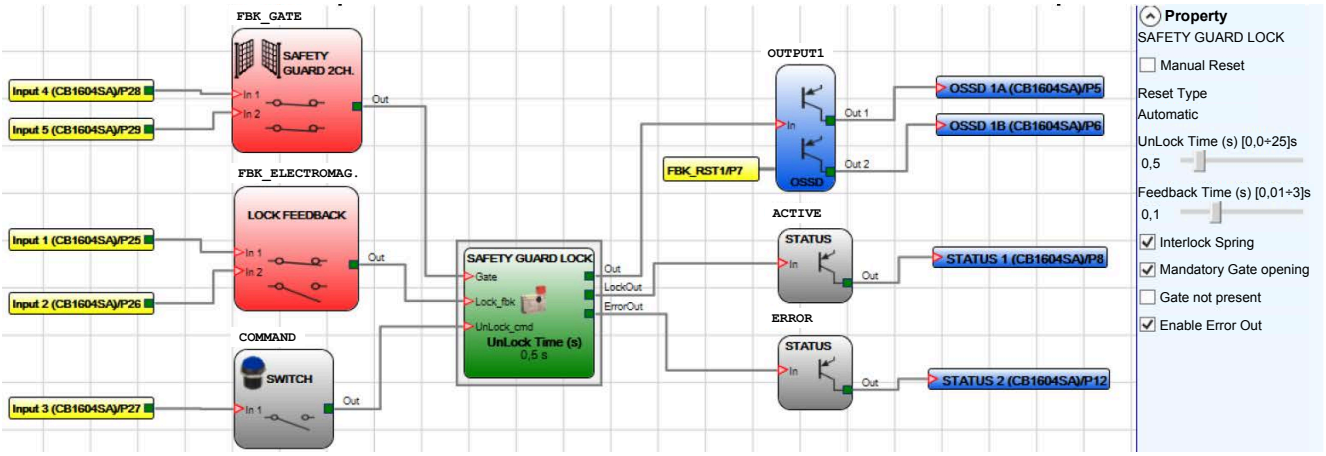
Example of Operating Principle C:

You unlock the guard lock with the *SWITCH* block. The LockOut signal controls a *STATUS* SIL 1/PL c output that controls the guard lock electromagnet, the status of which is detected by the *LOCK FEEDBACK* input block. OUTPUT1 indicates the status of the operations.

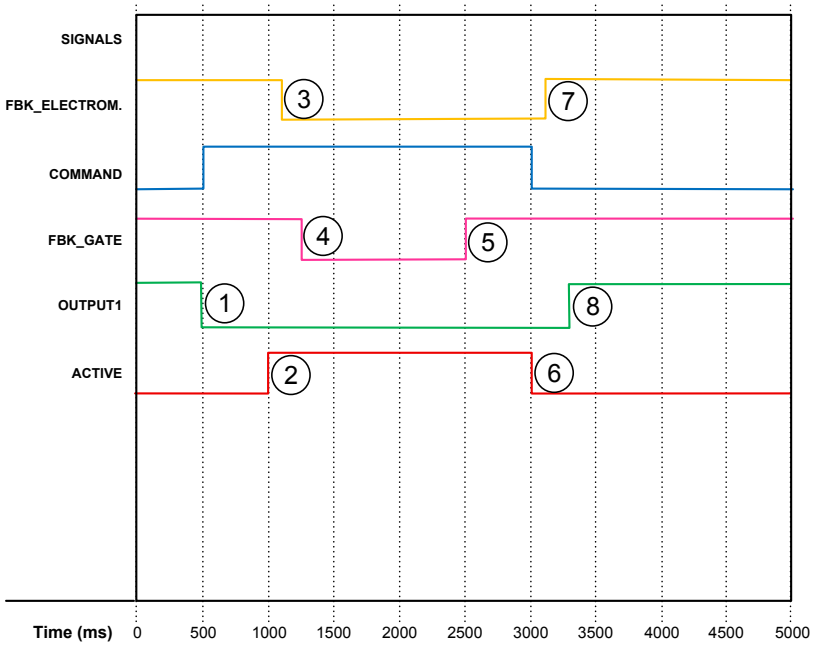
The status of the gate is monitored by the Gate input through the *SAFETY GUARD 2 CH* input if the **Mandatory Gate opening** parameter is selected.

The guard lock used in the following example continues to be locked when the electromagnet is not energized. Therefore, the **Interlock Spring** option must be selected.

NOTE: The electromagnet feedback consists of two contacts, one normally closed and one normally open. When the electromagnet is energized, the two contacts switch status. The gate feedback consists of two normally closed contacts.



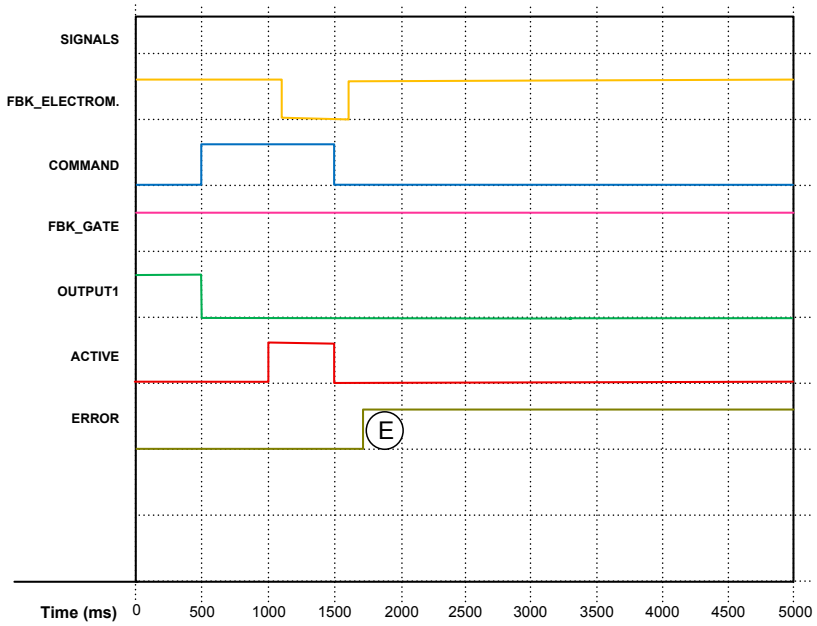
The following trace graphic displays the traces for the operation:



Step	Operation
1	You request the unlocking of the guard lock. The COMMAND signal switches from FALSE to TRUE, and the OUTPUT1 signal switches from TRUE to FALSE.
2	The electromagnet is activated with a delay of the **Unlock Time (s)**, after the command is sent. The delay has been set to 0.5 seconds. The ACTIVE signal switches from FALSE to TRUE.
3	The electromagnet is activated, 95 ms after the command. This delay is due to the technical characteristics of the electromagnet. In any case, the value of 95 ms is lower than the 100 ms of the **Feedback Time** and therefore, no errors are detected.
4	The guard lock is unlocked and you open the gate. The FBK_GATE signal switches from TRUE to FALSE.
5	You close the gate and the FBK_GATE signal switches from FALSE to TRUE.
6	You release the unlock gate command. The *SAFETY GUARD LOCK* detects the gate closed condition, through the FBK_GATE signal, and sends a command to lock the guard lock. The ACTIVE signal switches from TRUE to FALSE.
7	The electromagnet is deactivated, approximately 95 ms after the command was sent. This delay is due to the technical characteristics of the device. The guard lock is locked.
8	As soon as the *SAFETY GUARD LOCK* operator detects that the guard lock is locked and the gate is closed, the OUTPUT1 signal switches to TRUE.

In **Mandatory Gate opening** mode, the *SAFETY GUARD LOCK* operator indicates an error condition if it does not detect that the gate has been opened following a request to unlock the guard lock. If the **Enable Error Out** option has been selected, the detected error is shown in the graph.

As displayed in the following graphic, you request unlocking of the guard lock but the door is never opened. This condition is indicated by the `FBK_GATE` signal, which stays TRUE. Thus, when the guard lock unlocking/locking cycle ends, at time E, the *SAFETY GUARD LOCK* operator switches the status of the `ERROR` signal from FALSE to TRUE.



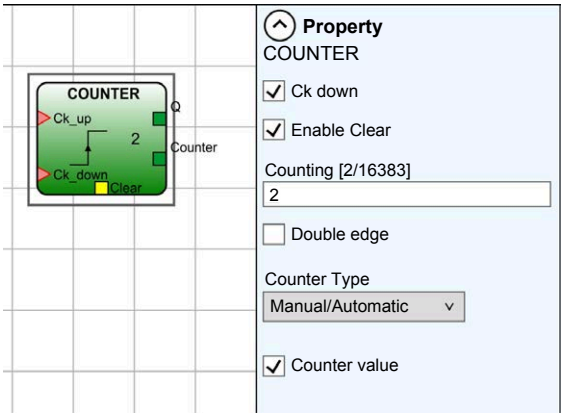
Counter Operators

COUNTER

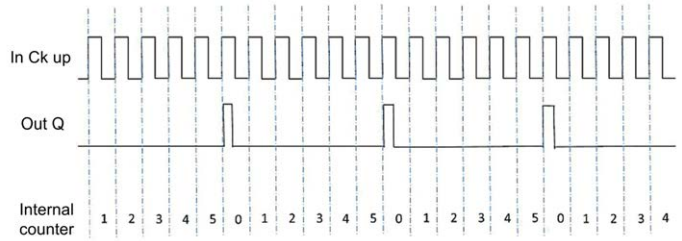
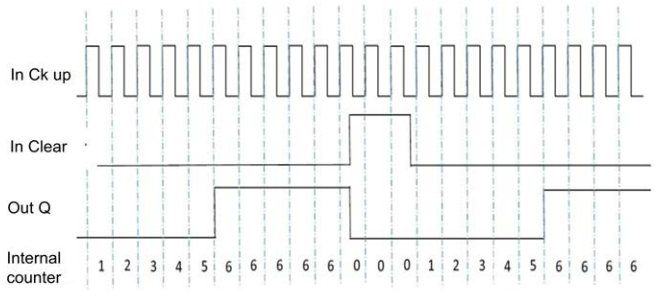
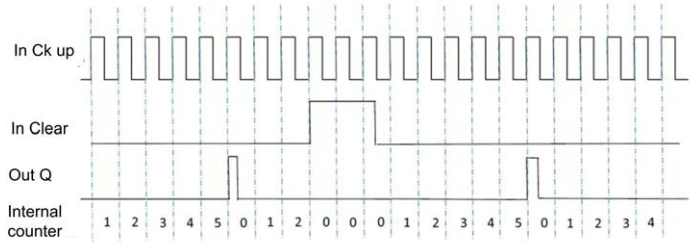
Presentation

You can configure a maximum of 16 *COUNTER* operators.

The *COUNTER* operator is a pulse counter that sets the output `Q` to TRUE, as soon as the desired count is reached.



The following table describes the counter types (in all examples, the desired count value is 6):

Counter Type	Description
Automatic Counter	Only available if **Enable Clear** is not selected. The counter generates a pulse with a duration of twice the cycle time (2 x *Tcycle*) as soon as the set count is reached. 
Manual Counter	Only available if **Enable Clear** is selected. The counter output is set to TRUE as soon as the set count is reached. The output `Q` changes to FALSE and the counter is reset to 0 when the input value to `Clear` is set to TRUE. 
Manual/ Automatic	Only available if **Enable Clear** is selected. The counter generates a pulse with a duration equal to the system response time as soon as the set count is reached. When the input value `Clear` is set to TRUE, the counter is reset to 0. 

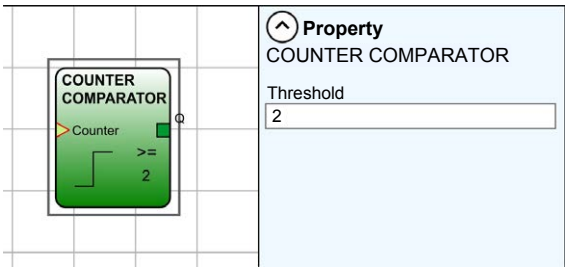
Parameters

Parameter	Description
Ck down	When selected, enables counting down.
Enable Clear	Allows the reset of the counter by clearing the accumulator of the counter on a rising edge. In addition the rising edge causes the output `Q` to reset to FALSE. On the falling edge, the counter restarts counting pulses. It also allows the enabling of automatic operation with manual reset. If this is not selected, the counter type is automatic. When the set count is reached, output `Q` is set to TRUE and stays in this condition for two internal cycles after which it is reset.
Counting	When the counter reaches this value, it triggers the output to be set to TRUE. The value range is from 2 to 16383.
Double edge	When selected, it enables counting on both rising and falling edges.
Counter value	When selected, it allows the counter value to be extracted from the counter. This output can be sent as input to one or more `COUNTER COMPARATOR` operators.

COUNTER COMPARATOR

Presentation

The *COUNTER COMPARATOR* operator enables to compare the value of the *COUNTER* connected with the set threshold value.



The Q output is set to FALSE as long as the Counter value is lower than the threshold value. The Q output is set to TRUE for Counter values equal to or higher than the threshold value.

NOTE: The *COUNTER COMPARATOR* operator can only be connected to the Counter value of a *COUNTER* operator.

You can connect multiple *COUNTER COMPARATOR* operators to a single *COUNTER* operator.

Timer Operators

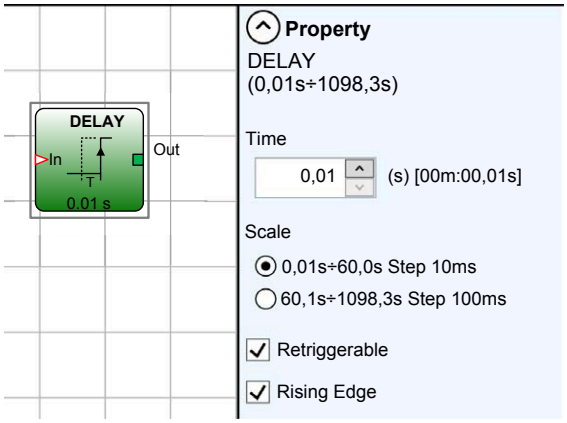
Timer operators generate a signal (TRUE or FALSE) for a user-defined period.

You can configure a maximum of 32 *TIMER* operators.

DELAY

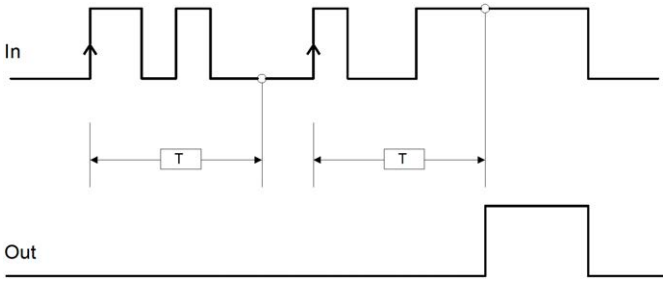
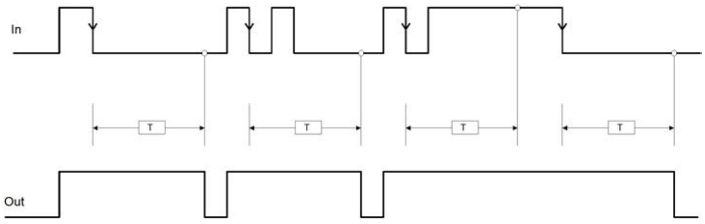
Presentation

The *DELAY* operator applies a delay between the input signal change and the output signal change.



Parameters

Parameter	Description
Time	The period can be set to between 10 ms and 1098.3 s.
Scale	Select one of the two ranges for the **Time** to be set.

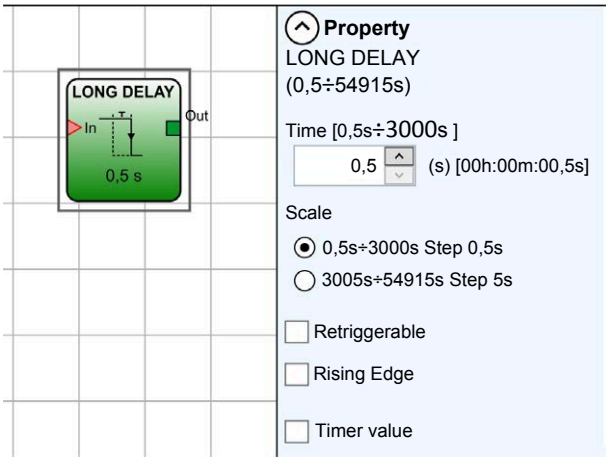
Parameter	Description
Retriggerable	When selected, the period configured in **Time** is reset each time the input state changes.
Rising Edge	When selected, the delay starts on the rising edge of the input signal. If the input signal is set to TRUE when the delay time has finished, the output transitions to TRUE and remains set to TRUE until the input signal is set to FALSE. If the input is no longer TRUE when the delay time has finished, the output remains set to FALSE. The next rising edge re-triggers the delay timer.  If **Rising Edge** is not selected, the logic is inverted, the output is set to TRUE on the rising edge of the input. The delay starts on the falling edge of the input. At the end of the delay time, the output transitions to FALSE only if the input is also set to FALSE, otherwise it remains set to TRUE. 

NOTE: A TRUE signal at an input does not generate a rising edge after a power cycle. The input needs to be re-operated to trigger the timer function.

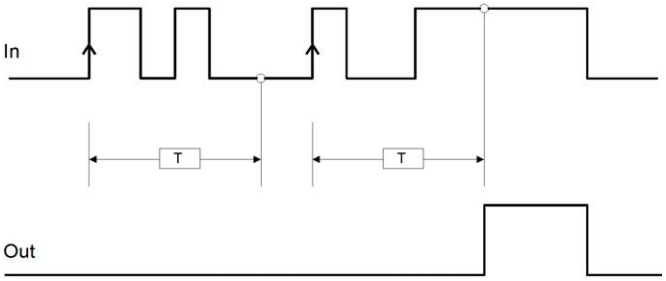
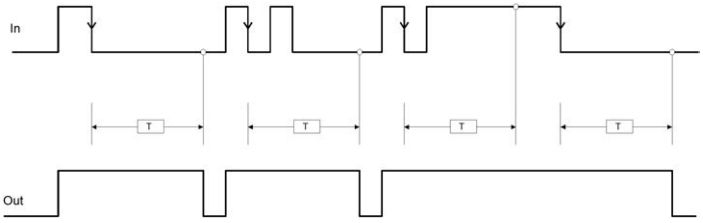
LONG DELAY

Presentation

The *LONG DELAY* operator allows you to apply a delay up to more than 15 hours (54915 s) between the input signal change and the output signal change.



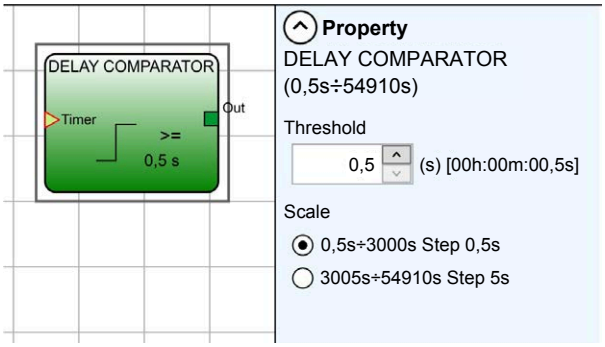
Parameters

Parameter	Description
Time	The period can be set to between 0.5 s and 54915 s.
Scale	Select one of the two ranges for the **Time** to be set.
Retriggerable	When selected, the period configured in **Time** is reset each time the input state changes.
Rising Edge	When selected, the delay starts on the rising edge of the input signal. If the input signal is set to TRUE when the delay time has finished, the output transitions to TRUE and remains set to TRUE until the input signal is set to FALSE. If the input is no longer TRUE when the delay time has finished, the output remains set to FALSE. The next rising edge re-triggers the delay timer.  If **Rising Edge** is not selected, the logic is inverted, the output is set to TRUE on the rising edge of the input. The delay starts on the falling edge of the input. At the end of the delay time, the output transitions to FALSE only if the input is also set to FALSE, otherwise it remains set to TRUE. 
Timer value	When selected, it allows you to extract from the delay block the value of the timer. This output can be sent as input to a *DELAY COMPARATOR* block.

DELAY COMPARATOR

Presentation

The *DELAY COMPARATOR* operator enables to compare the value of the *LONG DELAY* timer connected with a threshold value set manually.



Parameters

Parameter	Description
Threshold	The period can be set to between 0.5 s and 54915 s. The threshold determines the `OUT` behavior as follows: • The `OUT` is set to FALSE as long as the timer value is lower than the threshold value • The `OUT` is set to TRUE for timer values equal to or higher than the threshold value
Scale	Permits to change the scale of the threshold.

NOTE: The *DELAY COMPARATOR* operator can only be connected to the timer value output of a *LONG DELAY* operator. Multiple *DELAY COMPARATOR* operators can be connected to one *LONG DELAY* operator.

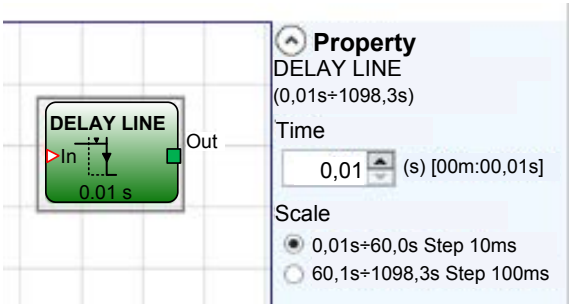
DELAY LINE

Presentation

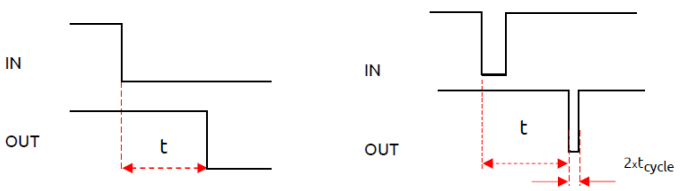
The *DELAY LINE* operator delays the falling edge of the input signal `In` by the set delay time.

After this delay, the output signal `Out` is set to FALSE and stays set to FALSE as long as the input remains FALSE. When the input is set to TRUE again, the output follows without delay.

If the input signal returns to TRUE before the delay time has expired, the output generates a low pulse of approximately twice the cycle time after the delay time has expired.



Parameters

Parameter	Description
Time	The period can be set to between 10 ms and 1098.3 s. 
Scale	Select one of the two ranges for the **Time** to be set.

NOTE: In contrast to the *DELAY* operator, the *DELAY LINE* operator does not filter out any interruptions in the input which are shorter than the delay time.

Use the *DELAY LINE* operator when you use delayed OSSD, page 96 (the *OSSD* is programmed with *USER RESTART MANUAL*, page 108 function).

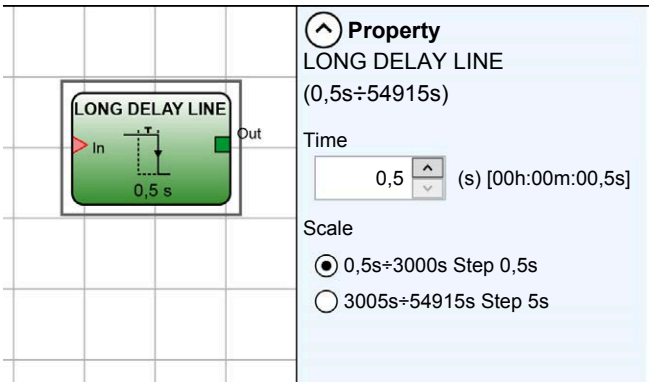
LONG DELAY LINE

Presentation

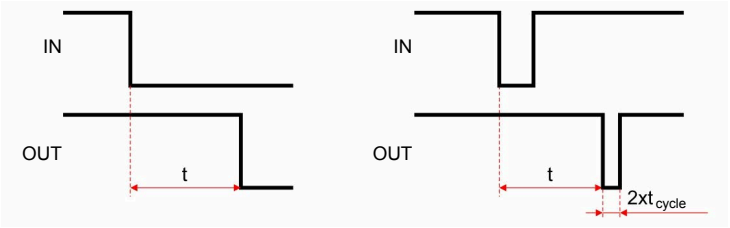
The *LONG DELAY LINE* operator delays the falling edge of the input signal `In` by the set delay time.

After this delay, the output signal `Out` is set to FALSE and stays set to FALSE as long as the input remains FALSE. When the input is set to TRUE again, the output follows without delay.

If the input signal returns to TRUE before the delay time has expired, the output generates a low pulse of approximately twice the cycle time after the delay time has expired.



Parameters

Parameter	Description
Time	It enables to select the desired delay time. The delay can be set from 0.5 s to 54915 s 
Scale	Permits to modify the scale of the **Time** parameter.

NOTE: In contrast to the *DELAY* operator, the *LONG DELAY LINE* operator does not filter out any interruptions to the `In` input that are shorter than the delay time.

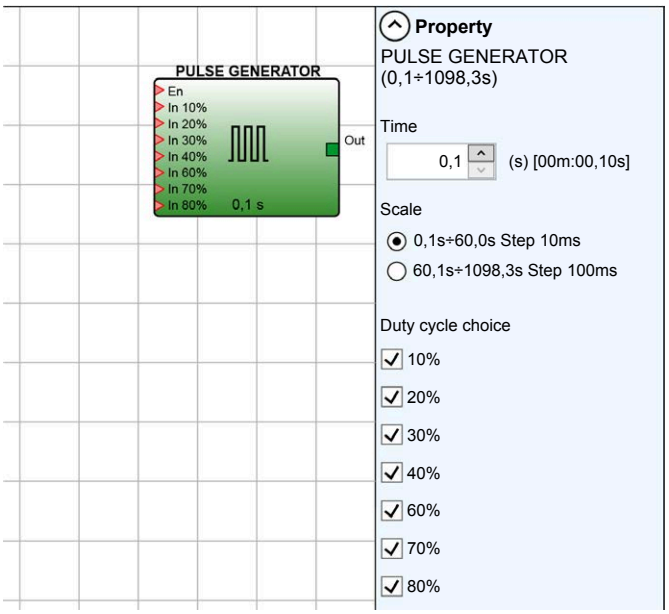
Use the *LONG DELAY LINE* operator when you use delayed OSSD, page 96 (the *OSSD* is programmed with *USER RESTART MANUAL*, page 108 function).

PULSE GENERATOR

Presentation

The *PULSE GENERATOR* operator generates a clock signal output with the set period if the input *In* is set to TRUE while the *Enable* is also set to TRUE.

The *PULSE GENERATOR* operator has up to 7 inputs to control the output duty cycle.



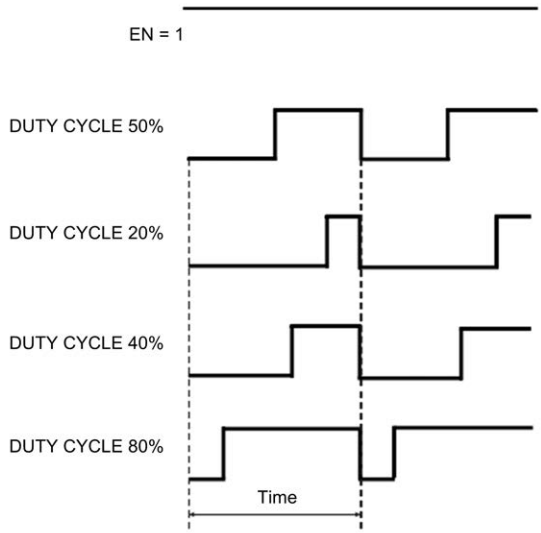
Parameters

Parameter	Description
Time	The period can be set to between 100 ms and 1098.3 s.
Scale	Select one of the two ranges for the **Time** to be set.
Duty cycle choice	Up to seven inputs can be selected for seven different output signal duty cycles. Depending on the active input, the *Out* clock signal has its corresponding duty cycle. The *EN* input must always be set to TRUE.

EN (*Enable*)	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%

NOTE: Exactly one of the duty cycle selection inputs (other than the Enable input EN) must be set to TRUE to generate an output signal of the appropriate duty cycle. The exception is the pair 10 % and 80 % which generates a duty cycle of 90 %.

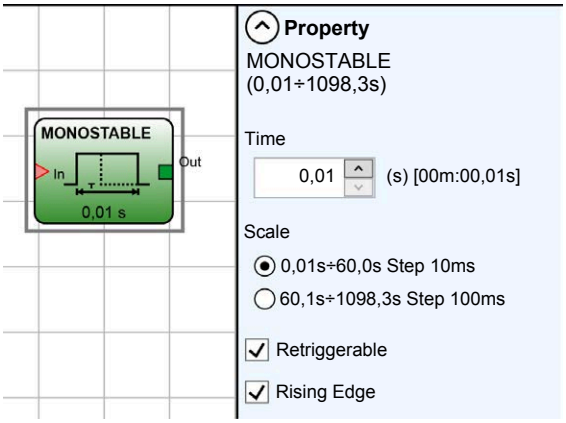
A TRUE signal at the Enable input EN without a TRUE signal at any of the duty cycle selection inputs or with multiple TRUE signals at the selection inputs generates an output signal with a duty cycle of 50 %.



MONOSTABLE

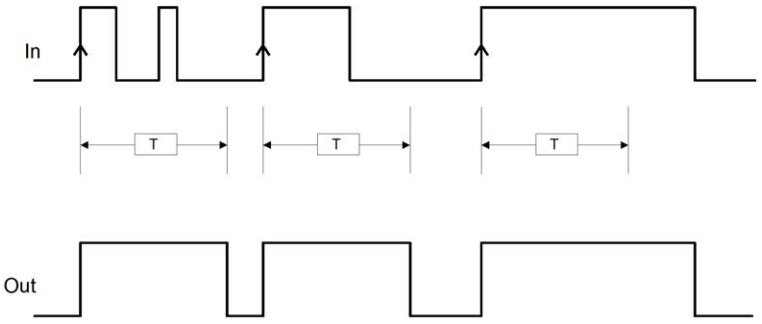
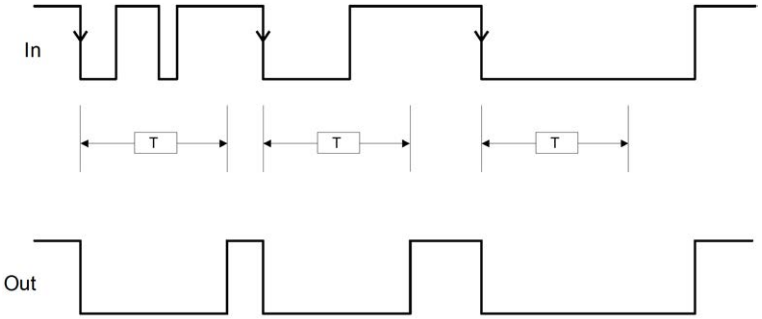
Presentation

The *MONOSTABLE* operator generates a pulse at the output triggered by the rising edge or the falling edge of the input.



Parameters

Parameter	Description
Time	The period can be set to between 10 ms and 1098.3 s.
Scale	Select one of the two ranges for the **Time** to be set.

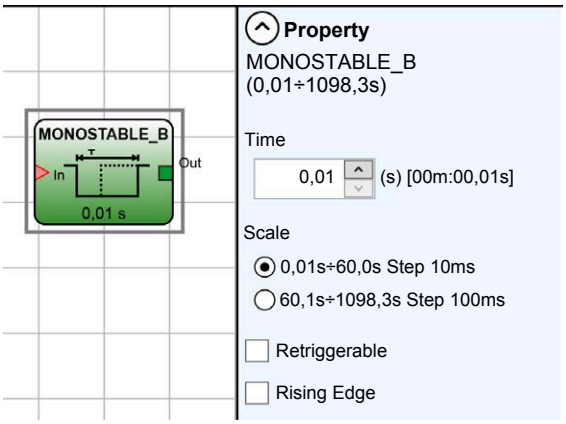
Parameter	Description
Retriggerable	When selected, the period configured in **Time** is reset each time the input state changes.
Rising Edge	When selected, the output is set to TRUE on the rising edge of the input signal and it remains TRUE for the set time, which is extended if the input remains TRUE.  When not selected, the output is set to FALSE on the falling edge of the input signal and it remains FALSE for the set time, which is extended if the input remains FALSE. 

NOTE: A TRUE signal at an input does not generate a rising edge after a power cycle. The input needs to be re-operated to trigger the timer function.

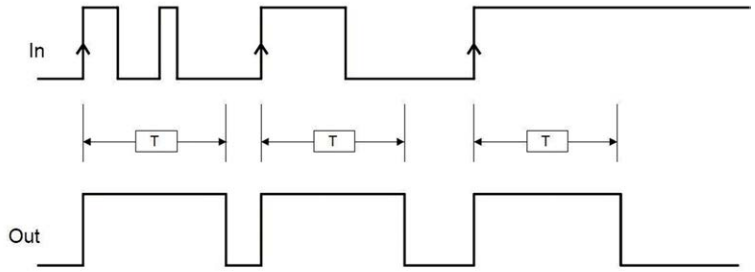
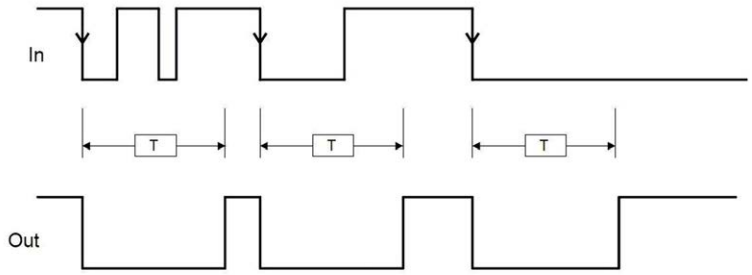
MONOSTABLE_B

Presentation

The *MONOSTABLE B* operator generates a pulse at the output triggered by the rising edge or the falling edge of the input.



Parameters

Parameter	Description
Time	The period can be set to between 10 ms and 1098.3 s.
Scale	Select one of the two ranges for the **Time** to be set.
Retriggerable	When selected, the period configured in **Time** is reset each time the input state changes.
Rising Edge	When selected, the *Out* output is set to TRUE if a rising edge is detected at the *In* input, and it remains TRUE for the set time.  When not selected, the logic is inverted. The *Out* output is set to FALSE on the *In* falling edge of the input signal, and it remains FALSE for the set time. 

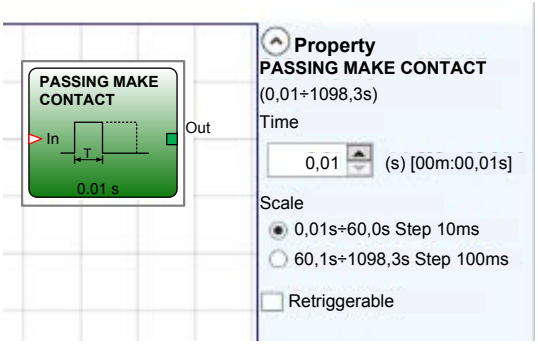
NOTE: In contrast to the *MONOSTABLE* operator, the *Out* output of the *MONOSTABLE_B* operator does not stay set to TRUE for a time which exceeds the set period.

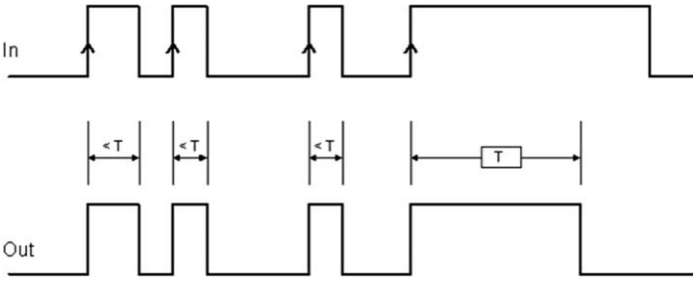
NOTE: A TRUE signal at an input does not generate a rising edge after a power cycle. The input needs to be re-operated to trigger the timer function.

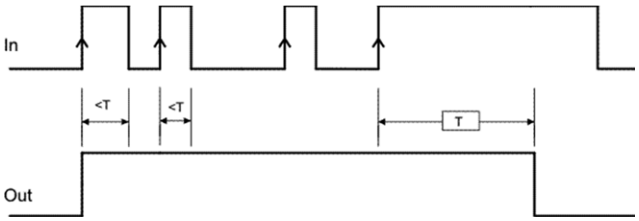
PASSING MAKE CONTACT

Presentation

In the *PASSING MAKE CONTACT* operator, the output follows the signal on the input. If the input is set to TRUE for longer than the set time the output changes to FALSE. When there is an input falling edge, the timer is cleared.





Parameter	Description
Time	The period can be set to between 10 ms and 1098.3 s.
Scale	Select one of the two ranges for the **Time** to be set.
Retriggerable	When selected, the time is not reset when there is an input falling edge. The output stays set to TRUE for the selected time. When there is a new input rising edge, the timer restarts. 

Muting Operators

The muting operators can be used for the temporary automatic bypass of electro-sensitive protective devices (ESPE) in order to permit the transit of material through the guarded opening.

The muting function can be controlled by two or four sensors in a row, either in concurrent or sequential mode, or by four sensors in L- or T-shaped configurations.

Muting can only be activated if the zone of operation protected by the ESPE is clear.

Muting operators must be used in conjunction with the *LIGHT CURTAIN* function block, page 70.

You can configure a maximum of four muting operators.

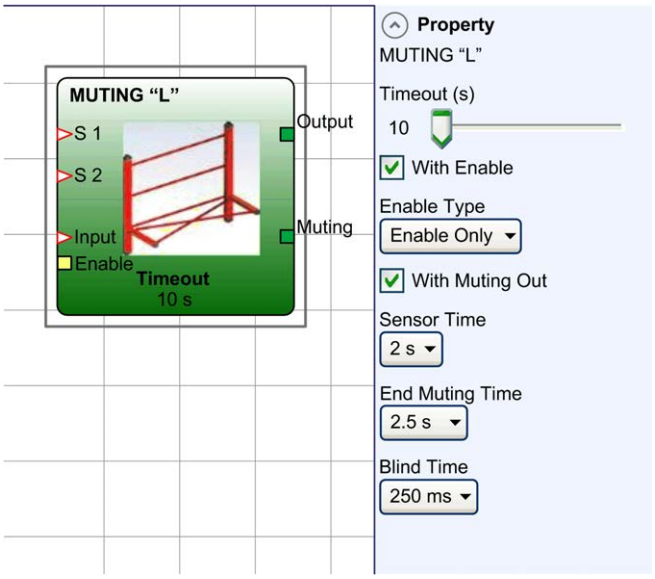
MUTING with L-Logic

Presentation

The *MUTING* operator with L-logic performs muting of the input signal through sensor inputs *S1* and *S2*. With the L-type muting, the sensors `S1` and `S2` are cross beam muting sensors with monitoring the timing between activation of sensor `S1` and `S2`.

NOTE: Preliminary condition: The muting cycle can only start if *S1* and *S2* are set to FALSE and the inputs are set to TRUE (no interruption of the protective field).

The activation of the *MUTING* function occurs following the interruption of the beams of sensors S1 and S2 (regardless of their order) within a user-defined time range between 2s and 5s. The *MUTING* ends when the monitored opening is free again.



Parameters

Parameters	Description
Timeout (s)	Sets the time, between 10 seconds and infinity, within which the muting cycle must end. If the cycle is not complete at the end of the set time, muting is immediately discontinued.
With Enable	This option provides an Enable input for the muting function. Without an Enable input, the muting function is always enabled.
Enable Type	• If **Enable/Disable** is selected, the muting cycle is started with a rising edge at the Enable input. A falling edge at the Enable input disables muting regardless of the condition of the muting sensors. • If **Enable Only** is selected, the muting cycle must also be started with a rising edge at the Enable input, but it is not disabled with a falling edge. The Enable input must be set to FALSE before a new rising edge can start the next muting cycle.
With Muting Out	When enabled, provides an output `Muting` on the function block which can be used to connect to a muting lamp to indicate that Muting is active.
Sensor Time	The maximum time between 2 to 5 seconds between activating the two muting sensors.
End Muting Time	Sets the muting termination delay time, from 2.5 to 6 seconds, after the first sensor has been cleared.
Blind Time	**Blind Time** starts after the complete material transition has been indicated by the sensors (muting cycle closed) to allow the passing of protruding parts that could still block the light curtain. It is an extension of the muting of the light curtain. During **Blind Time**, the input remains set to TRUE. **Blind Time** can range from 250 ms to 1 second.

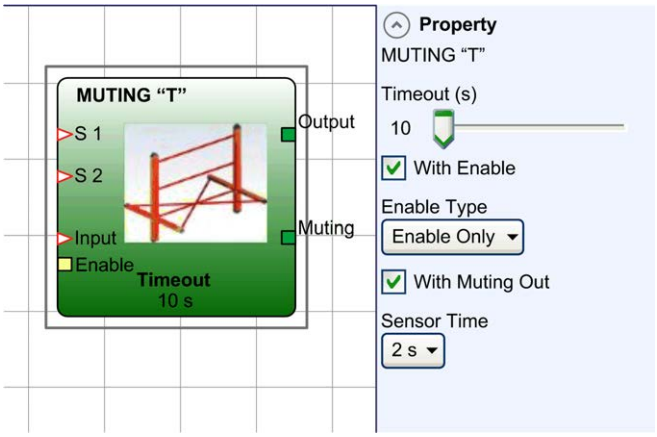
MUTING with T-Logic

Presentation

The *MUTING* operator with T - logic performs muting of the input signal through sensor inputs `S1` and `S2`. With the T-type muting, the sensors `S1` and `S2` are cross beam muting sensors with monitoring the timing between activation of sensor `S1` and `S2`.

NOTE: Preliminary condition: The muting cycle can only start if `S1` and `S2` are set to FALSE and the inputs are set to TRUE (no interruption of the protective field).

The activation of the *MUTING* function occurs following the interruption of the beams of sensors S1 and S2 (regardless of their order) within a user-defined time range between 2s and 5s. The *MUTING* ends when the last of the two sensor beams is not interrupted anymore.



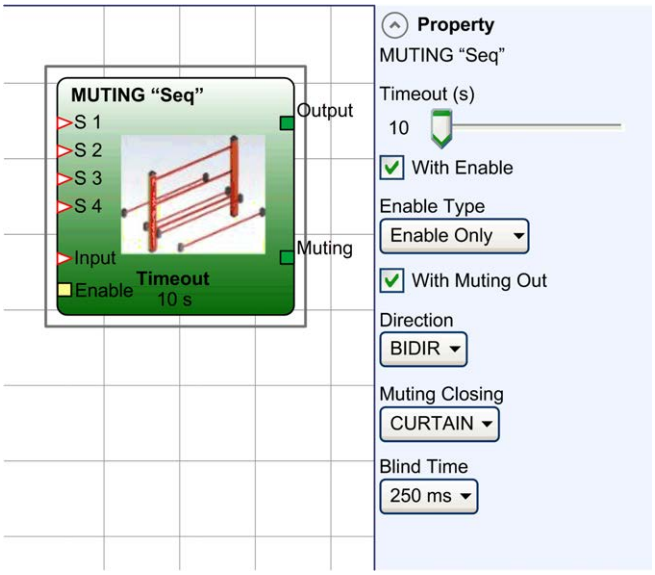
Parameter	Description
Timeout (s)	Sets the time, between 10 seconds and infinity, within which the muting cycle must end. If the cycle is not complete at the end of the set time, muting is immediately discontinued.
With Enable	This option provides an Enable input for the muting function. Without an Enable input, the muting function is always enabled.
Enable Type	• If **Enable/Disable** is selected, the muting cycle is started with a rising edge at the Enable input. A falling edge at the Enable input disables muting regardless of the condition of the muting sensors. • If **Enable Only** is selected, the muting cycle must also be started with a rising edge at the Enable input, but it is not disabled with a falling edge. The Enable input must be set to FALSE before a new rising edge can start the next muting cycle.
With Muting Out	When enabled, provides an output `Muting` on the function block which can be used to connect to a muting lamp to indicate that Muting is active.
Sensor Time	The maximum time between 2 to 5 seconds between activating the two muting sensors.

Sequential *MUTING "Seq"*

Presentation

The sequential *MUTING* function is activated after sequential interruption of the sensors S1 and S2 and continued by the following interruption of sensors S3 and S4, without a time limit between the interruptions. If the material moves in the opposite direction, then the interruptions must follow the sequence S4, S3, S2, S1. For sequential muting, the function requires the activation of each sensor in the correct sequence to allow muting to occur.

NOTE: Preliminary condition: The muting cycle can only start if all the sensors are set to FALSE and the inputs are set to TRUE (no interruption of the protective field).



Parameter	Description
Timeout (s)	Sets the time, between 10 seconds and infinity, within which the muting cycle must end. If the cycle is not complete at the end of the set time, muting is immediately discontinued.
With Enable	This option provides an Enable input for the muting function. Without an Enable input, the muting function is always enabled.
Enable Type	• If **Enable/Disable** is selected, the muting cycle is started with a rising edge at the Enable input. A falling edge at the Enable input disables muting regardless of the condition of the muting sensors. • If **Enable Only** is selected, the muting cycle must also be started with a rising edge at the Enable input, but it is not disabled with a falling edge. The Enable input must be set to FALSE before a new rising edge can start the next muting cycle.
With Muting Out	When enabled, provides an output `Muting` on the function block which can be used to connect to a muting lamp to indicate that Muting is active.
Direction	The order in which the sensors are activated. • If set to **BIDIR**, the sensors can be occupied in both directions: ◦ From `S1` to `S4` ◦ From `S4` to `S1` • If set to **UP**, the sensors can be occupied from `S1` to `S4`. • If set to **DOWN**, the sensors can be occupied from `S4` to `S1`.

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Muting Closing</td><td>There are 2 types:
• CURTAIN: If you select CURTAIN, muting terminates with a rising edge of the input signal.
• SENSOR: If you select SENSOR, muting terminates when the third sensor has been cleared.
Select CURTAIN:
<table>
<tr><th>S1</th><th>S2</th><th>Input</th><th>S3</th><th>S4</th><th>Muting</th></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>–</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>–</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>–</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>–</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
</table>
Select SENSOR:
<table>
<tr><th>S1</th><th>S2</th><th>Input</th><th>S3</th><th>S4</th><th>Muting</th></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>–</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>–</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>–</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>–</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
</table></td></tr>
<tr><td>Blind Time</td><td>Only with Muting Closing set to CURTAIN, Blind Time is enabled after the complete transition of the pallet (muting cycle close) some protruding objects could still occupy the light curtain and set the input to FALSE.
During Blind Time, the input remains set to TRUE. Blind Time can range from 250 ms to 1 second.</td></tr>
</table>

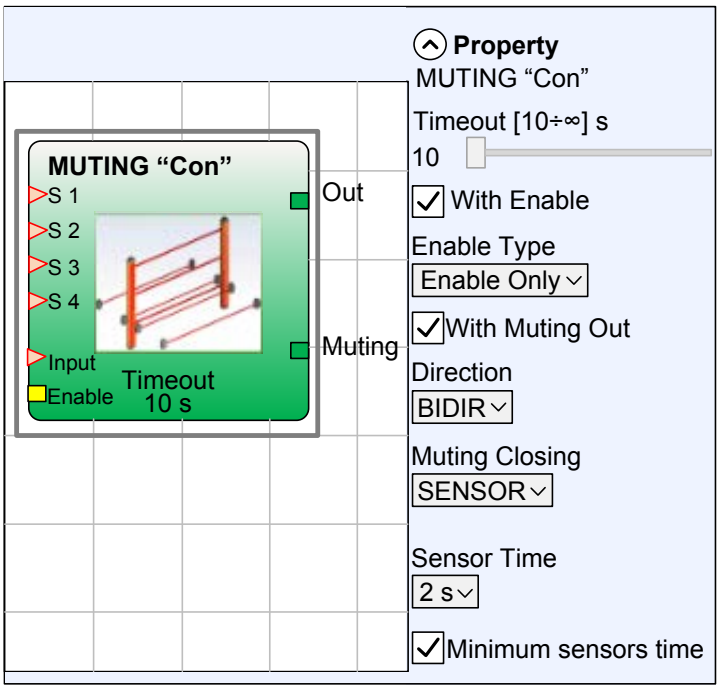
Concurrent *MUTING*

Presentation

The *MUTING* operator with concurrent logic performs muting of the input signal through sensor inputs *S1*, *S2*, *S3* and *S4*. Within this type of muting, 4 sensors are used and the activation of each sensor is monitored.

NOTE: Preliminary condition: The muting cycle can only start if the sensors are set to FALSE and the inputs are set to TRUE (no interruption of the protective field).

The activation of the *MUTING* function occurs following the interruption of the beams of sensors S1 and S2 (regardless of their order) within a user-defined time range between 2s and 5s (or the beams of sensors S3 and S4 if material is moving in the opposite direction).



Parameter	Description
Timeout (s)	Sets the time, between 10 seconds and infinity, within which the muting cycle must end. If the cycle is not complete at the end of the set time, muting is immediately discontinued.
With Enable	This option provides an Enable input for the muting function. Without an Enable input, the muting function is always enabled.
Enable Type	• If **Enable/Disable** is selected, the muting cycle is started with a rising edge at the Enable input. A falling edge at the Enable input disables muting regardless of the condition of the muting sensors. • If **Enable Only** is selected, the muting cycle must also be started with a rising edge at the Enable input, but it is not disabled with a falling edge. The Enable input must be set to FALSE before a new rising edge can start the next muting cycle.
With Muting Out	When enabled, provides an output `Muting` on the function block which can be used to connect to a muting lamp to indicate that Muting is active.
Direction	The order in which the sensors are activated. • If set to **BIDIR**, the sensors can be occupied in both directions: ◦ From `S1` and `S2` to `S3` and `S4` ◦ From `S3` and `S4` to `S1` and `S2` • If set to **UP**, the sensors can be occupied from `S1` and `S2` to `S3` and `S4`. • If set to **DOWN**, the sensors can be occupied from `S3` and `S4` to `S1` and `S2`.

<table>
<tr><th>Parameter</th><th colspan="6">Description</th></tr>
<tr><td rowspan="20">Muting Closing</td><td colspan="6">There are 2 types:
• CURTAIN: If you select CURTAIN, muting terminates when the input signal rises.
• SENSOR: If you select SENSOR, muting terminates when the third sensor has been cleared.
Select CURTAIN:</td></tr>
<tr><td>S1</td><td>S2</td><td>Input</td><td>S3</td><td>S4</td><td>Muting</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>–</td><td>0</td><td>0</td><td>1</td></tr>
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<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="6">Select SENSOR:</td></tr>
<tr><td>S1</td><td>S2</td><td>Input</td><td>S3</td><td>S4</td><td>Muting</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>–</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>–</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Blind Time</td><td colspan="6">Only with Muting Closing set to CURTAIN, Blind Time starts after the complete material transition has been indicated by the sensors (muting cycle closed) to allow the passing of protruding parts that could still block the light curtain. It is an extension of the muting of the light curtain.

During Blind Time, the input remains set to TRUE. Blind Time can range from 250 ms to 1 second.</td></tr>
<tr><td>Sensor Time</td><td colspan="6">The maximum time between 2 to 5 seconds between activating the two muting sensors.</td></tr>
<tr><td>Minimum sensors time</td><td colspan="6">When selected, allows the activation of Muting cycle only if a time greater than 150 ms elapses between the activation of the sensor 1 and sensor 2 (or sensor 3 and sensor 4).</td></tr>
</table>

MUTING OVERRIDE

Presentation

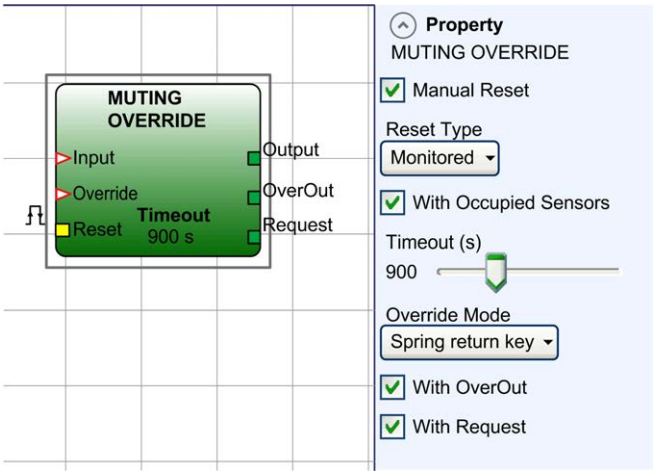
The *OVERRIDE* function must be used when the machine stops due to incorrect muting activation sequences with material blocking the guarded opening. The function activates the *OSSD* outputs, allowing you to remove the material that is blocking the guarded opening.

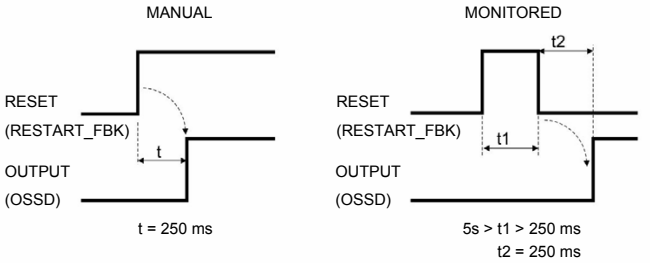
You can configure a maximum of four *MUTING OVERRIDE* operators, limited by the number of usable muting operators.

The operator permits an override of the connected muting input. Override can be activated only if muting is not active (INPUT=0) and at least one muting sensor is occupied or the light curtain is occupied. Override ends when the light curtain and sensors are cleared and the output switches to FALSE.

The **Output** of the related muting operator must be connected to the **Input** of the override operator.

OVERRIDE can be set to pulsed or maintained activation mode.



Mode	Description
Manual Reset	When selected, the behavior of the `MUTING OVERRIDE` is the following: • With `Input` active (TRUE), the reset enables the output of the function block. • With `Input` not active (FALSE), the output of the function block follows the OVERRIDE request.
Reset Type	When **Manual** is selected, the function verifies the reset signal transition from 0 to 1. When **Monitored** is selected, the function verifies the reset signal transition from 0 to 1 and then back to 0. 
Override Mode	Select **Spring return key** (maintained activation): The override input must stay activated (*OVERRIDE* = 1) during the whole override operation. If the override command will be deactivated (*OVERRIDE* = 0), then the override stops. It is possible to continue the override operation by reactivating the override input. When the light curtain and sensors are cleared (the guarded opening is free) or on expiry of the timeout, override ends without the need for further commands. Select **Pushbutton** (pulsed activation): The override operation starts by activation of the override input (*OVERRIDE* = 1) and ends when the light curtain and sensors are cleared (the guarded opening is free) or on expiration of the timeout. The override input does not need to stay active to complete the operation. The next activation is only possible when the active override operation has ended.

Parameters

Parameter	Description
With Occupied Sensors	Used to set the activation condition appropriate to the muting operator. Must be selected with "T", sequential and concurrent muting. Must be deselected for "L" muting **NOTE:** If not selected appropriately, an advisory is displayed in the compilation phase and in the report.
Timeout (s)	Used to set the time, between 10 sec and infinity, within which the override function must end.
With OverOut	Used to activate an override active signaling output (active when TRUE).
With Request	Used to activate a signaling output (active when TRUE) indicating that the override function can be activated.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

The *OVERRIDE* command device must be installed in a position where the zone of operation and the protected guarded opening are clearly visible.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

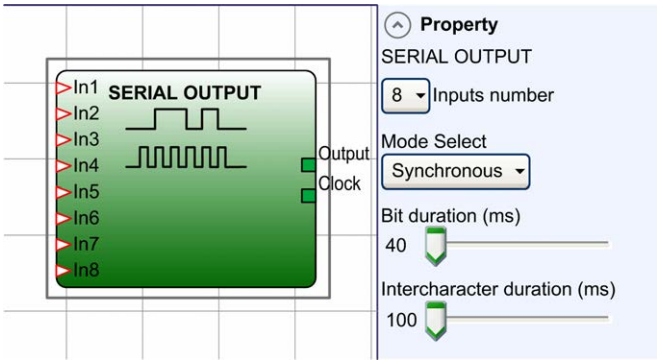
Miscellaneous Functions

SERIAL OUTPUT Function

Presentation

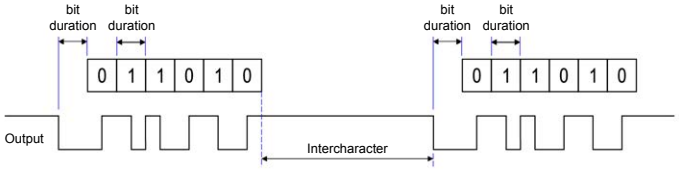
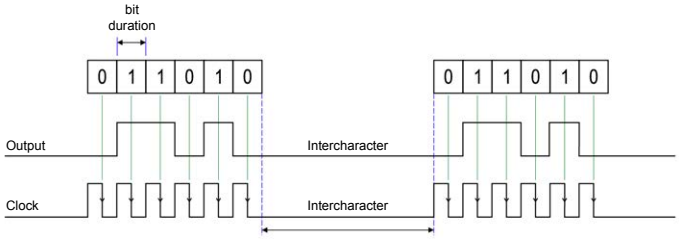
You can configure a maximum of eight *SERIAL OUTPUT* operators.

The *SERIAL OUTPUT* operator provides the output state of up to eight inputs, serializing the information.



Operating Principles

This operator outputs the state of the connected inputs in two different ways:

Mode Select	Description
Asynchro-nous	1. The state of the output in the idle condition is set to TRUE; 2. The start data transmission signal is 1 bit which is set to FALSE; 3. Transmission of n bits with the state of the connected inputs encoded using the Manchester coding: • State 0: rising edge of the signal at the center of the bit • State 1: falling edge of the signal at the center of the bit 4. Inter-character interval is set to TRUE to allow synchronization of an external device.  With the asynchronous method, the clock output is not present.
Synchronous	1. The output and the clock in the idle condition are set to FALSE. 2. Transmission of n bits with the input state using *Output* as data, *Clock* as the timing base. 3. Inter-character interval is set to FALSE to allow synchronization of an external device. 

Parameters

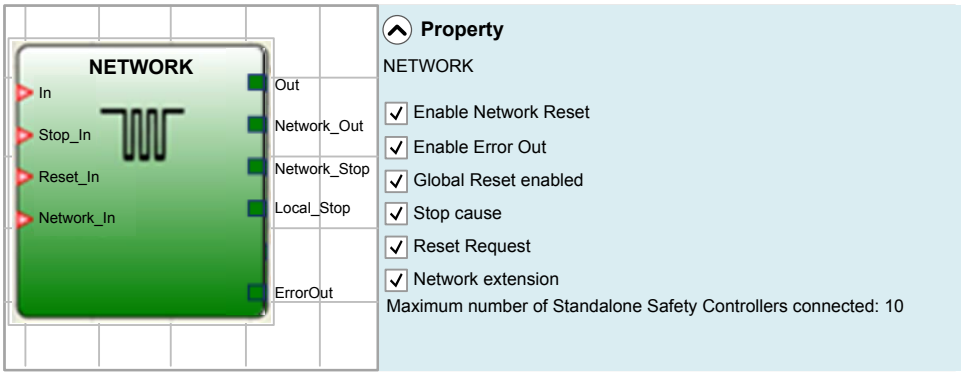
Parameter	Description
Inputs number	Defines the number of inputs of the operator, which may be 2 to 8 (asynchronous) or 3 to 8 (synchronous).
Bit duration (ms)	Enter the value corresponding to the duration of each single bit (input n) in the pulse train that makes up the transmission. • 40 to 200 ms (increments of 10 ms) • 250 ms to 0.95 s (increments of 50 ms)
Intercharacter duration (ms)	Enter the time that must elapse between the transmission of one pulse train and the next. • 100 ms to 2.5 s (increments of 100 ms) • 3 to 6 s (increments of 500 ms)

NOTE: Performance of the *SERIAL OUTPUT* operator is variable depending on cycle times, configuration, and other factors that may impact performance. Thoroughly validate that the timing is adequate for your application.

NETWORK Operator

The *NETWORK* operator is used to distribute Stop and Reset commands through a local hardwired controller network. Use *Network_in* and *Network_out* to exchange `START`, `STOP` and `RUN` signals between the different nodes.

NOTE: You can configure one *NETWORK* operator per controller.



Operating Principle

The *Network* operator requires the following:

- The `Network_In` input (single or double) must be connected to the `Network_Out` output of the preceding unit in the local network.
- The `Network_Out` (could be a *STATUS* or *OSSD* output), must be connected to the `Network_In` input of the next unit in the local network.
- The `Stop_In` and `Reset_In` inputs must be connected to input devices that act as a stop (for example, *E-STOP*) or as a Reset (for example, *SWITCH*), respectively.
- The `In` input can be connected freely in the diagram (for example, input function blocks or results of logical combinations).
- The `Out` output can be connected freely in the diagram. The `Out` output is set to TRUE when the `In` input is set to TRUE and the function block has been restarted.

Parameters

Parameter	Description
Enable Network Reset	When selected, allows the distribution network to reset the function block. If not enabled, the function block can only be reset through the local `Reset_In` input.
Enable Error Out	When selected, provides an output to indicate that an error has been detected by the function block.
Global Reset Enable	• When selected, the operator can restart the entire system with the reset button from any node in the network. • When not selected, the operator can restart the nodes that have not caused the stop from any point in the network, excluding the node that has caused the stop (this node has to be restarted with its own reset).
Stop cause	• When selected, enables the `Network_stop` and `Local_stop` outputs and indicates the cause of the STOP status. • These outputs are normally set to FALSE with the system in RUN and the `Out` output set to TRUE. • If a network stop is requested, the `Network_stop` output goes to TRUE. • If the `Out` output goes to FALSE due to the `In` input or the `Stop_in` input, the `Local_stop` output goes to TRUE. • The outputs remain in this status until the next main reset.

The `RESET` command must be installed outside the zone of operation in a position where the zone of operation and the entire work area concerned are clearly visible.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not operate the `RESET` command device from inside the zone of operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The maximum number of Standalone Safety Controllers XPSMCMCB1604SA(G) that can be connected in network configuration is equal to 10.

⚠WARNING

LOSS OF DESIGNATED SAFETY-RELATED FUNCTION

Do not connect more than 10 controllers to the same network.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Application Examples

Condition 1:

With reference to the configuration diagrams and application example below, at power-on:

1. The `Network_out` of the various nodes are set to FALSE;
2. The stop signal is sent through the `Network_out` line;
3. When the `Reset` command is pressed on one of the nodes, the nodes that are present are started when the START signal is sent;
4. As a result, the `Network_out` of the connected nodes is set to TRUE if the various `Network_in` inputs are set to TRUE;
5. The Run signal is sent through the network of the 4 nodes present.

Condition 2:

With reference to the configuration diagrams and application example below, when the emergency stop is pressed in one of the four nodes:

1. The `Network_out` is set to FALSE;
2. The stop signal is sent through the `Network_out` line;
3. The next node receives the stop code and deactivates the output;
4. The stop command generates the stop code for the `Network_in` and `Network_out` lines;
5. As a result, the `Network_out` of the connected nodes is set to FALSE.
6. When the emergency stop is restored to the normal position, all the nodes can be restarted by sending the Start signal with a single reset. The latter condition does not occur when **Enable Network Reset** is not enabled. In that case, the local reset method must be used. The system takes about 4 seconds to restore all the outputs of the blocks that make up the network.

   NOTE: Perform a local reset of the module which caused the network shutdown to restore its safety-related output.

Response Time

The response time of the network starting from emergency stop is given by the formula:

With Standalone Safety Controller XPSMCMCB1604SA(G):

t_{rTot}= [22 ms + [186 ms x (number of controllers – 1)]

A maximum of 10 controllers can be connected in the same network.

Condition 3:

With reference to the configuration diagrams and application example below, when the `IN` input of the *NETWORK* operator of one of the 4 nodes is set to FALSE:

1. The `Out` output is set to FALSE.
2. The RUN signal continues to be sent through the `Network_Out` lines.
3. The states of the remaining nodes remain unchanged.
4. In that case, local reset must be used.

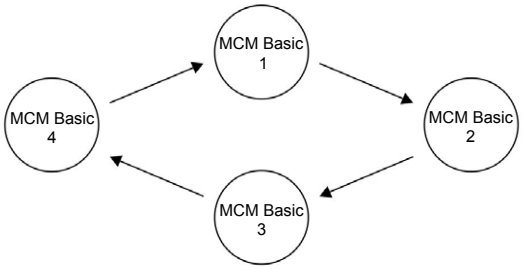
   The **IN** LED of the input configured for the`Reset_In` input of the function block flashes to indicate this condition.

   The `Reset` command restarts the corresponding node only unless `Global Reset` is enabled.

The `Network_in` input and the `Network_out` output can only be mapped to the I/O pins of the Standalone Safety Controller XPSMCMCB1604SA(G).

Example of 4 nodes network:

Controller used	Standalone Safety Controller 1	Standalone Safety Controller 2	Standalone Safety Controller 3	Standalone Safety Controller 4
Standalone Safety Controller XPSMCMCB1604SA(G)	22 ms	208 ms	394 ms	580 ms



Network Operator Signals

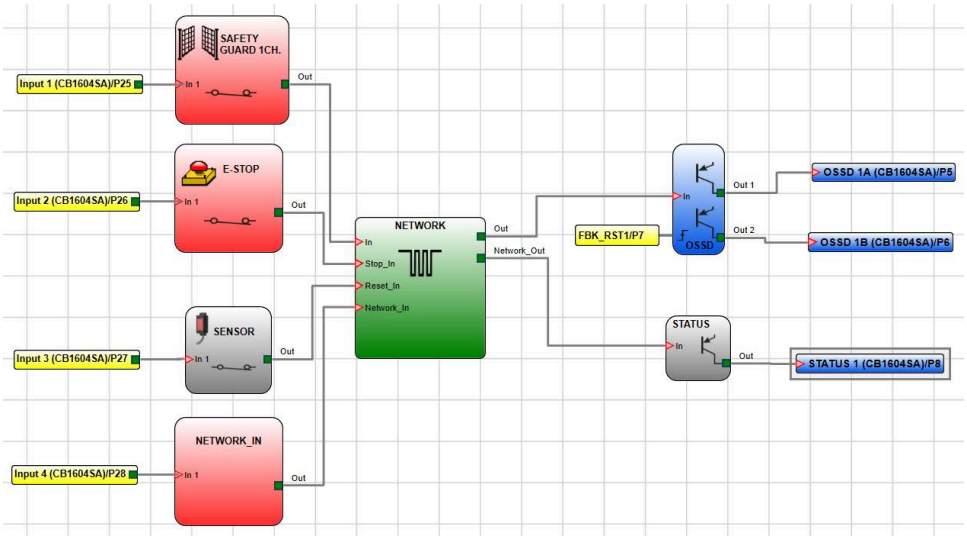
LED		E EX	IN(1)	OSSD(2)	STATUS(3)	IN(4)
Controller state	**STOP**	OFF	OFF	red	OFF	OFF
	CLEAR	OFF	flashing	red/green (flashing)	flashing	flashing
	RUN	OFF	ON	green	ON	ON
	ERROR	ON	flashing	–	–	–

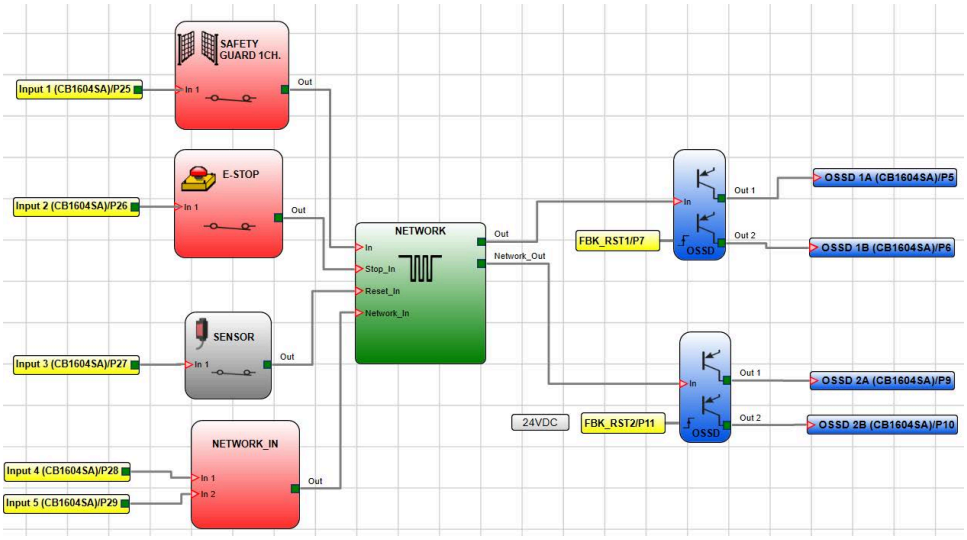
(1) Corresponding to the input where is wired `Network_In`

(2) Corresponding to the input where is wired `Network_Out`

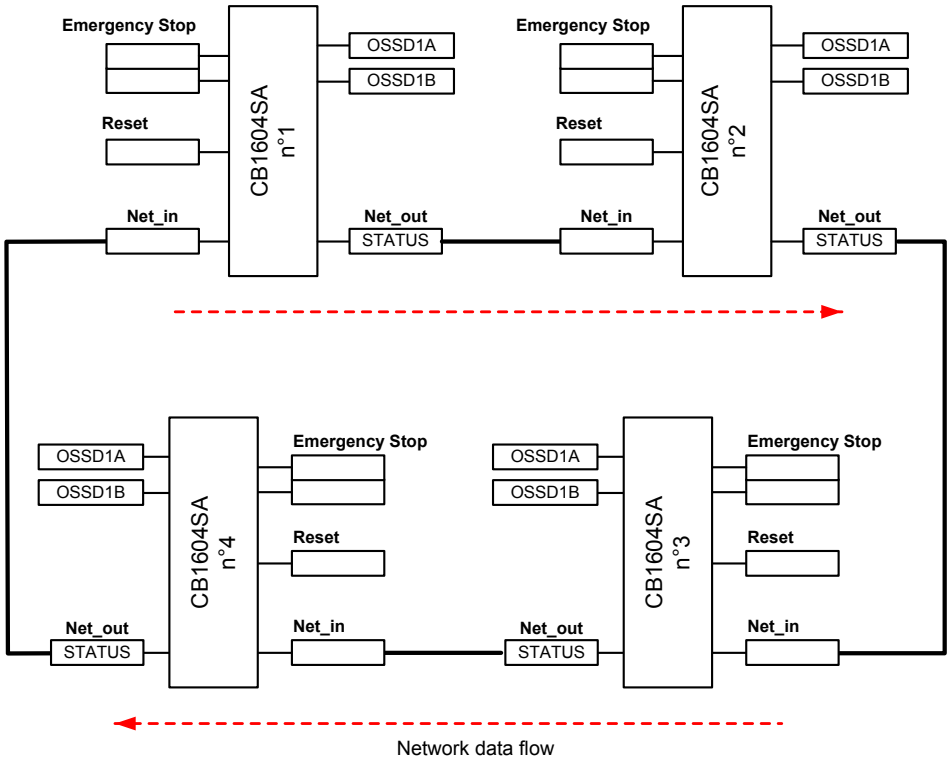
(3) Corresponding to the status output used for `Network_Out`

(4) Corresponding to the input where is wired `Reset_In`





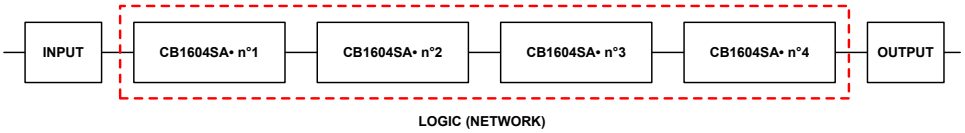
Example of application in Category 2 according to ISO 13849-1:



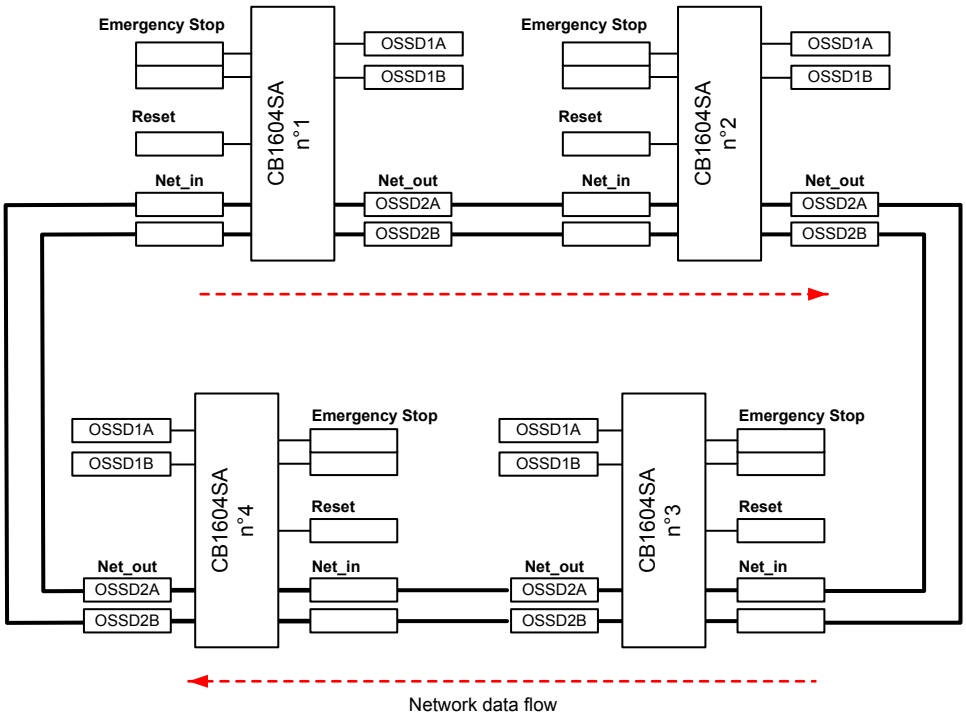
Network parameters for the PL calculation

Architecture:	Cat.2
Diagnostic coverage:	DC = 90%
Reliability of the Standalone Safety Controller XPSMCMCB1604SA(G):	MTTFd = 160.81 (years)

Logical block diagram of a safety-related function using the network:



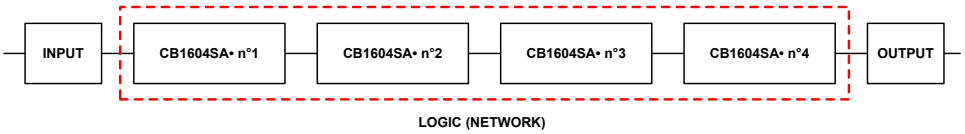
Example of application in Category 4 according to ISO 13849-1:



Network parameters for the PL calculation

Architecture:	Cat.4
Diagnostic coverage:	DC = 99%
Reliability of the Standalone Safety Controller XPSMCMCB1604SA(G):	PFHd = 1.50E-08 (hour-1)

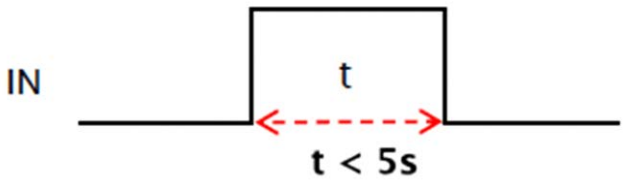
Logical block diagram of a safety function using the network



RESET

Presentation

The *RESET* function initiates a system reset when there is an OFF-ON-OFF transition on the corresponding input which lasts less than 5 s.



NOTE: The *RESET* function is not initiated when the OFF-ON-OFF transition on the corresponding input lasts more than 5 s.

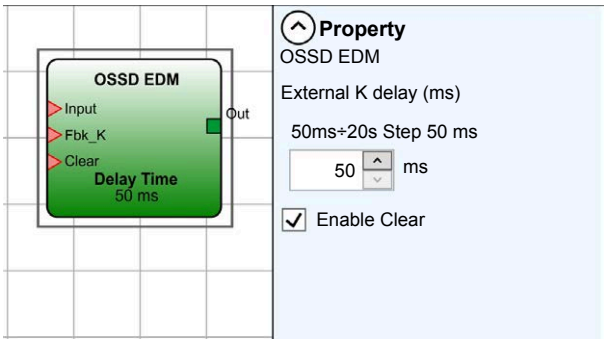
You can use the *RESET* function to reset detected errors without disconnecting system power, providing that the cause of the error has been removed.

OSSD EDM

Presentation

You can configure a maximum of four `OSSD EDM` operators.

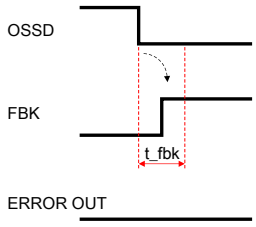
The *OSSD EDM* operator allows to control an EDM (External Device Monitoring) feedback related to a safety-related output using a generic controller input.



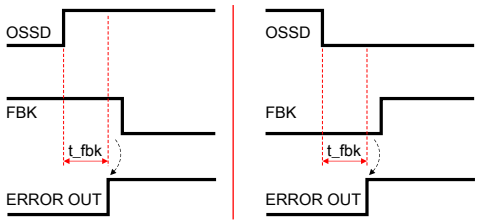
The `Out` can only be connected to one safety-related output operator (`OSSD`). This output function block must have the K external time monitor deactivated. With TRUE `Out` of the connected `OSSD`, the `Fbk_K` signal must be set to FALSE and vice versa, within the set time. Otherwise, `Out` is set to FALSE and the error is indicated by the flashing LED corresponding to the `OSSD` in error.

If **Enable Error Out** of the connected `OSSD` function block is selected, this `Out` is set to TRUE when an external `Fbk` error is detected.

Example of `OSSD` with correct `Fbk` signal: In this case `ERROR OUT`=FALSE:

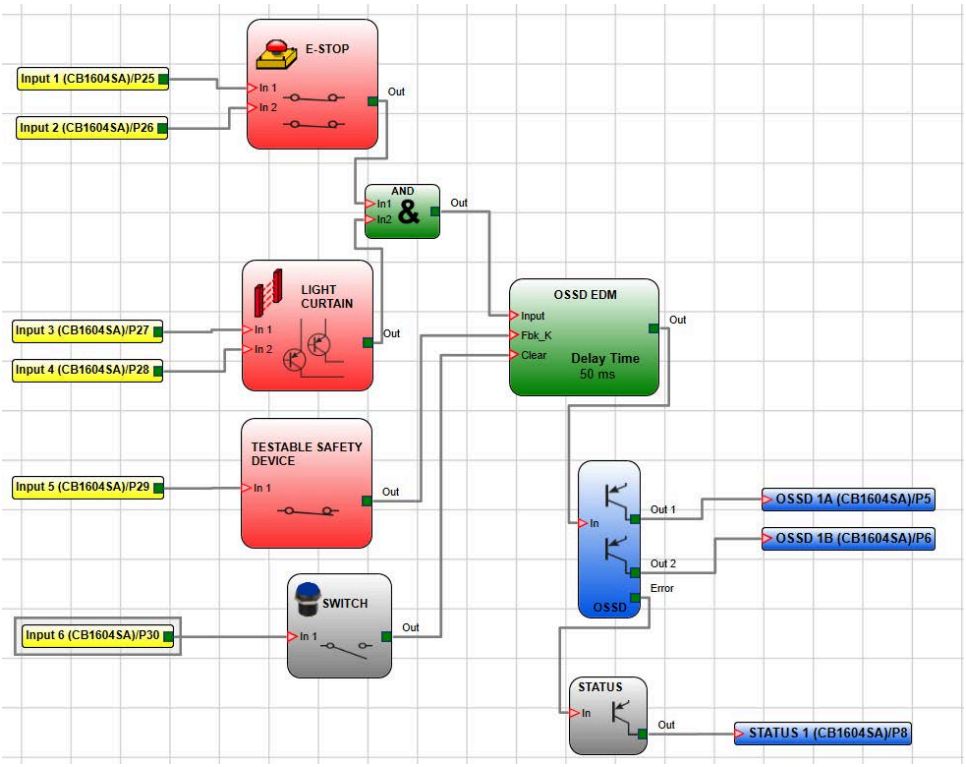


Example of OSSD with incorrect `Fbk` signal (**External K delay** exceeded): In this case `ERROR OUT`=TRUE



Parameter	Description
External K delay	Allows you to set the time window within which the external feedback signal (`Fbk_K`) is to be monitored (according to output conditions).
Enable Clear	When selected, it allows you to clear the error when the cause has been removed. Using this input, it is no longer necessary to reset the controller or turn off the system.

OSSD EDM Operator Project Sample



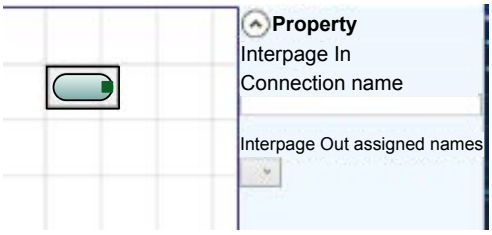
Interpage In and *Interpage Out* Operator

Overview

The *Interpage In* and *Interpage Out* operators make it possible to connect function block outputs and inputs by name rather than by drawing a net between the outputs and inputs, thereby simplifying complex schematics.

Interpage In

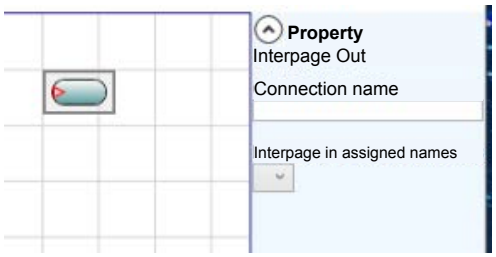
The *Interpage In* operator simplifies the working area by using this function every time the same output is required in multiple places.



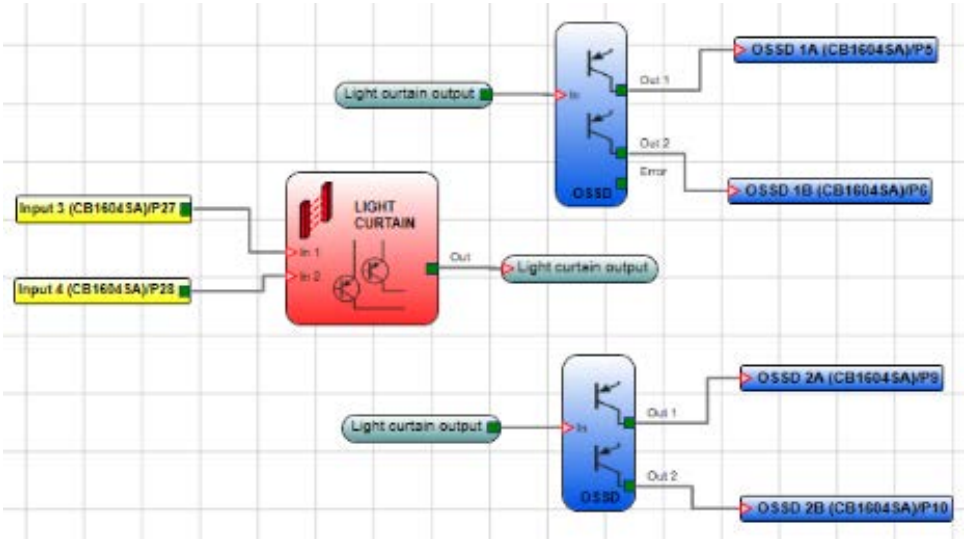
The operator is connected to the input of the function block, for example: *OSSD*. The operator must be given the same unique name as used on the *Interpage Out* operator function block.

Interpage Out

The *Interpage Out* operator is connected to the output of a function block, for example *LIGHT CURTAIN*. The operator must be given a unique name, and then the value can be reused multiple times by initializing the *Interpage In* operator with the same unique name.



In the following example the output of the *LIGHT CURTAIN* function block is connected to the *Interpage Out* operator. The *Interpage In* operator is used to connect to two *OSSD* outputs in the configuration.



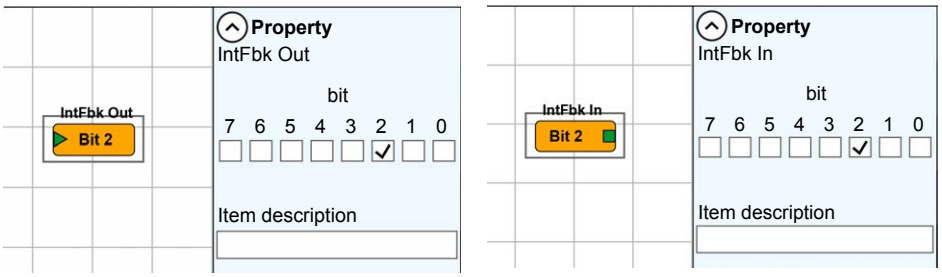
Internal Feedback Operators

IntFbk_In and *IntFbk_Out* Operators

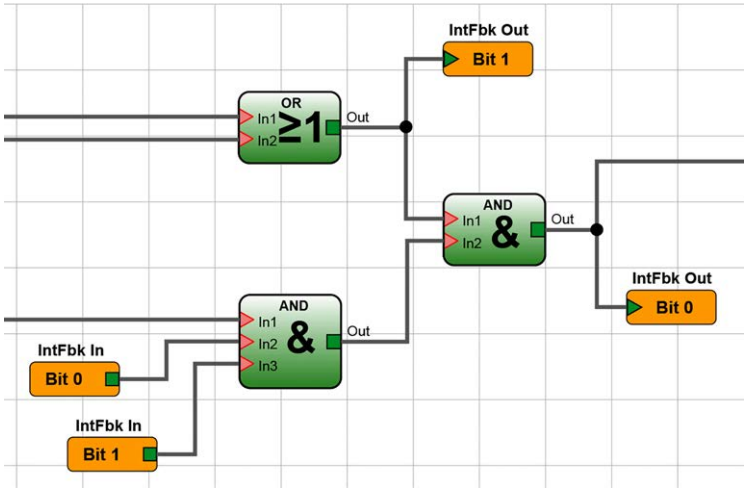
Presentation

With the *IntFbk* operators you can configure a maximum of eight internal feedback loops. You can connect the output of a function block by using the *IntFbk_Out* operator to the input of a function block by using the *IntFbk_In* operator. The logic state of the *IntFbk_In* operator follows the state of the *IntFbk_Out* operator with one controller cycle delay.

To link an *IntFbk_Out* to an *IntFbk_In* operator, you need to select the same bit number for both operators (bit 2 in the following example).



Application example:



⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Do not use positive feedback when designing feedback loops in order to prevent system oscillations and instability.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Appendices

What's in This Part

Diagnostic Information

What's in This Chapter

Error Codes

Overview

If an error is detected, the controller provides a corresponding error code to SoSafe MCM Basic.

To read the code, proceed as follows:

- Connect the controller (indicating **E IN** or **E EX** by LED) to the computer using the matching USB configuration cable.
- Open SoSafe MCM Basic. A pop-up window appears with the associated code.

The following table lists the error codes and their solution:

Code	Description	Solution
130D; 135D; 137D; 138D; 140D; 194D; 197D; 198D; 199D; 201D; 202D; 203D; 205D	Error detected on solid-state output OSSD1.	Verify the digital output (`OSSD1`) connections.
144D; 149D; 151D; 152D; 154D; 208D; 211D; 212D; 213D; 215D; 216D; 217D; 219D	Error detected on solid-state output OSSD2.	Verify the digital output (`OSSD2`) connections.
158D; 163D; 165D; 166D; 168D; 222D; 225D; 226D; 227D; 229D; 230D; 232D; 233D	Error detected on solid-state output OSSD1.	Verify the digital output (`OSSD1`) connections.
172D; 117D; 179D; 180D; 182D; 236D; 239D; 240D; 241D; 243D; 244D; 245D; 247D	Error detected on solid-state output OSSD4.	Verify the digital output (`OSSD4`) connections.

NOTE: Other codes are related to internal detected errors. If such a detected error persists after a system restart, replace the affected product.

The following table lists the internal error codes and their solution:

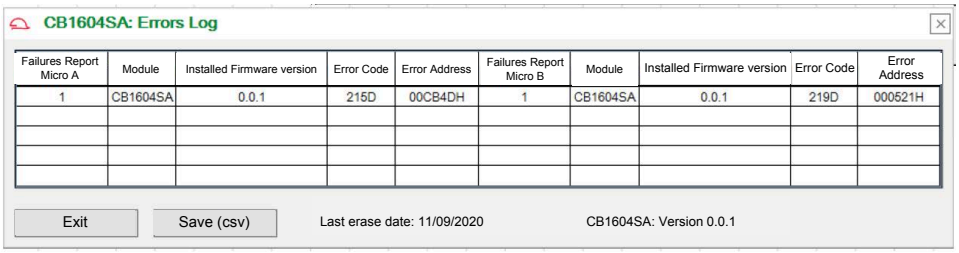
Code	Description	Solution
1D to 31D	Microcontroller error detected.	Try to restart the system. If the detected error persists, replace the affected product.
32D to 63D	Mainboard error detected.	
128D to 143D 192D to 205D	OSSD1 error detected.	
144D to 159D 206D to 219D	OSSD2 error detected.	
160D to 173D 220D to 233D	OSSD3 error detected.	
174D to 188D 234D to 247D	OSSD4 error detected.	

Errors Log Download

Presentation

Click the icon  or use the menu **Communication > Visualize errors history** to display the errors log file. (The **Level1 Password** is sufficient).

A table appears with the last 5 errors detected from the date when the schema was sent to the controller or from the date of error log cancelation (icon ).



Accessories and Spare Parts

What's in This Chapter

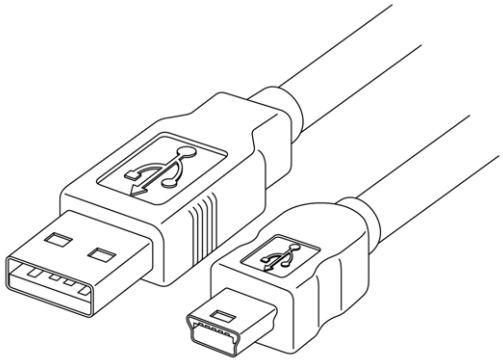
Accessories and Spare Parts

Reference	Description
TCSXCNAMUM3P	USB cable for connection to PC

USB/Mini B USB Configuration Cable

Presentation

The Standalone Safety Controller XPSMCMCB1604SA(G) has a dedicated USB 2.0 port for connection to a PC and SoSafe MCM Basic.



A USB/Mini B USB configuration cable is available as an accessory under the reference **TCSXCNAMUM3P**.

A commercially available USB/Mini B USB cable with a maximum length of 3 meters can also be used for configuration.

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EIO0000005307.00