wieland

samos® PRO

samos®PLAN6 Software

Manual

Doc. no. BA000968

Last Update: 06/2022 [11179]

INFO

Subject to change.

Subject to technical changes for reasons of continued development.

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1 ABOUT THIS MANUAL

Please read this section carefully before you work with this software manual and the samos® PRO system.

1.1 Function of this document

There are three manuals for the samos® PRO system with clearly delineated areas of application as well as installation instructions and brief instructions for each module.

- **This software manual** describes the programming of the system in which modules from the samos® PRO device family are installed.
  The software-supported configuration and parameterization of these devices is described in this manual. In addition, the software manual contains a description of the important diagnostic functions for operation and detailed information for identifying and eliminating errors. Use the software manual mainly for configuring, commissioning and operating.
- The **hardware manual** describes all of the modules and their functions in detail. Use the hardware manual mainly for designing devices.
- The **gateway manual** describes in-detail the samos® PRO gateways and their functions.
- Each module contains the **installation instructions/brief instructions**. These instructions provide information on the fundamental technical specifications of the modules and contain simple installation instructions. Use the installation instructions/brief instructions when installing the samos® PRO safety controller.

This manual contains original operating instructions in accordance with the Machinery Directive.

1.2 Scope of validity and applicable documents

This software manual is valid for samos® PLAN 6 software version 1.0.x and higher and controller module SP-COPx version A-01 and higher.

This manual contains original operating instructions in accordance with the Machinery Directive.

Table 1: Overview of the samos® PRO documentation

Document	Title	Article number
Software manual	samos® PLAN 6 software	BA000967
Hardware manual	samos® PRO hardware	BA000965
Gateway manual	samos® PRO gateways	BA000969
Operating instructions	SP-COPx (Controller modules of the modular samos® PRO safety controller)	BA001119
Operating instructions	SP-SDI/SP-SDIO Extended modules of the modular safety controller samos® PRO	BA001116
Operating instructions	SP-DIO Unsafe extended module of the samos® PRO modular safety controller	BA001190
Operating instructions	SP-SAC4/SP-SAR4/SP-SARCR22 Analog extended module of the modular safety controller samos® PRO	BA001169
Operating instructions	SP-PROFIBUS-DP Non-safe fieldbus module PROFIBUS-DP	BA001187
Operating instructions	SP-CANopen Non-safe fieldbus module CANopen	BA001188
Operating instructions	SP-EN-ETC Non-safe fieldbus module EtherCAT	BA001178

1.3 Target group

This software manual is intended for users of the samos® PLAN 6 software and developers and operators of systems in which a samos® PRO module safety controller is integrated. It is also aimed at persons commissioning such a system for the first time or maintaining such a system.

These software operating instructions **not** only provide instructions for operating the machine or system into which a samos® PRO safety controller is integrated. There are also instructions on how to operate the machine or system.

1.4 Function and setup of this software manual

This software manual guides technical personnel of the machine manufacturer or machine operator in the software configuration, operation, and diagnostics of a samos® PRO system with the samos® PLAN 6 software. It is only valid together with the Hardware Manual.

The basic safety information can be found here:

- Section: *Safety [ch. 2, p. 14]*
- Please ensure that you read this information.

NOTICE

Also consult our website on the Internet at the following link:
www.wieland-electric.com

There you will find the following files available for download:

- samos® PLAN 6 software
- Hardware and software manuals.
- EDS and GSD files

1.4.1 Recommendations for getting to know the software

We recommend the following procedure for users wishing to familiarize themselves for the first time with the samos® PLAN 6 software:

- Please read the section titled *samos® PLAN 6 graphical user interface [ch. 5, p. 20]* in order to familiarize yourself with the layout of the software.
- Along with your first samos® PLAN 6 projects, follow the guidelines under *Working with samos® PLAN 6 [ch. 6, p. 77]*.

1.4.2 Recommendations for experienced users

We recommend the following procedure for experienced users who have already worked with the samos® PLAN 6 software:

- Please familiarize yourself with the current version of the software (*Scope of validity and applicable documents [ch. 1.2, p. 12]*).
- The table of contents lists all of the functions provided by the samos® PLAN 6 software. Please use the table of contents to find information about the basic functions.

1.5 Symbols/icons and writing style/spelling standard used

NOTICE

These are notes that provide you with information regarding particularities of a device or a software function.

WARNING

Warning!

A warning lets you know about specific or potential hazards. It is intended to protect you from accidents and help prevent damage to devices and systems.

- **Please read and follow the warnings carefully!**
  Failure to do so may negatively impact the safety functions and cause a hazardous state to occur.

Menus and commands

The names of software menus, submenus, options, and commands, selection fields, and windows are written in **bold font**. Example: Click on **Edit** in the **File** menu.

2 SAFETY

This section is intended to support your safety and the safety of the system users.

➡ Please read this section carefully before you work with a samos® PRO system.

2.1 Qualified persons

A samos® PRO system may only be installed, configured, commissioned, and serviced by qualified persons.

Qualified persons are those who

- have suitable technical training **and**
- have been trained by the machine operator in the operation and applicable safety guidelines **and**
- have access to the samos® PRO system manuals and have read them and duly noted their contents.

2.2 Proper use

The samos® PLAN 6 software is used to configure a safety controller comprising modules from the samos® PRO device family.

The samos® PRO system may only be operated by qualified persons and may only be used on a machine on which the hardware and software have been installed and commissioned for the first time by a qualified person in accordance with the software and hardware manual.

WARNING

Any other use or any changes to the software or the devices – including within the scope of installation – shall nullify any kind of warranty claim against Wieland Electric GmbH.

- Follow the safety instructions and implement the protective measures described in the software and hardware manual!
- When implementing safety-relevant control logic, ensure that the regulations of national and international standards are adhered to, particularly the control strategies and measures for reducing risk that are prescribed for your application.

NOTICE

Please follow the standards and guidelines which apply in your country when installing and using a samos® PRO system.

NOTICE

The national and international legal regulations apply to the installation and use of the samos® PRO safety controller as well as for commissioning and repeated technical testing, particularly the following:

- Machinery Directive 2006/42/EC,
- EMC Directive 2014/30/EC,
- Work Equipment Directive 2009/104/EC and the supplementary directive 35/63/EC,
- Low-Voltage Directive 2014/35/EC, and
- The accident prevention regulations and safety rules.

NOTICE

The software and hardware manual must be made available to the operator of the machine on which a samos® PRO system is being used. The machine operator must be trained by a qualified person and required to read the manuals.

2.3 Overview safety and security mechanism

As the software for configuring and programming safety controllers, samos® PLAN 6 fulfills the pertinent requirements for safety products (e.g. normative requirements of IEC 61508).

Functional safety

In the area of functional safety (**Safety** aspect), the following mechanisms apply in samos® PLAN 6:

- Automatic review of the logic configuration for connection errors
  Further information: *Automatic logic check [ch. 6.3.4, p. 110]*
- Warning in the event of test pulse deactivation
  Additional information: *Parameter options for sensors and actuators [ch. 6.3.1.2, p. 98]*
- Blocking of functions if safety-relevant preconditions are not fulfilled
  Example: Verification is not possible until there are no more connection errors
- Default value ranges for configuration parameters
- Automatic calculation of the required CPU cycle time for the entire project
  (status bar on right)
  This means that you always can see the effects that your logic programming are having on the CPU cycle time.
- Checksums (CRC) for central safety-relevant project components:
  - CRC for the report
  - CRC for user-defined logic components

Access security

With regard to security samos® PLAN 6, also provides protection for project data in the following aspects:

- User administration that you can use to scale the access options to project content systematically.
  Important information in this context:
  - When you start working with samos® PLAN 6, define which user groups you want to set up with which access rights.
  - Change the default password for the previously set up user groups.

  Further information: *User administration [ch. 6.1.6, p. 84]*
- Password protection for user-defined libraries.
  You can precisely determine who can view or change the components you have developed yourself.
- Encryption of project files
  Project files cannot be read or evaluated without the samos® PLAN 6 software.
  Those who do not have the appropriate user rights or password cannot open project files, even using samos® PLAN 6.
- Password-protected connection to hardware modules in the samos® PRO device family
  Further information: *Connecting to the safety controller [ch. 6.7, p. 131]*

3 VERSION, COMPATIBILITY, AND FEATURES

There are different module versions of the controller modules that enable different station capabilities. A station capability could be the support of an extended module, a fieldbus protocol or a function library.

Table 2: Required controller modules and software versions for station capabilities

<table>
<tr><th>Station capabilities</th><th>From the build state of the controller module</th><th>Available in controller module variants</th><th>samos® PLAN 6 or later</th></tr>
<tr><td>Safe I/O modules
(SP-SDIO, SP-SDI)</td><td>A-01.xx</td><td rowspan="6">All</td><td rowspan="5">V1.0.0</td></tr>
<tr><td>CANopen</td><td>A-01.xx</td></tr>
<tr><td>PROFIBUS DP</td><td>A-01.xx</td></tr>
<tr><td>Standard I/O module
(SP-DIO)</td><td>C-01.xx</td></tr>
<tr><td>EtherCAT
(SP-EN-ETC)</td><td>C-01.xx</td></tr>
<tr><td>Extended security functions</td><td>E-01.xx</td><td>V1.2.0</td></tr>
<tr><td>Network (programming via Ethernet)</td><td>A-01.xx</td><td>SP-COP2-EN-x
SP-COP2-ENI-x</td><td>V1.0.0</td></tr>
<tr><td>Modbus TCP</td><td>A-01.xx</td><td rowspan="3">SP-COP2-ENI-x</td><td rowspan="4">V1.0.0</td></tr>
<tr><td>PROFINET IO</td><td>B-01.xx</td></tr>
<tr><td>EtherNet/IP</td><td>D-01.xx</td></tr>
<tr><td>Press functions</td><td>D-01.xx</td><td rowspan="5">SP-COP1-P-x
SP-COP2-EN-P-x
SP-COP2-ENI-P-x</td></tr>
<tr><td>Analog current measurement</td><td rowspan="3">F-01.xx</td><td rowspan="3">V1.3.0</td></tr>
<tr><td>Analog temperature measurement</td></tr>
<tr><td>Combustion technology</td></tr>
<tr><td>View and communicate internal values</td><td>F-01.xx</td><td>V1.3.5</td></tr>
<tr><td>Press functions, Analog current and temperature measurement, Combustion technology, View and communicate internal values</td><td>G-xx</td><td>All</td><td>V1.3.10</td></tr>
</table>

Info

- You can find the module version on the type plate of the modules.
- You will find the samos® PLAN 6 version in the *main menu [ch. 3.1, p. 17]*.
- The latest software version is available in the Internet at the following address www.wieland-electric.com.
- Newer modules are backwards-compatible, which means that each module can be replaced with a module having a higher module version.
- You can find the date of manufacture for a device on the type plate in the **S/N** field in the format <Product no.>yywwnnnnn (yy = year, ww = calendar week).

3.1 Version info

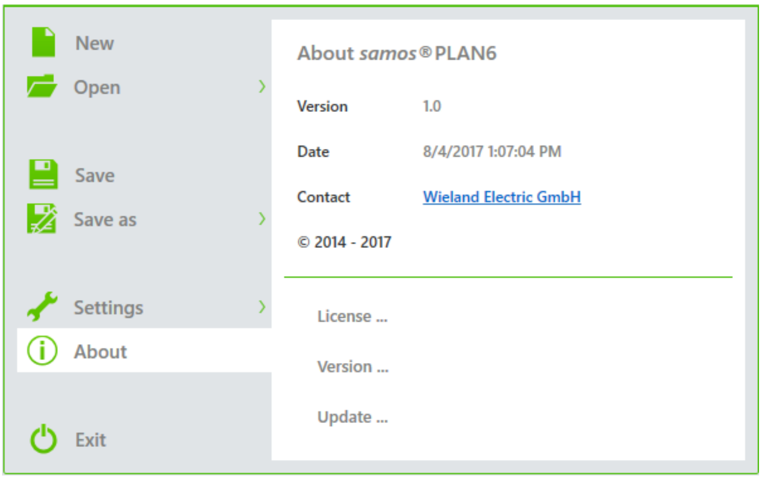
All changes in the current version of samos® PLAN 6 compared to previous versions can be viewed directly in the software in the **Version Information** window.

Activate

Main menu | About | Version

Example

Version information of samos® PLAN 6 1.0:



3.2 What's new in version 1.3.10 of samos®PLAN6?

Major changes at a glance: Read about the new features that the new version of samos® PLAN 6 has to offer.

samos® PRO COMPACT PLUS is now samos® PRO COMPACT BASIC.

The new version of the samos® PRO COMPACT BASIC variant (build state G-xx) also includes the functionality of the COMPACT PLUS variant. In the new version of samos® PRO COMPACT BASIC, you will find the following properties.

Table 3: Properties of the COMPACT BASIC variant

Characteristic	samos® PRO COMPACT BASIC	
	Build state F-01.xx and earlier	Build state G-xx
Basic safety functions	✓	✓
Integrated gateways	✓	✓
External gateways	✓	✓
Library for muting	✓	✓
Enhanced security	✓	✓
Display values in samos® PLAN 6		✓
Communicate values via gateways		✓
Library for presses		✓
Library for analog		✓
Library for combustion technology		✓

The required module and software versions can be found under *Version, compatibility, and features [ch. 3, p. 16]*.

4 INSTALLATION AND REMOVAL

4.1 System requirements

Recommended system configuration:

- Windows 7, Windows 8.1 or Windows 10
- 2.2 GHz processor
- 3 GB RAM
- 1280 × 800 pixels screen resolution
- 150 MB available hard drive space

The samos® PLAN 6 software is a .NET framework application. It requires .NET Framework version 4.0 or higher (you can find information on the current .NET Framework versions and supported operating systems on the Internet at http://www.microsoft.com/).

Microsoft .NET Framework version 4.0 or higher and any other required components can also be downloaded from http://www.microsoft.com/downloads/.

4.2 Installation

The installation files for samos® PLAN 6 can be found on the Internet at www.wieland-electric.com. We also provide the installation files on a USB stick in individual cases.

Use one of the following installation files, depending on the computer's operating system:

- 32-bit systems:
  samosPLAN6_%Version%_Setup.x86.msi
- 64-bit systems:
  samosPLAN6_%Version%_Setup.x64.msi

4.3 Update

The latest version of samos® PLAN 6 software can be downloaded from our website: www.wieland-electric.com

New software versions may contain new functions and support new modules of the samos® PRO device family.

If the software is being upgraded, the current version does not need to be uninstalled unless an earlier version is being installed.

4.4 Uninstalling software

Use the control system's uninstall function to uninstall the software.

4.5 Troubleshooting and eliminating errors

Table 4: Errors and error rectification

Error/error message	Cause	Elimination
This setup requires .NET Framework version 4.0 or higher. Please download the .Net installer from http://www.microsoft.com	Microsoft .NET Framework is not installed on the PC.	Install suitable version of Microsoft .NET Framework; contact your system administrator if necessary. .NET Framework is available for download on the Microsoft websites. **Note:** Install .NET Framework version 4.0 or higher.
This installer is intended for use on 64-bit operating systems. Please use the 32-bit installer from the manufacturer.	The 64-bit installer was used on a 32-bit computer.	Use the installer for the 32-bit computer.
This installer is intended for use on 32-bit operating systems. Please use the 64-bit installer from the manufacturer.	The 32-bit installer was used on a 64-bit computer.	Use the installer for the 64-bit computer.
Please remove the newer version before you install this one.	A newer version of the program has been installed on the computer.	Uninstall the installed software version

5 SAMOS® PLAN 6 GRAPHICAL USER INTERFACE

How is the graphical user interface of samos® PLAN 6 constructed? How does the new window layout support you, and which commands and options are available to you?

This chapter offers you a concise overview.

5.1 Overview of window layout

The user interface of samos® PLAN 6 is made up of a total of seven areas or window types:

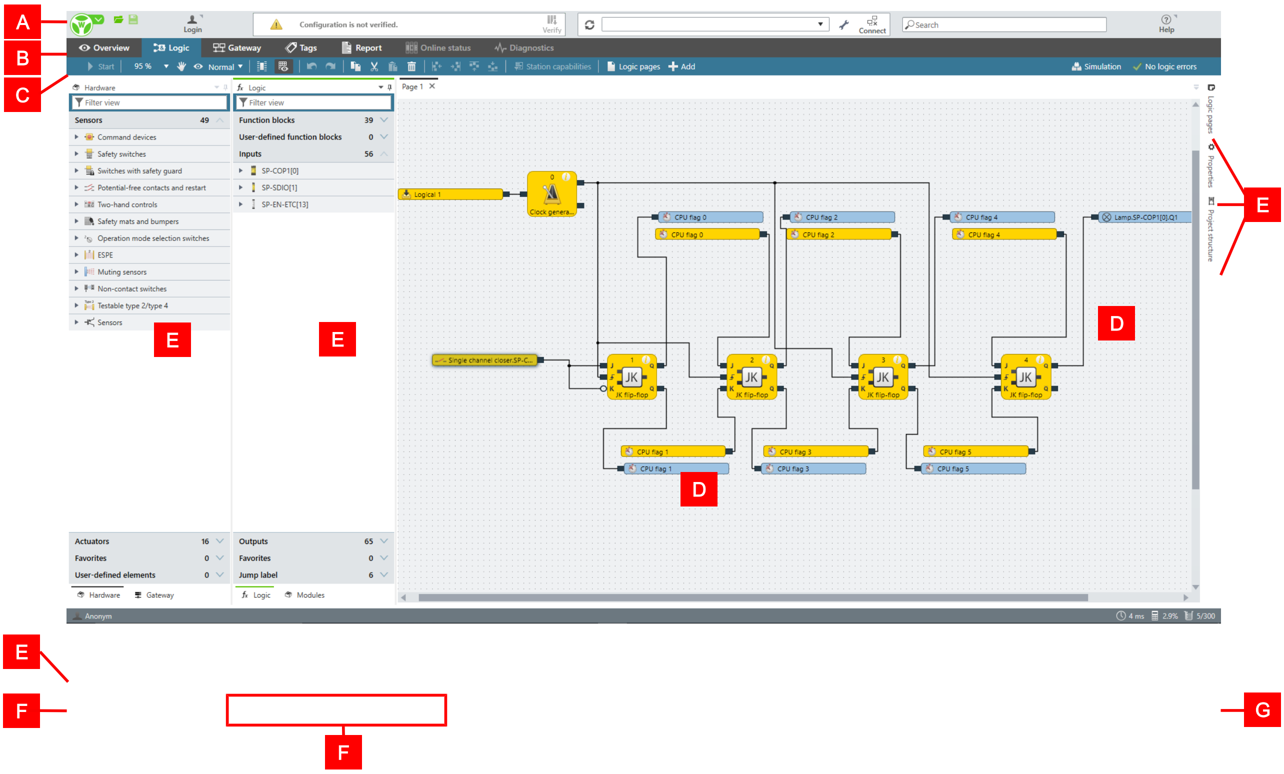


Illustration 1: User interface areas

Table 5: Key

Range	Description
A	**Menu bar** Settings and features across projects. Details: *Menu bar [ch. 5.2, p. 22]*
B	**Tab bar** Switching between the views that you can call up via the tabs.
C	**Command bar** Depends on the selected view: Available commands Details: *Views [ch. 5.3, p. 23]*
D	**Work area** Depends on the currently selected view: Graphical representation and configuration of the project content. Details: *Views [ch. 5.3, p. 23]*

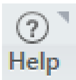
Range	Description	
E	**Docking window** Window with configuration or navigation function, which you can arrange either to the right and left of the work area. Details: *Docking window [ch. 5.4, p. 44]*	
F	**Status bar on left**	
	Anonym	User role with which the current user of samos® PLAN 6 is re-gistered. Further information: *Defining access rights (manage users) [ch. 6.1.6, p. 84]*
	1	Opens the **Notifications** window. It contains a history with all important activities of the user after the program start of samos® PLAN 6.
	Added module of type	Temporary display of notifications
G	**Status bar on right** Central status data about your target project:	
	4 ms	CPU cycle time resulting from your logic programming.
	0,0%	CPU usage as a percent
	0/300	Number of function blocks used

5.2 Menu bar

Regardless of which context you are working in: The menu bar of samos® PLAN 6 offers the following commands and features:

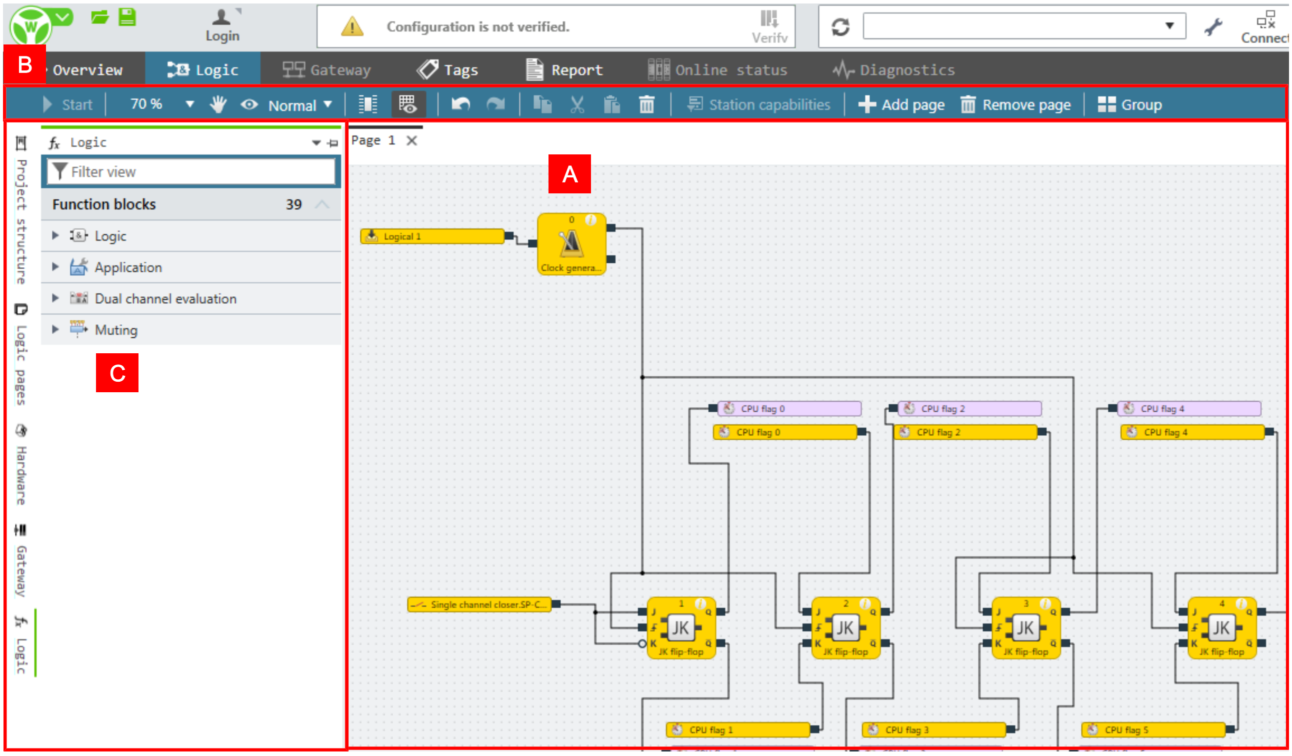
Table 6: Reference

Element	Description
	Main menu: This menu contains the basic functions and basic settings across projects. Setup in detail: *Settings and functions across projects (main menu) [ch. 5.9, p. 60]*
	This enables quick access to the following commands: **Open project** and **Save project**
Login	**User** menu: This enables logon with user and password. Further information: *User administration [ch. 6.1.6, p. 84]*
Configuration is not verified.	**Status display/text message** Displays status messages of the project currently open. The following messages concerning the verification status and the connection status of the project are permanently displayed as soon as they occur: • **Configuration has errors**: There are 1 or more logic components in the logic structure that do not have all their inputs connected (connection error). Further information: *Automatic logic check [ch. 6.3.4, p. 110]* • **Configuration is not verified:** There is no connection error in the configuration. However, the process of verification was not yet completed successfully. Further information: *Verifying the configuration [ch. 6.9.3, p. 136]* • **Configuration is verified:** The process of verification has been successfully completed.
Verify	**Verify** Starts the verification of your logic programming on the safety controller. Further information: *Verifying the configuration [ch. 6.9.3, p. 136]*
Falsify	**Falsify** Cancels a verification of the currently connected safety controller.
Test | 10.43.32.13	List **connection name** Shows a list of all safety controllers that are currently available or that you have manually set up in the **Edit** menu.
	Update Updates the list of **connection name**. Click on **Update**, if a controller connected to the PC via USB or Ethernet is not displayed.

Element	Description
	**Edit** menu Opens the dialog window in which you can manually add connections to safety controllers (manual address allocation).
	**Connect** Creates a connection to the safety controller, which you have selected under **Connection name**. Further information: *Connecting to the safety controller [ch. 6.7, p. 131]*
	**Disconnect** Only for an active connection to a safety controller: Disconnects the connection to the safety controller.
	**Search** This will initiate a search of the display names of all of the project components according to the character string entered. • The hit list will show all of the components whose display name contains the character string. • If you click on a hit, the **Properties** docking window shows the configuration for the selected object.
	**Help** Provides direct access to the support services of Wieland: • **Context-sensitive help** which opens in its own window (alternatively: **<F1>** key). • **What's New**: Quick start with the most important changes compared to the previous software version • **Open manual**: HTML help with full content of the three manuals (software, hardware and gateways) • Call-up of an Internet page from which the manuals for samos® PLAN 6 and samos® PRO (Hardware, Gateways) can be downloaded as PDF files. Further information: *Other relevant documentation [ch. 1.2, p. 12]* • Support request in the form of an automatically generated e-mail Further information: *Function description [ch. 5.3.5, p. 39]*

5.3 Views

The views in samos® PLAN 6 provide access to the different levels of a samos® PLAN 6 project, for example the logic programming or the gateway configuration.



- Each view provides you with an individually designed work area **[A]** and is equipped with its own set of commands **[B]**.
- The views are placed in the center of the samos® PLAN 6- interface, in the so-called work area. You can freely position the docking window **[C]** around the views.

What you will read below

This section gives you a brief overview of the views. Which tasks do you handle in which view? And which docking window do you need to perform the respective work steps?

5.3.1 "Logic" view

The **Logic** view in samos® PLAN 6 visualizes the logic programming of your project in the form of a graphical interface.

In the **Logic** view, you can connect sensors, actuators and function blocks with one another and thus program the complete functional logic with the assistance of the configurable parameters.

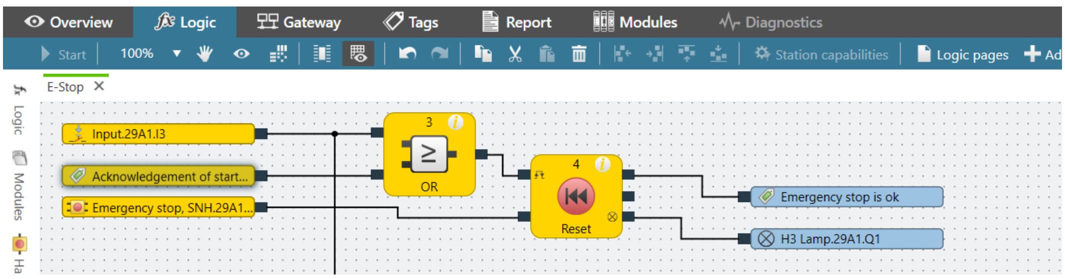
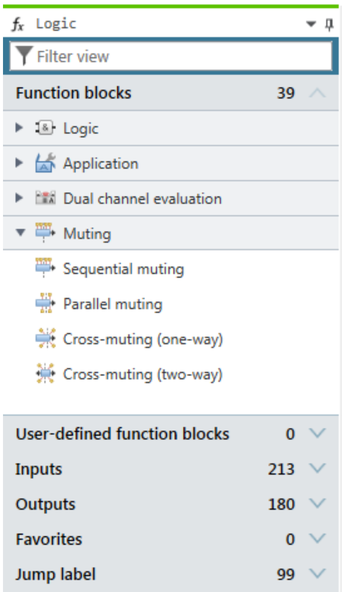
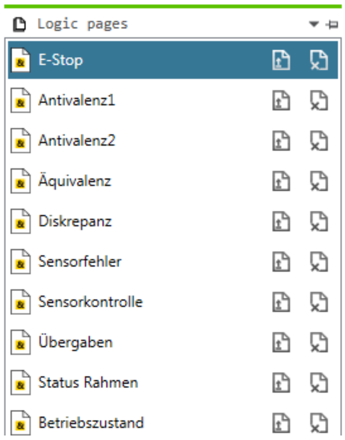
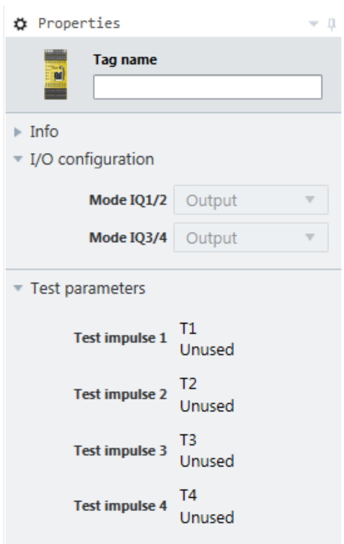


Illustration 2: Example for a logic configuration in the "Logic" view

If you require very extensive functional logic you can distribute the programming over several pages.

Required docking windows

When you are working in the Logic view you usually need the following docking windows:

<table>
<tr><th>Docking window</th><th></th><th>Function</th></tr>
<tr><td>Logic</td><td>
</td><td>Library of the function blocks or inputs and outputs, from which you program the control logic.
Further information: "Logic" docking window [ch. 5.4.6, p. 51]</td></tr>
<tr><td>Logic pages</td><td>
</td><td>Page management for the Logic view
• Call up pages.
• Toggle between pages.
• Delete pages.
• Open and close pages.
• Add new pages.
Further information: "Logic pages" docking window [ch. 5.4.7, p. 52]</td></tr>
<tr><td>Properties</td><td>
</td><td>Properties docking window
• Configure properties of logic elements.
• Renaming logic pages.
• Enter the content for the logic page report.
Further information: "Properties" docking window [ch. 5.4.2, p. 47]</td></tr>
</table>

Command bar and keyboard commands

In the **Logic** view, you have the following view-specific commands and features available:

Table 7: Reference

Element	Function
	Only with a connection to the controller: Stops the controller.
	Only with a connection to the controller: Starts a stopped controller.
	Scales the display in the work area. Keyboard command: **Ctrl** + <mouse wheel>
	Activates/deactivates the drag mode in the work area. Mouse operation: Keep the mouse wheel pressed down and move the mouse in the desired direction.
	Opens the **Overview** tab in the **Logic** view alongside the tabs that are already open. Further information: *Visualizing the logic programming [ch. 5.3.1.1, p. 30]*
	Opens the **Matrix** tab in the **Logic** view alongside the tabs that are already open. Further information: *Visualizing the logic programming [ch. 5.3.1.1, p. 30]*
	Activates/deactivates the marking of inputs and outputs.
	Activates/deactivates the grid points on the pages in the work area.
	Makes the last action undone (undo).
	Redoes the action that was recently undone (redo).
	Copies the currently selected project component. Keyboard command: **Ctrl + C**
	Cuts the currently selected project component. Keyboard command: **Ctrl + X**
	Inserts a copied or cut project component into the currently open page of the work area. Keyboard command: **Ctrl + V**
	Deletes the current selection in the work area. Keyboard command: **Del**
	If you have selected several elements: Align the elements selected jointly on the plane of the **Logic** view. Keyboard command: **Alt** + <up arrow key> or **Alt** + <down arrow key>
	Only with activated automatic module configuration: Opens the dialog window for configuring the station capabilities. Further information: *Activating automatic module configuration [ch. 6.1.2.2, p. 79]*

Element	Function
Logic pages	Opens the Explorer for logic pages. This has the same function as the **Logic pages** docking window. Further information: *"Logic pages" docking window [ch. 5.4.7, p. 52]*
	Adds a new logic page.
Simulation	Starts simulation mode. Further information: *Simulating logic programming [ch. 6.6, p. 124]*
No logic errors	Indicates whether there is a logic error (connection error). Further information: *Automatic logic check [ch. 6.3.4, p. 110]*

Context menu for logic elements

The context menu for logic elements contains the following commands and functions (selection):

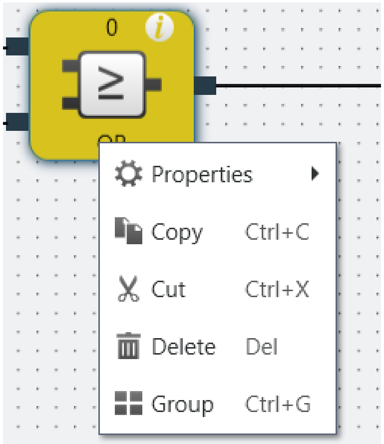


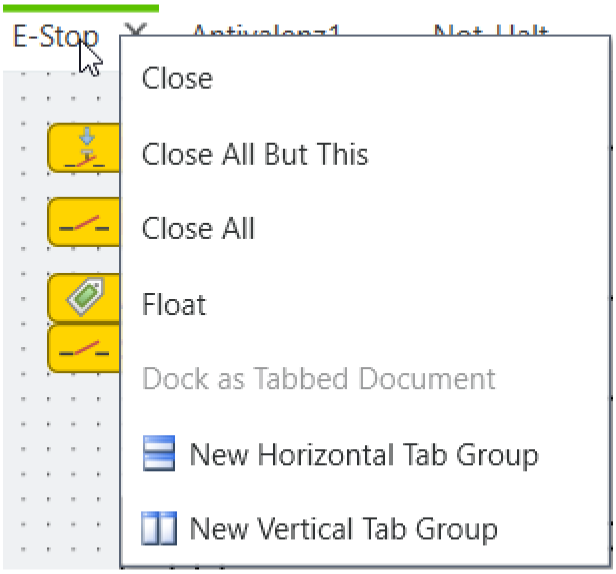
Table 8: Reference

Element	Function
Properties	Opens the Properties docking window for the selected logic element directly in the context menu.
Grouping	Groups together multiple function blocks selected in the work area to produce one complex switching logic. • You can only group function blocks. • Grouped function blocks are shown as an abstract element (black box) on the pages of the logic editor. The content of the grouping can be seen in editable form on its own page in the working area. From there, you can further edit and parameterize the interconnection. • You can save a grouping as a user-defined function block directly from this grouping page. • You will find the command to cancel a grouping in the context menu. Keyboard command: **Ctrl + G** Further information: *Creating and managing user-defined function blocks [ch. 6.3.5.2, p. 114]*
Cancel or undo grouping	Cancels a grouping from two or more function blocks.

Context menu for logic pages

You can use the context menu for the logic pages to adapt the working area to your individual requirements. You can:

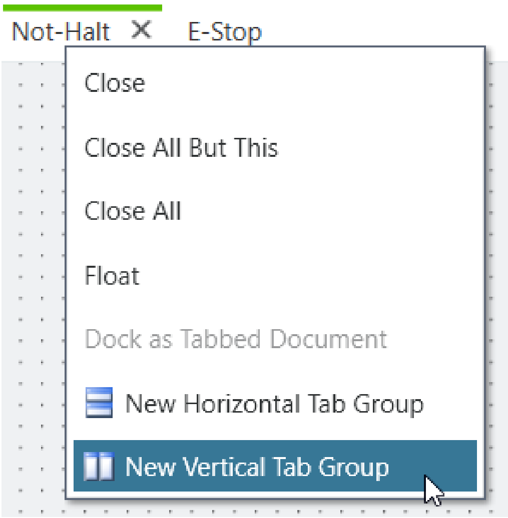
- Close individual or multiple tabs.
- Divide the working area into several windows using tab groups to display logic pages next to or above one another.



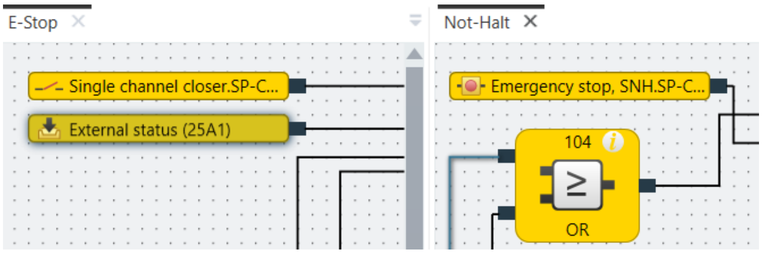
Example 1: You want to display two logic pages next to one another

➡ Open the two relevant logic pages in the working area.

➡ Click the first tab with the right mouse button and select the **New vertical tab group** command.



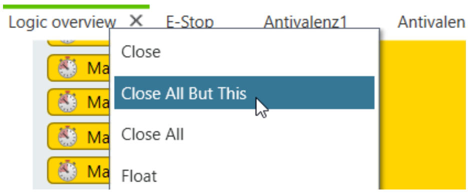
⇨ The two logic pages are displayed next to one another in the working area.



Example 2: You want to display the "Matrix" and "Overview" views next to one another

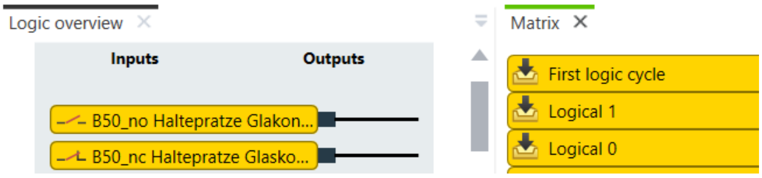
- ➡ Click the **Display logic overview** command in the command bar:

  - ⇨ The **Overview** view opens in another tab with the designation **Logic overview**.
- ➡ Select the **Close all except this** command in the context menu of the **Logic overview** tab.



  - ⇨ The **Logic overview** tab is the only tab that remains open in the working area.
- ➡ Click the **Display logic matrix** command in the command bar:

  - ⇨ The **Matrix** view opens in an additional tab.
- ➡ Select the **New vertical tab group** command in the context menu of the **Logic overview** tab.
- ⇨ You can view the **Overview** and **Matrix** views in parallel.



Visualizing inputs and outputs

You can differentiate between secure and non-secure IOs using the color scheme. The report also uses these colors:

	safe input	safe output	Standard input	Standard output
0 (Low)				
1 (High)				

- 0 (Low): **Offline**, **Not simulated**, **Simulated and inactive** or **Online and inactive** state
- 1 (High): **Online and active** or **Simulated and active** state

Simulation mode

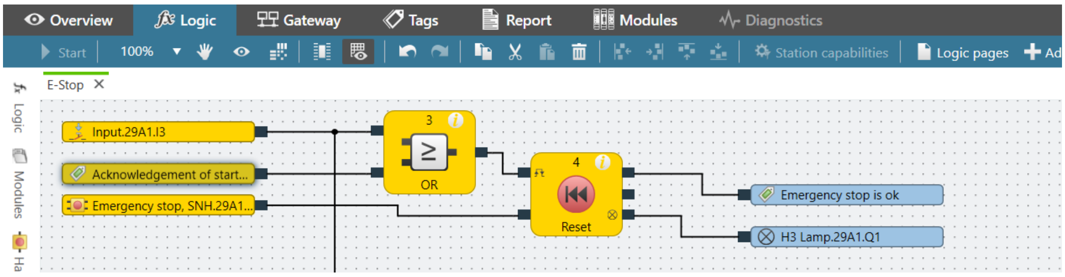
Once the logic programming is complete (error-free), you can test this via the simulation mode of samos® PLAN 6.

You can obtain additional information on this topic here: *Simulating logic programming [ch. 6.6, p. 124]*

5.3.1.1 Visualizing the logic programming

In order to ensure an optimal overview in extensive projects, you can visualize the logic programming in samos® PLAN 6 in three different ways.

The logic pages and all project components are displayed in the **Logic** view by default. On the logic pages, you can place and configure the project components or combine them with one another.



You can use two other types of visualization in addition to the analytical visualization on the logic pages. They open as additional tabs in the **Logic** view when you click the corresponding buttons:

Element	Function
	Opens the **Overview** tab.
	Opens the **Matrix** tab.

"Overview" tab

This tab shows all of the inputs and outputs, per page, that you use in logic programming. The logical links (logic components and connections) are shown in abstract as a black box.

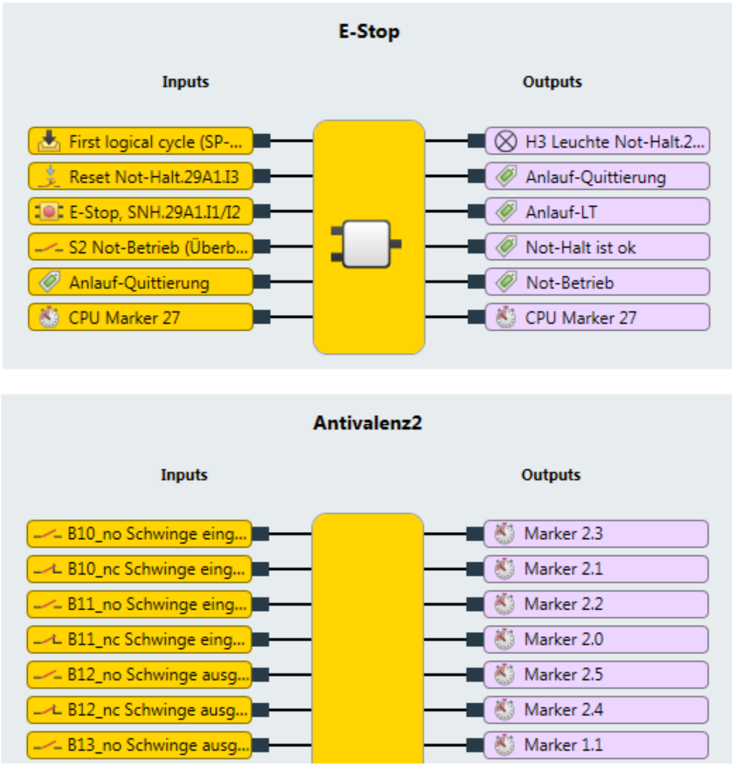


Illustration 3: "Overview" view

"Matrix" tab

This tab shows you a detailed view as to which inputs act on which outputs. This will help you in checking whether your logic programming is complete.

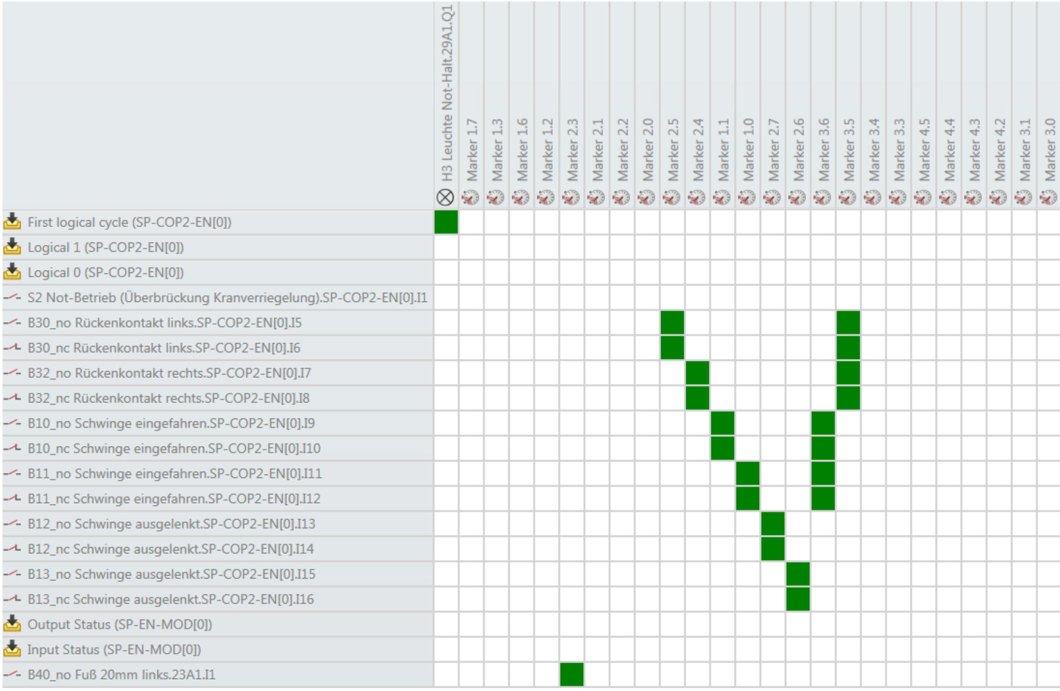


Illustration 4: "Matrix" view

You can determine the relationship of inputs and outputs using the color marking of the matrix intersections:

Table 9: Color key

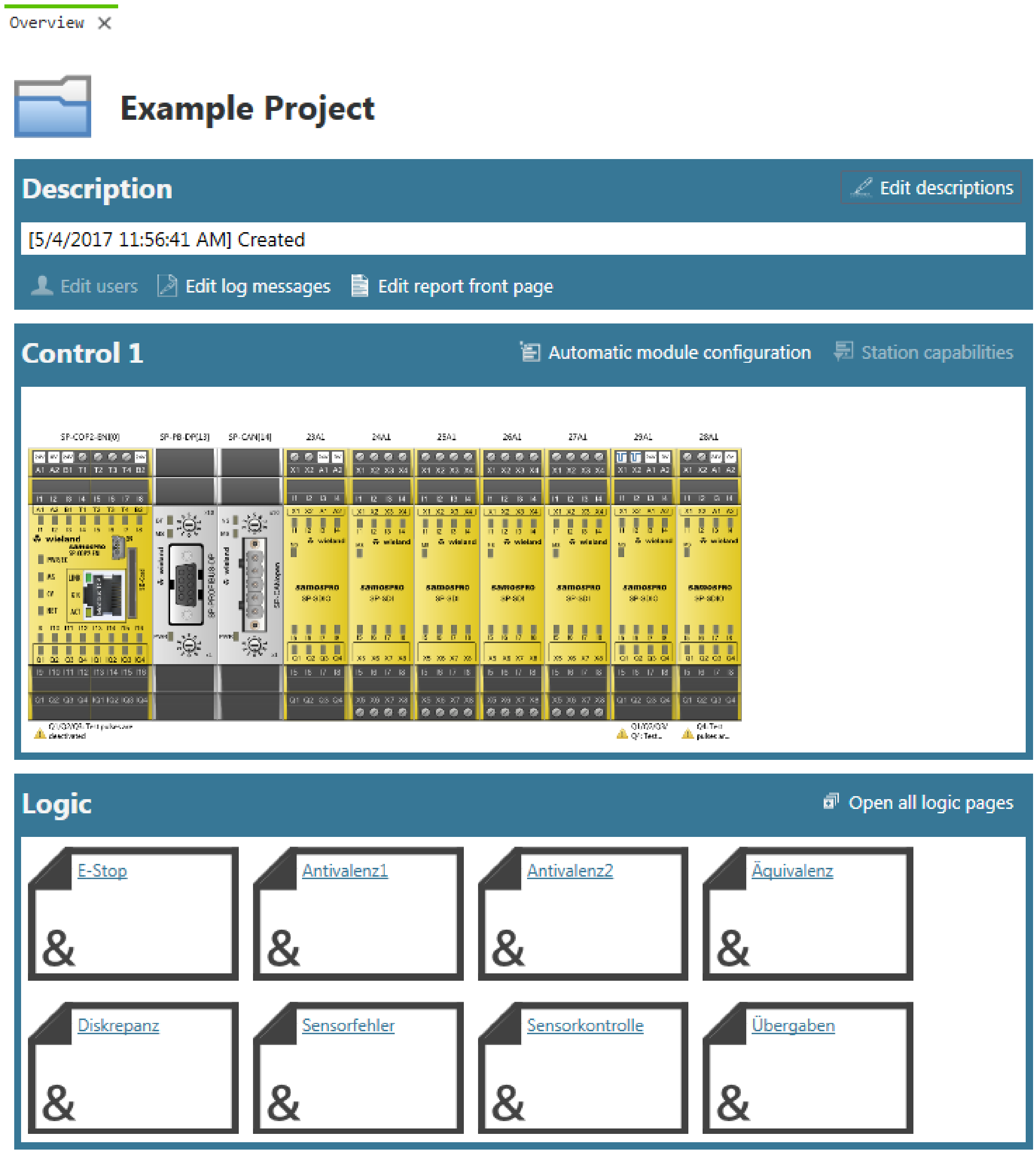
Marking	Explanation
Green intersection	Input (line) acts on output (column)
White intersection	No logical relationship between input and output

5.3.2 "Overview" view

The **Overview** view is a sort of organization center for your samos® PLAN 6 projects.

When you open an existing project

When you open an existing project, the **Overview** view offers a quick overview of the project type, e.g. which modules are being used or how the logic programming is organized.



When you create a new project

When you create a new project in samos® PLAN 6, you can define the basic settings for the project using the **Overview** view.

See here for more detailed information: *Setting up a project [ch. 6.1, p. 77]*

Features and commands

In the **Overview** view, the following view-specific commands and features are available:

Table 10: Reference

Element	Function
Edit users	Opens the user administration. Only active if you have the corresponding user rights. Details: *User administration [ch. 6.1.6, p. 84]*
Edit log messages	Opens an editor, via which you can define log messages for your samos® PLAN 6 project. Details: *Defining log messages [ch. 6.1.5, p. 83]*

Element	Function
Edit descriptions	Opens a dialog window, in which you can store descriptive information about a project. This information is also included on the front page of the project report. Details: *Storing project descriptions [ch. 6.1.3, p. 81]*
Edit report front page	Opens a dialog window, in which you record data, which additionally appears on the report front page as a project description. Details: *Storing company data for the report front page [ch. 6.1.4, p. 82]*
Automatic module configuration	Switches between both available module configuration modes: • Button active: Automatic module configuration is set. • Button inactive: Manual module configuration is set. Details: *Defining the mode for module configuration [ch. 6.1.2, p. 79]*
Station capabilities	Only active with automatic module configuration: Enables presets for central performance features of the controller, for connectivity, for example, for network communication and for the desired connection type of modules. samos® PLAN 6 takes these presets into consideration in the choice of suitable modules.
Open all logic pages	Switches to the **Logic** view and opens all logic pages.

5.3.3 "Gateway" view

You can find extensive information regarding the **Gateway** view here:

Gateway manual, Chapter "Configuration of gateways with samos® PLAN6"

5.3.4 "Tags" view

The **Tags** view contains a list of all project components. Here, you can configure the designation of the project components on the samos® PLAN 6 interface.

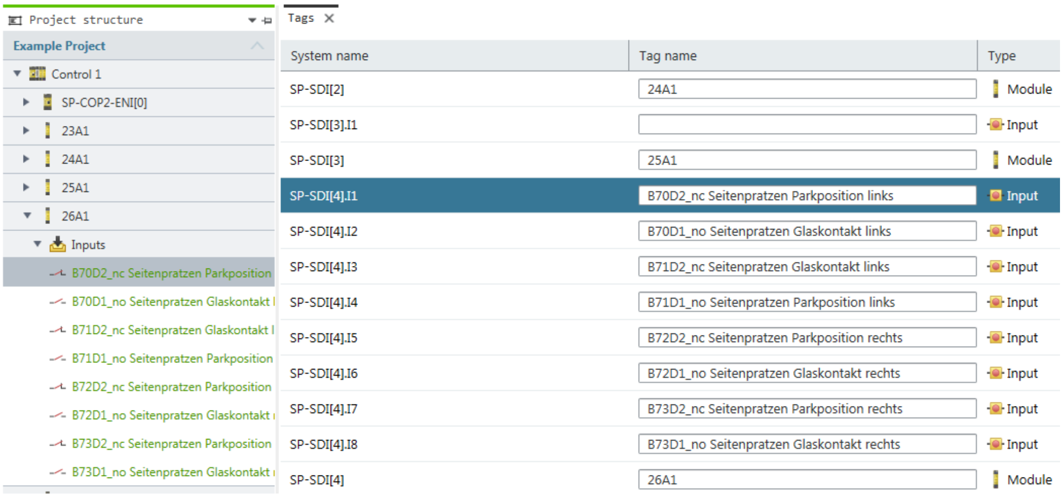
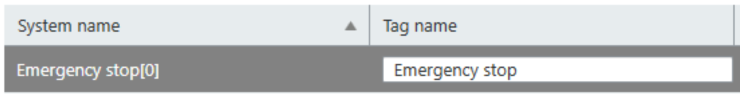


Illustration 5: Work area in the "Tags" view

Function

- **Requirement**
  To individually configure the names, you have to use the **Tag** element in the naming scheme. You define the naming scheme in the overall settings for the software: *Configuration of display names [ch. 5.9.2, p. 63]*
- **Effect**
  The effect your entries have on the designation of the project components depends on where you position the **Tag** element in the naming scheme.
  If you have a single-digit display name, a tag name will overwrite the entire display name. If you have a multi-digit display name, a tag name will only overwrite the component of the display name that you have explicitly defined as a tag name in the main menu (see *Configuration of display names [ch. 5.9.2, p. 63]*).

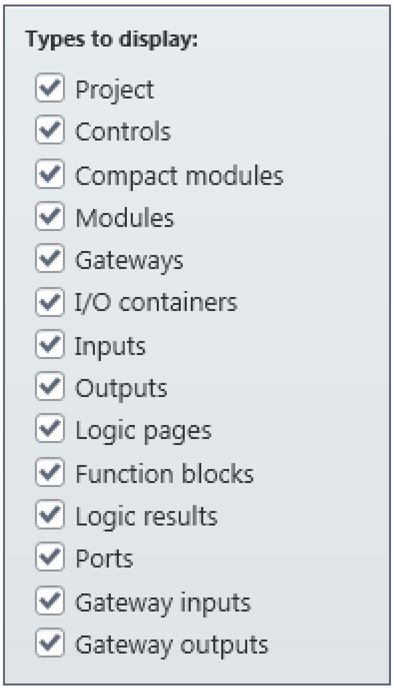
Table 11: Examples

Example	Explanation
Names of pages	Pages have a single-digit display name. As standard, it is constructed using the template "page + <number of page>":  If you overwrite the tag name, the new display name will correspond precisely to your input: 
Names of inputs	By default the display name of inputs consist of 3 digits together.  When you assign a tag name, only the digit that is defined as a tag name will change. Here is an example using the first digit: 

Command bar

In the **Tags** view, you have the following view-specific commands and features available:

Table 12: Reference of commands and features

Element	Function
	This enables the export or import of the display names defined here. Thus, you can also use your specifications in other projects.
	This reduces the display in the work area to the selected types of project components. 

5.3.5 "Report" view

The **Report** view contains full information regarding the currently loaded project and all of the settings, including logic programming and wiring diagrams.

All information can be saved in standard file formats and printed. The scope of the report can be individually compiled depending on the selection.

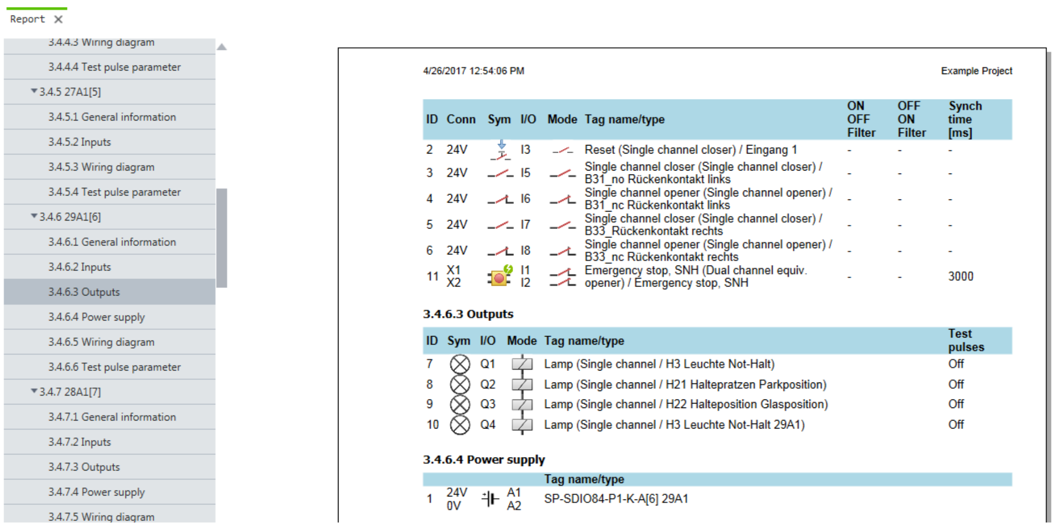


Illustration 6: Example of the "Report" view

Design

On the right of the work area you can see the content of the report.

All of the content is automatically compiled from your project configuration.

- You are not able to manually change the detailed content of the report.
  You can only determine which of the potential sections in the report will be generated.
- The front page of the report can be configured the most. In the **Overview** view you can store company and project data, which is automatically included on the report front page.
  Details: *Storing project descriptions [ch. 6.1.3, p. 81]*, *Storing company data for the report front page [ch. 6.1.4, p. 82]*

On the left, next to the report, you can see the breakdown of the report document. You can switch between sections by clicking on the corresponding entry in the tree view.

Command bar

The command line provides the following commands and features:

Table 13: Save, Print and Display functions

Element	Function
	Saves the report as a PDF file.
	Saves the report as an XML file.
	Opens the report with the default program for PDF files on your computer.
	Opens a dialog window that you can use to send the report to a printer.

Table 14: Configuration of the report

Element	Function
	Opens a dialog in which you can define which section the report should contain.
	Updates the structuring of the report after you have changed the chapter structure.

Table 15: Navigation and scaling

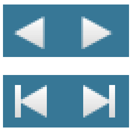
Elements	Function
	Enables navigation within the report: • From page to page • To the first page or to the last page of the report
	This determines the size of the display in the work area.

Table 16: Support request

Elements	Function
	Generates an e-mail that is addressed directly to Support at Wieland. **Note** You can define what information is processed in the email. Possibilities are: • Pure text messages • Current report from samos® PLAN 6 • File of the project currently open

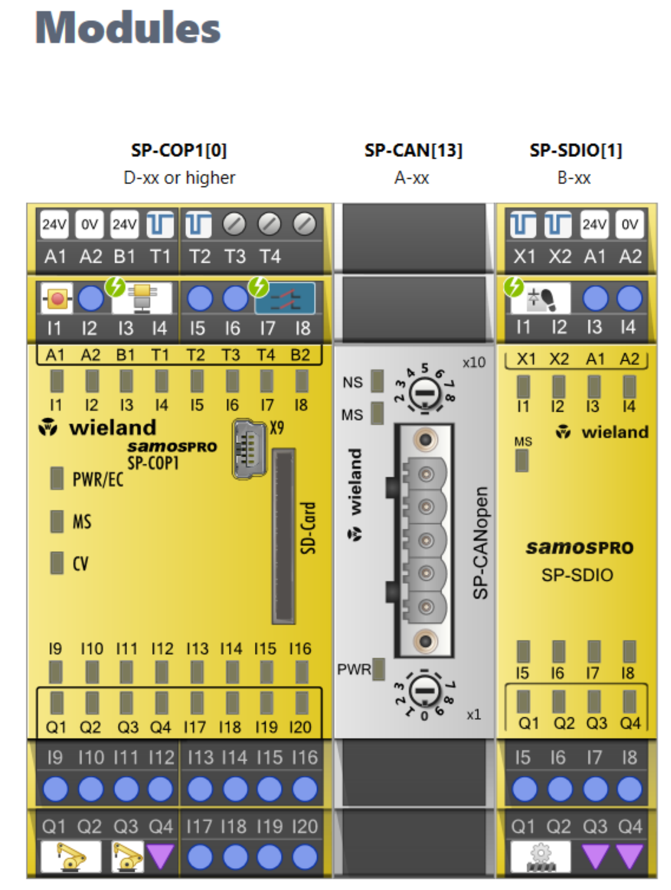
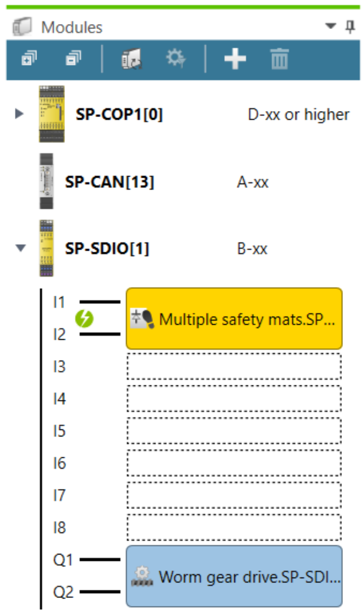
5.3.6 "Modules" view

The **Modules** view shows the current hardware configuration of your safety controller. All modules are displayed in a graphic illustration in the correct sequence. The sensors and actuators you selected are assigned to the outputs and inputs.

You can use the **Modules** view to …

- view the current hardware configuration of a project in a graphic presentation,
- assign sensors and actuators to inputs and outputs during manual module configuration,
- analyze the behavior of the modules when the controller is connected.

The content and functions of the **Modules** view are identical to those of the **Modules** docking window of the same name.

<table>
<tr><th>"Modules" view</th><th>"Modules" docking window</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Task bar in the "Modules" view

Table 17: Key

Element	Description
	**Automatic module configuration** Deactivates or activates the automatic module configuration.
	**Station capabilities** Only with automatic module configuration: Enables presets for connectivity, for network communication and for desired terminal type of modules.
	**Add module** Opens the **Add module** dialog, with which you can insert several modules at the same time.
	**Delete** Deletes the currently selected module. Note: A controller module can only be deleted when all other modules have been deleted.

Task bar in the main window

Table 18: Reference

Element	Function
	Only with a connection to the controller: Stops the controller.
	Scales the display in the work area. Keyboard command: **Ctrl** + <mouse wheel>
	Makes the last action undone (undo).
	Redoes the action that was recently undone (redo).

Behavior when controller is connected:

If a controller is connected, the status LEDs in the **Modules** view indicate the module status.

You can read how to create a connection to a safety controller here: *Connecting to the safety controller [ch. 6.7, p. 131]*

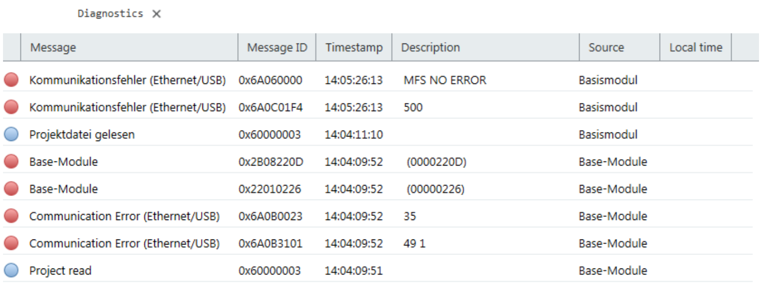
5.3.7 "Diagnostics" view

If you have connected a samos® PLAN 6 to a safety controller, the currently pending messages in this controller are automatically loaded in the **Diagnostic** view. Even if you disconnect the connection to the controller, the **Diagnostics** view remains active, as long as the associated samos® PLAN 6 project is open.

You can read how to create a connection to a safety controller here: *Connecting to the safety controller [ch. 6.7, p. 131]*

Design

The **Diagnostics** view is structured as a table. The following information is displayed in the columns:


Diagnostics

	Message	Message ID	Timestamp	Description	Source	Local time
	Kommunikationsfehler (Ethernet/USB)	0x6A060000	14:05:26:13	MFS NO ERROR	Basismodul	
	Kommunikationsfehler (Ethernet/USB)	0x6A0C01F4	14:05:26:13	500	Basismodul	
	Projektdatei gelesen	0x60000003	14:04:11:10		Basismodul	
	Base-Module	0x2B08220D	14:04:09:52	(0000220D)	Base-Module	
	Base-Module	0x22010226	14:04:09:52	(00000226)	Base-Module	
	Communication Error (Ethernet/USB)	0x6A0B0023	14:04:09:52	35	Base-Module	
	Communication Error (Ethernet/USB)	0x6A0B3101	14:04:09:52	49 1	Base-Module	
	Project read	0x60000003	14:04:09:51		Base-Module	

Table 19: Reference

Column	Description
	Severity level of the message: • Blue: Info • Orange: Warning • Red: Error
Message	Text title of the message
Message ID	Unique ID as a hexadecimal number throughout the system
Timestamp	Total operating time of the controller module when the message occurred
Description	Detailed information for the diagnostics
Source	Module that detected the error
Local time	Time at which the message occurred (system time of your PC) Further information: *Synchronize time for diagnostic purposes [ch. 6.10.3, p. 147]*

Info

NOTICE

If an error occurs, you can find additional information here:

- *List of all error messages, causes and aids [ch. 11.1, p. 408]* (Error codes, error causes and troubleshooting measures)
- Hardware manual

NOTICE

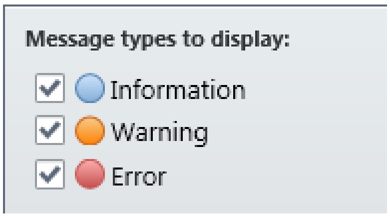
A maximum of 5000 of the latest error entries are automatically transferred to the samos® PLAN 6 from the safety controller.

If you want to transfer older error entries: Read in the **history.csv** file into samos® PLAN 6. This file is located on the SD card.

Command bar

In the **Diagnostics** view, the following view-specific commands and features are available:

Table 20: Reference of commands and features

Element	Function
	Stops the controller.
	Starts a stopped controller.
	Updates the list of messages in the work area for the connected safety controller.
	This opens a save dialog. From there you can save the message list of the work area as a CSV file.
	This reduces the list in the work area to the selected message types. 
	Deletes the entire list of diagnostic messages.

5.4 Docking window

Along with the view, in the docking window in samos® PLAN 6, central features are also available to you in window form.

This section gives you a brief overview of the docking windows. Which tasks do you handle in which window?

5.4.1 Individual window layout

You can arrange the docking windows individually around the work area of samos® PLAN 6 and show or hide them as required.

Many options

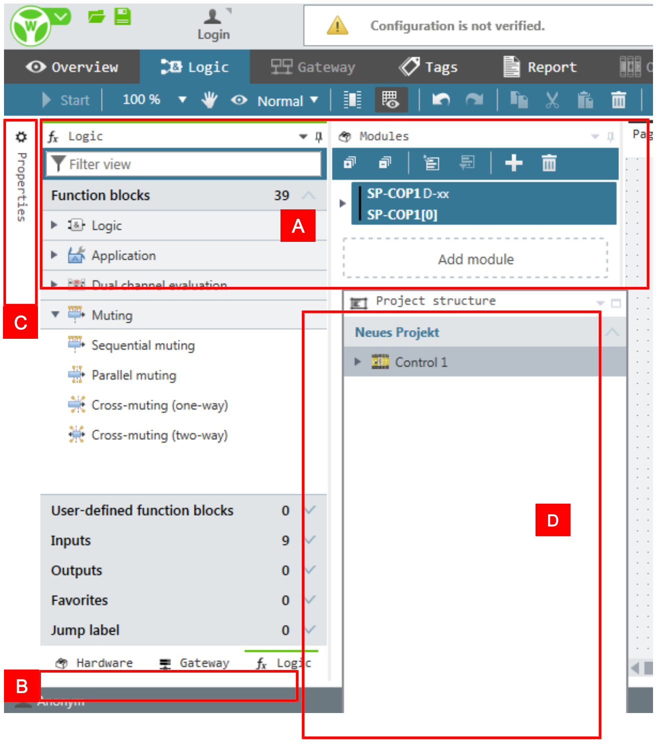
All of the following options are available for window arrangement. Docking windows: you can ...

A place them alongside each other.

B place them one behind the other as tabs.

C place them snapped shut on the left or right screen edge.

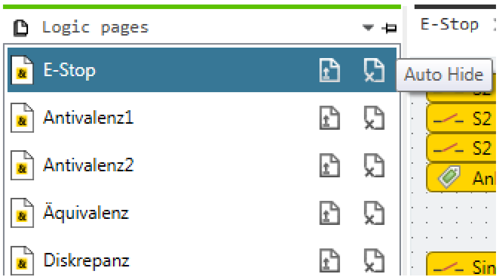
D docked, in order to spread them over several screens, for example.



Arrange docking window

To drag a docking window to a new position, proceed as follows:

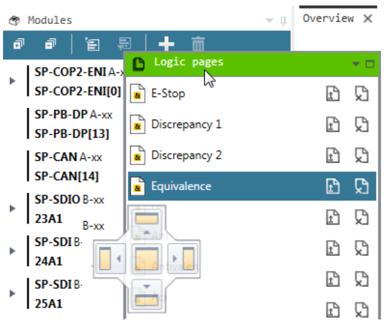
➡ If the docking window is not displayed, click on it and click on the **Pin** symbol (**Auto hide** function).



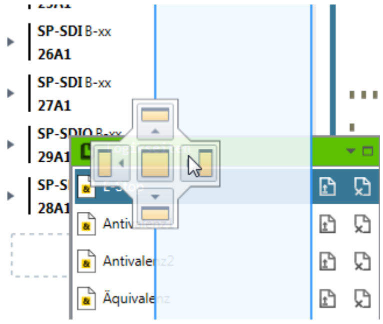
⇨ The docking window is permanently displayed.

➡ With the mouse, click on the green border right at the top of the window.

➡ Drag the window from its former position and keep the mouse button pressed.
Position markers which show you where you can move the window appear in the interface of samos® PLAN 6.



➡ Select the desired position by allowing the window to fall onto the corresponding position marker.



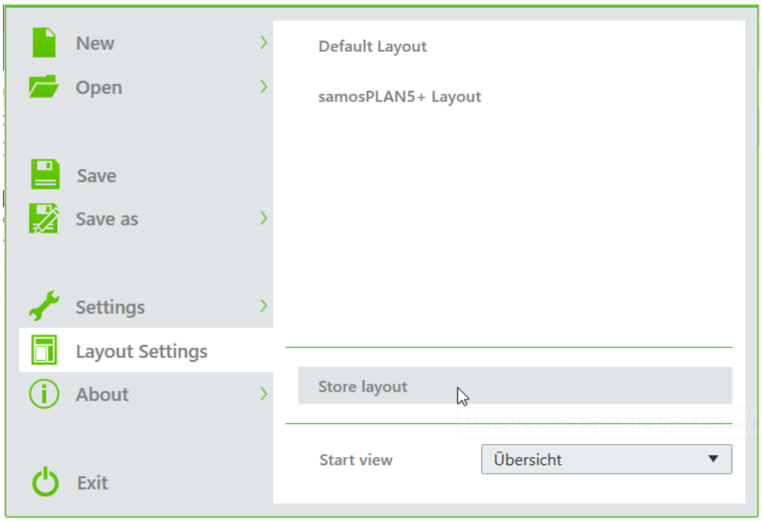
The window is displayed in the new position.

Save personal layout

You can use the save function to store the current window layout as a favorite and activate it as required.

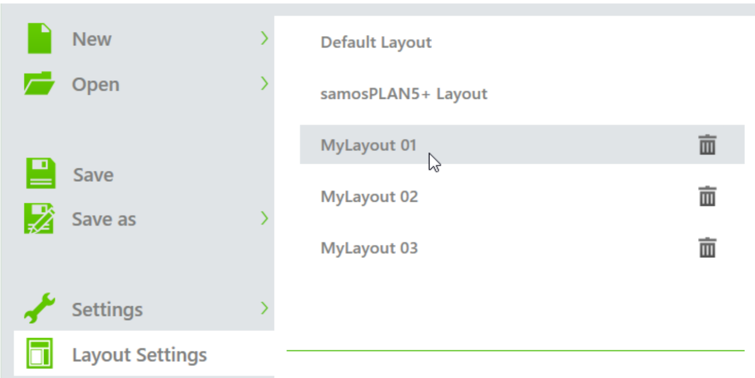
Activate

Main menu | Layout settings | Save layout



Function

- You can save multiple layouts.
  Examples: **MyLayout 01**, **MyLayout 02**, **MyLayout 03**
- Your personal layouts appear in the list of predefined layouts.
- When a layout is selected using the mouse, it is applied automatically and then becomes the standard layout after the samos® PLAN 6 is restarted.

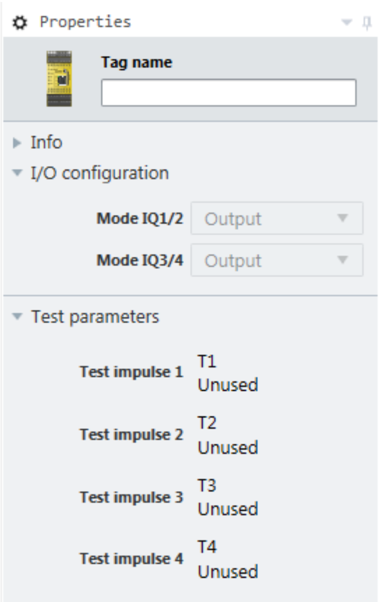


5.4.2 "Properties" docking window

The **Properties** docking window shows the configuration dialog of the element that you have currently selected in the work area or in another docking window. The contents of the configuration dialog varies depending on the element selected.

Example

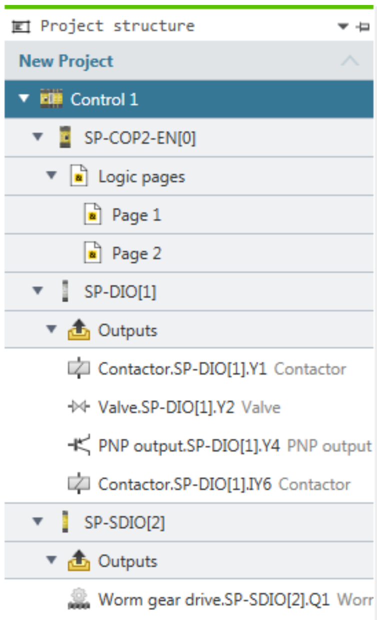
Configuration dialog for a controller module:



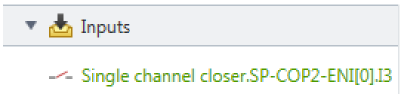
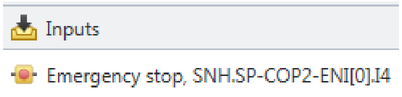
5.4.3 "Project structure" docking window

The **Project structure** docking window shows all components of a samos® PLAN 6 project as a hierarchical tree structure.

Using the drag-and-drop function, you can move the inputs and outputs resulting from the elements configured in the hardware into the **Logic** view.



Visualization

Example	Description
	**Input or output colored green** The elements is used on one or more logic pages.
	**Input or output without coloring** The element lies in a module as an input or output, but is not used in the logic.

Usage list

Right-clicking on an element highlighted in green brings up a usage list in the context menu:

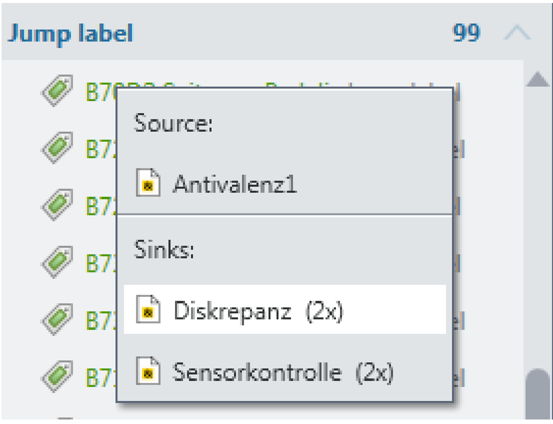


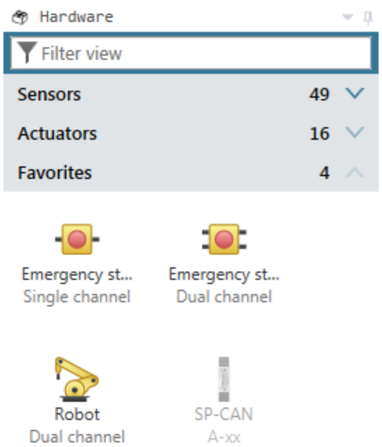
Illustration 7: Usage information on a jump label

The usage list documents how often an element is used in total, and on which pages of the **Logic** view the element is used. The usage list is available for inputs, outputs, jump labels and CPU flags.

Clicking on a source or target takes you directly to the corresponding point in the work area in the **Logic** view.

5.4.4 "Hardware" docking window

The **Hardware** docking window offers a library of all devices that you can use as sensors or actuators for your safety controller.



Further information: *Adding I/O elements [ch. 6.3.1, p. 94]*

5.4.5 "Modules" docking window

In the **Modules** docking window you can manually compile the samos® PRO module for your safety controller and make changes to the assignment of inputs and outputs.

NOTICE

With automatic module configuration

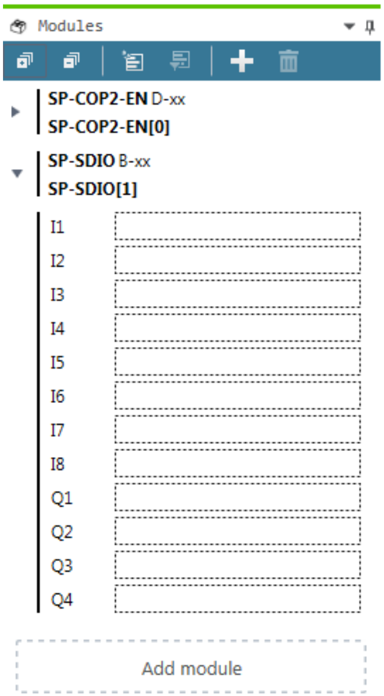
If you use automatic module configuration you can leave the module configuration completely to samos® PLAN 6. If required, in the **Modules** docking window, you can subsequently change the assignment of inputs and outputs.

Detailed information: *Automatic module configuration [ch. 5.7.2, p. 57]*

Example

One controller with two modules. The controller module is rolled up - the inputs and outputs are not visible. The I/O module is unrolled, so that all inputs and outputs are visible.

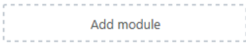
- The module is displayed with all inputs and outputs.
- The minimum version or type of each module that you will require to implement the controller with the other, planned modules or the control logic configured in the **Logic** view is shown on the right side of the module name.



Commands

Table 21: Key

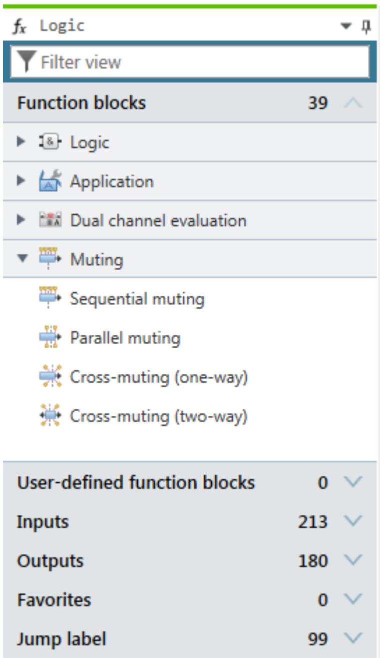
Element	Description
	**Expand all** Unrolls the list of inputs and outputs for all modules. You need this view if you want to equip the module with sensors and actuators with manual module configuration.
	**Collapse all** Collapses the list of inputs and outputs for all modules.
	**Automatic module configuration** Deactivates or activates the automatic module configuration.
	**Station capability** Only with automatic module configuration: Enables presets for connectivity, for network communication and for desired terminal type of modules.

Element	Description
 	**Add module** Opens the **Add module** dialog, with which you can insert several modules at the same time.
	**Delete** Deletes the currently selected module. Note: A controller module can only be deleted when all other modules have been deleted.

5.4.6 "Logic" docking window

You need the **Logic** docking window to drag all the function blocks or inputs and outputs into the **Logic** view for the functional logic of your safety controller.

Design



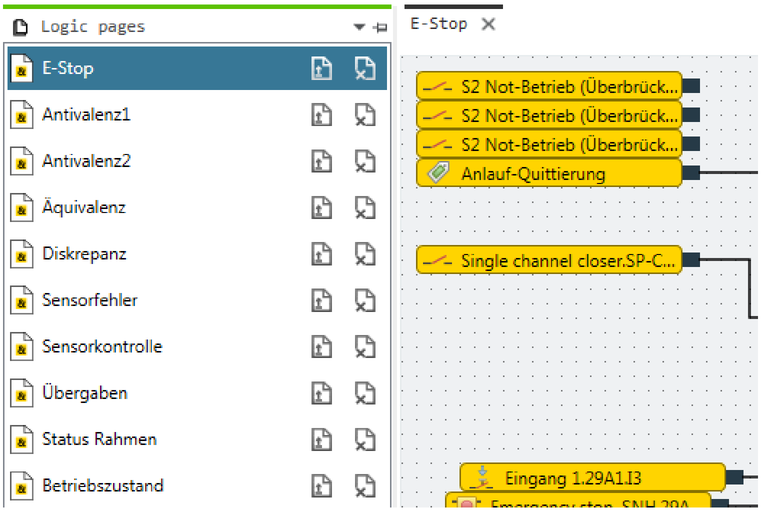
Description

Range	Description
Function blocks	Contains the library of all available function blocks. Only function blocks are selected which are permitted in conjunction with the functionality of the currently selected samos® PRO module.
User-defined function blocks	Allows you to install and select your own function blocks. Further information: *Creating and managing user-defined function blocks [ch. 6.3.5.2, p. 114]*
Inputs / outputs	Shows all inputs and outputs currently linked with sensors or actuators
Favorites	Allows you to define favorites for frequently required elements from the **Logic** docking window. Further information: *Favorites for hardware and logic [ch. 5.4.9, p. 53]*
Jump labels	Further information: *Jump addresses [ch. 6.3.1.4, p. 101]*

5.4.7 "Logic pages" docking window

The **Logic pages** docking window lists all pages which have been added in the **Logic** work area.

Design

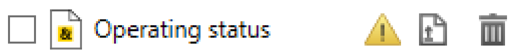


NOTICE

Display in alphabetical order

Logic pages are displayed in alphabetic order. The pages can be sorted individually by prefixing with a sequence of numbers (e.g. **01**_Xyz …, **02**_Abc…).

Commands and display options

Element	Description
	Selects all logic pages listed in the docking window.
	Opens the selected logic pages in the **Logic** view.
	Closes the selected logic pages in the **Logic** view.
	Deletes the selected logic pages, including the logic programming they contain.
	Adds a new logic page.
	Opens the selected page in the **Logic** view.
	**Error on logic page** Shows that on the associated logic page at least one input of a function block is not connected. Example: 

5.4.8 "Gateway" docking window

You can find detailed information regarding the **Gateway** docking window here:

Gateway manual, Chapter "Configuration of gateways with samos® PLAN 6"

5.4.9 Favorites for hardware and logic

You can create favorites for frequently used elements in the **Hardware** and **Logic** docking windows:

Procedure

➡ Click on the desired element with the right mouse key.
The context menu will open.

➡ Select **Add to favorites** in the context menu.

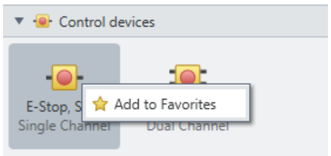


Illustration 8: Defining favorites via the context menu

Now you can select the element directly under **Favorites**:

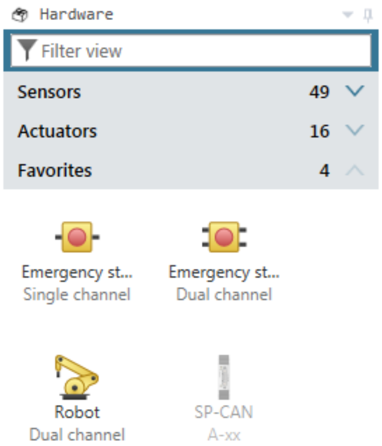
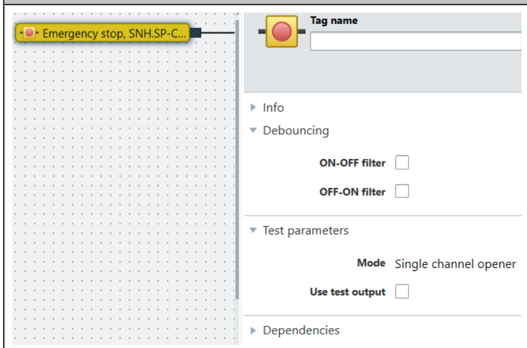
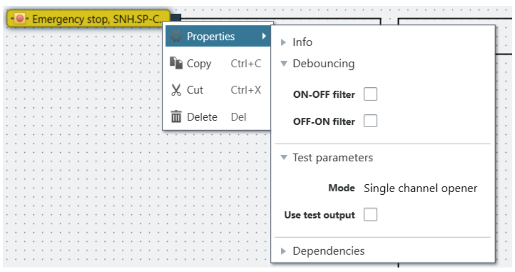


Illustration 9: Storage of the favorites in the “Hardware” and “Logic” docking windows

5.5 Configuring properties

You can configure properties for many of the project components in samos® PLAN 6.

The configuration dialog for properties is available at two locations. It has the same function at both locations:

In the "Properties” docking window	In the context menu
 Further information: *"Properties” docking window [ch. 5.4.2, p. 47]*	

Opening the configuration dialog

<table>
<tr><th>"Properties” docking window</th><th>Configuration dialog in the context menu</th></tr>
<tr><td>You can open the configuration dialog in the Properties docking window:
Use the mouse to select the desired project component and open the Properties docking window manually.
or
Use the mouse to select the desired project component and press the following key combination.
Alt + Enter
or
In the Logic and Modules views:
Double-click the desired project component with the mouse.</td><td>Use the right mouse button to select the desired project component.
Select the Properties entry in the context menu.</td></tr>
</table>

5.6 Commands

You can activate commands in samos® PLAN 6 in 3 ways:

- Mouse click on buttons
- Commands in the context menu
- Activate via keyboard

Frequently used commands

The following commands are effective in all views:

Table 22: List of frequently used commands

Command	Activate
Save currently open project	• Menu bar: **Save** • Keyboard: **<Ctrl> + <S>**
Creating a new project	• **Settings** menu: **New** • Keyboard: **<Ctrl> + <N>**
Undo last action	• Command bar: **Undo button** • Keyboard: **<Ctrl> + <Z>**
Redoing an action that was undone	• Command bar: **Redo button** • Keyboard: **<Ctrl> + < Y>**
Delete a selection in the work area	• Context menu: **Delete** • Keyboard: **<Del>**
Change the size of the display in the work area	• Keyboard: **< Ctrl >+ <mouse wheel>**
Search	• Menu bar: **Search** • Keyboard: **<Ctrl> + <F>**
Open help	**Get Context-sensitive help:** (You must have selected an object from the samos® PLAN 6 interface using the mouse.) • Keyboard: **<F1>** **Access to all Help functions:** • Menu bar: **? Icon**

5.7 Module configuration options

In samos® PLAN 6, you have two options for selecting and configuring the modules required for safety controllers. You use either automatic module configuration or you decide to use (classic) manual module configuration.

5.7.1 Manual module configuration

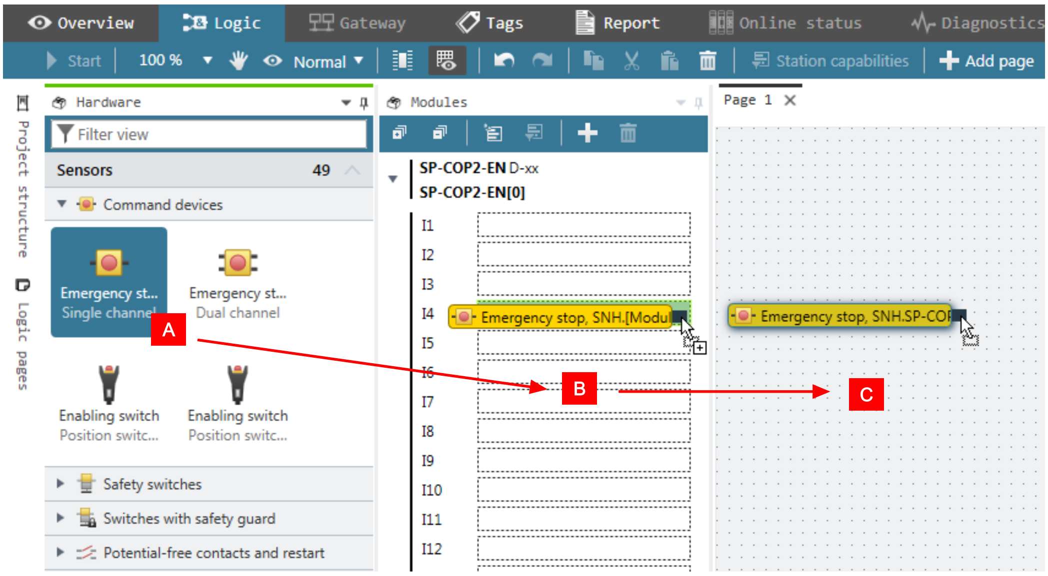
During manual module configuration, you can develop the hardware of your safety controller. First you chose the desired module, assign the inputs and outputs as required, with sensors and actuators, and finally model the logic.

Quick programming: With a single mouse click from the hardware through to the logic

The variable window layout samos® PLAN 6 provides optimal assistance for the hardware-driven approach. If you arrange the windows as shown in the following illustration:

The docking windows **Hardware**, **Modules** and the **Logic** view are located directly next to each other.

Now you can drag sensors and actuators from the library [A] to the corresponding module output or input [B] and the **Logic** [C] view with a single movement of the mouse.



As you can see, for example: After just one operation, the selected sensor lies under **Modules** on the input of your choice and is ready for configuration at the same time in the **Logic** view.

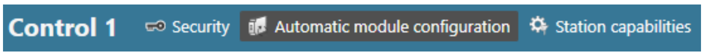
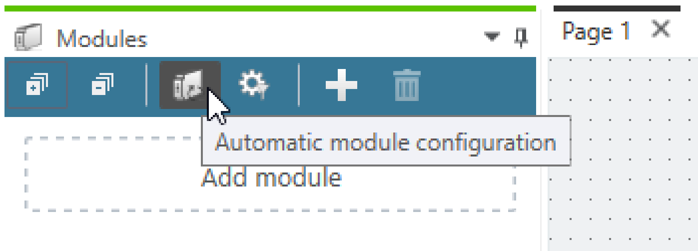
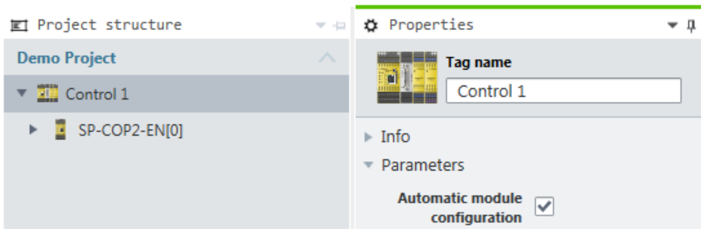
5.7.2 Automatic module configuration

Unlike manual module configuration, automatic module configuration supports a logic-driven approach. The module configuration of samos® PLAN 6 virtually runs on "autopilot": You model the logic directly and exclusively – and samos® PLAN 6 automatically assembles the required modules in the background.

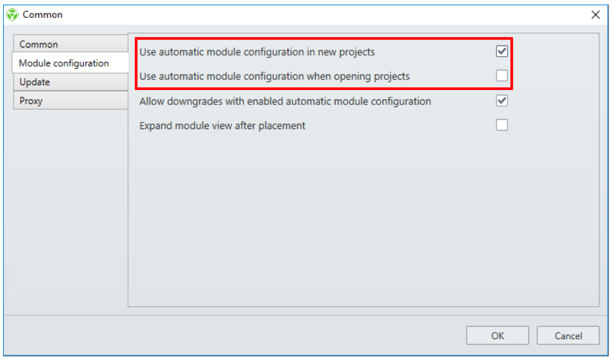
If you change your configuration and, for technical reasons, another module selection is required, samos® PLAN 6 automatically carries out the changes. Your control is always ensured, even for automatic module configuration.

How can the "Automatic module configuration" option be activated?

In order to be able to use this feature, you just need to activate the **Automatic module configuration** option. You can do that in a samos® PLAN 6 project in the following locations:

Window	
Overview view	
Modules docking window	
Control configuration dialog in the **Properties** docking window	

In the main menu you can also define the **Standard behavior** of samos® PLAN 6 for automatic module configuration. Such as, for example:

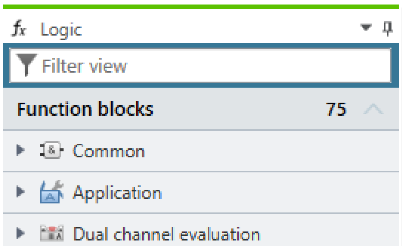


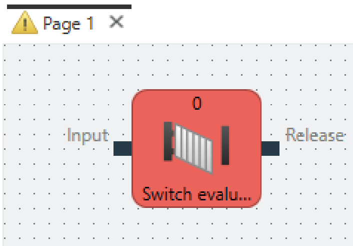
In this case, samos® PLAN 6 always activates automatic module configuration for new projects. When you open an existing project, samos® PLAN 6 automatically switches to manual module configuration.

Software behavior

Let's demonstrate the behavior of samos® PLAN 6 using a brief example:

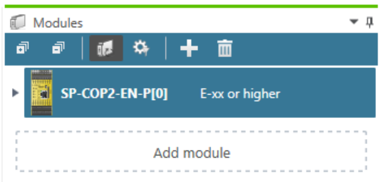
You want to use the **Switch evaluation** function block and drag a corresponding function block from the **Logic** docking window into the **Logic** view.





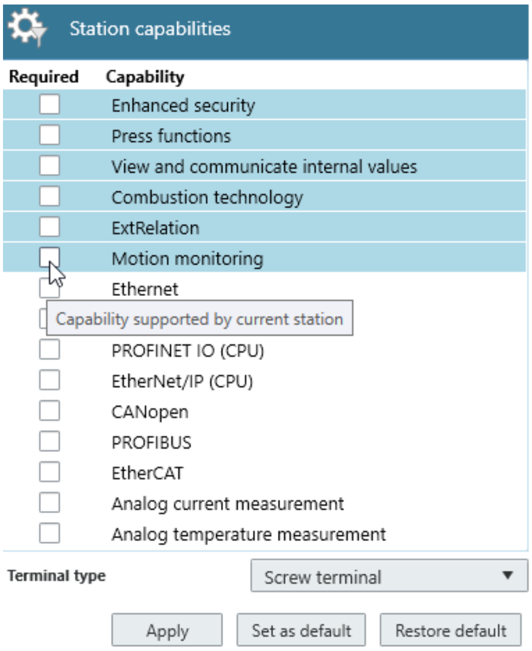
samos® PLAN 6 automatically selects the minimum appropriate controller module for this control function. In this case, a controller module SP-COP1 in the required build state.

You can see the hardware configuration at any time in the **Modules** docking window:



Defining station capabilities

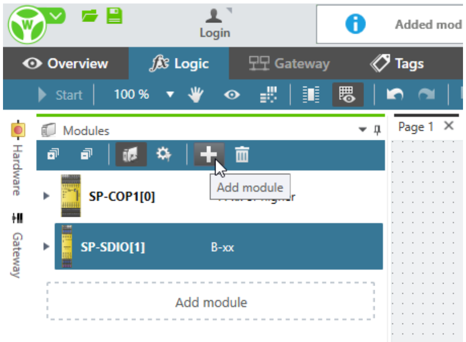
When you are working with automatic module configuration, you can define so-called station capabilities for your controller. These are presets which samos® PLAN 6 always takes into consideration when selecting the modules.



You can also make these presets in the **Modules** docking window.

The hardware is always the right version

If you should select the hardware yourself while the automatic module configuration has been activated, simply go to the **Modules** docking window and click on **Add module**:



Manual interventions are usually only required if, for example, you want to add a second gateway module or extension module, although the previous configuration already has sufficient inputs and outputs.

samos® PLAN 6 automatically corrects inconsistencies in the hardware configuration. So nothing can go wrong.

5.8 Program help

Program Help supports you in working with the software. Here, you will quickly find additional information, such as safety instructions, handling instructions, module descriptions and overview tables.

Program Help contains the full scope of all three manuals (software, hardware, gateway).

Open Help

➡ Press the **F1** key.

⇨ The Help window will open.

⇨ If you have selected an object in the software using the mouse (e.g. a sensor), help for the selected object opens automatically.

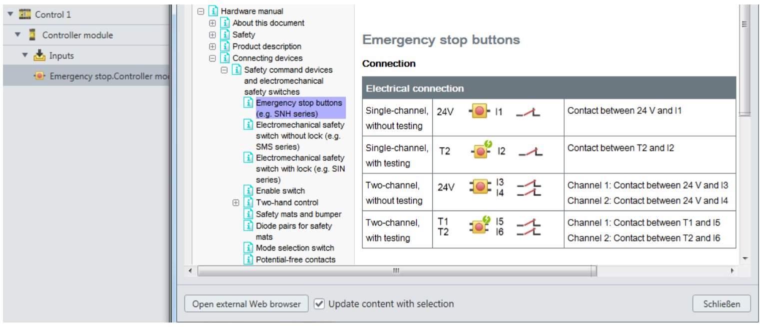


Illustration 10: Program Help on the selected "Emergency stop button" object

Display Help in web browser

You can also open Help in your web browser.

To do this click on the **Open in browser** button in the Help window.

5.9 Settings and functions across projects (main menu)

The main menu offers numerous options for adapting the user interface and the behavior of samos® PLAN 6 to suit your individual requirements.

The following commands and functions are available for all projects:

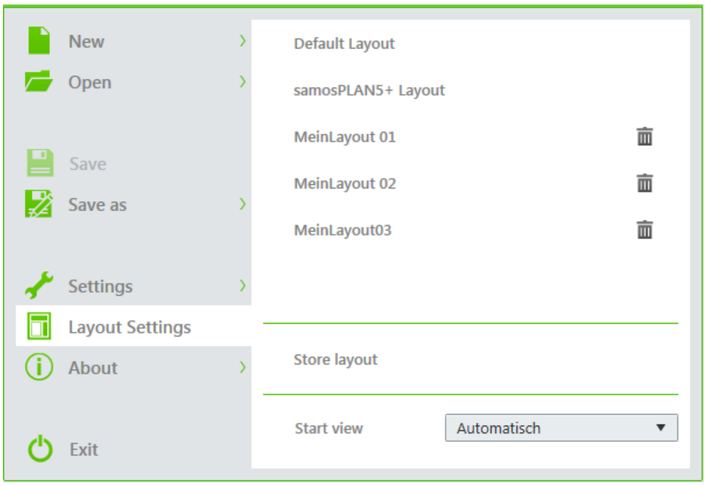


Illustration 11: Main menu of samos® PLAN 6

Table 23: Key

Element	Function
New	This closes the currently open project (with a prior save prompt) and creates a new empty project. If you have created project templates, you can start a new project based on one of these templates. Further information: *Project templates [ch. 5.9.9, p. 68]*
Open	• When selecting without mouse click: Shows a list of available projects in the right menu area that you can open with a mouse click. • When selecting with mouse click: Opens Windows Explorer. From there you can search for an already existing project and open it.
Save	Saves the current status of the open project.
Save as	This opens an Explorer window that you can use to save the currently open project under a new name or at a new target location. You can choose from the following save options: • **as a project file** (file format *.SPF) • **as a target project file** (file format *.XML) • **as a project template** (file format *.*template.SPF)

Element	Function
Settings	Contains cross-project basic settings that you can set for the software. **IMPORTANT:** Any changes made to the settings will only affect the currently logged-in Windows user. You can *export and import [ch. 6.3.5.3, p. 116]* the settings and thus make them available to other users or computers. You can make the following settings: • *User interface language [ch. 5.9.1, p. 62]* • *Configuration of display names [ch. 5.9.2, p. 63]* • *Edit report front page [ch. 5.9.14, p. 75]* • General *automation [ch. 5.9.4, p. 64]*, *display of start view [ch. 5.9.3, p. 63]*, *Specifications for the logic editor [ch. 5.9.5, p. 66]*
Layout settings	• Manages your stored window layouts and gives you access to the two default layouts in samos® PLAN 6. Further information: *Personalized window configuration [ch. 5.9.11, p. 71]* • Allows you to define which view is active in the working area when samos® PLAN 6 starts. Further information: *View at program start [ch. 5.9.12, p. 74]*
About	This opens a menu in the right area of the window containing the following: • Version information • License information
End	This closes the project and the software after a save prompt.

5.9.1 User interface language

You can choose from seven different languages for the user interface.

Activate

Main menu | Settings | Language

Overview

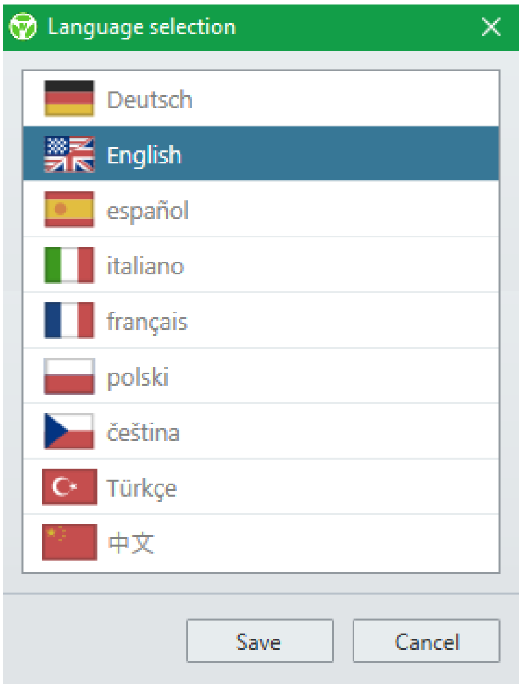


Illustration 12: Dialog window for language selection

5.9.2 Configuration of display names

You can define a naming scheme for the display names for modules, sensors, actuators and gateways. The display name is the designation with which the project components are displayed on the samos® PLAN 6 software interface.

Activate

Main menu | Settings | Display names

Overview of functions

The configuration window consists of two areas:

- Left: Configuration for modules, sensors and actuators
- Right: Configuration for gateways

You define the relevant naming scheme in the input field with a white background. You thus define the components that make up the display name. You can obtain the correct syntax for the components by clicking on the corresponding button above the input field.

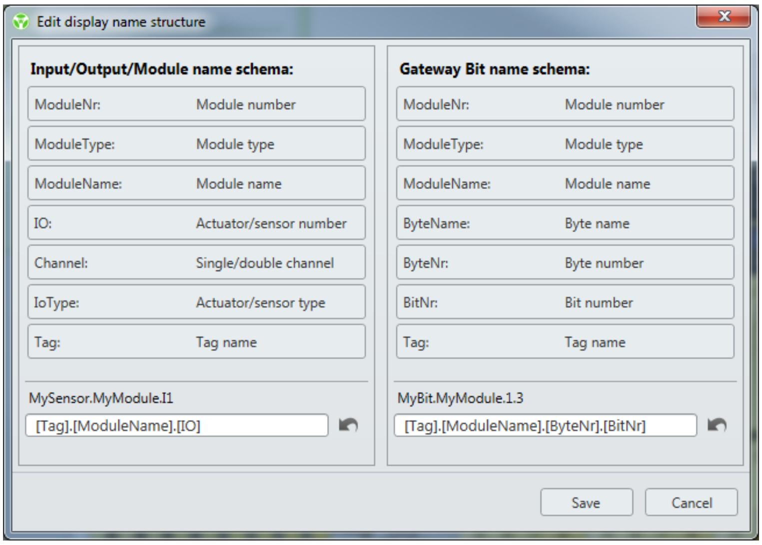


Illustration 13: Dialog window for configuring display names

NOTICE

"Tag" name element

The **Tag** name element allows you to integrate a user-defined character string in the display name. You can define which character string is used for the **Tag** name element at two locations:

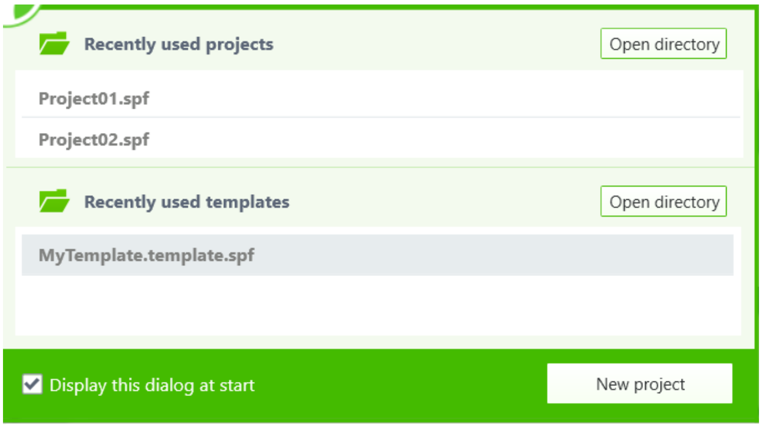
- The corresponding project component in the configuration window.
  You will find the configuration dialog in the **Hardware** view and in the **Logic** view.
- In the **Name** view: *Adapting display names of project components [ch. 6.4, p. 121]*

5.9.3 Displaying start view

After the start of the software, a start view will appear by default. From there you can select which of the following actions you wish to use to begin your work.

- Select one of the recently edited projects from a list.
- Create a new empty project.
- Create a new project using a template.
- Select a freely selected project (file format *.SPF) in Windows Explorer and open.
- Deactivate the start view.

Overview



Reactivating start view

Once you have deactivated start view, you can reactivate it here:

- ➡ Open the main menu.
- ➡ Click on **Settings** | **General**.
- ➡ Activate the **Display project selection dialog at start** checkbox.

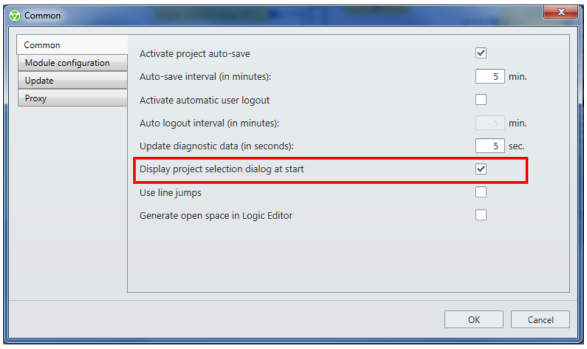


Illustration 14: Checkbox for activating start view

5.9.4 Instructions for automating (saving, logging off, updating)

The samos® PLAN 6 software offers the following automations in program behavior:

- Automatic saving of the project file
- Automatic log-off
- Updating of the diagnostic data

You can make the settings for this here:

Activate

Main menu | **Settings** | **General** | **General** tab

Overview

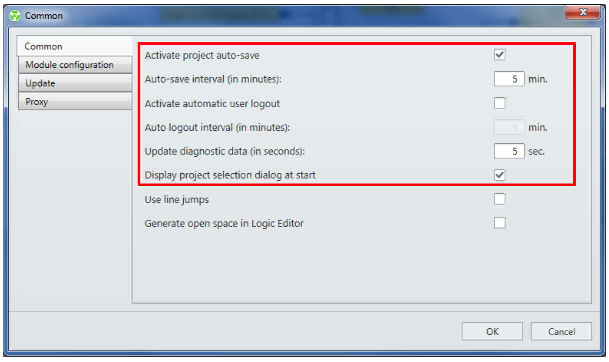


Illustration 15: Setting automatic features in the "General" dialog

5.9.5 Specifications for the logic editor

With the following options you can define the specifications for the visualization in the **Logic** view.

Activate

Main menu | Settings | General | General tab

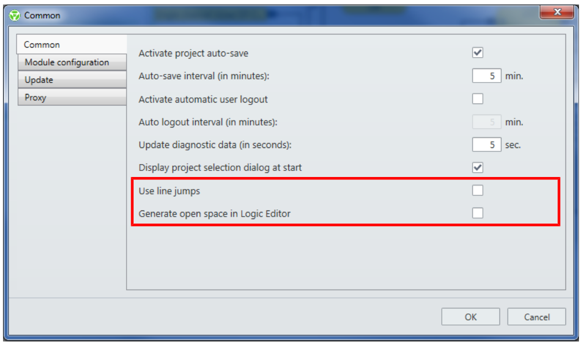
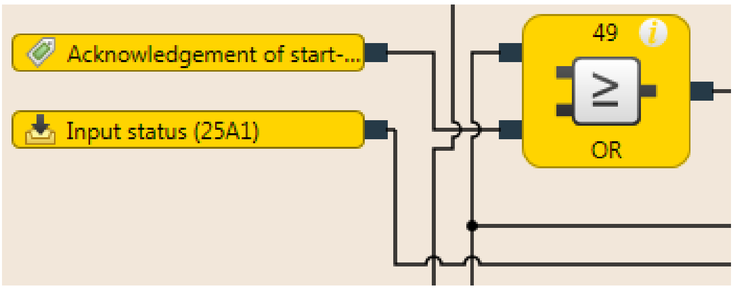


Illustration 16: Specifications for the visualization in the "Logic" view

Table 24: Reference

Element	Function
Uses line jumps	Defines that the **Logic** view shows line jumps for intersecting lines. **Example** 
Generate open space in the Logic Editor	Defines that the **Logic** view generates open space around the new object when adding a new object (if possible). The available project components move to the side or downwards.

5.9.6 Module configuration mode

With the following options you can define,

- in which cases in samos® PLAN 6 projects you want to use automatic module configuration, as standard.
- Whether downgrades should be made from the automatic module configuration
- Whether the inputs and outputs of the newly added modules should be shown in the **Modules** docking window as visible (expanded) or invisible (collapsed), as standard.

Activate

Main menu | **Settings** | **General** | **Module configuration** tab

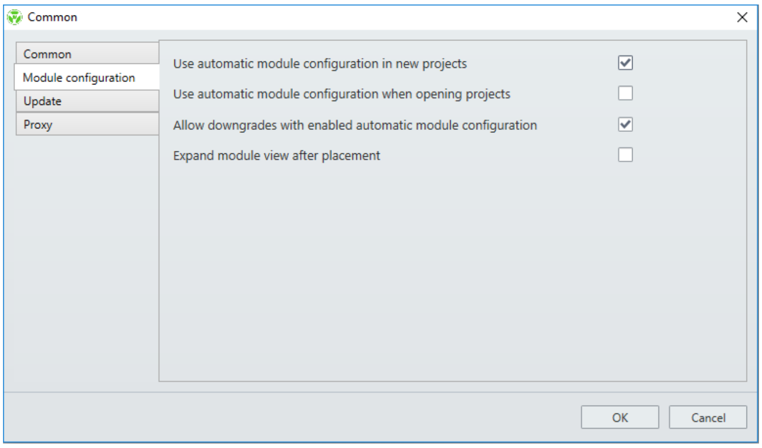


Illustration 17: Specifications for module configuration

Further information

You can find further information about automatic and manual module configuration in samos® PLAN 6 here: *Defining the mode for module configuration [ch. 6.1.2, p. 79]*.

5.9.7 Updates

In the **General** dialog window, you can specify whether and when the samos® PLAN 6 software should check for new versions of the program.

Activating the function

Main menu | **Settings** | **General** | **Update** tab

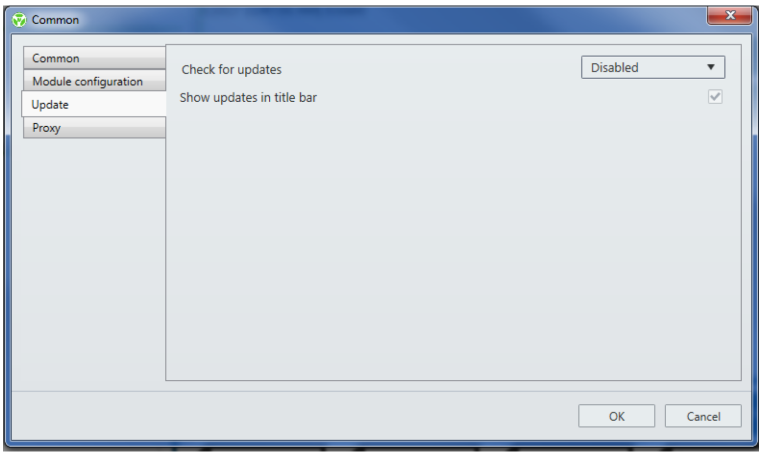


Illustration 18: Update settings

5.9.8 Proxy settings

You can define a proxy server for use with the samos® PLAN 6 software.

Activating the function

Main menu | Settings | General | Proxy tab

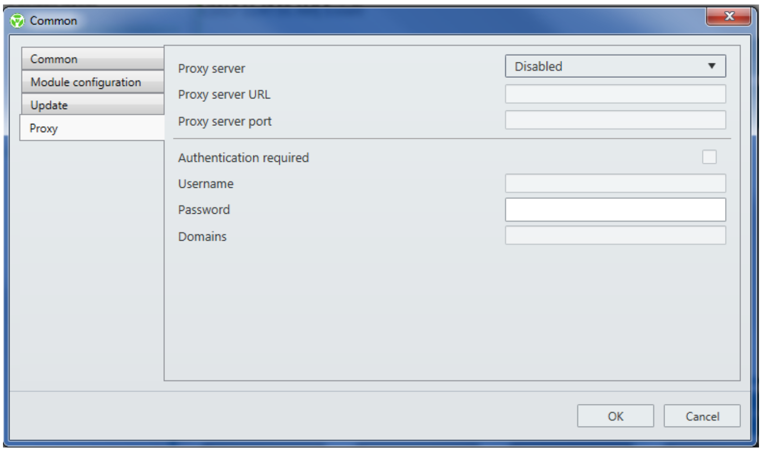


Illustration 19: Proxy settings

5.9.9 Project templates

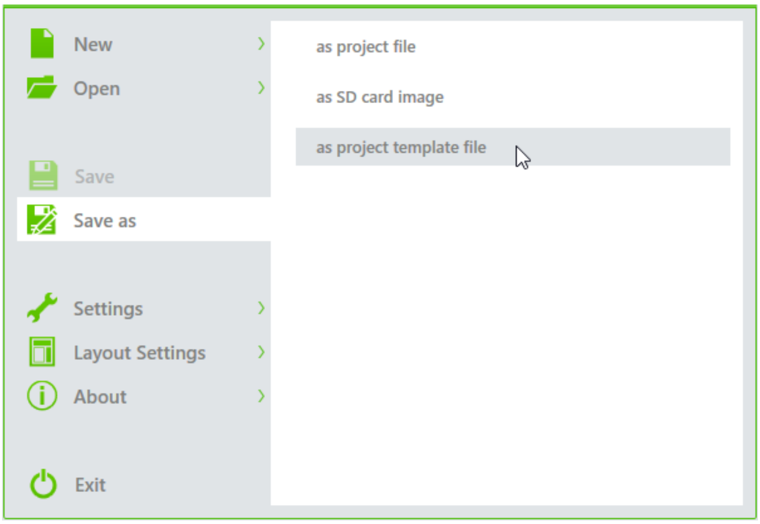
A project template stores all the components of a samos® PLAN 6 project including any custom configurations that you have created. You can open project templates at any time and create new projects based on the presets from these templates.

The project templates are stored outside of samos® PLAN 6 on a hard disk or drive.

Saving format (file format): *template.SPF

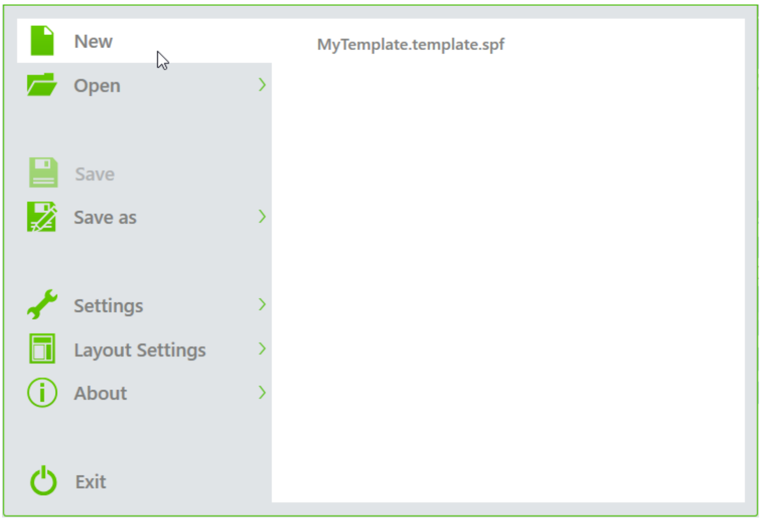
Saving a project template

Main menu | Save as | As project template



Opening a project template

Main menu | New | <Your template>



5.9.10 Saving of the project file

In samos® PLAN 6 there are two options for saving projects:

Save option	Explanation
As a project file	Saves the currently open project in the native samos® PLAN 6 format. You can address this save option directly via the menu bar or by using the key combination **<Ctrl> + <S>**.
As an SD card image	Compiles all the relevant data required to distribute software manually using an SD card. The scope of the data may vary depending on the processing status and selected features. Further information: *Protecting a project from manipulation (extended security function) [ch. 6.1.7, p. 85]* Please note the advice below.

Saving as an SD card image

Select this option if you do not have the possibility of loading the project directly to the control. All the relevant data for the SD card is prepared as a result. A folder that provides all the data required for the SD card in the "SD-Card" folder is created using the project name. In the case of verified projects, the report verification is also included as a PDF file.

Please note that all files must always be copied to the "SD-Card" folder on the SD card to guarantee reliable operation.

If you are working with extended security features, the verification report contains the falsification code required for falsification.

Special case: "Link project to station":

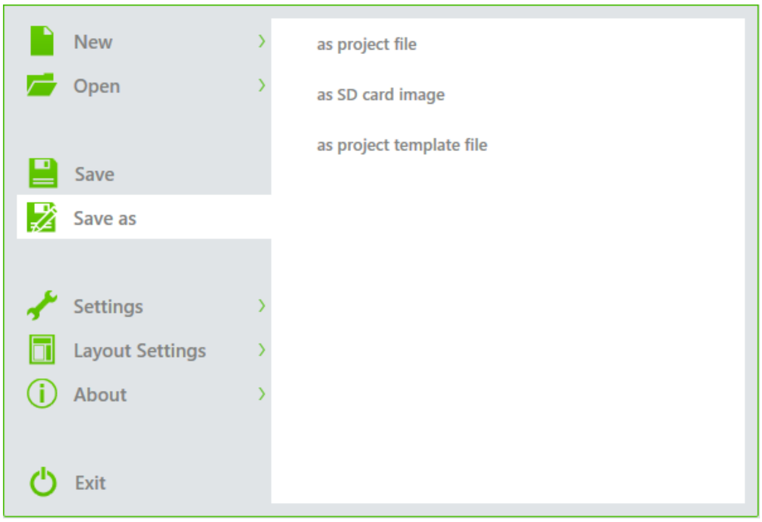
If you wish to save the currently open project directly from samos® PLAN 6 as a SD card image, proceed as follows:

Requirements

- The extended security feature **Link project to station** is enabled.
- The project is verified.

Procedure

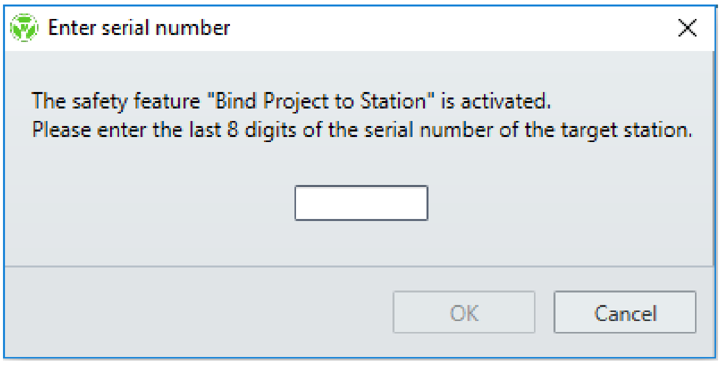
➡ Open the main menu.



➡ Select the option **Save as | as SD card image**.

➡ Select the target directory in the **Save as** dialog window.

⇨ The **Enter serial number** dialog window opens.



➡ Enter the last 8 digits of the serial number of your station.

➡ The project is saved as an SD card image.

5.9.11 Personalized window configuration

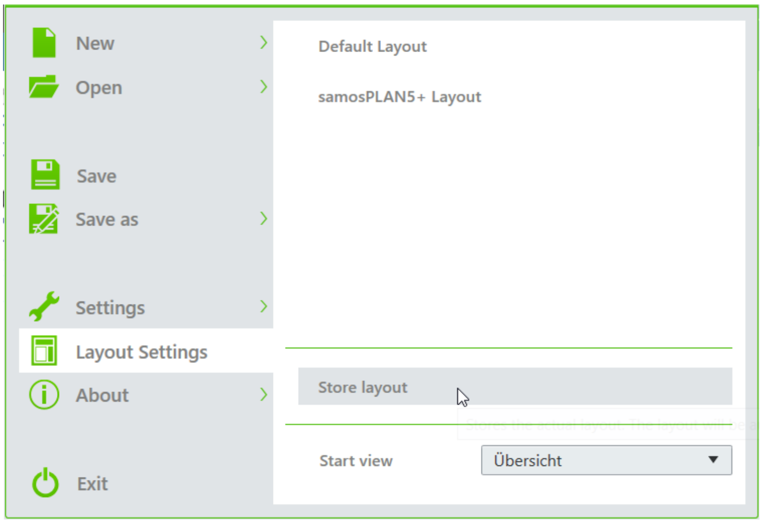
samos® PLAN 6 allows you to store frequently used window layouts and retrieve them as required. The window layout includes a selection and specific arrangement of all window elements on the software interface.

5.9.11.1 Creating and retrieving your own window configurations

You can use the save function to store the current window layout as a favorite and activate it as required.

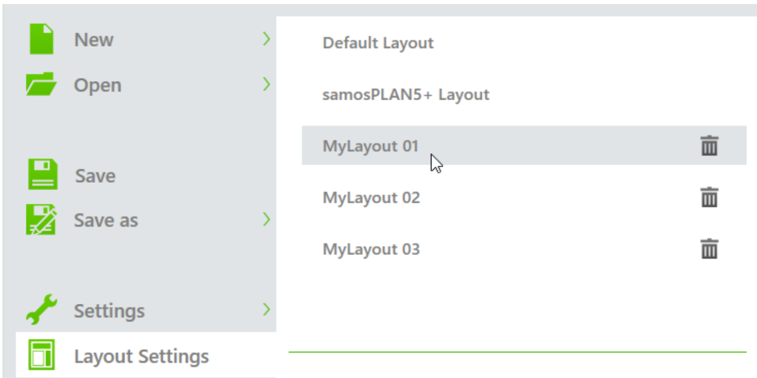
Activate

Main menu | Layout settings | Save layout



Function

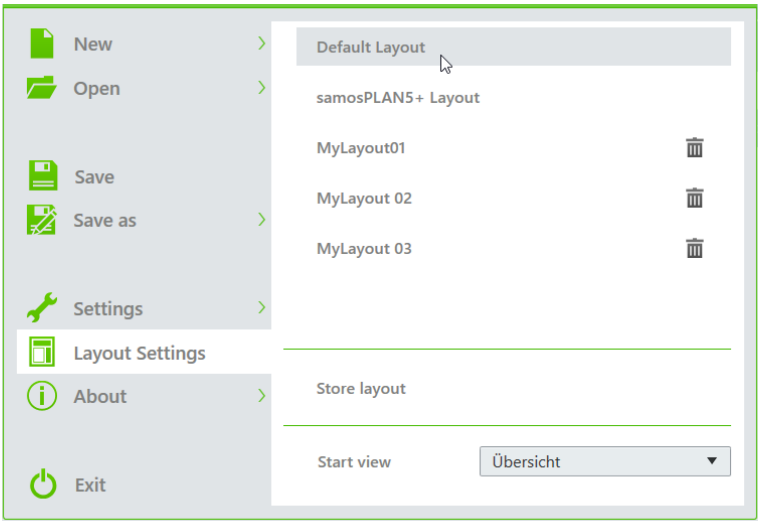
- You can save multiple layouts.
  Examples: **MyLayout 01**, **MyLayout 02**, **MyLayout 03**
- Your personal layouts appear in the list of predefined layouts.
- When a layout is selected using the mouse, it is applied automatically and then becomes the standard layout after the samos® PLAN 6 is restarted.



5.9.11.2 Activating default layouts

samos® PLAN 6 has two default layouts as standard. You can find these layouts in the **Layout settings** menu together with your personal layouts.

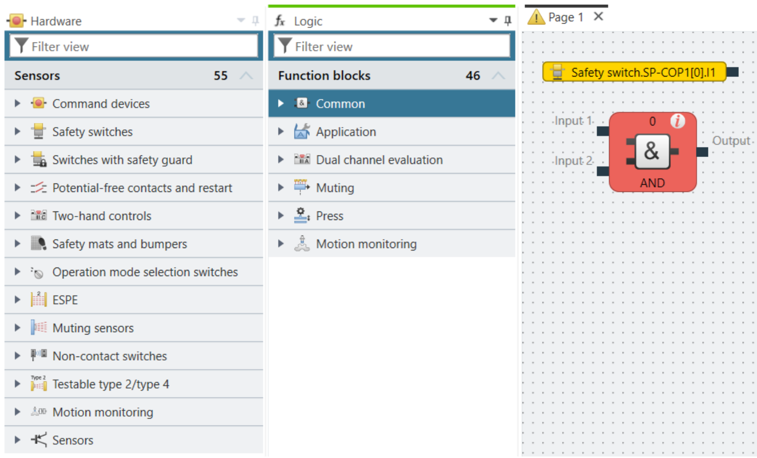
When working on an open project, you can activate a default layout at any time using the mouse.



"Default layout" option

Configures the window layout to provide optimal support when working with the automatic module configuration (available since samos® PLAN 6 1.0).

The **Hardware** docking window and the **Logic** docking window are positioned on the left of the user interface. Hardware elements and function blocks can be dragged and dropped into the **Logic** view without changing windows.

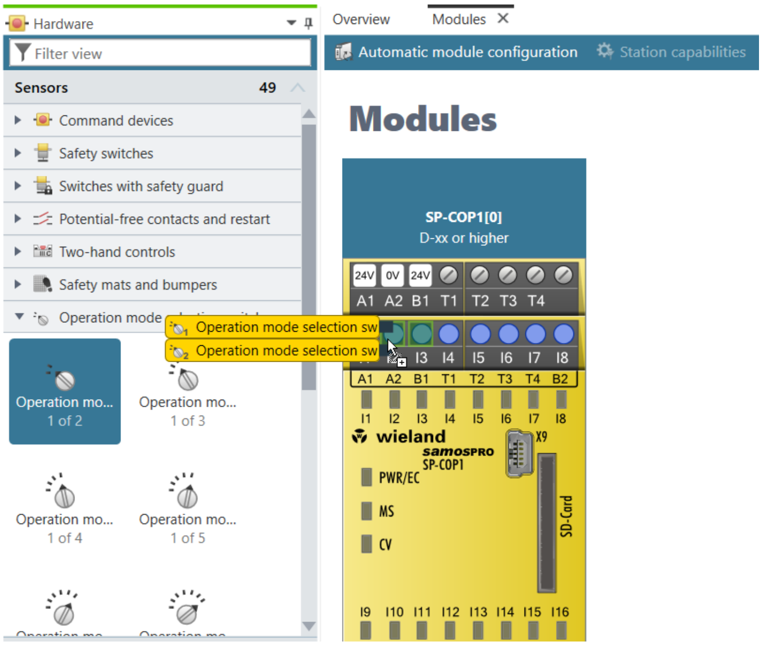


"samosPLAN5+ layout” option

Configures the window layout in the style of samos® PLAN 5+.

The **Hardware** docking window is positioned on the left of the user interface. If you open the **Modules** view in the working area, you can drag sensors and actuators from the **Hardware** docking window and drop them on the inputs and outputs on the graphically displayed modules.

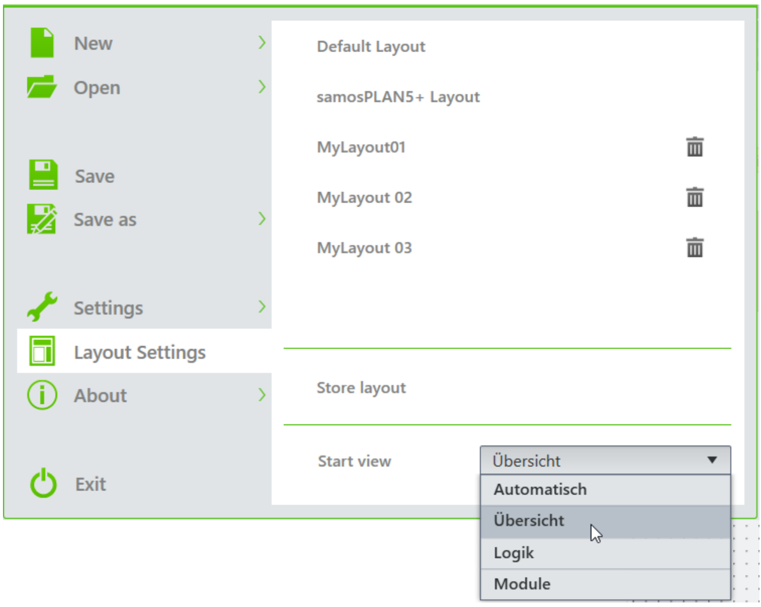
This window layout is suitable for configuring modules manually.



5.9.12 View at program start

Under **Layout settings**, you can select which samos® PLAN 6 view opens in the working area at program start. The following options are available for selection:

- **Automatic**
  Opens the **Overview** or **Logic** view at program start depending on the size of the project.
- **Overview**
  Opens the **Overview** view at program start.
  Further information: *"Overview" view [ch. 5.3.2, p. 32]*
- **Logic**
  Opens the **Logic** view at program start.
  Further information: *"Logic" view [ch. 5.3.1, p. 24]*
- **Modules**
  Opens the **Modules** view at program start.
  Further information: *"Modules" view [ch. 5.3.6, p. 40]*



5.9.13 Importing/Exporting settings

You can save and transfer user settings that you have configured in the main menu in file format via an export/import interface.

Function

- What is saved?
  - Language setting
  - Naming schema for display names
  - Settings from the settings dialog
    Exception: Password for the proxy server, if defined
- Saving format (file format):
  *.PLC

Activating the function

Main Menu | Settings | Export / Import

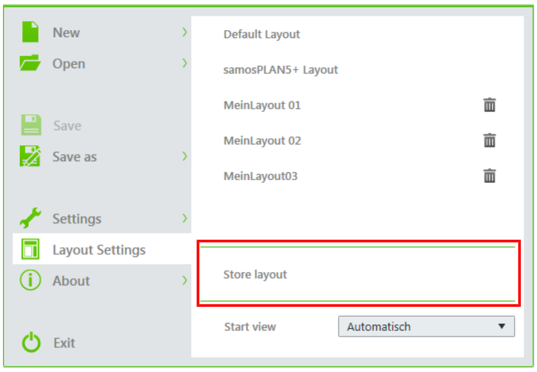


Illustration 20: Export and import function in the "Settings" menu

5.9.14 Template for the report front page

Here you can define a standard front page for all reports, which you produce from this instance of samos® PLAN 6. You can overwrite the presets, if required, in project-specific reports (*Storing company data for the report front page [ch. 6.1.4, p. 82]*).

Configuration options

In the template you can define standards for the following elements of the report front page:

- Company logo
- Company name
- Company address

The company logo, company name and company address are displayed in this order in the middle of the front page. The company name also appears in the report footer.

Activate

Main menu | Settings | Report front page template

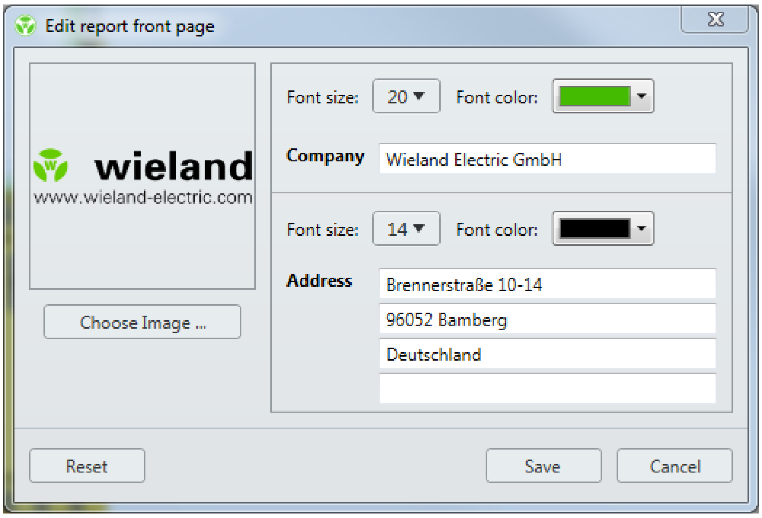


Illustration 21: Configuration example

Configuration options

Table 25: Reference

Element	Description
Choose image ...	You select the desired graphic from your local directory by clicking on the button. This graphic is saved in the project file.
Company	Enter the company name here. You can define a separate font size and font color for the company name.
Address	Enter the company address here. You can define a separate font size and font color for the company address.

6 WORKING WITH SAMOS® PLAN 6

What do you typically do, and in what order when you work with samos® PLAN 6?

This chapter offers guidelines to guide you through all the important work steps - starting with the creation of a new project through to monitoring a ready-programmed control when running.

- First of all you find out how to **create and set up your project** (*Setting up a project [ch. 6.1, p. 77]*). This includes:
  - Defining the **mode for the module configuration** (*Defining the mode for module configuration [ch. 6.1.2, p. 79]*),
  - Storing data for the **project description** (*Storing project descriptions [ch. 6.1.3, p. 81]*) and the report (*Storing company data for the report front page [ch. 6.1.4, p. 82]*),
  - Defining **log messages** (*Defining log messages [ch. 6.1.5, p. 83]*) and
  - Defining **access rights** (*Defining access rights (manage users) [ch. 6.1.6, p. 84]*) as well as extended **security functions** (*Protecting a project from manipulation (extended security function) [ch. 6.1.7, p. 85]*).
- You will learn how to **configure modules manually** if you have not selected automatic configuration (*Configuring modules [ch. 6.2, p. 86]*).
- Familiarize yourself with the **Logic view** (*Programming the logic [ch. 6.3, p. 94]*) and learn how to:
  - Add **sensors and actuators** (*Adding I/O elements [ch. 6.3.1, p. 94]*),
  - Use (*Connecting inputs and outputs with function blocks [ch. 6.3.2, p. 103]*) and group (*Grouping function blocks [ch. 6.3.3, p. 106]*) **function blocks**,
  - Have the logic **tested automatically** by samos® PLAN 6 (*Automatic logic check [ch. 6.3.4, p. 110]*),
  - Integrate **user-defined elements** (*User-defined elements [ch. 6.3.5, p. 111]*) and
  - View **dependencies between sensors and actuators** (*Viewing the dependencies between sensors and actuators [ch. 6.3.6, p. 118]*).
- Find out how to alter **display names** in your project (*Adapting display names of project components [ch. 6.4, p. 121]*).
- You can find information on how to add your **own content to the report** (*Saving individual content for the report [ch. 6.5, p. 123]*).
- Learn how to **simulate your logic programming** (*Simulating logic programming [ch. 6.6, p. 124]*).
- You can also find out how to establish a **connection between your** samos® PRO **modules and** samos® PLAN 6 (*Connecting to the safety controller [ch. 6.7, p. 131]*).
- Once there is a connection between the modules and samos® PLAN 6, you can **transfer configuration data to the modules** (*Transferring the system configuration [ch. 6.9, p. 135]*). Furthermore, the **configuration is checked for compatibility with the modules** (*Compatibility check [ch. 6.9.2, p. 135]*) and then **verified** (*Verifying the configuration [ch. 6.9.3, p. 136]*).
- You will then receive information about different **monitoring functions** in samos® PLAN 6 (*Using the monitoring functions [ch. 6.10, p. 139]*). You can:
  - Follow **the state of devices live during operation** (*Observing the device states of the system [ch. 6.10.1, p. 139]*),
  - Use **force mode** for inputs (*Forcing inputs (Force mode) [ch. 6.10.2, p. 144]*) and
  - **Synchronize** the **time** between the diagnostic computer and safety controller (*Synchronize time for diagnostic purposes [ch. 6.10.3, p. 147]*).

6.1 Setting up a project

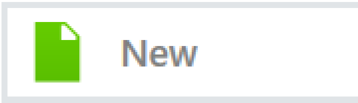
Up to the *cross-project settings [ch. 5.9, p. 60]* everything relates to what you do in samos® PLAN 6 on the project which is open at that particular time.

How do you create a project? And what kind of objects can you set and configure for a project?

6.1.1 Creating a new project

When you start samos® PLAN 6, you can create a new empty project in the start view using the **New project** button.

If samos® PLAN 6 is already open, you can create a new project by clicking on **New** in the samos® PLAN 6 menu.



NOTICE

Tip: Using project templates

If you frequently need to use certain configurations in new projects, you can create project templates. These also appear in the samos® PLAN 6 start view.

Further information: *Project templates [ch. 5.9.9, p. 68]*

Program behavior

In the case of a new project in samos® PLAN 6, either the **Overview**, **Logic** or **Modules** view is displayed in the working area, depending on your presets (see *View at program start [ch. 5.9.12, p. 74]*). Only these three views are active, unless otherwise configured in a project.

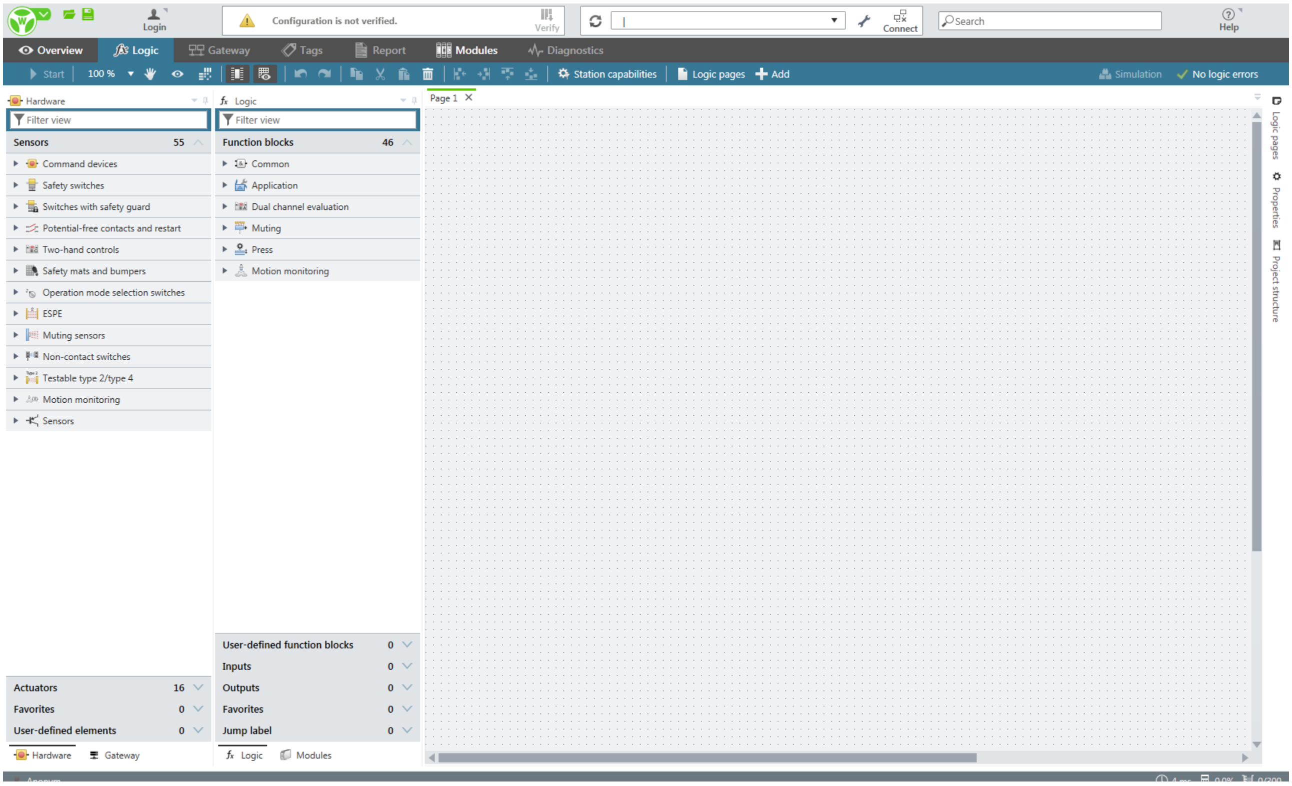


Illustration 22: A new project in samos® PLAN 6

Window layout

If you have not defined your own window layout, the docking windows of samos® PLAN 6 are arranged as shown in the illustration above.

If you have *defined your own window layout [ch. 5.4.1, p. 44]*, the new project starts with your individual window arrangement.

6.1.2 Defining the mode for module configuration

In samos® PLAN 6, you have two options for selecting and configuring the modules required for safety controllers. You use either automatic module configuration or you decide to use (classic) manual module configuration.

NOTICE

Store the preferred mode as the standard setting

In the main menu, you can define when samos® PLAN 6 should work with automatic module configuration and when with manual module configuration as standard.

Configuration dialog: *Module configuration mode [ch. 5.9.6, p. 67]*

6.1.2.1 Background

Here is a brief overview of how these concepts of automatic module configuration and manual module configuration differ:

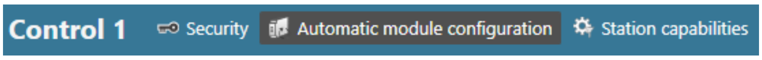
Mode	Description
Automatic module configuration	In automatic module configuration you model the logic directly and exclusively – and samos® PLAN 6 automatically assembles the required modules in the background. Detailed description: *Automatic module configuration [ch. 5.7.2, p. 57]*
Manual module configuration	In the same way as in the previous version of samos® PLAN 6, you choose the desired module yourself, assign the input and outputs as required, with sensors and actuators, and subsequently program the logic. Detailed description: *Manual module configuration [ch. 5.7.1, p. 56]*

6.1.2.2 Activating automatic module configuration

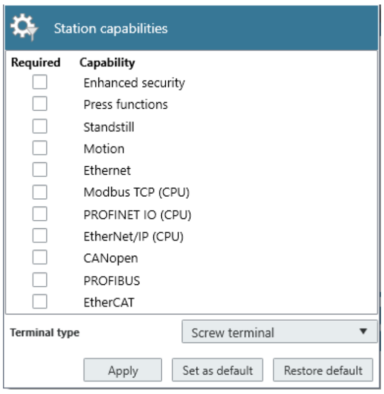
If you want to work with automatic module configuration, proceed as follows:

Procedure

- ➡ Switch to the **Overview** view.
- ➡ Ensure that the **Automatic module configuration** option is active.



- ➡ If you want to define other presets for automatic module configuration, click on **Station capabilities.**
  - ⇨ A dialog window opens, in which you can define the performance features for the control station, for example:



- ➡ Select the desired options and click on **Apply**.
  - ⇨ samos® PLAN 6 takes these presets into consideration in the choice of suitable modules.

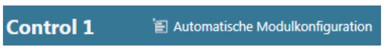
6.1.2.3 Activating manual module configuration

If you want to work with manual module configuration, proceed as follows:

Procedure

If you are creating a new project:

- ➡ Switch to the **Overview** view.
- ➡ Ensure that the **Automatic module configuration** option is deactivated.



What do you actively have to do for manual module configuration?

You can find guidelines here: *Configuring modules [ch. 6.2, p. 86]*

6.1.3 Storing project descriptions

In the **Overview** view in samos® PLAN 6 you can store a set of descriptive data for each project. This data is displayed in the following locations:

- **Overview** view
- Front page of your project report (**Report** view)

Procedure

➡ Switch to the **Overview** view.

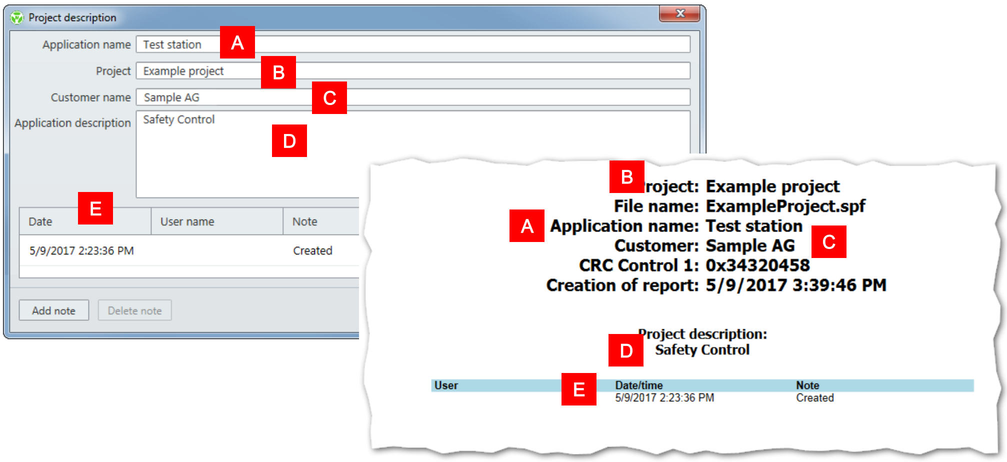
➡ In the command bar, click on **Edit description.**

⇨ The **Project description** dialog window opens.

➡ Store the desired information in the entry boxes.

Display of the data on the report front page

This is how the data from the project description is evaluated on the report front page:



6.1.4 Storing company data for the report front page

In addition to *Project description [ch. 6.1.3, p. 81]*, company data also appears on the front page of your project report.

You can define, via the **Edit report front page,** which data is used as the company data in which display.

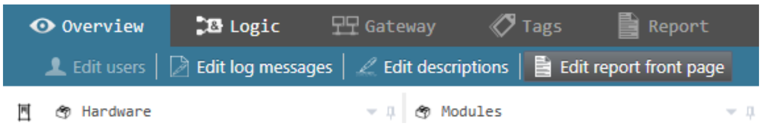
NOTICE

You can define company data that you need in every report as standard in cross-project settings.

Details: *Template for the report front page [ch. 5.9.14, p. 75]*

Procedure

- ➡ Switch to the **Overview** view.
- ➡ In the command bar, click on **Edit report front page.**

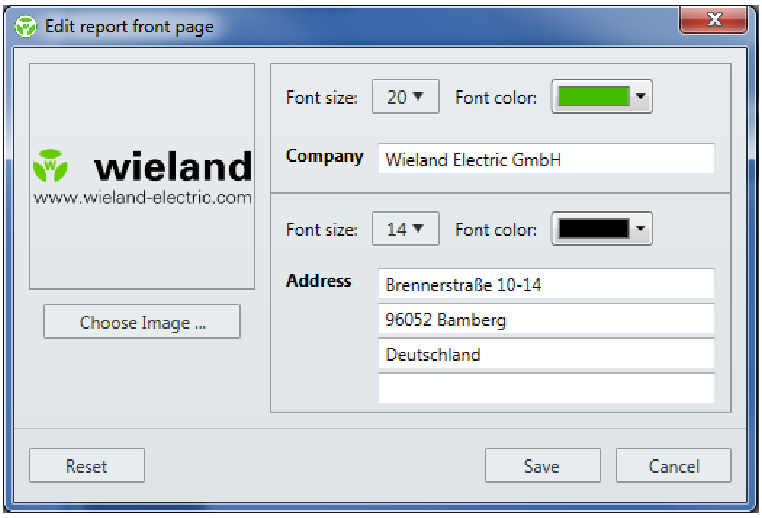


  ⇨ The configuration dialog for the report front page opens.

- ➡ Store the desired company data to appear on the title page of the report (**Logo**, **Company**, **Address**).
- ➡ Select the desired values of font size and font color for **Company** and **Address**.

Configuration dialog for the report front page

Standard configuration of the report front page:



You can change the corresponding entries and graphical specifications via the buttons and input boxes.

6.1.5 Defining log messages

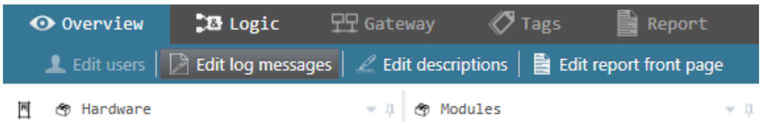
samos® PLAN 6 provides a set of 64 log messages which you can freely define.

The messages apply for the currently open project. If you wish to use a set of messages in other projects, use the export/import function for transferring.

Procedure

➡ Switch to the **Overview** view.

➡ In the command bar, click on **Edit log messages.**



⇨ The log message editor opens.

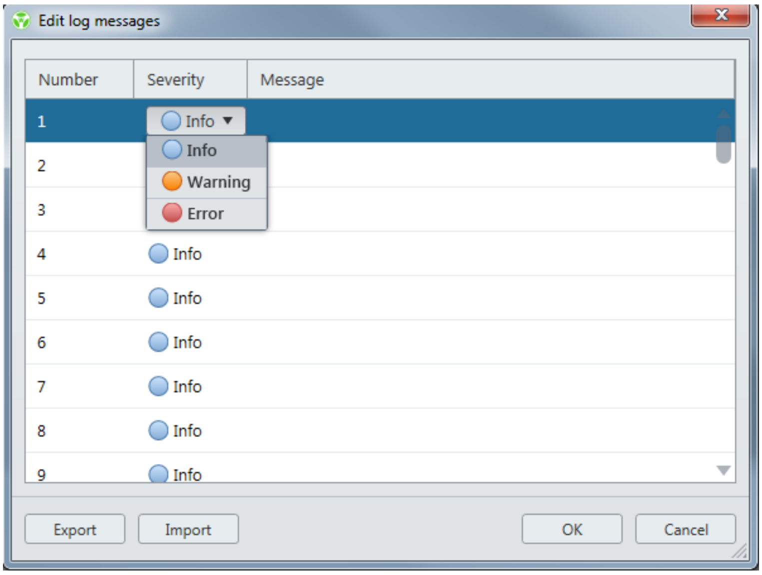


Illustration 23: Editor for log messages

Editor for log messages

Two values must be set for each log message:

- Severity level (selection list in the table column of the same name)
- Message text in the **Message** column

Exporting and importing log messages

Within the editor, click on the corresponding buttons in order to export or import log messages.

- File format: *.CSV

Integrating into the "Log generator" function block

In the **Logic** view, you can reference the log messages in function blocks of the **Log generator** type.

To do so, select the number of the required log message in the **Properties** docking window of the parts in the **Inputs 1** selection list:

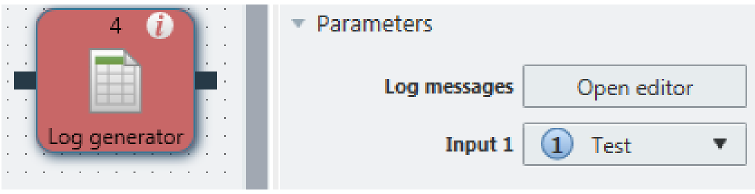


Illustration 24: Referencing log messages

6.1.6 Defining access rights (manage users)

You can centrally control access and editing rights via manage users.

The editing rights always apply to a specific samos® PLAN 6 project. If you wish to use a combination of rights in other projects, use the export/import function for transferring.

WARNING

Changing the preset standard password

In a new project, samos® PLAN 6 uses the following standard password for all users: SAMOSPRO

- Issue corresponding new passwords for all user roles when you start work on a new samos® PLAN 6 project.

Requirement

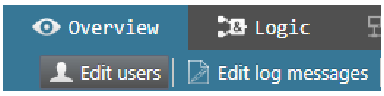
In order to activate user administration, you have to be registered in a user function that has the following authorization: **May edit users**

In the standard settings of samos® PLAN 6, only the **Authorized customer** user is permitted to do this.

Procedure

➡ Switch to the **Overview** view.

➡ In the command bar, click on **Edit user.**



⇨ The Manage users dialog window opens.

Setup and function overview

In user administration you can do the following: Change existing user rights, create new users, and copy. In addition, you have the option of exporting and importing users.

You can see the rights concept in the **Details** column.

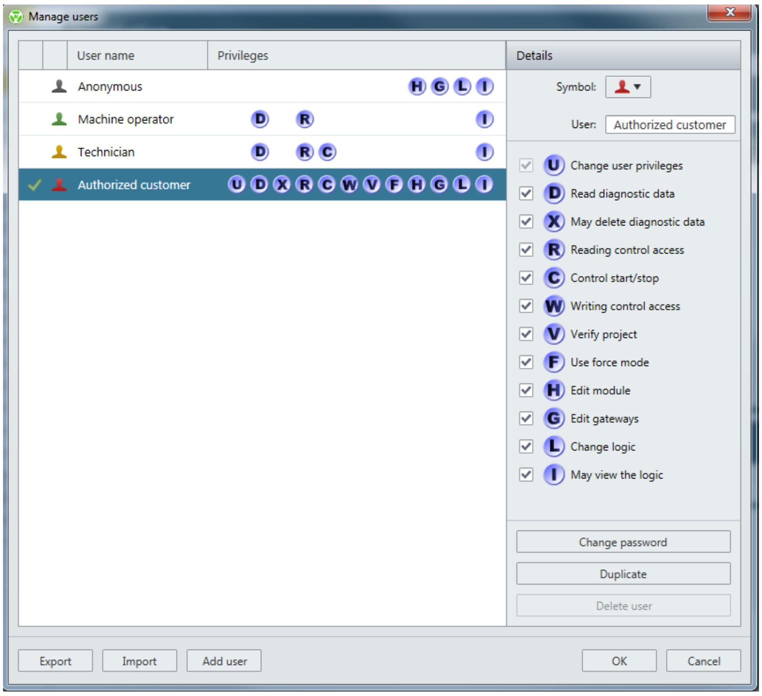


Illustration 25: Rights concept as-delivered

6.1.7 Protecting a project from manipulation (extended security function)

You can use the extended security function to protect the station or project from unauthorized changes.

The options selected from the extended security functions always apply to an actual samos® PLAN 6 project or station.

WARNING

Falsification code always required

If you decide to use the extended security function, you will always need the falsification code to overwrite a verified project.

- Also archive the report from the verification process.

Requirements

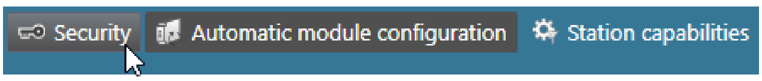
- The stations used must have module version E.
- You must use automatic module configuration.

Procedure

➡ Switch to the **Overview** view.

➡ The **Automatic module configuration** option must be selected to use the extended security functions.

➡ Click **Security** in the overview.



⇨ The **Enable extended security function** dialog window opens.

➡ Enable the **enable extended security function** checkbox.

➡ Select the required option underneath (multiple selection possible) and click **Apply**.

Function overview

In the extended security functions, you can select one or several of the following options simultaneously:

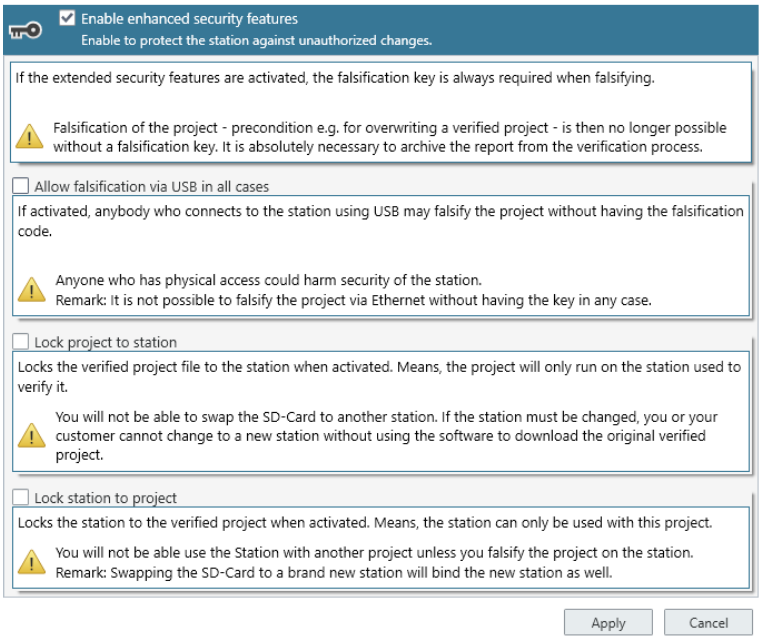


Illustration 26: Extended security function options

6.2 Configuring modules

This chapter shows you what you can or must do in combination with the module configuration actively in samos® PLAN 6.

If you are working with automatic module configuration

In this case you can leave all the configuration work to samos® PLAN 6. You don't need to do anything manually.

Here you can jump to another section in the manual: *Programming the logic [ch. 6.3, p. 94]*

If you are working with manual module configuration

In this case you have to assemble the desired modules in the **Module** docking window: *Adding modules [ch. 6.2.1, p. 86]*

6.2.1 Adding modules

If you are working with manual module configuration, you can define which modules should contain your safety controller.

NOTICE

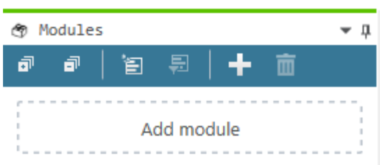
Manual interventions with automatic module configuration activated

Even if you are working with automatic module configuration, you can manually access module selection and add modules as described here.

With automatic module configuration activated, samos® PLAN 6 automatically corrects the module selection, if you use sensors or actuators which require a very specific module configuration.

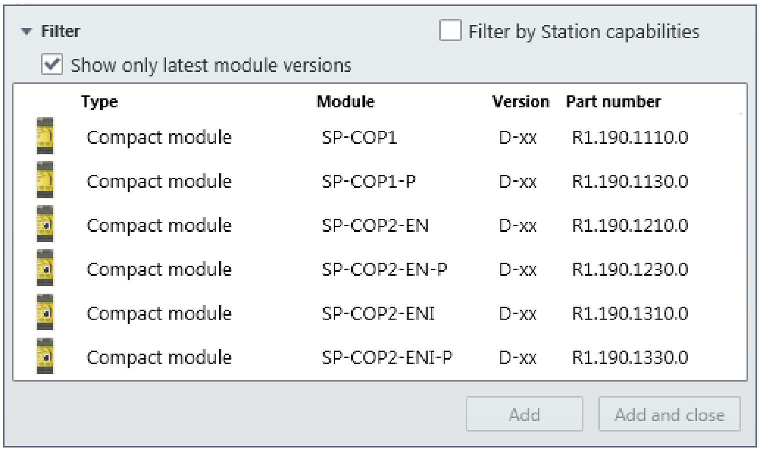
Step 1: Adding controller module

➡ Open the **Modules** docking window.



➡ Click on **Add module**.

⇨ A selection dialog appears containing all the controller modules which match the current context.
The **Show only latest module versions** checkbox is activated as standard.

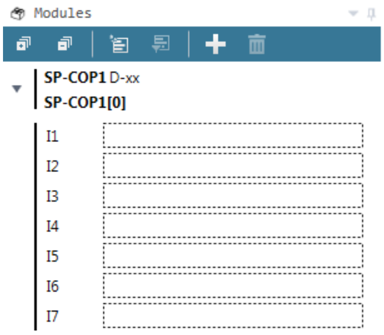


NOTICE

- You can also add older versions of a module.
  To do this, deactivate the **Show only latest module versions** checkbox.
- With automatic module configuration:
  The list only contains those modules which are permitted in combination with your presets for station capabilities.
  Leave the **Filter by Station capabilities** checkbox activated.

➡ Click in the line containing the module that you want to add, and click on **Add and close**.

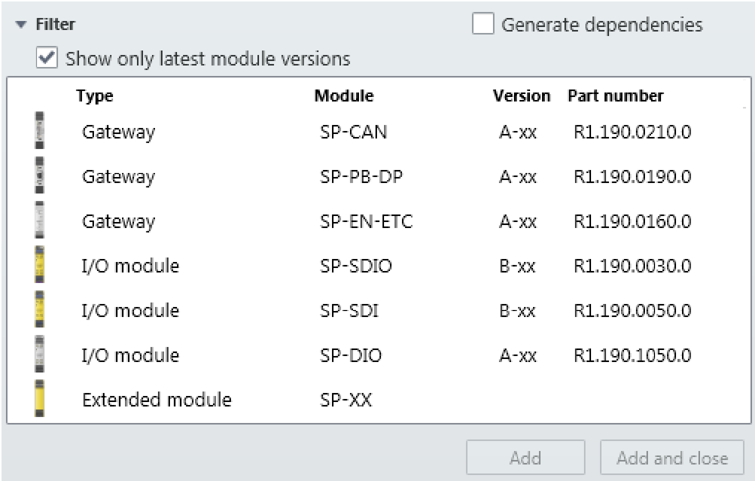
⇨ The selected controller module appears right at the top of the **Modules** docking window.



Step 2: Adding further modules

➡ Click on **Add module**.

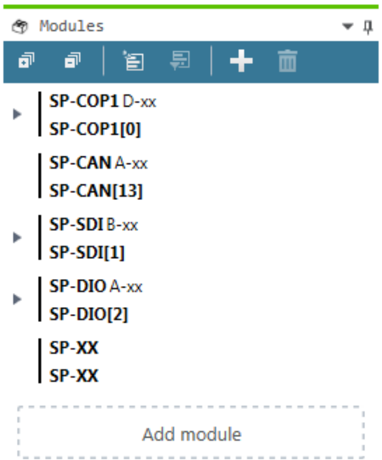
⇨ A selection dialog appears showing all the further modules which match the current context.
The **Show only latest module versions** checkbox is activated as standard.



NOTICE

- With manual module configuration:
  The list only contains modules which are permitted in combination with modules that have already been added.
- With automatic module configuration:
  The list only contains those modules which are permitted in combination with your presets for station capabilities.
  Activate the **Generate dependencies** checkbox.

- Click in the line containing the module that you want to add, and click on **Add and close**.
- Adding the desired additional modules.
  Example: Configuration with four additional modules to controller module.



  - ⇨ samos® PLAN 6 automatically places the modules in the correct sequence. The controller module will be located right at the top. Up to two gateways immediately come after the controller module. Only then come the I/O extended modules. Right at the end come the additional SP-XX modules.
  - ⇨ Using the drag-and-drop function, you can change the sequence of the modules within these groupings.

6.2.2 Special case: SP-XX expansion module

If you want to use an SP-XX extended module, proceed as follows:

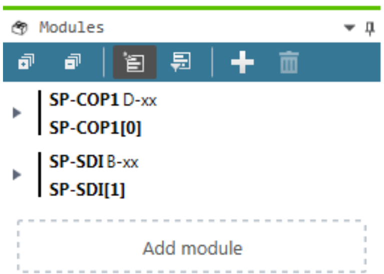
NOTICE You can also implement a SP-XX extended module with automatic module configuration by manually adding the **Modules** docking window.

Requirements

The module configuration in the **Modules** docking window already contains a controller module.

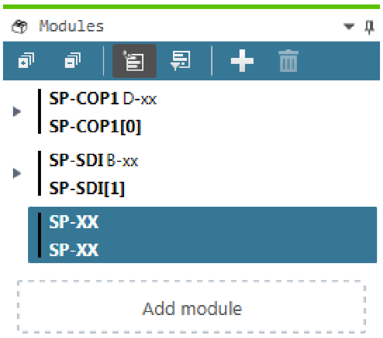
Step 1: Insert extended module

- Open the **Modules** docking window.

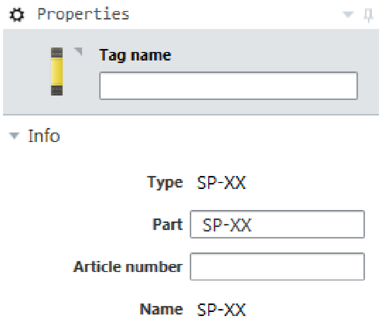


- Click on **Add module**.

- Select the SP-XX extended module from the list of modules and click on **Add and close**.
  - ⇨ The SP-XX extended module is inserted at the last position in the module configuration.



⇨ If required you can define additional options for the extended module in the **Properties** docking window.



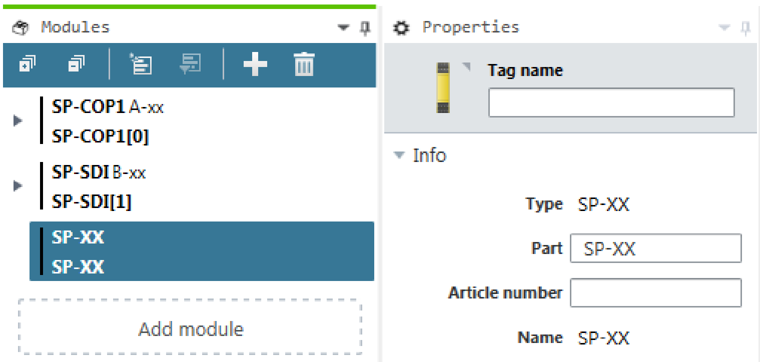
Step 2: Define module image

As standard samos® PLAN 6 offers different displays with which the extended module SP-XX is visualized in the **Overview** view, in the **Modules** view and in the project report. If required, you can import a self-defined display in samos® PLAN 6.

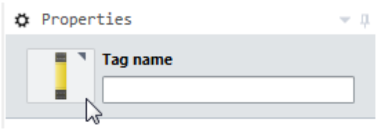
This is how you configure the visualization of an extended module SP-XX:

➡ In the **Modules** docking window, select the desired extended module and open the **Properties** docking window.

⇨ You will see the configuration dialog for the extended module.



➡ Click on the **Select module image** button.



⇨ The **Available elements** dialog window opens with a selection of predefined displays.

➡ If you want to use an existing display, double-click on the associated module image.

➡ If you want to use a self-defined module image click on **Select module image** and import a suitable display.

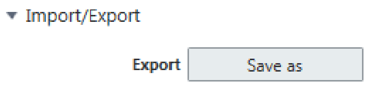
NOTICE

Specifications for self-defined module images

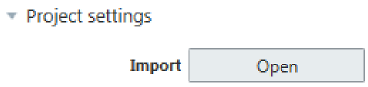
- Dimensions: 1600 x 384 pixels (height x width)
- File formats: *.JPG, *.JPEG, *.JPE, *.JFIF, *PNG

Step 3: Exporting and importing module configuration

In the **Properties** docking window, you can export the configuration for an additional module including its module image and options that you have defined in the **Properties** docking window.



You can reuse this configuration in any samos® PLAN 6 projects by importing the associated file in *.SPI format via the **Properties** docking window.



6.2.3 Parameterizing the module properties

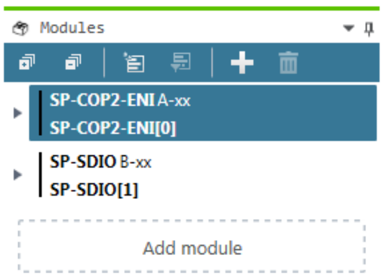
Regardless of whether you are working with automatic or manual module configuration, you can parametrize properties for the modules being used.

NOTICE

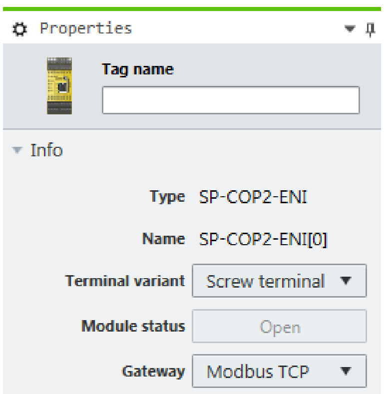
You can only parametrize some module properties after you have dragged the required I/O elements into the **Logic** view.

Procedure

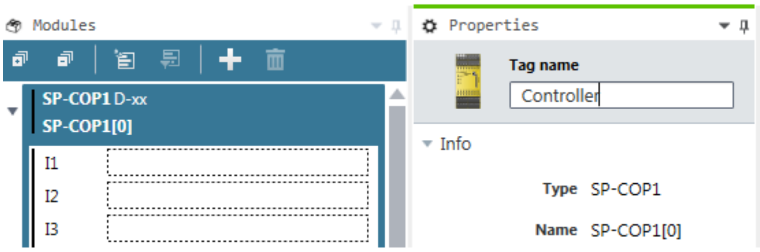
➡ Open the **Modules** docking window and select the module that you want to define properties for.



➡ Open the **Properties** docking window.



➡ Define the required options in the **Properties** docking window.
Example: You can enter an individual tag for modules in the **Tag name** input box.



All parameterizing options

The options that are available for parameterizing the modules are shown here:
Hardware manual

6.3 Programming the logic

The aim of your work with samos® PLAN 6 is to program a control logic for your safety controller. This section shows you the work steps that are necessary for this.

6.3.1 Adding I/O elements

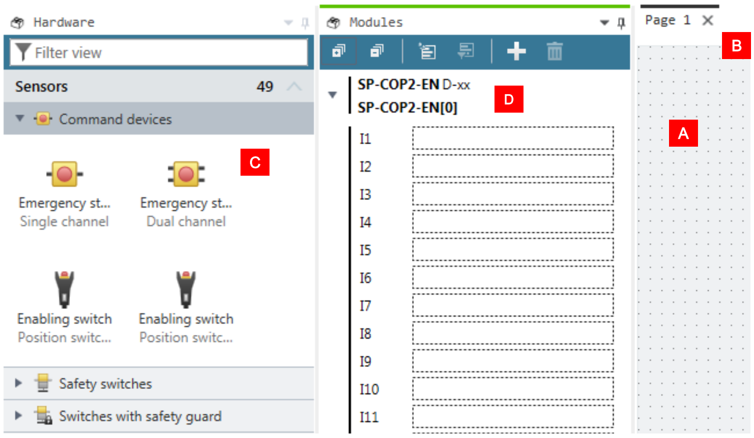
In the first step of logic programming you place the required I/O elements in the **Logic** view. The section *Place sensors and actuators [ch. 6.3.1.1, p. 94]* explains how this works.

In the other section you will find additional information on logic programming.

6.3.1.1 Place sensors and actuators

You can place sensors and actuators directly in the **Logic** view using drag & drop.

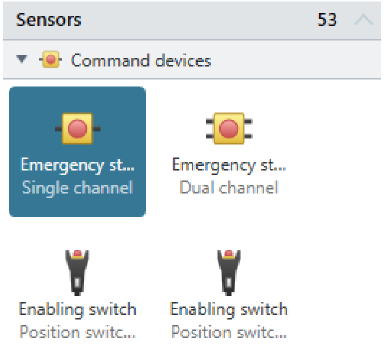
Requirements



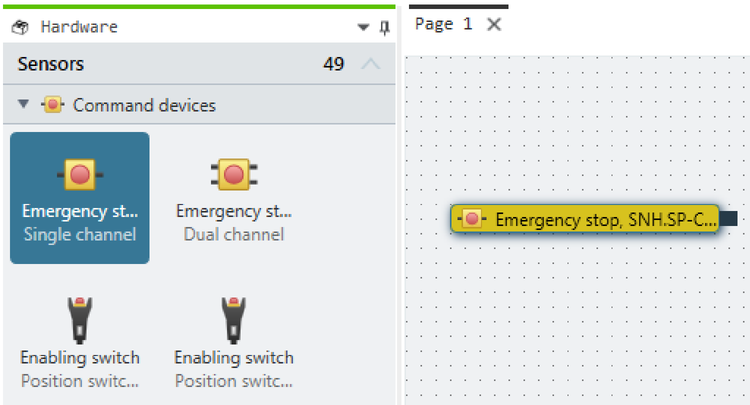
- You have opened the **Logic** view [A] with a logic page [B].
- You have opened the **Hardware** [C] docking window.
- With manual module configuration:
  You have also opened the **Modules** [D] docking window.

Procedure

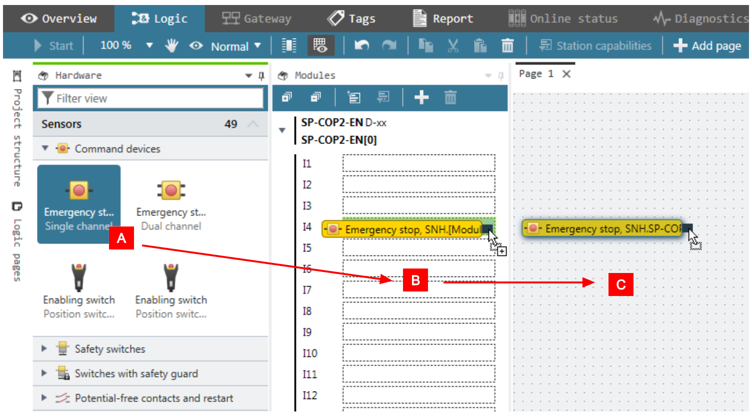
➡ In the **Hardware** docking window select an actuator or sensor (e.g. **Emergency stop**).



➡ With automatic module configuration:
Drag the selected element with your mouse directly onto the open logic page in the **Logic** view.



➡ With manual module configuration:
Drag the selected element [A] with a single mouse movement to a suitable output or input in the **Modules** [B] docking window and immediately continue with the **Logic** [C] view.



Results

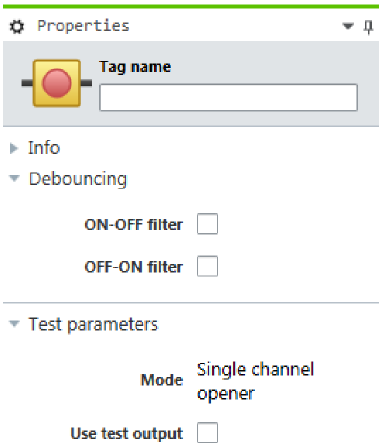
- **With automatic module configuration**
  In the **Modules** docking window, samos® PLAN 6 automatically creates the minimum required module configuration, required for the sensors and actuators used, and assigns the corresponding inputs and outputs.
  If you then later change the hardware selection, samos® PLAN 6 automatically ensures the correct module selection. Depending on the change made, samos® PLAN 6 will select an appropriately higher module version (Upgrade) or an appropriately lower module version (Downgrade) as minimum requirement.
- **With manual and automatic module configuration**

You can change the assignment of the inputs and outputs at any time in the **Modules** docking window by re-sorting the assignments using drag & drop.

Next steps

You can parametrize the inputs and outputs located on a logic page:

- On the logic page, select the element that you want to parametrize.
- Open the **Properties** docking window.



- Set the required parameters in the **Properties** docking window.
  For information on available parameter options, read: *Parameter options for sensors and actuators [ch. 6.3.1.2, p. 96]*

6.3.1.2 Parameter options for sensors and actuators

The following parameters are available for sensors and actuators. Depending on the type of element, they will vary in scope and selection:

Tag name

If you do not assign your own tag name, the default tag name will be used.

Synchronous time

Two-channel elements can be selected with or without synchronous time. Synchronous time determines how long the two inputs will be allowed to have discrepant values after one of the two input signals has changed its value without this being evaluated as an error.

Detailed information on synchronous time monitoring by the I/O modules: *Two-channel evaluation and synchronous time [ch. 6.3.1.2.1, p. 99]*

Procedure

- Enter a value between 0 and 30000.

Info

For elements which are connected to modules of the SP-SDI or SP-SDIO class, the following limitations apply:

The value for synchronous time can be set to 0 = deactivated or to a value of 4 ms to 30 s. Due to the internal evaluation frequency of the modules, the value is automatically rounded up to the next-higher multiple of 4 ms.

If signals of tested sensors are connected to modules of the SP-SDI or SP-SDIO class, the synchronous time must be greater than the test gap + the max. OFF-ON delay of the test output used. You can find these values in the project report under **Configuration, I/O module, Test pulse parameter**.

If you attempt to set a synchronous time that is less than permitted, the minimum value will be displayed in the dialog window.

On-Off filter or Off-On filter

Upon the opening or closing of a contact-based component, multiple short signal changes will undesirably result due to the bounce of the contacts. Because this can influence the evaluation of the input, you can use the **On-Off** filter for falling edges (i.e., transitions from high to low) and the **Off-On** filter for rising edges (i.e., transitions from low to high) in order to eliminate this effect.

Procedure

➡ Activate or deactivate the corresponding checkboxes.

Info

- Once the **On-Off** filter or the **Off-On** filter is active, then a change in the signal is only recognized as such when it is confirmed by three identical evaluations of the input directly after one another with an evaluation frequency of 4 ms, i.e. when the signal is constantly present for 8-12 ms.
- When there are two-channel elements with a discrepancy evaluation, the respective filter (On-Off or Off-On) always relates to the lead channel. The filter for the complementary channel is automatically active.

WARNING

Be aware of the extended response times if you use the input filter!

- Due to the internal evaluation frequency of the modules of 4 ms, the On-Off filter and the Off-On filter will extend the response time by at least 8 ms.
- If the signal changes within this initial 8 ms, then the signal change can be delayed significantly longer, i.e. until a constant signal of at least 8 ms has been detected.

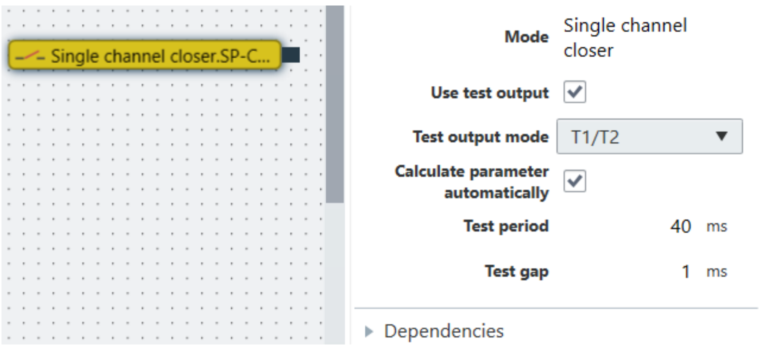
Using test outputs

By activating or deactivating the **Use test outputs** option, you can determine whether the respective element will be tested or not. By connecting an element to the test outputs ...

- short-circuits in the sensor cabling for the operating voltage that could prevent the switch-off condition can be detected
- electronic sensors with test inputs can be tested.

Procedure: Using test outputs

Example: **Single channel closer** sensor



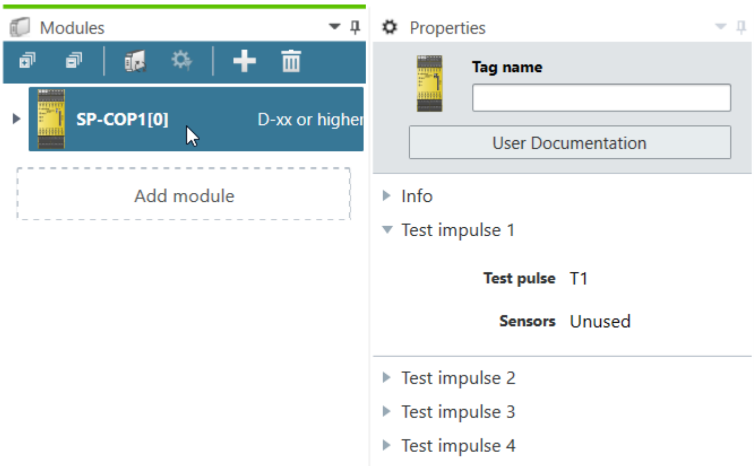
➡ Select the desired element in the **Logic** view.
Here: **Single channel closer** sensor

➡ Activate the **Use test output** option in the properties.

⇨ The configuration options for the test outputs are displayed.
The **Define parameters automatically** option is activated by default.

➡ If you wish to configure the test period and test gap manually, deselect the **Define parameters automatically** checkbox and enter the desired values.

You can view the configuration for the test parameters both in the properties of the sensor or actuator and the properties of the associated module.



Note

A module of the SP-SDI class only has two test sources, even though it has eight test output terminals.

Safety information

WARNING

Protect single-channel inputs against short-circuits and cross-connections!

When a short-circuit to high occurs at a single-channel input with test pulses that were previously low, this signal can then look like a pulse for the logic. A short-circuit to high means that the signal is first to high and then is back to low after the error detection time. A pulse can be generated due to the error detection.

Because of this, note the following specifications for single-channel signals with test pulses:

- If the short-circuit to high occurs at a single-channel input with test pulses that was previously high, this signal for the logic then looks like a delayed falling edge (transition from high to low).
- If a single channel input is used and an unexpected pulse or delayed falling edge (High to Low) could lead to a risky situation at this input, then you must take the following measures:
  - Protected cabling for the signal in question (in order to prevent cross-connections with other signals)
  - No cross-connection detection, i.e. no connection to a test output.
    This must be noted in particular for the following inputs:
  - Input reset at the function block reset
  - Input restart at the function block restart
  - Restart input at the function blocks for press applications (contact monitor, excenter, universal press contact monitor, cycle operation, press setup, single stroke monitoring, press automatic)
  - Override input at a function block for muting
  - Reset input at a function block for valve monitoring
  - Reset inputs to zero and set to start value on a counter function block

Deactivating test pulses

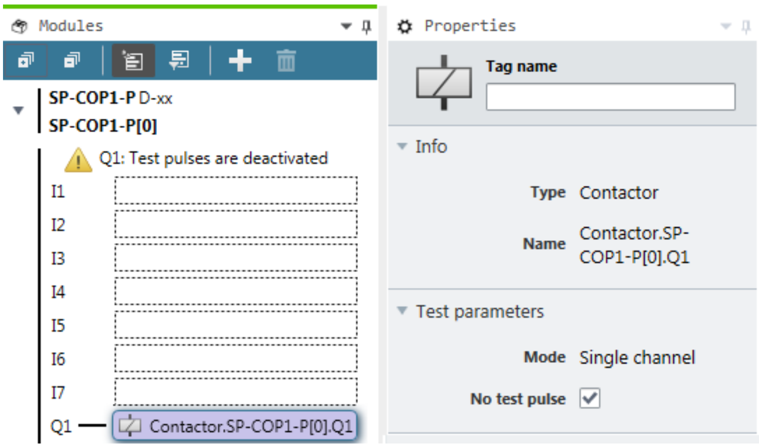
It is possible to deactivate the test pulse of one or more outputs of modules of the SP-COPx or SP-SDIO types with module version B-01 and higher.

WARNING

Deactivating the test pulses at any of the outputs reduces the security parameters of all the outputs!

- Deactivating the test pulses at one or more outputs of an SP-SDIO module reduces the safety parameters of all Q1...Q4 outputs of this module. Be aware of this in order to ensure that your application corresponds to an appropriate risk analysis and risk avoidance strategy!
- The deactivating of the test pulses at one or more outputs of an SP-COPx module reduces the safety parameters of the relevant outputs. Be aware of this in order to ensure that your application corresponds to an appropriate risk analysis and risk avoidance strategy!
  You can find more detailed information on the safety parameters in the Hardware manual.

Procedure



➡ Click on the output whose test pulses you want to deactivate.

➡ Open the **Properties** docking window and activate the **No test pulse**s checkbox in the configuration dialog.

⇨ A warning message appears on the controller module in the **Modules** docking window.

6.3.1.2.1 Two-channel evaluation and synchronous time

The modules, e.g. SP-COPx, SP-SDIO or SP-SDI, can undertake a dual channel evaluation if pre-defined input sensor elements are placed from the **Hardware** docking window (e.g. solenoid switches or safety light curtains). When this type of input sensor element is selected, then you do not require a separate function block for the dual channel evaluation (e.g. light curtain evaluation, switch evaluation, or solenoid switch).

The dual channel evaluation checks the correct sequence of the two input signals. When one of the two signals has effected a switch-off, then it is expected that the other signal will follow accordingly. The question as to what values the two signals must have depends on the type of two-channel evaluation. There are two options:

- Equivalent evaluation
- Discrepant evaluation

A **Synchronous time** can be configured as an option. Synchronous time determines how long the two inputs will be allowed to have discrepant values after one of the two input signals has changed its value without this being evaluated as an error.

NOTICE

The following must be noted during the configuration of the synchronous time:

- The synchronous time must be a multiple of 4 ms.
- When signals from tested sensors are connected to safe modules (e.g. SP-SDI) the synchronous time should be at least the set **Test gap** [ms] plus the **Max. Off-On delay** [ms] because a signal change at the input to this module can be delayed by this time.
  Both values are displayed in the samos® PLAN 6 report for the test output used.

The following truth table describes the synchronous time conditions for the dual channel equivalent and the dual channel discrepant input assessment:

Table 26: Dual channel evaluation

Evaluation type	Input A	Input B	Synchronous time timer[2)]	Status of the two-channel evaluation	Input to the I/O module in the "Logic" view	Synchronization time error
Equivalent	0	0	0	Inactive	0	Unchanged[3)]
	0	1	< Synchronous time	Discrepant	0	Unchanged
	1	0	< Synchronous time	Discrepant	0	Unchanged
	1	1	0	Active	1	0
	x	y	≥ Synchronous time (timeout)	Error	0	1
Discrepant	0	1	0	Inactive	0	Unchanged
	0	0	< Synchronous time	Discrepant	0	Unchanged
	1	1	< Synchronous time	Discrepant	0	0
	1	0	0	Active[4)]	1	Unchanged
	x	x	≥ Synchronous time (timeout)	Error	0	1

[2)] If synchronous time is active (> 0), the synchronization time timer is restarted with the first signal change that leads to a discrepant state. When synchronous time is deactivated (= 0), the synchronous time timer does not start, i.e. a timeout will never occur.

[3)]Unchanged = The last state is retained.

[4)]If the correct sequence was retained.

The following rules apply to the transitions between the various states of the two-channel evaluation:

A dual channel evaluation can only be active (the input of the I/O module in the **Logic** view changes from low to high) if ...

- The status since the last active was inactive at least once; i.e. it is not possible to switch from active to discrepant and back to active; and
- Synchronous time has not expired or is deactivated.

NOTICE

If the correct sequence for reaching the active state has not been maintained (i.e. if the status has switched from active to discrepant to active), then modules of the SP-SDIO and SP-SDI class will indicate this sequence error within 100 ms at the latest if the synchronous time has not elapsed before this (i.e. if the synchronization time is set at 0 or to a value > 100 ms). Older modules will not show this sequence error; however, their input in the **Logic** view likewise remains at low.

In the event of a synchronization time error or a sequence error, the module will behave as follows:

- The MS LED for the respective module will flash **red** (1 Hz).
- The LEDs for the respective inputs will flash **green** (1 Hz).
- The **Input data status** of the module will be low in the **Logic** view.

Resetting the error:

A synchronous time error (timeout) or sequence error is reset when the inactive state was reached.

6.3.1.3 CPU flag

CPU flags are available as inputs and outputs in the **Logic** view. They can be used to create logical loopbacks, for example.

A CPU flag consists of an output flag and an input flag. The input flag always assumes the same value (**high** or **low**) as the corresponding output flag with a delay of a logic cycle (i.e. the logic execution time).

You can use input flags multiple times.

WARNING

Increased delay times can make the control unstable.

CPU flags always cause a delay of 1x the logic execution time. The reason for this is that the input flags always assume the value that the output flag had in the previous logic cycle.

- Always calculate the resulting delay when computing the response time and functionality.

6.3.1.4 Jump addresses

Jump addresses consist of a source jump address and a target jump address. The target jump address assumes the same value (**high** or **low**) as the corresponding source jump addressed without delay – provided it does not involve a loopback. In this respect, jump addresses differ from CPU flags.

You can use jump addresses in order to interconnect components that are on different logic pages.

You can use target jump addresses multiple times.

6.3.1.5 Internal inputs for controller modules

For SP-COP type modules that you install as hardware, the following internal inputs are available in the logic.

Location

You can find the internal inputs in the **Inputs** section of the **Logic** docking window:

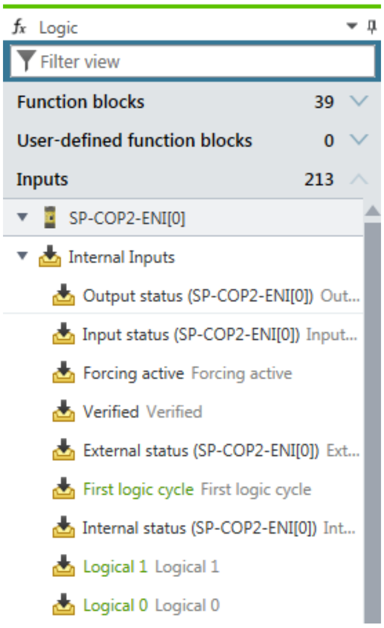


Illustration 27: Status bits

Reference

Table 27: Status bits and their values

Bit	Possible values
Output status	Indicates whether there is an error with respect to the output test pulses and the plausibility check or with internal outputs. • **1 (High):** No error • **0 (Low):** Error present.
Input status	Indicates whether there is a sequence error, synchronization time error, test pulse error, or an internal error at one of the inputs. • **1 (High):** No error • **0 (Low):** Error present.
First logic cycle	You can trigger initialization functions in the logic program using this input. • **1 (High):** First logic cycle after the transition from the **Stop** state into the **Run** state. • **0 (Low):** State during all other logic cycles.
External status	Indicates whether there is a B1, B2 voltage error and/or overcurrent error at the outputs. From A-03 onwards, errors of the output state or the input state can also be detected on this state bit. • **1 (High):** No error • **0 (Low):** Error present.

Bit	Possible values
Force active	Indicates whether the force mode is active. • **1 (High):** Force mode is active. • **0 (Low):** Force mode is not active.
Internal state	**1 (High)**
Logical 0 and logical 1	You can use these status bits in order to obtain a valid logical configuration when it contains functional block inputs that a) are not required and b) cannot be deactivated. • **Logical 0**: Permanently sets the input of a function block to **0** (low). • **Logical 1**: Permanently sets the input of a function block to **1** (high).
Verified	**Indicates whether the configuration is verified.** • **1 (High)**: Configuration is verified. The CV-LED on the controller module is permanently lit up in yellow. • **0 (Low)**: Configuration is not verified. The CV-LED on the controller module is flashing yellow at a 1 Hz cycle.

6.3.2 Connecting inputs and outputs with function blocks

If you have placed the required inputs and outputs in the **Logic** view, you can connect them using the function blocks provided by samos® PLAN 6 . Your logic programming is created in this way.

This section shows you how you can program simple logic in samos® PLAN 6 using an example.

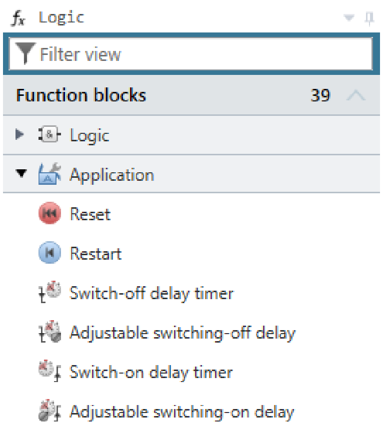
Requirements

The following inputs and outputs can be found in the **Logic** view:

Step 1: Select and place logic module

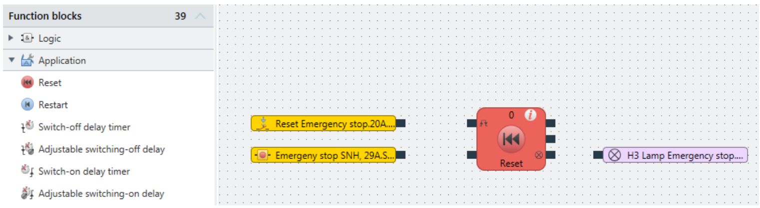
➡ Open the **Logic** docking window.

➡ Select the desired function block under **Function blocks**.



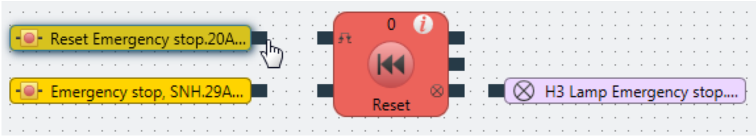
➡ Drag the function block onto the open logic page.

⇨ Because not all of the inputs are connected, the function block will be marked in red. In addition, the status display will indicate an error in the menu bar.

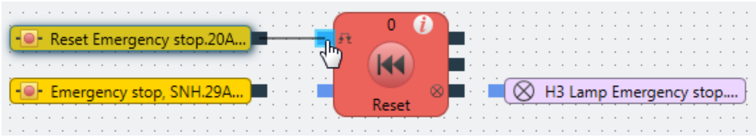


Step 2: Connecting the inputs and outputs using the function block

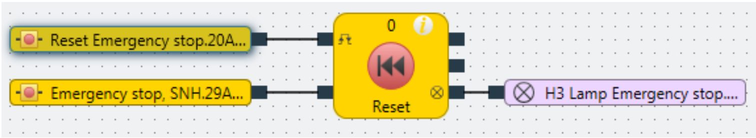
- ➡ Using the mouse, click on the node of an input and push and hold the mouse key.
  - ⇨ A hand icon will appear.



- ➡ Move the hand icon on to the input node of the function block and release the mouse key.
  - ⇨ The input and the function block will be connected with a line (logical connection).

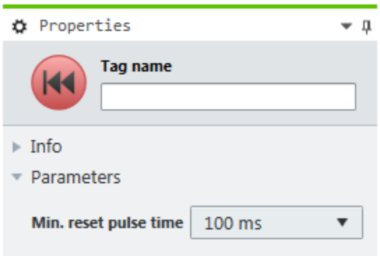


- ➡ In the same manner, establish the connection for the other input and for the output.
  - ⇨ As soon as all inputs of the function block are connected, the function block will be marked in yellow and the status display will no longer show an error in the menu bar.



Step 3: Parameterizing the logic module

- ➡ Click on the function block with the mouse.
- ➡ Open the **Properties** docking window.



- ➡ Set the required parameters in the **Properties** docking window.

NOTICE

Parameterizing reference for function blocks

You can find an extensive reference of the parameters here: *Referencing the function blocks [ch. 8, p. 157]*

Tips for working in the "Logic" view

Topic	Tip
Interconnecting elements	An alternative to the previously described procedure: Using drag-and-drop, move an input or output over the node of the function block to which the connection is to be established.
Placing components	You can move function blocks, inputs, and outputs anywhere you wish. Click on them with the mouse and move them to the desired location. As a placement aid, you can activate the grid points in the command bar.
Adding notes	You can save text notes anywhere. To do this, click with the right mouse key on the empty background of the work area and select the **Add note** entry in the context menu. You can also add interactive display values to your notes. Further information: *Integrating active display values in the notes [ch. 6.3.7, p. 120]*
Working with multiple pages	In order to maintain an overview of an extensive project, you can create additional pages in the **Logic** view. • Creating a new page: In the command bar, click on **+ Add page** • You can generate connections between the pages using a CPU flag or jump addresses.
Deleting connections	To delete a project component or a connection: • Click on the element. • Press the button: **Del**.
Paste tag names directly in the **Logic** view	Double click on the input or output and write the desired tag name directly in the element.

6.3.3 Grouping function blocks

You can select groups of function blocks in order to convert them into a single grouped function block. This is useful for simplifying repeated use of logic groups and for reducing the number of function blocks on one page.

Function block diagram

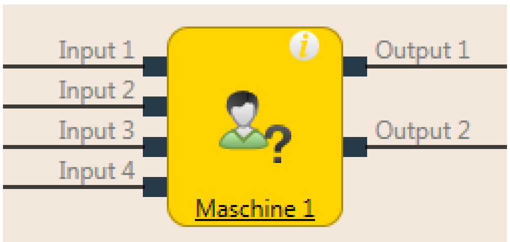


Illustration 28: Logical connections for grouped function block

Properties

A grouped function block has the following properties:

- It can have a maximum of 16 inputs and 16 outputs.
- It cannot contain the fast shut-off function block or a different grouped or user-defined function block.
- The symbol for a grouped function block can be selected from a permanent library in samos® PLAN 6.
- It is created in the **Logic** view but is not displayed in the list of function blocks (**Logic** docking window) .
- It is stored with the project. If the project is opened on a different PC, the grouped function block will be displayed.
- It can be stored as a user-defined function block.

NOTICE

When calculating the total number of function blocks in a project, a grouped function block is not counted as one block but rather as the number of function blocks used within it.

This is how you create a grouped function block

➡ Select the function blocks to be grouped together in the **Logic** view.

➡ Activate the context menu by right clicking on one of the selected function blocks.

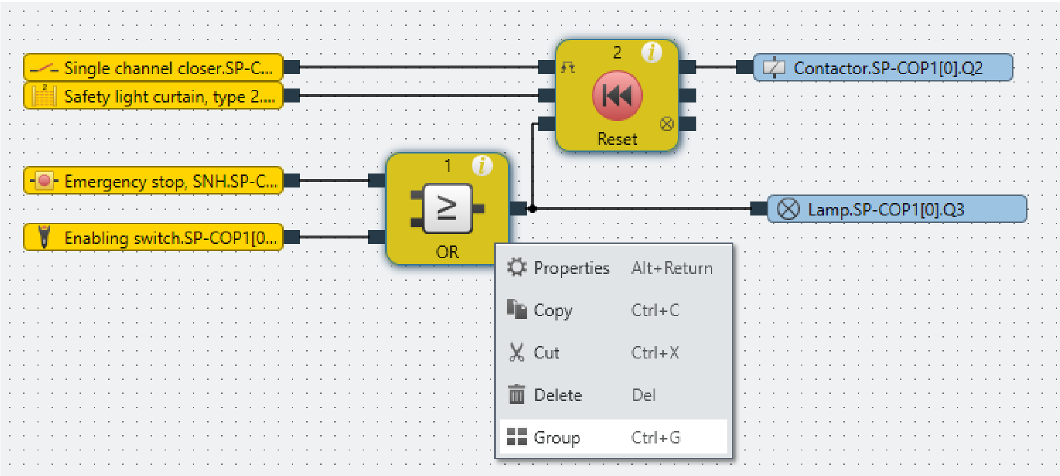


Illustration 29: Creating a grouped function block

➡ Click on **Group...**

⇨ The **Grouping** dialog will open.

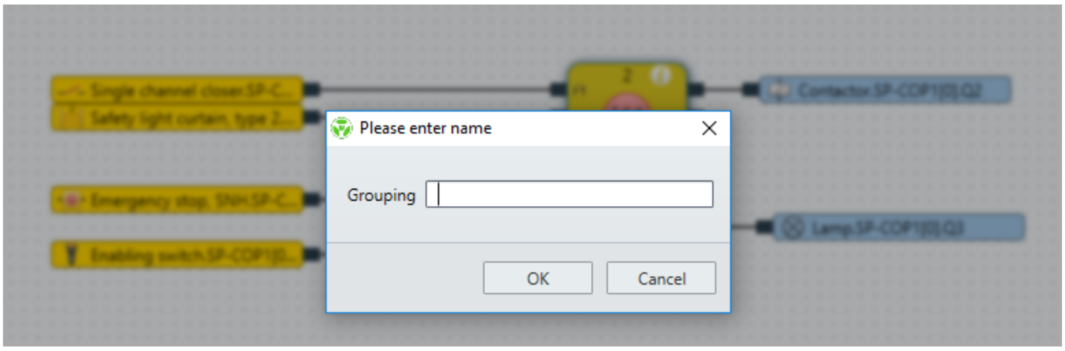
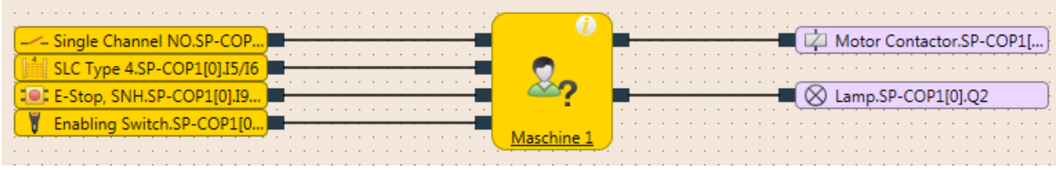


Illustration 30: Dialog for editing function block details for the grouped function block

➡ Enter a name for the new grouped function block.

➡ Within the dialog, click on **OK** to confirm your changes and close the dialog.

⇨ The selected function blocks will be reduced to a single grouped function block on the worksheet for the main program.

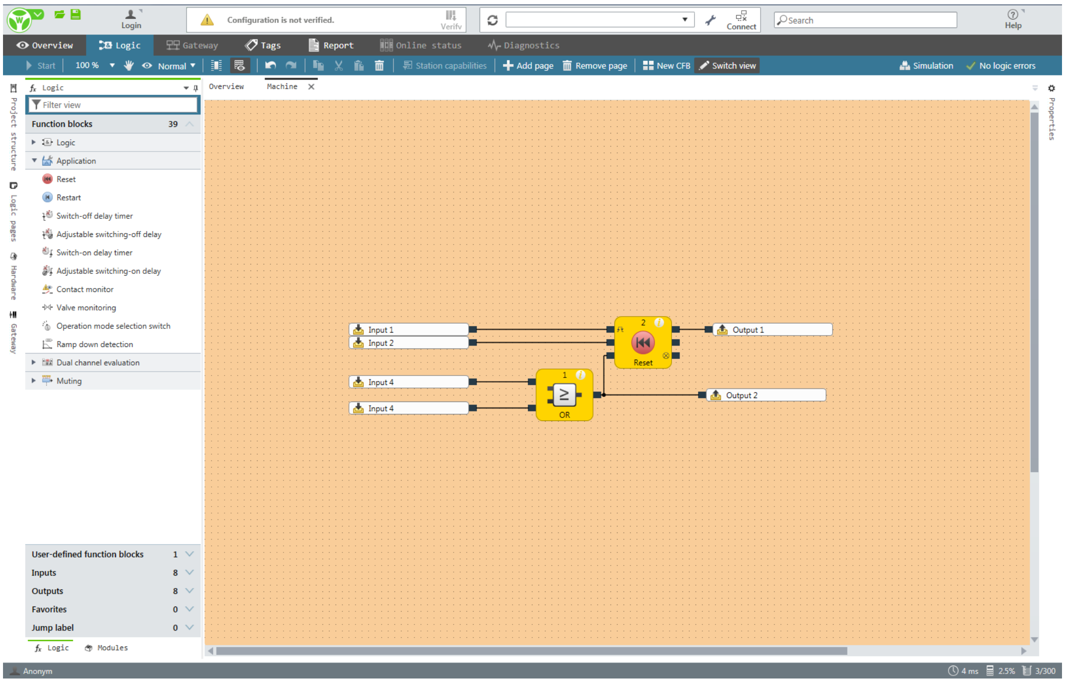


NOTICE

The name of the grouped function block can be edited here by clicking on the icon of the function block and then **Edit**.

When you click on the corresponding tab (in this case: **Machine 1**), you can edit the grouped function block.

The content of the new grouped function block will be saved on a new page. In the example, the name of the new grouped function block is **Machine 1**. The work area of the grouped function block is displayed in orange.



This is how you can add inputs and outputs to a grouped function block.

➡ Click on the tab for the grouped function block in the **Logic** view.

➡ Open the **Logic** docking window.

➡ From the **Inputs** and **Outputs** sections, drag the desired elements onto the logic page of the grouped function block.

➡ Connect the inputs and outputs as required with the grouped function block.

➡ In order to change the tag name of the inputs and outputs used:
Click the desired element and write the desired designation in the **Tag name** entry field in the **Properties** docking window.

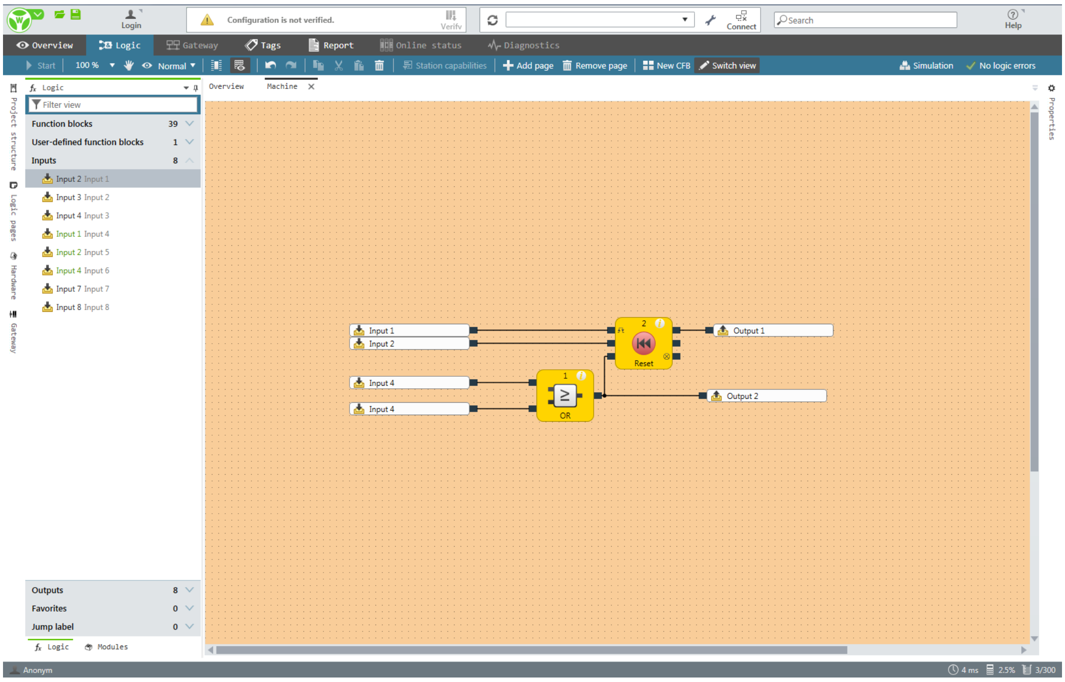


Illustration 31: Adding inputs and outputs to a grouped function block

Inputs and outputs added to the grouped function block are displayed in the main program for the function block itself and devices can be connected to it. As soon as the device has been connected, it is displayed in the logic of the grouped function block when the **External view** is displayed.

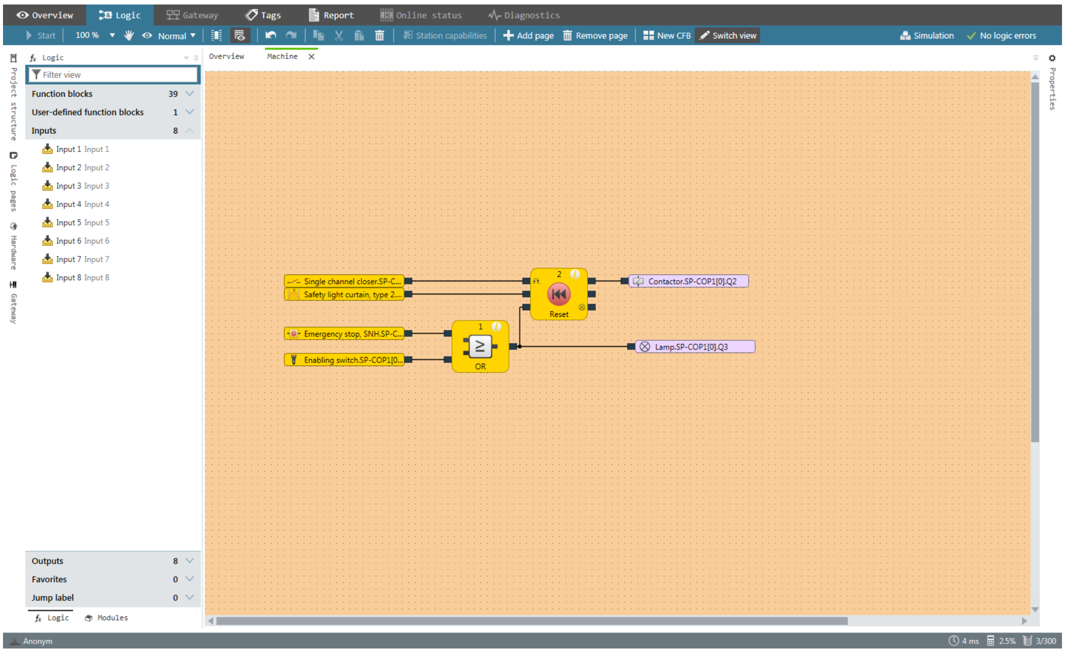


Illustration 32: Grouped function block with connected devices

In order to toggle between the internal tag name of the grouped function block (internal view) and the external I/O descriptions (external view), click on **Change view** in the toolbar.

- The **Internal view** indicates the tag name of the grouped function block for its inputs and outputs.
- The **External view** indicates what is connected to the grouped function block.

This is how you can transfer a grouped function block to another PC:

➡ Save the project and open it on the other PC. The grouped function blocks contained in the project will automatically be imported.

6.3.4 Automatic logic check

samos® PLAN 6 automatically checks the logic programming in your project. Connection errors are checked; other errors are not detected.

As long as the configuration is not valid, it will not be possible to start simulation mode or to transfer the configuration.

Important security information

WARNING

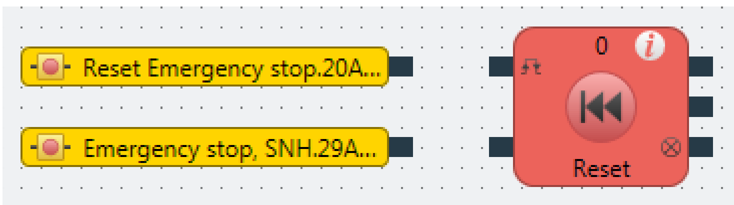
Check your application thoroughly for correctness!

Because the samos® PLAN 6 only checks for logic-internal connection errors, you have to check the following aspects systematically yourself:

- Does your application correspond to the results from the risk analysis and the avoidance strategy?
- Have all of the applicable standards and guidelines been complied with?
  If not, you are placing the machine's operator in danger.

Displaying errors

If there is a connection error, you can see this in several locations within the software:

Display	Explanation
Status display in the menu bar	If there is a connection error, the status display will show the following message:  You will always see this display regardless of which view is currently act-ive.
Logic command bar, outside right	If there are errors present, this display shows the number of function blocks having the connection errors. 
Logic view	Pages that have a connection error have a warning symbol displayed in the tab:  Function components at which one or more inputs are not connected are shown in red. 

Eliminating connection errors

➡ Connect all of the inputs at function blocks to the corresponding hardware inputs.

⇨ The function blocks are shown in yellow.

⇨ The error message in the **Logic** command bar and in the menu bar will be deleted.

6.3.5 User-defined elements

In addition to the standard elements in the **Hardware** and **Logic** docking windows, it is also possible to create, configure, import, and export user-defined elements. This function makes it possible for you to create your own elements with preset configuration options (e.g. single-channel or dual channel evaluation, synchronous time, On-Off filtering, connection to test outputs, etc.) that comply with the requirements of your individual equipment.

6.3.5.1 Creating I/O elements

Step 1: Creating a new library

➡ Open the **Hardware** docking window.

➡ Click on the **User-defined elements** section heading.

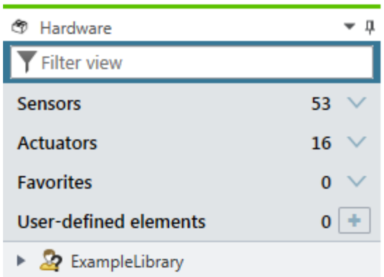
⇨ The **Add** icon will appear to the right next to the section heading.

➡ Click on the **Add** icon.

⇨ The **Please enter name** window will open.

➡ Enter a name and click on **OK.**

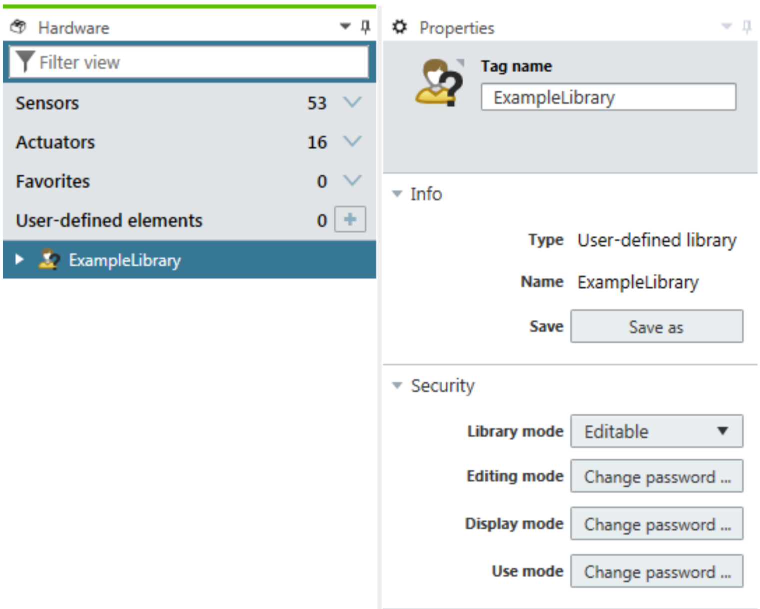
⇨ Underneath the **User-defined elements**, a new library will appear.



Step 2: Specify the properties of the library

➡ Click on the newly created library.

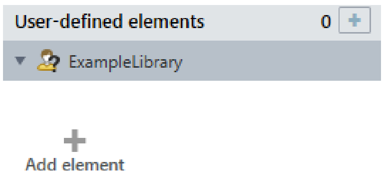
➡ Open the **Properties** docking window and use it to configure the properties required.



- **Security** section:
  Make the following security settings for the library.
  You can define different access modes and assign respective of passwords for them.
- **Info** section:
  Click on the **Save** button and back up the library (file format: *.**SPI**).

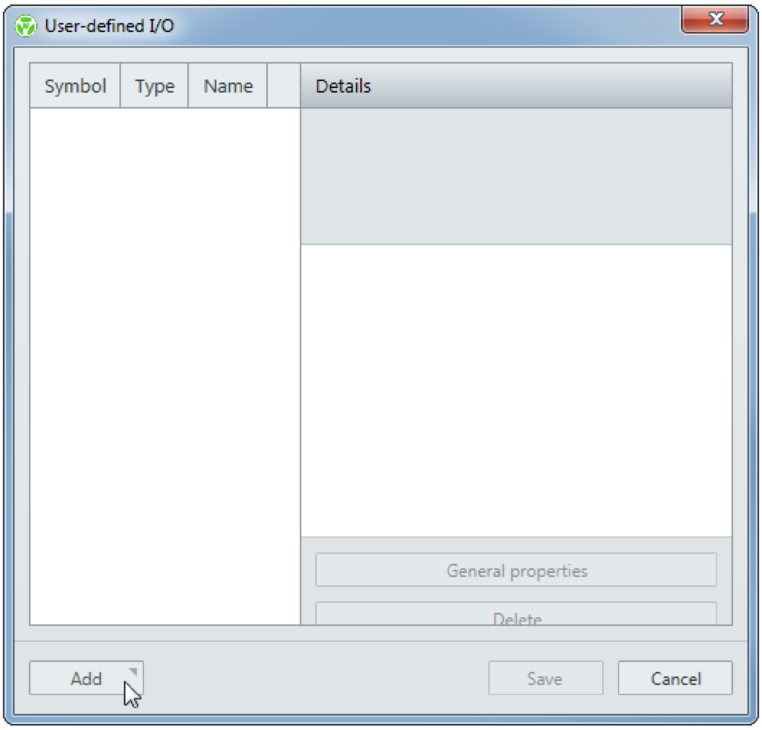
Step 3: Create and configure a new element

➡ Open the newly created library by clicking on the **Arrow** symbol.

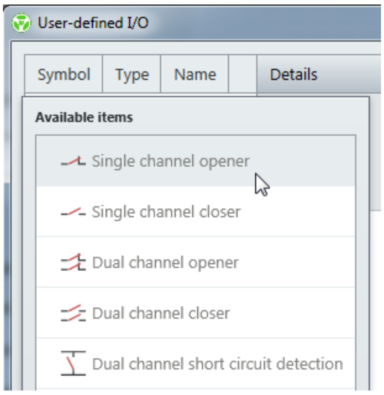


➡ Click on **Add element**.

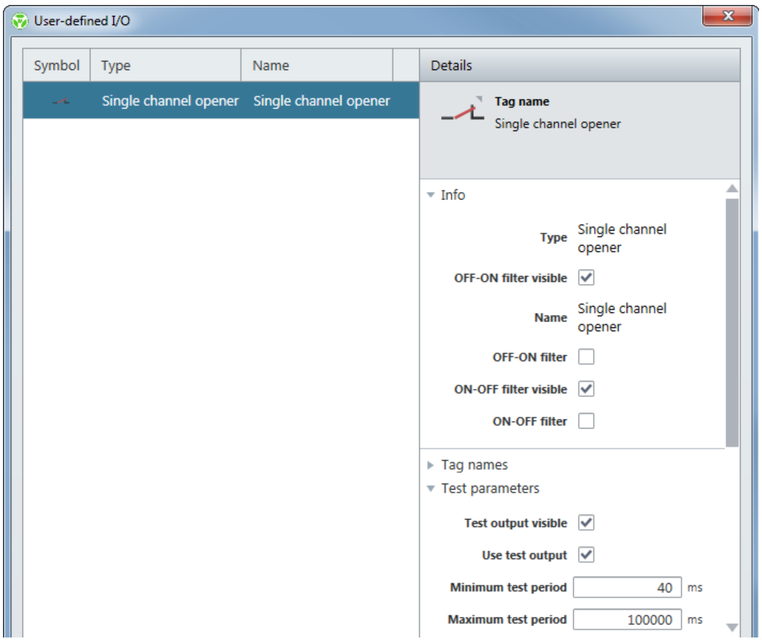
⇨ The configuration dialog will open.



➡ Click on **Add** and click on the desired element type in the **Available elements** dialog.



⇨ The selected element is inserted into the configuration dialog overview.



➡ Click on the element in the overview.

➡ Enter the chosen parameters for the added element in the **Details** column.
The type and scope of the parameters is different, depending on the element type.

You can obtain more detailed information on the element types and their parameters in the **Hardware** manual.

6.3.5.2 Creating and managing user-defined function blocks

Once you have created a grouped function block (*Grouping function blocks [ch. 6.3.3, p. 106]*), you can protect it against changes and import it into the selection list of function blocks to use it in future projects. The resulting function block is called a user-defined function block.

Function block diagram

Illustration 33: Logical connections for a user-defined function block

A user-defined function block has the following properties:

- It can have a maximum of 8 inputs and 8 outputs.
- It cannot contain the fast shut-off function block or a different grouped or user-defined function block.
- The symbol for a user-defined function block can either be user-defined or it can be selected from a permanent library in samos® PLAN 6.
- The user-defined function block is created in the **Logic** view and displayed in the selection list of function blocks (**Logic** docking window).
- When you open a project containing the user-defined function blocks on a different PC, you have the following options:
  - You can import the user-defined function blocks into the selection list of function blocks on the new PC in order to use them in other projects.
  - Or you can import the user-defined function blocks for this project only. In this case, they will not be displayed in the selection list of function blocks.

NOTICE

When calculating the total number of function blocks in a project, a user-defined function block is not counted as one block but instead as the number of function blocks used within it.

This is how you create a user-defined function block

In order to create a user-defined function block, you must have previously created it as a grouped function block (see *Grouping function blocks [ch. 6.3.3, p. 106]*).

➡ Open the view of the grouped function block by clicking on its tab.

➡ In the toolbar, click on **New CFB....** The **Function block details** dialog will open.

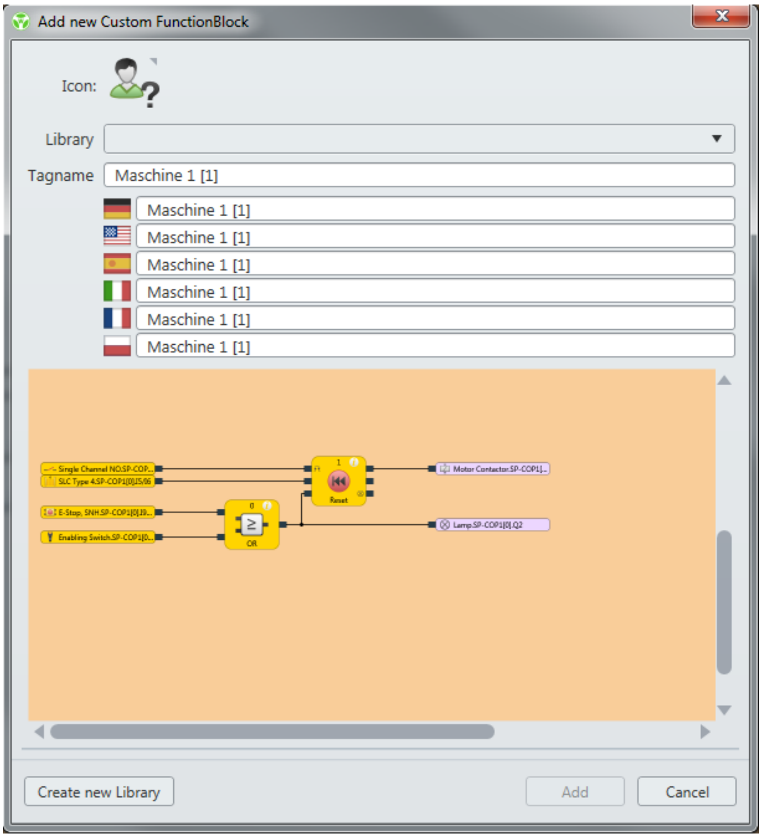
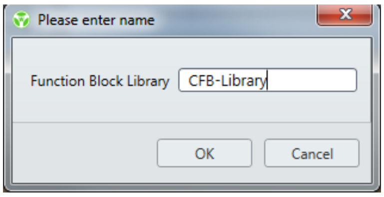


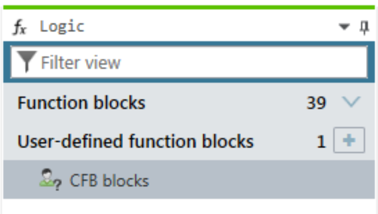
Illustration 34: Dialog for editing function block details for the user-defined function block

➡ Enter a name for the new user-defined function block.

➡ If you have not created any libraries for user-defined function blocks, on the bottom left click on **Create new library** and assign a name for the library in the subsequent dialog window.



⇨ In the **Logic** docking window a user-defined function block appears in the selected library.



This is how you can edit the properties of a function block library

After you have given the library a name, you can set the library mode. This mode determines the properties of all of the function blocks contained in this library.

- Editable
- Use and display

- Use
- Protected

In addition, user rights can be assigned for access to the various properties of the function blocks.

Function block libraries can be saved with the **Save as** command in the **Properties** docking window.

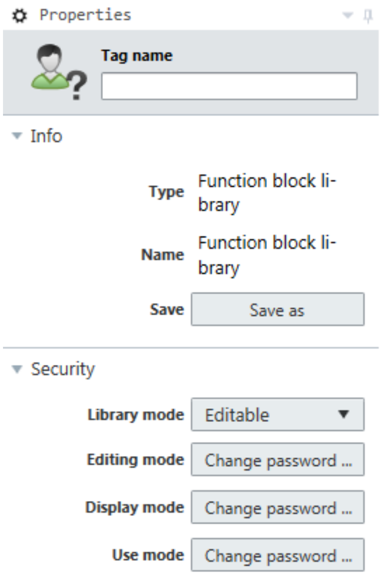


Illustration 35: Editing a library for user-defined function blocks

When a user-defined function block is placed in the **Logic** view, its content is displayed on a new page. In the example, the name of the user-defined function block is **Machine 1**. The work area of the user-defined function block is displayed in orange. The options of use, display, and edit for a user-defined function block depend on the parameters of the library from which the function block comes.

This is how you edit a user-defined function block

- The user-defined function block can be edited the same as a grouped function block, provided the user rights for the respective library allow this.
- A subsequently edited user-defined function block can be re-saved by clicking on **New CFB** in the toolbar.

This is how you can permanently delete a user-defined function block from your PC

➡ Delete all occurrences of the user-defined function block on your computer or convert each individual one into a grouped function block by clicking on **Edit....** in the toolbar.

➡ Using the right mouse key, click on the user-defined function block that you wish to delete in the selection list of function blocks. The context menu will open.

➡ Select the **Delete user-defined function block** command.

NOTICE

You cannot undo this command!

You will still be able to use other projects containing the deleted user-defined function blocks. If you open an older project containing the user-defined function blocks that have been deleted from your PC, it will be treated as a project that was transferred from another PC. You will be asked whether you wish to import the user-defined function blocks in the project permanently as user-defined function blocks or as grouped function blocks for use in the current project only.

6.3.5.3 Exporting and importing user-defined elements

You can export libraries with user-defined elements that you have created in and import them into a different installation of samos® PLAN 6.

File format

- I/O elements: *.SPI
- Function blocks: *.SPL

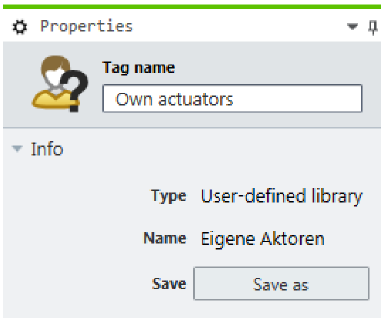
Transferring user-defined libraries to a different PC (exporting)

➡ Open the **Hardware** or **Logic** docking window.

➡ From there, click on the library you wish to use in a different installation of the samos® PLAN 6 software.

➡ Open the **Properties** docking window.

⇨ You will see the configuration dialog for the selected library.



➡ Click on **Save as**.

⇨ Windows Explorer will open.

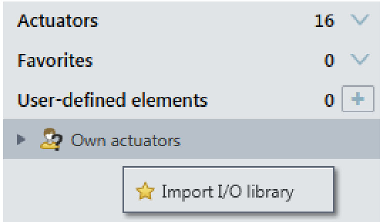
➡ Save the library at the desired location.

Importing user-defined libraries

➡ Open the **Hardware** or **Logic** docking window.

➡ Click on **User-defined elements** or **User-defined function blocks** with the right mouse key.

⇨ The context menu will open.



➡ In the context menu, click on **IO-Import library** or on **Import function block library**.

⇨ Windows Explorer will open.

⇨ You can search for the library using Windows Explorer and select it.

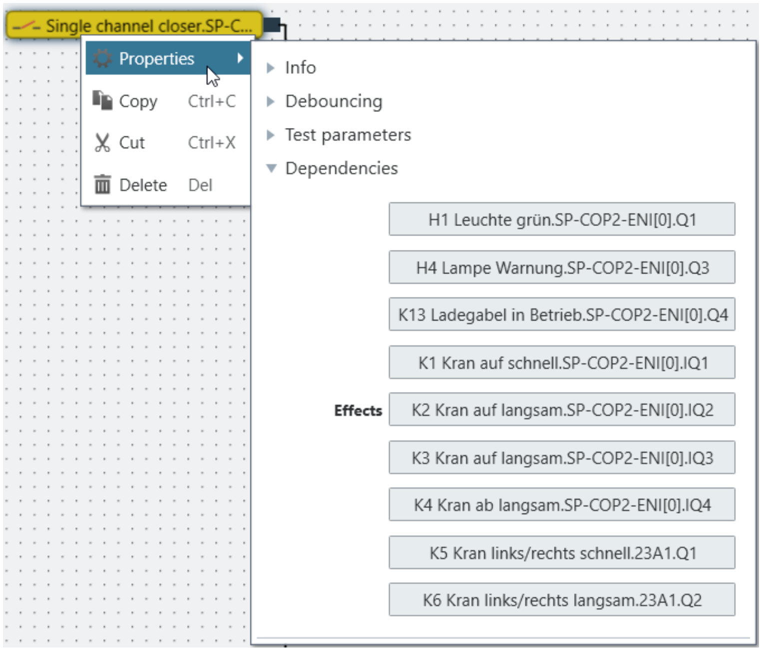
6.3.6 Viewing the dependencies between sensors and actuators

You can view the dependencies between the sensors and actuators used in the logic programming in their respective properties.

Example 1: Sensor (single channel closer)

All actuators affected by this sensor are listed in the **Dependencies** section of the sensor's properties.

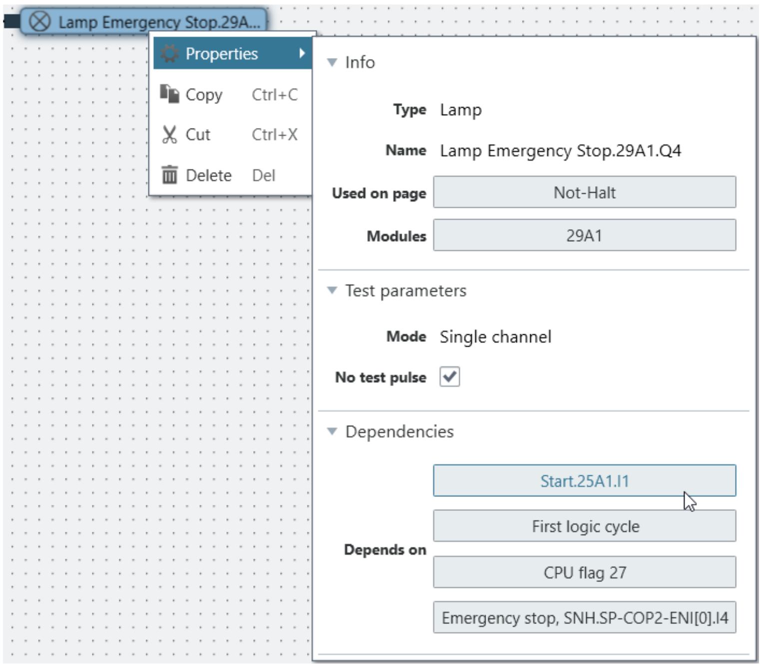
You can jump straight to one of the displayed actuators simply by clicking directly on it.



Example 2: Actuator (lamp)

All sensors that this actuator is dependent on are listed in the **Dependencies** section of the actuator's properties.

You can jump straight to one of the displayed sensors simply by clicking directly on it.


Lamp Emergency Stop.29A...
Properties
Copy Ctrl+C
Cut Ctrl+X
Delete Del
Info
Type Lamp
Name Lamp Emergency Stop.29A1.Q4
Used on page Not-Halt
Modules 29A1
Test parameters
Mode Single channel
No test pulse
Dependencies
Depends on
Start.25A1.I1
First logic cycle
CPU flag 27
Emergency stop, SNH.SP-COP2-ENI[0].I4

6.3.7 Integrating active display values in the notes

You can integrate active values that show the live values of the connected function blocks in the notes for your logic programming.

Example

The values marked in red are real-time values for the inputs of these function blocks. In other words, if the input current changes when the control is connected, the active display values simultaneously reflect this change.

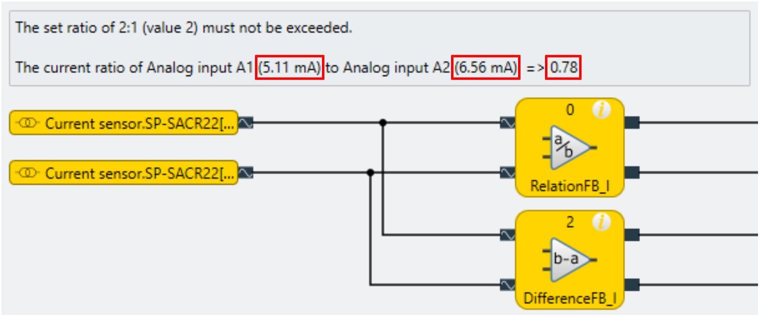


Illustration 36: Note with active display values

Function

- The active display values help you to configure and monitor your project.
- Depending on the function block, you can select different display values to then be displayed in the regular note, e.g. input values, times or number of different events.
- You can also enter static text in the note in the normal way, e.g. as an explanation for the display values.
- The live values selected from the function blocks are then displayed in the note.

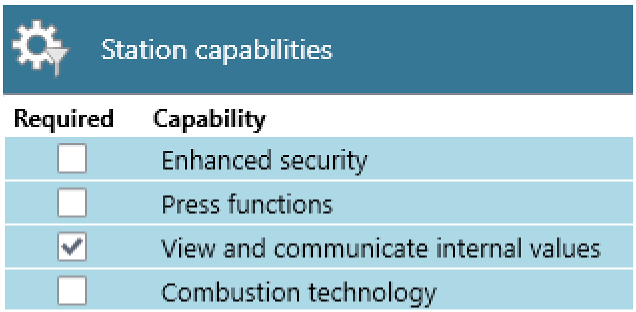
NOTICE

You can only select and add the active display values to your logic controller during configuration.

Requirement

- Your logic controller is fully operational.

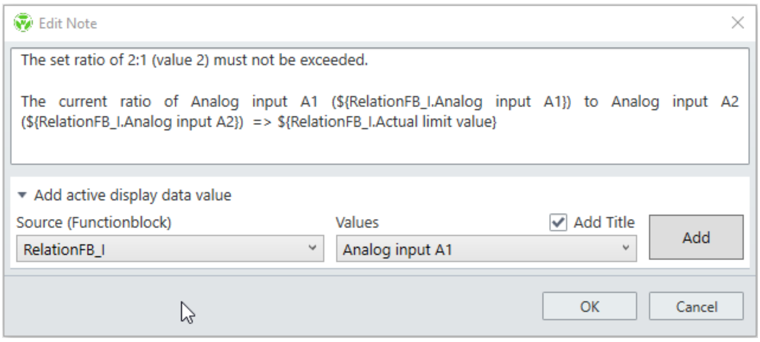
- "View and communicate internal values" is activated under Station capabilities.



Procedure

Add the active display values as follows:

- Create a note and open the **Edit note** window.
- Click **Add active display values**.
- Select the required function block as the **Source** and then the display value under **Values**.



- Click **Add**.
  - ⇨ A variable is added to the **Edit note** window. This consists of: *${Function block[Identifier].value}*
  - ⇨ The active display values appear in the note in the Logic view.

Recommendation: Assign unique tag names for function blocks

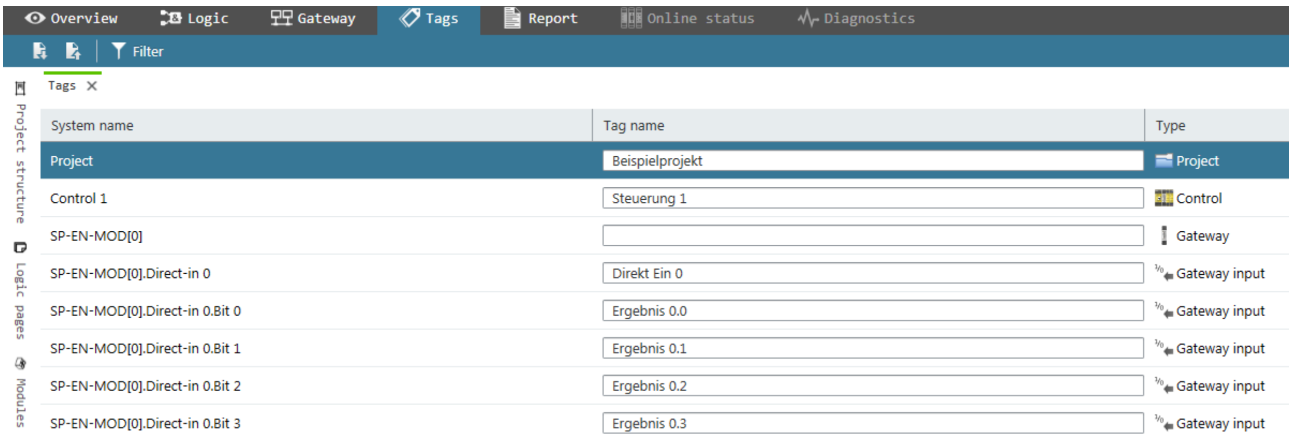
If you have not allocated a tag name to the function block, the index of the function block is selected as the identifier by default. If additional function blocks are added, the index of the function blocks may change. However, this change is not adopted in the variables for the active display values. It may not be possible to display the value or the value may not correspond to your intended display value.

Therefore, always use appropriate, unique tag names for your function blocks in your logic programming.

6.4 Adapting display names of project components

At any time while working with samos® PLAN 6, you can adapt the display names of project components to your information requirements.

The **Name** view is particularly well suited to this task, since, within a window, you can here see all the project components as a linear list and you can thus assign the desired new designations element by element.



Requirement

In the naming scheme of the element, for which you want to change the display name, the **Tag** element is used.

Detailed information: *"Tags" view [ch. 5.3.4, p. 35]*

Procedure

- ➡ Switch to the **Name** view.
- ➡ Select a project component containing the display names that you would like to adapt and click on the **Tag name** in the input field.
- ➡ Enter any desired character string into the input field.
  - ⇨ Depending on the selected project component, either the entire name or only part of the display name changes (see *"Tags" view [ch. 5.3.4, p. 35]*).

6.5 Saving individual content for the report

Information regarding selected elements can be entered in the **Properties** docking window. This is included in the report and is shown with the respective element under the **User documentation** heading.

The documentation function is available for the following elements:

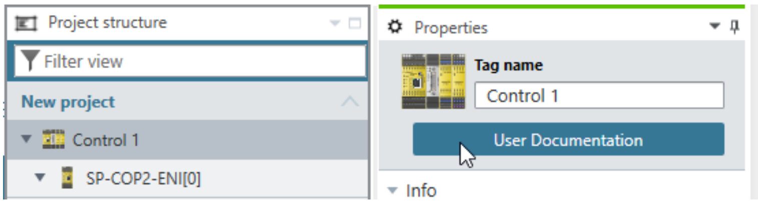
- Controller
- Modules used in the **Module** docking window
- Logic pages
- Function blocks used on a logic page

Calling up the documentation function

➡ Use the mouse to select one of the elements mentioned above.

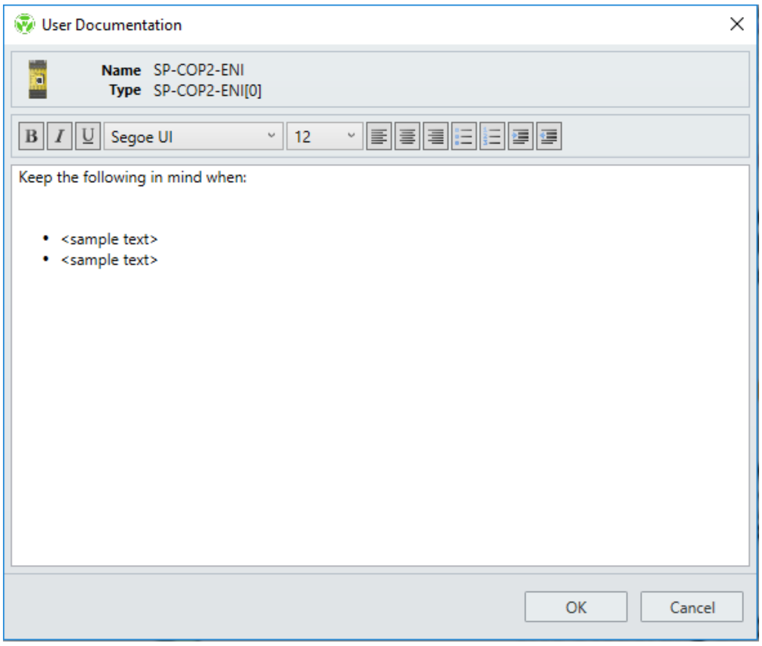
➡ Open the **Properties** docking window.

➡ Click on the **User documentation** button.

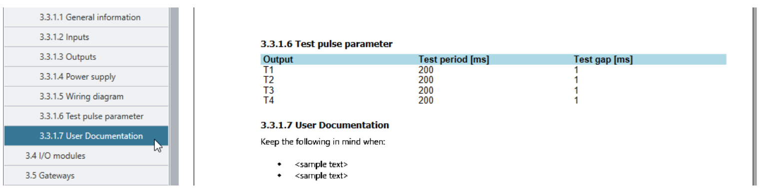


⇨ The **User documentation** editor will open.

⇨ You can format text by using the buttons in the command bar of the editor.



Display in report



6.6 Simulating logic programming

You can use the simulation mode to check your programming logic off-line. You can start the simulation mode in the **Logic** view.

During the simulation, the inputs are set to low or high by mouse click. The subsequent switching of the output can be seen in the **Logic** view.

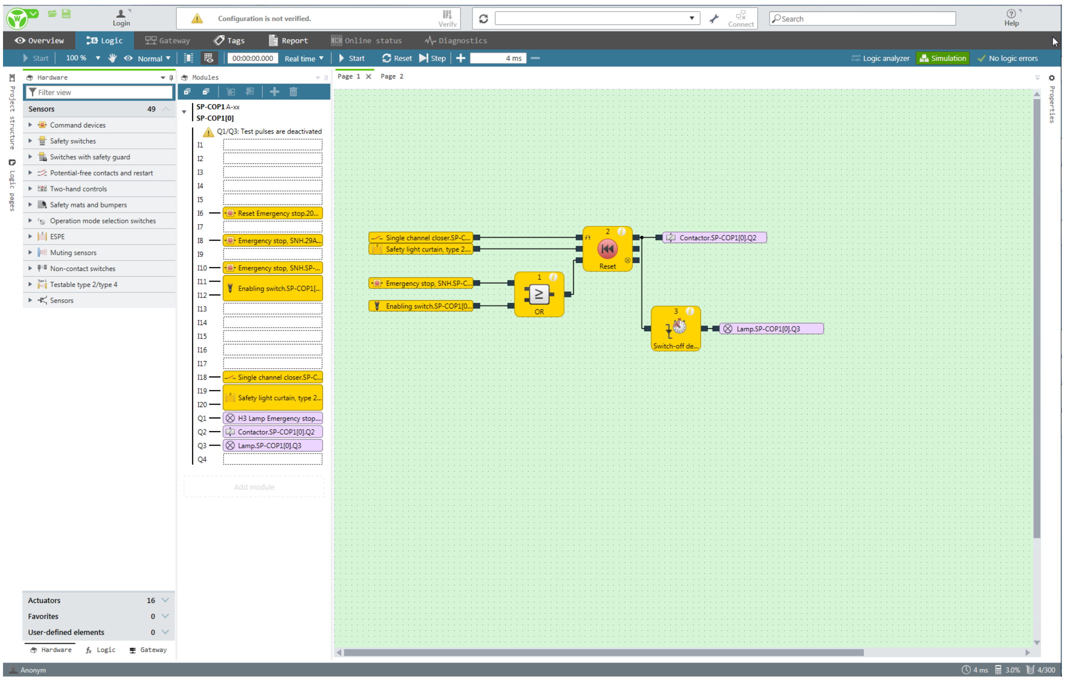


Illustration 37: Simulation of a valid logic configuration

Info

- The logic programming must be valid before you can simulate a project. Thus, samos® PLAN 6 cannot display any logic errors.
- While the simulation mode is active, the background of the **Logic** view turns green.

6.6.1 Performing the simulation

How to proceed when you want to perform a simulation in samos® PLAN 6. And what functions does the **Logic** view provide?

Procedure

➡ Open the **Logic** view.

➡ Ensure that your programming logic is error-free.

➡ Click on **Simulation** in the task bar of the Logic view.

⇨ Simulation mode will start.

⇨ The background of the **Logic** view appears in green and the task bar reveals the commands for the simulation.

➡ In order to start a simulation of the logic, click on the **Start/Pause** (A) button for a simulation at full speed.

⇨ The **Timer** (B) will show the elapsed time.

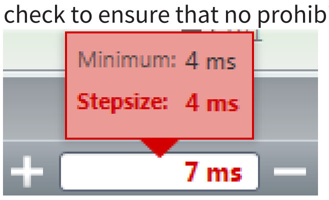
⇨ The timer can be reset using the **Reset** (C) button.

➡ In order to stop a simulation, click again on the **Start/Pause** (A) button.

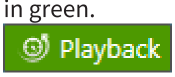
Simulation time control

For logic processes that proceed too quickly in real time for them to be followed, there are two options:

- The simulation is executed continuously when you click on **Start/Pause** (A).
  Use the pulldown menu under **Real-time** (D) in order to slow down the sequence of the simulation.
- It is possible to execute a simulation incrementally. Stop the simulation with the **Start/Pause** (A) for that purpose. You now have the following options:
  - You can move the simulation forwards stepwise by using the **Forward** (E) button. The time increments can be adjusted in the **Time window** (F) using the **Plus/Minus** button. When you click on the **Forward** (E) button, the simulation will jump forward by the corresponding time interval. In this input method, samos® PLAN 6 rounds up the entered time to the next possible permitted logic execution time.
    Alternatively, you can enter the time increments using the keyboard. To do this, click in the **Time window** (F) and enter the desired number. samos® PLAN 6 automatically performs a check to ensure that no prohibited values are entered.



  - The **Back** (G) button activates the playback mode. This allows you to reset the simulation by a defined time value. This is either a predefined time value that you can select by clicking the **Back** button. Alternatively it might be a freely defined time value that you can enter into the **Time window** (F).
    When playback mode is active, the task bar shows a button with the same name highlighted in green.



    Playback mode is terminated by clicking the **Back to simulation** (H) button.

Action possibilities

While the simulation is running, you can set an input to high by clicking on it. Inputs on high are displayed in green. You can set the input back to low by clicking again.

Once the simulation is stopped, it is possible to select inputs that are supposed to switch at the next-possible time. When you click on an input with the simulation stopped, initially only the input will appear (not the connected connection) in green to indicate that it will switch during the next cycle of simulation. This makes it possible to simultaneously switch multiple elements with the simulation stopped or in increment mode and to then observe the effect on the logic.

After the desired inputs have been set, the simulation can continue so that the logic and the outputs will switch accordingly. To do this, either click on the **Start/Pause** (A) button for continuous execution or use the **Forward** (E) button for incremental execution.

Info

NOTICE

Not possible: Simulation of fast shut-off

The **Fast Shut-Off** function cannot be simulated.

NOTICE

Wieland **recommends a stepwise simulation with dual channel evaluation, EDM or valve monitoring**

If **EDM** or **Valve monitoring** function blocks with dual channel evaluation are used, it is recommended to execute the simulation in increments.

These functional blocks expect that several inputs change their status within a (parameterizable) synchronous time or that the signal on a read-back input changes within a (parameterizable) synchronization time after the respective output has been switched. This cannot always be simulated in real time, but might require the use of appropriately small time increments.

6.6.2 Logic analyzer

The logic analyzer integrated into the **Logic** view allows for detailed tracing of individual signal sequences or combined, multiple signal sequences and can record the result.

Important notes for use

WARNING

- Use the signal sequences of the logic analyzer as a tool, e.g. for application development, fault analysis or commissioning.
- Do NOT make the signal sequences of the logic analyzer the basis for validating the safety functions.

- **Off-line mode**
  The simulation mode must be active when the logic analyzer is to be used without a connection to the controller (off-line) (see: *Performing the simulation [ch. 6.6.1, p. 125]*).
- **Online mode**
  The logic analyzer is then also available when the controller is connected (on-line). Please note the following regarding the signal sequences shown:

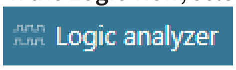
WARNING

- The signal sequences shown in on-line mode do not correspond to the actual control behavior. The reason is the update interval, which is approx. 250 ms in on-line mode. It is possible that short pulses are not shown.
- Signal representation may be delayed due to the connection quality.

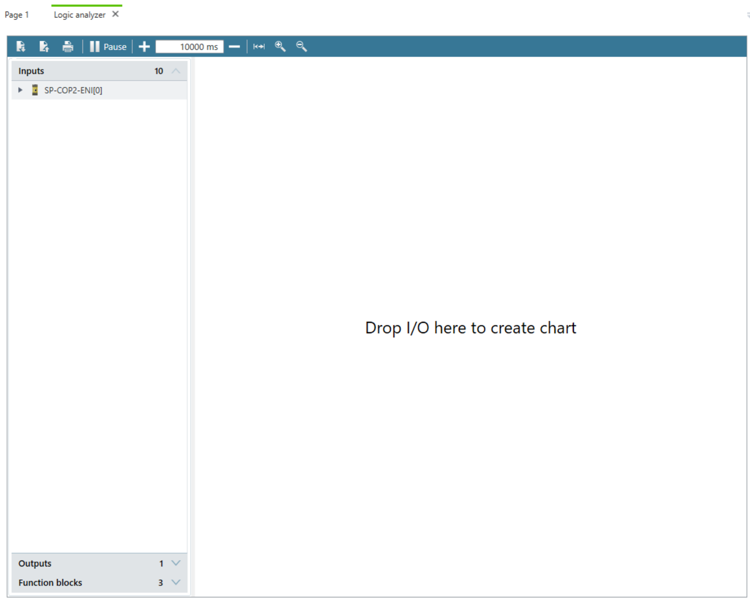
Starting the logic analyzer

➡ If you wish to use the logic analyzer off-line:
Start the *simulation mode [ch. 6.6.1, p. 125]*.
- or -
if you wish to use the logic analyzer online:
Connect your PC to the safety controller [ch. 6.7, p. 131].

➡ In the **Logic** view, select the **Logic analyzer** button in the command bar.

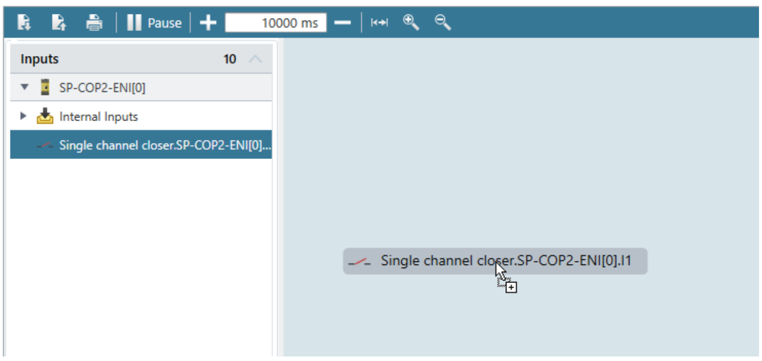


⇨ The logic analyzer will open as a separate window in the work area.
This window opens on the right side, next to the Logic pages opened in the work area.

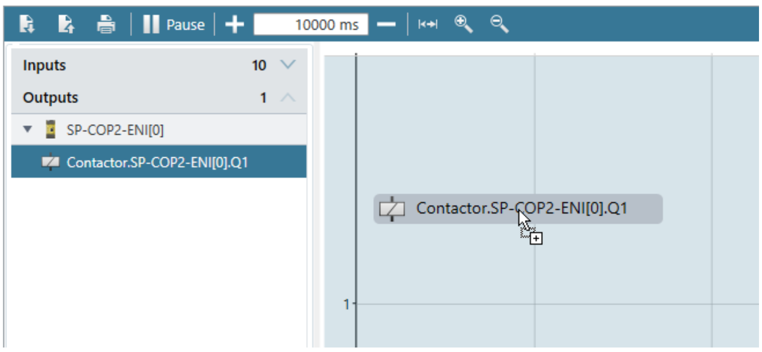


Adding inputs and outputs

➡ Pull the desired inputs out of the left bar and onto the area of the logic analyzer.

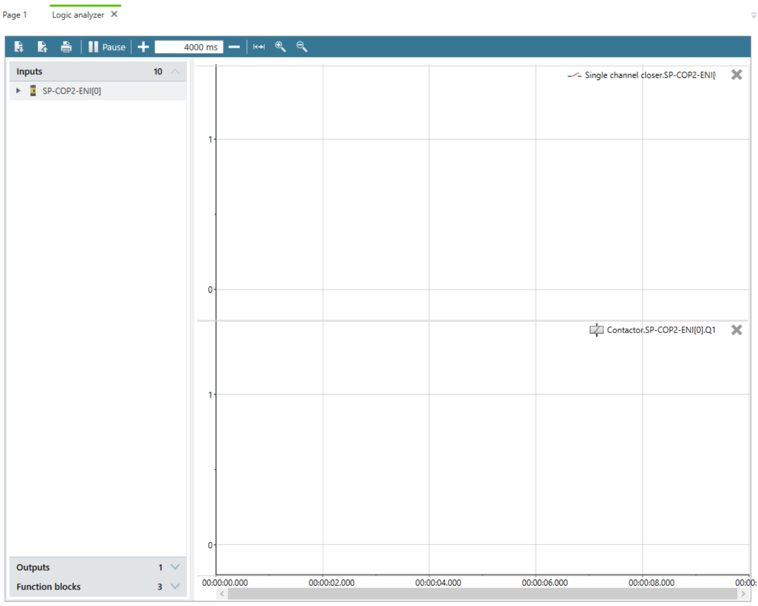


➡ Pull the desired outputs out of the left bar and into the area of the logic analyzer.



Example

Logic analyzer with two signal sequences:



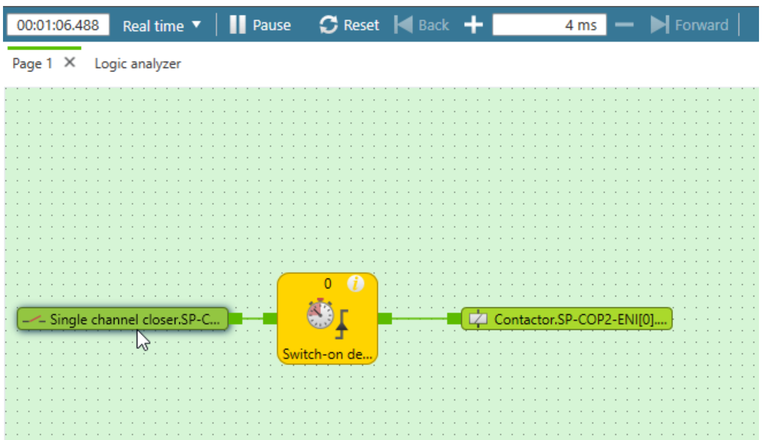
Info

- You can use the mouse to change the sequence of the inputs and outputs.
- Unused elements can be hidden with the following button:
  
- The time panel can be used to stipulate the time interval in which the real-time view is shown.
  

Off-line mode: Recording and analyzing data

➡ Change to the desired logic page and start the simulation.

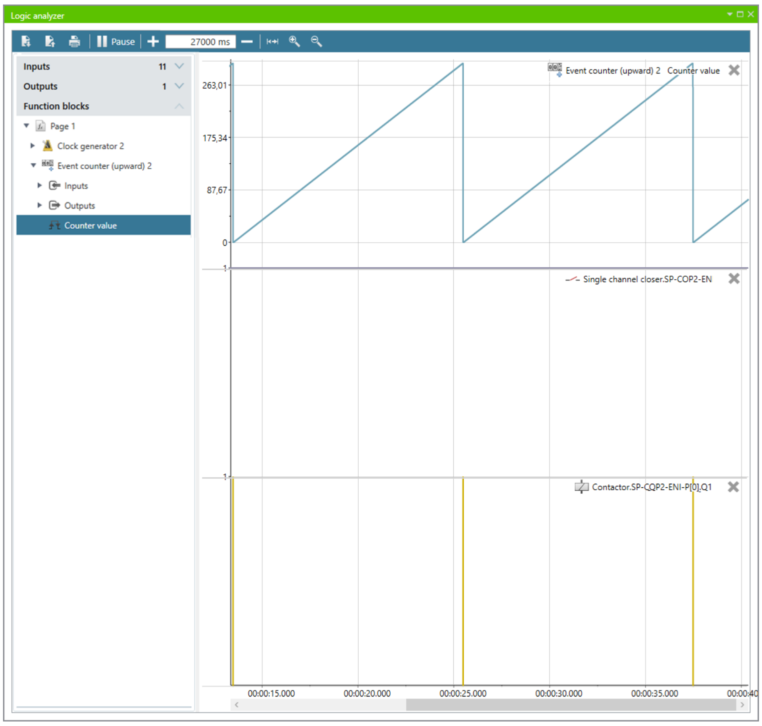
➡ Set the desired inputs to high or low, using the mouse.



➡ Change to the logic analyzer.

⇨ You will see the signal sequence for the active controller.

⇨ The time bar at the very bottom can be used to follow the signal sequence for the entire simulation period.



➡ If you wish to stop the logic analyzer, click on **Pause**.

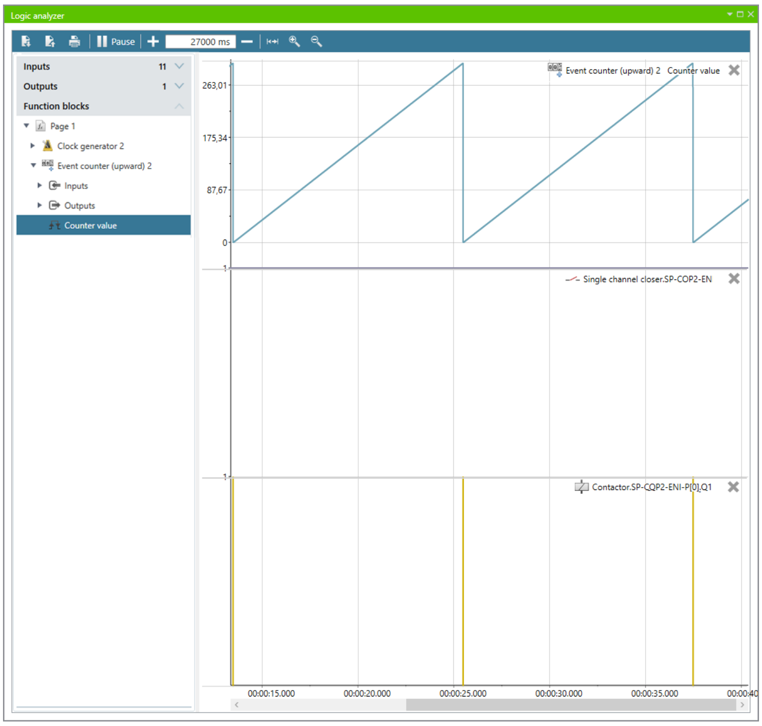
Online mode: Recording and analyzing data

➡ Start the controller.

➡ Change to the logic analyzer.

⇨ You will see the signal sequence of the active controller.

⇨ The time bar at the very bottom can be used to follow the signal pattern for the entire period of connection to the controller.



➡ If you wish to stop the logic analyzer, click on **Pause**.

NOTICE

You can also display internal values of the function blocks in the logic analyzer.

Exporting, importing and printing recorded data

In addition to the control functions for recording, the following functions are also available in the command bar of the logic analyzer.

Table 28: Key

Element	Function
	Imports a previously exported signal sequence in samos® PLAN 6. You can view the signal sequence again in the logic analyzer.
	Exports the recorded data. You can import the export file with the recorded signal sequence again in samos® PLAN 6 at a later point.
	Prints the recording most recently completed.

6.7 Connecting to the safety controller

This section describes how you can set up an initial connection between the samos® PRO safety controller and a PC or notebook.

The controller modules SP-COP2-EN and SP-COP2-ENI as well as a USB interface, have a TCP/IP configuration interface, which enables the station to be configured via samos® PLAN 6. This interface works in parallel with other field bus Ethernet protocols.

Important notes

WARNING

Do not connect the safety controller via the USB and the Ethernet interface simultaneously!

The samos® PRO system can only communicate with one single instance of samos® PLAN 6 at the same time. If you wish to establish multiple connections to the safety controller, either from a single PC or from multiple PCs, this can lead to inconsistencies in the configuration and diagnostics or to errors in operation. This applies to both USB and Ethernet connections.

WARNING

Also take note of the signal run-times in the case of remote TCP/IP connections!

Remote TCP/IP connections to the gateway may be unstable if the signal run-time is too long.

- Use the ping command to check the signal run-time to the gateway. Signal run times > 250 ms may result in a connection loss.

Possible solutions:

- Ensure that the connection is fast enough or change the routing if possible.

Or:

- Use a program such as TeamViewer to control a local computer on which samos® PLAN 6 has been installed and that is locally connected to the safety controller.

Or:

- Contact Support at Wieland Electric.

Step 1: Establish the cable connection and start the software

➡ Connect a PC or notebook to the USB or Ethernet interface of the SP-COPx controller module.

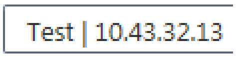
➡ Switch the safety controller on.

➡ Open the configuration software installed on the samos® PLAN 6 PC.

Step 2: Establish a connection from the software

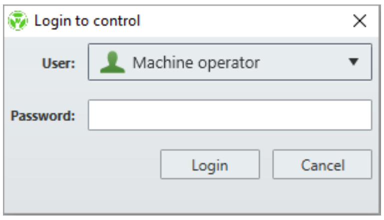
➡ In the menu bar click on **Update**.

➡ In the **Connection name** list select the controller which you wish to connect samos® PLAN 6 to.



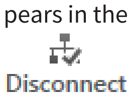
➡ Click on **Connect**.

⇨ The **Login to control** dialog window appears.

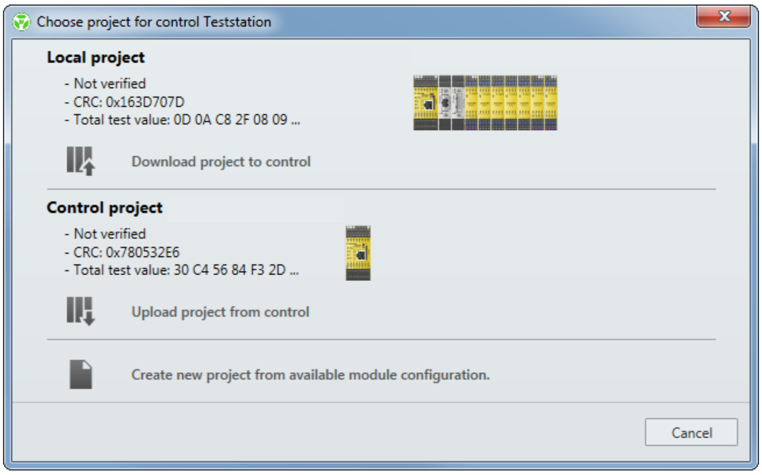


➡ Store the user data for a user, who has the corresponding rights to establish a connection and click on **Login**.

⇨ The connection is established as soon as, instead of **Connect,** the **Disconnect** button appears in the menu bar:



⇨ The following dialog window appears, in which you can select an action for the connection:



Step 3: Execute action

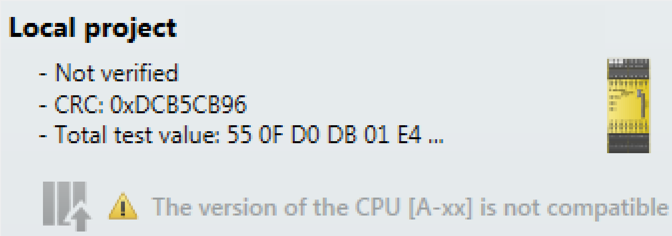
NOTICE

Automatic compatibility check

samos® PLAN 6 prevents the transfer of a project that is not compatible with the controller module to which it should be loaded, in terms of the module version.

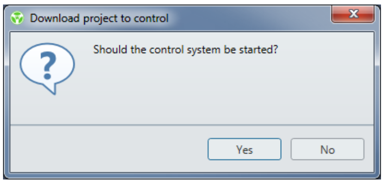
Example: You want to transfer a project from samos® PLAN 6which uses a controller version C-xx. The controller module controller has a lower module version (e.g. A-xx).

In such a configuration the connection dialog shows an exclamation mark and an error message:



➡ Select the desired action.

➡ If you have selected the action **Download project to control**:
Acknowledge the following message with **Yes** to start the control immediately.



⇨ Control is started (**Run** status).

⇨ If you have selected the **Upload project from control** option as an action, the selected project appears in the views of samos® PLAN 6.

6.8 Configuring the connection to the safety controller

Viewing connection information

➡ Click on **Edit device configuration** in the menu bar.

⇨ The **Control configuration** window will open. Here you can view all relevant connection information.

Starting and stopping the safety controller

➡ Click on **Start** to start the controller.

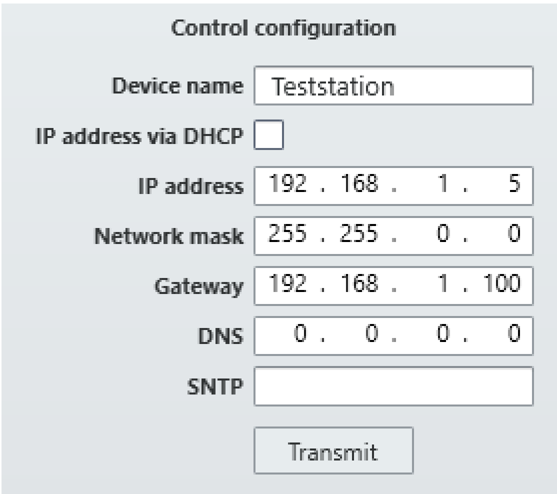
➡ Click on **Stop** to stop the controller.

Changing IP settings

✓ The controller is stopped.

➡ Click on **Edit device configuration** in the menu bar.

⇨ The **Control configuration** window will open. Here you can change the connection settings.



6.9 Transferring the system configuration

The configuration of the safety controller initially only exists as a project, i.e. as a samos® PRO project file. This project file must be transferred to the samos® PRO removable program storage SP-COP-CARD1 via the controller module.

NOTICE

The removable program storage SP-COP-CARD1 and the controller modules communicate via an internal interface.

It is also possible to connect a PC directly to the removable program storage SP-COP-CARD1. In this way, the project file can be directly transferred from samos® PLAN 6 to the removable storage (further information: *Saving of the project file [ch. 5.9.10, p. 69]*).

The configuration data are checked for compatibility during their transfer to the removable program storage and can subsequently be verified (by reading and comparing).

Transferring verified project data to several safety controllers

The removable program storage can, for example, be used on a PC to copy the verified project data without further processing in the samos® PLAN 6 software and transfer them to any number of samos® PRO safety controllers. This process copies the configuration data without any changes, including the verification information that was determined when the first safety controller was configured with these data.

6.9.1 Transferring project data to the safety controller

How to connect samos® PLAN 6 with the safety controller and how to transfer a project to the controller is explained here:

Connecting to the safety controller [ch. 6.7, p. 131]

6.9.2 Compatibility check

The configuration data contain an electronic type code and a version code for each module that is supposed to be configured. During transfer, each module checks whether it is compatible with the configuration data. The compatibility check is solely based on the functional part of the respective module, not on the hardware version; the design of the terminals, for example, is not included.

If the compatibility check has a negative result, a corresponding error message is generated in the respective module and in the controller module.

NOTICE

Some modules in samos® PLAN 6 have different version numbers stored, which means that a compatible module can be selected from a list underneath the module.

6.9.3 Verifying the configuration

After the project has been downloaded to the control, the samos® PRO system can be verified. To do this, samos® PLAN 6 reads back the configuration data of the samos® PRO system and generates a new report. If it matches, the data is displayed in a report. If the user confirms the correctness of the report, the system is verified.

WARNING

Scope of the verification

The control project transforms to a safe state upon verification. With this step, which is a safety-related application, the configuration becomes the legal responsibility of the person who signs the verification report or confirms the correctness of the verification report in the system.

- Carefully check the report as described below before pressing the button with the same name to confirm the verification.
- Only verify projects that precisely correspond to the configuration you expect.
- Use suitable independent measuring techniques to check the plausibility of the values measured by the samos® PRO control, such as velocities or analog measured variables.

WARNING

Always keep the final report

If you use the **Extended security function** and have activated falsification protection, you will need the code from the final report to perform falsification activities.

- Always save the report from the verification.
- Further information: *Protecting a project from manipulation (extended security function) [ch. 6.1.7, p. 85]*

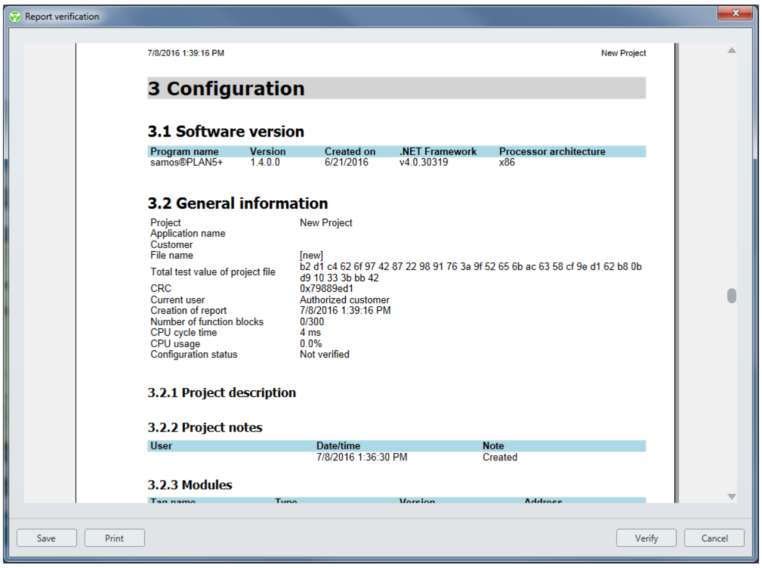
NOTICE

Once the configuration is verified, the samos® PRO system automatically switches into the **Run** state after the supply voltage is switched on.
If the configuration is not verified, then the system must be manually placed into the **Run** state with the help of samos® PLAN 6 (see *Changing the device state [ch. 6.10.1.3, p. 143]*).
Verification of a samos® PLAN 6 project is only possible in connection with a samos® PRO system and corresponding controller modules.

This is how you can verify a configuration

➡ Click on **Verify** in the menu bar.

⇨ The **Verification report** window opens.



➡ Carefully check the report.
The report exactly reflects the configuration of the project on the control. If you see any items that require changing in the report, you must adapt the samos® PLAN 6 project accordingly. Changes are not possible directly in the report.

➡ If the configuration displayed in the report corresponds to the configuration expected, click on **Verify** bottom right.

NOTICE

The configuration data of more complex sensors and actuators, which are configured outside of samos® PLAN 6 (e.g. safety light curtains), are not included in the verification. They are verified according to the operating instructions for these devices.

⇨ **If the verification fails**
If any differences are detected between the configuration data of the project and the project data from the report, a corresponding message is displayed with information about appropriate actions. Verification of configuration cannot take place. In that case, note the information in the error message as to how to proceed. End the dialog by clicking on **Cancel**.

⇨ **If the verification is successful**
If the samos® PLAN 6 is able to perform verification successfully, a final report will be created, which you must then print out or save.
The system is verified once you have performed one of the two actions.

Info

The status verified/not verified is displayed in the status display of the menu bar as well as by the status LED **CV** on the controller module (see *Device state and LED displays in the controller modules [ch. 6.10.1.1, p. 139]*).

Illustration 38: Configuration verified successfully

The safety controller samos® PRO is also ready for use without verification. However, in this case, the automatic state transition to **Run** after the power supply is switched on is not performed. The project must be started manually by the user using the Start function of samos® PLAN 6.

NOTICE

The project can only be verified by the user on request.

- Through the verification, the user confirms that all the project data from the verification report agrees with the samos® PRO system that they have programmed.
- As a precondition for the verification of a samos® PRO system, the user must have fully tested the safety functions of the machine or the system. This validates the correct function and reaction in all applications.
  The validation is identical with respect to content to the technical check during the commissioning of the samos® PRO system.

6.10 Using the monitoring functions

With online controllers, you can use the following monitoring functions in the **Module** view and in the **Diagnostics** view of samos® PLAN 6.

NOTICE

You can read here how to connect samos® PLAN 6 to a safety controller: *Connecting to the safety controller [ch. 6.7, p. 131]*

6.10.1 Observing the device states of the system

In the **Modules** view, you can observe the status of all installed modules, as well as the status of the inputs and outputs in live operation.

The following table provides an overview of the device states of the samos® PRO system.

Some device states require user intervention, e.g. change of the state from **Stop** to **Run** (*Changing the device state [ch. 6.10.1.3, p. 143]*). Other states are based on the internal self-test of the samos® PRO system, e.g. **Internal errors**.

6.10.1.1 Device state and LED displays in the controller modules

Flash code meaning

Table 29: Key

Symbol	Meaning
○	LED off
✹	LED flashing
●	LED lights up

Table 30: Device state and LED displays in the controller modules

PWR/EC LED	Meaning	Additional info
Red flashing	An error has occurred in the control. All 24 V outputs have been switched off. The control must be restarted with a power ON reset after the cause of the error has been eliminated. The number of flash pulses indicates the error class to which the occurring error belongs.	Number of flashing pulses = error class 2: Configuration data 3: Application 4: Self-test 5: Voltage/current monitoring 6: I/O modules 7: Cross-communication 8: Internal
Green flashing (1 Hz)	The supply voltage at A1, B1, or B2 is outside of the range of 16.8 V to 30 V.	
Green	The supply voltage at A1, B1, and B2 is within the range of 16.8 V to 30 V.	

MS LED module state	State	Additional info
Red flashing (1 Hz)	There is no project at the control or the project data is faulty (because, e.g., the number of inserted I/O modules does not match the project).	No or incorrect module configuration
Green flashing (1 Hz)	Project data was adopted from control and I/O modules, control waiting for start command	
Green	Control has started.	
/ Red/green flashing	One or more inputs have a cable break or short-circuit to 24 V. Or there is a sequence/synchronization time error at a dual channel input. Or an output has a test error (e.g. short-circuit).	

Code-verified CV LED	Control behavior
Yellow flashing (1 Hz)	The project at the control has not been verified. The control will not start automatically after power ON reset.
Yellow	The project at the control has been verified. The control will start automatically after power ON reset.

NET	Meaning
Flashing green (for 3 s)	Connection setup with control

Input LED	Meaning	Additional info
Green flashing (1 Hz)	A single-channel input has a test error (cable break or short-circuit at 24 V) or the input was not configured in the project and 24 V is pending.	Applies to I1 to I16 and IQ1 to IQ4 if single-channel has been configured. Flashes synchronously with MS LED in red.
Green flashing, alternating (1 Hz)	Dual channel input has synchronization time error or a sequence error or at least one of the two inputs has a test error (cable break or short-circuit at 24 V)	Applies to I1 to I16 and IQ1 to IQ4 if dual channel has been configured. Input pair flashing on and off.
Off	Signal level at the input terminal is 0 V.	
Green	Signal level at the input terminal is 24 V.	

Output LED	Meaning	Additional info
Green flashing (1 Hz)	Output has a test error.	Applies to Q1..Q4 and IQ1..IQ4
Off	Output is switched off.	
Green	Output is switched off.	

6.10.1.2 Device state and LED displays in the safe input/output modules

NOTICE The displays of the MS LED and the input LEDs I1 to I8 are identical to those for the SP-SDIO and SP-SDI expansion modules.

Flash code meaning

Table 31: Key

Symbol	Meaning
○	LED off
☀	LED flashing
●	LED lights up

Table 32: Displays of the MS LED

MS LED	Meaning	Info
○	Supply voltage outside of operating range	Check supply voltage at terminals A1 and A2.
☀ / ☀ Red/green flashing (1 Hz)	Repairable external error	Check cable of flashing inputs and outputs. If all output LEDs are flashing, check the supply voltage of terminal A1 and A2 for this module.
☀ Green flashing (1 Hz)	System is in the stop state or the voltage supply to A1 is outside the range of 16.8 V to 30 V.	Start the application in samos® PLAN 6. Check voltage supply to A1.
● Green	System in the run state and the voltage supply to A1 is within the range of 16.8V to 30V.	
☀ Red flashing (1 Hz)	Invalid configuration	
☀ Red flashing (2 Hz)	Critical error in the system; suspected in this module. Application has been stopped. All outputs are switched off.	Switch supply voltage off and back on. If the error has not been eliminated after this has been done multiple times, then replace module. In order to identify the module affected, use the diagnostics display in samos® PLAN 6.
● Red	Critical error in the system; suspected in a different module. Application has been stopped. All outputs are switched off.	Switch supply voltage off and back on. If the error has not been eliminated after this has been done multiple times, then replace module in which the red LED is flashing (2 Hz). In order to identify the module affected, use the diagnostics display in samos® PLAN 6.

Table 33: Displays of input LEDs

Input LEDs (I1–I8)	Meaning
○	Signal level at the input terminal is 0 V. Safety mat: Both inputs actuated.
● Green	Signal level at the input terminal is 24 V.
Green (1 Hz) Synchronous with the red MS LED	Signal level at the input terminal is 0V and a repairable error at a dual channel input is pending.
Green (1 Hz) Alternating with the red MS LED	Signal level at the input is 24V and a repairable error is pending.

Table 34: Displays of output LEDs

Output LEDs (Q1–Q4)	Meaning
Green (1 Hz) Synchronous with the red MS LED	Output has a test error.
○	Output is switched off.
● Green (1 Hz)	Output is switched off.

6.10.1.3 Changing the device state

You must implement certain state changes in the samos® PRO system manually in the samos® PLAN 6 software. These changes in the device state are as follows:

- Change from **Stop** to **Run**
- Change from **Run** to **Stop**

To change the device state, click on the corresponding button in the command bar of the **Modules** view:

Table 35: Start and Stop buttons

Button	Description
Start	Sets the samos® PRO system to the **Run** state.
Stop	Places the samos® PRO system in the **Stop** state.

NOTICE

Once the configuration is verified, the samos® PRO system automatically switches into the **Run** state after the supply voltage is switched on.

If the configuration is not verified, the system must be set to the **Run** state manually.

WARNING

Do not use the feature for switching from Run to Stop to perform work in the danger zone of a plant.

Following a voltage drop and a subsequent restart, the system may inadvertently switch to **the Run** state.

The system must be in a safe state while work is being performed in the danger zone!

6.10.1.4 Behavior at system start

If the safety controller of samos® PRO transfers from **Stop** to the **Run** state:

- The **First logic cycle** status bit of the controller module is high for the duration of the logic execution time. This status bit is available in the **Logic** view as an input element of the controller module.
- All timers and states, including the error states of the function blocks, will be reset.

6.10.2 Forcing inputs (Force mode)

Inputs and undetermined outputs, for example of the gateways, can be forced while the controller is connected, when the **ForcingRun** state in the **Logic** view is selected.

This means that you can set inputs high or low controlled by software, regardless of the actual value of the physical inputs. In this case, the samos® PRO system, including the programmed logic, will behave precisely as if the physical inputs or outputs had actually assumed the respective value.

This will make it possible to test the wiring of your system in online mode and to check the function of your logic program, for example, during commissioning or maintenance.

Technical information

- With force mode, you can only directly influence inputs in the logic of a samos® PRO system but not safe outputs or logic events, such as function blocks or jump labels.
- The force mode is only available during the first 18 hours after switching on the controller (Power on).
  When the controller module has been switched on for longer, switch it off and on again to be able to activate force mode.

Safety information

WARNING

Ensure that there can be no danger to people or damage to equipment!

In force mode, you can freely influence the value of the safety inputs. By doing so, you can cancel the protective function of your safety equipment and induce a hazardous situation.

- Make sure that no one is in the hazardous area of your machine or system before you activate force mode.
- Make sure that no one can enter the hazardous area of the machine or system during the time that force mode is active.
- Additional safety measures may be necessary when force mode is used.

WARNING

Do not use force mode simultaneously on multiple PCs.

When using force mode:

- Make sure that no one can also activate force mode from a second PC. This could result in a hazard-inducing condition.

Requirements

The following requirements must be met in order to use the force mode:

- The module version of the controller module must be at least A-03.
- The configuration of your samos® PRO project may not be verified (LED **CV** on controller module flashes **Yellow** at 1 Hz).

NOTICE

If you attempt to activate force mode even though the configuration has already been verified (**CV** LED on the controller module lit in **Yellow**), a dialog will appear that will enable you to reset the status to **Not verified**.

- You must be logged on as a user with the authorization **F (use force mode)** (see *Defining access rights (manage users) [ch. 6.1.6, p. 84]*).
- Recommendation: Connect your PC to the USB interfaces using the samos® PRO system.

Step 1: Starting force mode

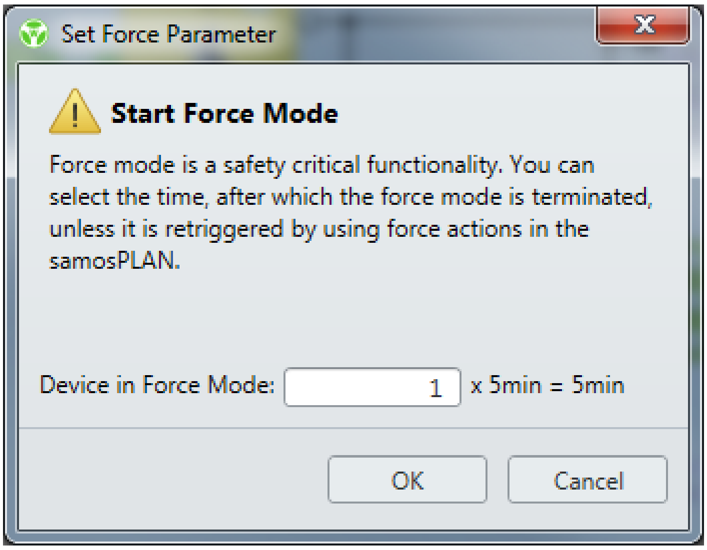
➡ *Connect your PC to the safety controller [ch. 6.7, p. 131]*.

➡ Stop the controller.

➡ Switch to the **Logic** view and click on the **Forcing** button.

⇨ The controller changes to the **Run** state.

⇨ A dialog for entering the time opens after which the force mode will be automatically ended.

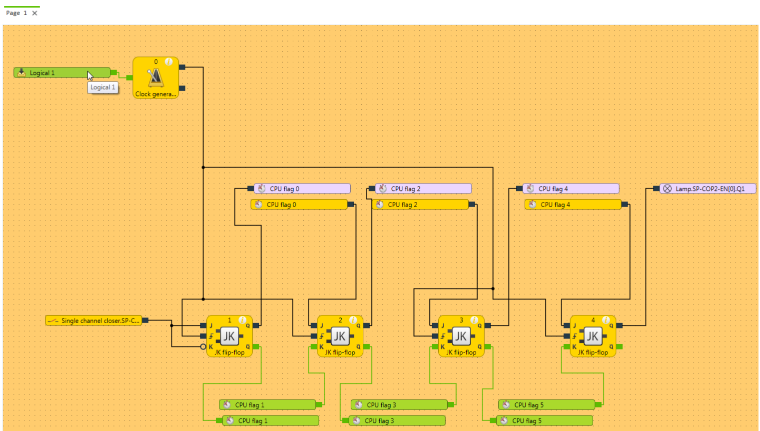


➡ Click on the desired time in the selection list and click on **OK**.

⇨ The force mode is started.

⇨ The color of the **Forcing** button switches to green.

⇨ The background color of the **Logic** view changes to orange.



NOTICE

When force mode is active, it is not possible to log out, to receive and compare a configuration, or to stop the device.

Step 2: Forcing one or more inputs

➡ Select one or more inputs that you would like to force.

- Force individual input: Click on the input.
- Simultaneously force several inputs: Left-click on the empty background of the work area and drag a capture frame (marked in blue) around the desired inputs.

➡ In the context menu, select the desired forcing option.

Table 36: Forcing options in the context menu

Option	Function
Forcing	Starts the force mode.
Switch over all force values	Switches over the input value. **Note:** You can also switch over an individual input by clicking it.
Deactivate forcing	Stops the force mode. The input will be evaluated with its actual physical value by the samos® PRO system.

Instructions on visualization

A forced input is indicated with an exclamation mark. An active input (high) is shown in green, while an inactive input (low) is yellow. Inputs whose forced value is different than their actual physical value are shown in light blue.

Table 37: Display in the force mode

State	Display
Physically low input, non-forced	
Physically high input, non-forced	
Physically high input, forced to low	
Physically high input, forced to high	

Instructions on functions

- When an input is being forced in the logic, the real value of the physical input is not displayed in the **Logic** view, but only in the **Modules** view or the **Modules** docking window.
- Forcing only influences the inputs in the logic program but not the physical inputs of the extended modules. Examples:
  - Forcing does not affect the inputs of a module that are being used for fast shut-off. Thus, the output in the hardware may stay at low even though the inputs in the logic are forced to high, because fast shut-off in the module is being controlled directly by the physical inputs.
  - Forcing does not affect inputs whose values are not being controlled by the logic program but instead are being directly transferred to a PLC via a gateway.
- Force mode always applies to the entire project. For logic programs comprising multiple pages in the **Logic** view, this means that a forced input is not only set to the same value on the currently opened logic page but everywhere that it is used.
- Contrary to simulation mode, you can use the **EDM** or **Valve monitoring** function blocks as well in force mode if corresponding devices are actually connected that will transmit the required read-back signal when the outputs are activated.
- A maximum of 10 inputs can be forced simultaneously.
- When using a samos® PRO gateway, note that the process image of the gateway **always** reflects the actual physical value of the inputs and outputs of the connected devices and not the (simply virtual) forced value of an input in the logic program. If the value of an **Output** is changed (e.g.

from high to low) by forcing an **Input** in the logic program (e.g. from high to low), the (actually changed) physical value of the **Output** (low in the example) in the process image is transmitted to the PLC, however **not** the forced low value of the input in the logic program, but again the actual physical value of the input on the device (high in the example). Consider this when evaluating the data transmitted in the SPS.

Step 3: Ending the force mode

The force mode can be ended in the following ways:

- Manually by the user
- Automatically after the time defined at the start has elapsed when no further actions have been initiated. You can see the timer in the command bar of the **Logic** view:
  

- Automatically, after 3 seconds, if the samos® PRO system detects an error (e.g. if there is a disruption in the connection to the PC).

When ending force mode, all of the outputs of the samos® PRO system are set to low and the active application is stopped.

WARNING

Make sure that exiting the force mode does not create a hazardous situation!

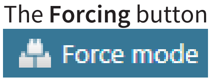
- Make sure that your machine or system is in a safe state and cannot be damaged when ending force mode.
- During force mode, the real value of an input may have changed (e.g. switches pressed, safety doors open, etc.). Before restarting your machine or system, make sure that this will not result in any hazard.

Procedure: Manually ending the force mode

➡ In the command bar, click on the green button **Forcing**.

⇨ The force mode will end.

⇨ The **Forcing** button loses its green highlight.



⇨ The background color of the **Logic** view changes back to blue.

⇨ All of the outputs of the samos® PRO system are set to low and the active application is stopped.

6.10.3 Synchronize time for diagnostic purposes

With connected safety controllers, in the **Diagnostics** view, you can synchronize the time on the safety controller with the time on the connected diagnostic computer. This provides you with an absolute time for error tracking.

If you use this function, a corresponding absolute time value is displayed in the **Diagnostics** view for each message in the **Local Time** column.

NOTICE

The time synchronized here does not affect the control function.

The time continues running as long as the module is live, and it is noted for the subsequent diagnostics messages.

Example

	Message	Message ID	Timestamp	Description	Source	Local time
	Base-Module	0x2B082FF0	03:16:14:37	(00002FF0)	Base-Module	7/14/2015 5:28:23 PM
	Base-Module	0x22010226	03:16:14:37	(00000226)	Base-Module	7/14/2015 5:28:23 PM
	Communication Error (Ethernet/USB)	0x6A0B0023	03:16:14:37	35	Base-Module	7/14/2015 5:28:23 PM
	Communication Error (Ethernet/USB)	0x6A0B3101	03:16:14:37	49 1	Base-Module	7/14/2015 5:28:23 PM

Illustration 39: The "Local Time" column displays the time when the message occurred

Synchronizing the time

This is how you synchronize the time on the safety controller with the time on the connected diagnostics computer:

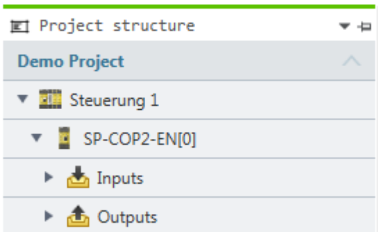
Requirement

- You are *connected [ch. 6.7, p. 131]* to the safety controller.
- You have logged on as a user with authorization **D** (**output of diagnostic data**).
  Further information: *Defining access rights (manage users) [ch. 6.1.6, p. 84]*

Procedure

➡ Switch to the **Project structure** docking window.

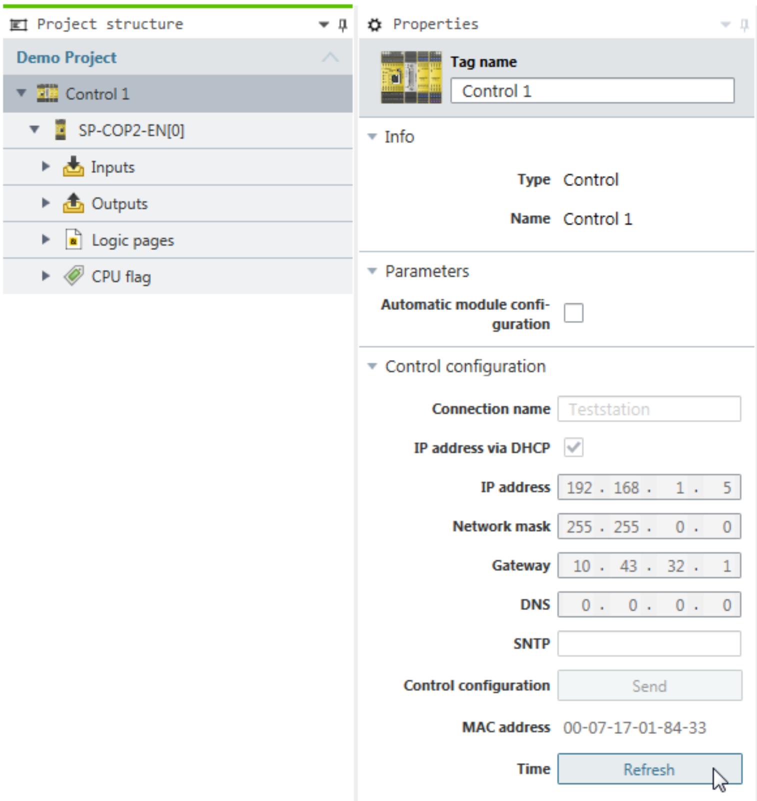
➡ Click on the top element, which represents the controller.



➡ Open the **Properties** docking window.

⇨ You will see the control configuration dialog.

➡ Under **Time**, click on **Update**.



7 SENSOR AND ACTUATOR REFERENCES

The following chapters describe the analog sensors in more detail.

Detailed information on the other sensors and actuators can be found in the hardware manual:

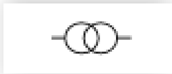
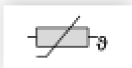
- Safety command devices and electromechanical safety switches
- Contactless safety sensors
- Testable single-beam safety light barriers
- ESPE – Electro-sensitive Protective Equipment

7.1 Analog sensors

NOTICE

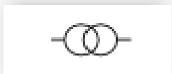
The sensor library is only available if the "Analog current measurement" or "Analog temperature measurement" station capabilities are supported. See *Version, compatibility, and features [ch. 3, p. 16]*.

You can use two different analog sensors.

Sensor elements in samos® PLAN 6	
	Current sensor
	Temperature sensor

For information on selecting suitable analog sensors, see Analogue sensors in the hardware manual.

7.1.1 Current sensor



Dimensioning

The dimensioning function can be used to convert the analog measured value (mA) of current sensors into another numerical value (physical variable of the transducer such as bars). To do so, you must parameterize the sensor type and characteristic curve according to the data sheet and then configure the measurement range of the sensor by entering the **Upper limit of measurement range** and **Lower limit of measurement range** values. A unit can also be defined in the **Unit** field (e.g. Pascal, °C, etc.).

Dimensioning may only be used for sensors with a linear characteristic curve.

In order to simplify handling of dual channel temperature sensors or to enable the use of diverse temperature sensors, the **Output as temperature sensor** field must be selected. When this function is selected, an RTD sensor (e.g. PT100) with a current sensor for temperature measurement can be operated on two channels on a functional component.

Dimensioning	Possible values / description
Characteristic curve	• Positive, linear • Negative, linear
Dimensioning	• Not active • Active
Output as temperature sensor	• Not active • Active
Unit	• Symbol for physical variable (e.g. °C, Bar, Nm, etc,) • maximum of 12 characters
Upper limit of measurement range	At this point, the physical measured value at 20 mA must be entered according to the sensor data sheet.
Lower limit of measurement range	At this point, the physical measured value at 4 mA / 0 mA must be entered according to the sensor data sheet.
Parameters	Possible values / description
Connection type	• 2-wire • 3-wire • 4-wire
Sensor type	• 4 – 20 mA • 0 – 20 mA
Filter values	Number of values for calculating average value: 1 / 2 / 4 / 8 / 16 / 32
Upper limit of monitoring range	Variable value that cannot be less than or the same as the maximum value for the selected sensor type. If this value exceeds the upper limit, a warning is generated in the connected function blocks.
Lower limit of monitoring range	Variable value that cannot be greater than or the same as the minimum value for the selected sensor type. If this value falls below the lower limit, a warning is generated in the connected function blocks. Restriction at 0– 20 mA: minimum 0.1 mA

Monitoring range / error range

You can use the monitoring range to define the range within which valid numerical values are generated and then processed in function blocks. Two limit values that define the monitoring range are selected.

The error ranges have permanent limit values and are designed to identify sensor errors or wiring faults.

WARNING

Suitable measures must be implemented to ensure that wire breaks, short-circuits and sensor faults are detected.

Sensor type 4 – 20 mA

The default settings correspond with NAMUR recommendation NE 43 for standardizing the signal level for failure information.

- Errors in the lower measurement range (fixed): 0 … 3.6 mA (e.g. open circuit)
- Monitoring range (variable adjustment): 3.8 … 20.5 mA (default setting: 4 … 20 mA)
  - Lower monitoring limit = 3.8 mA

  - upper limit of monitoring range = 20.5 mA
- Error in upper measurement range (fixed): > 21mA (e.g. short-circuit or signal sensor error)

Sensor type 0 – 20 mA

- Error in lower measurement range (fixed): 0 … 0.1 mA (e.g. open circuit)
- Monitoring range (variable adjustment): 0.1 … 20.5 mA (default setting: 0.1 … 20.0 mA)
  - lower monitoring limit = 0.1 mA
  - upper limit of monitoring range = 20.5 mA
- Error in upper measurement range (fixed): > 21 mA (e.g. short-circuit or signal sensor error)

Dimensioned current sensors

With dimensioned current sensors, the monitoring range can be configured within the limits of the preset measurement range.

NOTICE If the maximum possible monitoring range (=measuring range) is configured, the monitoring range is extended internally to (0.1) 3.8 ... 20.5 mA linearly according to the NAMUR recommendation.

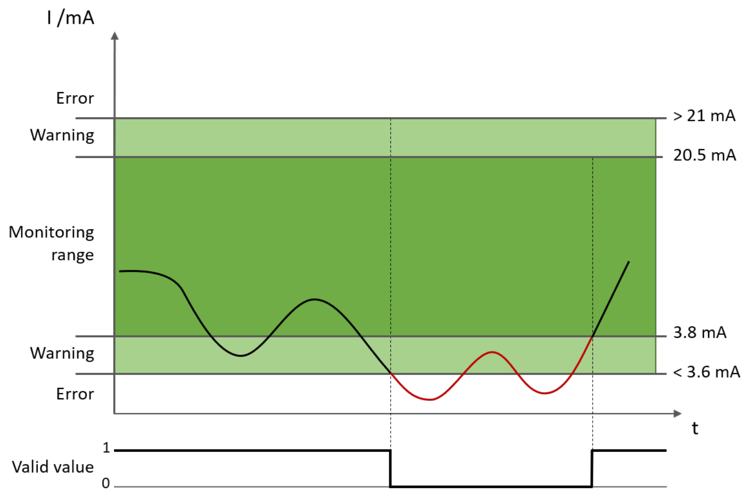


Illustration 40: Example: Value below lower limit of monitoring range (sensor 4-20mA)

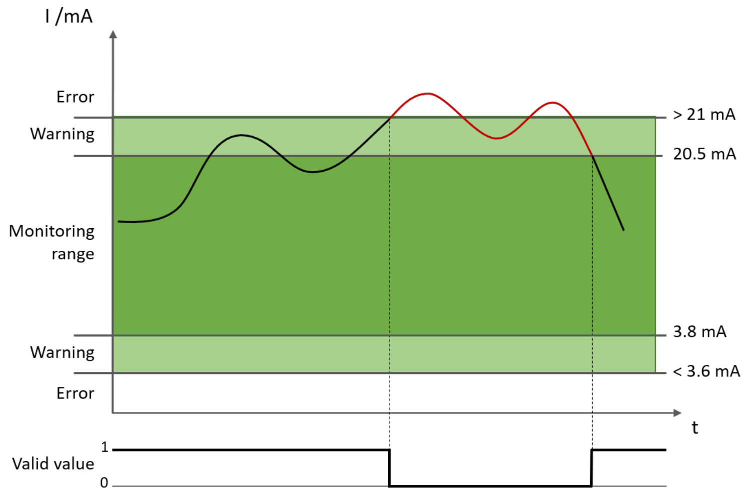
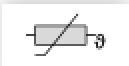


Illustration 41: Example: Value above upper limit of monitoring range (sensor 4-20mA)

7.1.2 Temperature sensor



Parameters	Possible values / description
Connection type	• 2-wire • 3-wire • 4-wire
Sensor type	Pt100 / Pt200 / Pt500 / Pt1000 Ni100 / Ni1000
Filter value	Number of values for calculating average value: 1 / 2 / 4 / 8 / 16 / 32
Upper limit of monitoring range	Variable value that cannot be less than or the same as the maximum value for the selected sensor type. If this value exceeds the upper limit, a warning is generated in the connected function blocks.
Lower limit of monitoring range	Variable value that cannot be greater than or the same as the minimum value for the selected sensor type. If this value falls below the lower limit, a warning is generated in the connected function blocks.

Monitoring range / error range

You can use the monitoring range to define the range within which valid numerical values are generated and then processed in function blocks. Two limit values that define the monitoring range are selected.

The error ranges have permanent limit values and are designed to identify sensor errors or wiring faults.

WARNING

Suitable measures must be implemented to ensure that wire breaks, short-circuits and sensor faults are detected.

Table 38: Measurement range

Sensor type	Error in lower measurement range (fixed)	Type of error	Error in upper measurement range (fixed)	Type of error
Pt100	< 10 Ω	Short-circuit of sensor	> 400 Ω – ∞	Idle state of sensor
Pt200	< 37 Ω	Short-circuit of sensor	> 790 Ω – ∞	Idle state of sensor
Pt500	< 85 Ω	Short-circuit of sensor	> 2000 Ω – ∞	Idle state of sensor
Pt1000	< 180 Ω	Short-circuit of sensor	> 4000 Ω – ∞	Idle state of sensor
Ni100	< 65 Ω	Short-circuit of sensor	> 230 Ω – ∞	Idle state of sensor
Ni1000	< 690 Ω	Short-circuit of sensor	> 2240 Ω – ∞	Idle state of sensor

Table 39: Monitoring range

Sensor type	lower limit Monitoring range		upper limit Monitoring range	
PT100	18.52 Ω	-200°C	390.48 Ω	850°C
PT200	37.04 Ω	-200°C	780.96 Ω	850°C
PT500	92.60 Ω	-200°C	1952.40 Ω	850°C
PT1000	185.20 Ω	-200°C	3904.42 Ω	850°C
NI100	69.52 Ω	-60°C	223.15 Ω	180°C
NI1000	695.20 Ω	-60°C	2231.52 Ω	180°C

Overview of limit values and effects of values falling below lower limit / exceeding upper limit

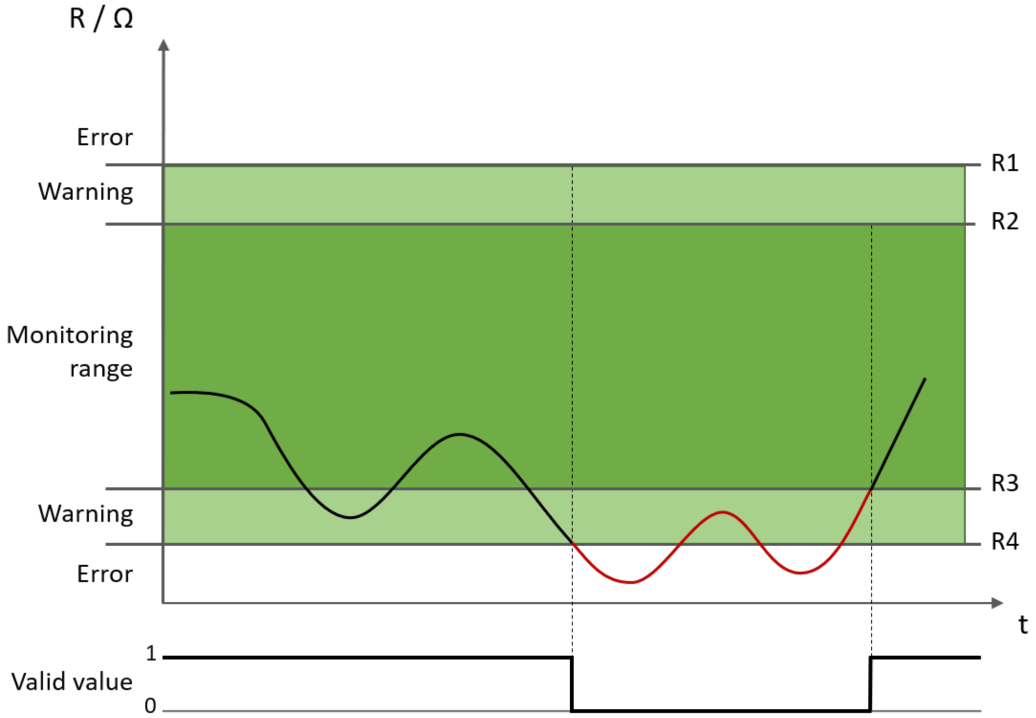


Illustration 42: Example: Value below lower limit of monitoring range (sensor RTD)

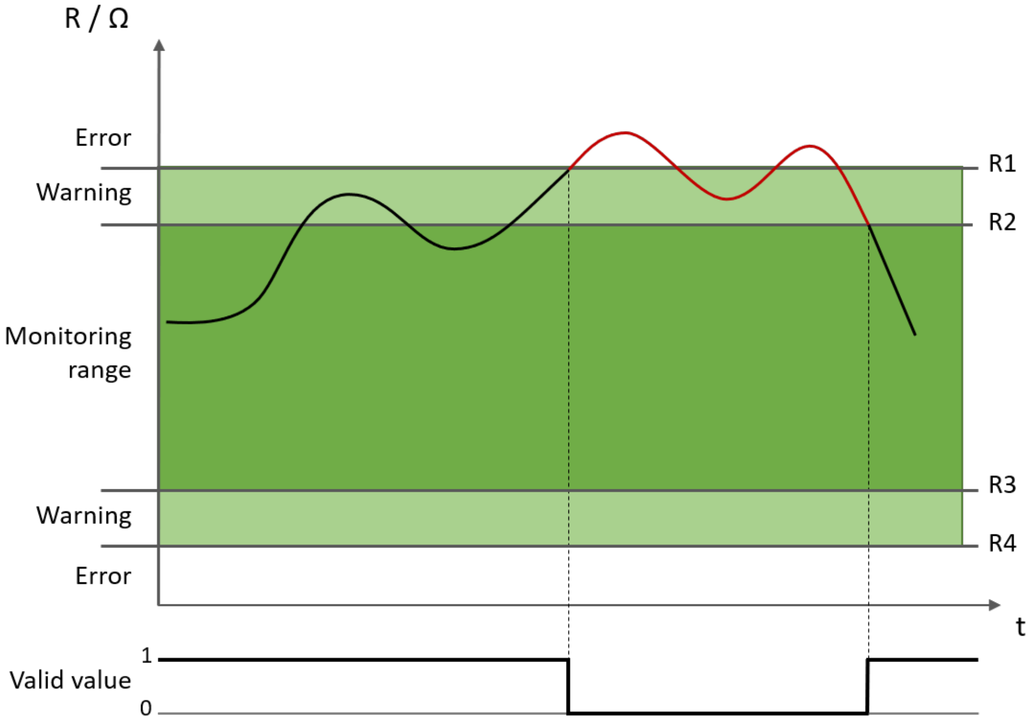


Illustration 43: Example: Value above upper limit of monitoring range (sensor RTD)

8 REFERENCING THE FUNCTION BLOCKS

8.1 General security information regarding logic programming

The functional logic of the samos® PRO system is programmed using function blocks. These function blocks are certified for use in safety-relevant functions when all safety standards are being maintained during implementation. The following sections provide information on the important aspects of using function blocks in the samos® PRO system.

WARNING

Be aware of the corresponding standards and safety regulations!

All of the safety-related parts of the system (wiring, connected sensors and control devices, configuration) must meet the respective standards (e.g. EN 62061 or EN ISO 13849-1) and safety regulations. Safety-relevant signals must be used for safety-input and safety-output signals in safety-relevant applications. Make sure that the application meets all of the applicable standards and regulations!

You are responsible for checking that the correct signal sources are being used for these function blocks and that the entire implementation of the safety logic meets the applicable standards and regulations. Always check the function of the samos® PRO hardware and logic program in order to ensure that they are behaving according to your risk reduction strategy.

WARNING

Implement additional safety measures if the safety value could lead to a hazardous state.

The safety value for process data and outputs is low and is set if an error is determined. If the safety value (signal = low) could lead to a hazard-inducing state in the application, additional measures must be implemented, such as evaluation of the status of the process data and switch-off of the output signals in question, if the status evaluation detects an error. This applies particularly to inputs with edge detection.

WARNING

Pay particular attention to unexpected rising or falling edges.

Particular care must be taken during the planning of applications in which an unexpected rising or falling edge could lead to a hazard-inducing situation at an input with edge detection. An error at an input can generate such types of edges (e.g. interruption in network communication, cable break at a digital input, short-circuit at a digital input that is connected to a test output). The safe value is set until the conditions have been met for resetting the error. For this reason, the signal in question may behave as follows:

- It temporarily switches to high instead of remaining in the error-free low state (falling edge and rising edge, i.e. transition from low to high to low), or
- It temporarily switches to low instead of remaining in the error-free high state (falling edge and rising edge, i.e. transition from high to low to high), or
- It remains low instead of changing to the error-free state to high.

WARNING

Note the delays from the CPU flag in the reverse path.

A reverse path signal is an input signal that is connected at the output of a function block with the same or a higher function block index (the function block index is displayed at the top in each function block). Thus, the input uses the output value of the prior logic cycle. This must be considered for the functionality and particularly when calculating the response time.

In order to connect a reverse path signal, you have to use a CPU flag. A CPU flag generally causes a delay of a logic cycle (see below: *Example*).

Example: CPU flag in the reverse path

Illustration 44: CPU flag in the reverse path

8.2 Function block overview

The samos® PRO uses function blocks to define the safety-based logic. A configuration may not consist of more than 300 function blocks. There are logical function blocks and application-specific function blocks. The following table lists all the available function blocks for SP-COPx:

Table 40: Overview of function blocks

Logic	
• AND (And operation) • OR (Or operation) • XOR (exclusive OR) • NOT (negation)	• RS flip-flop • JK flip-flop • T flip-flop • Binary decoder • Binary encoder
Start/edge	
• Reset • Restart	• Edge detection
Delays	
• Switch-on delay • Switch-off delay	• Adjustable switch-on delay • Adjustable switch-off delay
Counter and cycle	
• Counter (upward, downward, upward and downward) • Cycle generator	• Ramp down detection • Log generator • Retentive memory
EDM/output components	
• EDM • Valve monitoring	• Fast shut-off with bypass • Fast shut-off
Muting	
• Sequential muting • Parallel muting	• Cross muting (timer-controlled, with/without direction detection)
Presses	
• Contact monitor, universal presses • Eccentric press contact monitor • Press single stroke	• Press set-up • Press automatic mode • Cyclic operation
Analog value monitoring	
• Limit • Range	• Relation • Difference
Combustion technology	

• Analog min pressure • Analog min flow • Analog min temperature • Analog flue draft • Analog ratio • Digital min pressure • Digital min flow • Digital min temperature • Digital flue draft • Digital fuel off	• Analog max pressure • Analog max flow • Analog max temperature • Analog hearth pressure • Analog extended ratio • Digital max pressure • Digital max flow • Digital max temperature • Digital hearth pressure
Others	
• Operation mode selection switch • Emergency stop • Switch evaluation • Solenoid switch	• Light grid evaluation • Two-hand, type IIIA • Two-hand, type IIIC • Multi-two-hand
User-defined function blocks	
• Grouped function block	• User-defined function block

The samos® PRO system can support up to 300 function blocks in a given application. The response time is influenced by the number of function blocks. Therefore, you should keep the number function blocks in your application as low as possible.

8.3 Function block properties

Function blocks have a host of different properties that you can utilize. The configurable parameters are different depending on the function block. You can access the configurable properties of a function block, by selecting the **Logic** view and calling up the **Properties** docking window. The following example shows the function block **Switch evaluation** with the **Parameters** section unfolded:

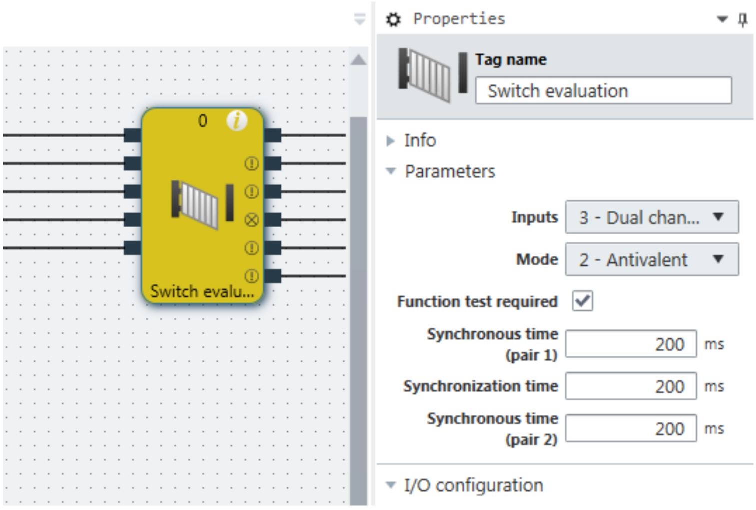


Illustration 45: Configurable parameters of function blocks

You can find the configurable parameters, depending on the specific function block, in the **Parameters** and **I/O configuration** sections. The **Tag name** field makes it possible for you to replace the specified description of the function block with your own description and to add a name or descriptive text to the function block, which will be displayed in the **Logic** view under the function block. The description of the inputs and outputs can be changed by clicking on the respective connection of the function block. You can find a general description and the index of the function block under **Info**.

8.4 Input and output signal connections of function blocks

8.4.1 Function block input connections

Possible sources for function block inputs are:

- All input elements, that are offered to you in the **Logic** and the **Hardware** docking window.
- Outputs from function blocks

8.4.2 Inverting inputs or outputs

The inputs and outputs of some function blocks can be configured in an inverted manner. This means that the function block evaluates a high signal at an inverted input as low and vice versa.

Function blocks with invertible inputs or outputs

Function blocks with invertible inputs or outputs include the following, among other things:

• AND • OR • XOR	• RS flip-flop • JK flip-flop • T flip-flop

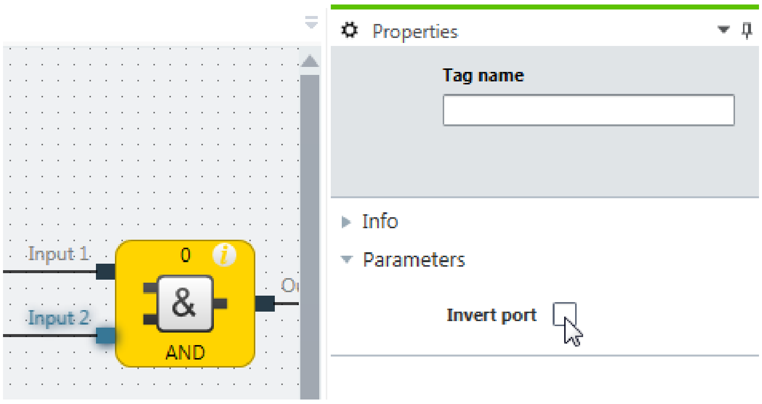
Procedure

You can invert an input or output in two ways:

"Properties" docking window

➡ Click the relevant input or output of the function block in the **Logic** view.

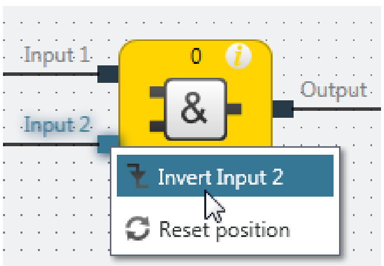
➡ Activate the **Inverted port** parameter in the **Properties** docking window.



Context menu

➡ Click the relevant input or output of the function block in the **Logic** view.

➡ Select **Invert input** in the context menu.



Display of inverted inputs or outputs

Inverted inputs or outputs are displayed with a small white circle:

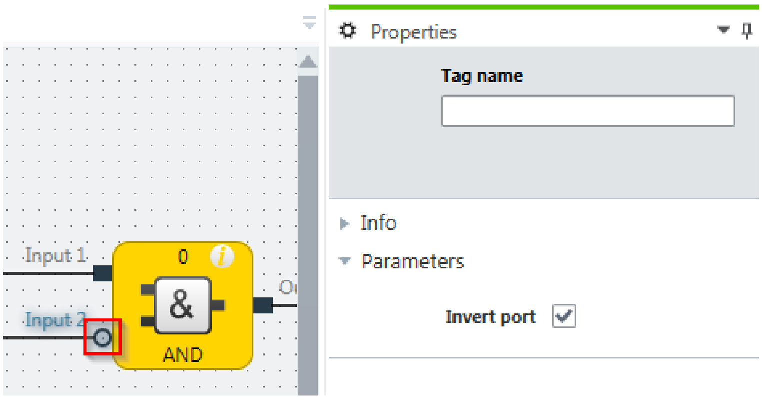


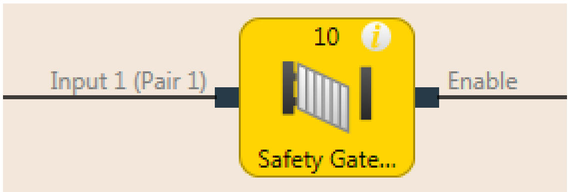
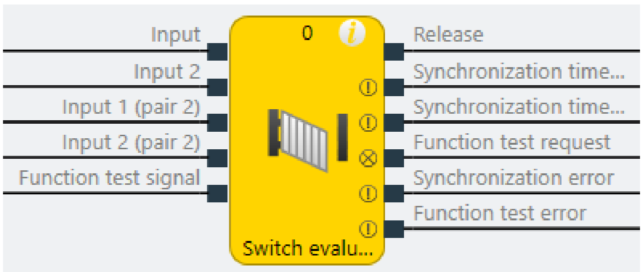
Illustration 46: An example of an AND function block with an inverted input

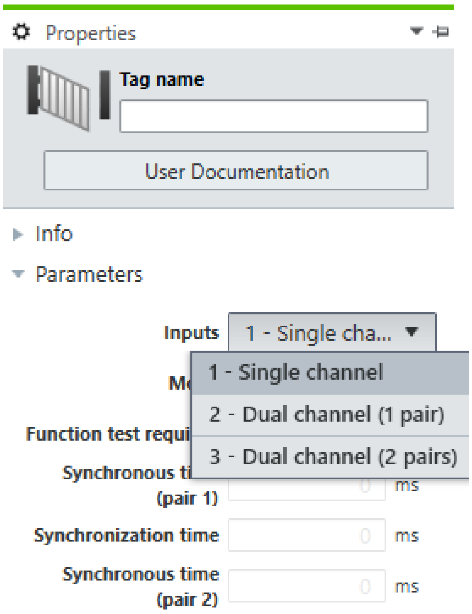
8.4.3 Output connections of function blocks

Function blocks provide various output signal connections for connecting to physical outputs or to other function blocks.

The output of a function block can be connected to multiple subordinate function blocks or to multiple output elements. The behavior of the outputs is explained in the description of the individual function blocks.

Table 41: I/O configuration of the function block, switch evaluation

Switch evaluation function block with configuration basic setting	
Switch evaluation function block with all available inputs and outputs	

Properties parameter area for the switch evaluation function block	

8.5 Parameterization of function blocks

Except for the type of input (e.g. single-channel, two-channel equivalent etc.), function blocks can have additional parameters, which are defined on the property page of the function blocks shown above.

8.5.1 Time values and logic execution time

NOTICE

When selecting time monitoring for synchronous time, pulse duration, muting time, etc., the following should be noted

The times

- must be greater than the logic execution time and
- have an accuracy of ± 10 ms, plus the logic execution time, during the evaluation.

The logic execution time depends on the number and type of function blocks used. It is a multiple of 4 ms. If the logic execution time used exceeds 100%, it is increased by 4 ms. The logic execution time is displayed in the **Logic** view. It has an accuracy of ± 100 ppm (parts per million).

8.5.2 Error outputs

Various function blocks have one or more error outputs. These error outputs are either present

- by default
  or
- appear automatically at the function block as soon as the corresponding parameters (e.g. synchronous time) are set
  or
- appear at the function block once they have been selected in the parameterization of the function block.

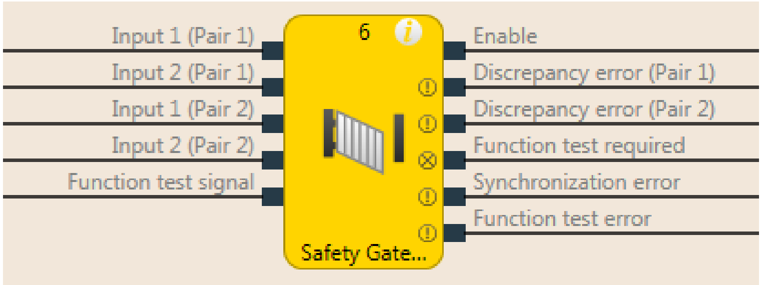


Illustration 47: Error output

The error outputs are high if an error has been detected based on the configured function block parameter (e.g. synchronous time error, function test error, synchronization error, etc.). If an error output is high, the main output (e.g. the output release) is low.

The error outputs are low when the respective error has been reset. The conditions for resetting an error are described in the section for the respective function block.

8.6 Logical function blocks

8.6.1 NOT

Function block diagram

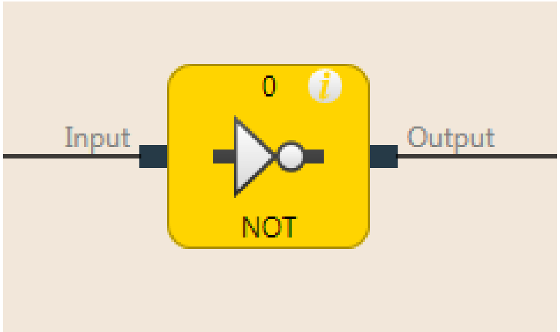


Illustration 48: Function block diagram for the NOT function block

General description

The inverted value of the input appears at the output. When the input, for example, is high, then the output is low.

Truth table

The following applies to the truth table in this section:

0 means logical low

1 means logical high

Truth table for NOT

Table 42: Truth table for the NOT function block

Input	Output
0	1
1	0

8.6.2 AND

Function block diagram

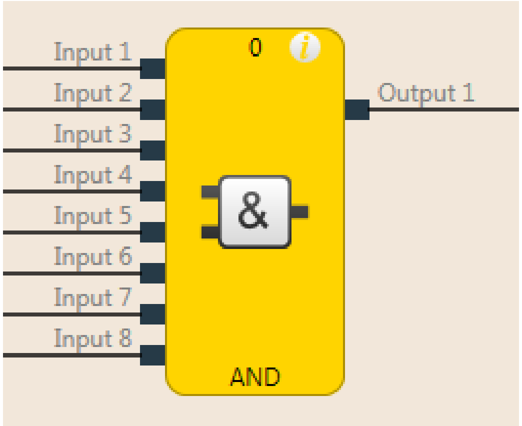


Illustration 49: Function block diagram for the AND function block

General description

The output is high when all of the evaluated inputs are high. Up to eight inputs are evaluated.

Example: When eight emergency stop buttons are connected at the inputs of the function block, then the output is low as soon as one of the emergency stop buttons is pressed.

Parameters of the function block

Table 43: Parameters of the AND function block

Parameters	Possible values
Number of inputs	2 to 8
Inverting input x	Any input of this function block can be inverted.

Further information: *Inverting inputs or outputs [ch. 8.4.2, p. 160]*

Truth table

The following applies to the truth tables in this section:

0 means logical low

1 means logical high

x means "any" = 0 or 1

Truth table for AND evaluation with one input

Table 44: Truth table for AND evaluation with one input

Input 1	Output
0	0
1	1

Truth table for AND evaluation with two inputs

Table 45: Truth table for AND evaluation with two inputs

Input 1	Input 2	Output
0	x	0
x	0	0
1	1	1

Truth table for AND evaluation with eight inputs

Table 46: Truth table for AND evaluation with eight inputs

Input 1	Input 2	Input 3	Input 4	Input 5	Input 6	Input 7	Input 8	Output
0	x	x	x	x	x	x	x	0
x	0	x	x	x	x	x	x	0
x	x	0	x	x	x	x	x	0
x	x	x	0	x	x	x	x	0
x	x	x	x	0	x	x	x	0
x	x	x	x	x	0	x	x	0
x	x	x	x	x	x	0	x	0
x	x	x	x	x	x	x	0	0
1	1	1	1	1	1	1	1	1

8.6.3 OR

Function block diagram

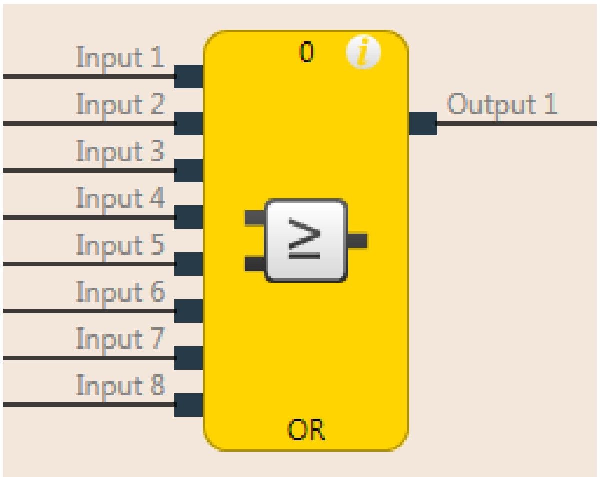


Illustration 50: Function block diagram for the OR function block

General description

The output is high when any of the evaluated inputs is high. Up to eight inputs are evaluated.

Example: When eight light curtains are connected at the inputs of the function block, then the output is high as soon as at least one of the light curtains is free.

Parameters of the function block

Table 47: Parameters of the OR function block

Parameters	Possible values
Number of inputs	2 to 8
Inverting input x	Any input of this function block can be inverted.

Further information: *Inverting inputs or outputs [ch. 8.4.2, p. 160]*

Truth table

The following applies to the truth tables in this section:

0 means logical low

1 means logical high

x means "any" = 0 or 1

Truth table for OR evaluation with one input

Table 48: Truth table for OR evaluation with one input

Input 1	Output
0	0
1	1

Truth table for OR evaluation with two inputs

Table 49: Truth table for OR evaluation with two inputs

Input 1	Input 2	Output
0	0	0
1	x	1
x	1	1

Truth table for OR evaluation with eight inputs

Table 50: Truth table for OR evaluation with eight inputs

Input 1	Input 2	Input 3	Input 4	Input 5	Input 6	Input 7	Input 8	Output
0	0	0	0	0	0	0	0	0
1	x	x	x	x	x	x	x	1
x	1	x	x	x	x	x	x	1
x	x	1	x	x	x	x	x	1
x	x	x	1	x	x	x	x	1
x	x	x	x	1	x	x	x	1
x	x	x	x	x	1	x	x	1
x	x	x	x	x	x	1	x	1
x	x	x	x	x	x	x	1	1

8.6.4 XOR (exclusive OR)

Function block diagram

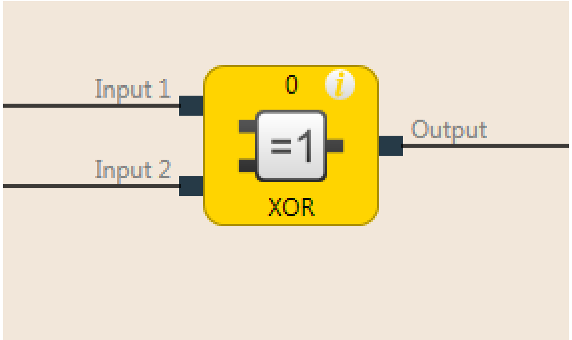


Illustration 51: Function block diagram for the XOR function block (exclusive OR)

General description

The output is only high if the two inputs are discrepant (i.e. have opposite values; one input high and one input low).

Truth table

The truth table uses the following designations:

0 means logical low

1 means logical high

Truth table for XOR evaluation

Table 51: Truth table for XOR evaluation

Input 1	Input 2	Output
0	0	0
0	1	1
1	0	1
1	1	0

8.6.5 T flip-flop

Function block diagram

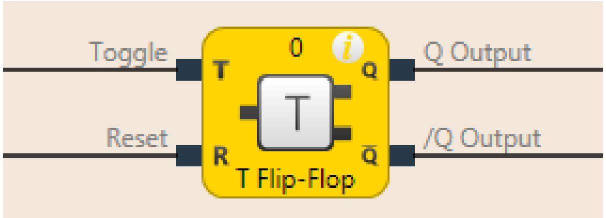


Illustration 52: Function block diagram for the T flip-flop function block

General description

The Q output switches its state at the **Toggle** input with any rising edge. The **Reset** inputs resets the **Q** output, regardless of the state at the **Toggle** input.

Truth table

The truth table uses the following designations:

- 0 means logical low
- 1 means logical high
- "n–1" relates to the previous value
- "n" relates to the current value
- x means "any" = 0 or 1
- "/" stands for the negated value

Truth table for T flip-flop evaluation

Table 52: Truth table for T flip-flop evaluation

Toggle	Reset	Output Q_{n-1}	Output $/Q_{n-1}$	Output Q_n	Output $/Q_n$
0 ⊠ 1	0	0	1	1	0
0 ⊠ 1	0	1	0	0	1
1 ⊠ 0	0	Q_{n-1}	$/Q_{n-1}$	Q_n	$/Q_n$
x	1	x	x	0	1

8.6.6 RS flip-flop

Function block diagram

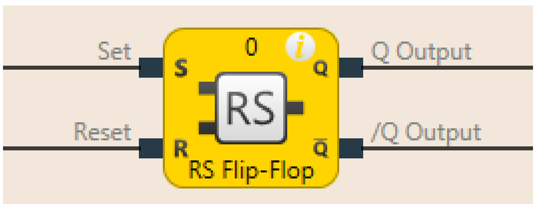


Illustration 53: Logical connections for the RS flip-flop function block

General description

The RS flip-flop function block saves the last value of the **Set** and **Reset** inputs. It is used as a simple memory cell. **Reset** has a higher priority than **Set**. If **Set** was most recently high, output **Q** is high and output **/Q** (Q inverted) is low. If input **Reset** was most recently high, output **Q** is low and output **/Q** is high.

Parameters of the function block

Table 53: Parameters of the RS flip-flop function block

Parameters	Possible values
Inverting Set	Any input of this function block can be inverted.
Inverting Reset	

Further information: *Inverting inputs or outputs [ch. 8.4.2, p. 160]*

Truth table for the RS flip-flop function block

The following applies to the truth table in this section:

- 0 means logical low
- 1 means logical high
- "n–1" relates to the previous value
- "n" relates to the current value
- x means "any" = 0 or 1
- "/" stands for the negated value

Table 54: Truth table for the RS flip-flop function block

Set	Reset	Output Q_{n-1}	Output Q_n	Output $/Q_n$
0	0	0	0	1
0	0	1	1	0
0	1	x	0	1
1	0	x	1	0
1	1	x	0	1

8.6.7 JK flip-flop

Function block diagram

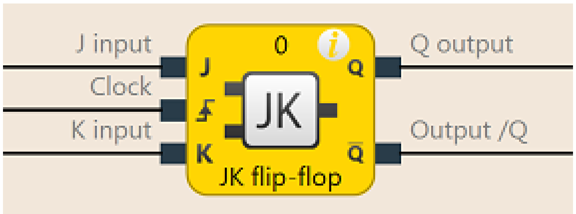


Illustration 54: Logical connections for the JK flip-flop function block

General description

The JK flip-flop function block has three inputs. Inputs **J** and **K** only act upon the outputs if a rising edge is detected at the **Clock** input. In this case ...

- If the **J** input is high and the **K** input is low, the **Q** output is high and the /**Q** output (= Q converted) is low
- If the **J** input is low and the **K** input is high, the **Q** output is low and the /**Q** output is high
- If both inputs are low, outputs **Q** and /**Q** retain the last value.
- If both inputs are high, the outputs switch over, i.e. their last values are inverted.

Parameters of the function block

Table 55: Parameters of the JK flip-flop function block

Parameters	Possible values
Number of outputs	2 (Q and /Q)
Inverting J	Any input of this function block can be inverted.
Inverting cycle	
Inverting K	

Further information: *Inverting inputs or outputs [ch. 8.4.2, p. 160]*

Truth table for the RS flip-flop function block

The following applies to the truth table in this section:

- 0 means logical low
- 1 means logical high
- "↑" means that a rising edge has been detected at the input
- "↓" means that a falling edge has been detected at the input
- "n–1" relates to the previous value
- "n" relates to the current value
- x means "any" = 0 or 1
- "/" stands for the negated value

NOTICE The following truth table applies to a configuration of the JK flip-flop function block without inverted inputs.

Table 56: Truth table for the JK flip-flop function block

J	K	Cycle	Output Q_{n-1}	Output Q_n	Output $/Q_n$
x	x	0, 1, or ↓	0	0	1
x	x	0, 1, or ↓	1	1	0
0	0	↑	0	0	1
0	0	↑	1	1	0
0	1	↑	0	0	1
0	1	↑	1	0	1
1	0	↑	0	1	0
1	0	↑	1	1	0
1	1	↑	0	1	0
1	1	↑	1	0	1

8.6.8 Cycle generator

Function block diagram

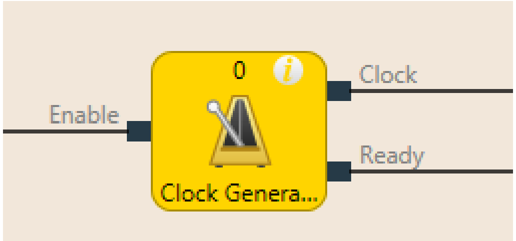


Illustration 55: Logical connections for the cycle generator function block

General description

The cycle generator function block makes it possible to generate a pulsed signal. When the **Release** input is high, the **Cycle** output pulses from low to high and back to low, according to the parameter settings of the function block.

The **Ready** output indicates with a pulse (duration: 1 logic cycle) the end of the cycle generation.

The pulse generator function block has 3 different operating modes, which determine the period, pause, and sequence parameters.

Endless cycle

Parameter setting: Pulses in a sequence = 0, pauses in a sequence = any, sequences to be generated = any

Endless sequence

Parameter setting: Pulses in a sequence ≠ 0, pauses in a sequence ≠ 0, sequences to be generated = 0

Sequence run

Parameter setting: Pulses in a sequence ≠ 0, pauses in a sequence ≠ 0, sequences to be generated ≠ 0

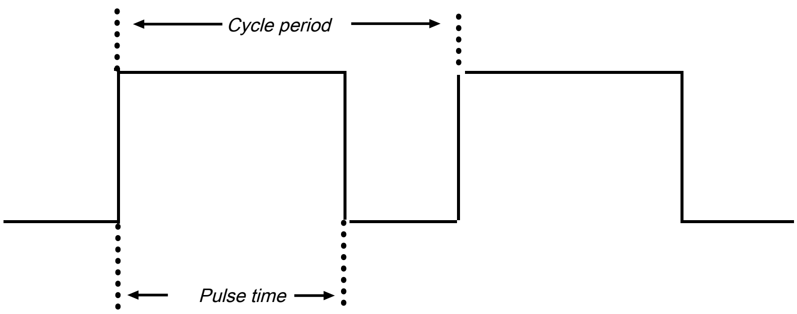


Illustration 56: Parameter diagram for the "Cycle generator" function block

Pulse time < cycle period (cycle duration)

Pulse time and cycle period are configured as a multiple of the logic execution time

Parameters of the function block

Table 57: Parameters of the "Cycle generator" function block

Parameters	Possible values
Stop mode	• Immediately after removal of the start signal • After current cycle period of the last cycle • After current sequence • After completion of all sequences
Duration of high pulse	4 to 65532 ms (minimum value and step size correspond to current logic cycle time. The maximum value is an integer multiple of the logic cycle time.)

Parameters	Possible values
Duration of low pulse	4 to 65532 ms (minimum value and step size correspond to current logic cycle time. The maximum value is an integer multiple of the logic cycle time.)
Pulses in a sequence	0 to 65535
Pauses in a sequence	0 to 65535
Sequences to be generated	0 to 65535

Sequence/timing diagram

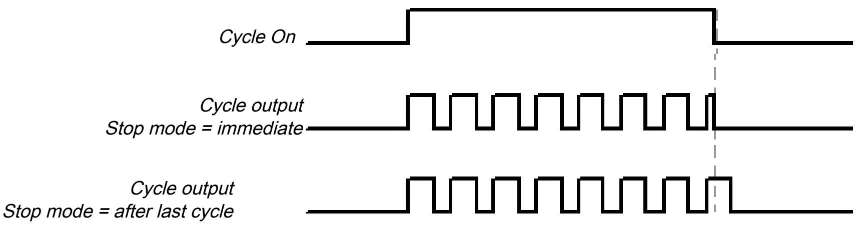


Illustration 57: Timing diagram for the cycle generator function block

Internal values

Time until next clock change

Properties	Description
Size / data format	32-bit unsigned integer
Unit	Time in ms
Value range	4 … 2^{32}-1
Factor	1

8.6.9 Counter (upward, downward, upward and downward)

Function block diagram

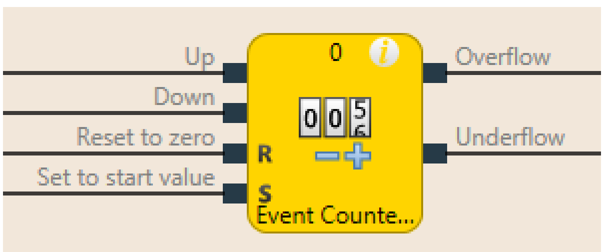


Illustration 58: Logical connections for the counter function block (up and down)

General description

The counter function blocks make it possible to count events, either upward and/or downward, in order to show them when a preset threshold value is reached at the **Upper threshold** output or when zero is reached at the **Lower threshold** output. Depending on the required counting direction, there are Upward counter, Downward counter, and Upward and Downward counter function blocks.

Parameters of the function block

Table 58: Parameters of the Upward counter, Downward counter, and Upward and Downward counter function blocks

Parameters	Possible values
Reset to zero after upper threshold exceeded	• Manual • Automatically
Set to start value after lower threshold reached	• Manual • Automatically
Upper threshold value	Integer between 1 and 65535 The upper threshold value must be greater than or equal to the reset value.
Start value	Integer between 1 and 65535
Min. pulse time for reset to zero	• 100 ms • 350 ms
Min. pulse time for set to start value	• 100 ms • 350 ms

Upward and downward inputs

A rising edge (low to high) at the **Upward** input increases the value of the internal counter by 1.

A rising edge (low to high) at the **Down** input decreases the value of the internal counter by 1.

If a rising edge (low to high) occurs at both the **Upward** input and the **Downward** input (only relates to the Upward and Downward counter function block), then the value of the internal counter remains unchanged.

Reset to zero

A valid pulse sequence with a transition of low to high to low at the **Reset to zero** input sets the internal counter to "0". This occurs regardless of whether the **Upper threshold value** was reached or not and likewise regardless of whether **Reset to zero after upper threshold** was configured with the **Manual** setting or **Automatic**.

The **Minimum pulse time for reset to zero** determines the minimum duration of the pulse at the **Reset to zero** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

Set to start value

A valid pulse sequence with a transition from low to high to low at the **Set to start value** input sets the internal counter to the configured value of the **Start value** parameter. This occurs regardless of whether **Set to start value after lower threshold** was configured with **Manual** setting or **Automatic**.

The **Minimum pulse time for reset to start time** determines the minimum duration of the pulse at the **Reset to start value** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

WARNING

Make sure that the transitions of the signals for reset to zero and for set to start value meet the requirements.

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, then the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Upper threshold value and reset to zero after reaching upper threshold

The **Reset to zero after upper threshold** parameter determines what occurs when the counter reaches the **Upper threshold** value. If this parameter is configured as **Automatic** and the internal counter is equal to the **Upper threshold value**, the **Upper threshold** output will be at high for the duration of the logic execution time. Following this, the value of the internal counter will be reset to zero.

When the **Reset to zero after upper threshold** parameter has been configured as **Manual** and the **Upper threshold value** has been reached, the **Upper threshold** output is set at high and remains on high until the counter value changes, either through a downward count due to a valid pulse sequence at the **Reset to zero** input, or due to a valid pulse sequence at the **Set at start value** input when the start value is less than the upper threshold value. Until then, all of the additional "Upward" count pulses will be ignored.

Start value and set to start value after lower threshold

The **Set at start value after lower threshold** parameter determines what occurs when the counter reaches the zero value. If this parameter is configured as **Automatic** and the internal counter is equal to zero, the **Lower threshold** output will be at high for the duration of the logic execution time. Subsequently, the value of the internal counter will be set at the configured **Start value**.

If the **Set to start value after underflow** parameter is configured as **Manual** and the lower limit, i.e. zero, has been reached, the **Underflow** output is set at high and remains on high until the counter value changes, either due to a count upwards or due to a valid pulse sequence at the **Set to start value** input. Until then, all of the additional "Downward" count pulses will be ignored.

Truth table for the Upward, Downward, and Upward/Downward counter function blocks.

The following applies to the truth table in this section:

- 0 means logical low
- 1 means logical high
- "↑" means that a rising edge has been detected at the signal input
- "↓" means that a falling edge has been detected at the signal input
- "n–1" relates to the previous value
- "n" relates to the current value
- "Y" relates to the value of the internal counter
- "X" means "any" For example, the Reset to zero and Set to start value inputs have priority over the Upward and Downward inputs.

Table 59: Truth table for the Upward, Downward, and Upward/Downward counter function blocks

Upward	Down	Reset to zero	Set to start value	Counter value $_{n-1}$	Counter value $_n$	Upper threshold $_n$	Lower threshold $_n$
↑	0, 1, or ↓	0	0	Y	Y+1	0	0
↑	0, 1, or ↓	0	0	Y	Y+1 = upper threshold value	1	0
↑	0, 1, or ↓	0	0	Y = upper threshold value	Y = upper threshold value	1	0
0, 1, or ↓	↑	0	0	Y	Y-1	0	0
0, 1, or ↓	↑	0	0	Y	Y–1 = 0	0	1
0, 1, or ↓	↑	0	0	Y = 0	Y = 0	0	1

Upward	Down	Reset to zero	Set to start value	Counter value $_{n-1}$	Counter value $_{n}$	Upper threshold $_{n}$	Lower threshold $_{n}$
↑	↑	0	0	Y	Y	0	0
X	X	1	0	Y	Reset to zero	0	0
X	X	0	1	Y	Set to start value	0	0
X	X	1	1	Y	Reset to zero	0	0

Internal values

Counter value

Properties	Description
Size / data format	16-bit unsigned integer
Unit	–
Value range	0 to 65,535
Factor	1

8.6.10 Fast shut-off and fast shut-off with bypass

Function block diagram

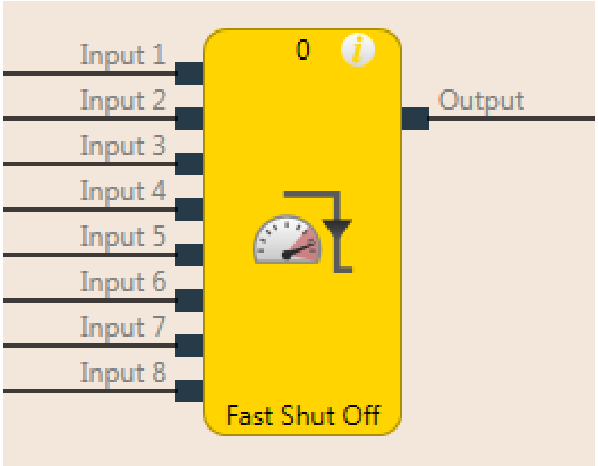


Illustration 59: Logical connections for the fast shut-off function block

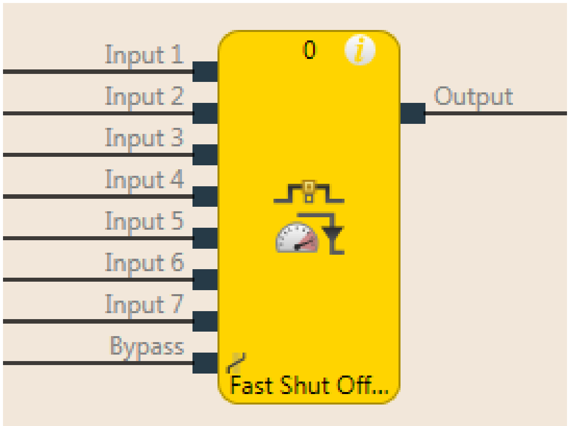


Illustration 60: Logical connections for the fast shut-off with bypass function block

General description

The fast shut-off and fast shut-off with bypass function blocks are used to minimize the response time of a safety switching path within the samos® PRO system. To this end, both the inputs and the outputs of the switching path are connected to the same input/output module (i.e. SP-SDIO or SP-COP).

The fast shut-off function blocks, regardless of the logic execution time and the logic actually provided for the output switching, cause an immediate shutdown of an output.

The fast shut-off with bypass makes it possible to temporarily bypass the fast shut-off function using the bypass input.

NOTICE

The fast shut-off with bypass function block is available in SP-SDIO modules from module version B-01 or higher.

NOTICE

The signal path from the output of the fast shut-off function block to the physical output that is selected in the fast shut-off function block must be constructed such that a switch-off of the output of the fast shut-off function block always causes a direct switch-off of the physical output. Typically, the AND, Restart, or EDM function blocks can be used in the signal string. An OR function block on the other hand will not comply with this rule.

WARNING

Consider the overall response time of the entire safety function.

The response time of the fast shut-off function block is not the same as the overall response time of the entire safety function. The overall response time includes multiple parameters outside of this function block. You can find a description of how you can calculate the overall response time of the samos® PRO system in the Hardware manual.

Parameters of the function block

Table 60: Parameters of the fast shut-off function block

Parameters	Possible values
Number of inputs	Fast shut-off: 1 to 8 Fast shut-off with bypass: 1 to 7
Fast shut-off output	All outputs of that I/O module whose inputs are also used for the input signals.

This is how you configure the fast shut-off function block:

The following example shows the function with three light barriers connected to a fast shut-off function block.

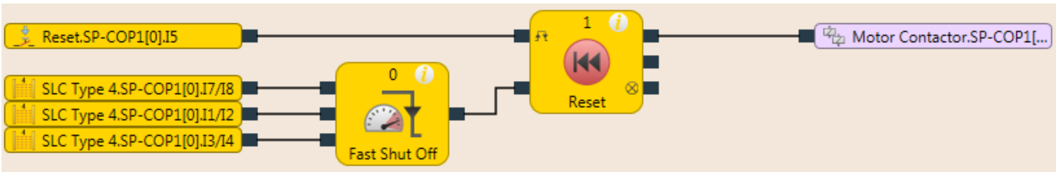


Illustration 61: Configuration example for a fast shut-off with three light barriers

NOTICE

The input signals that are intended to trigger the fast shut-off function (i.e. the input signals of the FB) must be wired in the logic such that they alone could also shut down the fast shut-off output.

WARNING

The output on which the fast shut-off function block acts must only be configured using the parameters of the function block.

The state output of the function block is only used to indicate the function of the FB or to process it further in the logic.

In order to configure the fast shut-off function block, proceed as follows:

- ➡ In the **Logic** view, connect input elements to the function block.
- ➡ Open the properties of the function block by double-clicking on the function block.
- ➡ Enter the **I/O configuration** area.
- ➡ Select the number of inputs you wish to connect to the function block.

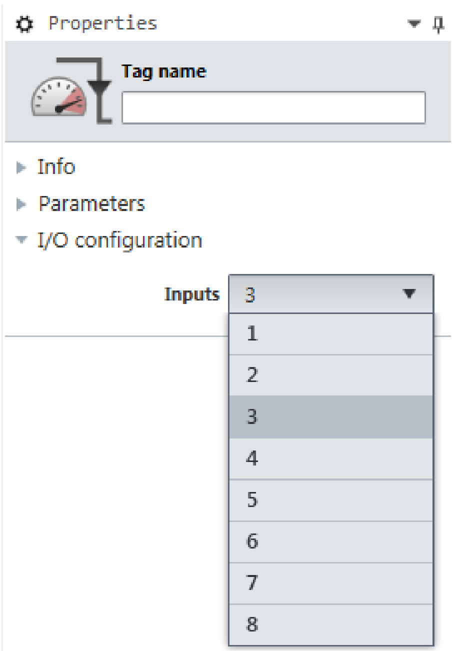


Illustration 62: I/O Settings for the fast shut-off function block

➡ Go to the **Parameters** area and select the desired zone.

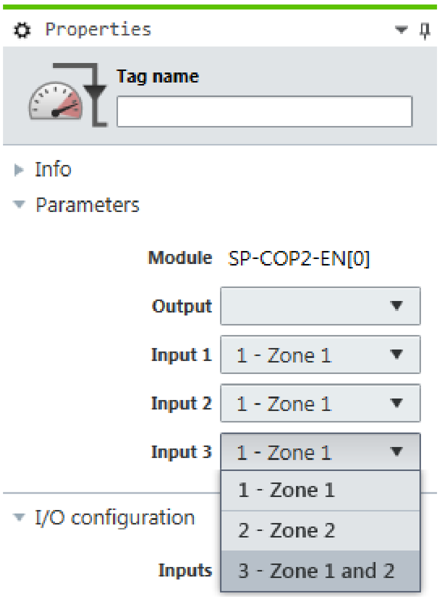


Illustration 63: Parameter settings for the fast shut-off function block

NOTICE

Inputs for the fast shut-off function block can act upon one or even two different zones. The inputs within a zone always involve an AND link. The results of AND links of the inputs of the two zones are OR linked.

If inputs are only supposed to act on zone 1, then you do not need the zone 2 or zone 1 and zone 2 parameters.

If inputs of an application are supposed to act upon both protection zones, then the zone 1, zone 2, or zone 1 and zone 2 parameters are parameterized according to the function of the inputs.

At least one of the two zones must have the state "Good" before the output is activated via the logic. If the zone signals are applied simultaneously or before the logic signal, the output does not become active.

➡ Finally, select the output for fast shut-off.

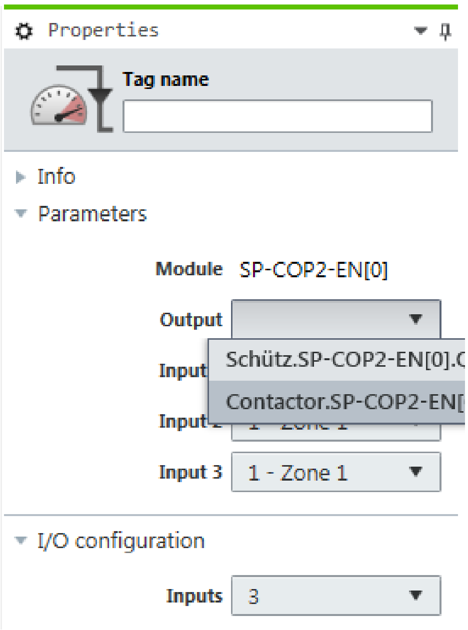


Illustration 64: Select output for fast shut-off

The selected inputs and outputs will then be connected with one another such that the outputs in the hardware configuration can no longer be moved to a different position and the inputs must remain connected at the same module. A special symbol in front of the input/output in the hardware configuration indicates whether elements are connected in this way.

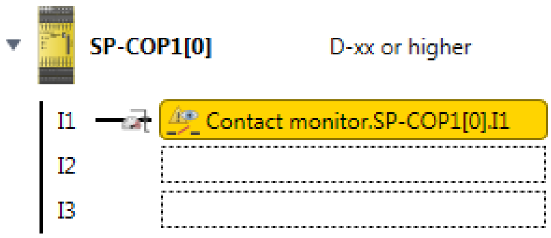


Illustration 65: View of the inputs and outputs connected with fast shut-off in the hardware configuration

These connections are canceled when the fast shut-off function block is edited or deleted.

Fast shut-off with bypass

In some applications, it may be necessary to bypass the fast shut-off, for example in a safe setup mode for a machine, in which the machine can only be operated in jog mode. To do this, the fast shut-off with bypass function block is available. It is used and configured precisely as the fast shut-off function block. The only difference is that one of the inputs of the fast shut-off with bypass function block is used for the bypass function. When the **Bypass** input is high, the fast shut-off with bypass function block is bypassed.

Make sure that the system or the machine is in a safe state when using the bypass function.

As long as the bypass function is active, a stop condition, such as the violation of a protective field, will **not** lead to a switch-off of the machine. You must ensure that other protective measures are absolutely effective during the bypass, such as the safe setup mode of the machine, so that the machine cannot endanger people or parts of the system during the bypass.

Note the longer response time when deactivating the bypass.

When the **Bypass** input is deactivated while a switch-off condition exists, then the outputs will not be switched-off until after the normal response time of the application. The minimum response time for fast shut-off does not apply to the **Bypass** input. Consider this for your risk analysis and avoidance strategy. Otherwise, there is a hazard for the operator of the machine.

Info

- Contrary to the other inputs and outputs of this function block, the **Bypass** input can be connected to an output of another function block as well as to any other input element that also can be moved to a different module in the hardware configuration.
- The **Bypass** input has a switch-on delay of three logic cycles in order to compensate for delays due to the processing time of the logic and the transmission time of the internal safety bus. This delay ensures that the corresponding module has received the bypass signal before it is used for further logic processing in the fast shut-off function block. As a result of this delay, the **Bypass** input must be at high for three logic cycles beforehand in order to bypass the fast shut-off successfully. Once this condition is fulfilled, then the fast shut-off function block output and the physical output at the I/O module will remain at high.
- The fast shut-off directly switches off the output connected to it of the corresponding module while the following logic programming is ignored. Therefore, it is not possible to program additional bypass conditions in the **Logic** view between the output of the fast shut-off function block and the module output connected to it.
- Note that the value of the connected module output in the online monitor can deviate from the actual value of the physical output of the corresponding module. For example, the connected output may be low due to the following logic, while the output of the fast shut-off function block and the physical output of the module are high because the **Bypass** input is high.
- If your application requires that it be possible to switch off the output of the module independently of an existing bypass condition (e.g. emergency stop), then the underlying logic must be implemented such that the respective switch-off signal (e.g. emergency stop) also switches off the **Bypass** input of the function block, as shown in the following example:

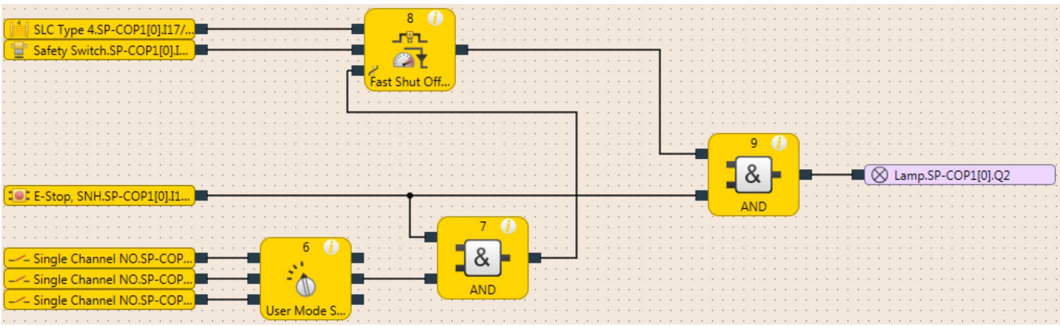


Illustration 66: Example of a fast shut-off with bypass with more than one condition for bypass

8.6.11 Edge detection

Function block diagram

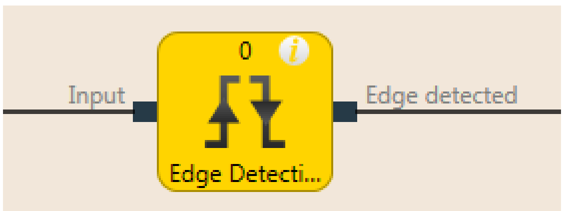


Illustration 67: Logical connections for the edge detection function block

General description

The edge detection function block makes it possible to detect a positive (rising) or negative (falling) edge of the input signal. The function block can then be configured to detect a positive edge, a negative edge, or both. When an edge is detected according to the parameter settings, the **Edge detected** output will be at high for the duration of the logic execution time.

Parameters of the function block

Table 61: Parameters of the edge detection function block

Parameters	Possible values
Edge detection	• Positive • Negative • Positive and negative

Sequence/timing diagram

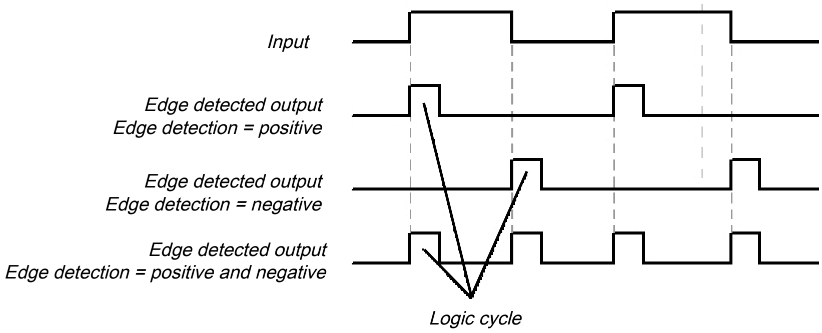


Illustration 68: Timing diagram for the edge detection function block

8.6.12 Binary encoder

Function block diagram

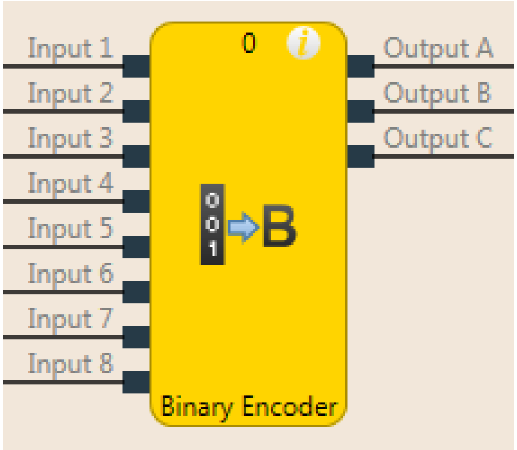


Illustration 69: Logical connections for the binary encoder function block

General description

The binary encoder function block converts one-hot coding or greatest value code into binary code, as a function of the current configuration (output A = 2^0, output B = 2^1, output C = 2^2) 2 to 8 inputs can be configured. The number of outputs is determined by the number of inputs. An **Error flag** output is available as an option.

Parameters of the function block

Table 62: Parameters of the binary encoder function block

Parameters	Possible values
Number of inputs	2 to 8
Coding mode	• Peak • Greatest value • Greatest value with input 1 dominant
Use error flag	• With • Without

Peak

In **Peak** mode, only one input can be high at any time. The outputs are set as a function of the index (input 1 = 1, input 2 = 2, etc.) of this input. Once all of the inputs are at low or once more than one input is simultaneously set at high, all of the outputs are set at low and the **Error flag** output is set at high.

Greatest value

In **Greatest value** mode, multiple inputs can be set at high simultaneously. The outputs are set as a function of the respective input thereof with the highest index (input 1 = 1, input 2 = 2, etc.). Once all of the inputs are simultaneously at low, all of the outputs are set at low and the **Error flag** output is set at high.

Greatest value with input 1 dominant

In this mode, all the outputs are low when input 1 is high. The other inputs are not considered here. If input 1 is low, the function block will behave as in **Greatest value** mode. Once all of the inputs are simultaneously at low, all of the outputs are set at low and the **Error flag** output is set at high.

Truth tables for the binary encoder function block

The following applies to the truth tables in this section:

- 0 means logical low
- 1 means logical high
- x means "any" = 0 or 1

Table 63: Truth table for the binary encoder function block with 2 inputs in peak mode

Input 2	Input 1	Output A	Error flag
0	0	0	1
0	1	0	0
1	0	1	0
1	1	0	1

Table 64: Truth table for the binary encoder function block with 8 inputs in peak mode

Input 8	Input 7	Input 6	Input 5	Input 4	Input 3	Input 2	Input 1	Out-put C	Out-put B	Out-put A	Error flag
0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	1	0	0	0	1	0
0	0	0	0	0	1	0	0	0	1	0	0
0	0	0	0	1	0	0	0	0	1	1	0
0	0	0	1	0	0	0	0	1	0	0	0
0	0	1	0	0	0	0	0	1	0	1	0
0	1	0	0	0	0	0	0	1	1	0	0
1	0	0	0	0	0	0	0	1	1	1	0
More than one input = 1								0	0	0	1

Table 65: Truth table for the binary encoder function block with 2 inputs in greatest value mode

Input 2	Input 1	Output A	Error flag
0	0	0	1
0	1	0	0
1	x	1	0

Table 66: Truth table for the binary encoder function block with 8 inputs in greatest value mode

Input 8	Input 7	Input 6	Input 5	Input 4	Input 3	Input 2	Input 1	Out-put C	Out-put B	Out-put A	Error flag
0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	0	1	x	0	0	1	0
0	0	0	0	0	1	x	x	0	1	0	0
0	0	0	0	1	x	x	x	0	1	1	0
0	0	0	1	x	x	x	x	1	0	0	0
0	0	1	x	x	x	x	x	1	0	1	0
0	1	x	x	x	x	x	x	1	1	0	0
1	x	x	x	x	x	x	x	1	1	1	0

Table 67: Truth table for the binary encoder function block with 2 inputs in greatest value mode with input 1 dominant.

Input 2	Input 1	Output A	Error flag
0	0	0	1
x	1	0	0
1	0	1	0

Table 68: Truth table for the binary encoder function block with 8 inputs in greatest value mode with input 1 dominant.

Input 8	Input 7	Input 6	Input 5	Input 4	Input 3	Input 2	Input 1	Out-put C	Out-put B	Out-put A	Error flag
0	0	0	0	0	0	0	0	0	0	0	1
x	x	x	x	x	x	x	1	0	0	0	0
0	0	0	0	0	0	1	0	0	0	1	0
0	0	0	0	0	1	x	0	0	1	0	0
0	0	0	0	1	x	x	0	0	1	1	0
0	0	0	1	x	x	x	0	1	0	0	0
0	0	1	x	x	x	x	0	1	0	1	0
0	1	x	x	x	x	x	0	1	1	0	0
1	x	x	x	x	x	x	0	1	1	1	0

WARNING

Evaluate the error flag when the binary encoder function block is set for security purposes.

When you use the binary encoder function block for safety-relevant logic, then you may have to evaluate the **Error flag** output. This is the only way to determine whether only input 1 is high or whether an invalid input state exists. In both cases, all outputs are low.

8.6.13 Binary decoder

Function block diagram

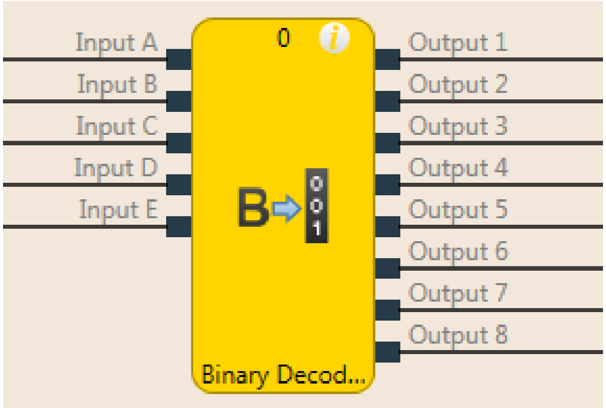


Illustration 70: Logical connections for the binary decoder function block

General description

The binary decoder function block converts binary code into one-hot code or into greatest value code as a function of its current configuration. Up to five inputs can be configured. The number of outputs is determined by the number of inputs. The evaluation of inputs A, B, and C enables the decoding of binary codes with decimal values of 0 to 7 with a single binary decoder function block (input A = 2^0, input B = 2^1, input C = 2^2). With optional inputs D and E, it is possible to combine up to four binary decoders in order to decode binary codes with decimal values of 0 to 31.

Parameters of the function block

Table 69: Parameters of the binary decoder function block

Parameters	Possible values
Coding mode	• Peak • Level
Inputs	• Not inverted • Inverted
Number of inputs	1 to 5
Value range	• 0-7 • 8-15 (only available when more than 3 inputs are used) • 16-23 (only available when 5 inputs are used) • 24-31 (only available when 5 inputs are used)

Peak

In **Peak** mode, only the output whose number corresponds to the current input values is high.

Level

In **Level** mode, the output is high whose number corresponds to the current input values as well as all outputs with low numbers.

Inputs inverted/not inverted

With the assistance of this parameter, it is possible to invert all inputs.

Truth tables for the binary decoder function block

The following applies to the truth tables in this section:

- 0 means logical low
- 1 means logical high

Table 70: Truth table for the binary decoder function block with 1 input in peak mode

Input A	Output 2	Output 1
0	0	1
1	1	0

Table 71: Truth table for the binary decoder function block with 2 inputs in peak mode

Input B	Input A	Output 4	Output 3	Output 2	Output 1
0	0	0	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	1	0	0	0

Table 72: Truth table for the binary decoder function block with 3 inputs in peak mode

Input C	Input B	Input A	Output 8	Output 7	Output 6	Output 5	Output 4	Output 3	Output 2	Output 1
0	0	0	0	0	0	0	0	0	0	1
0	0	1	0	0	0	0	0	0	1	0
0	1	0	0	0	0	0	0	1	0	0
0	1	1	0	0	0	0	1	0	0	0
1	0	0	0	0	0	1	0	0	0	0
1	0	1	0	0	1	0	0	0	0	0
1	1	0	0	1	0	0	0	0	0	0
1	1	1	1	0	0	0	0	0	0	0

Table 73: Truth table for the binary decoder function block with 1 input in level mode

Input A	Output 2	Output 1
0	0	1
1	1	1

Table 74: Truth table for the binary decoder function block with 2 inputs in level mode

Input B	Input A	Output 4	Output 3	Output 2	Output 1
0	0	0	0	0	1
0	1	0	0	1	1
1	0	0	1	1	1
1	1	1	1	1	1

Table 75: Truth table for the binary decoder function block with 3 inputs in level mode

Input C	Input B	Input A	Output 8	Output 7	Output 6	Output 5	Output 4	Output 3	Output 2	Output 1
0	0	0	0	0	0	0	0	0	0	1

Input C	Input B	Input A	Output 8	Output 7	Output 6	Output 5	Output 4	Output 3	Output 2	Output 1
0	0	1	0	0	0	0	0	0	1	1
0	1	0	0	0	0	0	0	1	1	1
0	1	1	0	0	0	0	1	1	1	1
1	0	0	0	0	0	1	1	1	1	1
1	0	1	0	0	1	1	1	1	1	1
1	1	0	0	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1	1

Evaluating more than three inputs

If 4 or 5 inputs are used, up to four binary decoders can be combined in order to decode binary codes with values of 0 to 31.

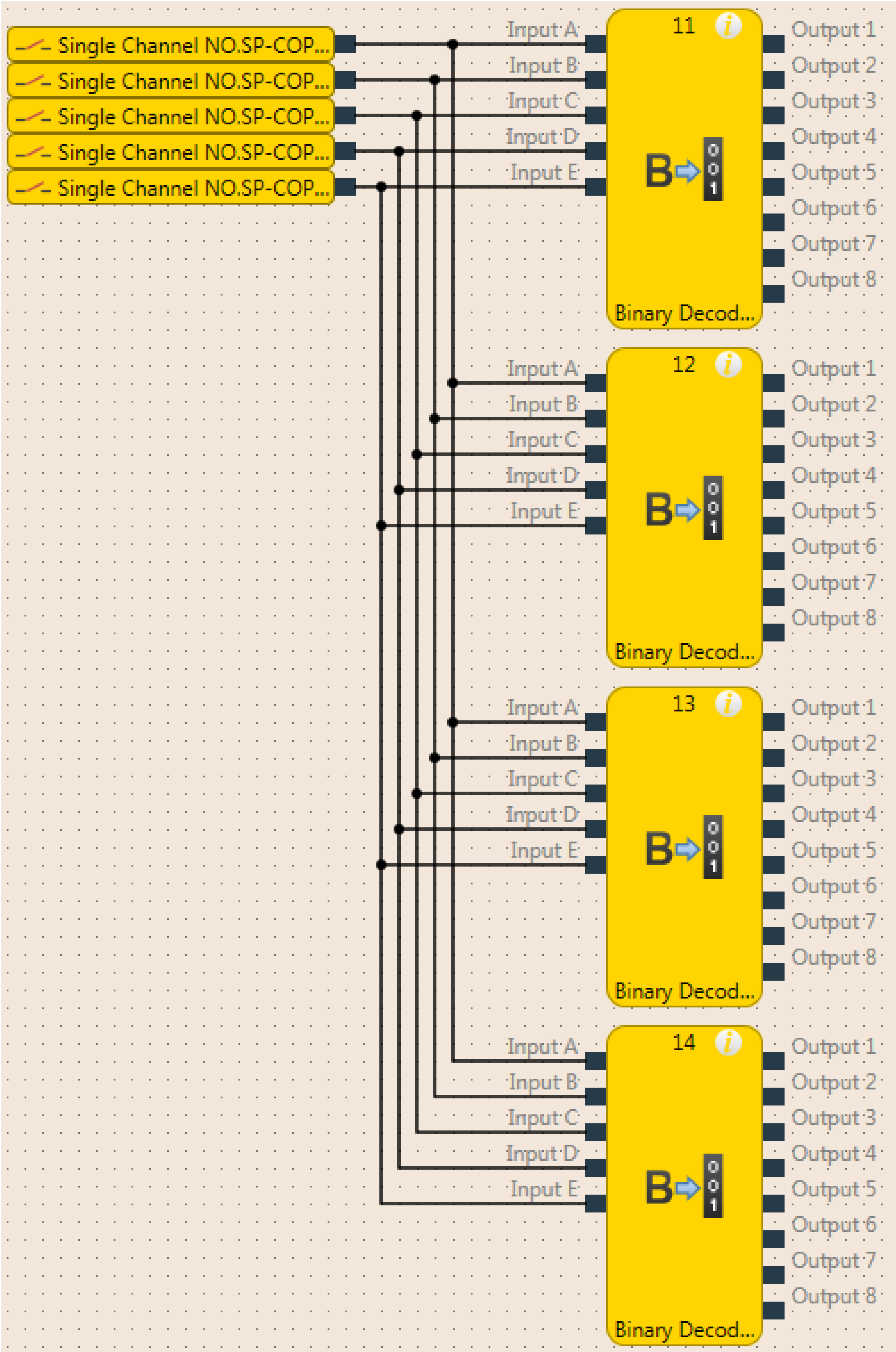


Illustration 71: Combination of four binary decoders

If you combine multiple binary decoders, you must configure the value range that should be covered for each of these function blocks with the assistance of the **Value range** option. This range is determined by the value of inputs D and E.

Table 76: The value range of the binary decoder function block depends on input D.

Input D	Outputs
0	0-7
1	8-15

Table 77: The value range of the binary decoder function block depends on inputs D and E

Input E	Input D	Outputs
0	0	1-7
0	1	8-15
1	0	16-23
1	1	24-31

- When **Input D** and **Input E** have the same value as the **Value range** parameter (e.g. when **Input E** = 1, **Input D** = 0, and the **Value range** is set at 16-23), the function block behaves as shown in the truth tables above, depending on the value of inputs A, B, and C and on the configured coding mode (peak or level).
- When **Input D** and **Input E** have a **lower** value than the **Value range** parameter (e.g. when **Input E** = 0, **Input D** = 1, and the **Value range** = 16-23), then all of the outputs are low, regardless of the configured coding mode (peak or level).
- When **Input D** and **Input E** have a **higher** value than the **Value range** parameter (e.g. **Input E** = 1, **Input D** = 1, and **Value range** = 16-23) …
  - all outputs are low in peak mode,
  - all outputs are high in level mode.

8.6.14 Log generator

Function block diagram

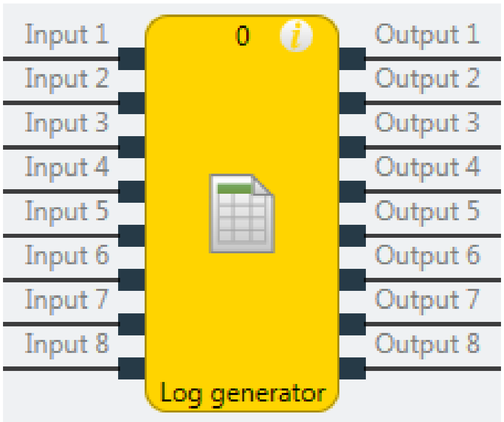


Illustration 72: Function block diagram for the log generator function block

General description

The log generator function block evaluates up to eight inputs. If an edge is detected at one of these inputs according to the configuration, the function block sets the corresponding output to high for the duration of the logic execution time and adds a user-defined text message to the diagnostic history. This text message can be read in online mode with the assistance of the samos® PLAN 6 software diagnostic function.

Further information: *Using the monitoring functions [ch. 6.10, p. 139]*

NOTICE

You can generate no more than 10 messages within 3 seconds with the log generator function components. Use text that is as brief as possible.

Parameters of the function block

Table 78: Parameters of the log generator function block

Parameters	Possible values
Number of inputs	1 to 8

Parameters	Possible values
Messages	Up to 64 user-definable messages per project.
Input condition	• Rising edge • Falling edge

This is how to configure the log generator function block

The following example shows the log generator function block with an emergency stop button, a safety light curtain, and a safety switch connected.

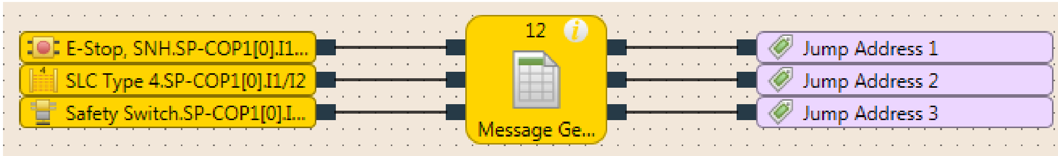


Illustration 73: Configuration example of a log generator with two emergency stop buttons and one safety switch

In order to configure the log generator function block, proceed as follows:

➡ Connect the input elements to the function block. Double-click the function block to display the function block properties and then select the **I/O configuration** area.

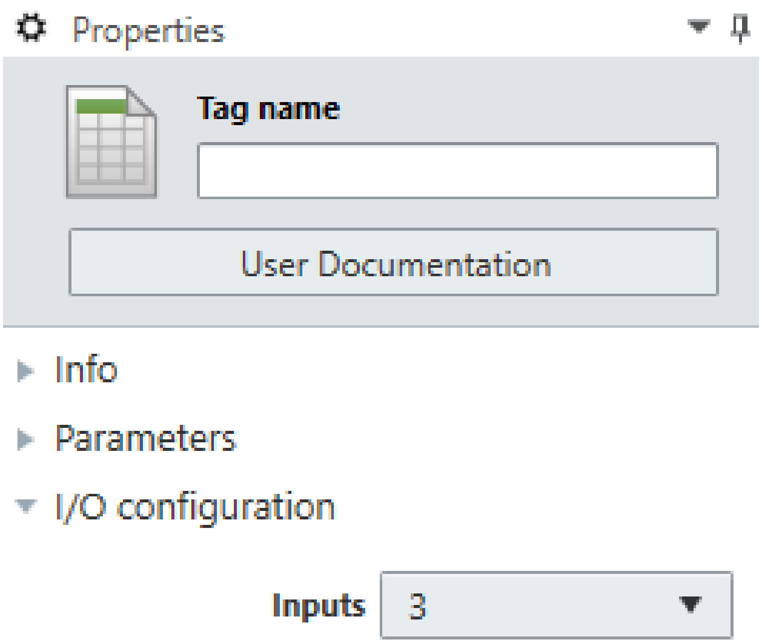


Illustration 74: I/O configuration for the log generator function block

➡ Select the number of inputs you wish to connect to the function block.

➡ In the **Parameter** area, click **Open editor** and enter the messages to be output in the diagnostics system.

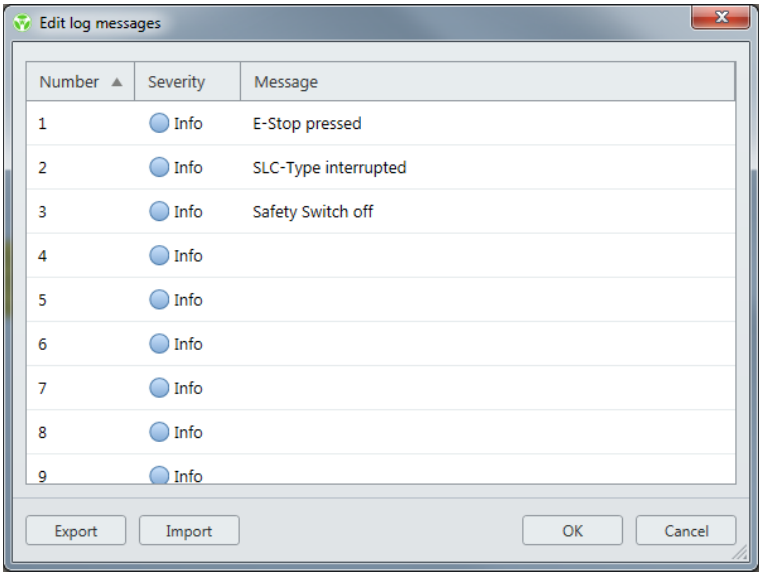


Illustration 75: Available messages in the log generator function block

NOTICE

- The messages entered will apply to all log generator function blocks used throughout a project.
- You can enter up to 64 different messages with a length of up to 110 characters each per project. To internally save umlauts and special characters, they need two or three characters in UTF-8 format so that the displayed character string is correspondingly shorter.
- Using the **Export** and **Import** button to the lower left in this window, you can save messages as a text file in CSV format (Comma Separated Values) or import messages from a CSV file.

➡ In the **Parameter** area, assign the required message to each input used and select the input condition for each input (by activating/deactivating the input inverting) which, when fulfilled, will trigger the generation of the respective message (rising edge or falling edge).

NOTICE

The message assignment cannot be exported or imported.

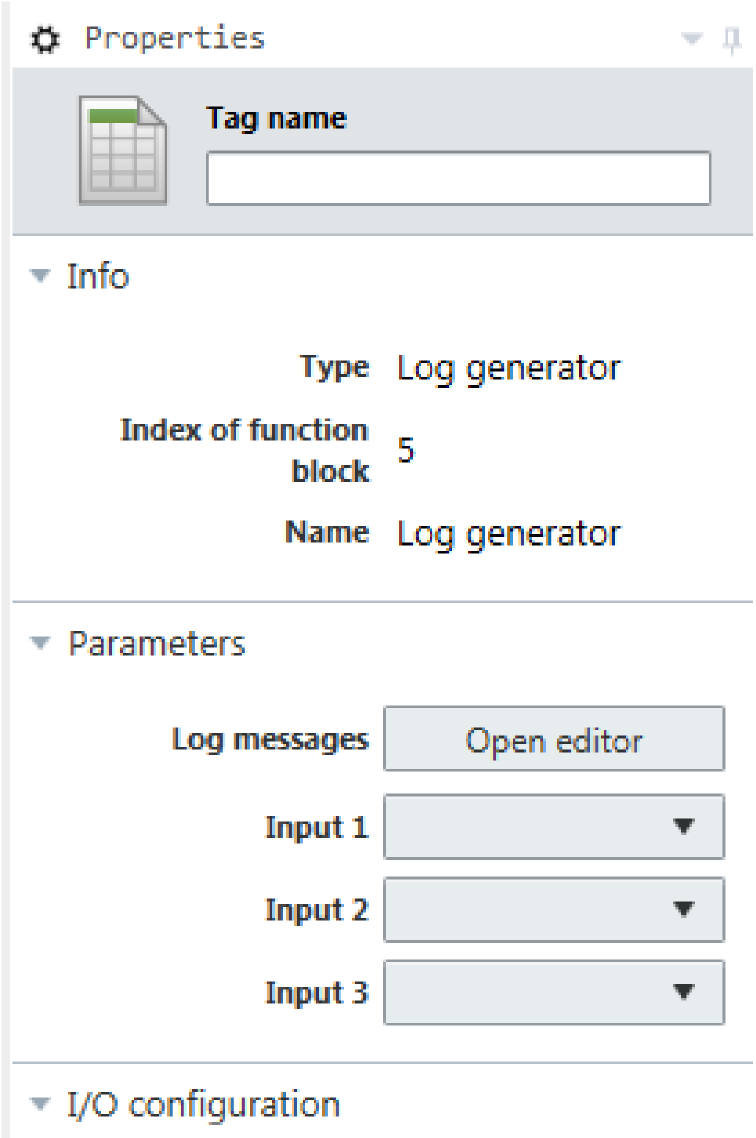


Illustration 76: Assignment of the input conditions for the log generator function block

Priority of messages

If more than one condition is met simultaneously, the following priorities will apply:

- When there is a single log generator function block, the input with the lowest number has priority, i.e. the message generated from this input is logged first.
- If there are multiple log generator function blocks being used, the function block with the lowest function block index has priority, i.e. the messages generated from this function block are logged first.

8.6.15 Retentive memory

Function block diagram

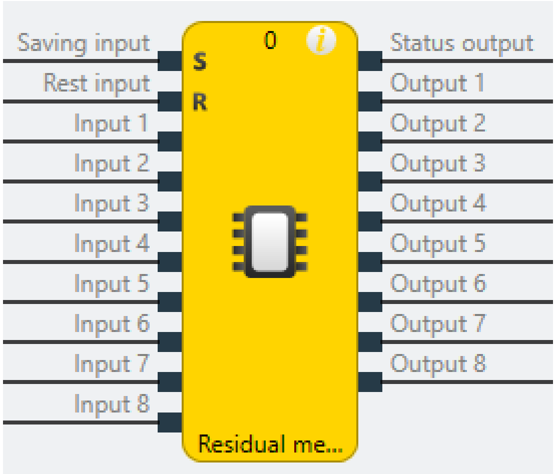


Illustration 77: Function block diagram for the retentive memory function block

General description

The residual memory function block can store up to 8 bits of non-volatile memory in the controller module. The value present at the inputs is stored by means of a High signal at the Memory input S in the function block.

The status output is always High when the control is in operation.

Saving and deleting data

If **Memory input S** is high, after it was previously low, the data present at the inputs is stored retentively and is present at the outputs. If **Memory input S** is once again low, no new data can be saved and the most recently saved data will be present at the outputs and will thus also be once again available after a power failure and restoration of the power.

If **Memory input S** is at high up to the point of failure of the power supply, the data present at the inputs will be permanently stored in the retentive memory. After power is restored, the outputs will be updated with the most recently saved data, even if memory input S is at high. There will be no saving of new data until **Memory input S** is once again at low and then switches back to high. This functionality can be used to construct, for example, a retentive error memory in that an error bit can only be deleted through manual acknowledgment (interruption of a high signal at memory input S).

The content of the retentive memory and its outputs can be reset by means of a high signal at **Reset input R** if memory input S is simultaneously at high (low-high edge after power-up or stop → run).

Project change - behavior up to and including module version E 01.01

If the SD card is removed while the supply voltage is still present or a new project is transferred to the control using samos® PLAN 6, the residual data is deleted.

When changing the SD card, ensure that the meaning of the stored data has not changed in the project.

If the SC card is changed while the voltage is disconnected and the new memory card also contains a project with a residual memory, the stored values will continue to be used in the new project.

Project change - behavior from module version F 01.01

The residual data is deleted when a new valid project is detected. This also occurs if the SD card is changed while the voltage is disconnected. A verification or falsification is not a new project in this sense.

Only a maximum of 2 instances of this function block can be used for each project.

NOTICE

- In order to save the required data in the event of a power failure, it must be ensured that the store signal reaches the low state before the data to be saved.
- The pre-processed signal is relevant as an input signal for all inputs. If an input signal has the logical level "1" and there is a test pulse error, a "0" is saved. The same applies to the memory and reset input.

Parameters of the function block

Table 79: Parameters of the retentive memory function block

Parameters	Possible values
Number of inputs	3 to 10
Number of outputs	2 to 9

8.7 Application-specific function blocks

8.7.1 Reset

Function block diagram

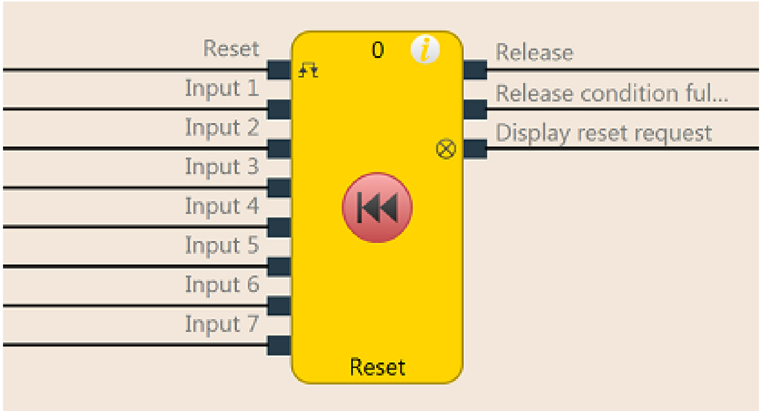


Illustration 78: Function block diagram for the reset function block

General description

The reset function block can be used to fulfill the standard requirements of safety applications for acknowledging a manual safety stop and the subsequent prompt for restart of the application. Typically, each safety logic function of a flexible safety controller based on samos® PRO contains a reset function block.

Parameters of the function block

Table 80: Parameters of the reset function block

Parameters	Possible values
Min. reset pulse time	• 100 ms • 350 ms
Number of inputs	2 to 8 (= 1 to 7 release inputs activated)

Release condition fulfilled output

The **Release condition fulfilled** output indicates the result of an AND link of all activated **Release** inputs. It is high when all activated **Release** inputs are high.

Reset required output

The **Reset required** output indicates, by pulsing at 1 Hz, that the function block is expecting a valid reset pulse at the **Reset** input, so that the **Release** output can go to high. This is the case when the **Release condition fulfilled** output is at high, i.e. all activated **Release** inputs are high, but the **Release** output is still low. Typically, this output is used to actuate an indicator lamp.

Release output

The **Release** output is at high when the **Release condition fulfilled** output is high and a valid reset pulse has been detected at the **Reset** input, provided all activated **Release** inputs remain high.

The **Min. reset pulse time** determines the minimum duration of the pulse at the **Reset** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

The **Release** output is low when one or more **Release** inputs go to low.

WARNING

Make sure that the transitions of the signals for reset meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, then the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Sequence/timing diagram

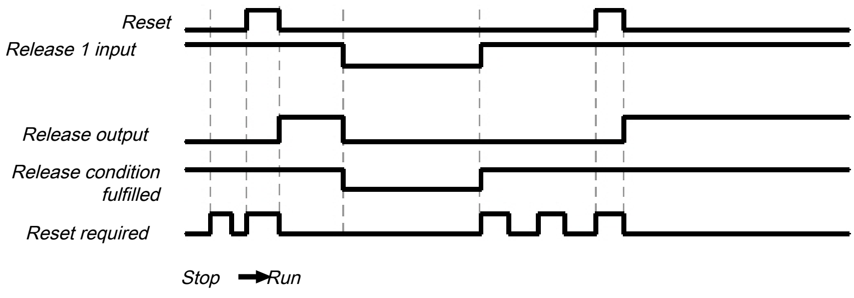


Illustration 79: Sequence/timing diagram for the reset function block

8.7.2 Restart

Function block diagram

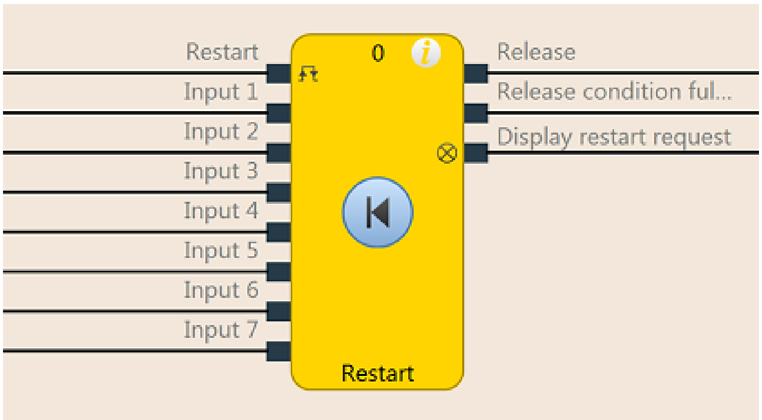


Illustration 80: Function block diagram for the restart function block

General description

The internal logic of the restart function block has the same function as that of the reset function block. The restart function block enables graphical differentiation of the function blocks while adhering to application standards for acknowledging a manual restart request.

Parameters of the function block

Table 81: Parameters of the restart function block

Parameters	Possible values
Min. restart pulse time	• 100 ms • 350 ms
Number of inputs	2 to 8 (= 1 to 7 release inputs activated)

Release condition fulfilled output

The **Release condition fulfilled** output indicates the result of an AND link of all activated **Release** inputs. It is high when all activated **Release** inputs are high.

Restart required output

The **Restart required** output indicates, by pulsing at 1 Hz, that the function block is expecting a valid restart pulse at the **Restart** input, so that the **Release** output can go to high. This is the case when the **Release condition fulfilled** output is at high, i.e. all activated **Release** inputs are high, but the **Release** output is still low. Typically, this output is used to actuate an indicator lamp.

Release output

The **Release** output is at high when the **Release condition fulfilled** output is high and a valid restart pulse has been detected at the **Restart** input, provided all activated **Release** inputs remain high.

The **Min. restart pulse time** determines the minimum duration of the pulse at the **Restart** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

The **Release** output is low when one or more **Release** inputs go to low.

WARNING

Make sure that the transitions of the signals for restart meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, then the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Sequence/timing diagram

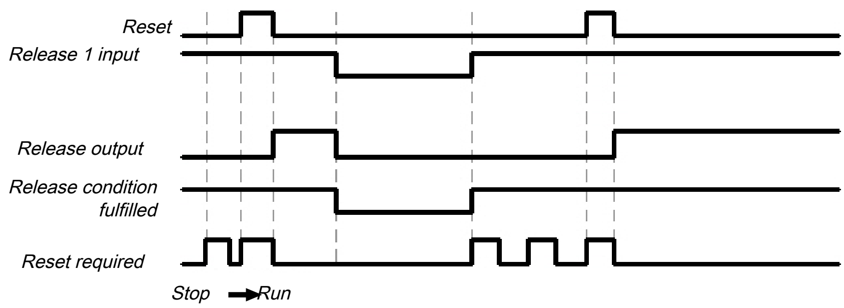


Illustration 81: Sequence/timing diagram for the restart function block

8.7.3 Switch-off delay

Function block diagram

Illustration 82: Function block diagram for the switch-off delay function block

General description

The switch-off delay function block delays the switch-off of the **Release** output for a configurable length of time.

Parameters of the function block

Table 82: Parameters of the switch-off delay function block

Parameters	Possible values
Switch-off delay time	0 to 300 seconds in 10 ms increments. If the value is not 0, it must be greater than the logic execution time.

The timer starts with the delay sequence upon a transition of the input from high to low. If the timer has expired after the configured time, the **Release** output is likewise low, provided the input continues to be low. If the input is high, the **Release** output immediately goes to high and the timer is reset.

Sequence/timing diagram

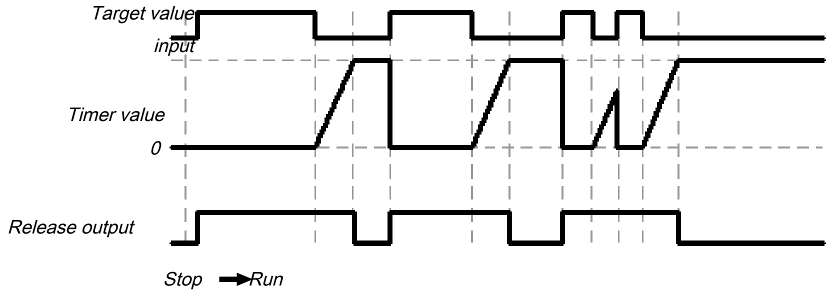


Illustration 83: Sequence/timing diagram for the switch-off delay function block

Internal values

Time until next change of the release output

Properties	Description
Size / data format	24-bit unsigned integer
Unit	Time in ms
Value range	0 … 600,000 (total delays)
Factor	1

8.7.4 Adjustable switch-off delay

Function block diagram

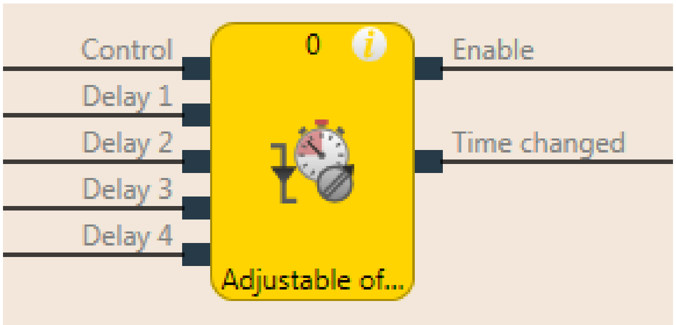


Illustration 84: Function block diagram for the adjustable switch-off delay function block

General description

The adjustable switch-off delay function block delays the switch-off of the **Release** output for an adjustable length of time. Four individual switch-off delay times, each of which can be activated using a corresponding **Delay** input, can be configured. The total delay is equal to the total of all activated delay times.

Parameters of the function block

Table 83: Parameters of the adjustable switch-off delay function block

<table>
<tr><th>Parameters</th><th>Possible values</th></tr>
<tr><td>Delay 1</td><td rowspan="4">0 to 600 seconds in 10 ms increments.
If the value is not 0, the corresponding input is activated. In this case, the value must be greater than the logic execution time.
The total delay (total of all switch-off delay times) is limited to 600 seconds.</td></tr>
<tr><td>Delay 2</td></tr>
<tr><td>Delay 3</td></tr>
<tr><td>Delay 4</td></tr>
</table>

The timer starts with the delay sequence when there is a falling edge (high to low) at the **Control input**. If the timer has expired after the selected total delay time, the **Release** output is likewise low, provided the **Control input** continues to be low. If the **Control input** is high, the **Release** output immediately goes to high and the timer is reset.

If one of the **Delay** inputs assumes a different value during an ongoing delay sequence, then the **Time change** output goes to high and remains high until the **Control input** goes back to high.

The effective total delay time depends on which **Delay** inputs were high at the time the falling edge occurred at the **Control input**. This means that a change at the **Delay** inputs has no effect on the current delay sequence during a delay sequence.

If the **Control input** is low during the first logic cycle after a transition from the stop state to the run state, the **Release** output likewise remains low.

Sequence/timing diagram

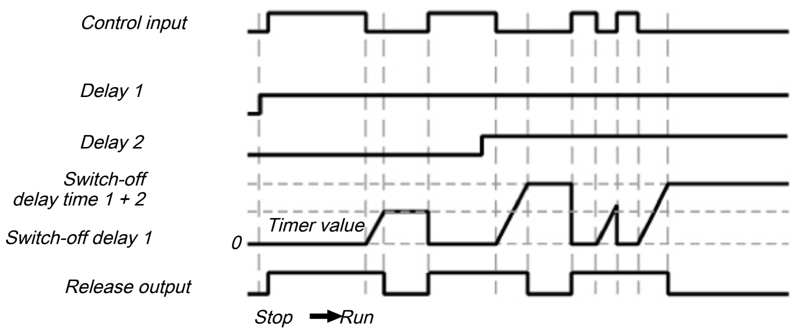


Illustration 85: Sequence/timing diagram for the adjustable switch-off delay function block with switch-off delay time 1 and switch-off delay time 2

Internal values

Time until next change of the release output

Properties	Description
Size / data format	24-bit unsigned integer
Unit	Time in ms
Value range	0 … 600,000 (total delays)
Factor	1

8.7.5 Switch-on delay

Function block diagram

Illustration 86: Function block diagram for the switch-on delay function block

General description

The switch-on delay function block delays the switch-on of the **Release** output for a configurable length of time.

Parameters of the function block

Table 84: Parameters of the switch-on delay function block

Parameters	Possible values
Switch-on delay time	0 to 300 seconds in 10 ms increments. If the value is not 0, it must be greater than the logic execution time.

The timer starts with the delay sequence upon a transition of the input from low to high. If the timer has expired after the configured time, the **Release** output is likewise high, provided the input continues to be high. If the input is low, the **Release** output immediately goes to low and the timer is reset.

Sequence/timing diagram

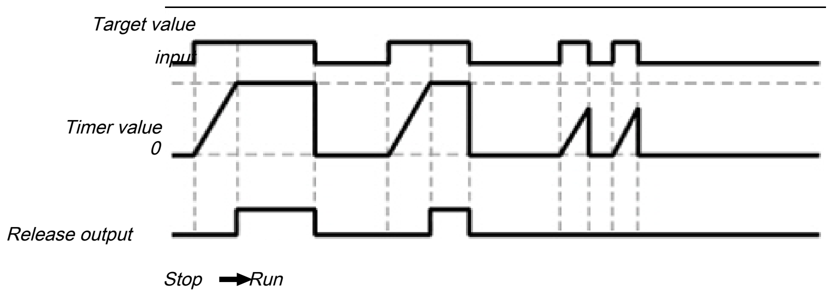


Illustration 87: Sequence/timing diagram for the switch-on delay function block

Internal values

Time until next change of the release output

Properties	Description
Size / data format	24-bit unsigned integer
Unit	Time in ms
Value range	0 … 600,000 (total delays)
Factor	1

8.7.6 Adjustable switch-on delay

Function block diagram

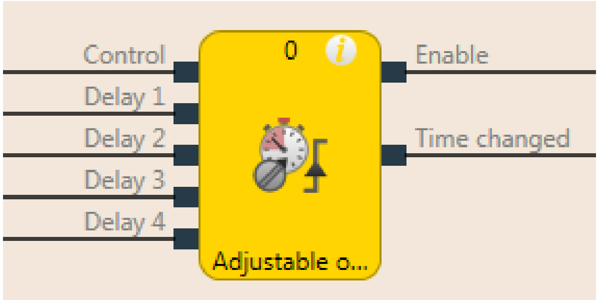


Illustration 88: Function block diagram for the adjustable switch-on delay function block

General description

The adjustable switch-on delay function block delays the switch-on of the **Release** output for an adjustable length of time. Four individual delay times, each of which can be activated using a corresponding **Delay** input, can be configured. The total delay is equal to the total of all activated delay times.

Parameters of the function block

Table 85: Parameters of the adjustable switch-on delay function block

Parameters	Possible values
Delay 1 Delay 2 Delay 3 Delay 4	0 to 300 seconds in 10 ms increments. If the value is not 0, it must be greater than the logic execution time.

The timer starts with the delay sequence when there is a rising edge (low to high) at the **Control input**. If the timer has expired after the selected total delay time, the **Release** output is likewise high, provided the **Control input** continues to be high. If the Control input is low, the **Release** output immediately goes to low and the timer is reset.

If one of the **Delay** inputs assumes a different value during an ongoing delay sequence, then the **Time change** output goes to high and remains high until the **Control input** goes back to low.

The effective total delay time depends on which **Delay** inputs were high at the time the rising edge occurred at the **Control input**. This means that a change at the **Delay** inputs has no effect on the current delay sequence during a delay sequence.

If the **Control input** is high during the first logic cycle after a transition from the stop state to the run state, the **Release** output immediately goes to high without delay.

Sequence/timing diagram

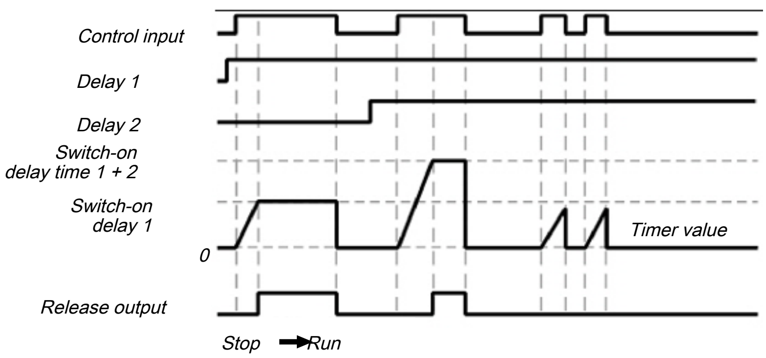


Illustration 89: Sequence/timing diagram for the adjustable switch-on delay function block with switch-on delay time 1 and switch-on delay time 2

Internal values

Time until next change of the release output

Properties	Description
Size / data format	24-bit unsigned integer
Unit	Time in ms
Value range	0 … 600,000 (total delays)
Factor	1

8.7.7 EDM (contactor monitor)

Function block diagram

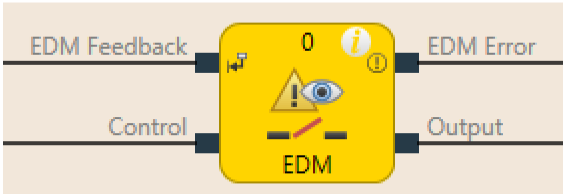


Illustration 90: Function block diagram for the EDM function block

General description

The EDM (contactor monitor) function block makes it possible to actuate an external device (e.g. a contractor) and to check whether it has switched as expected by means of its feedback signal. The external device is connected to the **Output** for this. The feedback signal is connected to the **EDM read-back signal** input. The **Control input** is connected to the logic signal, which represents the desired state for the external device, e.g. the **Release** output of a reset function block.

After the maximum feedback delay has elapsed, a de-bounce time of 12 ms takes effect. If the EDM read-back signal switches into the wrong state for more than 12 ms, an EDM error occurs.

Parameters of the function block

Table 86: Parameters of the EDM function block

Parameters	Possible values
Max. feedback delay	100 to 1000 ms in 10 ms increments. The value must be greater than the logic execution time.

Output

The output is high when the **EDM read-back signal** is high and then the control input switches from low to high.

The **Output** is low when the **Control input** is **Low** or when an EDM error is pending (**EDM error** output is high).

EDM errors and error flag

In general, it is expected that the **EMD read-back signal** will always assume the inverted value of the **Control input** within the configured max. feedback delay (T_{EDM}).

The **EDM error** outputs and **Error flag** are high when …

- The **Control input** switches from low to high and the **EDM read-back signal** is low (independently of T_{EDM}), or
- The **Control input** switches from low to high and the **EDM read-back signal** does not switch from high to low within T_{EDM}, or
- The **Control input** switches from high to low and the **EDM read-back signal** does not switch from low to high within T_{EDM}, or

- The **Control input** is low and the **EDM read-back signal** switches to low for more than 12 ms
- The **Control input** is high and the **EDM read-back signal** switches to high for more than 12 ms

The **EDM error** outputs and **Error flag** are low when a signal sequence has been detected that sets the **Output** to high.

NOTICE If you require a delay of signals from the **Output**, then you must implement the output delay with another function block before the EDM function block and not after. Otherwise, this could lead to an EDM error.

Sequence/timing diagram

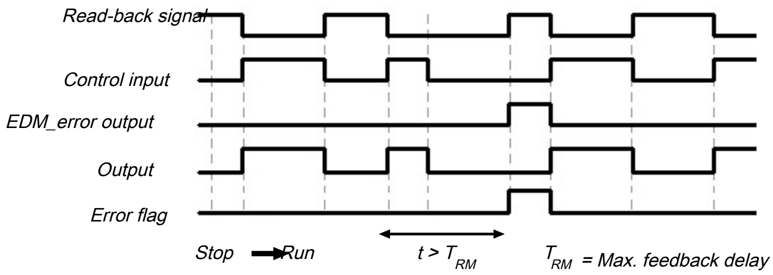


Illustration 91: Sequence/timing diagram for the EDM function block

8.7.8 Valve monitoring

Function block diagram

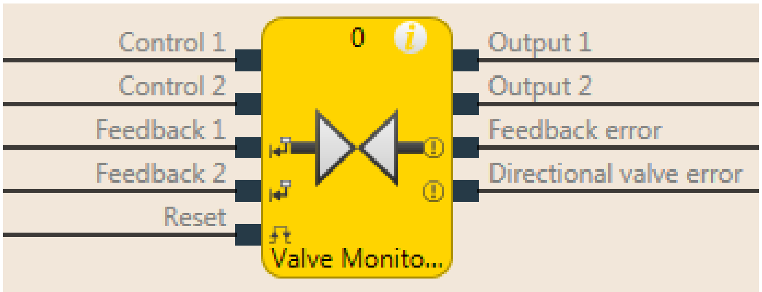


Illustration 92: Logical connections for the valve monitoring function block configured for a directional valve

General description

The valve monitoring function block makes it possible to actuate valves and to check, using their feedback signals, whether they have switched as expected.

To this end, the valves are connected to **Output 1** to **Output 2**. The feedback signals are connected to the **Read-back 1** and **Read-back 2** inputs. **Control input 1** and **Control input 2** are connected to the logic signal that represents the desired state for the valve, e.g. the **Release** output of a reset function block. Depending on the valve type, some signals will not be required.

Three different valve types are available: Single valves, double valves, and directional valves.

Parameters of the function block

Table 87: Parameters of the valve monitoring function block

Parameters	Possible values
Reset condition	• Manual reset • Automatic reset
Continuous monitoring with active valve	• Active • Inactive
Valve type	• Single valve (control output 1, output 1, read-back 1 activated) • Double valve (control input 1, output 1, read-back-1, output 2, read-back 2 activated) • Directional valve (control input 1, output 1, read-back-1, control input 2, read-back 2, directional error activated)
Max. switch-on feedback delay	50 ms to 10 s in 10 ms increments (0 = inactive, only available from controller module version B-01). If this parameter is deactivated, then the continuous monitoring option with active valve must also be deactivated. If the value is not 0, it must be greater than the logic execution time.
Max. switch-off feedback delay	50 ms to 10 s in 10 ms increments (0 = inactive, only available from controller module version B-01). If this parameter is activated, the value must be greater than the logic execution time.
Min. reset pulse time	• 100 ms • 350 ms
Use error flag	• With • Without

WARNING

Connect the read-back signals correctly!

The signals for **Read-back 1** and **Read-back 2** must be protected against short-circuits at the signals for outputs (e.g. **Output 1 and 2**) and against short-circuits among each other (e.g. through protective wiring or wiring these signals exclusively within the switchbox).

Output 1 to output 2

Output 1 and/or **Output 2** is high when the corresponding **Read-back 1** and/or **Read-back 2** input is high and then the corresponding **Control input** switches from low to high.

Output 1 and/or **Output 2** is low when the corresponding **Control input** is low or when an error is pending (**Read-back error** output is high or **Directional error** output is high).

The corresponding control input for **Output 1** is always **Control input 1**.

The corresponding control input for **Output 2** depends upon the configured valve type.

- For **Directional valve: Control input 1**
- For **Double valve: Control input 2**

Read-back error, directional error, and error flag

In general, it is expected that the **Read-back 1/2** input will always assume the inverted value of the corresponding **Control input** within the configured max. switch-on feedback delay (T_{ON}) or max. switch-off feedback delay (T_{OFF}).

The **Read-back error** output is high when ...

- The **Control input** switches from low to high and the corresponding **Read-back signal** is low (independently of T_{ON} and T_{OFF}), or
- T_{ON} is greater than zero and the **Control input** switches from low to high and the corresponding **Read-back signal** does not switch from high to low within T_{ON}, or
- T_{OFF} is greater than zero and the **Control input** switches from high to low and the corresponding **Read-back signal** does not switch from low to high within T_{OFF}, or
- **Continuous monitoring with active valve** is active and the **Control input** is high and the corresponding **Read-back signal** is switched to high.

The **Directional error** output is high when the **Valve type** parameter is = **Directional valve** and **Control input 1** and **Control input 2** are high at the same time.

The **Error flag** output is high when the **Read-back error** and/or **Directional error** is high.

The **Read-back error**, **Directional error**, and **Error flag** outputs are low when all activated control inputs are low and all activated read-back inputs are high. When **Manual reset** is configured as a reset condition, then a valid reset pulse must additionally be implemented at the **Reset** input.

The **Min. reset pulse time** determines the minimum duration of the pulse at the **Reset** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

WARNING

Make sure that the transitions of the signals for reset meet the requirements of the safety standards and regulations!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, then the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Sequence/timing diagrams

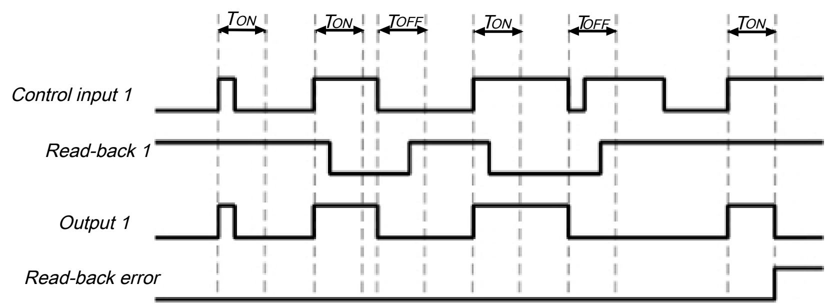


Illustration 93: Sequence/timing diagram for single valve in manual reset mode

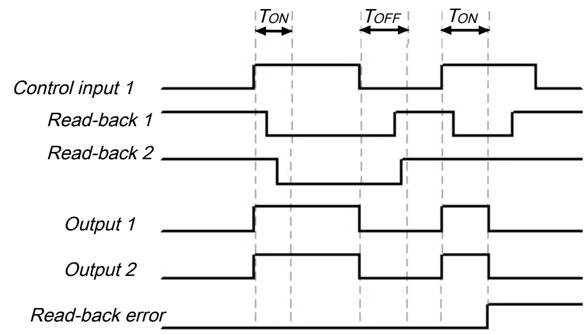


Illustration 94: Sequence/timing diagram for double valve in manual reset mode

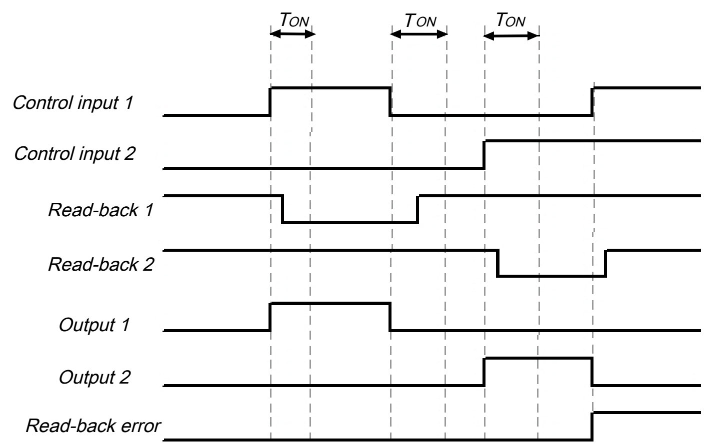


Illustration 95: Sequence/timing diagram for directional valve

8.7.9 Operation mode selection switch

Function block diagram

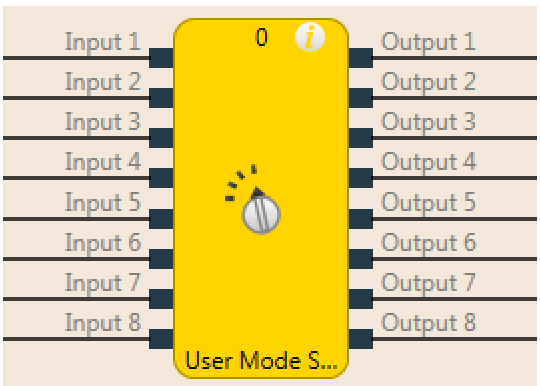


Illustration 96: Function block diagram for the mode selection switch function block

General description

The mode selection switch function block selects an output as a function of an input value. Output x is high when input x is high.

The function block supports two to eight inputs and the corresponding outputs.

Exactly only one input can be high at any one time. If no input or more than one input is high, then the output that was most recently high remains high for the duration of the set high synchronous time. After the synchronous time has elapsed, the outputs are set to the values defined in the error output combination and the **Error flag** output goes to high.

If there is no valid input combination present during the first logic cycle after the transition from the stop state to the run state, then the outputs are immediately set to the values defined in the error output combination and the **Error flag** output goes to high.

Parameters of the function block

Table 88: Parameters of the mode selection switch function block

Parameters	Possible values
Synchronous time	0 to 10 seconds in 10 ms increments
Error output combination	Marked outputs are high and unmarked outputs are low when the error flag is high.
Number of inputs and number of outputs	2 to 8
Use error flag	• With • Without

Truth table for the mode selection switch function block

The truth table uses the following designations:

0 means logical low

1 means logical high

Table 89: Truth table for the mode selection switch function block

Inputs								Outputs								
1	2	3	4	5	6	7	8	Error flag	1	2	3	4	5	6	7	8
1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
More than one input high or no input high for shorter than the configured synchronous time								0	= last output combination							
More than one input high or no input high for longer than the configured synchronous time								1	= error output combination							

Sequence/timing diagram

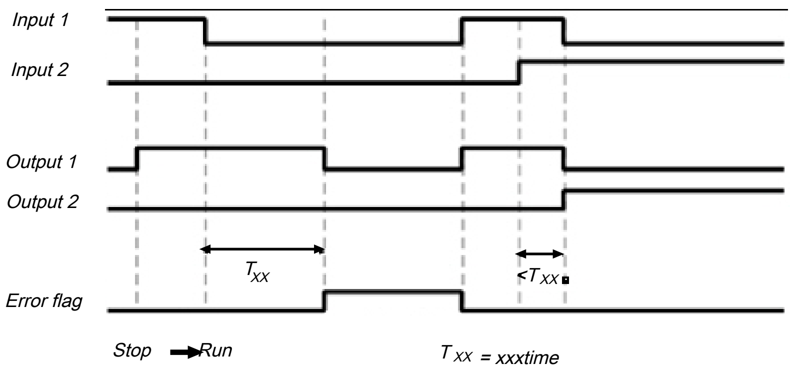


Illustration 97: Sequence/timing diagram for the mode selection switch function block

Info

- When the inputs of the function block are connected at the inputs of an expansion module that are connected to test outputs, and the faulty input combination is the result of a test pulse error (short-circuit to high) that will lead to a low input value, then the test pulse error must first be reset, e.g. by briefly disconnecting the particular line at the input are at the test output.
- When the inputs of the function block are connected at inputs of an expansion module that are connected to test outputs, then a cross-connection can only be detected between the inputs used when an operating mode is selected that activates one of these inputs.

8.7.10 Ramp down detection

Function block diagram

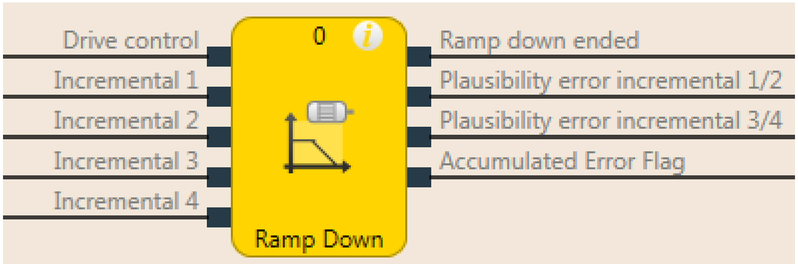


Illustration 98: Logical connections for the ramp down detection function block

General description

The ramp down detection function block checks whether a connected drive has stopped, i.e. that no pulses have been detected from the pulse encoder system for the duration of a configurable time span (e.g. from an HTL encoder or from proximity switches). A safety door lock can be released, for example, depending on the results of this check.

The ramp down detection is started by a falling edge of the **Drive control** input signal. A stop of the drive is detected when no signal change (rising or falling edge) has taken place for at least the duration of the configured **Min. time between the signal changes** at any **Pulse encoder** input. In this case, the **Ramp-down ended** output is at high. When the **Drive controller** input is high, this sets the **Ramp-down ended** output to low immediately and ends any currently running ramp down detection as well.

In **drive-is-running** state (**Drive control** input is high) and **stop-detected** state (**Ramp-down ended** output is high), the **Pulse encoder** inputs are not monitored for signal changes (see *Figure [ch. 8.7.10, p. 214]*).

The function block enables an optional plausibility check of the **Pulse encoder** inputs in order to detect disconnections in the cabling provided that the pulse encoder provides suitable signals such as complementary outputs or proximity switches and a gearwheel with 270° span and a phase offset of 180°. When the possibility check is active, there must be at least one signal of each signal pair at high at all times. The **Pulse encoder plausibility error** output goes to high when this condition is not fulfilled for the duration of two successive logic cycles. This means that both inputs of a pair may be at low for the duration of the logic execution time without this being evaluated as an error (see *Figure [ch. 8.7.10, p. 214]*).

The **Pulse encoder plausibility error** output is reset to low when at least one signal of a signal pair is high and the **Drive controller** input is low.

The **Collective error flag** is high when any **Pulse encoder plausibility error** output is high. The **Error flag** output is low when all error outputs are low.

Parameters of the function block

Table 90: Parameters of the ramp down detection function block

Parameters	Possible values
Number of pulse encoder inputs	• Single-channel pulse encoder input • One pair of pulse encoder inputs • Two pairs of pulse encoder inputs
Input plausibility check	• Inactive • Active If active, then the number of pulse encoder inputs must either be 1 pair or 2 pairs.
Time period within which the signal change can still be interpreted as movement of the drive (tolerance time)	100 ms to 10 seconds in 10 ms increments. The value must be greater than the logic execution time.
Use error flags (input plausibility check active)	• With • Without

NOTICE

Make sure that your application meets the following requirements!

The duration of the pulse encoder signals must be at least as long as the logic execution time (see step 1 below).

Connect the signal that controls the physical output for the drive to the **Drive Controller** input. Make sure that the torque for the drive is switched off under all circumstances when this input is low.

The pulse encoders must be locally connected to a module belonging to one of the following classes: SP-COP, SP-SDIO or SP-SDI

Configuration steps

- Check the minimum duration of the pulse encoder signals (see step 1 below).
- Determine the time between the signal changes for the speed limit (see step 2 below).

Step 1: Check the maximum signal frequency of the pulse encoder signals.

The minimum duration of signals t_{high} and t_{low} of the pulse encoder must be greater than the logic execution time. This limits the permissible signal frequency and the pulse encoder speed as a function of the type of pulse encoder. The following figures show typical signal patterns for various types of pulse encoders:

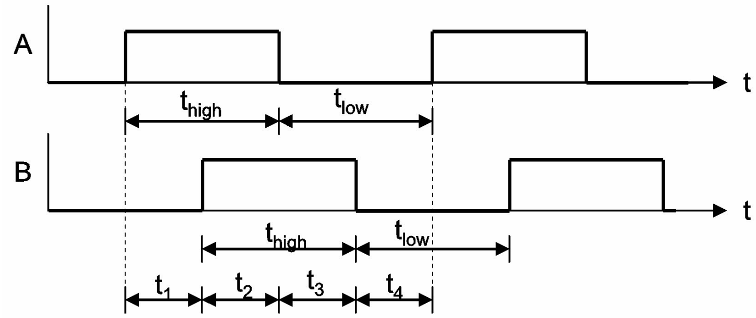


Illustration 99: Signal pattern for A/B pulse encoder with 90° phase offset

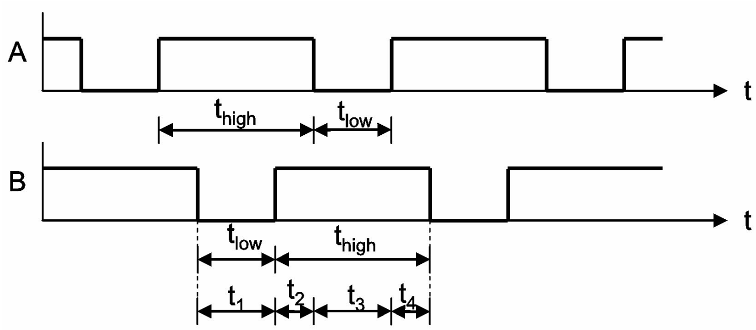


Illustration 100: Signal pattern for 1/3 gap pulse encoder with 180° phase offset

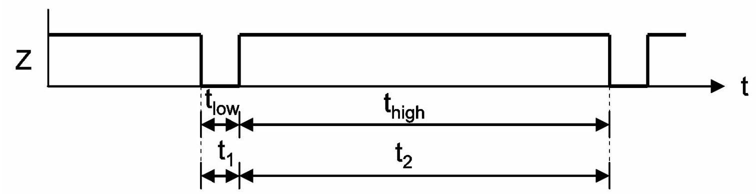


Illustration 101: Signal pattern for individual pulse encoder signal

Based on the design of your system, you must ensure that the minimum duration of pulse encoder signals t_{high} and t_{low} are each always greater than the logic execution time. In doing so, consider all of the potential tolerance values, such as switching tolerances, gearwheel tolerances, etc. The following table shows typical values for various types of pulse encoders:

Table 91: Maximum permissible signal frequency and speed (RPM) of pulse encoders, as a function of the type and the logic execution time

Pulse encoder type	Max. permissible pulse encoder signal frequency (Hz) for logic execution time									
	4 ms	8 ms	12 ms	16 ms	20 ms	24 ms	28 ms	32 ms	36 ms	40 ms
A/B, 90° phase offset	120	60	40	30	24	20	17.1	15	13.3	12
1/3 gap[1)]	80	40	26.6	20	16	13.3	11.4	10	8.8	8
1/4 gap[1)]	60	30	20	15	12	10	8.5	7.5	6.6	6
Pulse 180°	120	60	40	30	24	20	17.1	15	13.3	12

1) 180° Phase offset, at least 1 signal always high.

Step 2: Determine the time between signal changes for the speed limitation

1. Determine the speed at which the **Ramp-down ended** output should be activated, for example in order to release a safety door.
2. Determine the maximum time between two signal changes at this speed (maximum values of t_1 to t_4). In doing so, consider all of the potential tolerance values, such as switching tolerances, gearwheel tolerances, etc.

Min. time between signal changes = maximum values of t1 to t4 + 10 ms

The **Min. time between single changes** must absolutely be greater than the logic execution time and must be rounded up to the next multiple of 10 ms.

WARNING

Note the increased logic execution times!

Any time the logic program is changed, the logic execution time can be increased. In this case, it may be necessary to recalculate the maximum signal frequency of the pulse encoder. Otherwise, there is a hazard for the operator of the machine.

Example 1: A/B 90° phase offset

- 4 teeth per rotation
- Switching tolerances ±5°→ teeth 175° to 185° (corresponds to t_{low}, t_{high}); signal change 85° to 95° (corresponds to t_1 to t_4)
- Maximum drive speed = 750 RPM → 12.5 Hz
- Drive speed for release = 15 RPM → 0.25 Hz
- Logic execution time = 8 ms

Procedure

➡ Check the maximum signal frequency of the pulse encoder signals:
Max. signal frequency = 12.5 Hz × 4 teeth/rotation = 50 Hz
Lowest t_{low} = 1/50 Hz × 175°/360° = 9.7 ms
→ Higher than the logic execution time
Lowest t_{high} = 1/50 Hz × 175°/360° = 9.7 ms
→ Higher than the logic execution time

➡ Determine the time between signal changes for the speed limitation:
Signal frequency for release = 0.25 Hz × 4 teeth/rotation = 1 Hz
Max. duration input pattern = 1/1 Hz × 185°/360° = 514 ms
Time between signal changes = 514 ms + 10 ms = 524 ms
→ Min. time between signal changes = 530 ms (rounded up to the next multiple of 10 ms)

Example 2: 1/3 gap 180° phase offset

- 8 teeth per rotation
- Switching tolerances ±2°→ teeth 118° to 122° (corresponds to t_{low}, t_{high}); signal change 118° to 122° (corresponds to t_1 to t_4)
- Maximum drive speed = 120 RPM → 2 Hz
- Drive speed for release = 12 RPM → 0.2 Hz
- Logic execution time = 16 ms

Procedure

➡ Check the maximum signal frequency of the pulse encoder signals:
Max. signal frequency = 2 Hz × 8 teeth/rotation = 16 Hz
Lowest t_{low} = 1/16 Hz × 118°/360° = 20.5 ms
→ Higher than the logic execution time
Lowest t_{high} = 1/16 Hz × 238°/360° = 41.3 ms
→ Higher than the logic execution time

➡ Determine the time between signal changes for the speed limitation:
Signal frequency for release = 0.2 Hz × 8 teeth/rotation = 1.6 Hz
Max. duration input pattern = 1/1.6 Hz × 122°/360° = 212 ms
Time between signal changes = 212 ms + 10 ms = 222 ms
→ Min. time between signal changes = 230 ms (rounded up to the next multiple of 10 ms)

Example 3: Zero pulse 10°

- 1 tooth per rotation
- Switching tolerances ±1°→ tooth 9° to 11° (corresponds to t_{low}, t_{high}); signal change 349° to 351° (corresponds to t_1 to t_4)
- Maximum drive speed = 300 RPM → 5 Hz
- Drive speed for release = 3 RPM → 0.05 Hz
- Logic execution time = 4 ms

Procedure

➡ Check the maximum signal frequency of the pulse encoder signals:
Max. signal frequency = 5 Hz × 1 tooth/rotation = 5 Hz
Lowest t_{low} = 1/5 Hz × 9°/360° = 5 ms
→ Higher than the logic execution time
Lowest t_{high} = 1/5 Hz × 351°/360° = 195 ms
→ Higher than the logic execution time

➡ Determine the time between signal changes for the speed limitation:
Signal frequency for release = 0.05 Hz × 1 tooth/rotation = 0.05 Hz
Max. duration input pattern = 1/0.05 Hz × 11°/360° = 611 ms
Time between signal changes = 611 ms + 10 ms = 621 ms
→ Min. time between signal changes = 630 ms (rounded up to the next multiple of 10 ms)

Logic example

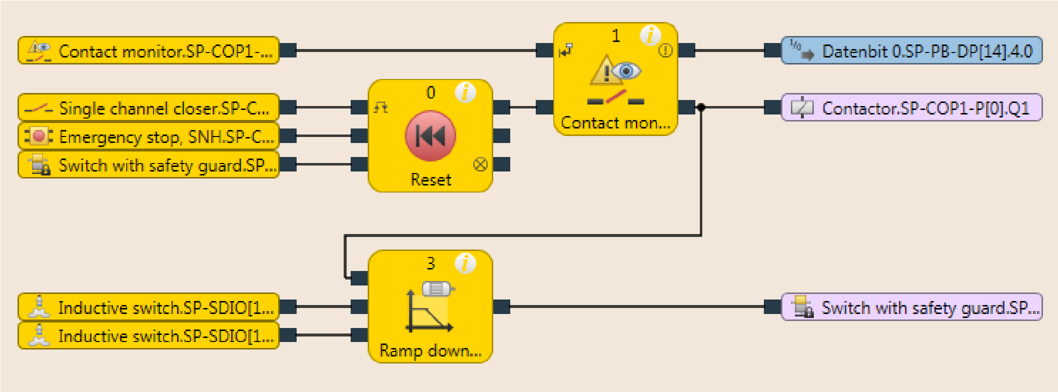


Illustration 102: Logic example of the "ramp down detection" function block

Sequence/timing diagrams

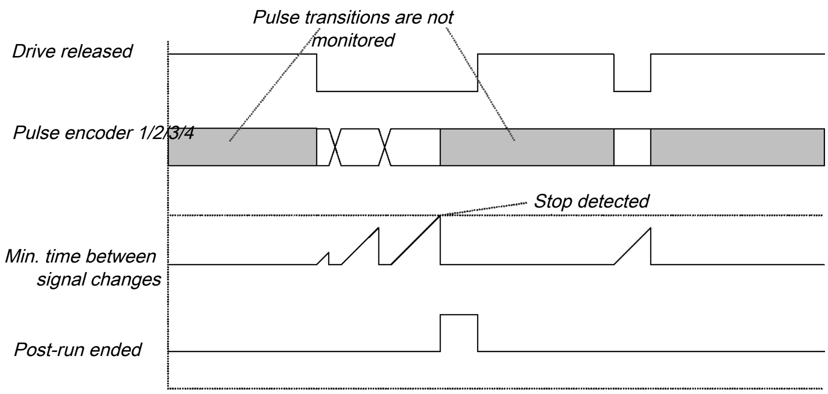


Illustration 103: Sequence/timing diagram for the ramp down detection function block

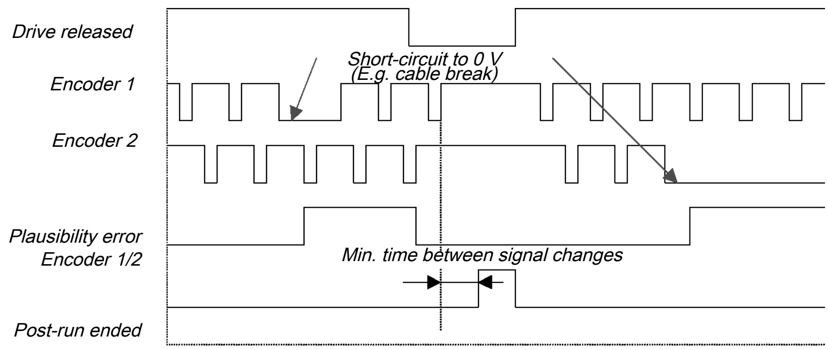


Illustration 104: Sequence/timing diagram for the ramp down detection with plausibility check function block

8.8 Function blocks for two-channel evaluation

The samos® PRO system supports applications up to SIL3 (as per EN 62061) and Performance Level PL e (as per EN ISO 138491). Potential sources for function block inputs include one or two safety signals locally connected to the samos® PRO safety controller. You can choose between the following input evaluations (depending on the function block):

- Single-channel
- Two-channel
  - Two-channel equivalent (1 pair)
  - Two-channel discrepant (1 pair)
  - Two-channel equivalent (2 pairs)
  - Two-channel discrepant (2 pairs)

The following truth tables contain the internal analysis for the individual types of input signal analyses of the samos® PRO safety controller.

Truth table

The following applies to the truth tables in this section:

0 means logical low

1 means logical high

x means "any" = 0 or 1

NOTICE The error flag is high when the logic processing of the samos® PRO safety controller detects an error in the combination or in the sequence of input signals.

8.8.1 Emergency stop

Function block diagram

Illustration 105: Function block diagram for the emergency stop function block

General description

The emergency stop function block enables implementation of an emergency stop function with an emergency stop button.

If a corresponding dual channel input element is configured in the hardware configuration of samos® PLAN 6, this function block is no longer required in the logic because the preliminary evaluation then takes place directly at the module (e.g. SP-COP, SP-SDI or SP-SDIO). However, if the **Error flag** output is required for further processing, this function block can be used. To this end, the two input signals are to be configured as single-channel signals and routed to the inputs of the function blocks.

With emergency stop buttons, a reset and/or restart function block must take over the processing of the reset/restart conditions for the security string when the **Release** output is low. This may also be necessary for emergency stop buttons with a combined push/pull release.

If the startup lock is activated, it is ensured that the release after controller startup is only active if both inputs change from low to high within the set synchronous time. If the inputs are already on High at the start time, the release is not activated.

Parameters of the function block

Table 92: Parameters of the emergency stop function block

Parameters	Possible values
Inputs	• Single-channel • Two-channel equivalent • Two-channel discrepant
Synchronous time	0 = inactive, 10 to 30000 ms in 10 ms increments. When active, the value must be greater than the logic execution time.
Start interlock	• Without startup lock (default) • with start interlock
Number of outputs	• 3 (release output, synchronous time error, and sequence error)

Sequence/timing diagrams

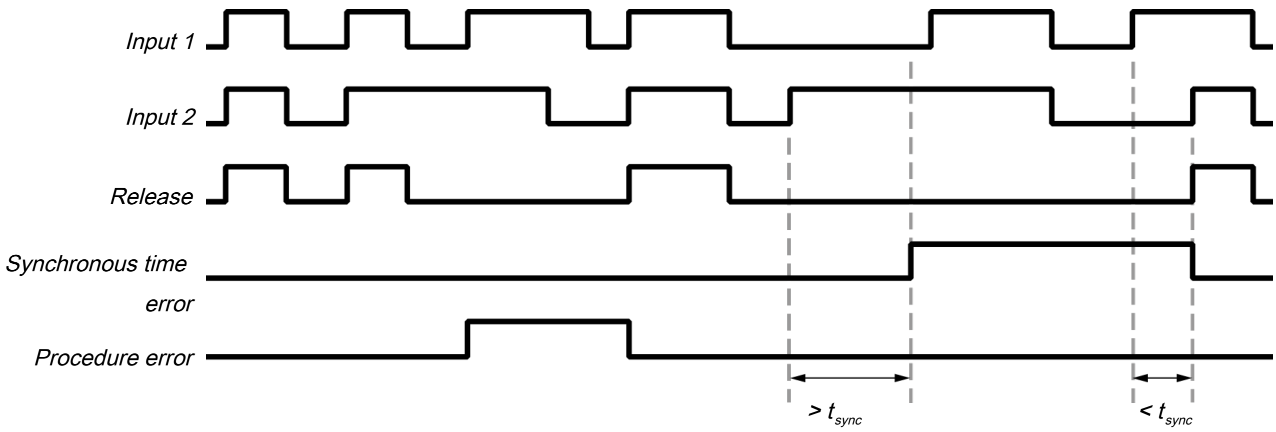


Illustration 106: Sequence/timing diagram for the emergency stop function block

Further information

You can find additional information on the behavior of this function block here: *Two-channel evaluation and synchronous time [ch. 6.3.1.2.1, p. 99]*.

8.8.2 Solenoid switch

Function block diagram

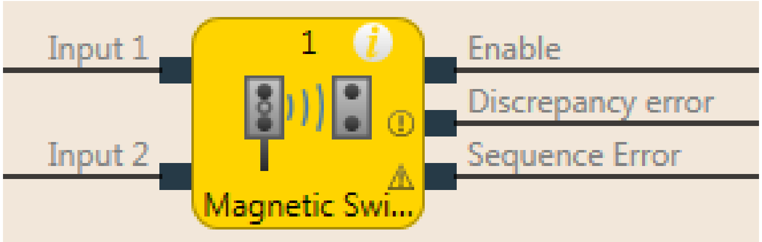


Illustration 107: Logical connections for the solenoid switch function block

General description

The internal logic of the solenoid switch function block has the same function as that of the emergency stop function block, only with limited parameter selection. The function block enables graphic differentiation according to use.

The solenoid switch function block is a predefined function block for reed switches or other sensors for which synchronous time monitoring is required. When the evaluation of the discrepant inputs is high, the **Release** output is high.

Further information: *Two-channel evaluation and synchronous time [ch. 6.3.1.2.1, p. 99]*

If the startup lock is activated, it is ensured that the release after controller startup is only active if both inputs change from low to high within the set synchronous time. If the inputs are already on High at the start time, the release is not activated.

Parameters of the function block

Table 93: Parameters of the solenoid switch function block

Parameters	Possible values
Inputs	• Two-channel equivalent • Two-channel discrepant
Synchronous time	10 to 3000 ms in 10 ms increments. The value must be greater than the logic execution time.
Start interlock	• Without startup lock (default) • with start interlock
Number of outputs	• 3 (release output, synchronous time error, and sequence error)

8.8.3 Light grid evaluation

Function block diagram

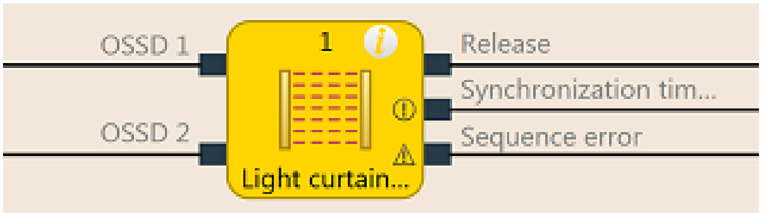


Illustration 108: Function block diagram for the light grid evaluation function block

General description

The light grid evaluation function block enables the implementation of a semi-conductor protective device functionality with BWS.

The internal logic of the light grid evaluation function block corresponds to the function of the emergency stop function block, but with limited parameter selection. The single-channel input type is not selectable in the light grid evaluation function block. When the evaluation of the discrepant inputs is high, the **Release** output is high.

Further information: *Two-channel evaluation and synchronous time [ch. 6.3.1.2.1, p. 99]*

If the startup lock is activated, it is ensured that the release after controller startup is only active if both inputs change from low to high within the set synchronous time. If the inputs are already on High at the start time, the release is not activated.

NOTICE

If a corresponding dual channel input element is configured in the hardware configuration of samos® PLAN 6, this function block is no longer required in the logic because the preliminary evaluation then takes place directly at the respective module (e.g. SP-COP, SP-SDI or SP-SDIO). However, if the **Error flag** output is required for further processing, this function block can be used. To this end, the two input signals are to be configured as single-channel signals and routed to the inputs of the function blocks.

Parameters of the function block

Table 94: Parameters of the light grid evaluation function block

Parameters	Possible values
Input type	Two-channel equivalent
Synchronous time	0 = inactive, 10 to 500 ms in 10 ms increments. When active, the value must be greater than the logic execution time.
Start interlock	• Without startup lock (default) • with start interlock
Number of outputs	3 (release output, synchronous time error, and sequence error)

8.8.4 Switch evaluation

Function block diagram

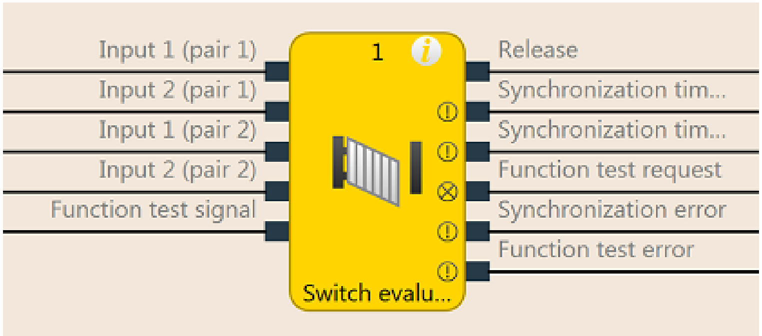


Illustration 109: Function block diagram for the switch evaluation function block

General description

The function block can be used to evaluate two-channel switches. 1 pair or 2 pairs can be selected.

See the following for the behavior of the two-channel evaluation: *Two-channel evaluation and synchronous time [ch. 6.3.1.2.1, p. 99]*

Furthermore, the function block enables function test monitoring as an option.

Parameters of the function block

Table 95: Parameters of the switch evaluation function block

Parameters	Possible values
Inputs / Mode	• Single-channel • Two-channel equivalent (1 pair) • Two-channel discrepant (1 pair) • Two-channel equivalent (2 pairs) • Two-channel discrepant (2 pairs)
With function test	• yes: With function test • no: without function test
Synchronous time pair 1 Synchronous time pair 2	For inputs 1 and 2 of pair 1 and inputs 1 and 2 of pair 2 separately adjustable. Values: 0 = inactive, 10 to 30000 ms in 10 ms increments. When active, the value must be greater than the logic execution time.
Synchronization time	0 = inactive, 10 to 30000 ms in 10 ms increments. When active, the value must be greater than the logic execution time.
Number of outputs	1 to 6

Function test

In some applications, safety devices require a cyclic physical check in order to ensure that the safety device is still functioning correctly.

When the switch evaluation function block is configured with the **Function test** parameter so that the **Require function test** input must be present, the input signal of the safety inputs must change once per machine cycle such that the enable condition is no longer met and back again (e.g. in the sequence of opening and closing a safety door).

The **Require function test** input is typically connected to the machine cycle contact.

If a function test is required according to the configuration, then it must be implemented in the following cases:

- after the samos® PRO system has switched from the stop state into the run state and
- after each rising edge (low to high) at the **Require function test** input.

This is indicated by the **Function test required** output going to high. The **Function test required** output goes back to low when, before the next rising edge at the **Require function test** input, a signal sequence has been detected at the inputs, causing the **Release** output to switch from low to high.

The **Function test error** output goes to high and the **Release** output goes to low when the next machine cycle starts, before a function test has been conducted, i.e. when the **Function test required** output is still high and an additional rising edge (low to high) occurs at the **Require function test** input.

The **Function test error** output returns to low when a signal sequence has been detected causing the **Release** output to switch from low to high.

Sequence/timing diagrams

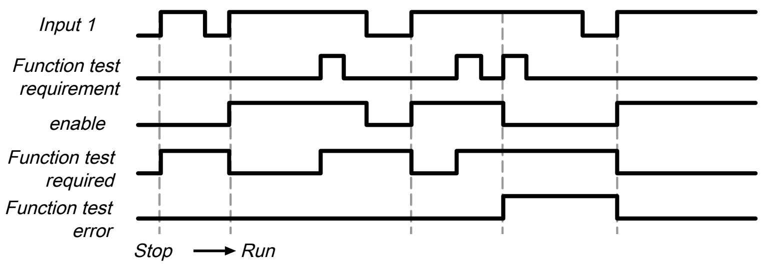


Illustration 110: Sequence/timing diagram for switch evaluation function block, category 2, single-channel with function test

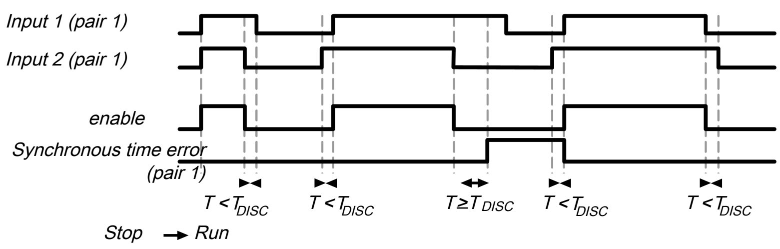


Illustration 111: Sequence/timing diagram for switch evaluation function block, category 4, two-channel without function test

8.8.5 Two-hand, type IIIA

Function block diagram

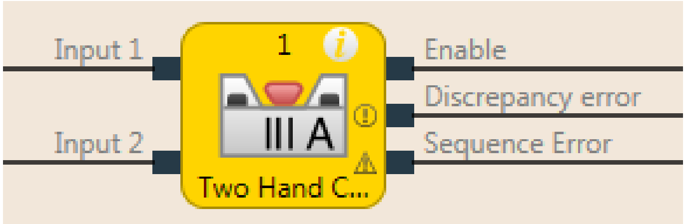


Illustration 112: Function block diagram for two-hand type IIIA function block

General description

The two-hand type IIIA function block is a predefined function block for two-hand controls for which synchronous time monitoring of equivalent inputs is required. The internal logic of the two-hand type IIIA function block corresponds to the function of the emergency stop function block, but with limited parameter selection. The function block enables graphic differentiation according to the application.

Input 1 and **Input 2** form a two-channel evaluation and must be equivalent. When the evaluation of the inputs is high, the **Release** output is high.

Further information: *Two-channel evaluation and synchronous time [ch. 6.3.1.2.1, p. 99]*

The synchronous time is 500 ms (the synchronous time is permanently set and cannot be changed).

If the startup lock is activated, it is ensured that the release after controller startup is only active if both inputs change from low to high within the set synchronous time. If the inputs are already on High at the start time, the release is not activated.

Parameters of the function block

Table 96: Parameters of two-hand type IIIA function block

Parameters	Possible values
Inputs	Permanently defined value: Two-channel equivalent
Start interlock	• without start interlock • with start interlock
Number of outputs	• 3 (release output, synchronous time error, and sequence error)

8.8.6 Two-hand, type IIIC

Function block diagram

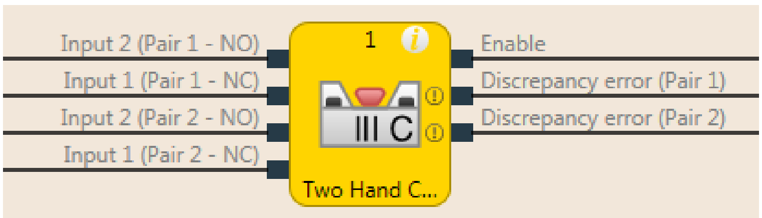


Illustration 113: Function block diagram for two-hand type IIIC function block

General description

The two-hand type IIIC function block provides the logic for monitoring the inputs of a two-hand control according to EN 13851.

WARNING

Only use the two-hand type IIIC function block together with safe inputs, otherwise the requirements of EN ISO 13851 are not fulfilled!

The inputs used as single-channel input signals must be configured in the hardware configuration, i.e. no two-channel input evaluation at the extended module.

Parameters of the function block

Table 97: Parameters of two-hand type IIIC function block

Parameters	Possible values
Synchronous time (pair 1) (T_{SYN1})	0 = inactive, 10 to 500 ms in 10 ms increments. When active, the value must be greater than the logic execution time.
Synchronous time (pair 2) (T_{SYN2})	0 = inactive, 10 to 500 ms in 10 ms increments. When active, the value must be greater than the logic execution time.
Synchronization time T_{SZ}	Permanently defined value: 500 ms
Number of outputs	3 (release output, synchronous time error pair 1 output, and synchronous time error pair 2 output)

The function block evaluates its input signals. **Input 1 and Input 2 of pair 1** form a two-channel evaluation and must be discrepant. **Input 1 and Input 2 of pair 2** form a two-channel evaluation and must also be discrepant. A synchronous time can be specified for each of the two input pairs.

The synchronization time is the time during which the **input pairs** are allowed to have different values. As specified in the standards and regulations, the synchronization time for two-hand circuit evaluation may not exceed 500 ms (the synchronization time is permanently defined and cannot be changed).

See the following for the behavior of the two-channel evaluation: *Two-channel evaluation and synchronous time [ch. 6.3.1.2.1, p. 99]*

The synchronization evaluation with the two-hand type IIIC function block differs from the switch evaluation function block with respect to the condition for synchronization state inactive. With the two-hand type IIIC function block, both two-channel evaluations must be inactive, i.e. the 1/2 inputs of the two input pairs must be low/high simultaneously.

Furthermore, with the two-hand type IIIC function blocks, there is no **Synchronization error** output, because with a two-hand control, it is not evaluated as an error when the two manual switches are not activated simultaneously within the specified 500 ms. That said, this synchronization time may not be exceeded, because if it is, the **Release** output will not go to high.

Sequence/timing diagram

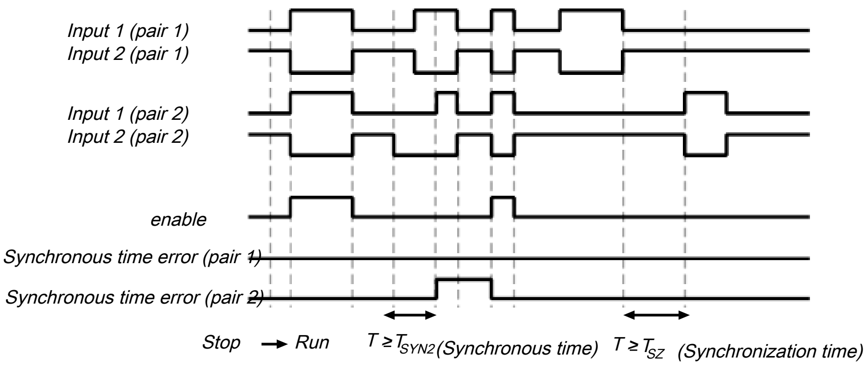


Illustration 114: Sequence/timing diagram for the two-hand type IIIC function block

8.8.7 Multi-two-hand

Function block diagram

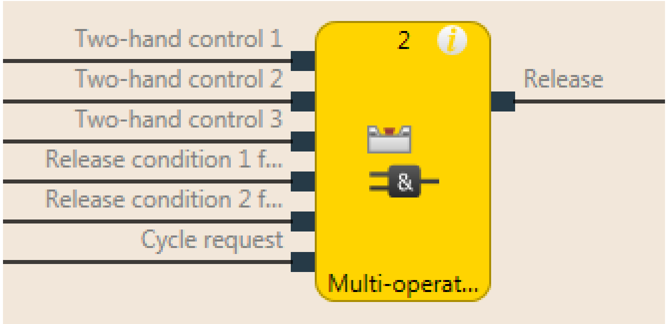


Illustration 115: Logical connections for the multi-two-hand function block

General description

The multi-two-hand function block makes it possible to monitor the simultaneous operation of up to three two-hand controls. For example, for a press application with more than one operator, multiple two-hand controls or foot switches may be required in order to jointly trigger the downward movement of the press. Typically, each **Two-hand** input is connected to a two-hand function block.

Alternatively, **Release** inputs (e.g. safety light curtains) can be connected to ensure that the assigned devices are at high before the **Release** output can go to high. Reset and restart must be treated independently of this function block.

The **Cycle request** input can be used to force each connected two-hand control to have to be released at least once before a restart is possible. Typically, this input is connected to a signal that generates a pulse with each machine cycle. This can prevent one or more of the two-hand controls to remain active permanently.

WARNING

The two-hand and the release inputs must be pre-evaluated signals!

- Only connect safely pre-evaluated signals to the **Two-hand** inputs, e.g. the **Release** output of a two-hand type IIIA or two-hand type IIIC function block. A safety-relevant evaluation of the inputs of a two-hand control must occur either through another function block (e.g. two-hand control or light grid evaluation) or as a component of the configuration of the safety inputs (e.g. configuration of the inputs with two-channel evaluation).
- The **Cycle request** input must not be used for safety functions. This input is only used for automation control.

Parameters of the function block

Table 98: Parameters for the multi-two-hand function block

Parameters	Possible values
Cycle request	• Rising edge • Falling edge
Number of operators	• 2 operators • 3 operators
Number of enable conditions	• 0 • 1 • 2

The **Release** output is high when ...

- all **Release** inputs are high and remain high; and

- every activated **Two-hand** input was at low at least once (including chronologically offset), after the samos® PRO system has switched from the stopped state into the run state or after a rising or falling edge (depending on the configuration) has been detected at the **Cycle request** input; and
- all activated **Two-hand** inputs are then at high.

The **Release** output is low when ...

- one or more **Release** inputs are low; or
- one or more **Two-hand** inputs are low; or
- a rising or falling edge (depending on the configuration) has been detected at the **Cycle request** input.

Sequence/timing diagram

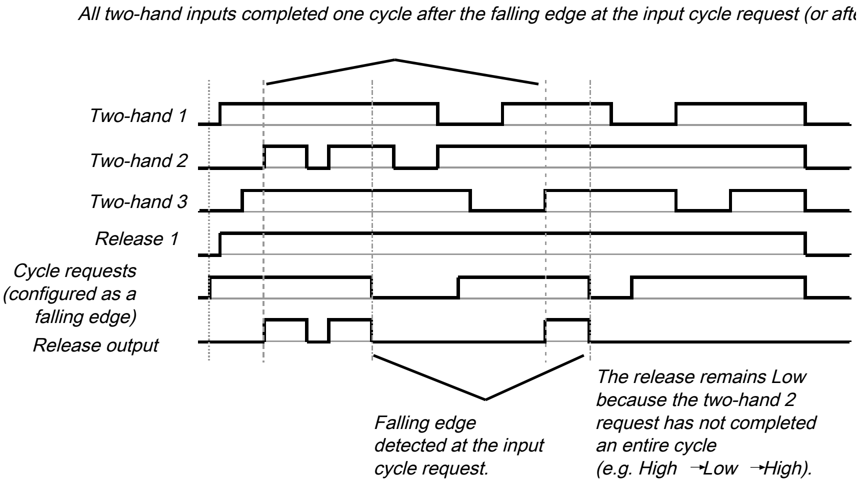


Illustration 116: Sequence/timing diagram for the multi-two-hand function block

8.9 Function blocks for parallel muting, sequential muting, and cross muting

8.9.1 Overview and general description

Muting is the automatic temporary suppression of safety-oriented monitoring of an access area with the assistance of a contactless-acting safety device (BWS), while certain objects, e.g. pallets of material, are being moved into the hazardous area.

Muting sensors monitor the presence of the material while it is being transported. By carefully selecting the type and arrangement of the sensors, it is possible to differentiate between objects and people.

Working together with the muting sensors and the contactless safety device, the object being conveyed generates a precisely defined signal sequence while it is moving in the hazardous area. The muting sensors must ensure that any potential hazard is excluded if a person enters the area being protected by the contactless safety device (i.e. a hazard-inducing state must be ended immediately). It must not be possible for a person to generate the same signal sequence as the object being conveyed.

The placement of muting sensors is determined by the shape of the object to be detected. To this end, the following options, among other things, are available with differing numbers of sensor input signals:

- Two sensors
- Two sensors and one C1 auxiliary signal
- Four sensors (two sensor pairs)
- Four sensors (two sensor pairs) and one C1 auxiliary signal

Muting sensor signals can be generated by the following external sensors:

- Optical sensors
- Inductive sensors
- Mechanical switches
- Signals from the control

If you use optical sensors for muting applications, use sensors with background suppression in order to ensure that only the material being conveyed meets the muting conditions. The sensors detect material only up to a certain distance. Objects that are further away therefore cannot fulfill the input conditions of the muting sensors.

There are three different function blocks available for muting:

- Parallel muting
  Muting with two parallel sensor pairs
- Sequential muting
  Muting with two sequential sensor pairs
- Cross muting (time-controlled, with/without direction detection)
  Muting with a crossed sensor pair

Info

- The muting cycle is the defined sequence of all processes that occur during muting.
- The muting cycle starts when the first muting sensor is activated. The muting cycle ends depending on the configuration in the function block for the muting end condition. It is not possible to reactivate muting until the previous muting cycle has ended.
- Material can be transported multiple times within a muting cycle if the muting condition is continuously maintained during this time, i.e. at least one sensor pair remains activated continuously.

Safety information

Because the safety functions of a safety device are bypassed by the muting, multiple requirements must be fulfilled, as shown below, in order to ensure the safety of the application.

WARNING

The general safety regulations and safety measures must be followed!

If you use muting, make absolutely sure that the following information is followed for correct use of muting.

- Access to the hazardous area must be reliably detected by the contactless safety device or be prevented by other measures. It must not be possible for a person to bypass, climb over, crawl under, or cross the contactless safety device undetected. Note the operating instructions for the contactless safety device for correct installation and use of the device.
- Always follow the valid local, regional, and national regulations and standards that apply to your application. Make sure that your application corresponds to an appropriate risk analysis and avoidance strategy.
- Muting must never be used to convey a person into the hazardous area.
- Install the command devices for reset and override outside of the hazardous area, so that they can never be operated by someone who is inside of the hazardous area. In addition, the operator must have a complete overview of the hazardous area when operating a command device.
- The muting sensors must be arranged such that, after access into the protective field, the hazardous area can only be reached once the hazard-inducing state has been ended. A condition for this is that the safety distances required and defined in EN ISO 13855 are maintained. At least two muting signals, which are independent from one another, are required.
- Muting may only be activated for the time span in which the object that is triggering the muting condition is blocking access to the hazardous area.

- The area between the ESPE and the muting sensors must be secured against someone accessing the area from the rear:
  - With realization as Parallel muting between the ESPE and A1/A2 sensors and between the ESPE and B1/B2 sensors (see *Illustration [ch. 8.9.6, p. 238]*).
  - With realization as Sequential muting between the ESPE and A2 sensor and between the ESPE and B1 sensor (see *Illustration [ch. 8.9.7, p. 240]*).
  - With realization as Cross muting (time-controlled, with/without direction detection) between the ESPE and A1 sensor and between the ESPE and A2 sensor (see *Illustration [ch. 8.9.8, p. 243]*).
- Muting must take place automatically but not depend on a single electric signal.
- The material to be transported must be detected over the entire length, i.e. there must not be any interruption in the output signals.
- Muting must be triggered by at least two independently wired signals (e.g. by muting sensors) and must not depend completely on software signals (e.g. on a PLC).
- The muting condition must be ended immediately after the object has traveled through so that the safety device returns to its normal state, not suppressed by muting (i.e. so that it is again effective).
- The muting sensors must be arranged such that muting cannot be unintentionally triggered by a person.

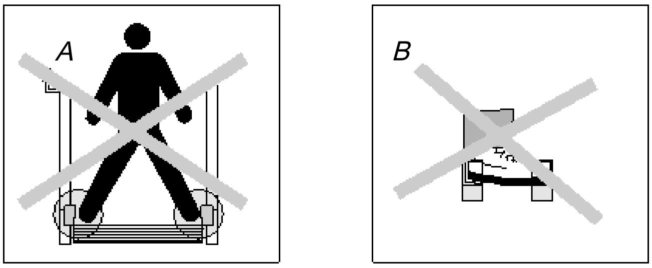


Illustration 117: Safety when installing the muting sensors

- Always arrange the muting sensors such that only the material is detected and not the transport means (pallet or vehicle).

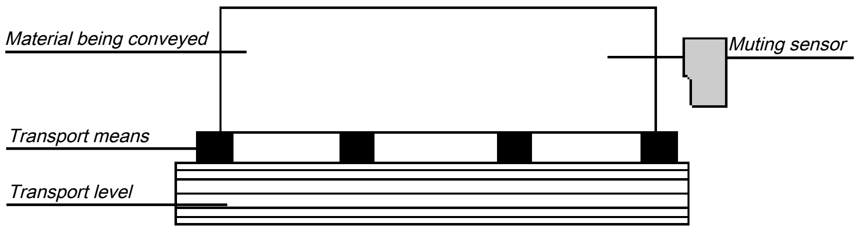


Illustration 118: Detection of material during muting

- Always arrange the muting sensors such that the material can travel through without hindrance but that people are always reliably detected.
- Always arrange the muting sensors such that when the material is detected a minimum distance is always maintained with respect to the detection area of the ESPE (e.g. with respect to the light beam of a light curtain).
- Before and during activation of override, ensure that there is no one within the hazardous area.
- Before you activate override, make sure that the device is in proper working condition, particularly the muting sensors (visual inspection).
- If it was necessary to activate override, afterward check the function of the device and the arrangement of the muting sensors.
- During longer muting cycles (i.e. longer than 24 hours) or during longer shutdowns of the machine, the correct function of the muting sensors must be checked.

- In order to indicate that muting or override is active, a muting and/or override lamp must be used. An external muting/override lamp or one integrated into the contactless safety device can be used.
- Depending on the local, regional, and national regulations and standards, it may be necessary to monitor the muting/override lamp(s). If this is the case, additional measures will be necessary for this. The modules of classes SP-SDIO and SP-SDI do not support any lamp monitoring.
- Always attach the muting or override lamp so it is highly visible. The muting or override lamp must be clearly visible from all sides around the hazardous area and to the operator of the system.
- If safety-relevant information (i.e. decentralized safety input values and/or decentralized safety output values) is transmitted via a safety fieldbus network, you must always consider the associated delay times. These delay times can influence both the system behavior and the requirements for the minimum safety distances associated with the response times.
- Once an override input has been configured, no test pulse outputs can be used when configuring the safety inputs.
- For sensor signals A1 and A2 (B1 and B2), separate lines must be used.
- For the signals for reset and reset required, a line that is independent from the other input signals must be used in order to prevent any unintentional resetting of the system. The line must also be routed in a protected manner.
- The total muting time cannot be set to endless (inactive) without additional precautions being made. If the total muting time is deactivated, additional measures must be undertaken in order to ensure that no one can reach the hazardous area while muting is active.

8.9.2 Parameters of the function blocks

The following table shows the potential configuration parameters of the function blocks for muting.

Table 99: Modes of the function blocks for muting

Modes	Possible values
Directional detection	• Inactive Only for the function blocks Parallel muting and Sequential muting: • Forwards (A1/A2 first) • Backwards (B1/B2 first)
Condition for muting start	• All sensors are free Only for the function blocks Parallel muting and Sequential muting: • At least one sensor is free
Condition for muting end	• With muting sensor pair • With contactless safety device
C1 input	• With • Without
Belt signal	• With • Without
Override input	• With • Without

Modes	Possible values
Sequence monitoring	Not selectable This is specified by selecting the muting function block. • Active: For the function block Sequential muting • Inactive: For function blocks Parallel muting and Cross muting (timer-controlled, with/without direction recognition)

Table 100: Parameters of the function blocks for muting

Parameters	Possible values
Total muting time	0 = inactive, 5 s to 3600 s, adjustable in 1 s increments
Simultaneity monitoring time	0 = inactive, 10 to 3000 ms, adjustable in 10 ms increments. When active, the value must be greater than the logic execution time.
Muting sensor filter time (Suppression of sensor signal gaps)	0 = inactive, 10 to 1000 ms, adjustable in 10 ms increments. When active, the value must be greater than the logic execution time.
Additional muting time after the contactless safety device is free	0 ms, 200 ms, 500 ms, 1000 ms
Min. override pulse time	• 100 ms • 350 ms

8.9.2.1 Directional detection

Directional detection is used when material being conveyed has to be moved in a certain direction. The direction depends on the sequence in which the muting sensors are activated.

When directional detection is inactive, the material being conveyed can be moved in both directions in order to fulfill the muting conditions. In this case, it does not matter which sensor pair is activated first.

If **Forwards (A1/A2 first)** was selected as the direction, the muting sensor pairs must be activated in the sequence (A1/A2) before (B1/B2). In the opposite direction, muting is not possible. A transition from four active sensors to an inactive "B" sensor pair (0 or 1 sensor active) ends muting.

If **Backwards (B1/B2 first)** was selected as the direction, the muting sensor pairs must be activated in the sequence (B1/B2) before (A1/A2). Muting is not possible in the forward direction. A transition from four active sensors to an inactive "A" sensor pair (0 or 1 sensor active) ends muting.

8.9.2.2 Condition for muting start

The **Condition for muting start** parameter determines when a valid muting sequence can begin. The **Condition for muting start** can be defined as follows:

- Both sensors are free: All muting sensors have jointly or individually gone to low and the OSSDs of the safety device (e.g. safety light curtain) are high (i.e. the protective field is free);
  or
- At least one sensor is free: All muting sensors except for the last muting sensor are low and the OSSDs of the safety device (e.g. safety light curtain) are high (i.e. the protective field is free).

If a higher throughput rate is required, it can be advantageous to enable the start of the next muting sequence as soon as the material being conveyed has passed the protective device and all of the muting sensors with the exception of the last one (i.e. **At least one sensor is free**).

8.9.2.3 Condition for muting end

Contrary to the **Condition of the other sensor pair for muting start** parameter, the **Condition for muting end** parameter determines when a valid muting state is over. You can select when the **Condition for muting end occurs**.

- **With muting sensor pair:** When a muting sensor of the last muting sensor pair goes to low (sensor free)
  or
- **With contactless safety device:** When the OSSDs of the safety device (e.g. safety light curtain) indicate that the protective field is no longer being violated, i.e. that the protective field is free and the OSSDs are back at high.

If the OSSD input of the contactless safety device is low after muting end (e.g. due to a violation of the safety device's protective field), before the next valid muting sequence has begun, the **Release** output of the function block goes to low. The next muting cycle cannot begin until the **Condition for muting end** has been fulfilled.

8.9.2.4 Total muting time

The **Total muting time** is used in order to limit the maximum duration of the muting sequence. If the set value for the **Total muting time** is exceeded, then the **Muting error** outputs and the **Error flag** go to high and the **Release** output goes to low.

The timer for the **Total muting time** starts upon activation of the muting function, and this is indicated by the transition of the **Muting status** output to high. The timer for the **Total muting time** is maintained and reset to zero when the muting function is again deactivated. If an optional **Belt signal** input is used, the timer pauses for the total muting time when the **Belt signal** input is high and thus indicates that the conveyor belt has stopped.

8.9.2.5 Additional muting time after the contactless safety device is free

The **Additional muting time after contactless safety device is free** parameter is used when the **Condition for muting end** parameter has been configured as **with contactless safety device.** When the contactless safety device is not always precisely detecting the muting end due to irregularities in the material or the transport means, then you can increase the machine availability by configuring an additional muting time of up to 1000 ms. The **Additional muting time after contactless safety device is free** parameter will only determine the additional muting time in this case after the OSSDs of the contactless safety device have gone back to high, i.e. the safety light curtain is no longer interrupted.

8.9.2.6 Simultaneity monitoring time

The simultaneity monitoring time is used to check whether the muting sensors are being activated simultaneously. This value indicates the maximum duration for which each of the two muting sensor inputs being evaluated as two channels can have different values without this being evaluated as an error. This means that input pair A1 and A2 or input pair B1 and B2 must adopt the equivalent values before the simultaneity monitoring time has elapsed.

The simultaneity monitoring time starts with the first change of an input value for a muting sensor. If the simultaneity monitoring time has elapsed and the two inputs for an input pair still have different values, an error occurs.

If the simultaneity monitoring time determines an error with at least one input pair, the function block indicates this error by setting the muting error output at high.

8.9.2.7 Suppressing sensor signal gaps

Occasionally, malfunctions occur in the output signals of muting sensors that have no significance for muting. The **Suppression of sensor signal gaps** function makes it possible to filter out brief malfunctions without muting being interrupted.

If **Suppression of sensor signal gaps** is active, a low signal from a muting sensor input is ignored for the duration of the set value for the **Suppression of sensor signal gaps**. The function block continues to interpret this signal as an uninterrupted high as long as only one sensor per A1/A2 or B1/B2 pair has a signal gap. If a signal gap has been detected at a sensor, the simultaneous occurrence of an additional signal gap at another sensor will lead to the termination of muting.

8.9.2.8 Sequence monitoring

Sequence monitoring makes it possible to define a special forcibly defined sequence in which the muting sensors must be active. The following table shows the valid sequence of muting sensor input signals. This parameter is only available for configurations with four muting sensors, e.g. for Parallel muting or Sequential muting.

Table 101: Requirements for sequence monitoring

Directional detection	Requirements for muting sensor signal inputs for sequence monitoring
Inactive	A1 before A2 before B1 before B2 or B2 before B1 before A2 before A1
Forwards	A1 before A2 before B1 before B2
Backwards	B2 before B1 before A2 before A1

This parameter depends on the function block. Deviations from the previously shown sequence will cause a muting error that is displayed at the **Muting error** output. In order to prevent machine stoppages, the configured time for the **Suppression of sensor signal gaps** should additionally be less than the timeframe that the object being conveyed requires in order to pass a muting sensor pair (e.g. A1/A2 or B1/B2).

8.9.2.9 C1 input

The **C1** input is used as additional safeguarding against manipulations. If the **C1** input is used, a transition from low to high must occur before the first muting sensor pair goes to high. The **C1** input must then remain at high until both sensors of the muting sensor pair are at high so that a valid muting condition can result. If this condition is not fulfilled, this will lead to a muting error, which is indicated at the **Muting error** output. The **C1** input must then go back to low before the next muting cycle is enabled.

8.9.2.10 Override input

An **Override** input signal makes it possible to remove objects being conveyed that remain lying in the protective field of the safety device (e.g. safety light curtain) after power failures, triggering of an emergency stop, muting errors, or other similar circumstances.

The **Override required** output pulses at 2 Hz when the following conditions are fulfilled:

- Muting is currently low (i.e. **Muting status** is low).
- At least one muting sensor is high.
- The OSSDs of the contactless safety device are low (e.g. safety light curtain has been interrupted).
- The **Release** output is low.

Once the conditions for the **Override required** output have been fulfilled and a valid override sequence with a low-high-low transition (at least 100 ms or 350 ms and a maximum 3 seconds; longer or shorter pulses are ignored) has occurred at the **Override** input, the **Release** output goes to high as if the muting conditions had been fulfilled. Once all of the muting sensors have gone back to low and the OSSD input of the contactless safety device is at high (e.g. indicates that the protective field of a safety light curtain is now free), the next valid muting cycle will be expected. If the next object does not fulfill the conditions for a muting cycle, but does meet the conditions for the **Override required** output, an additional override cycle can be used to remove the material being conveyed. The number of override cycles is limited (see table titled *Number of permissible override cycles* below).

NOTICE

A reset button can also be suitable for the override function. Check the requirements of your application to ensure that the safety-relevant logic meets the requirements of the local, regional, national, and international regulations.

You can find information on the **Override required** output and when override is possible under the conditions shown and when not in the following table:

Table 102: Conditions for override required and override possible

Muting status	At least one muting sensor is high	Contactless safety device OSSDs are high	Override required output	Override possible
0	No	0	No	No
0	No	1	No	No
0	Yes	0	Pulses (2 Hz)	Yes when the maximum permissible number of override cycles has not been exceeded
0	Yes	1	No	No
1	No	0	No	No
1	No	1	No	No
1	Yes	0	No	No
1	Yes	1	No	No

The following figure shows an example sequence for **Override** and **Override required**.

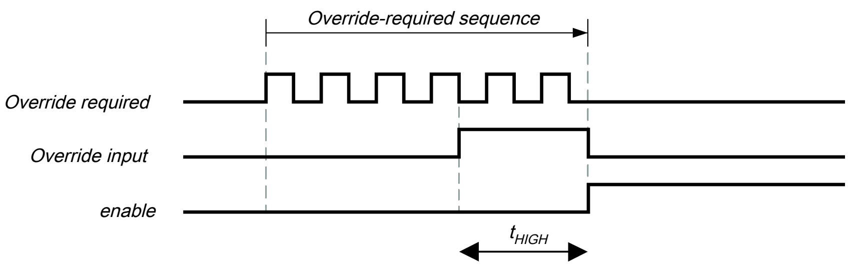


Illustration 119: Logic diagram for override and override requirement

NOTICE

t_{HIGH} must be equal to or greater than the minimum override pulse time (100 ms or 350 ms) but less than or equal to 3 s. When t_{HIGH} is less than the minimum override pulse time or greater than 3 s, the **Override** input is ignored.

WARNING

When you use override, check whether the system is in a safe state!

The override function makes it possible for you to activate the **Release** output of the muting function block even though the safety device (e.g. safety light curtain) is indicating that a hazard-inducing state could be present. The **Override** input should only be used when the hazardous area has been visually checked and there is no one in the hazardous area and no one has had access to the hazardous area while the **Override** input is being used.

WARNING

Make sure that the transitions of the signals for restart meet the requirements of the safety standards and regulations!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, then the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

During an override cycle, the **Release** output is set at high, just as during a valid muting sequence. To prevent excessive use of the override function, the number of permissible override cycles is limited. The number of permissible override cycles depends on the value for the total muting time. The following table has a compilation of the number of permissible override cycles:

Table 103: Number of permissible override cycles

Total muting time	Number of permissible override cycles	Remarks
5 s	360	Maximum number of override cycles = 360
10 s	360	
20 s	180	= 60 min/total muting time
30 s	120	
1 min	60	
5 min	12	
15 min	5	Minimum number of override cycles = 5
30 min	5	
60 min	5	
Inactive (unlimited)	5	

The number of override cycles is stored in the function block. This value is increased each time the **Override required** output starts to pulse. The value is reset to 0 when a valid muting cycle has taken place after a system reset (e.g. with the assistance of the samos® PLAN 6) or after a transition from the stop state to the run state.

After the **Override required** output has started to pulse at 2 Hz and a subsequent **Override** signal has been set at high, muting starts again and the **Release** output is set at high.

When the muting cycle is stopped due to a faulty input signal of a muting sensor, **Override required** is at high for the duration of the logic execution time when the remaining conditions are fulfilled for **Override required**. When the faulty input of the muting sensor goes back to high and subsequently back to low, the muting cycle is again maintained and **Override required** goes to high when the remaining conditions for **Override required** are met.

During a valid override state, directional detection, sequence monitoring (depending on the function block), and simultaneity monitoring time are not executed for the duration of an override cycle.

8.9.2.11 Belt signal

If the movement of the transported material is stopped during the muting cycle, it is possible that the total muting time and other parameters that could lead to a muting error are being exceeded. This can be avoided with the assistance of the **Belt signal** inputs. This input makes it possible to stop time-dependent functions associated with muting when the material to be conveyed does not continue to move.

The **Belt signal** input must correspond to EN 61131 and have the following properties:

- 0 V DC = conveyor belt stopped, e.g. low
- 24 V DC = conveyor belt running, e.g. high

The following timer functions are influenced by the value of the **Belt signal** input:

Table 104: Effects of conveyor belt monitoring on timer functions

Monitoring of total muting time	• When a belt stop is detected, the timer functions will pause. • When the conveyor belt starts back up, the timer will continue with the value stored before detection of the belt stop. When this occurs for the first time, the total muting time is increased once by 5 seconds.
Simultaneity monitoring time	

NOTICE

The **Suppression of sensor signal gaps** is not influenced by a belt stop.

8.9.2.12 Min. override pulse time

The **Min. override pulse time** determines how long the **Override** input must be at least high so that the override signal is valid.

8.9.2.13 Muting status output

The **Muting status** output indicates the status of the muting function according to the following table:

Table 105: Output values for muting status

Condition	Muting status output
Muting cycle inactive, no error	Low
Muting cycle active, no error	High
Muting error detected	Low
Override active, no error	High

8.9.2.14 Muting lamp output

The **Muting lamp** output is used to indicate an active muting cycle. The value for the **Muting lamp** output depends directly on the value for the **Muting status**, as shown in the following table:

Table 106: Output values for the muting lamp output

Status of the function block for muting	Value of the muting lamp output
Muting status output is low	Low
Muting status output is high	High
Override cycle active	High
Override requirement	Pulses at 2 Hz

8.9.2.15 Muting error output

The **Muting error** output is used to indicate that an error associated with the muting function block has been detected. The value of the **Muting error** output is high when any muting error is detected. In order to reset a muting error, it is necessary for all of the muting sensors to go back to low and for the OSSD signal of the contactless safety device to be at high.

8.9.2.16 Release output

When a valid muting condition is present, a valid override cycle takes place or if the OSSD input of the contactless safety device is free and no error/error state is active, then the **Release** output is high.

8.9.3 Information regarding cabling

When muting functions are supposed to be implemented, potential errors in the cabling must be considered. If certain signal combinations are to be transferred in a common cable, additional precautions must be implemented in order to ensure that the respective signals are correct. Suitable measures must be undertaken (e.g. protected cabling) in order to ensure that no errors can occur as a result of the cabling.

Table 107: Cabling combinations for muting and requirements

Signal description	A1	A2	B1	B2	C1	Belt signal	ESPE	Override input	Release output	Muting lamp	Muting status	Override required
A1	–	A	B	B	A	A	A	A	A	A	A	C
A2	A	–	B	B	A	A	A	A	A	A	A	C
B1	B	B	–	A	A	A	A	A	A	A	A	C
B2	B	B	A	–	A	A	A	A	A	A	A	C
C1	A	A	A	A	–	A	A	A	A	C	C	C
Belt signal	A	A	A	A	A	–	C	A	A	C	C	C
ESPE	A	A	A	A	A	C	–	C	A	C	C	C
Override input	A	A	A	A	A	A	C	–	A	A	C	A

A—The indicated signals must not be installed in a common cable if a protected cable is not being used.

B—The indicated signals must not be installed in a common cable if a protected cable or sequence monitoring is not being used.

C—The indicated signals must not be installed in a common cable.

– —Not applicable

8.9.4 State transition from stop to run

When the samos® PRO safety controller transitions from the stop state to the run state, the following behaviors may occur depending on the state of the muting sensors and the OSSDs of the sensors (e.g. safety outputs of a safety light curtain). The following table shows details regarding the system behavior during the transition from stop to run.

Table 108: Stop-to-run transition behavior for muting functions

State after the transition from stop to run		System behavior	
Contactless safety device input	**State of the muting sensors**	**Run**	**Next action**
High (e.g. no object in the protective field)	All muting sensors are low.	A normal muting sequence is possible.	Muting is possible after correct activation/sequence of the muting sensors.
	The muting condition is partially fulfilled.		All muting sensors must return to low before the sensor OSSDs go to low. Once the OSSDs of the sensors are low, the override must be used before all of the muting sensors are at low.
	The muting condition is fulfilled.		
Low (e.g. object detected)	All muting sensors are low.	Muting is blocked.	The sensor OSSDs must be high before muting can take place.
	The muting condition is partially fulfilled.	Override is required if configured.	Either transition to normal behavior (upon cyclically correct sequence of the sensor states) or the total override time will be exceeded.
	The muting condition is fulfilled.		

8.9.5 Error states and information regarding reset

Table 109: Error states and information regarding reset for muting function blocks

Diagnostic outputs	Error state reset	Remarks
Muting error: • Error in simultaneity monitoring time • Error in total muting time monitoring • Error in directional detection • Sequence error detected • Error in sensor gap monitoring	Before any muting error can be reset, a complete valid muting cycle must take place. To this end, either override must be used or all of the muting sensors and the OSSDs of the contactless safety device must be free and subsequently a valid muting sequence must take place. Once one of these two conditions is fulfilled, the muting error output goes back to low, provided that no other error is pending.	The release output goes to low and the error flag goes to high when the muting error output is high.

8.9.6 Parallel muting

Function block diagram

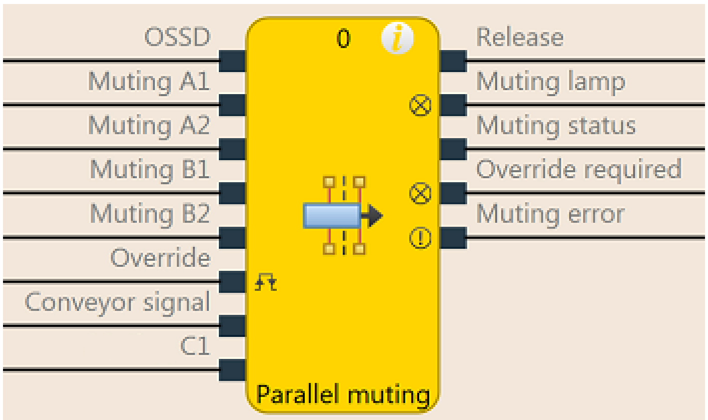


Illustration 120: Logical connections for the range function block Parallel muting

Representation of use

The following figure shows an example of the placement of sensors for parallel muting Parallel muting:

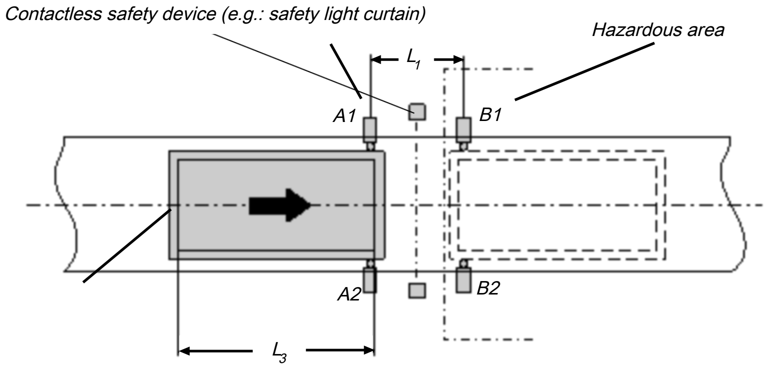


Illustration 121: Muting with two parallel sensor pairs

The material in this example is moving from left to right. As soon as the first muting sensor pair, A1 & A2, is activated, the protective effect of the safety device is bypassed. The protective effect remains bypassed until muting sensor pair B1 & B2 is once again free.

You will find a description of the parameters here: *Parameters of the function blocks [ch. 8.9.2, p. 227]*

Input conditions for muting sensors

Table 110: Conditions for function block Parallel muting

Condition	Description
A1 & A2 (or B1 & B2)	Starts the muting cycle. The first sensor pair is activated depending on the transport direction of the material.
A1 & A2 & B1 & B2	Condition for transferring the muting function to the second sensor pair.
B1 & B2 (or A1 & A2)	Muting applies as long as this condition is fulfilled. The seconds sensor pair is activated depending on the transport direction of the material.

Formulas and requirements for calculating the distance:

- $L_1 \geq v \times 2 \times T_{\text{IN Muting sensor}}$
- $v \times t > L_1 + L_3$
- $L_1 < L_3$
- $T_{\text{IN Light curtain}} < T_{\text{IN Muting sensor}}$

The following is valid ...

L_1	Distance between the sensors (symmetrical arrangement with respect to the detection area of the contactless safety device)
L_3	Length of the material in the conveying direction
v	Speed of the material (e.g. of the conveyor belt)
t	Set total muting time [s]
$T_{\text{IN Light curtain}}$ $T_{\text{IN Muting sensor}}$	Response time of the light curtain or muting sensors in the samos® PRO system (see hardware manual, Response times for basic safety functions)

Info

- The material can be moved in both directions or a defined transport direction can be defined for it as follows:
  - Using the optional **C1** input If used, the **C1** input must always be activated before both muting sensors of the first sensor pair (e.g. A1 and A2) go to high.
  - Using the **Directional detection** configuration parameter
- With a parallel arrangement, the width of the permissible object is additionally checked through the position of the muting sensors. The objects must always pass the muting sensors with an identical width.
- For this application, optical scanners and all types of non-optical sensors can be used. Use sensors and scanners with background suppression.
- Avoid interaction between sensors.
- You can increase the protection against manipulation and the security with the assistance of the following configurable functions:
  - Simultaneity monitoring time
  - Monitoring of total muting time
  - Muting end through contactless safety device
- Further information: *Information regarding cabling [ch. 8.9.3, p. 235]*

Sequence/timing diagram

The function block requires a valid muting sequence to take place. The following figure shows an example of a valid muting sequence based on the basic parameter setting for this function block:

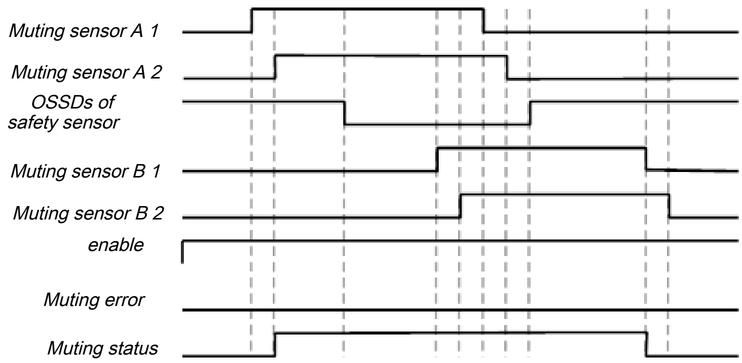


Illustration 122: Valid muting sequence when using the basic configuration setting

Internal values

Muting time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in s
Value range	0 to 3,600
Factor	1

8.9.7 Sequential muting

Function block diagram

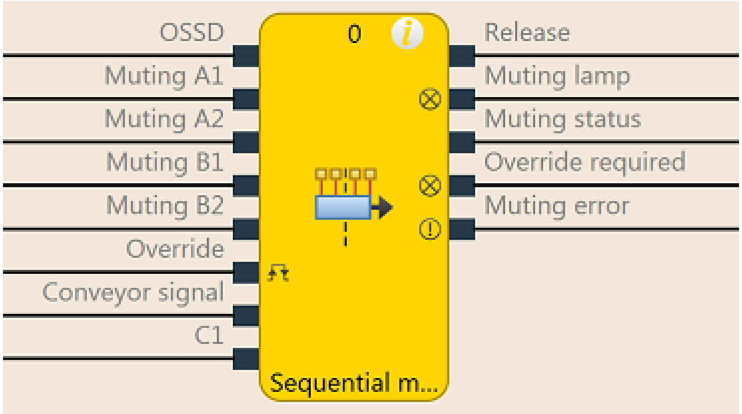


Illustration 123: Logical connections for the range function block Sequential muting

Representation of use

The following figure shows an example of the arrangement of sensors for the Sequential muting function block.

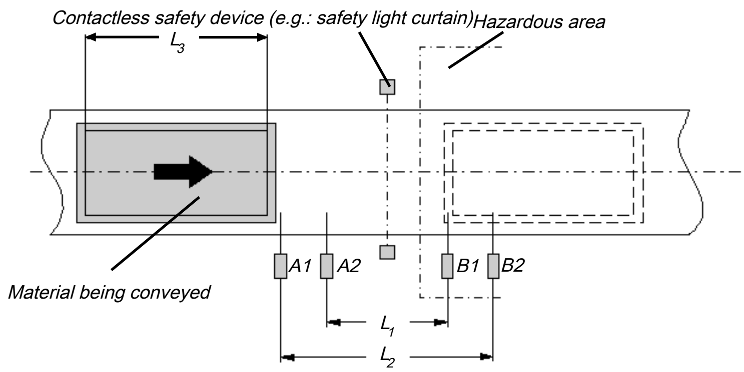


Illustration 124: Example of the sequential arrangement of muting sensors

The material in this example is moving from left to right. As soon as muting sensors A1 & A2 are activated, the protective effect of the safety device is bypassed. The protective effect remains bypassed until a sensor of muting sensor pair B1 & B2 is once again free.

You will find a description of the parameters here: *Parameters of the function blocks [ch. 8.9.2, p. 227]*

Input conditions for muting sensors

Table 111: Conditions for muting with four sensors with sequential arrangement

Condition	Description
A1 & A2 (or B1 & B2)	Starts the muting cycle. The first sensor pair is activated depending on the transport direction of the material.
A1 & A2 & B2 & B1	Condition for transferring the muting function to the second sensor pair.
B1 & B2 (or A1 & A2)	Muting applies as long as this condition is fulfilled. The seconds sensor pair is activated depending on the transport direction of the material.

Formulas and requirements for calculating the distance:

$L_1 \geq v \times 2 \times T_{\text{IN Muting sensor}}$

$v \times t > L_1 + L_3$

$L_2 < L_3$

$T_{\text{IN Light curtain}} < T_{\text{IN Muting sensor}}$

The following is valid ...

L_1	Distance between the inner sensors (symmetrical arrangement with respect to the detection area of the contactless safety device)
L_2	Distance between the outer sensors (symmetrical arrangement with respect to the detection area of the contactless safety device)
L_3	Length of the material in the conveying direction
v	Speed of the material (e.g. of the conveyor belt)
t	Set total muting time [s]
$T_{\text{IN Light curtain}}$, $T_{\text{IN Muting sensor}}$	Response time of the light curtain or muting sensors in the samos® PRO system (see hardware manual, Response times for basic safety functions).

Info

- In this example, the material can either be moved in both directions or a specified transport direction can be defined as follows:
  - Using the optional **C1** input If used, the **C1** input must always be activated before both muting sensors of the first sensor pair (e.g. A1 and A2) go to high.
  - Using the **Directional detection** configuration parameter
- The arrangement of sensors shown in this example is suitable for all types of sensors.
- Avoid interaction between sensors.
- You can increase the protection against manipulation and the security with the assistance of the following configurable functions:
  - Simultaneity monitoring time
  - Monitoring of total muting time
  - Muting end through contactless safety device
  - Sequence monitoring
- You can find information on cabling here: *Information regarding cabling [ch. 8.9.3, p. 235]*

Sequence/timing diagram

The function block requires a valid muting sequence to take place. The following figure shows an example of a valid muting sequence based on the basic parameter setting for this function block.

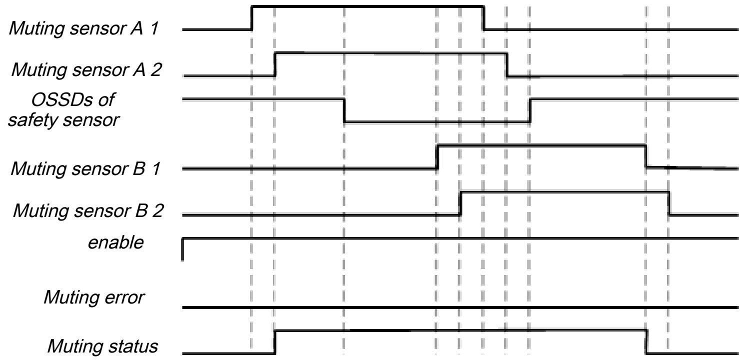


Illustration 125: Valid muting sequence when using the basic configuration setting

Internal values

Muting time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in s
Value range	0 to 3,600
Factor	1

8.9.8 Cross muting (one side)

Function block diagram

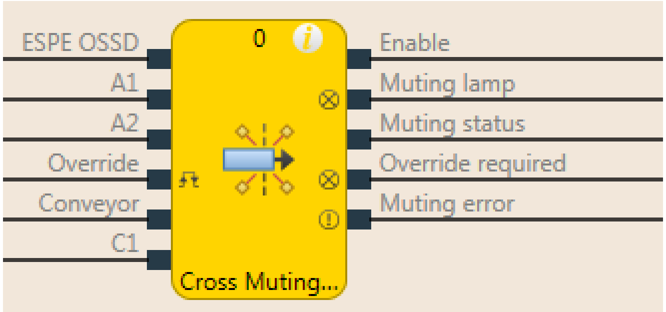


Illustration 126: Logical connections for the Cross muting (one side) function block with the C1 input

Representation of use

The figure below shows an example of the arrangement of the sensors for the Cross muting (one side) function block. The **C1** input is used as additional manipulation protection for the muting system.

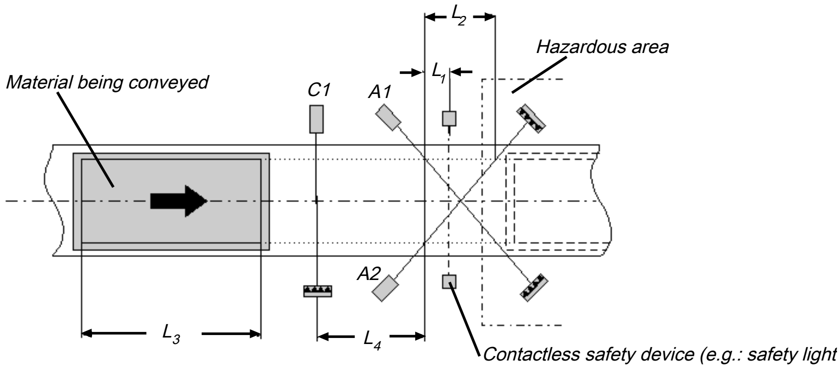


Illustration 127: Example of Cross muting (one side) with C1 input

The protective effect of the safety device is bypassed when the muting sensors are activated in a defined sequence. The **C1** input must always be activated before **both** muting sensors of the first sensor pair (e.g. A1 and A2) go to high.

You will find a description of the parameters here: *Parameters of the function blocks [ch. 8.9.2, p. 227]*

Input conditions for muting sensors

Table 112: Conditions for Cross muting (one side) with C1 input

Condition	Description
C1 & A1 & A2	C1 must always be activated before both muting sensors of the sensor pair (e.g. A1 and A2) go to high.
A1 & A2	Muting applies as long as this condition is fulfilled and the previously shown requirement is also met.

Formulas and requirements for calculating the distance:

$L_1 \geq v \times T_{\text{IN Muting sensor}}$

$v \times t > L_2 + L_3$

$L_3 > L_4$

$T_{\text{IN Light curtain}} < T_{\text{IN Muting sensor}}$

The following is valid ...

L_1	Minimum distance between the detection line of the contactless safety device and detection through A1, A2
L_2	Distance between the two detection lines of the sensors (sensors activated/ sensors free)
L_3	Length of the material in the conveying direction
L_4	Maximum distance between C1 and the detection line of A1, A2
v	Speed of the material (e.g. of the conveyor belt)
t	Set total muting time [s]
$T_{\text{IN Light curtain}}$, $T_{\text{IN Muting sensor}}$	Response time of the light curtain or muting sensors in the samos® PRO (see hardware manual, Response times for basic safety functions).

Info

- In this example, the flow of material is only possible in one direction.
- In order to move material in both directions (i.e. bidirectionally), place the crossing point directly in the light beam of the ESPE.
  Further information: *Cross muting (two sides) [ch. 8.9.9, p. 246]*
- The arrangement of the sensors shown in this example is suitable for both through-beam light barriers as well as for reflection light barriers.
- Avoid interaction between sensors.
- You can increase the protection against manipulation and the security with the assistance of the following configurable functions:
  – Simultaneity monitoring time
  – Monitoring of total muting time
  – Muting end through contactless safety device
- Further information: *Information regarding cabling [ch. 8.9.3, p. 235]*

Sequence/timing diagram

The function block requires a valid muting sequence to take place. The following figure shows an example of a valid muting sequence based on the basic parameter setting for this function block. The **C1** input is not included in the sequence shown below.

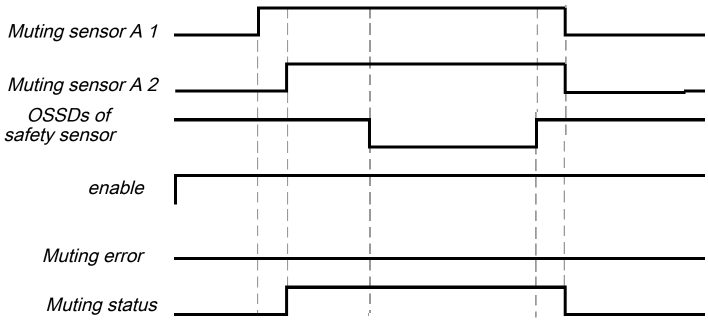


Illustration 128: Valid muting sequence when using the basic configuration setting

Internal values

Muting time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in s
Value range	0 to 3,600
Factor	1

8.9.9 Cross muting (two sides)

Function block diagram

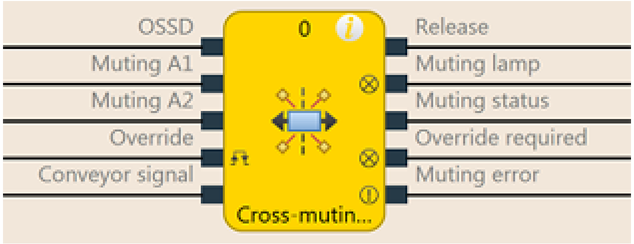


Illustration 129: Logical connections for the range function block Cross muting (two sides)

Representation of use

For muting applications with a crossed sensor pair with which material must be moved in both directions, the sensors can be arranged in the following manner.

Make sure that the muting sensors only detect the material being moved!

You must ensure that the muting sensors are arranged such that no one can enter the hazardous area by fulfilling the muting conditions (i.e. activate both muting sensors and thus create the prerequisites for muting).

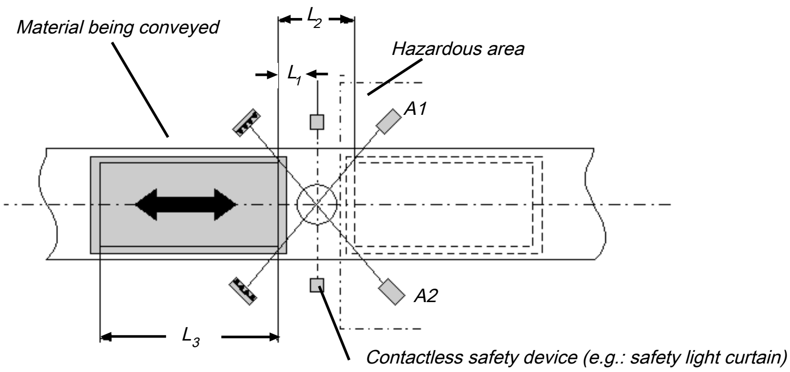


Illustration 130: Cross muting (two sides) with bidirectional movement of material

You will find a description of the parameters here: *Parameters of the function blocks [ch. 8.9.2, p. 227]*

Input conditions for muting sensors

Table 113: Conditions for Cross muting (two sides) without the optional C1 input

Condition	Description
A1 & A2	Muting applies as long as this condition is met.

Formulas and requirements for calculating the distance:

$L_1 \geq v \times T_{IN\ Muting\ sensor}$

$v \times t > L_2 + L_3$

$T_{IN\ Light\ curtain} < T_{IN\ Muting\ sensor}$

The following is valid ...

L_1	Minimum distance between the detection line of the contactless safety device and detection through A1, A2
L_2	Distance between the two detection lines of the sensors (sensors activated/sensors free)
L_3	Length of the material in the conveying direction
v	Speed of the material (e.g. of the conveyor belt)
t	Set total muting time [s]
$T_{IN\ Light\ curtain}$, $T_{IN\ Muting\ sensor}$	Response time of the light curtain or muting sensors in the samos® PRO system (see hardware manual, Response times for basic safety functions).

Info

- In this example, a flow of material is possible in both directions.
  - In order to move material in both directions, place the crossing point of the muting sensors precisely in the light beam of the contactless safety device.
  - In order to move material only in one direction, place the crossing point in the conveying direction behind the light beams of the ESPE (see *Cross muting (one side) [ch. 8.9.8, p. 243]*).
- The arrangement of the sensors shown in this example is suitable for both through-beam light barriers as well as for reflection light barriers.
- Avoid interaction between sensors.
- You can increase the protection against manipulation and the security with the assistance of the following configurable functions:
  - Simultaneity monitoring time
  - Monitoring of total muting time
  - Muting end through contactless safety device
- You can find information on cabling here: *Information regarding cabling [ch. 8.9.3, p. 235]*

Sequence/timing diagram

The function block requires a valid muting sequence to take place. The following figure shows an example of a valid muting sequence based on the basic parameter setting for this function block.

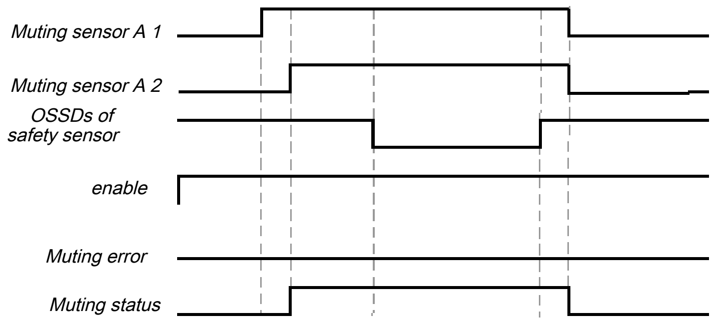


Illustration 131: Valid muting sequence when using the basic configuration setting

Internal values

Muting time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in s
Value range	0 to 3,600
Factor	1

8.10 Function blocks for presses

8.10.1 Function blocks for press contact monitoring

8.10.1.1 Overview and general description

There are two complementary types of function blocks available for press applications. This chapter describes the function blocks for contact monitoring, which provide signals for the function blocks that control the press cycles of mechanical presses (e.g. eccentric presses) and universal presses.

There are two different function blocks for press contact monitoring that can be used to monitor the correct signal sequence of the contacts and the correct stoppage of the press (ramp-down). The outputs of these function blocks indicate in which phase of the press cycle the press currently is (e.g. startup or top dead center). Typically the **Release** output, the **Top** (top dead center) output, and the **Startup** output of a function block for press contact monitoring are connected to the corresponding inputs of one or more function blocks for press cycle control.

Table 114: Overview of the function blocks for press contact monitoring

	Eccentric press	**Universal press**
Typical press types	Eccentric press	Eccentric press Mechanical press
Direction of movement of the press	Forwards	Forwards and backwards
Contacts	TDC contact (**T**op**D**ead**C**enter) BDC contact (**B**ottom**D**ead**C**enter) Dynamic contact	TDC contact BDC contact Ramp-down
Condition for TDC	If TDC contact = high	If TDC contact = low
Startup condition	If BDC contact = high	If BDC contact = high
Ramp-down monitoring	Optional	Optional
enable	Mandatory	Mandatory

8.10.1.2 Eccentric press contact monitor

8.10.1.2.1 Function block diagram

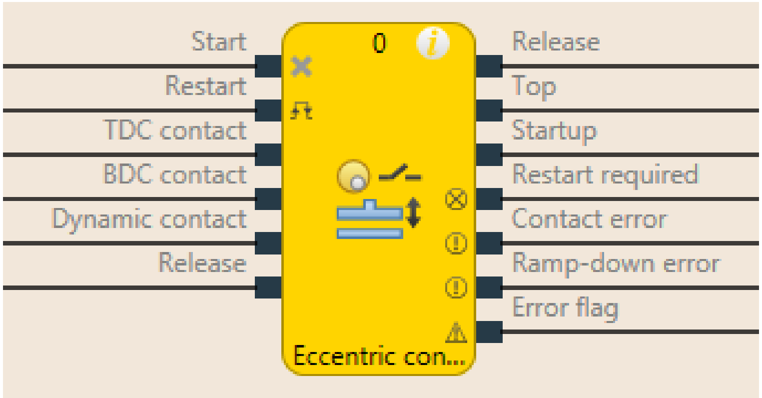


Illustration 132: Logical connections for the eccentric press contact monitor function block

Inputs		
Description	**Type**	**Short description**
Start	Mandatory	Connection of a signal that controls the physical output of the press drive, e.g. the release output from the FB single stroke or automatic.
Restart	Optional	Reset the state of the press component
TDC contact	Mandatory	Contact for the detection of top dead center
BDC contact	Mandatory	Contact for detection of the press startup stroke
Dynamic contact	Optional	Contact for bringing forward of detection of top dead center
enable	Mandatory	Connection of a signal which stops the press motion, e.g. by shaft breakage detection

Parameters	Possible values
Dynamic contact	• On: **Dynamic contact** input is activated. • Off: **Dynamic contact** input is deactivated.
Restart input	• On: **Restart** input is activated. • Off: **Restart** input is deactivated.
Min. restart pulse time	• 100 ms: **Restart** input must be at high for at least 100 ms. • 350 ms : **Restart** input must be at high for at least 350 ms.
Use error flag	• On: **Error flag** output is present. • Off: **Error flag** output is not present.

Outputs		
Description	**Type**	**Short description**
enable	Mandat-ory	Release of the press process.
Top	Mandat-ory	The press is in the TDC area.
Startup	Mandat-ory	The press is in the startup area.
Restart required	Mandat-ory	The press must be reset because of an error.
Contact error	Mandat-ory	Invalid sequence of the contact signals.
Ramp-down error	Mandat-ory	A ramp-down error was detected.
Error flag	Optional	A contact error or ramp-down error is present.

8.10.1.2.2 General description

The **Eccentric Press Contact Monitor** function block (FB) can be used for certain types of mechanical presses (e.g. eccentric presses). Besides the **Start** input, the minimum configuration requires the inputs **TDC contact**, **BDC contact** and release. The remaining inputs are optional.

The function block has the special feature that the **Release** output is set to High from the outset when the inputs are not set up in a configuration that results in an error. The signal sequence at the **Start** input is evaluated if a falling edge at the **TDC contact** input is detected and the **BDC contact** input is low (the press is leaving the top dead center).

Another special feature is that the **Restart required** output can be high even if the **Restart** input is *not* present. A reset of this output is then possible only by a stop/run transition of the samos® PRO.

A typical sequence of the function block is that the press is at top dead center (**TDC contact** input high) and in the first step therefore the **Release** and **Top** outputs are high. In this state the **Start** input must either remain high or go through a high-low sequence. The press now goes through its stroke motion so that the next **TDC contact** input is low, because the press is leaving the top dead center. If the **Start** input has previously failed to changed its state as specified, the FB enters the **Ramp-down error** and the associated output is high, the **Release** output is low and **Restart required** high. If there is no error, then the press continues to operate and eventually reaches the bottom dead center to then start the startup stroke. This is reported by the **BDC contact** input, which is high at this point. The **Startup** output is also high. If the press approaches the top dead center, the **TDC contact input** is again high, the **Top** output is high, the **Startup** output is low. Shortly afterwards the **BDC contact** input is low and the sequence can begin again. If the contacts do not respond as specified, then the **Contact error** is detected and the associated output is high, **Release** is low, and **Restart required** high.

8.10.1.2.3 Parameters of the function block

Table 115: Parameters of the eccentric press contact monitor function block

Parameters	Possible values
Dynamic contact	• On: **Dynamic contact** input is activated. • Off: **Dynamic contact** input is deactivated.
Restart input	• On: **Restart** input is activated. • Off: **Restart** input is deactivated.
Min. restart pulse time	• 100 ms: **Restart** input must be at high for at least 100 ms. • 350 ms: **Restart** input must be at high for at least 350 ms.
Use error flag	• On: **Error flag** output is present. • Off: **Error flag** output is not present.

Dynamic contact parameter

The **Dynamic contact** parameter specifies whether the start of the TDC phase can be advanced by a falling edge at the **Dynamic contact** input.

If the **Dynamic contact** parameter is set to **On,** then the start of the TDC phase can be advanced by a falling edge at the **Dynamic contact** input. In this case the **BDC contact** and **TDC contact** inputs must behave as described in the **General description** section. The falling edge at the **Dynamic contact** input ends the startup phase, the **Startup** output is low, the **Top** output is high.

Restart input parameter

This parameter activates the **Restart** input. If the **Restart** input is present, then errors can be reset by a valid restart sequence. A valid restart sequence consists of a low-high-low sequence on the **Restart** input with a high time of 100 ms or 350 ms, depending on the configuration. Shorter high times or high times longer than 30 seconds are ignored.

Min. restart pulse time parameter

A restart sequence (low-high-low **Restart** input) is only valid if the **Restart** input was set to high for at least 100 ms or 350 ms. This value is set with the **Min. restart pulse time** parameter.

Use error flag parameter

This parameter can make an additional output available that is set to high when the function block enters an error state.

8.10.1.2.4 Function block inputs

Table 116: Inputs of the eccentric press contact monitor function block

Description	Type	Short description
Start	Mandatory	Connection of a signal that controls the physical output of the press drive, e.g. the release output from the FB single stroke or automatic.
Restart	Optional	Reset the state of the press component
TDC contact	Mandatory	Contact for the detection of top dead center
BDC contact	Mandatory	Contact for detection of the press startup stroke
Dynamic contact	Optional	Contact for bringing forward of detection of top dead center
enable	Mandatory	Connection of a signal which stops the press motion, e.g. by shaft breakage detection

Start input

The **Start** input is used to monitor the press ramp-down. The input must be connected to the signal that controls the physical output of the press drive so that the FB can detect whether the press is currently running or has been stopped.

NOTICE

Do *not* connect any physical input signals to the Start input. Use a CPU flag to connect the signal that controls the physical output for the press drive.

Restart input

Using the Restart input it is possible to reset errors using a valid restart sequence.

A valid restart sequence at the **Restart** input corresponds to the low-high-low transition with a pulse duration of at least 100 ms or 350 ms and a maximum of 30 s. Shorter or longer pulses are ignored.

If the **Restart** input is deactivated, then an error can only be reset by stopping execution of the logic program, e.g. by briefly switching off and back on again or by switching the system from the run state to the stop state and then back to the run state using samos® PLAN 6.

WARNING

Make sure that the transitions of the signals for reset meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, then the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

WARNING

Safety signals must conform to the applicable standards and regulations!

Always take into account the valid national, regional, and local regulations and standards for your application. Type C standards such as EN 692 and EN 693 contain requirements as to how safety-related signals must be used. For example, in the case of ramp-down errors it may be necessary for the restart signal to be suitably protected (e.g. by a key switch or in a locked cabinet).

TDC contact and BDC contact inputs

These inputs are used for contact monitoring. The input signals for the **TDC contact**, **BDC contact,** and **Start** inputs must match the illustration below and the rules described therein.

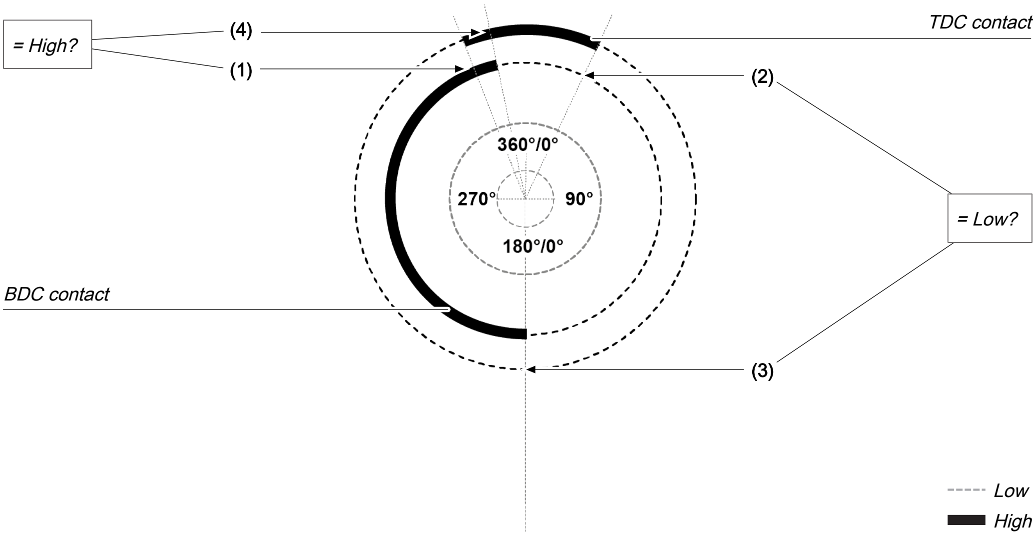


Illustration 133: Contact monitoring with the eccentric press contact monitor function block

Item	Explanation
(1)	The ramp-down must start during the startup phase: The rising edge at the **TDC contact** input (low-high transition) must occur while the **BDC contact** input is high.
(2)	The ramp-down must end after the end of the startup phase: The falling edge at the **TDC contact** input (high-low transition) must occur if the **BDC contact** input is low.
(3)	The startup phase must begin after ramp-down has ended: The rising edge at the **BDC contact** input (low-high transition) must occur while the **TDC contact** input is low.
(4)	The startup phase must end during ramp-down: The falling edge at the **BDC contact** input (high-low transition) must occur while the **TDC contact** input is high.

If during operation even just one of these conditions is not met, the **Release** output is low and the **Contact error** output is high.

A valid sequence that satisfies these conditions looks as follows:

Step	System behavior
0)	Start condition: **TDC contact** input = high, **BDC contact** input = low, Start = high (or sequence low → high (→ low))
1)	**TDC contact** input: High → Low
2)	**BDC contact** input: Low → High
3)	**TDC contact** input: Low → High
4)	**BDC contact** input: High → Low

WARNING

Be aware of the corresponding standards and safety regulations!

All of the safety-related parts of the system (wiring, connected sensors, and control devices, configuration) must meet the respective standards (e.g. EN 62061 or EN ISO 13849-1 or type C standards such as EN 692 and EN 693) and safety regulations. Only safety signals may be used for safety applications. Make sure that the application meets all of the applicable standards and regulations!

This must be noted in particular for the **BDC contact** input if the **Startup** output is being used for startup muting, e.g. in connection with a function block for press cycle control.

In order to satisfy the safety regulations, it may be necessary to use tested switches each with different test sources for the contact input signals. In order to use different test sources for the contact signals, the **TDC contact**, **BDC contact,** and **Dynamic contact** inputs must be connected to the different modules of the class SP-SDI or SP-SDIO.

NOTICE

A class SP-SDI module has only two test sources, although it has eight test output terminals.

Description of ramp-down monitoring

The eccentric press contact monitor function block monitors the press ramp-down. If the **TDC contact** is left, although the press would actually have to have stopped, then the function block detects a ramp-down error, and the **Ramp-down error** output is set to high.

The **Start** input must then correspond to the following illustration and rule:

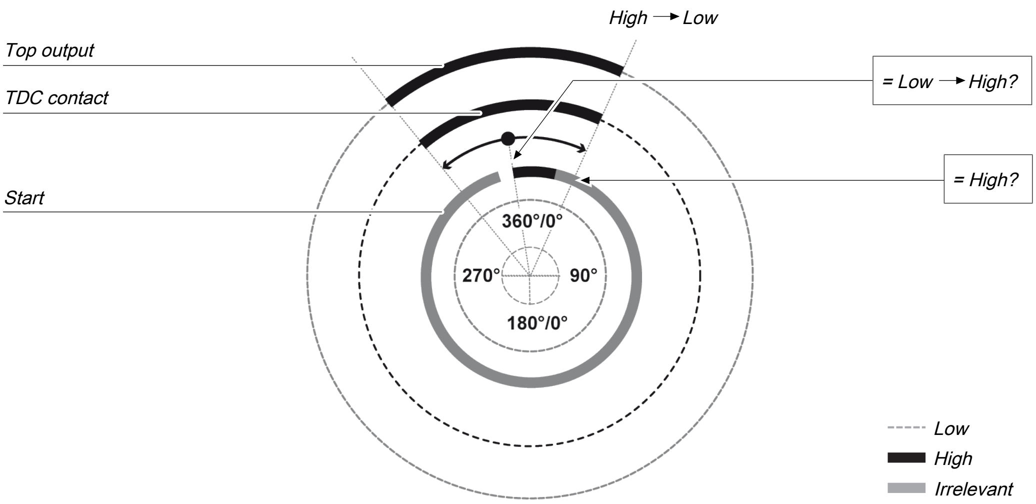


Illustration 134: Ramp-down monitoring with the eccentric press contact monitor function block

Either at least one rising edge must occur at the **Start** input while the **Top** output is high or the **Start** input must be high at the end of the ramp-down area (falling edge at **Top** output). If neither of these two conditions is met, then the **Release** output is low and the **Ramp-down error** and **Restart required** outputs are high.

The **Start** input must be connected to the signal that controls the physical output of the press drive so that the function block can detect whether the press is currently running or has been stopped. Typically this is the **Release** output of a downstream press setup or press single stroke function block.

NOTICE

Do not connect any physical input signals to the **Start** input. Use a CPU flag to connect the signal that controls the physical output for the press drive.

Dynamic contact input

Using the dynamic contact, the start of the top phase can be advanced (falling edge at the **Dynamic contact** input).

The **Startup** output moves to high in the case of a rising edge (transition from low to high) at the **BDC contact** input. It moves to low either in the event of a rising edge of the **TDC contact** input or a falling edge at the **Dynamic contact** input, depending on which of these occurs first.

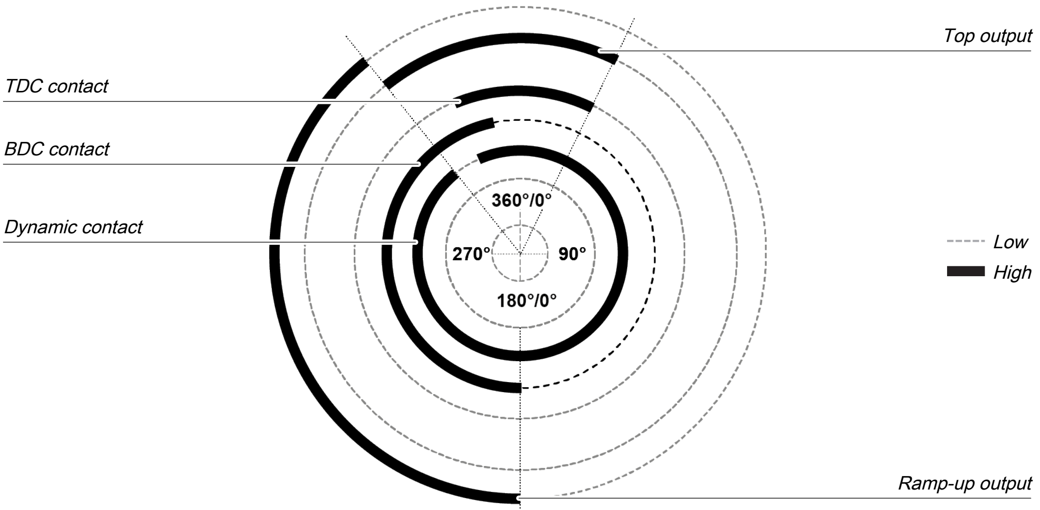


Illustration 135: Press cycle for the eccentric press contact monitor function block with dynamic contact on the upstroke

If a falling edge occurs at the **Dynamic contact** input while the **BDC contact** input is low, i.e. during the downward phase of the press cycle, then the **Top** output moves to high until a rising edge is detected at the **BDC contact** input. The **Startup** output remains low during the remaining press cycle.

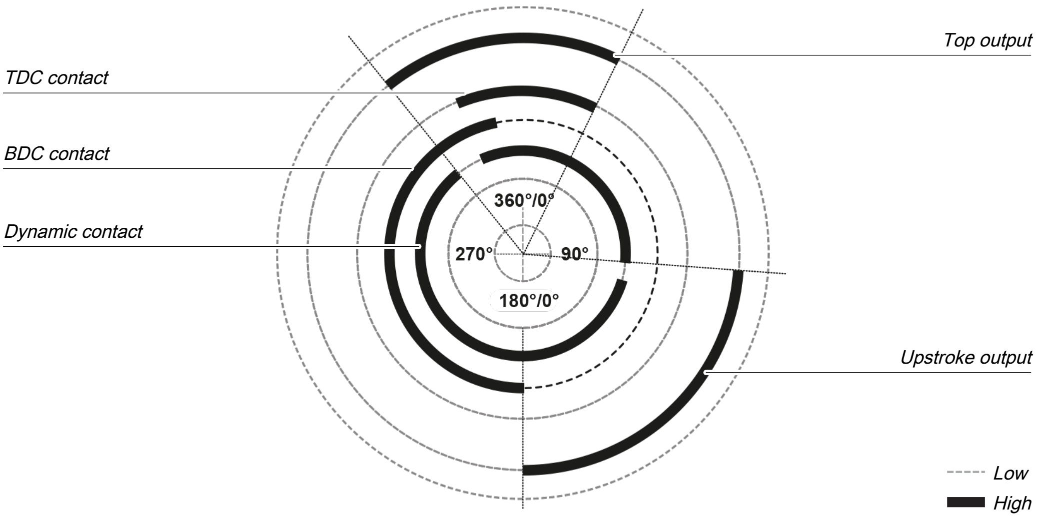


Illustration 136: Press cycle for the eccentric press contact monitor function block with dynamic contact at startup and for the downward movement

Release input

This input is used to connect shaft breakage detection.

If the **Release** input is low, then the **Release** output of the function block is low and monitoring of the contact signal sequence and the ramp-down is deactivated, assuming that there is no error. The error outputs are not affected by this**.**

If the **Release** input changes from low to high, then depending on the configuration of the inputs the suitable state is assumed and the outputs are actuated in accordance with the state.

8.10.1.2.5 Function block outputs

Table 117: Outputs of the eccentric press contact monitor function block

Description	Type	Short description
enable	Mandat-ory	Release of the press process.
Top	Mandat-ory	The press is in the TDC area.
Startup	Mandat-ory	The press is in the startup area.
Restart required	Mandat-ory	The press must be reset because of an error.
Contact error	Mandat-ory	Invalid sequence of the contact signals.
Ramp-down error	Mandat-ory	A ramp-down error was detected.
Error flag	Optional	A contact error or ramp-down error is present.

Release output

The **Release** output is used to stop the press and is connected to another supplementary press function block such as press setup or press single stroke. If no error has been detected, the **Release** output of the function block is high.

If an error is detected in the sequence of contact signals, the **Release** output moves to low, the affected error output moves to high, and the **Reset required** output moves to high. A valid restart sequence at the **Restart** input is then required.

The **Release** output also moves to low when the **Release** input is deactivated.

Top output

The **Top** output moves to high in the event of a rising edge at the **TDC contact** input or a falling edge at the **Dynamic contact input (the Release input cannot have a falling edge)**, depending on which of them occurs first. The **Top** output moves to low in the event of a falling edge at the **TDC contact** input.

The **Top** output is typically used to stop the press and is connected to another supplementary press function block such as press setup or press single stroke.

Startup output

The **Startup** output is typically connected to another supplementary press function block such as press setup or press single stroke. It can also be used to trigger startup muting.

This function block sets the **Startup** and **Top** outputs based on the state changes at the contact inputs. If the function block detects an error, both outputs are set to low.

Restart required output

The **Restart required** output is high if a valid restart sequence is expected at the **Restart** input. This output is set back to low only after a valid restart sequence and the **Release** output cannot be high while this output is high. A valid restart sequence is described in the **Restart input** and **Min. restart pulse time parameter** sections.

Contact error output

This output is set to high when the predetermined sequence of the contact states is not adhered to. The valid sequences were described in the **TDC contact input**, **BDC contact input,** and **Dynamic contact input** sections. Above all, activation of the **Dynamic contact** parameter changes the contact sequence fundamentally. All variants of an invalid sequence lead to errors and the Contact error output is set to high.

Ramp-down error output

This output is set to high when the ramp-down monitoring detects an unexpected movement of the press. If the TDC contact is left, although the press should have been stopped, this input is set to high.

Error flag output

This output is set to high if any error is present or if at least one of the contact error or ramp-down error outputs is set to high and the output is configured as active.

8.10.1.2.6 Error states and information regarding reset

Table 118: Error states and information regarding reset for the universal press function block

Outputs	Error state reset	Remarks
Contact error	The contact error output is high if an unauthorized signal sequence has been detected. Resetting requires a valid restart sequence.	The Release output is low, the Restart required output is high. If the Error flag output is present, this is high.
Ramp-down error	The **Ramp-down error** output is high if the TDC contact is left, although the press should actually have been stopped. Resetting requires a valid restart sequence.	

8.10.1.2.7 Example sequence of a press cycle

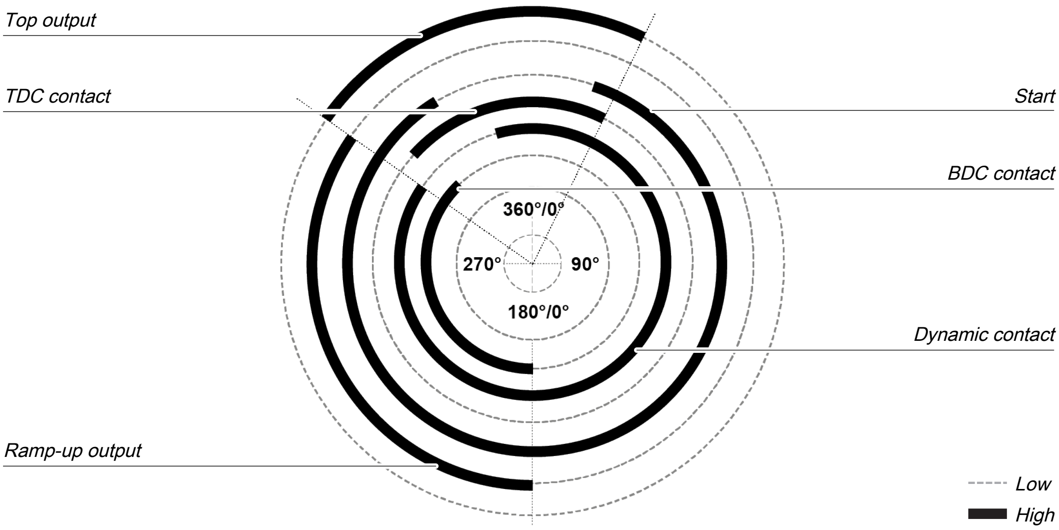


Illustration 137: Contact and output sequence of an eccentric press during an error-free sequence (example)

8.10.1.3 Universal press contact monitor

8.10.1.3.1 Function block diagram

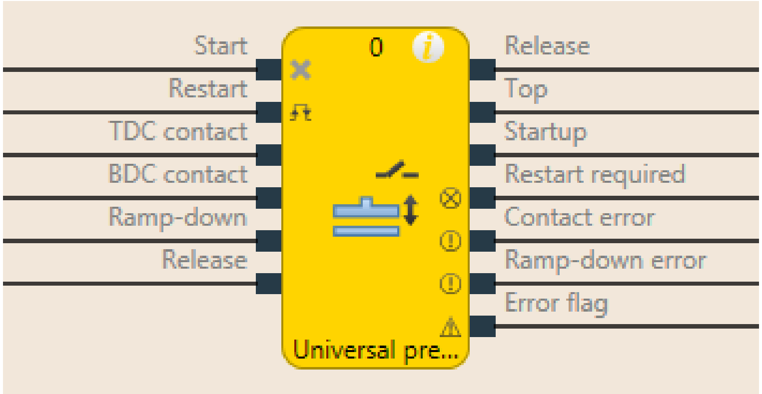


Illustration 138: Logical connections for the universal press contact monitor function block

Inputs		
Description	**Type**	**Short description**
Start	Mandatory	Connection of a signal that controls the physical output of the press drive, e.g. the release output from the FB single stroke or automatic.
Restart	Optional	Reset the state of the press.
TDC contact	Mandatory	Contact for the detection of top dead cen-ter.
BDC contact	Mandatory	Contact for startup area.
Ramp-down contact	Optional	Contact for ramp-down area.
enable	Mandatory	Connection of a signal which stops the press motion, e.g. by shaft breakage detec-tion

Parameters	Possible values
Restart input	• On: **Restart** input activated • Off: **Restart** input deactivated
Startup signals per cycle	• 0-2 (e.g. universal press) • 1 (e.g. eccentric press)
Min. restart pulse time	• 100 ms • 350 ms
Use error flag	• On: **Error flag** output activated • Off: **Error flag** output deactivated

Outputs		
Description	**Type**	**Short description**
enable	Mandatory	Release of the press process.
Top	Mandatory	The press is in the TDC area.
Startup	Mandatory	The press moves upwards.
Restart required	Mandatory	The press must be reset because of an error.
Contact error	Mandatory	Invalid sequence of the contact signals.
Ramp-down error	Optional	A ramp-down error was detected.
Error flag	Optional	A contact error or ramp-down error is present.

8.10.1.3.2 General description

The universal press contact monitor function block can be used for different types of presses (e.g. mechanical presses). The minimum configuration requires the inputs **Start**, **TDC contact , BDC contact, Ramp-down contact, Release**. Optionally, the **Restart** input can be connected.

Description of ramp-down

If the **Ramp-down contact** input is activated, then the input signals for **Ramp-down contact** must match the following illustration and the following rules:

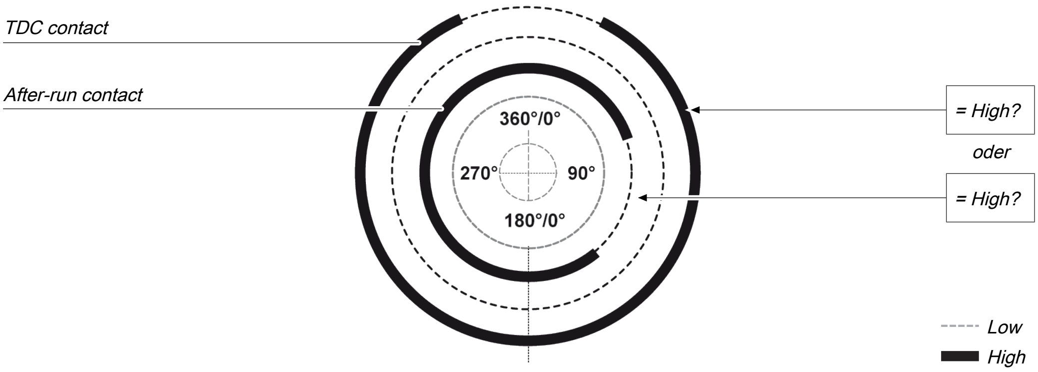


Illustration 139: Contact monitoring with the universal press contact monitor function block with activated ramp-down

Precisely one pulse must occur at the **Ramp-down** input per cycle. The rising edge at the **Ramp-down** input (transition low-high) must happen before the falling edge at the **TDC contact** input. The falling edge at the **Ramp-down** input (transition high-low) must happen after the rising edge at the **TDC contact** input. This means that at any time at least one of the two inputs must be high.

8.10.1.3.3 Parameters of the function block

Table 119: Parameters of the universal press contact monitor function block

Parameters	Possible values
Restart input	• On: **Restart** input activated • Off: **Restart** input deactivated
Startup signals per cycle	• 0-2 (e.g. universal press) • 1 (e.g. eccentric press)
Min. restart pulse time	• 100 ms • 350 ms
Use error flag	• On: **Error flag** output activated • Off: **Error flag** output deactivated
Ramp-down contact	• On: **Ramp-down contact** input activated • Off: **Ramp-down contact** input deactivated

Restart input parameter

This parameter activates the **Restart** input. If the **Restart** input is present, then errors can be reset by a valid restart sequence. A valid restart sequence consists of a low-high-low sequence at the Restart input with a high time of 100 ms or 350 ms, depending on the configuration. Shorter high times or high times longer than 30 seconds are ignored.

Startup signals per cycle parameter

The **BDC contact** input signals that the press has reached the BDC area (bottom dead center). This happens when a rising edge is detected at the **BDC contact** input, while the **TDC contact** input is high. If the parameter is set to **1 (e.g. eccentric press)** then this signal must occur exactly once during the press cycle. The **TDC contact** input therefore cannot immediately change to low without the **BDC contact** input having had a rising edge at least once. A deviation from these processes would result in a contact error.

If the parameter is set to **0-2 (e.g. universal press)**, it is possible to deviate from this sequence in the framework of the configuration. In other words 0 rising edges at BDC, 1 rising edge at BDC, or two rising edges at BDC are allowed. For the first rising edge at BDC, the **Startup** output is set to high. If two rising edges occur, then **Startup** is low with the first falling edge from BDC and no longer high with the second rising edge.

Description of startup monitoring

If the **Startup signals per cycle** parameter is set to 1, then the input signals for **BDC contact** must match the following illustration and the following rules:

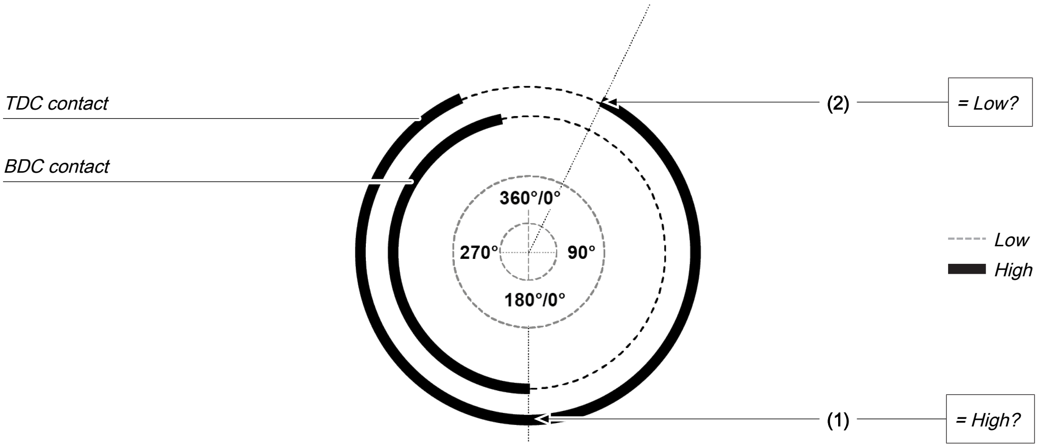


*Illustration 140: Contact monitoring with the universal press contact monitor function block with activated **BDC contact***

Item	Description
(1)	The start of the signal at the **BDC contact** (rising edge) must be close to 180° and must occur while the **TDC contact** input is high. The rising edge at the **BDC contact** switches the startup output to high.
(2)	The falling edge at the **BDC contact** (transition high-low) must happen before the rising edge (transition low-high) at the **TDC contact** input. This means that the **BDC contact** input must be low if a rising edge (transition low-high) occurs at the **TDC contact** input.

This cycle can be changed with the **Startup signals per cycle** parameter if it is configured to 0-2 (see previous section and BDC contact input section).

Min. restart pulse time parameter

A restart sequence (low-high-low **Restart** input) is only valid if the **Restart** input was set to high for at least 100 ms or 350 ms. This value is set with the **Min. restart pulse time** parameter.

Use error flag parameter

This parameter can make an additional output available that is set to high when the function block enters an error state.

Input signals of the universal press contact monitor function block

Description	Type	Short description
Start	Mandatory	Connection of a signal that controls the physical output of the press drive, e.g. the release output from the FB single stroke or automatic.
Restart	Optional	Reset the state of the press.
TDC contact	Mandatory	Contact for the detection of top dead center.
BDC contact	Mandatory	Contact for startup area.
Ramp-down contact	Optional	Contact for ramp-down area.
enable	Mandatory	Connection of a signal which stops the press motion, e.g. by shaft breakage detection

Start input

The **Start** input is used to monitor the press ramp-down. The input must be connected to the signal that controls the physical output of the press drive so that the FB can detect whether the press is currently running or has been stopped. Typically this is the **Release** output of a downstream press setup, press automatic, or press single stroke function block.

NOTICE

Do not connect any physical input signals to the **Start** input. Use a CPU flag to connect the signal that controls the physical output for the press drive.

Restart input

Using the Restart input it is possible to reset errors using a valid restart sequence.

A valid restart sequence at the **Reset** input corresponds to a low-high-low transition with a pulse duration of at least 100 ms or 350 ms and a maximum of 30 s. Shorter or longer pulses are ignored.

If the Restart input is deactivated, then an error can only be reset by stopping execution of the logic program, e.g. by briefly switching off and back on again or by switching the system from the run state to the stop state and then back to the run state using samos® PLAN 6.

WARNING

Make sure that the transitions of the signals for reset meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, then the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

WARNING

Safety signals must conform to the applicable standards and regulations!

Always take into account the valid national, regional, and local regulations and standards for your application. Type C standards such as EN 692 and EN 693 contain requirements as to how safety-related signals must be used. For example, in the case of ramp-down errors it may be necessary for the restart signal to be suitably protected (e.g. by a key switch or in a locked cabinet).

TDC contact input

Precisely one pule must occur at the **TDC contact** input per cycle.

BDC contact input

If the **BDC contact** input is high at the start of the function block (switch-on), then the **Startup** output remains low during the first press cycle.

The diagrams below show the press cycle with differently designed switching gates for the BDC contact (falling edge of BDC after falling edge of TDC contact or falling edge BDC leading the falling edge of the TDC contact)

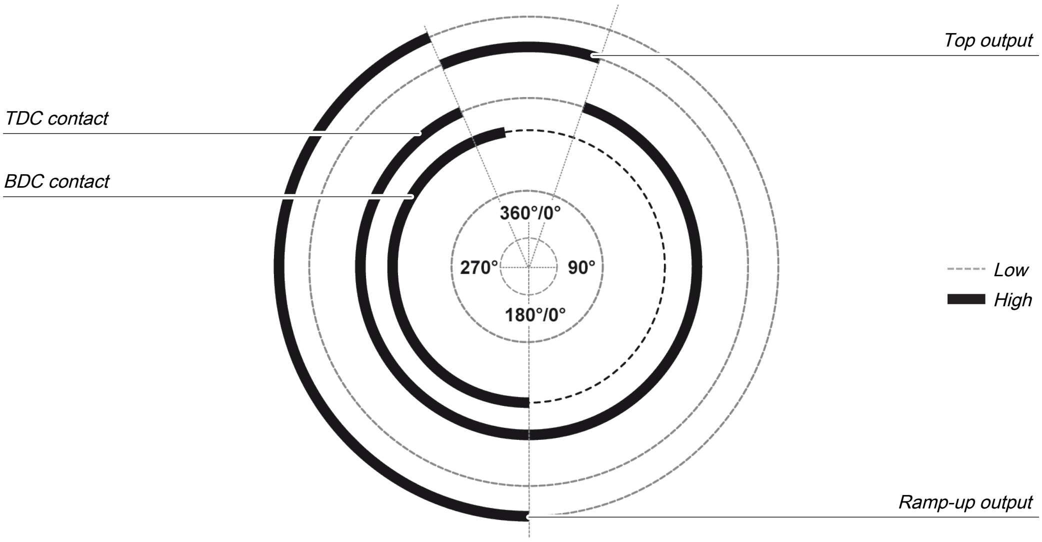


*Illustration 141: Press cycle for the universal press contact monitor function block with falling edge of **TDC contact** before **BDC contact***

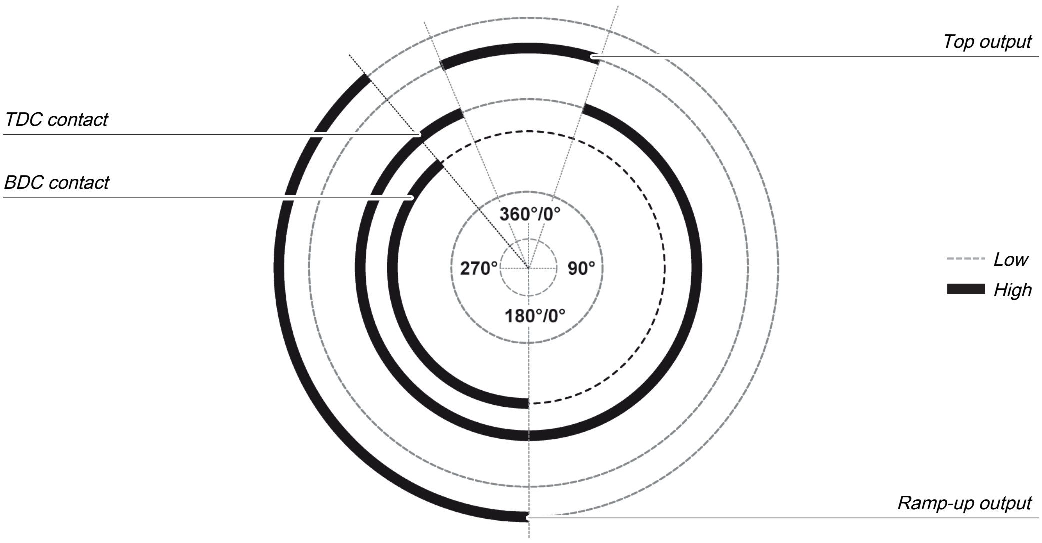


Illustration 142: Press cycle for the universal press contact monitor function block with falling edge of BDC contact before TDC contact

A second rising edge at the **BDC contact** input does not re-start the upstroke phase. This is the case if the **Number of BDC signals per cycle** parameter is configured to 0-2 (e.g. universal press) and the press moves forwards and backwards in the lower section.

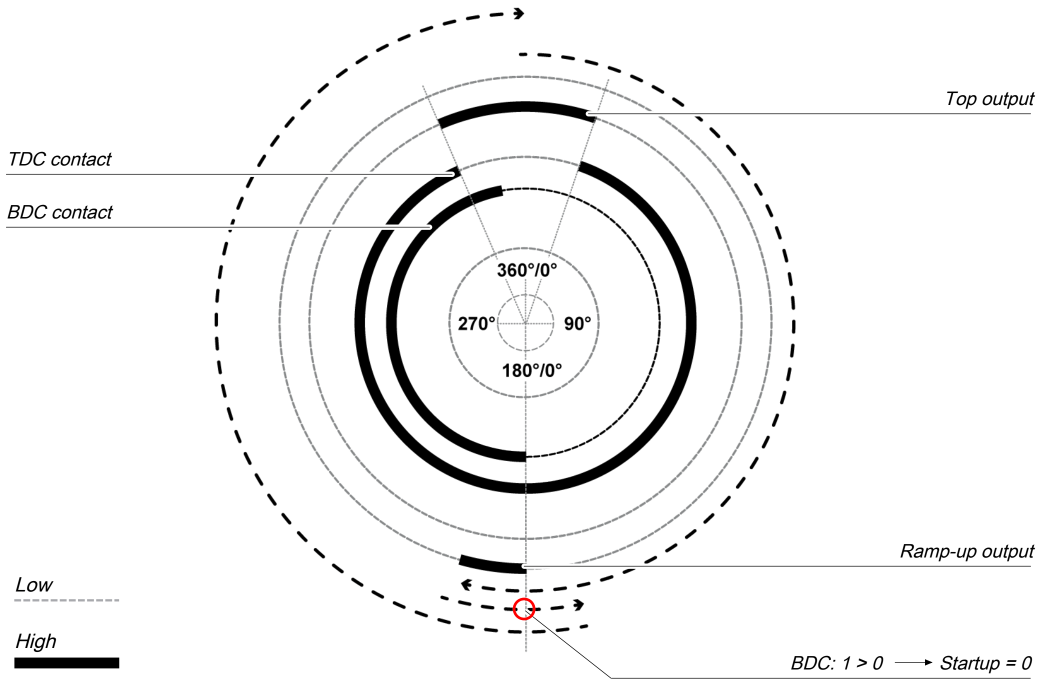


Illustration 143: Press cycle for the universal press contact monitor function block with 2 BDC transitions

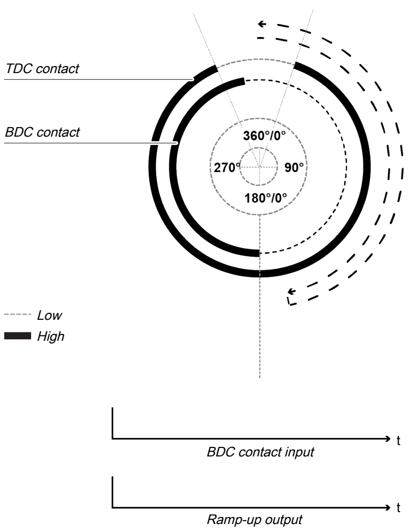
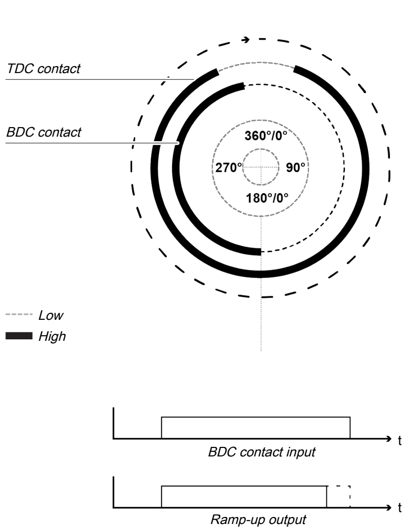
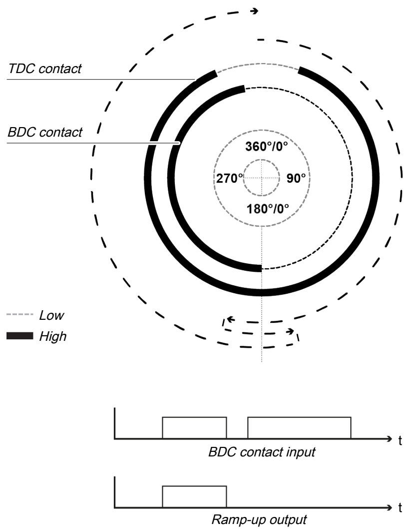
If no pulse occurs at the **BDC contact** input during the cycle with this setting, then the **Startup** output remains low during entire the cycle.

NOTICE

If the **BDC contact** input is already high when monitoring of the contact inputs begins (e.g. during the first logic cycle after resetting an error) then the **Startup** output remains low during the first logic cycle. The next transition from low to high at the **BDC contact** input is only accepted if previously a transition from high to low has occurred at the **Top** output.

The following illustrations show the different press operations with 0, 1, and 2 BDC contact sequences.

Table 120: Timing diagrams for 0, 1, and 2 BDC contact signals per cycle

0 BDC contact signal per cycle	1 BDC contact signal per cycle	2 BDC contact signals per cycle
		

The **BDC contact** input can be combined with the **Ramp-down** input. In this case the processes described in the **BDC contact and Ramp-down inputs** section apply.

Ramp-down contact input

The universal press contact monitor function block monitors the press ramp-down. If the **Ramp-down contact** is left although the press should actually have been stopped, then the function block detects a ramp-down error.

The Start input must then correspond to the following illustration and following rules:

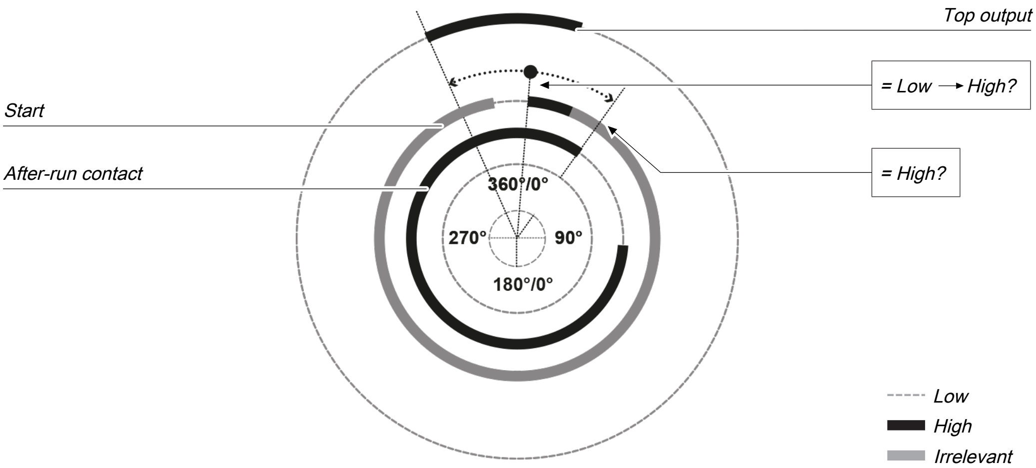


Illustration 144: Ramp-down monitoring with the universal press contact monitor function block

Either a rising edge must occur at **Start** between the rising edge of the **Top** output and the end of the ramp-down area (falling edge at the **Ramp-down contact** input) or the **Start** input must be high at the end of the ramp-down area (falling edge at the **Ramp-down contact** input). If neither of these two conditions is met, then the **Release** output is low and the **Ramp-down error** and **Restart required** outputs are high.

The **Ramp-down contact** input is also combined with the **BDC contact** input. The processes described in the **BDC contact and Ramp-down inputs** section apply.

Release input

This input is used to connect shaft breakage detection.

If the **Release** input is low, then the **Release** output of the function block is low and monitoring of the contact signal sequence and the ramp-down is deactivated, assuming that there is no error. The error outputs are not affected by this.

If the **Release** input changes from low to high, then depending on the configuration of the inputs the suitable state is assumed and the outputs are actuated in accordance with the state.

If the **Release** input changes from high to low, then the **Release, Top** and **Startup** outputs are inactive. The error outputs are not affected by this. If the **Release** input is activated again, then the outputs assume their corresponding state. Monitoring is not deactivated during an active **Release** input.

8.10.1.3.4 Output signals of the universal press contact monitor function block

Description	Type	Short description
enable	Mandatory	Release of the press process.
Top	Mandatory	The press is in the TDC area.
Startup	Mandatory	The press moves upwards.
Restart required	Mandatory	The press must be reset because of an error.
Contact error	Mandatory	Invalid sequence of the contact signals.
Ramp-down error	Optional	A ramp-down error was detected.

Description	Type	Short description
Error flag	Optional	A contact error or ramp-down error is present.

Release output

The **Release** output is used to stop the press and is connected to another supplementary press function block such as press setup or press single stroke. If no error has been detected, the **Release** output of the function block is high.

If an error is detected in the sequence of contact signals, the **Release** output moves to low, the affected error output moves to high, and the **Restart required** output moves to high. A valid restart sequence at the **Restart** input is then required.

The **Release** output also moves to low when the **Release** input is low.

Top output

The **Top** output is typically used to stop the press and is connected to another supplementary press function block such as press setup or press single stroke.

This function block sets the **Top** output based on the changes to the values at the contact inputs. If the function block detects an error, the output is set to low. The **Top** output moves to high when the **TDC contact** input is low.

The **Top** output moves to low when the **Release** input is low.

Startup output

The **Startup** output is typically connected to another supplementary press function block such as press setup or press single stroke. It can also be used to trigger startup muting.

This function block sets the **Startup** output based on the changes to the values at the contact inputs. If the function block detects an error, the output is set to low.

The **Startup** output moves to high in the case of a rising edge (transition from low to high) at the **BDC contact** input. It moves to low in the event of a falling edge at the **TDC contact** input or a falling edge at the **BDC contact** input, depending on which of these occurs first.

The **Startup** output moves to low when the **Release** input is low.

Restart required output

The **Restart required** output is high if a valid restart sequence is expected at the **Restart** input. This output is set back to low only after a valid restart sequence and the **Release** output cannot be high while this output is high. A valid restart sequence is described in the **Restart, Restart input** and **Min. restart pulse time parameter** sections.

Contact error output

This output is set to high when the predetermined sequence of the contact states is not adhered to. The valid sequences were described in the **Ramp-down input**, **TDC contact input**, **BDC contact input, and BDC contact and Ramp-down inputs** sections. All variants of an invalid sequence lead to errors and the Contact error output is set to high.

Ramp-down error output

This output is set to high when the ramp-down contact detects an unwanted movement of the press. If the ramp-down contact is left, although the press should actually have been stopped, this input is set to high.

BDC contact and Ramp-down contact inputs

The signals at the **TDC contact**, **BDC contact,** and **Ramp-down contact** inputs must match the illustration below and the following rules:

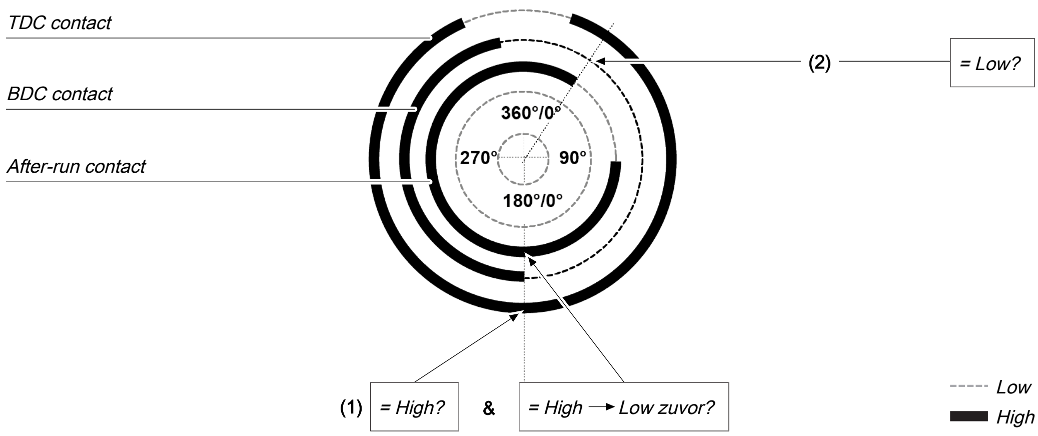


Illustration 145: Contact monitoring with the universal press contact monitor function block with activated BDC contact and ramp-down

Item	Description
(1)	The beginning of the signal at the **BDC contact** (transition low-high) must be close to 180° and must occur while the **TDC contact** input is high and after the falling edge (transition high-low) of the **Ramp-down contact** input (the **Ramp-down contact** input may have moved back to high in the meantime).
(2)	The end of the signal at the **BDC contact** (transition high-low) must happen before the falling edge (transition high-low) at the **Ramp-down contact** input. This means that the **BDC contact** input must be low if a falling edge (transition high-low) occurs at the **Ramp-down contact** input.
(3)	The rules for the **Start** input (see **Start input** section) must be followed.

A valid sequence that satisfies the conditions for **BDC contact** and **Ramp-down** looks like this:

Step	System behavior
1.	Start condition: **TDC contact** = low, **BDC contact** = low, **Ramp-down contact** = high
2.	**TDC contact**: Low → High
3.	**Start** = High (satisfies the condition for ramp-down monitoring)
4.	**Ramp-down contact**: High → Low
5.	**BDC contact**: Low → High (**Startup** output is high only for the first rising edge)
6.	**Ramp-down contact**: Low → High
7.	**TDC contact**: High → Low and **BDC contact**: High → Low (sequence irrelevant, startup output is low)

Depending on the type of press it can happen that the start of the **BDC contact** signal (step 5 above) does not just occur once, but twice or even not at all. In order to prevent this leading to a contact error, the **Number of BDC signals per cycle** parameter must be configured to *0-2 (e.g. universal press)*. With this setting the conditions for the **BDC contact** still apply for every pulse at the **BDC contact** input with the exception of the falling edge at the **Ramp-down contact** input (step 4 above).

If during operation even just one of these conditions is not met, the **Release** output is low and the **Contact error** output is high.

WARNING

Be aware of the corresponding standards and safety regulations!

All of the safety-related parts of the system (wiring, connected sensors, and control devices, configuration) must meet the respective standards (e.g. EN 62061 or EN ISO 13849-1 or type C standards such as EN 692 and EN 693) and safety regulations. Only safety signals may be used for safety applications. Make sure that the application meets all of the applicable standards and regulations!

This must be noted in particular for the **BDC contact** input if the **Startup** output is used for upstroke muting, e.g. in connection with a function block for press cycle control.

If the **Number of BDC signals per cycle** parameter is configured to *0-2 (e.g. universal press)* then the possibilities of the function block for error detection are reduced and not all input errors can be detected (e.g. short circuit after 0 V at the **BDC contact** input).

In order to satisfy the safety regulations, it may be necessary to use tested switches each with different test sources for the contact input signals. In order to use different test sources for the contact signals, the **TDC contact**, **BDC contact** and **Ramp-down** inputs must be connected to different secure modules.

NOTICE

An SP-SDI module has only two test sources, although it has eight test output terminals.

8.10.1.3.5 Error states and information regarding reset

Table 121: Error states and information regarding reset for the universal press function block

Outputs	Error state reset	Remarks
Contact error	The **Contact error** output is high if an unauthorized signal sequence has been detected. Resetting requires a valid restart sequence.	The **Release** output is low, the **Restart required** output is high. If the **Error flag** output is present, this is high.
Ramp-down error	The **Ramp-down error** output is high if the Ramp-down contact is left, although the press should actually have been stopped. Resetting requires a valid restart sequence.	

8.10.1.3.6 Example sequence of a press cycle

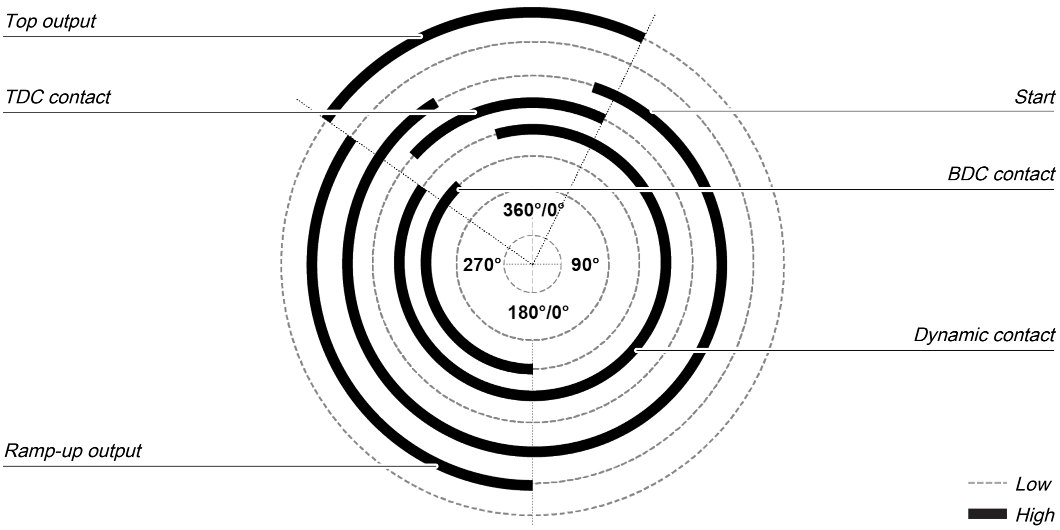


Illustration 146: Contact and output sequence of a universal press during an error-free sequence (example)

8.10.2 Function blocks for press cycle control

8.10.2.1 Press setup

Function block diagram

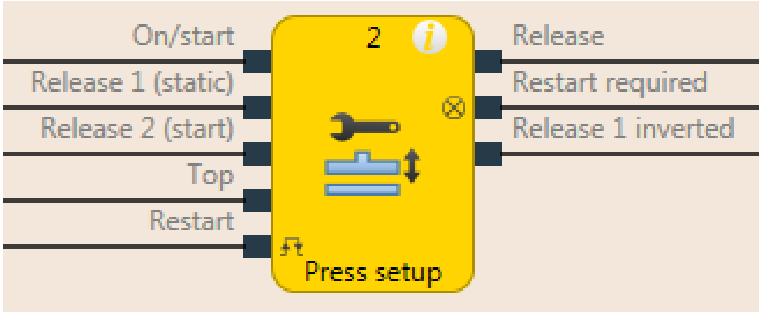


Illustration 147: Logical connections for the press setup function block

Inputs		
Description	**Type**	**Short description**
On/Start	Mandatory	Start a press operation with the rising edge or stop with the falling edge
Release 1 (static)	Mandatory	Main release of the press
Release 2 (start)	Optional	Additional release input is only evaluated when the Release output is low.
Top	Optional	Top dead center for single stroke monitor-ing
Restart	Mandatory	Reset the state of the press

Parameters	Possible values
Restart interlock	• 1- without • 2 - always • 3 - if **On/Start** or **Release 1** inactive • 4 - if **Top** active or **Release 1** inactive
Release 2	• On: The **Release 2** input is available • Off: The **Release 2** input is not available
Press single stroke	• On: Single stroke monitoring active, **Top** input present • Off: Single stroke monitoring deactivated, **Top** input not present
Min. restart pulse time	• 100 ms • 350 ms

Outputs		
Description	**Type**	**Short description**
enable	Mandatory	Release of the press process.
Restart required	Mandatory	The press must be reset because of an activated restart interlock.
Release 1 inverted	Mandatory	Output with inverted signal of the Release 1 input.

8.10.2.1.1 General description

The press setup function block is generally used together with the universal press contact monitor function block or the eccentric press contact monitor function block in order to set up the press. The **Top** output of the contact monitor FB is used as input for the Press setup function block. If the **Press single stroke** parameter is active (single stroke monitoring active) then the **Release** output is low once the press has reached the top dead center (rising edge at the **Top** input). Depending on the setting of the **Restart interlock** parameter, it is possible to implement a step operation using the **On/ Start** input. Depending on this setting a restart sequence is required after a press stop in order to reset or not reset the restart interlock. An activated restart interlock is signaled by a high at the **Restart required** output.

The module has a **Release 1** input. If this is low then the **Release** output is immediately low. The **Release 2** input (if configured as active) is only required during the start sequence. As soon as the **Release** output is high, **Release 2** is no longer monitored. The **On/Start** input starts the press movement with a rising edge, in the event of a falling edge the press movement is stopped (**Release** output is low). A restart sequence can be triggered with the **Restart** input; this sequence resets an activated restart interlock. The **Release 1 inverted** output always shows the inverted state of the **Release 1** input.

WARNING

Make sure that the transitions of the signals for restart meet the requirements of the safety standards and regulations!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, then the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Sequence/timing diagram

The diagram below shows a typical progression of the input and output states of the function block. The sequence shows three cycles of the press with the press operation interrupted twice by the falling edge at the **On/Start** input. A restart interlock was not activated.

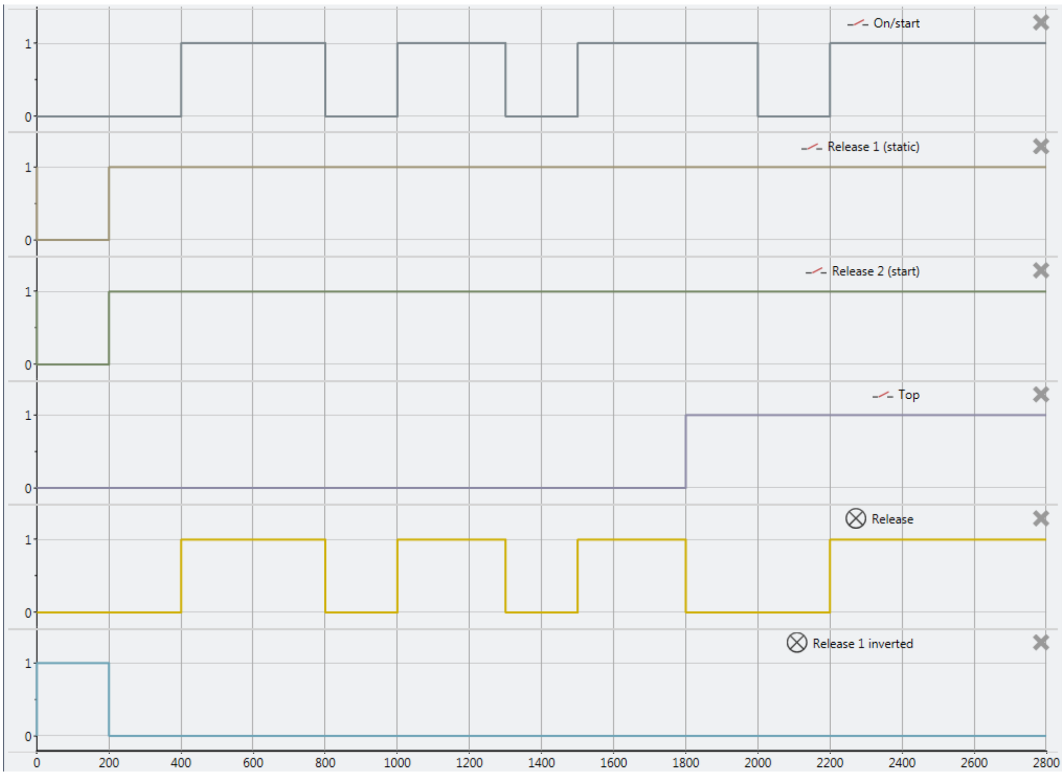


Illustration 148: Typical sequence/timing diagram for the press setup function block

8.10.2.1.2 Parameters of the function block

Table 122: Parameters of the press setup function block

Parameters	Possible values
Restart interlock	• 1- without • 2 - always • 3 - if **On/Start** or **Release 1** inactive • 4 - if **Top** active or **Release 1** inactive
Release 2	• On: The **Release 2** input is available • Off: The **Release 2** input is not available
Press single stroke	• On: Single stroke monitoring active, **Top** input present • Off: Single stroke monitoring deactivated, **Top** input not present
Min. restart pulse time	• 100 ms • 350 ms

Restart interlock parameter

The **Restart interlock parameter** can be used to configure the behavior of the module after a stop. An activated restart interlock (triggered by a previous stop or a restart of the module) is signaled by a high signal at the **Restart required** output. The **Restart required** output only shows the activated restart interlock if the preconditions for a valid restart sequence are present. These are: **Release 1** high and, if configured as active, also **Release 2**high.

In the case of configuration with **1 - without**, no restart interlock is active (and the **Restart required** output is not available) and the press operation can be advanced without a valid restart sequence. In other words in the event of interruption of the press operation by a rising edge at the **Top** input (with active single stroke monitoring) the press operation can be continued by a rising edge at the **On/Start** input. In the event of interruption of press operation by a falling edge at the **On/Start** input, the press operation can be continued by a rising edge at the **On/Start** input.

In the case of configuration with **2 - always** the restart interlock is always active, i.e. the module starts with an activated restart interlock and each stop results in an active restart interlock that has to be reset by a valid restart sequence. Stops caused by a falling edge at **On/Start**, a rising edge of **Top**, or a falling edge of **Release 1**.

In the case of configuration with **3 - if On/Start or Release 1 inactive** the restart interlock is active, i.e. the module starts with an activated restart interlock and every stop due to a falling edge at **On/Start** or a falling edge at **Release 1** results in an active restart interlock that has to be reset through a valid restart sequence.

In the case of configuration with **4 - if Top active or Release 1 inactive,** the restart interlock is active, i.e. the module starts with an activated restart interlock and every stop due to a rising edge at **Top** or a falling edge at **Release 1** results in an active restart interlock that has to be reset by a valid restart sequence.

Release 2 parameter

This parameter activates the **Release 2** input, if the parameter is active

Press single stroke parameter

This parameter activates the single stroke monitoring, if the parameter is active. This means the **Top** input is available and a rising edge at the **Top** input ends the press operation (i.e. a complete single stroke has been fully performed).

Min. restart pulse time parameter

A restart sequence (low-high-low **Restart** input) is only valid if the **Restart** input was set to high for at least 100 ms or 350 ms. This value is set with the **Min. restart pulse time** parameter.

8.10.2.1.3 Inputs of the press setup function block

Table 123: Inputs of the press setup function block

Description	Type	Short description
On/Start	Mandatory	Start a press operation with the rising edge or stop with the falling edge
Release 1 (static)	Mandatory	Main release of the press
Release 2 (start)	Optional	Additional release input is only evaluated when the **Release** output is low.
Top	Optional	Top dead center for single stroke monitor-ing
Restart	Optional	Reset the state of the press

The press setup function block supports the following input signals:

On/Start input

The **On/Start** input signal is used to indicate the beginning and end of the press movement. A rising edge (low to high) at the **On/Start** input signals a start of the press. A falling edge at the **On/Start (High to Low)** input signals a stop of the press. If the **Restart interlock parameter** is set to **2 - always** or **3 - When On/Start or Release 1 is inactive** then a valid **Restart** sequence is required after a stop caused by a Low at the **On/Start** input.

Release 1 (static) input

The **Release 1 (static)** input signal is mandatory. The **Release** output is always immediately low when **Release 1 (static)** is low.

If this function block is used together with a press contact function block (e.g. eccentric press contact monitor or universal press contact monitor), its **Release** output must be connected to the **Release 1 (static)** input of the press setup function block.

Release 2 (start)

The **Release 2 (start)** input signal is optional. If **Release 2 (start)** is configured, the **Release** output can only be high (e.g. during switch-on) if **Release 2 (start)** is high. If the **Release** output is high, **Release 2 (start)** is no longer monitored.

WARNING

Do not use the Release 2 (start) input for safety purposes!

Do not use the **Release 2 (start)** input to initiate an emergency stop, because this input is only utilized temporarily during the start sequence. Otherwise you will place the press operator in danger.

Top input

The **Top** input signal is optional. It is used to determine the end of the press cycle (i.e. the press has reached the top reversal point). This signal is available on the eccentric press contact monitor or universal press contact monitor function blocks. The **Top** input signal is used for single stroke monitoring. If the **single stroke monitoring** configuration parameter is set to **active**, the **Release** output is low if the **Top** input changes from low to high.

WARNING

Do not use the Top input for safety purposes!

Only connect the **Top** input to a **Top** output of the universal press contact monitor or eccentric press contact monitor function blocks or to an equivalent signal source. Do not use the **Top** input to initiate an emergency stop. Otherwise you will place the press operator in danger.

Restart input

If the **Restart interlock parameter** is set to **1 - without**, no **restart** signal is required to restart the press after a stop. The **Restart interlock parameter** can be set to the following values:

1	**without**
2	**always**
3	**if On/Start or Release 1 inactive**
4	**if Top active or Release 1 inactive**

This parameter determines when a **Restart** sequence is expected as input signal for the function block.

If the **Release** output is low and, due to the aforementioned setting of the **Restart interlock parameter** a restart interlock is configured, the **Release** output can only be reset after a valid **restart** sequence has been completed with a low-high-low transition (minimum 100 ms or 350 ms; shorter pulses and pulses over 30 s are ignored).

8.10.2.1.4 Outputs of the "Press setup” function block

Table 124: Outputs of the press setup function block

Description	Type	Short description
enable	Mandatory	Release of the press process.
Restart required	Optional	The press must be reset because of an activated restart interlock.
Release 1 inverted	Mandatory	Output with inverted signal of the Release 1 input.

Release output

The **Release** output is high if **Restart required** is low (i.e. no restart is required) and the following conditions are satisfied:

If the **Single stroke parameter** is set to **inactive**, **Release 1 (static)** is high, and **Release 2 (start)** (if configured) is high; and a rising edge (low to high) is detected at the **On/Start** input. (In this case the **Release** output is low if the **On/Start** input changes from high to low or the Release 1 input is low); or

If the **Single stroke parameter** is set to **active**, **Release 1 (static)** is high and **Release 2 (start)** (if configured) is high; **and a rising edge (low to high) is detected at the On/Start** input. (In this case the **Release** output is low if the **Top** input changes from low to high or the **On/Start** input changes from high to low or the **Release1** input is low)

Restart required output

The **Restart required** output is high if a valid restart sequence is expected at the **Restart** input. This output is set back to low only after a valid restart sequence and the **Release** output cannot be high while this output is high. A valid restart sequence is described in the **Restart interlock parameter, Min. restart pulse time parameter** and **Restart input** sections.

Release 1 inverted output

The **Release 1 inverted** output indicates whether a release signal is pending at the press setup function block. If the **Release 1** input is high, the **Release 1 inverted** output is low and vice versa.

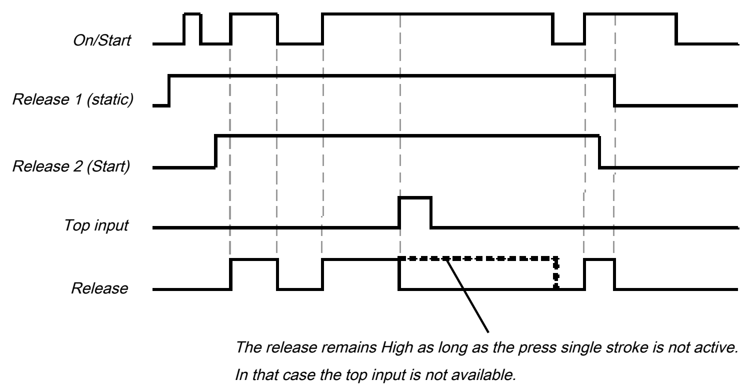


Illustration 149: Sequence/timing diagram for the press setup function block

NOTICE If no immediate change from setup to productive operation is needed, a corresponding wait time should be programmed in the **Logic** view.

8.10.2.1.5 Error states and information regarding reset

Table 125: Error states and information regarding reset for the setup function block

Outputs	Error state reset	Remarks
Restart required	The Restart required output is high if a valid restart sequence is expected at the Restart input. This output is set back to low only after a valid restart sequence and the Release output cannot be high while this output is high. A valid restart sequence means a change in the restart input from low to high to low, where the time of the high signal must be at least 100 or 350 ms (depending on the configuration of min. restart pulse time). Times less than the configured min. restart pulse time or greater than 30 seconds are ignored.	This occurs when the release is switched off and a restart interlock is active depending on the configuration.

8.10.2.2 Press single stroke

Function block diagram

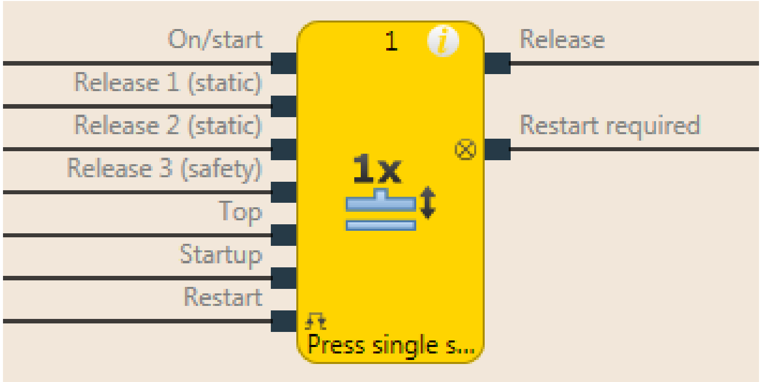


Illustration 150: Logical connections for the press single stroke function block

Inputs		
Description	**Type**	**Short description**
On/Start	Mandatory	Start a press operation with the rising edge or stop with the falling edge
Release 1 (static)	Mandatory	Main release of the press
Release 2 (start)	Optional	Additional release input
Release 3 (safety)	Optional	Additional release input
Top	Mandatory	Top dead center
Startup	Optional	Contact for signaling of the press startup
Restart	Optional	Reset the state of the press

Parameters	Possible values
Restart interlock	• 1- without • 2 - always • 3 - if On/Start, Release 1 or Release 3 inactive • 4 - if Top active or Release 1 or Release 3 inactive • 5 - if Release 1 or Release 3 inactive
Release 2	• On: The **Release 2** input is available • Off: The **Release 2** input is not available
Release 3	• On: The **Release 3** input is available • Off: The **Release 3** input is not available
On/Start mode	• 1 - Inching • 2 - Single start
Mode for upstroke muting	• 1- without • 2 - always (only for Release 3) • 3 - for Release 3 and On/Start
Max. time for startup muting	1 to 7200 s.
Min. restart pulse time	• 100 ms • 350 ms
Deselect restart interlock (for Release 3) in TDC	• On • Off

Outputs		
Description	**Type**	**Short description**
enable	Mandatory	Release of the press process.
Restart required	Optional	The press must be reset because of an activated restart interlock.

8.10.2.2.1 General description

The press single stroke function block is generally used together with the universal press contact monitor function block or the eccentric press contact monitor function block in order to provide information of the **Top** and **Startup these modules** outputs as input for this function block. The **Top** output is required for single-stroke operation. The press can be controlled for example using a two-hand control or by means of a cycle operation function block in conjunction with a safety light curtain.

Single stroke monitoring is always active and cannot be configured. This means: If a rising edge is detected at the **Top** input, then the **Release** output is always low. The preconditions for a restart depend on the configuration of the **Restart interlock** parameter.

The **Release 2** and **Release 3**, **Startup, Restart** inputs and the **Restart required** output are optional. These are present or not depending on the configuration.

The FB has

- a configurable restart interlock,
- the option to choose between inching mode and a complete single stroke cycle,
- time configurable startup muting, and
- the configurable option to have falling edges of the Release 3 input not lead to a restart interlock for a regular stop at top dead center.


WARNING

Make sure that the transitions of the signals for restart meet the requirements of the safety standards and regulations!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, then the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Sequence/timing diagram

A typical sequence in minimum configuration (see also the figure below) starts with a press cycle from the top dead center (**Top** input high). If then the **Release 1** input is high and then a rising edge follows at the **On/Start** input, the Release output is high. Now the press stroke begins and the top dead center is left (**Top** input is low). If subsequently in the press cycle the top dead center is reached again (rising edge at the **Top** input), then the **Release** output is low again. A rising edge at the **On/Start** input would start this sequence from the beginning.

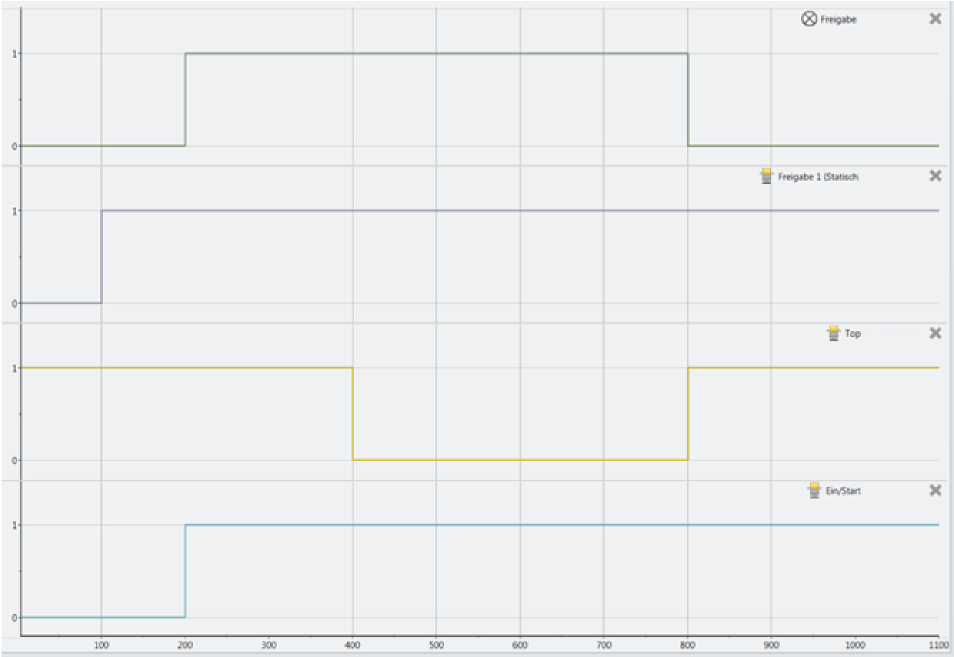


Illustration 151: Minimalist sequence press setup module

8.10.2.2.2 Parameters of the function block

Table 126: Parameters of the press single stroke function block

Parameters	Possible values
Restart interlock	• 1- without • 2 - always • 3 - if **On/Start**, **Release 1** or **Release 3** inactive • 4 - if **Top** active or **Release 1** or **Release 3** inactive • 5 - if **Release 1** or **Release 3** inactive
Release 2	• On: The **Release 2** input is available • Off: The **Release 2** input is not available
Release 3	• On: The **Release 3** input is available • Off: The **Release 3** input is not available
On/Start mode	• 1 - Inching • 2 - Single start
Mode for upstroke mut-ing	• 1- without • 2 - always (only for **Release 3**) • 3 - for Release 3 and On/Start
Max. time for startup muting	• 1 to 7200 s.
Min. restart pulse time	• 100 ms • 350 ms
Deselect restart interlock (for Release 3) in TDC	• On • Off

Restart interlock parameter

The **Restart interlock** parameter can be used to configure the behavior of the module after a stop. An activated restart interlock (triggered by a previous stop or a restart of the module) is signaled by a high signal at the **Restart required** output. The **Restart required** output only shows the activated restart interlock if the preconditions for a valid restart sequence are present. These are: **Release 1** high, if configured as active, **Release 2**also high and **Release 3** high. In the case of configuration of the restart interlock from 2 to 5 the following applies: If the **Restart interlock deselect** parameter is active, then a low signal from Release 3 in the top dead center (**Top** input is high) does not result in a restart interlock.

In the case of configuration with **1 - without**, no restart interlock is active (and the **Restart required** output is not available) and the press operation can be advanced without a valid restart sequence. In other words in the event of interruption of the press operation by a rising edge at the **Top** input, the press operation can be continued by a rising edge at the **On/Start** input. In the event of interrup-tion of press operation by a falling edge at the **On/Start** input, the press operation can be continued by a rising edge at the **On/Start** input.

In the case of configuration with **2 - always** the restart interlock is always active, i.e. the module starts with an activated restart interlock and each stop results in an active restart interlock that has to be reset by a valid restart sequence. Stops due to a falling edge at **On/Start**, a rising edge of **Top**, a falling edge of **Release 1** or a falling edge of **Release 3**.

In the case of configuration with **3 - if On/Start, Release 1 or Release 3 inactive** the restart interlock is active, i.e. the module starts with an activated restart interlock and every stop due to a falling edge at **On/Start**, a falling edge at **Release 1**, or a falling edge at **Release 3** results in a restart inter-lock that has to be reset by a valid restart sequence.

In the case of configuration with **4 - if Top active or Release 1 or Release 3 inactive** the restart interlock is active, i.e. the module starts with an activated restart interlock and every stop due to a rising edge at **Top** or a falling edge at **Release 1** or **Release 3** results in a restart interlock that has to be reset by a valid restart sequence.

In the case of configuration with **5 - if Release 1 or Release 3 inactive** the restart interlock is active, i.e. the module starts with an activated restart interlock and every stop due to a falling edge at **Release 1** or **Release 3** results in a restart interlock that has to be reset by a valid restart sequence.

Release 2 (input) parameter

This parameter activates the **Release 2** input, if the parameter is active.

Release 3 (input) parameter

This parameter activates the **Release 3** input, if the parameter is active.

On/Start mode parameter

If the parameter is configured to **1 - Inching**, then it is possible to stop the press cycle with a falling edge at the On/Start input and (depending on the configured restart interlock) to restart it with a rising edge. If the parameter is configured to **2 - Single start**, then the started press cycle cannot be stopped by a falling edge at the On/Start input.

Mode for upstroke muting parameter

If the parameter is configured to **1 - without**, then the **Startup** input is not present and startup muting cannot be performed.

If the parameter is configured to **2 - for Release 3**, then it is possible during the time defined under **Max. startup muting** to let the **Release 3** input become low without the restart interlock being activated.

If the parameter is configured to **3 - for Release 3 and On/Start**, then after the rising edge at the startup input and while this input remains high within the time set under **Max. startup muting time**, it is possible to let the **Release 3** input or the **On/Start** input become low without the restart interlock being activated.

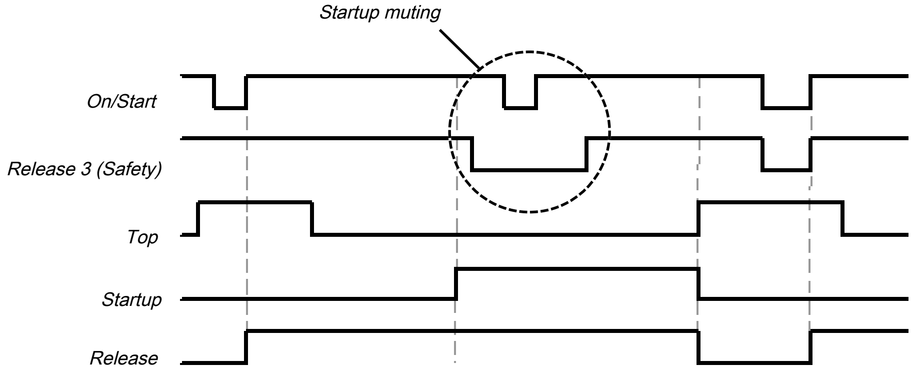


Illustration 152: Sequence/timing diagram for the press single stroke function block startup muting of On/Start and Release 3 (safety)

WARNING

Rule out any hazard during the upward stroke of the press!

If you use startup muting, you must ensure that there are no hazards during startup, e.g. due to the startup movement itself.

Max. startup muting time parameter

The maximum time for bridging the **Release 3** input and the **On/Start** input during the startup phase can be configured (1-7200s). The time starts with the rising edge at the **Startup** input. If the time expires before a falling edge is detected at the **Startup** input, then the FB ends the muting of the configured **Release 3** and **On/Start** inputs. If at this time or afterwards one of these inputs (dependent on the configuration) is or becomes low, then the Release output is also low.

Min. restart pulse time parameter

A restart sequence (low-high-low Restart input) is only valid if the Restart input was set to high for at least 100 ms or 350 ms. This value is set with the Min. restart pulse time parameter.

Deselect restart interlock parameter (for Release 3) in TDC

The activated parameter prevents the restart interlock being activated if the Release 3 input is low during a regular stop at top dead center (Top input high).

8.10.2.2.3 Input signals of the single stroke function block

Description	Type	Short description
On/Start	Mandatory	Start a press operation with the rising edge or stop with the falling edge
Release 1 (static)	Mandatory	Main release of the press
Release 2 (start)	Optional	Additional release input
Release 3 (safety)	Optional	Additional release input
Top	Mandatory	Top dead center
Startup	Optional	Contact for signaling of the press startup
Restart	Optional	Reset the state of the press

On/Start input

The **On/Start** input signal is used to indicate the beginning and end of the press movement. A rising edge (low to high) at the **On/Start** input signals a start of the press. A low at the **On/Start** input signals a stop of the press. If the **On/Start mode** parameter is set to **2 - Single start**, the press cannot be stopped by a low at the **On/Start** input.

Take additional safety precautions when the mode for the On/Start input is set to "2 - Single start"!

If the **On/Start mode** parameter is set to **2 - Single start**, you must take additional security measures (e.g. secure the hazard zone with a light curtain). Otherwise you will place the press operator in danger.

If the **On/Start mode** parameter is set to **1 - Inching** and the **Condition for restart interlock** is set to **2 - always** or **3 - if On/Start, Release 1, or Release 3 inactive**, then a valid **Restart** sequence is required after a stop caused by a low at the **On/Start** input.

The release signal of a two-hand control or a function block for cyclic operation is particularly suitable for connection to the **On/Start** input.

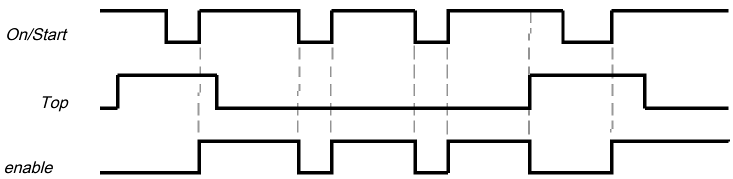


Illustration 153: Sequence/timing diagram for the press single stroke function block with configuration of On/Start to 1 - inching

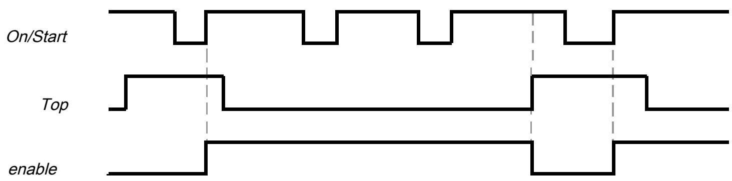


Illustration 154: Sequence/timing diagram for the press single stroke function block with configuration of On/Start to 2 - single start

Release 1 (static) input

The **Release 1 (static)** input signal is mandatory. The **Release** output is always immediately low when **Release 1 (static)** is low.

If this function block is used together with a press contact function block (e.g. eccentric press contact monitor or universal press contact monitor), its release signal must be connected to the **Release 1 (static)** input of this function block.

Release 2 (start) input

The **Release 2 (start)** input signal is optional. If **Release 2 (start)** is configured, the **Release** output can only be high (e.g. during switch-on) if **Release 2 (start)** is high. If the **Release** output is high, **Release 2 (start)** is no longer monitored.

WARNING

Do not use the Release 2 (start) input for safety purposes!

Do not use the **Release 2 (start)** input to initiate an emergency stop, because this input is only utilized temporarily during the start sequence. Otherwise you will place the press operator in danger.

Release 3 (safety) input

The **Release 3 (safety)** input signal is an optional signal. If **Release 3 (safety)** is configured, the **Release** output can only be high if **Release 3 (safety)** is high. If **Release 3 (safety)** is low and **Startup muting is not active**, then the **Release** output is set to low and a **Restart** sequence must be done in accordance with the configuration.

If **Release 1 (static)** and **Startup** are high and the configured startup time has not yet expired, then the **Release 3 (safety)** signal is bypassed (startup muting).

Top input

The **Top** input signal is used to determine the end of the press cycle (i.e. the press has reached the top dead center). This signal is available at the eccentric press contact monitor and universal press contact monitor function blocks. The **Top** input signal is used for single stroke monitoring. The **Release** output is low if the **Top** input passes from low to high.

WARNING

Do not use the Top input for safety purposes!

Only connect the **Top** input to a **Top** output of the universal press contact monitor or eccentric press contact monitor function blocks or to an equivalent signal source. Do not use the **Top** input to initiate an emergency stop. Otherwise you will place the press operator in danger.

Startup input

If the **Startup** input is present because of the configuration, then this must be connected.

NOTICE

Only connect the **Startup** input to the **Startup** output of an eccentric press contact monitor or universal press contact monitor function block.

If the input is available, then the **Release 3 (safety)** and **On/Start** input signals are bypassed (muting of the **On/Start** input depends on the parameter settings) if the **Release** output is high and the **Startup** input is high. This function block does not perform a plausibility check of the **Startup** input signal. If the **Startup** input is high several times during a single press cycle, then it is possible to bypass the corresponding input of the function block several times. If a signal should not be bypassed, then together with other signals that must be connected to the **Release 1 (static)** input it should be connected to the **Release 1 (static)** input by means of an AND function block.

WARNING

Rule out any hazard during the startup of the press!

If you use startup muting, you must ensure that there are no hazards during startup, e.g. due to the startup movement itself.

Restart input

If the **Restart interlock** parameter has been set to **1 - without**, no **restart** signal is required to restart the press after a stop. The **Restart interlock** parameter can be set to the following values:

- 1- without
- 2 - always
- 3 - if On/Start, Release 1 or Release 3 inactive
- 4 - if Top active or Release 1 or Release 3 inactive
- 5 - if Release 1 or Release 3 inactive

This parameter determines when a valid **restart** sequence is expected as input signal for the function block.

If the **Release** output is low, the **Release** output can only be reset in the case of settings 2 to 5 after a valid **Restart** sequence has been completed at the **Restart** input with a low-high-low transition (minimum 100 ms or 350 ms; shorter pulses and pulses over 30 s are ignored).

8.10.2.2.4 Output signals of the function block

Description	Type	Short description
enable	Mandatory	Release of the press process.
Restart required	Optional	The press must be reset because of an activated restart interlock.

Release output

The **Release** output is high if **Restart required** is low (i.e. no restart is required) and the following conditions are satisfied:

- The Release 1 input is high;
- if activated, Release 2 must also be high;
- if activated, Release 3 must also be high;
- and a rising edge at the On/Start input is detected;

Restart required output

The **Restart required** output is high if a valid **Restart** sequence is expected at the **Restart** input.

8.10.2.2.5 Internal values

Muting time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in s
Value range	0 to 7,200
Factor	1

8.10.2.2.6 Error states and information regarding reset

Table 127: Error states and information regarding reset for the single stroke function block

Outputs	Error state reset	Remarks
Restart required	The Restart required output is high if a valid restart sequence is expected at the Restart input. This output is set back to low only after a valid restart sequence and the Release output cannot be high while this output is high. A valid restart sequence means a change in the restart input from low to high to low where the time of the high signal must be at least 100 ms or 350 ms (depending on the configuration of min. restart pulse time). Times less than the configured min. restart pulse time or greater than 30 seconds are ignored.	This occurs when stopped depending on the configuration of the restart interlock.

8.10.2.3 Press automatic mode

Function block diagram

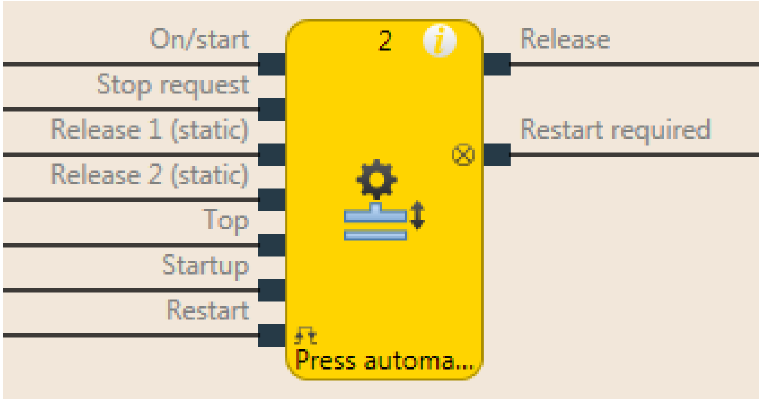


Illustration 155: Logical connections for the press automatic function block

Inputs		
Description	**Type**	**Short description**
On/Start	Mandatory	Start a press operation (and trigger a stop request if Off/Stop is not available)
Stop request	Optional	Trigger a stop request if the input is present
Release 1 (static)	Mandatory	Main release of the press
Release 2 (start)	Optional	Additional release input
Top	Mandatory	Top dead center
Startup	Optional	Press is in startup (upstroke)
Restart	Optional	Reset the state of the press

Parameters	Possible values
Restart interlock after stop condition	On: After an error the FB must be reset with a valid restart sequence. Off: No restart required, **Restart** input not present.
Stop request	On: Stop request is triggered via the **Stop request** input Off: Stop request is triggered via a low signal at the **On/Start** input
Startup input	On: The **Startup** input is present Off: The **Startup** input is not present
Release 2	On: The **Release 2** input is available Off: The **Release 2** input is not available
Min. restart pulse time	For a valid reset: 100 ms: The **Restart** input must be at high for at least 100 ms. 350 ms: The **Restart** input must be at high for at least 350 ms.

Outputs		
Description	**Type**	**Short description**
enable	Mandatory	Release of the press process.
Restart required	Optional	The press must be reset because of an activated restart interlock.

8.10.2.3.1 General description

The **press automatic** function block (FB) is used in connection with press applications where the workpieces are moved automatically to and from the press, whereby access to the press is **required** occasionally, e.g. to change a die.

The function block can generate a stop signal for the press for this purpose at top dead center (**Top** input high) (i.e. The **Release** output is low) if a stop has previously been requested. The request for a stop is triggered by a rising edge at the **Stop request** input or by a falling edge from **On/Start** (depending on the configuration of the stop request).

If the **Stop request** input is not configured, then a falling edge at the **On/Start** input leads to shutting down of the **Release** output. If the **Startup** input is active, then the shutting down of the **Release** output is delayed until the **Top** input is active. If the **Startup** input is or becomes inactive, the **Release** output is shut down immediately. If the **Startup** input is configured as active, then a rising edge at the **Stop request** input (or a falling edge at **On/Start**) causes an immediate change of the **Release** output to low while the **Startup** input is low. If the press is in startup (**Startup** input high), but has not yet reached the top dead center (**Top** input low) and a rising edge is detected at **Stop request** (or a falling edge at **On/Start**), then the **Release** output is only low if a rising edge is subsequently detected at the **Top** input or a falling edge is detected at the **Startup** input.

If the **Startup** input is not configured as active, then a falling edge at the **On/Start** input only leads to shut down of the **Release** output if the top dead center has been reached (**Top** input high)

In addition the FB has its own **Restart** input that can be activated with the **Restart interlock after stop condition** parameter.

WARNING

Make sure that the transitions of the signals for restart meet the requirements of the safety standards and regulations!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, then the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Sequence/timing diagram

The diagram below shows a typical progression of the input and output states of the function block. The sequence shows five cycles of the press with the press operation interrupted twice by the **Stop request** input.

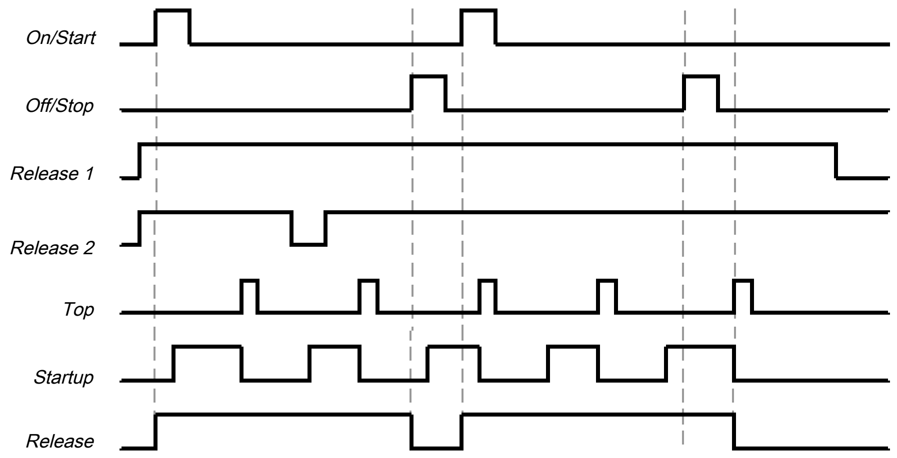


Illustration 156: Typical sequence/timing diagram for the press automatic function block

8.10.2.3.2 Parameters of the function block

Table 128: Parameters of the press automatic function block

Parameters	Possible values
Restart interlock after stop condition	• On: After an error the FB must be reset with a valid restart sequence. • Off: No restart required, **Restart** input not present.
Stop request	• On: Stop request is triggered via the **Stop request** input • Off: Stop request is triggered via a low signal at the **On/Start** input
Startup input	• On: The **Startup** input is present • Off: The **Startup** input is not present
Release 2	• On: The **Release 2** input is available • Off: The **Release 2** input is not available
Min. restart pulse time	For a valid reset: • 100 ms: The **Restart** input must be at high for at least 100 ms. • 350 ms: The **Restart** input must be at high for at least 350 ms.

Restart interlock after stop condition parameter

If the **Restart interlock after stop condition** parameter is not active, then no **Restart** sequence is required to restart the press after a stop.

If the **Restart interlock after stop condition** parameter is active, the FB requires a valid restart sequence after the function block start or if the stop request was triggered. If this is the case, the **Release** output is low and the **Restart required** output is in the high state. The Release output cannot be set to high without a valid restart sequence. If during the stop request or during the first start of the FB, the inputs that are necessary for starting the FB are not in the expected state (**Release 1** and **Release 2** high) then the **Restart required** output is not set to high. This only changes to the high state after reaching the start states (**Release 1** and **Release 2** high). The **Restart required** output is only reset after a valid restart sequence has occurred with a low-high-low transition (at least 100 ms or 350 ms; shorter pulses and pulses over 30 s are ignored). Then the **Release** output can be reset to the high state by a rising edge at the **On/Start** input.

Stop request parameter

The **Stop request** parameter determines the stop mode of the press automatic function block. If this parameter is not active, then the **On/Start** input (falling edge) is used to trigger a stop request. If the **Stop request parameter is active then a rising edge at the Stop request input triggers a stop request.**

In both cases the **Release** output is only high if the following conditions are met:

A transition from low to high takes place at the **On/Start** input; and

The **Stop request** input is low, if used; and

there is no other reason that would normally trigger a stop signal; e.g. **If Release 1 (static)** is low; and

- if the restart interlock after stop condition parameter is active, a valid restart sequence must occur beforehand.

If the **Startup** input is configured as active, then a stop request causes an immediate change of the **Release** output to low, while the **Startup** input is low. If the press is in startup (**Startup** input high), but has not yet reached the top dead center (**Top** input low) and a stop request is detected, then the **Release** output is only low if a rising edge is detected subsequently at the **Top** input or a falling edge is detected at the **Startup** input.

If the **Startup input** parameter is not active, then a stop request causes a change of the **Release** output to low, immediately after a rising edge is detected at the **Top** input.

WARNING

Do not use the On/Start and Stop request inputs for safety stops!

Regardless of the configuration of the **Condition for stop request**, the **On/Start** and **Stop request** inputs may not be used to initiate a safety stop. These inputs may only be used to trigger stop requests of the automation control system. Signals to initiate a safety stop (e.g. emergency stop) must be connected to the **Release 1 (static)** input of the function block.

Startup input parameter

If the **Startup input** parameter is active, a high signal at the **Startup input (the press moves upwards)** makes it possible to stop the press both during the upwards movement and in the top dead center (**Top** input high) (the **Restart required** output is high, if present).

After the **Startup** input has been set to high, a stop request (a rising edge at the **Stop request** input or a falling edge at **On/Start**, depending on configuration) can be triggered without the **Release** output immediately switching to low.

If this parameter is not active, then regular stops are only possible at top dead center (**Top** input high).

NOTICE

Only connect the **Startup** input to the **Startup** output of a universal press contact monitor or eccentric press contact monitor function block.

Release 2 (input) parameter

This parameter activates the **Release 2** input, if the parameter is active

Min. restart pulse time parameter

A restart sequence (low-high-low **Restart** input) is only valid if the **Restart** input was set to high for at least 100 ms or 350 ms. This value is set with the **Min. restart pulse time** parameter.

8.10.2.3.3 Input signals of the press automatic function block

Table 129: Parameters of the press automatic function block

Description	Type	Short description
On/Start	Mandatory	Start a press operation (and trigger a stop request if Off/Stop is not available)
Stop request	Optional	Trigger a stop request if the input is present
Release 1 (static)	Mandatory	Main release of the press
Release 2 (start)	Optional	Additional release input
Top	Mandatory	Top dead center
Startup	Optional	Press is in startup (upstroke)
Restart	Optional	Reset the state of the press

On/Start input

The **On/Start** input signal is used to give a signal for the start of the press operation. If the **Stop request** parameter is not active, the falling edge of the **On/Start** input is evaluated as a stop request. If a rising edge (low to high) is detected at the **On/Start** input, then the **Release** output is high, provided that the **Stop request** input is low and there is no other reason that would normally trigger a stop. These are:

- The Release 1 input must be high,
- if Release 2 is present, then this input must also be high,

if the **Stop request** input is present, then this input must be low.

Before the signal transition of **On/Start** from low to high, a valid restart sequence is required if the **Restart interlock after stop condition** parameter is active. If you connect command devices (e.g. a two-hand controller) to the **On/Start** input, you must ensure that no unintended restart is possible.

Off/Stop input

If the **Stop request** parameter is active, then the **Stop request** input is used to signal a stop request (rising edge at Off/Stop) to the press. If the **Startup** input is configured as active, then a stop request causes an immediate change of the **Release** output to low, while the **Startup** input is low. If the press is in startup (**Startup** input high), but has not yet reached the top dead center (**Top** input low) and a stop request is detected, then the **Release** output is only low if a rising edge is detected subsequently at the **Top** input or a falling edge is detected at the **Startup** input. If the **Release** output is low then in this case the **Restart required** output is set to high if the **Restart interlock after stop condition** parameter is active.

If the **Startup input** parameter is not active, then a stop request causes a change of the **Release** output to low, immediately after a rising edge is detected at the **Top** input.

This input can be used only if the **Stop request** parameter is active.

The **Stop request** input is intended for the connection of non-safety related signals (e.g. from a programmable logic controller (PLC)). Safety-related signals may only be connected to the **Release 1 (static)** input, not to the **Stop request** input.

Release 1 (static) input

The **Release 1** input signal is mandatory. The **Release** output is always immediately low when **Release 1** is low.

If this function block is used together with a press contact function block (e.g. eccentric press contact monitor or universal press contact monitor), its **Release** output must be connected to the **Release 1** input of this function block.

Release 2 (start) input

The **Release 2** input is optional. If the **Release 2** parameter is active, the **Release** output can only be high (e.g. during switch on) if the **Release 2** input is high. As soon as the Release output is high, the Release 2 input is no longer monitored.

WARNING

Do not use the Release 2 (start) input for safety purposes!

Do not use the **Release 2 (start)** input to initiate an emergency stop, because this input is only utilized temporarily during the start sequence. Otherwise you will place the press operator in danger.

Top input

The **Top** input is used to determine the end of the press cycle (i.e. the press has reached the top dead center). If the **Restart interlock after stop condition** parameter is active and a stop request was present, then the **Restart required** output is high and the **Release** output low due to the rising edge of the **Top** input.

If the **Restart interlock after stop condition** parameter is not active and a stop request was present, then only the **Release** output is low due to the rising edge of the **Top** input. This signal is available at the eccentric press contact monitor and universal press contact monitor function blocks.

WARNING

Do not use the Top input for safety purposes!

Do not use the **Top** input to initiate an emergency stop. Otherwise you will place the press operator in danger.

Startup input

The **Startup** input allows the press to stop both during the upwards movement and in the top dead center (**Top** input high). If the parameter is not active, then regular stops are only possible at top dead center.

NOTICE

Do not use the Startup input for safety purposes!

Only connect the **Startup** input to the **Startup** output of a universal press contact monitor or eccentric press contact monitor function block.

Restart input

If the **Restart interlock after stop condition** parameter is active, then the **Restart** input is present. In this case the **Restart required** output must be reset in the event of the first start of the module or after a successful stop (**Release** output is low). Reset is done by a valid restart sequence. This means a change in the **Restart** input from low to high to low where the time of the high signal must be at least 100 ms or 350 ms (depending on the configuration of **Min. restart pulse time**). Times less than the configured **Min. restart pulse time** or greater than 30 seconds are ignored.

8.10.2.3.4 Outputs of the press automatic function block

Table 130: Parameters of the press automatic function block

Description	Type	Short description
enable	Mandatory	Release of the press operation
Restart required	Optional	The press must be reset because of an error.

Release output

The press operation can only be performed is the **Release** output is high. The output is controlled depending on the parameters and input states of the function block. If the **Release** output is high, the **Restart required** output is always low. Both outputs can be low at the same time.

Restart required output

The **Restart required** output is high if a valid restart sequence is expected at the **Restart** input. This output is set back to low only after a valid restart sequence and the **Release** output cannot be high while this output is high. A valid restart sequence is described in the **Restart interlock after stop condition parameter, Min. restart pulse time parameter,** and **Restart input** sections.

8.10.2.3.5 Error states and information regarding reset

Table 131: Error states and information regarding reset for the automatic function block

Outputs	Error state reset	Remarks
Restart required	The **Restart required** output is high if a valid restart sequence is expected at the **Restart** input. This output is set back to low only after a valid restart sequence and the Release output cannot be high while this output is high. A valid restart sequence means a change in the **Restart required** input from low to high to low where the time of the high signal must be at least 100 ms or 350 ms (depending on the configuration of min. restart pulse time). Times less than the configured min. restart pulse time or greater than 30 seconds are ignored.	This occurs when stopped depending on the configuration of the restart interlock.

8.10.2.4 Cyclic operation

Function block diagram

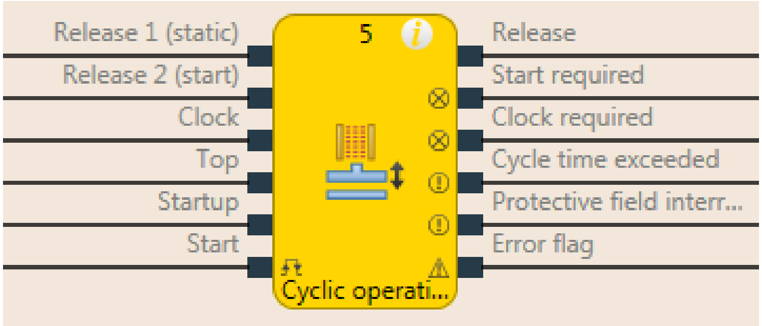


Illustration 157: Logical connections for the cyclic operation function block

Inputs		
Description	**Type**	**Short description**
Release 1 (static)	Mandat-ory	Main release of the press
Release 2 (start)	Optional	Additional release input
Cycle	Mandat-ory	Cycle input e.g. from a light curtain (ESPE)
Top	Mandat-ory	Top dead center
Startup	Optional	Contact for signaling of the press startup
Start	Optional	Reset the state of the press
Drive release	Optional	Connection of a signal that controls the physical output of the press drive, e.g. the release output from the FB single stroke or automatic.

Parameters	Possible values
Number of cycles	1 to 8 (according to EN692 and EN693 max. 2)
Mode	• 1 - Standard • 2 - Sweden
Max. startup muting time	0 = inactive, 1 to 7200 s. The Startup input is only available if the value is not set to 0.
Cycle time monitoring	0 = inactive, 1 to 500 s (According to EN 692 and EN 693, the time must not exceed 30s)
Release 2	• 1- Without • 2 - Required for every start • 3 - Required for first start
Start of the first cycle	• 1 - After reaching the TDC • 2 - After start of the startup
Restart interlock	• 1- without • 2 - always • 3 - after shutdown in downstroke or initial position
Min. restart pulse time	• 100 ms • 350 ms
Start position	• 1 - everywhere • 2 - only in TDC
Min. cycle pulse time	• 100 ms • 350 ms
Use error flag	• On: The error flag output is present • Off: The error flag output is not present

Outputs		
Description	**Type**	**Short description**
enable	Mandatory	Release of the press process.
Start required	Optional	The press must be reset in the event of an activated restart interlock.
Cycle required	Mandatory	One (or several) intervention(s) is (are) required to continue the press cycle.
Cycle time exceeded	Mandatory	Exceeding the set cycle time monitoring is signaled.
Protective field intervention	Mandatory	Signals an unauthorized intervention.
Start not possible here	Optional	A stop outside of the top dead center has been performed. The press must first be moved back to top dead center.
Error flag	Optional	A cycle time exceeded or an unexpected cycle is present

8.10.2.4.1 General description

The cyclic operation function block is used for press applications with cyclic operation (PSDI = Press Sensing Device Initiation).

WARNING

Ensure the safety rules for cyclic operation are satisfied!

The requirements for cyclic operation (PSDI) are described in local, regional, national, and international standards. Always bring the cyclic operation applications in line with these standards and regulations as well as with your risk analysis and avoidance strategy.

If the ESPE (e.g. safety light curtain) is not used in an operating mode, the ESPE must be switched off in this mode so that it is clear that the ESPE is not currently active in safety mode.

If more than one ESPE (e.g. safety light curtain) is used in an application that uses the N-cycle functions (PSDI), then only one ESPE may be used to meet the requirements for the N-cyclic operation (PSDI).

In accordance with EN 692 and EN 693 for press applications, the number of interventions is limited to 1 or 2 and cycle time monitoring must not exceed 30s.
Other applications are subject to the applicable standards.

WARNING

Prevent access to dangerous movement!

Press systems with a configuration that would allow a person to penetrate the safety zone of an ESPE, cross it and leave it, are not permitted for cyclic operation.

This function block defines a specific sequence of interventions that trigger a press cycle. **Interventions** are defined as the transition from high to low to high of the **Cycle** input signal. In cyclic operation of a press there is an indirect manual triggering of a press cycle based on a predefined number of "interventions" into the ESPE. If the ESPE (e.g. safety light curtain) detects that the operator's work movements in connection with the loading or unloading of parts have ended and that the operator has removed all body parts from the safety zone of the ESPE, the press may trigger automatically.

The cyclic operation function block can be used in conjunction with the universal press contact monitor or press single stroke function blocks and an input for a safety light curtain. The **Release** output of this function block controls, for example, the **On/Start** input of a press single stroke function block.

The cyclic operation function block checks whether the start sequence is valid and when the intervention counter or the function block have to be reset.

In the minimum configuration shown below the following sequence must be performed to switch the **Release** output to high. The **Release 1** input and the **Cycle** input must be high. The **Cycle required** output then signals with a high that an intervention is required. A subsequent intervention at the **Cycle** input (high-low-high sequence) switches the **Release** output to high.

Complete start sequence

A complete start sequence is required to be able to reset errors or stops if restart interlock is active.

If the **Release** output is low due to one of the following conditions, a complete start sequence may be required:

Release 1 (static) is low

The **Protective field intervention** output is high while the Cycle input is low and there is no active startup muting and no stop at the top dead center (Top input low).

- In the event that the cycle time is exceeded (Cycle time exceeded output high)
- After switching on the controller

If the **Protective field intervention** output is high, the **Release** output is low, the **Cycle** input is also low, and **Restart interlock** is configured to **1 - without**, then a restart is possible without a complete **Restart** sequence. This can also apply during the startup of the press if **Restart interlock** is configured to **3 - After shutdown in downstroke or initial position**.

Cycle start sequence

A cycle start sequence is required in order to start the next press cycle in the event of a regular stop at top dead center. A cycle start sequence consists of the programmed number of cycles.

Sequence/timing diagram

The following diagram shows a typical progression in mode **1 - Standard** with a programmed number of interventions of 2 and without restart interlock.

Intervention in this case means that the safety outputs of the ESPE are switched off by an intervention. A high-low-high transition at the Cycle input (a consecutive falling and then rising edge) is evaluated as 1 intervention (1 cycle).

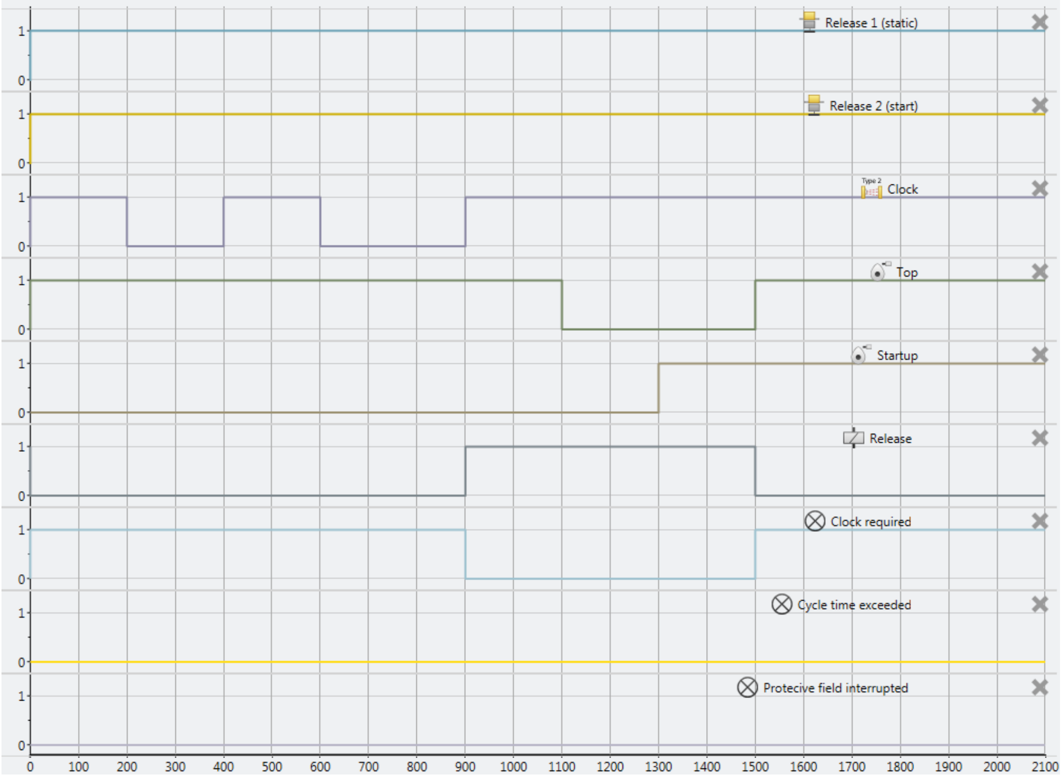


Illustration 158: Sequence/timing diagram for a complete sequence in standard mode with 2 programmed interventions without restart interlock.

WARNING

Make sure that the transitions of the signals for restart meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, then the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

8.10.2.4.2 Parameters of the cycle operation function block

Table 132: Parameters of the cycle operation function block

Parameters	Possible values
Number of cycles	• 1 to 8 (according to EN692 and EN693 max. 2)
Mode	• 1 - Standard • 2 - Sweden
Max. startup muting time	0 = inactive, 1 to 7200 s. The Startup input is only available if the value is not set to 0.

Parameters	Possible values
Cycle time monitoring	0 = inactive, 1 to 500 s
Release 2	• 1- Without • 2 - Required for every start • 3 - Required for first start
Start of the first cycle	• 1 - After reaching the TDC • 2 - After start of the startup
Restart interlock	• 1- without • 2 - always • 3 - after shutdown in downstroke or initial position
Min. restart pulse time	• 100 ms • 350 ms
Start position	• 1 - everywhere • 2 - only in TDC
Min. cycle pulse time	• 100 ms • 350 ms
Use error flag	• On: The error flag output is present • Off: The error flag output is not present

Number of cycles parameter

This parameter is used to set the number of cycles (interventions) run through before the press restarts a new cycle. The press only starts if the configured number of cycles has been detected. If more cycles are detected than are configured, then the press stops immediately (**Release** output low and **Protective field intervention output** high) If the cycle time monitoring is configured not equal to 0, then both a complete start sequence (depending on **Standard/Sweden** configuration first the cycles and then a valid restart sequence or vice versa) and a cycle start sequence (without restart sequence) occur with the configured time.

Mode parameter

The **Mode** parameter can be used to influence the order of a complete start sequence. A complete start sequence consists of the programmed number of cycles and a valid restart sequence.

In **Standard** mode, the configured number of cycles must occur first, followed by a valid restart sequence (see illustration below).

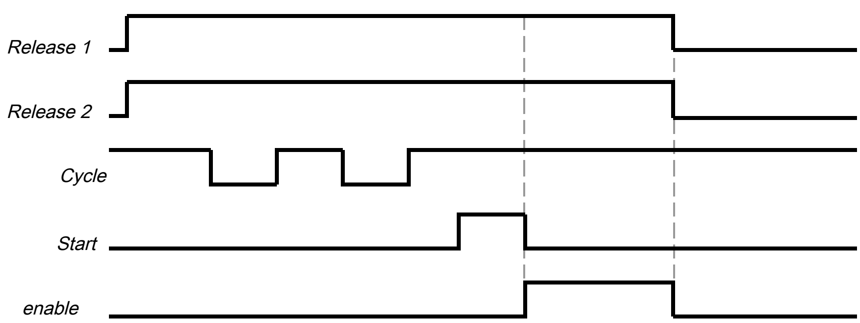


Illustration 159: Cycle/timing diagram for a complete start sequence in standard mode in two-cycle operation

In **Sweden** mode, the valid restart sequence must occur first, followed by the configured number of cycles (see illustration below).

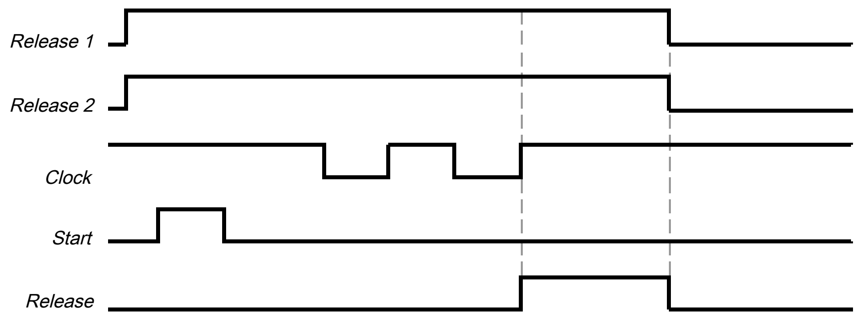


Illustration 160: Sequence/timing diagram for a complete start sequence in Sweden mode in two-cycle operation

The minimum intervention time at the **Cycle** input is 100 ms or 350 ms (see **Min. cycle pulse time** parameter). Shorter interventions are not evaluated as valid, i.e. are ignored. If the parameter for the **Release 2** input is configured as **3 - Required for first start**s or as **2 - Required for every start**, the **Release 2 (start)** input must also be high if a complete start sequence is required.

After the initial complete start sequence has been completed and the press has completed a press cycle, the **Top** input has to show that the press has reached the top dead center. This is indicated by a rising edge (low to high) of the **Top** input. If this happens, the internal intervention counter is reset. The **Release** output is low and the **Cycle required** output high.

In order to trigger a subsequent cycle, a cycle start sequence is required. In this case the **Release** output is high if the configured number of interventions has occurred and the other configured conditions are met (e.g. The **Release 2 (input)** parameter can be configured as **2 - Required for every start**).

Max. startup muting time parameter

Startup muting allows bypassing of the **Cycle** input (e.g. of the OSSD of a safety light curtain) during the press startup. Startup muting is activated if the **Max. startup muting time** parameter is set to a value greater than 0. Startup muting is inactive if the **Max. startup muting time** parameter is set to 0.

If startup muting is activated...

it is mandatory that the **Startup** input is connected to a suitable signal. This can be the **Startup** output e.g. of the eccentric press contact monitor function block or the universal press contact monitor function block.

The **Cycle** input of the function block is bypassed if the **Startup** input is high and the **Top** input remains low.

The function block does not check the **Startup** input for plausibility. This means that it is possible to bypass the **Cycle** input several times if the **Startup** input is activated several times during a single press cycle.

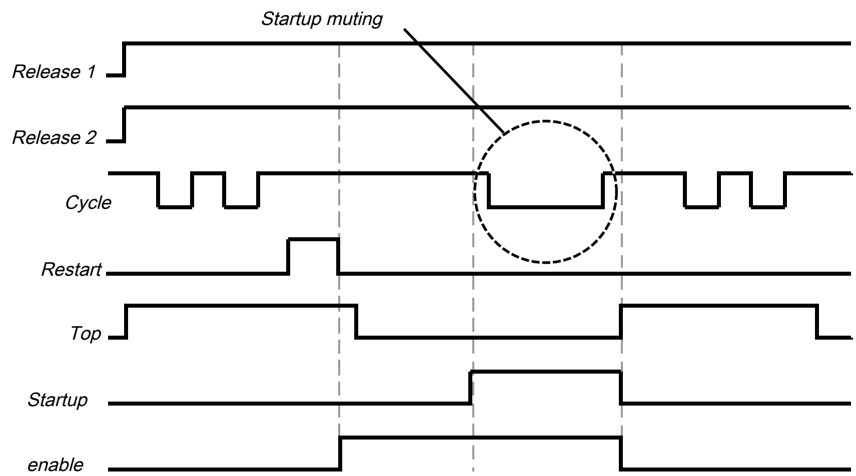


Illustration 161: Sequence/timing diagram for startup muting in standard mode in two-cycle mode

The **Max. time for startup muting** can be configured. The timer for startup muting starts when there is a rising edge (low to high) at the **Startup** input. If the timer reaches the configured **Max. startup muting time** or the **Startup** input is low, the startup muting ends and, if the **Cycle** input is low, then the **Release** output is set to low and the **Protective field intervention** output is high. If a second rising edge at the **Startup** input occurs and the **Release** output is high, the startup muting begins anew.

Cycle time monitoring parameter

The **Cycle time monitoring** parameter defines the necessary time both for a complete start sequence and for a cycle start sequence. If the **Cycle time monitoring** is exceeded, the **Cycle time exceeded** output is high. In this case a complete start sequence is required so that the **Release** output can be high again (e.g. to start the press). The cycle time timer starts when the press is stopped at top dead center (i.e. The **TDC** input changes from low to high). After all other stops, **Cycle time monitoring** starts in standard mode, with the rising edge of the first valid cycle pulse (rising edge at the **Cycle** input) and in Sweden mode at the end of the restart sequence (falling edge at the **Start** input).

The basic setting for **Cycle time monitoring** is 30 s in accordance with the maximum permitted cycle time for eccentric presses (defined in EN 692). If **Cycle time monitoring** is set to 0, the cycle time monitoring is inactive.

Release 2 (input) parameter

The use of the Release 2 input can be configured with this parameter. With the setting **1 - Without** the input is not present.

With the setting **2 - Required for every start** the input must be high for a complete start sequence or a cycle start sequence.

With the setting **3 - Required for first start** the input only needs to be high for a complete start sequence.

Start of the first cycle parameter

The **Start of the first cycle** parameter determines from what point of the press cycle an intervention is deemed as valid.

If the **Start of the first cycle** parameter is set to **2 - After start of the startup**, then an intervention is valid if the start of the intervention (i.e. falling edge (high to low) at the **Cycle** input) occurs after the rising edge at the **Startup** input. Here it doesn't matter whether the **Top** input has already moved to high.

If the **Start of the first cycle**parameter is set to **1 - After reaching TDC**, then an intervention is only valid if the start of the intervention (i.e. falling edge (high to low) at the **Cycle** input) first occurs after the rising edge at the **Top** input.

In both cases the end of the intervention (i.e. rising edge (low to high) at the **Cycle** input) must occur after the rising edge at the **Top** input. Here it doesn't matter whether the **Top** input is still high or has already moved back to low.

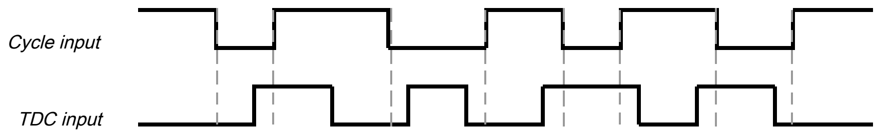


Illustration 162: Valid interventions if the Start of the first cycle parameter is set to 2 - After start of the startup.

NOTICE

If the Start of the first cycle parameter is set to **2 - After start of the startup**, then startup muting must be activated. Otherwise the **Release** output moves to low as soon as the **Cycle** input moves to low (i.e. at the beginning of the intervention).

Restart interlock parameter

Using the restart interlock parameter it is possible to configure the reset behavior of the FB after a stop. If the restart interlock is configured to **1 - without**, then no valid restart sequence is required if the module stops. The **Start** input and the **Start required** output are not present in this case.

If the restart interlock was triggered by a stop (**Release** output is low) that is not part of the configured press cycle, then the restart interlock must be reset by a complete start sequence. The requirement of a complete start sequence is signaled, depending on the use of standard or Sweden mode, by a high at the **Start required** output (Sweden) or **Cycle required** output (standard). If the first part of the start sequence has been performed (valid restart sequence for Sweden or configured number of cycles for standard) then the necessary second part of the start sequence is signaled by a high at the **Cycle required** output (Sweden) or **Start required** (standard). The **Release** output is only high again after the start sequence for standard or Sweden has been completed in full.

If the restart interlock is configured to **2 - always** and the **Max. startup muting time** is set to 0, then an intervention (**Cycle** input is low) results in the **Release** output being low, the **Protective field intervention** output high, and an activated restart interlock. A complete start sequence is required.

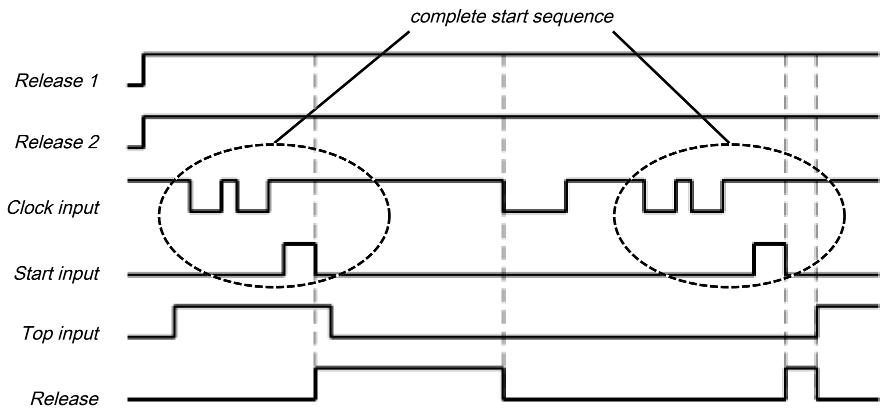


*Illustration 163: Sequence/timing diagram if the Cycle input is low, startup muting inactive, and restart interlock set to **2 - always**.*

If the restart interlock is configured to **2 - always** and the **Max. startup muting time** is set as not equal to 0, then an intervention with the **Startup** input low results in the **Release** output being low, the **Protective field intervention** output high, and an activated restart interlock. A complete start sequence is required.

If the restart interlock is configured to **2 - always** and the **Max. startup muting time** is set as not equal to 0 and the **Start of the first cycle** parameter is configured to **2 - After start of the startup**, then an intervention with **Startup** input high (the intervention may not be ended) based on the startup muting and the **Start of the first cycle** parameter setting does not result in an activated restart interlock. If the intervention is ended after reaching the top dead center (**Top** input is high), the intervention is counted as a valid intervention and then the subsequent interventions must be performed as configured in order to trigger a new cycle start.

If the restart interlock is configured to **2 - always** and the **Max. startup muting time** is set as not equal to 0 and the **Start of the first cycle** parameter is configured to **2 - After start of the startup**, then an intervention with **Startup** input high due to the startup muting and the **Start of the first cycle** parameter setting does not immediately result in an activated restart interlock. If, however, the intervention is ended (**Cycle** input is high again) before reaching the top dead center (**Top** input is high), then when top dead center is reached the **Protective field intervention** output is high, the **Release** output low, and the restart interlock is activated. A complete start sequence is required.

If the restart interlock is configured to **2 - always** and the **Max. startup muting time** is set as not equal to 0 and the **Start of the first cycle** parameter is configured to **1 - After reaching TDC**, then an intervention with **Startup** input high (regardless of whether the intervention remains or is ended) due to the startup muting does not immediately result in an activated restart interlock . When the top dead center is reached (**Top** input is high) the **Protective field intervention** output is high, the **Release** output low, and the restart interlock is activated. A complete start sequence is required.

If the restart interlock is configured to **3 - After shutdown in downstroke or initial position** and an intervention occurs in the downstroke (**Top** input and **Startup** input low) or in the top dead center (**Top** input high) after the configured number of interventions, then the **Protective field intervention** output is high, the **Release** output low, and the restart interlock is activated. A complete start sequence is required.

If the restart interlock is configured to **3 - After shutdown in downstroke or initial position** and the **Startup** input is high, then the **Release** output remains high even if several interventions are made as long as startup muting time is running. If the **Cycle** input is low, when the startup muting time elapses, the **Release** output is low and the **Protective field intervention** output is high. However, ending the intervention is sufficient to switch the **Release** output back to high, even if the top dead center has been reached. No restart interlock is activated or cycle start required.

If the restart interlock is configured to **3 - After shutdown in downstroke or initial position** and the **Startup** input is high, then the **Release** output remains high even if several interventions are made as long as startup muting time is running. If the **Clock** input is low once, when the startup muting time has elapsed the **Release** output is low and the **Protective field intervention** output is high. However, ending the intervention is sufficient to switch the **Release** output back to high, even if the top dead center has been reached. No restart interlock is activated or cycle start required

If the restart interlock is configured to **3 - After shutdown in downstroke or initial position** and the **Startup** input is high, then the **Release** output remains high even if several interventions are made as long as startup muting time is running. If the **Cycle** input is high, when the startup muting time has elapsed a signal change at the **Cycle** from high to low to high causes the **Release** output to be actuated in the same way. (If an intervention is performed again after completion of this signal change, the **Protective field intervention** output is high, the **Release** output low, and the restart interlock is activated). If then the top dead center is reached (**Top** input is high), then the **Release** output is low and a cycle start sequence is required (configured number of interventions), see also figure below.

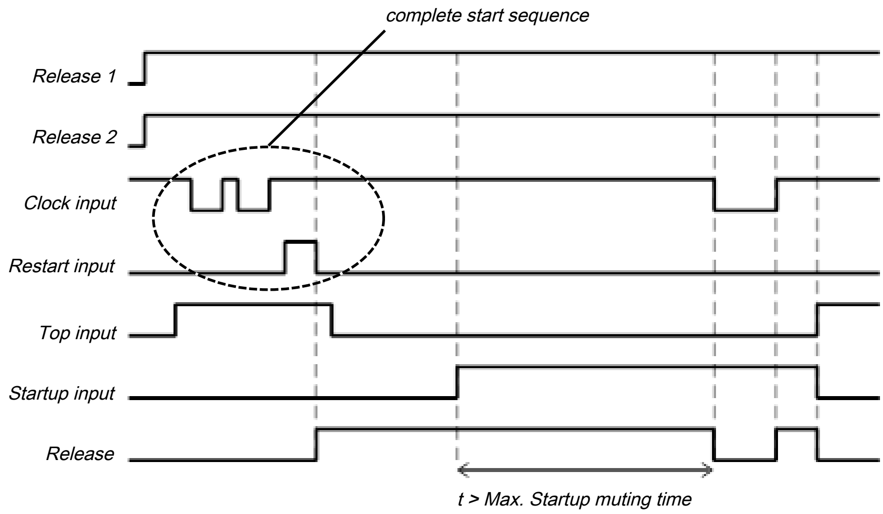


Illustration 164: Sequence/timing diagram if the Cycle input is low, maximum startup muting time > 0, and restart interlock set to 3 - After shutdown in downstroke or initial position.

Min. restart pulse time parameter

A restart sequence (low-high-low **Restart** input) is only valid if the **Restart** input was set to high for at least 100 ms or 350 ms. This value is set with the **Min. restart pulse time** parameter.

Start position parameter

If the **Start position** parameter is set to **2 - only at TDC**, a restart of the press is only possible at the top dead center. In any other position a restart is prevented. If the press e.g. during the downward movement was stopped by an intervention into the protective field of the light curtain, you must switch to another operating mode (e.g. in connection with the press setup function block) in order to move the press back into the position at the top dead center, because the cycle mode function block uses this parameter setting to prevent a restart.

If the **Start position** parameter is set to **2 - only in TDC**, the optional **Drive release** input must be connected in order to determine whether the press is running or has been stopped. This must be the same signal that controls the press directly. Usually the **Drive release** input is connected to the output signal in the **Logic** view by a CPU flag and this output signal is connected to the physical output for the press.

NOTICE

Do not connect any physical input signals to the **Drive release** input. Use a CPU flag to connect the signal that controls the physical output for the press drive.

If the **Release** output is low, because either the **Release 1 (static)** input or the **Cycle** input are low, then the **Start not possible here** diagnostic output is high. A restart of the press is then prevented until the **Top** input is high again and no new start in another operating mode has occurred.

Min. cycle pulse time parameter

A cycle sequence (high-low-high **Cycle** input) is only valid if the **Cycle** input was set to low for at least 100 ms or 350 ms. This value is set with the **Min. cycle pulse time** parameter.

8.10.2.4.3 Input signals of the cyclic operation function block

Description	Type	Short description
Release 1 (static)	Mandatory	Main release of the press
Release 2 (start)	Optional	Additional release input
Cycle	Mandatory	Cycle input e.g. from a light curtain (ESPE)
Top	Mandatory	Top dead center
Startup	Optional	Contact for signaling of the press startup
Start	Optional	Reset the state of the press
Drive release	Optional	Connection of a signal that controls the physical output of the press drive, e.g. the release output from the FB single stroke or automatic.

Release 1 (static) input

The **Release 1 (static)** input signal is mandatory. The **Release** output is always immediately low when **Release 1 (static)** is low.

If this function block is used together with a press contact function block (e.g. eccentric press contact monitor or universal press contact monitor), its **Release** output must be connected to the **Release 1 (static)** input of this function block.

Release 2 (start) input

The **Release 2 (start)** input signal is optional. If **Release 2 (start)** is configured, the **Release** output can only be high (e.g. during switch-on) if **Release 2 (start)** is high (this only applies for complete start sequences when the **Release 2 (input)** parameter is set to **3 - Required for first start**). If the **Release** output is high, **Release 2 (start)** is no longer monitored.

WARNING

Do not use the Release 2 (start) input for safety purposes!

Do not use the Release 2 (start) input to initiate an emergency stop, because this input is only utilized temporarily during the start sequence. Otherwise you will place the press operator in danger.

Cycle input

At the **Cycle** input a contactless safety device is connected e.g. the output of a safety light curtain. Every completed intervention causes a high-low-high transition at the **Cycle** input. The **Cycle** input remains low for as long as the intervention lasts.

Top input

The **Top** input signal is used to determine the end of the press cycle (i.e. the press has reached the top dead center). This signal is available at the eccentric press contact monitor and universal press contact monitor function blocks.

WARNING

Do not use the Top input for safety purposes!

Only connect the Top input to a Top output of the universal press contact monitor or eccentric press contact monitor function blocks or to an equivalent signal source. Do not use the Top input to initiate an emergency stop. Otherwise you will place the press operator in danger.

Startup input

The startup input is optional and only present if **Max. startup muting time** is greater than 0. If startup muting is active (i.e. if the **Max. startup muting time** is greater than 0) then the **Cycle** input of the function block is bypassed when the **Startup** input is high, the **Top** input remains low, and the

Max. startup muting time has not yet elapsed. If the restart interlock is configured to **1 - always** then unauthorized interventions during startup muting, after reaching top dead center, result in an activated restart interlock (**Protective field intervention** output is high, **Release** low). A complete start sequence is then necessary.

Start input

If the **Restart interlock parameter** is set to **1 - without**, no **Start** signal is required to restart the press after a stop. The **Restart interlock parameter** can be set to the following values:

1	**without**
2	**always**
3	**after shutdown in downstroke or initial position**

This parameter determines when a **Start** sequence is expected as input signal for the function block.

If the **Start required** output is high due to an activated restart interlock during a required complete Start sequence, then this is only reset once a valid **Start** sequence has been completed at the **Start** input with a low-high-low transition (minimum 100 ms or 350 ms; shorter pulses and pulses over 30 s are ignored).

Drive controller input

If the **Start position** parameter is set to **2 - only in TDC**, the optional **Drive release** input must be connected in order to determine whether the press is running or has been stopped. This must be the same signal that controls the press directly. Usually the **Drive release** input is connected to the output signal in the **Logic** view by a CPU flag and this output signal is connected to the physical output for the press.

NOTICE

Do not connect any physical input signals to the **Drive release** input. Use a CPU flag to connect the signal that controls the physical output for the press drive.

8.10.2.4.4 Output signals of the cyclic operation function block

Description	Type	Short description
enable	Mandatory	Release of the press process.
Start required	Optional	The press must be reset in the event of an activated restart interlock.
Cycle required	Mandatory	One (or several) intervention(s) is (are) required to continue the press cycle.
Cycle time exceeded	Mandatory	Exceeding the set cycle time monitoring is signaled.
Protective field intervention	Mandatory	Signals an unauthorized intervention.
Start not possible here	Optional	A stop outside of the top dead center has been performed. The press must first be moved back to top dead center.
Error flag	Optional	A cycle time exceeded or an unexpected cycle is present

Release output

The press operation can only be performed is the **Release** output is high. The output is controlled depending on the parameters and input states of the function block. If the **Release** output is high, the **Start required** output is always low. Both outputs can be low at the same time.

Start required output

The **Start required** output is high if a valid start sequence is expected at the **Start** input. This output is set back to low only after a valid start sequence and the **Release** output cannot be high while this output is high. A valid start sequence is described in the **Restart interlock parameter, Min. restart pulse time parameter,** and **Start input** sections.

Cycle required output

The **Cycle required** output is high if an intervention is expected at the **Cycle** input.

Cycle time exceeded output

The **Cycle time exceeded** output is high when a complete start sequence or a cycle start sequence has lasted longer than the set cycle time monitoring. A complete start sequence is then necessary.

Protective field intervention output

The **Protective field intervention** output is high if an intervention has occurred at an unauthorized time. Depending on the configuration of the restart interlock and the startup muting, only a rising edge at the **Cycle** input, the configured number of cycle, or a complete start sequence is required to acknowledge this error. Details can be found in the **Restart interlock parameters** chapter.

Output start not possible here

If the **Release** output is low, because either the **Release 1 (static)** input or the **Cycle** input are low, then the **Start not possible here** output is high. A restart of the press is then prevented until the **Top** input is high again and no new start in another operating mode has occurred.

Error flag output

This output is set to high if at least one of the **Cycle time exceeded** or **Protective field intervention** outputs is set to high and the output is configured as active.

8.10.2.4.5 Internal values

Muting time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in s
Value range	0 to 7,200
Factor	1

Cycle time monitoring

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in s
Value range	0 to 500
Factor	1

8.10.2.4.6 Error states and information regarding reset

Table 133: Error states and information regarding reset for the cyclic operation function block

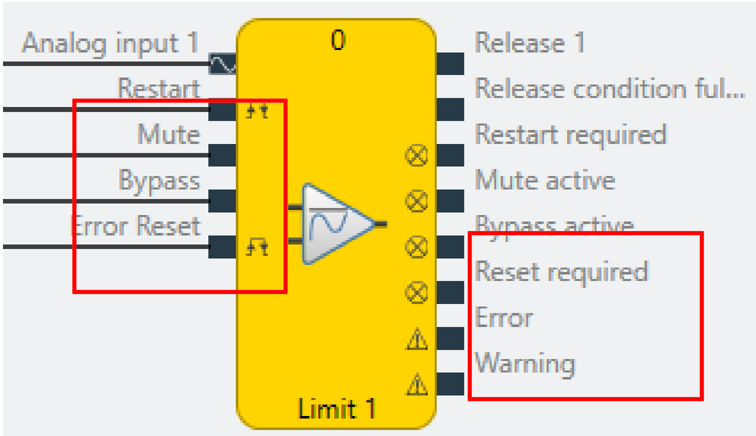
Outputs	Error state reset	Remarks
Protective field intervention	The **Protective field intervention** output is high if an intervention has occurred at an unauthorized time. Depending on the configuration of the restart interlock and the startup muting, only a rising edge at the **Cycle** input, the configured number of cycle, or a complete start sequence is required to acknowledge this error. Details can be found in the **Restart interlock parameters** chapter.	The **Release** output is low and the **Error flag** is high when **Protective field intervention** or **Cycle time exceeded** is high.
Cycle time exceeded	In the event that the cycle time is exceeded, the error is reset by a complete start sequence.	

8.11 Function blocks for monitoring analog values

8.11.1 General functions

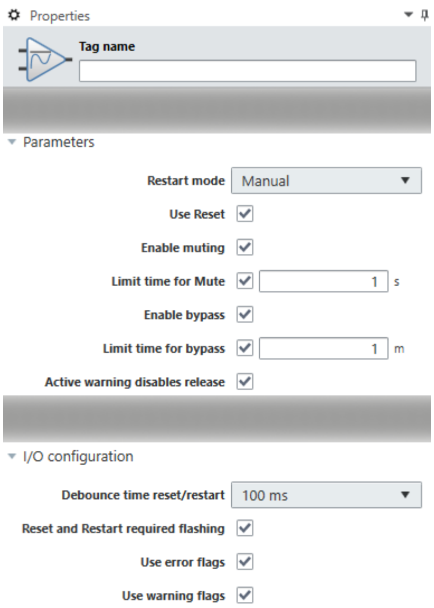
The function blocks for monitoring analog values offer a series of identical functions and therefore connected inputs and outputs for controlling system behavior.

Example: Function block limit



Note

The **Restart required, Mute active, Bypass active, Reset required** signaling outputs and the **Mute**, **Bypass, Error reset** and **Restart** control inputs and the error outputs can be activated in the properties of the relevant function block.



8.11.1.1 Restart

With a (re)startup lock (**manual** restart mode), the user can prevent a functional component release from becoming "high" without the approval of the user.

If the function block wishes to activate a release signal due to its internal processing and Restart mode has been configured manually, the function block then activates the output **Restart required**.

With an active **Bypass** and **manually** configured Restart mode, the user can switch from the so-called **start-up bridge** to regular operation by providing a valid Restart signal. Then, the Bypass signal can be deactivated and the release remains intact.

Restart mode

Manual restart	The Restart input and the Restart required output are displayed on the function block.
Automatic restart	The Restart input and the Restart required output are not displayed on the function block. A release does not need to be confirmed by the user but is automatic.

An **Error reset/Restart** signal (Low-High-Low) must have a minimum length of the High level. This minimum length is specified by the debounce time in the I/O configuration. The maximum length is always set to 30 sec.

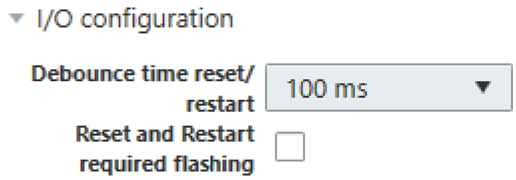
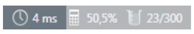


Illustration 165: Selecting the debounce time for the Reset and Restart signals

1 ms	The **Error reset/Restart** signal is not monitored for a minimum duration. However, it should still be as long as the current logic cycle time which is displayed in samos® PLAN 6. 
100 ms/350 ms	The minimum duration of the **Error reset/Restart** signal must be either 1 ms, 100 ms or 350 ms.

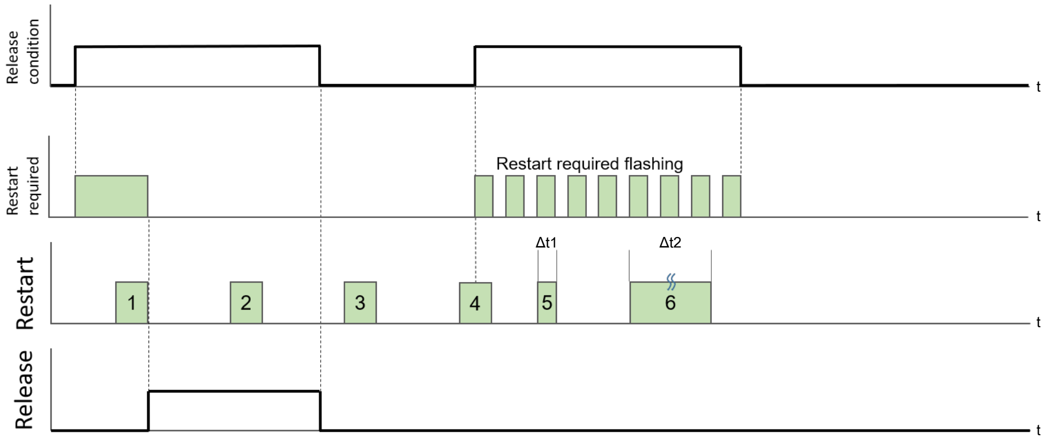


Illustration 166: Restart function

1	Valid restart impulse, activates the release
2	Invalid Restart pulse, because the release was already confirmed with **Restart**.
3	Invalid Restart pulse because **Restart required** is active.
4	Invalid Restart pulse, due to High-Low instead of Low-High-Low sequence.
5	Invalid Restart pulse, because t < the set minimum length.
6	Invalid Restart pulse, because t > 30 seconds.

Note

For the Restart required signal, the Flashing property can be activated in the function block properties.

8.11.1.2 Muting

The muting input can be used to hold a current release on **High** for as long as the muting input is activated or until the optionally defined time limit has elapsed. Only the releases that were already previously set to **High** are **muted**.

Releases can also be set when the muting input is active, but they are not muted, i.e. they can also be reset again during muting.

Rising edge (low to high) at the input	Activate muting, hold release.
Falling edge (high to low) at the input	Deactivate muting, release dependent on evaluation of the sensor inputs.

The input is not debounced.

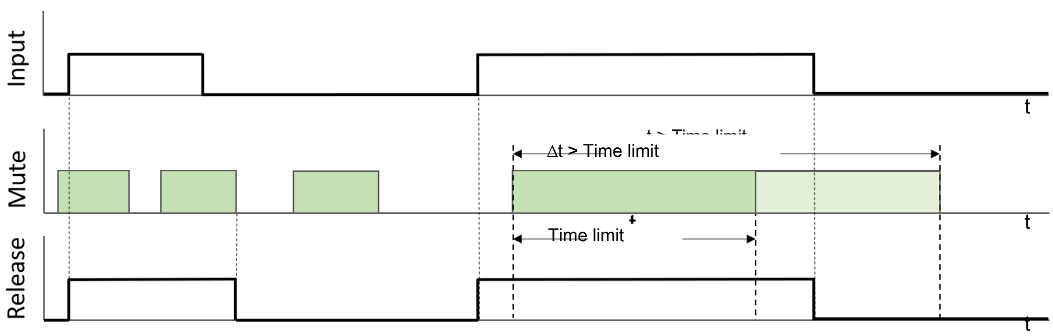
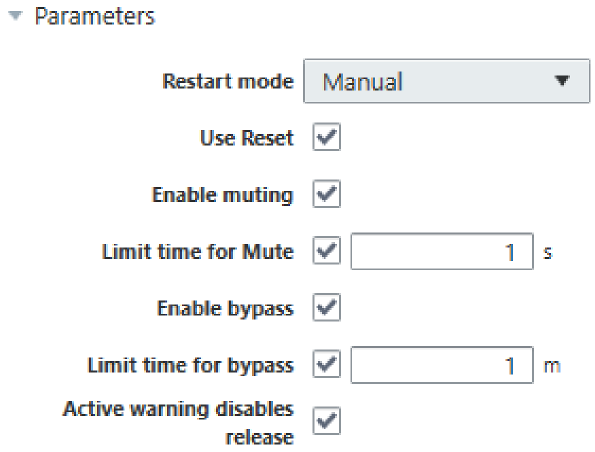


Illustration 167: Muting function with time limit t

Time limit



The muting function can be chronologically limited to max. 7200 s (8 hours/1 shift).

Info

Only a rising edge (low-high) at the mute input switches muting on. If a high signal is already present at the input when the system is switched on/started, muting is not activated.

Muting always affects all the release signals from the relevant function block in equal measure.

8.11.1.3 Bypass

Depending on the configuration, the corresponding release outputs 1–4 are set to High either for the duration of a High signal at the **Bypass** input or until the optionally defined time limit has elapsed.

A bypass input can be used to activate a release regardless of the evaluation of the sensor inputs.

Rising edge (low to high) at the input	Activate bypass, switch on release.
Falling edge (high to low) at the input	Deactivate bypass, release dependent on evaluation of the sensor inputs.

The bypass input is not debounced.

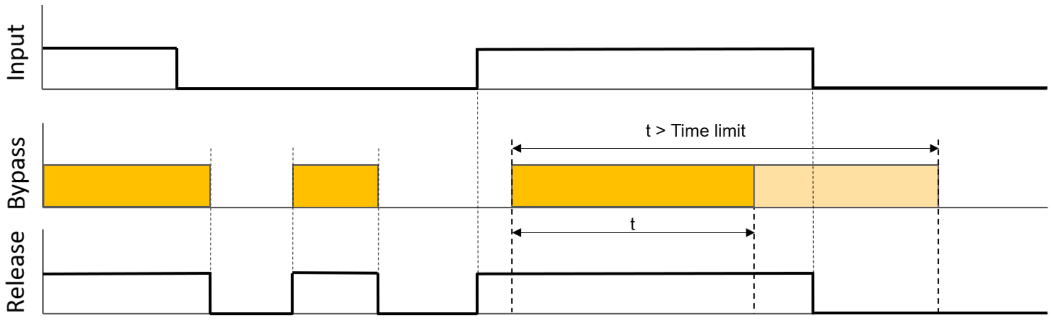
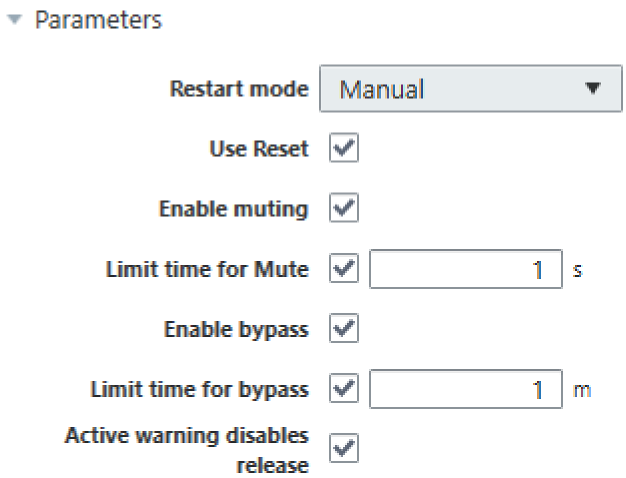


Illustration 168: Bypass function with time limit t

Time limit



The bypass function can be chronologically limited to max. 600 min (10 hours).

Note

Only a rising edge (low-high) at the bypass input switches on the bypass function. If a high signal is already present at the input when the system is switched on/started, the bypass function is not activated.

Bypass always affects all the release signals from the relevant function block in equal measure.

Application example

A protective enclosure with maintenance door prevents access to the danger zones on a machine. The maintenance door is monitored and locked by a safety switch with interlock.

The release of the interlock for set-up and maintenance work, for example, is controlled via a standstill monitor. The workspace can only be accessed if a detected speed of the driven component is below the permitted lower limit.

External influences or vibrations cause the speed to temporarily exceed this limit and prevent the interlock from being released.

Due to the bypass signal, the release can still be set and the door opened.

8.11.1.4 Error

If an error is detected during pre-processing of the input, the Error function switches an existing High signal at the **Release** output to Low if a fault is present in the sensor elements (short-circuit or open circuit) or (if parameterized accordingly by the user) if a warning is pending (upper or lower limit of monitoring range exceeded). After the cause of the fault or warning has been rectified, the error function is either reset automatically or by a High impulse at the **Error reset** input.

8.11.1.5 Consolidation

Consolidation can only be configured for dual channel sensors and combines the two sensor values to generate a single, consolidated value that is used for internal processing (e.g. comparison with limit values).

Selection of consolidation type

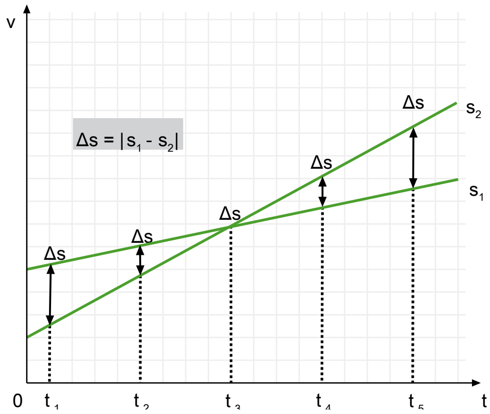
Selecting the consolidation type determines how the consolidated value is produced. The consolidated value is:

- Input 1
- Input 2
- Higher value
- Lower value
- Average

Parameterizing the tolerance

The maximum permitted deviation of both sensor values is defined by specifying the tolerance type and the extent of the tolerance.

This tolerance is always compared with the deviation Δs of the two sensors. If the current deviation Δs is greater than the specified tolerance, the error output is activated on the function block and the release is deactivated.



Deviation Δs of the two sensors

Release condition: Δs <= tolerance

Error condition: Δs > tolerance

In addition to specifying the permitted tolerance deviation, a tolerance time can be set. During this time, a more significant deviation (than the maximum permitted deviation specified by the defined tolerance) in the sensor values does not result in a deactivation of the release.

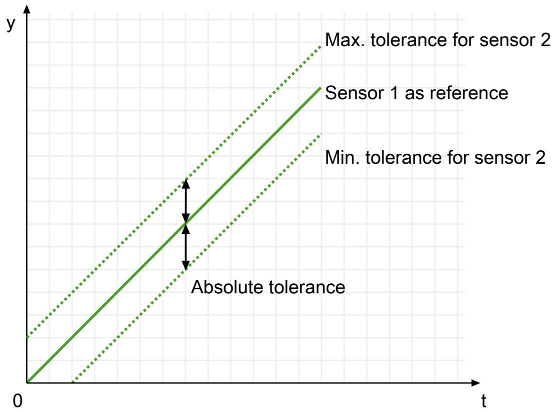
NOTICE

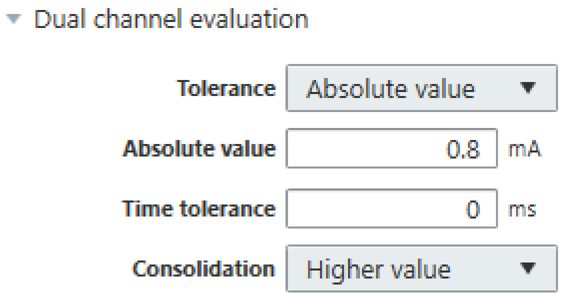
If the system status changes from STOP to START with the configured tolerance time, the release is provided for the duration of the set tolerance time so that diverging sensor values can be intercepted during the system start.

This must be taken into consideration when creating the project.

The following tolerances are available in the function blocks:

Absolute value

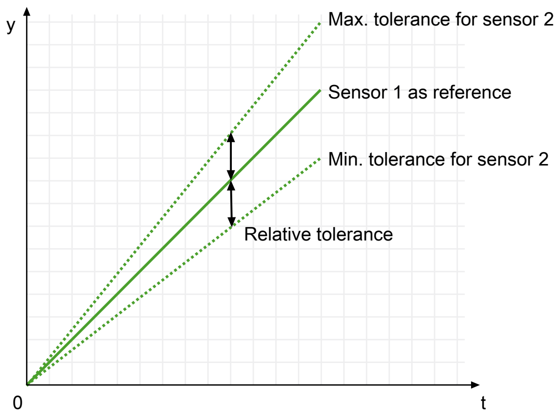


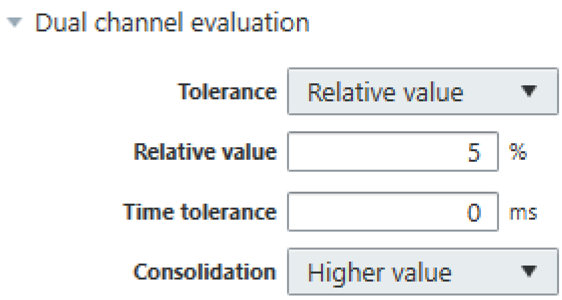


Specify tolerance as an absolute value in the selected unit, e.g. ±0.8 mA

Tolerance = absolute value

Relative value

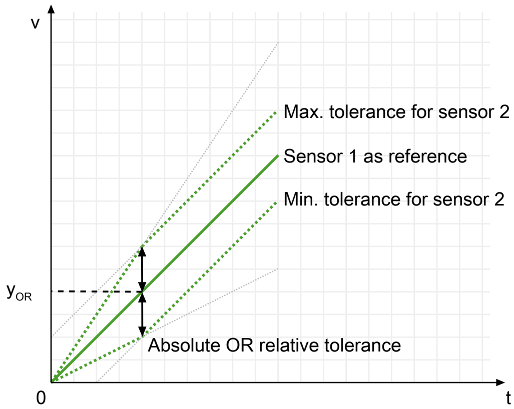


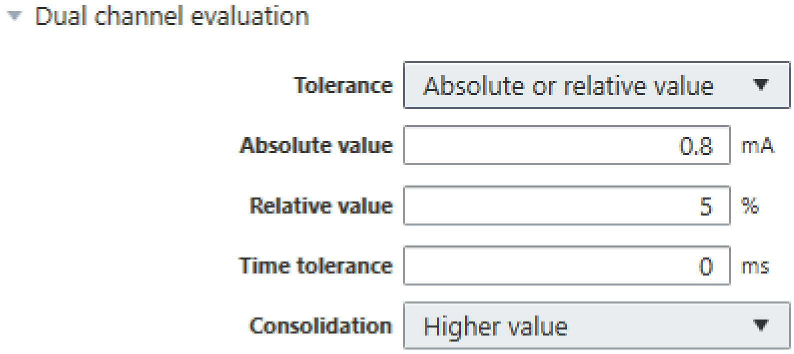


Specify tolerance as a relative value (percentage), e.g. ±5%, based on the consolidation

Tolerance = consolidation × (relative value (%) ÷ 100)

Absolute or relative value





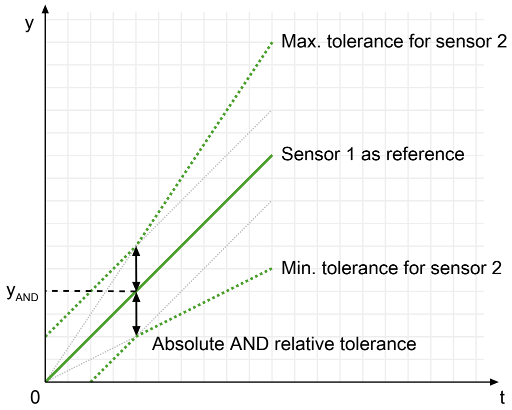
Specify tolerance both as an absolute value and a relative value (percentage), whereby the two tolerance types are logical OR linked.

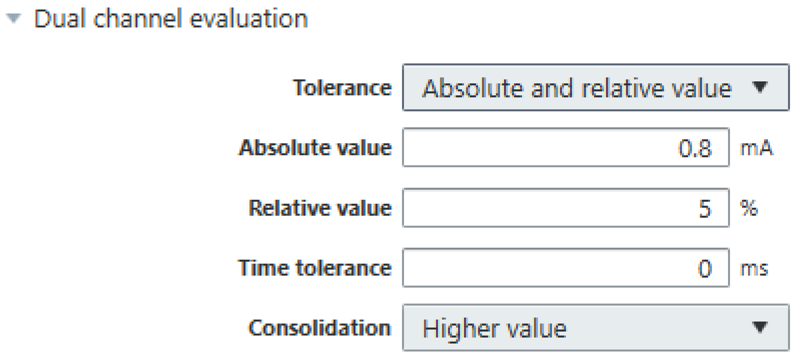
With the OR link, only one comparison type must be exceeded in order to end the release. The tolerance therefore defines the lower value of the two tolerance types.

The switching point Y_{OR} is calculated with:

(absolute value ÷ relative value(%)) × 100

Absolute and relative value





Specify tolerance both as an absolute value and as a relative value (percentage), whereby the two tolerance types are logical AND linked.

With the AND link, both comparison types must be exceeded in order to end the release. The tolerance therefore defines the higher value of the two tolerance types.

The switching point Y_{AND} is calculated with:

(absolute value ÷ relative value(%)) × 100

8.11.2 Limit

8.11.2.1 Function block diagram

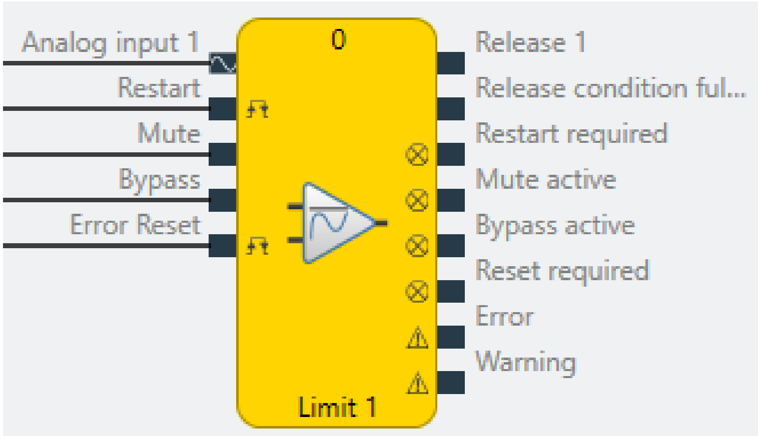


Illustration 169: Logical connections for the limit function block

8.11.2.2 General description

The function block allows the comparison of an analog actual value at the **Analog input** with up to 4 predefined limit values (setpoints) for the purpose of limit value monitoring.

It is also possible to monitor the consolidated value of two connected analog sensors (dual channel monitoring at analog input 1 and analog input 2). In this case, other settings must be configured (see “Analog value comparison“ parameter).

Limit value monitoring

With limit value monitoring, limit values are defined and then used to monitor process variables (e.g. temperature values).

Hysteresis:
Two threshold values are configured for each limit value. One threshold value (switch-on threshold) defines when the respective output is switched on. The second threshold value (switch-off threshold) defines when the output is switched off again.

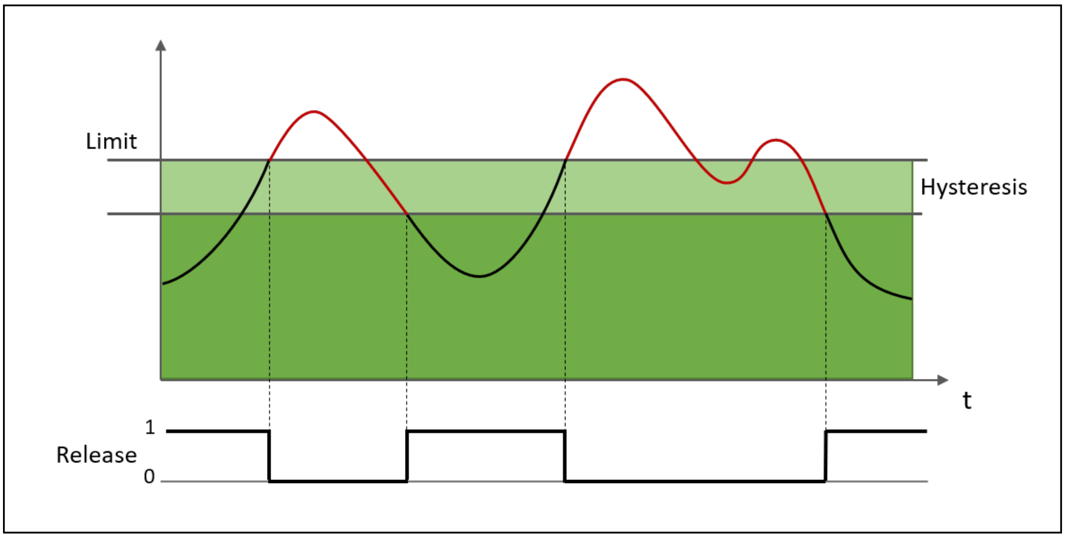


Illustration 170: Monitoring for “Upper limit exceeded”

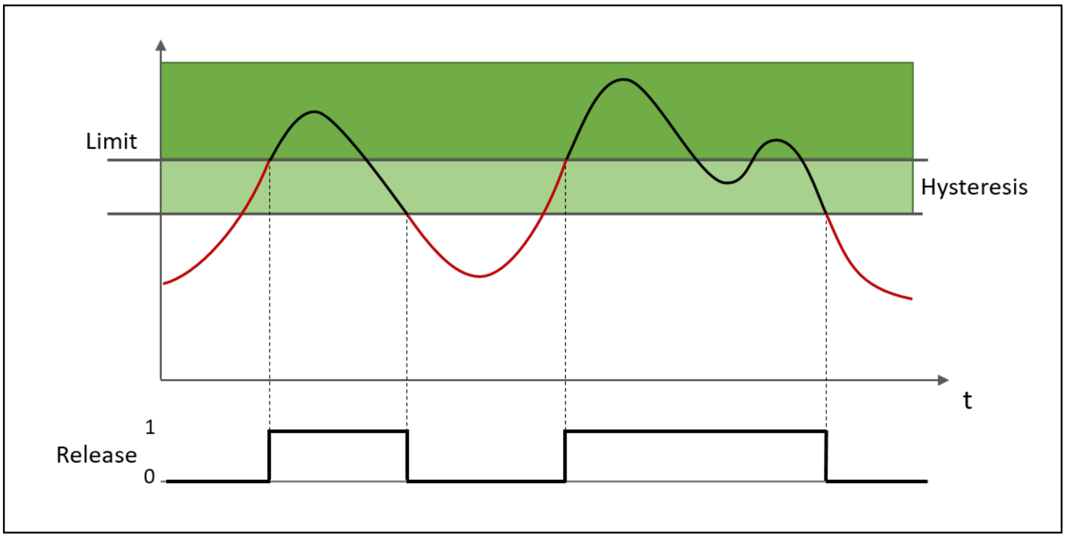


Illustration 171: Monitoring for "Lower limit exceeded"

8.11.2.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)
Number of limit values	1 – 4 (default: 1)

Dual Channel

Properties	Possible values
Activate dual channel capability (for the connected sensor elements)	• Without (default) • With

Dual channel evaluation

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Limit value

Limit value settings for each release output (1 – 4)

Properties	Possible values
Monitoring mode	• Value above limit (default) • Value below limit
Limit value	Input of limit value
Hysteresis type	• Absolute (default) • Relative
Hysteresis value	Input of hysteresis value
Release responds to mute	• Yes (default) • No
Release responds to bypass	• Yes (default) • No

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.11.2.4 Outputs

Release 1 – 4

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.11.2.5 Internal values

Input value 1

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-32768.000 to 32767.000
Factor	$1 * 10^{-3}$

Input value 2

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-32768.000 to 32767.000
Factor	$1 * 10^{-3}$

Effective input value (configuration-dependent)

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Muting time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in s
Value range	0 to 7,200
Factor	1

Bypass time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in min
Value range	0 to 600
Factor	1

8.11.3 Range

8.11.3.1 Function block diagram

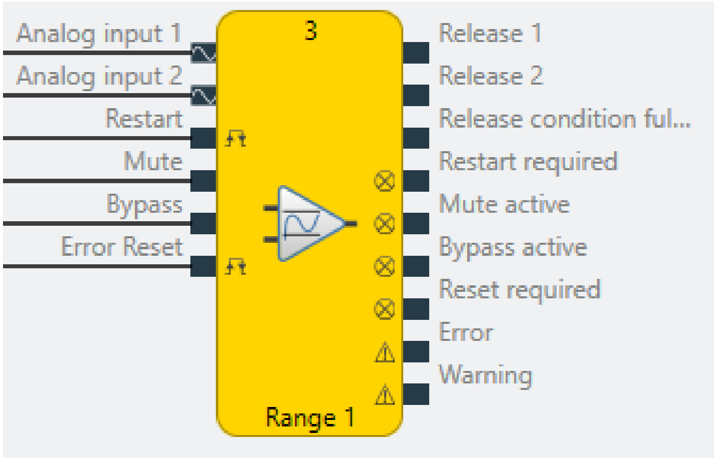


Illustration 172: Logical connections for the range function block

8.11.3.2 General description

The function block allows a comparison to be performed to establish whether an analog actual value at the **analog output** is inside or outside a predefined range with 2 limit values (setpoints). One function block can monitor a maximum of two ranges. It is also possible to monitor the consolidated value of two connected analog sensors (dual channel monitoring at analog input 1 and analog input 2).

Range monitoring

With range monitoring, one lower and one upper limit value are defined. You can monitor whether the value is inside or outside this range.

Hysteresis:
Two threshold values are configured for each limit value. One threshold value (switch-on threshold) defines when the respective output is switched on. The second threshold value (switch-off threshold) defines when the output is switched off again.

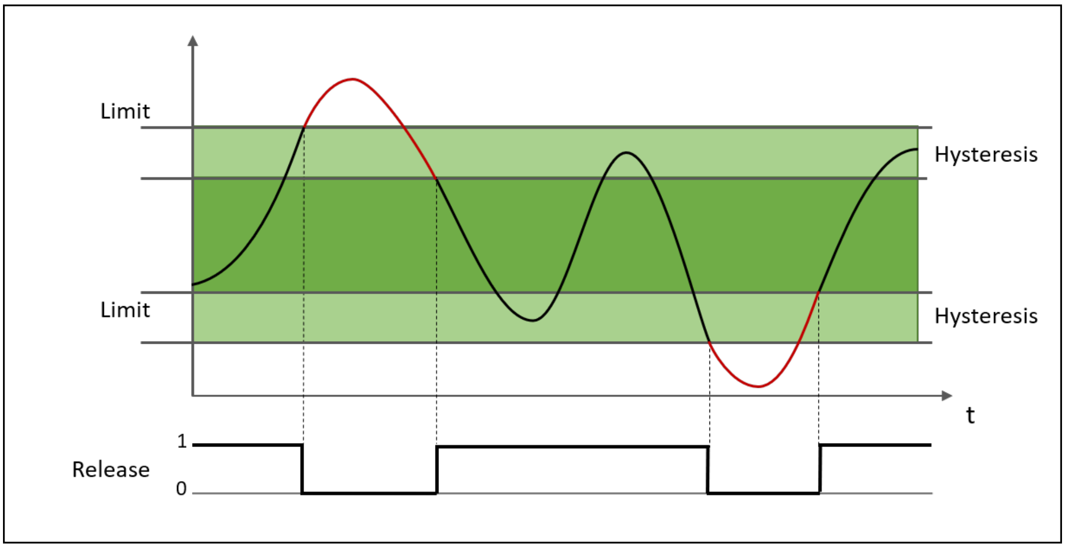


Illustration 173: Monitoring for "inside a window"

8.11.3.3 Function block properties

Parameters

Properties	**Possible values**
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)
Number of ranges	1 – 2 (default: 1)

Dual Channel

Properties	**Possible values**
Activate dual channel capability (for the connected sensor elements)	• Without (default) • With

Dual channel evaluation

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Range

Properties	Possible values
Monitoring mode	• Inside the window (default) • Outside the window
Upper limit	• Input of upper limit value (default: 0)
Lower limit	• Input of lower limit value (default: 0)
Hysteresis type	• Absolute (default) • Relative
Hysteresis value	Input of hysteresis value
Release responds to mute	• Yes (default) • No
Release responds to bypass	• Yes (default) • No

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.11.3.4 Outputs

Release 1 – 2

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.11.3.5 Internal values

Input value 1

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-32768.000 to 32767.000
Factor	$1 * 10^{-3}$

Input value 2

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-32768.000 to 32767.000
Factor	$1 * 10^{-3}$

Effective input value (configuration-dependent)

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Muting time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in s
Value range	0 to 7,200
Factor	1

Bypass time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in min
Value range	0 to 600
Factor	1

8.11.4 Relation

8.11.4.1 Function block diagram

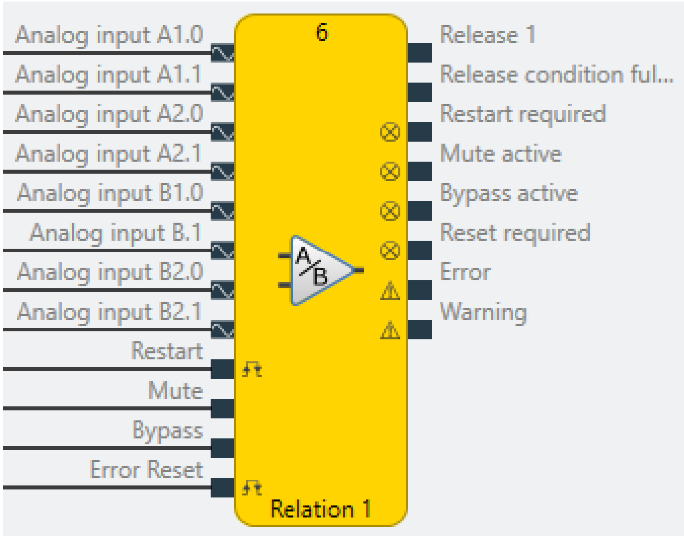


Illustration 174: Logical connections for the ratio function block

8.11.4.2 General description

The function block allows the comparison of two analog actual values at analog inputs A and B or monitoring to determine whether a predefined relation V of these two actual values is above or below a limit value or whether this relation is inside or outside a limit range.

Example:

V = A/B = analog input A/analog input B

If defined parameter means upper limit is overshot: V > limit value

If defined parameter means lower limit is undershot: V < limit value

If the parameterized condition is true (i.e. overshoot or undershoot is present), the output changes from High to Low.

Sum Aggregate for A and/or B

Options:

V = A1 + A2 / B = analog input A1 + A2 / analog input B

V = A/B1 + B2 = analog input A/analog input B1 + B2

V = A1 + A2/B1+B2 = analog input A1 + A2/analog input B1 + B2

The function block can only compare the same variables with one another, e.g. temperature with temperature or pressure with pressure.

8.11.4.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)

Dual Channel

Properties	Possible values
Analog input A1/A2/B1/B2	• Enabled • Not enabled (default)

Dual channel evaluation (1 to 4)

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Relation

Properties	Possible values
Formula	• (A1 + A2) / (B1 + B2) • (A1 + A2) / B • A / (B1 + B2) • A / B (default)
Monitoring mode	• Value above limit (default) • Value below limit • Inside the window • Outside the window
Factor, input A	Input of whole value for a (default: 2)
Factor, input B	Input of whole value for b (default: 1)
Hysteresis value	Input of relative hysteresis value in % (default: 0 %)

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.11.4.4 Outputs

Release 1

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.11.4.5 Internal values

Analog input A1

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Analog input A2

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
$1 * 10^{-3}$	$1 * 10^{-3}$

Analog input B1

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Analog input B2

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Effective input value A

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Effective input value B

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Actual limit value

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Muting time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in s
Value range	0 to 7,200
Factor	1

Bypass time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in min
Value range	0 to 600

Properties	Description
Factor	1

8.11.5 Difference

8.11.5.1 Function block diagram

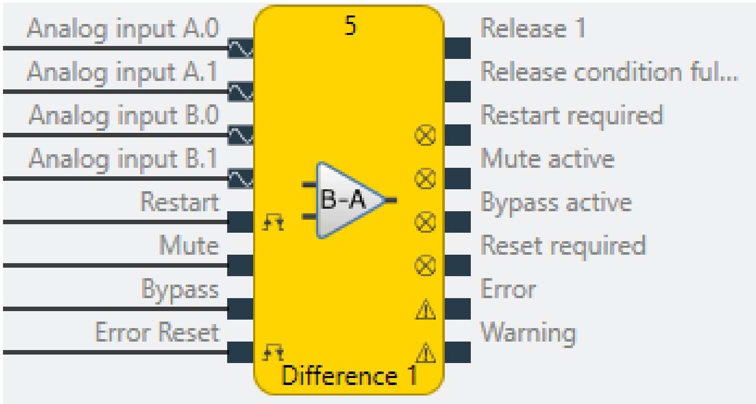


Illustration 175: Logical connections for the difference function block

8.11.5.2 General description

The function block allows the creation of a difference between two analog actual values at analog inputs 1 and 2, and a comparison to establish whether this difference is higher or lower than a specified limit value or inside/outside a specified limit range.

Example:

Difference = B − A = analog input B − analog input A

If defined parameter means upper limit is overshot: B − A > limit

If defined parameter means lower limit is undershot: B − A < limit

If the parameterized condition is true (i.e. an overshoot or undershoot is present), the output changes from High to Low.

WARNING

The function block can only compare the same variables with one another, e.g. temperature with temperature or pressure with pressure.

8.11.5.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)

Dual Channel

Properties	Possible values
Analog input A/B	• Enabled • Not enabled (default)

Dual channel evaluation 1 – 2

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Difference (input B – A)

Properties	Possible values
Monitoring mode	• Value above limit (default) • Value below limit • Inside the window • Outside the window
Limit value	Input of limit value (default: 0)
Use absolute value	• Yes: The result of the difference creation process is used for the comparison with the difference limit value (default) without a plus/minus symbol • No: The result of the difference creation process is used without a plus/minus symbol for the comparison with the difference limit value
Difference limit value	Input of limit value for the difference
Hysteresis value	Specification of relative hysteresis value in % (default: 0 %)

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.11.5.4 Outputs

Release 1

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.11.5.5 Internal values

Analog input A1

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Analog input A2

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
$1 * 10^{-3}$	$1 * 10^{-3}$

Analog input B1

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Analog input B2

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Effective input value A

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Effective input value B

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Actual limit value

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Muting time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in s
Value range	0 to 7,200
Factor	1

Bypass time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in min
Value range	0 to 600

Properties	Description
Factor	1

8.11.6 Legacy items

8.11.6.1 Relation (Legacy)

8.11.6.1.1 Function block diagram

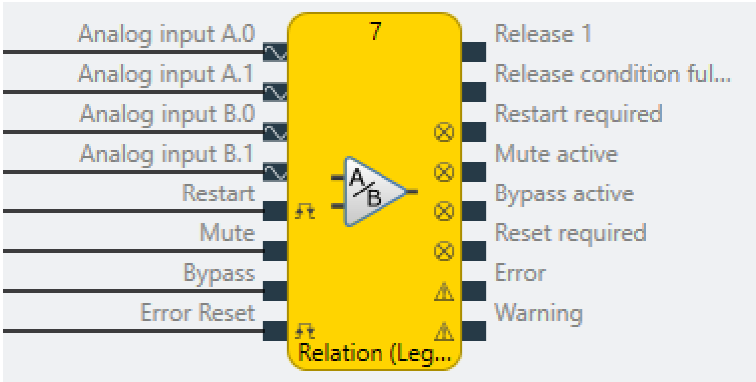


Illustration 176: Logical connections for the ratio function block

8.11.6.1.2 General description

The function block allows the comparison of two analog actual values at analog inputs A and B or monitoring to determine whether a predefined relation V of these two actual values is above or below a limit value or whether this relation is inside or outside a limit range.

Example:

V = A/B = analog input A/analog input B

If defined parameter means upper limit is overshot: V > limit value

If defined parameter means lower limit is undershot: V < limit value

If the parameterized condition is true (i.e. upper or lower limit is exceeded), the output changes from High to Low.

WARNING

The function block can only compare the same variables with one another, e.g. temperature with temperature or pressure with pressure.

8.11.6.1.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)

Dual Channel

Properties	Possible values
Analog input A/B	• Enabled • Not enabled (default)

Dual channel evaluation

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Relation

Properties	Possible values
Monitoring mode	• Value above limit (default) • Value below limit • Inside the window • Outside the window
Factor, input A	Input of whole value for a (default: 2)
Factor, input B	Input of whole value for b (default: 1)
Hysteresis value	Input of relative hysteresis value in % (default: 0 %)

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.11.6.1.4 Outputs

Release 1

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.11.6.1.5 Internal values

Analog input A1

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Analog input A2

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
$1 * 10^{-3}$	$1 * 10^{-3}$

Analog input B1

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Analog input B2

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Effective input value A

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Effective input value B

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Actual limit value

Properties	Description
Size / data format	32-bit signed floating point (3 decimal points)
Unit	Setting from function block
Value range	-2,147,483,647 to 2,147,483,647
Factor	$1 * 10^{-3}$

Muting time

Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in s
Value range	0 to 7,200
Factor	1

Bypass time

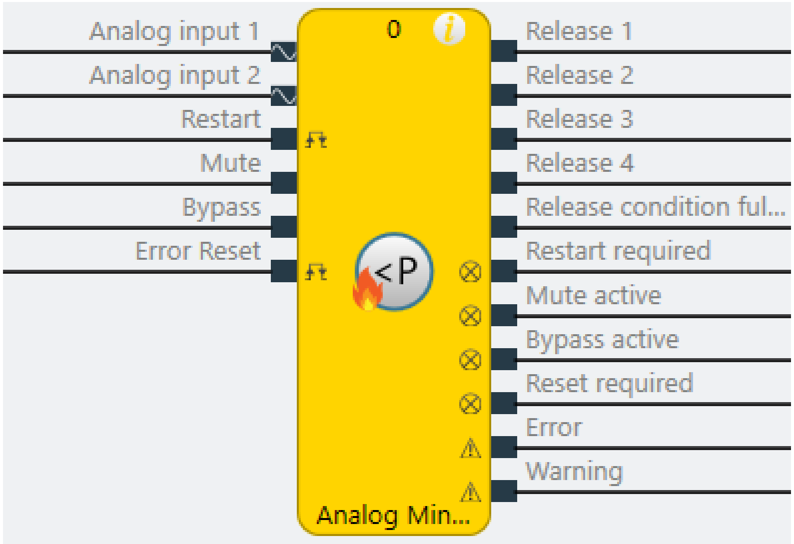
Properties	Description
Size / data format	16-bit unsigned integer
Unit	Time in min
Value range	0 to 600
Factor	1

8.12 Function blocks for firing technology

8.12.1 General functions

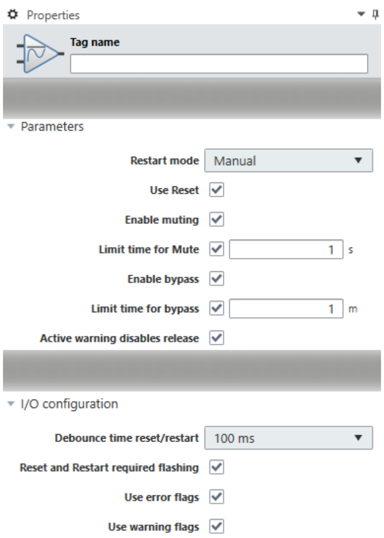
The function blocks for firing technology offer a series of identical functions and therefore offer connected inputs and outputs for controlling system behavior. Each functional component is a complete block that can be installed in boiler systems, thermal oil heaters and thermal process facilities, and that uses default values such as talking function block icons to provide a better overview when designing a safety function. Firing technology components can be used for both analog and potential-free sensors and switches.

Example: Analog min pressure function block



Note

The **Restart required, Mute active, Bypass active, Reset required** signaling outputs and the **Mute, Bypass, Error reset** and **Restart** control inputs and the error outputs can be activated in the properties of the relevant function block.



8.12.1.1 Restart

With a (re)startup lock (**manual** restart mode), the user can prevent a functional component release from becoming “high” without the approval of the user.

If the function block wishes to activate a release signal due to its internal processing and Restart mode has been configured manually, the function block then activates the output **Restart required**.

With an active **Bypass** and **manually** configured Restart mode, the user can switch from the so-called **start-up bridge** to regular operation by providing a valid Restart signal. Then, the Bypass signal can be deactivated and the release remains intact.

Restart mode

Manual restart	The Restart input and the Restart required output are displayed on the function block.
Automatic restart	The Restart input and the Restart required output are not displayed on the function block. A release does not need to be confirmed by the user but is automatic.

An **Error reset/Restart** signal (Low-High-Low) must have a minimum length of the High level. This minimum length is specified by the debounce time in the I/O configuration. The maximum length is always set to 30 sec.

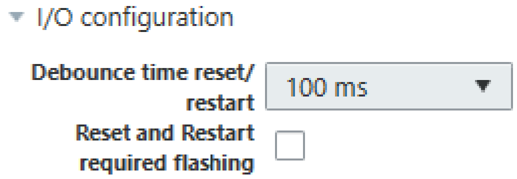
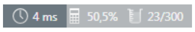


Illustration 177: Selecting the debounce time for the Reset and Restart signals

1 ms	The **Error reset/Restart** signal is not monitored for a minimum duration. However, it should still be as long as the current logic cycle time which is displayed in samos® PLAN 6. 
100 ms/350 ms	The minimum duration of the **Error reset/Restart** signal must be either 1 ms, 100 ms or 350 ms.

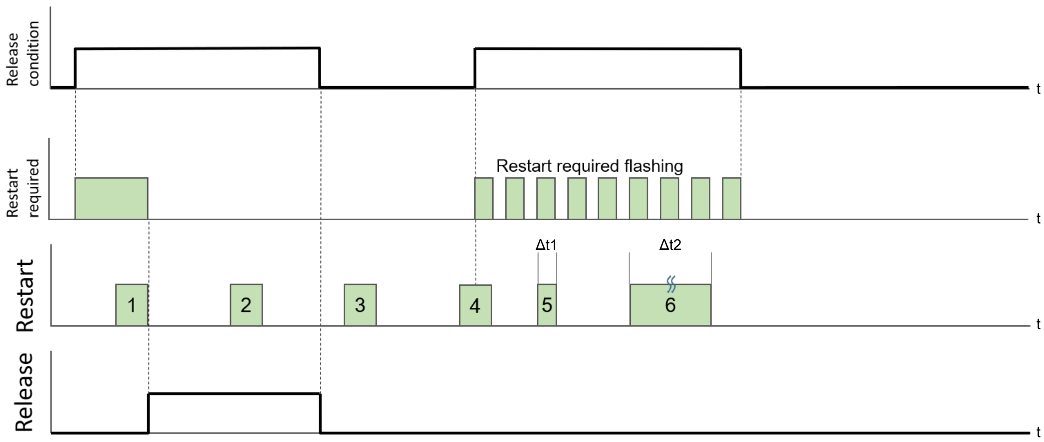


Illustration 178: Restart function

1	Valid restart impulse, activates the release
2	Invalid Restart pulse, because the release was already confirmed with **Restart**.
3	Invalid Restart pulse because **Restart required** is active.
4	Invalid Restart pulse, due to High-Low instead of Low-High-Low sequence.
5	Invalid Restart pulse, because t < the set minimum length.
6	Invalid Restart pulse, because t > 30 seconds.

Note

For the Restart required signal, the Flashing property can be activated in the function block properties.

8.12.1.2 Muting

The muting input can be used to hold a current release on **High** for as long as the muting input is activated or until the optionally defined time limit has elapsed. Only the releases that were already previously set to **High** are **muted**.

Releases can also be set when the muting input is active, but they are not muted, i.e. they can also be reset again during muting.

Rising edge (low to high) at the input	Activate muting, hold release.
Falling edge (high to low) at the input	Deactivate muting, release dependent on evaluation of the sensor inputs.

The input is not debounced.

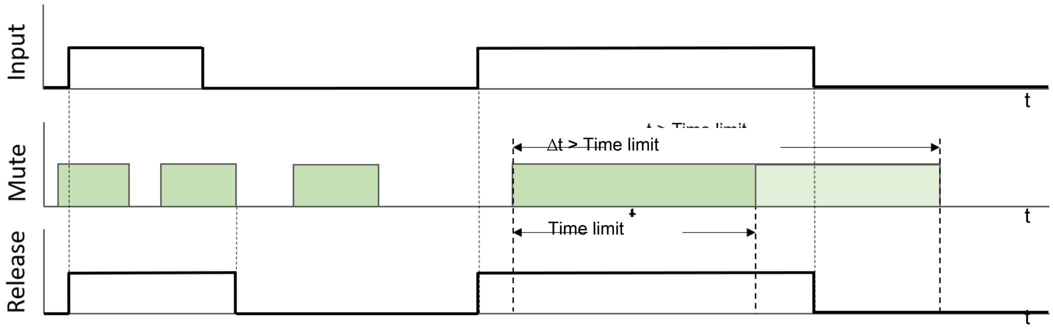
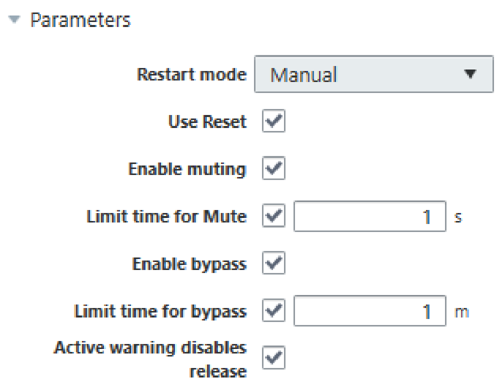


Illustration 179: Muting function with time limit t

Time limit



The muting function can be chronologically limited to max. 7200 s (8 hours/1 shift).

Info

Only a rising edge (low-high) at the mute input switches muting on. If a high signal is already present at the input when the system is switched on/started, muting is not activated.

Muting always affects all the release signals from the relevant function block in equal measure.

8.12.1.3 Bypass

Depending on the configuration, the corresponding release outputs 1–4 are set to High either for the duration of a High signal at the **Bypass** input or until the optionally defined time limit has elapsed.

A bypass input can be used to activate a release regardless of the evaluation of the sensor inputs.

Rising edge (low to high) at the input	Activate bypass, switch on release.
Falling edge (high to low) at the input	Deactivate bypass, release dependent on evaluation of the sensor inputs.

The bypass input is not debounced.

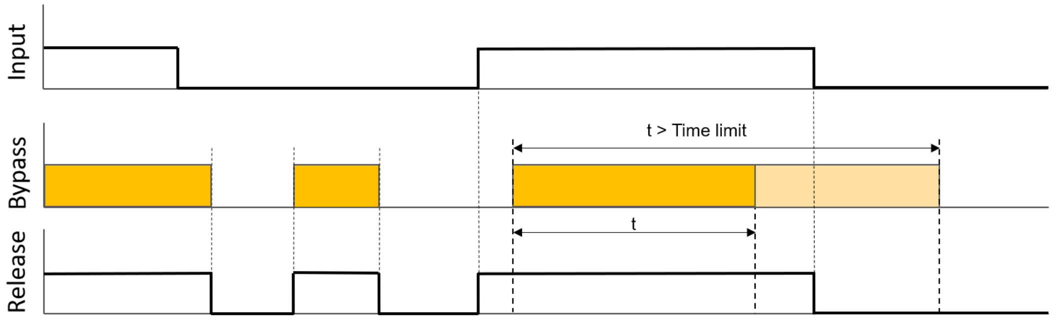
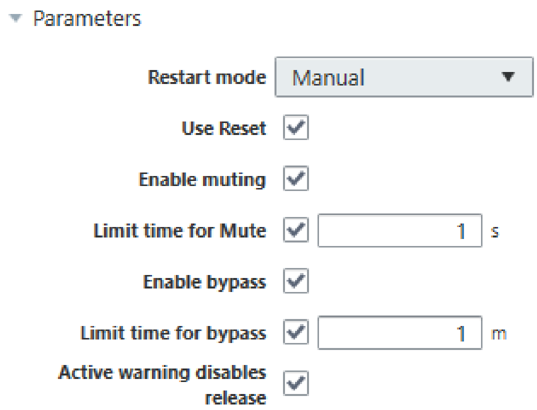


Illustration 180: Bypass function with time limit t

Time limit



The bypass function can be chronologically limited to max. 600 min (10 hours).

Note

Only a rising edge (low-high) at the bypass input switches on the bypass function. If a high signal is already present at the input when the system is switched on/started, the bypass function is not activated.

Bypass always affects all the release signals from the relevant function block in equal measure.

Application example

A protective enclosure with maintenance door prevents access to the danger zones on a machine. The maintenance door is monitored and locked by a safety switch with interlock.

The release of the interlock for set-up and maintenance work, for example, is controlled via a standstill monitor. The workspace can only be accessed if a detected speed of the driven component is below the permitted lower limit.

External influences or vibrations cause the speed to temporarily exceed this limit and prevent the interlock from being released.

Due to the bypass signal, the release can still be set and the door opened.

8.12.1.4 Error

If an error is detected during pre-processing of the input, the Error function switches an existing High signal at the **Release** output to Low if a fault is present in the sensor elements (short-circuit or open circuit) or (if parameterized accordingly by the user) if a warning is pending (upper or lower limit of monitoring range exceeded). After the cause of the fault or warning has been rectified, the error function is either reset automatically or by a High impulse at the **Error reset** input.

8.12.1.5 Consolidation

Consolidation can only be configured for dual channel sensors and combines the two sensor values to generate a single, consolidated value that is used for internal processing (e.g. comparison with limit values).

Selection of consolidation type

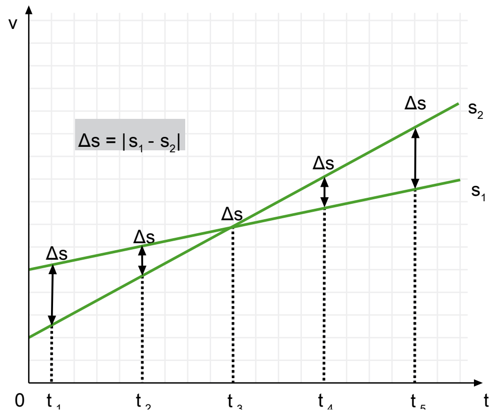
Selecting the consolidation type determines how the consolidated value is produced. The consolidated value is:

- Input 1
- Input 2
- Higher value
- Lower value
- Average

Parameterizing the tolerance

The maximum permitted deviation of both sensor values is defined by specifying the tolerance type and the extent of the tolerance.

This tolerance is always compared with the deviation Δs of the two sensors. If the current deviation Δs is greater than the specified tolerance, the error output is activated on the function block and the release is deactivated.



Deviation Δs of the two sensors

Release condition: Δs <= tolerance

Error condition: Δs > tolerance

In addition to specifying the permitted tolerance deviation, a tolerance time can be set. During this time, a more significant deviation (than the maximum permitted deviation specified by the defined tolerance) in the sensor values does not result in a deactivation of the release.

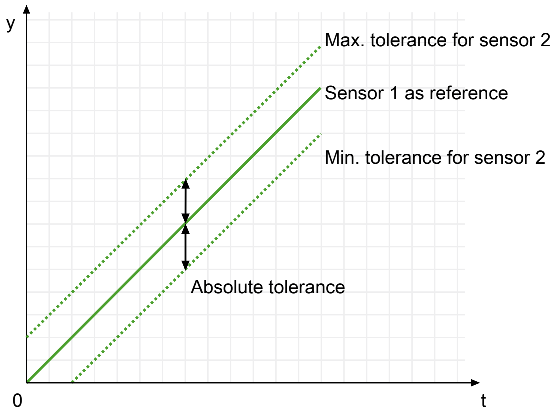
NOTICE

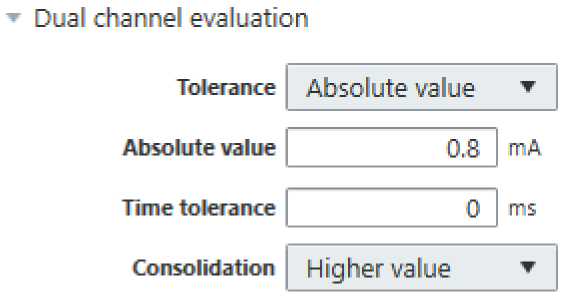
If the system status changes from STOP to START with the configured tolerance time, the release is provided for the duration of the set tolerance time so that diverging sensor values can be intercepted during the system start.

This must be taken into consideration when creating the project.

The following tolerances are available in the function blocks:

Absolute value

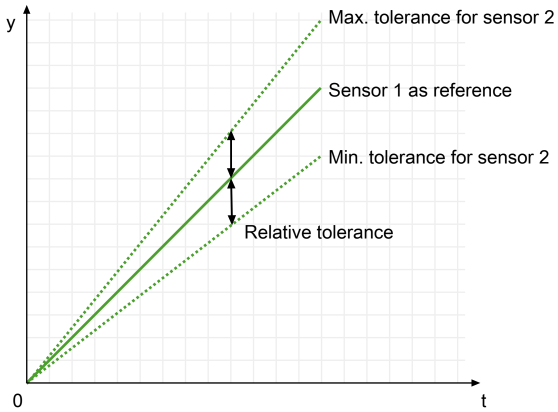


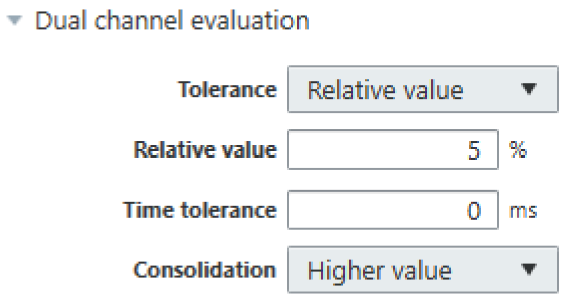


Specify tolerance as an absolute value in the selected unit, e.g. ±0.8 mA

Tolerance = absolute value

Relative value

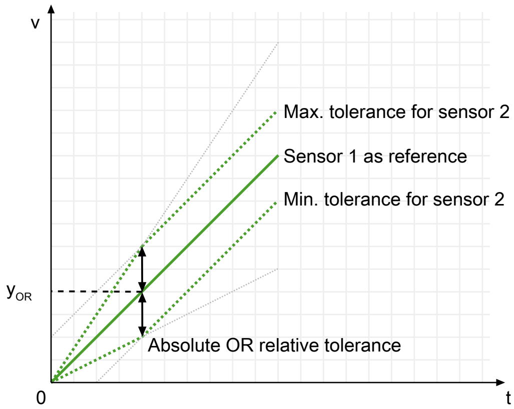


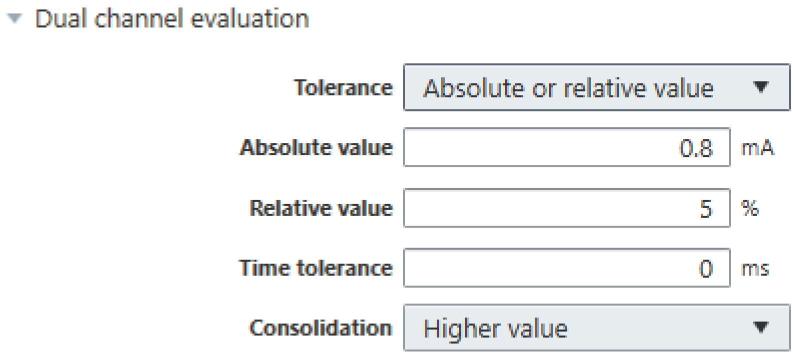


Specify tolerance as a relative value (percentage), e.g. ±5%, based on the consolidation

Tolerance = consolidation × (relative value (%) ÷ 100)

Absolute or relative value





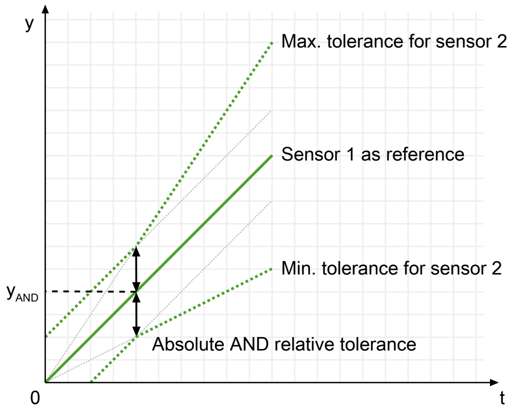
Specify tolerance both as an absolute value and a relative value (percentage), whereby the two tolerance types are logical OR linked.

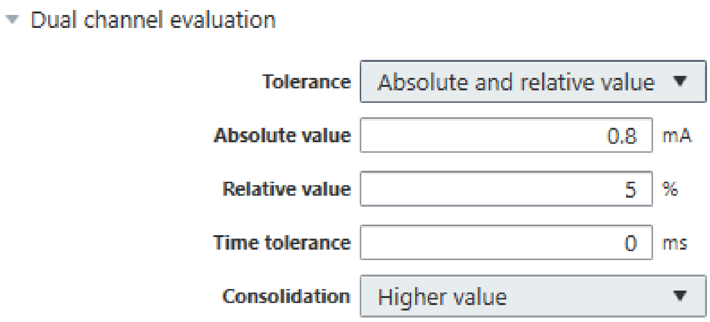
With the OR link, only one comparison type must be exceeded in order to end the release. The tolerance therefore defines the lower value of the two tolerance types.

The switching point Y_{OR} is calculated with:

(absolute value ÷ relative value(%)) × 100

Absolute and relative value





Specify tolerance both as an absolute value and as a relative value (percentage), whereby the two tolerance types are logical AND linked.

With the AND link, both comparison types must be exceeded in order to end the release. The tolerance therefore defines the higher value of the two tolerance types.

The switching point Y_{AND} is calculated with:

(absolute value ÷ relative value(%)) × 100

8.12.2 Analog min pressure

8.12.2.1 Function block diagram

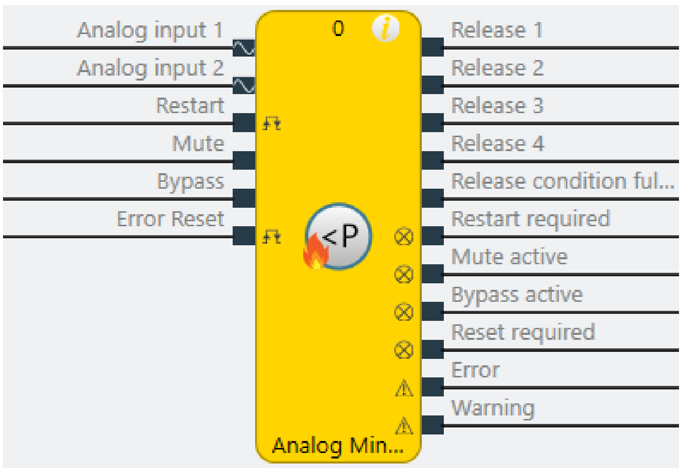


Illustration 181: Logical connections for Analog min pressure function block

8.12.2.2 General description

The function block allows the comparison of an analog actual value at the **Analog input** with up to 4 predefined limit values (setpoints) for the purpose of limit value monitoring.

It is also possible to monitor the consolidated value of two connected analog sensors (dual channel monitoring at analog input 1 and analog input 2). In this case, other settings must be configured (see “Analog value comparison“ parameter).

Limit value monitoring

With limit value monitoring, limit values are defined and then used only to evaluate pressure transmitters in 0/4..20mA for analog minimum pressure monitoring. As a result, only “lower limit exceeded” can be selected as a monitoring mode.

Dual channel monitoring with manual restart is set by default.

Hysteresis:
Two threshold values are configured for each limit value. One threshold value (switch-on threshold) defines when the respective output is switched on. The second threshold value (switch-off threshold) defines when the output is switched off again.

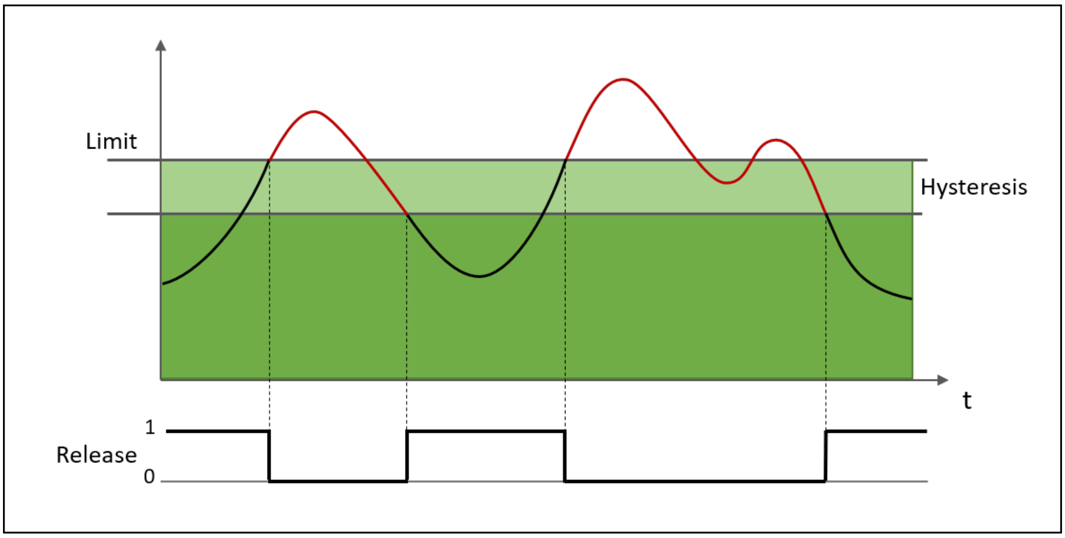


Illustration 182: Monitoring for "Upper limit exceeded"

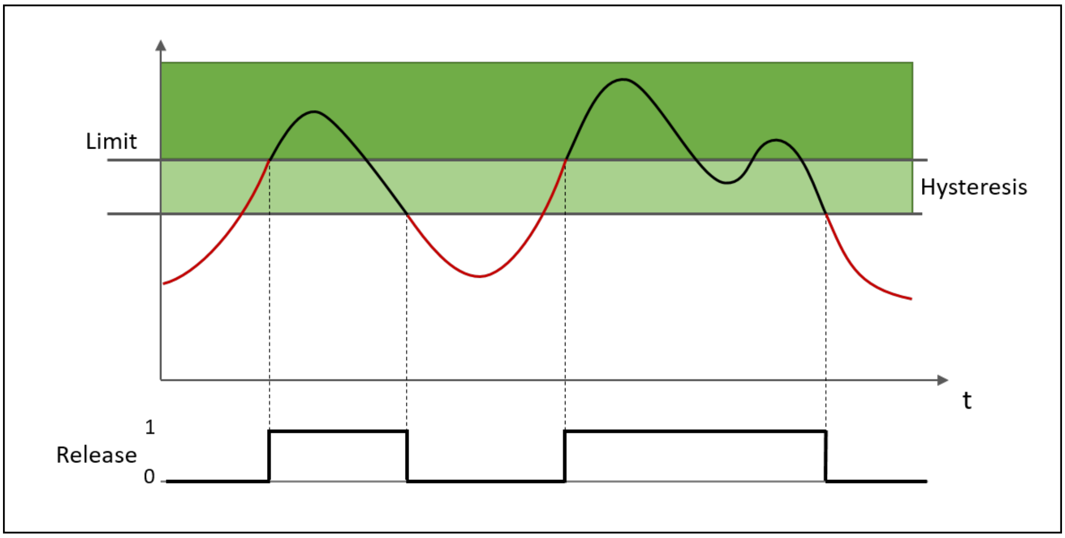


Illustration 183: Monitoring for "Lower limit exceeded"

8.12.2.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)
Number of limit values	1 – 4 (default: 1)

Dual Channel

Properties	Possible values
Activate dual channel capability (for the connected sensor elements)	• Without (default) • With

Dual channel evaluation

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Limit value

Limit value settings for each release output (1 – 4)

Properties	Possible values
Monitoring mode	• Undershoot (default)
Limit value	Input of limit value
Hysteresis type	• Absolute (default) • Relative
Hysteresis value	Input of hysteresis value
Release responds to mute	• Yes (default) • No
Release responds to bypass	• Yes (default) • No

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.12.2.4 Outputs

Release 1 – 4

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.12.3 Analog max pressure

8.12.3.1 Function block diagram

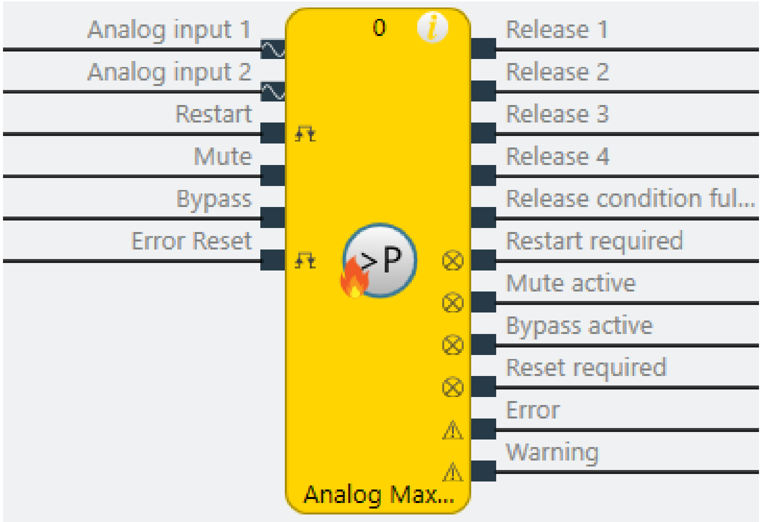


Illustration 184: Logical connections for the Analog max pressure function block

8.12.3.2 General description

The function block allows the comparison of an analog actual value at the **Analog input** with up to 4 predefined limit values (setpoints) for the purpose of limit value monitoring.

It is also possible to monitor the consolidated value of two connected analog sensors (dual channel monitoring at analog input 1 and analog input 2). In this case, other settings must be configured (see "Analog value comparison" parameter).

Limit value monitoring

With limit value monitoring, limit values are defined and then used only to evaluate pressure transmitters in 0/4..20mA for analog maximum pressure monitoring. As a result, only "upper limit exceeded" can be selected as a monitoring mode.

Dual channel monitoring with manual restart is set by default.

Hysteresis:
Two threshold values are configured for each limit value. One threshold value (switch-on threshold) defines when the respective output is switched on. The second threshold value (switch-off threshold) defines when the output is switched off again.

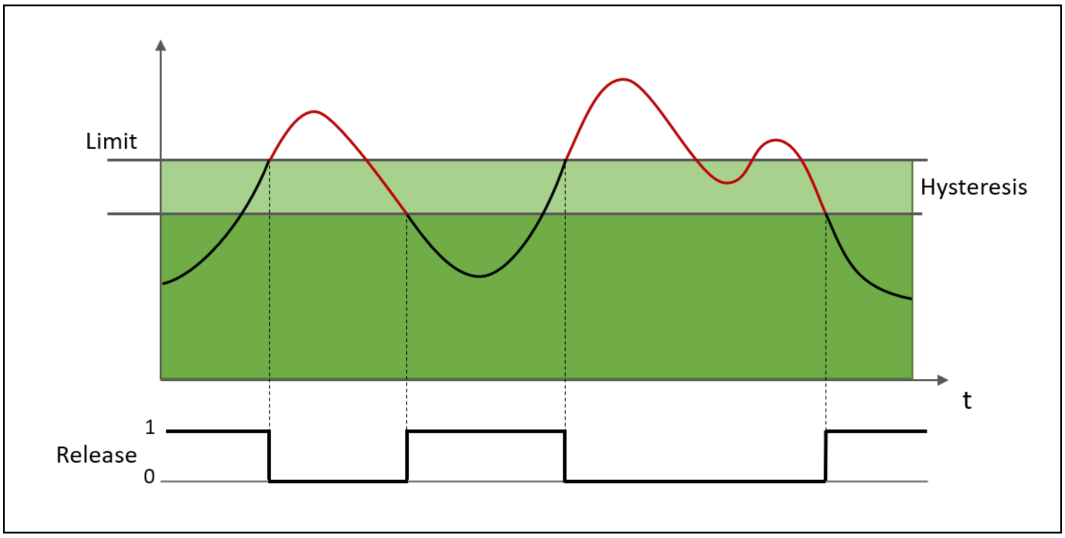


Illustration 185: Monitoring for "Upper limit exceeded"

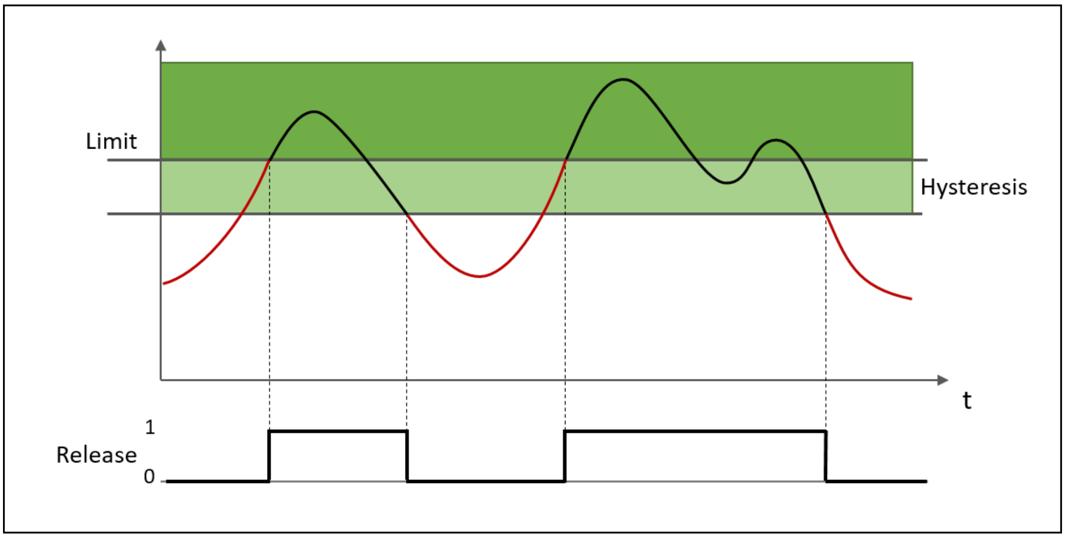


Illustration 186: Monitoring for "Lower limit exceeded"

8.12.3.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)
Number of limit values	1 – 4 (default: 1)

Dual Channel

Properties	Possible values
Activate dual channel capability (for the connected sensor elements)	• Without (default) • With

Dual channel evaluation

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Limit value

Limit value settings for each release output (1 – 4)

Properties	Possible values
Monitoring mode	• Value above limit (default)
Limit value	Input of limit value
Hysteresis type	• Absolute (default) • Relative
Hysteresis value	Input of hysteresis value
Release responds to mute	• Yes (default) • No
Release responds to bypass	• Yes (default) • No

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.12.3.4 Outputs

Release 1 – 4

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.12.4 Analog min flow

8.12.4.1 Function block diagram

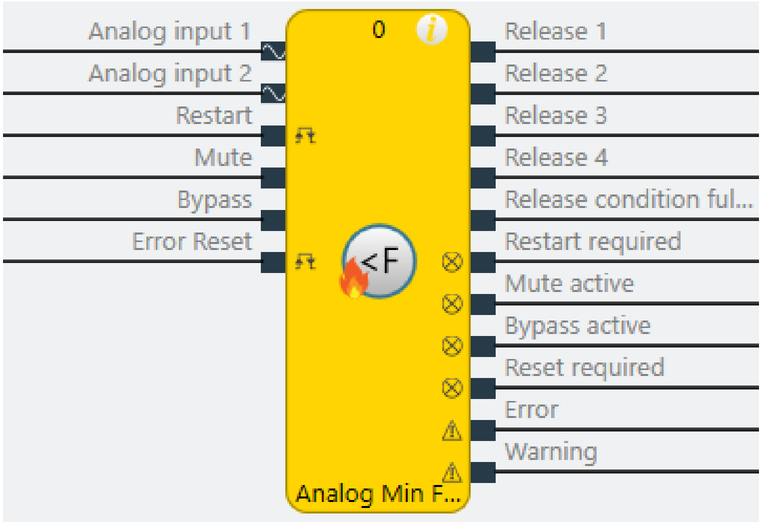


Illustration 187: Logical connections for the Analog min flow function block

8.12.4.2 General description

The function block allows the comparison of an analog actual value at the **Analog input** with up to 4 predefined limit values (setpoints) for the purpose of limit value monitoring.

It is also possible to monitor the consolidated value of two connected analog sensors (dual channel monitoring at analog input 1 and analog input 2). In this case, other settings must be configured (see “Analog value comparison“ parameter).

Limit value monitoring

With limit value monitoring, limit values are defined and then used only to evaluate pressure or flow transmitters in 0/4..20mA for analog minimum pressure monitoring. As a result, only “lower limit exceeded” can be selected as a monitoring mode.

Dual channel monitoring with manual restart is set by default.

Hysteresis:
Two threshold values are configured for each limit value. One threshold value (switch-on threshold) defines when the respective output is switched on. The second threshold value (switch-off threshold) defines when the output is switched off again.

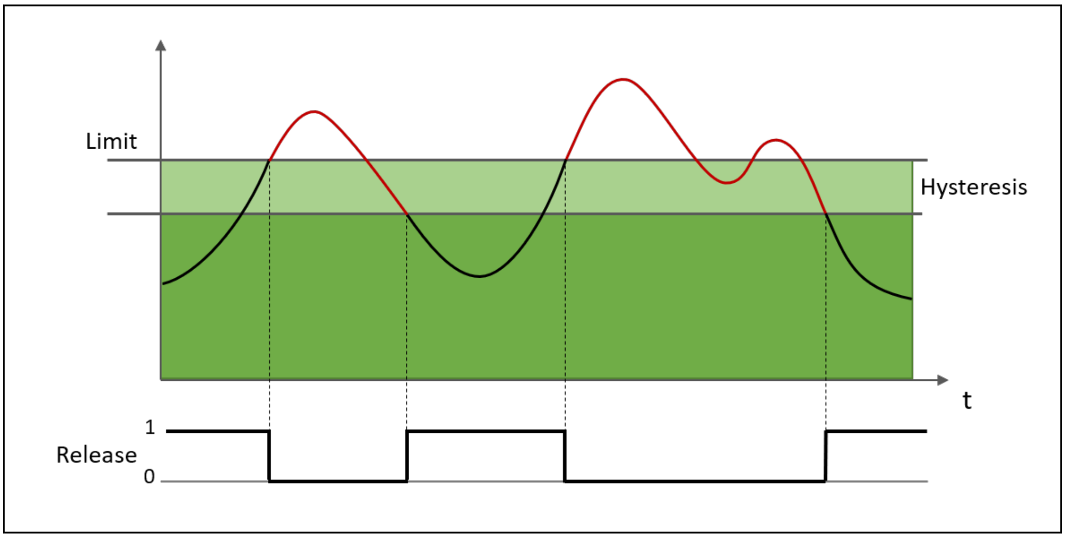


Illustration 188: Monitoring for “Upper limit exceeded”

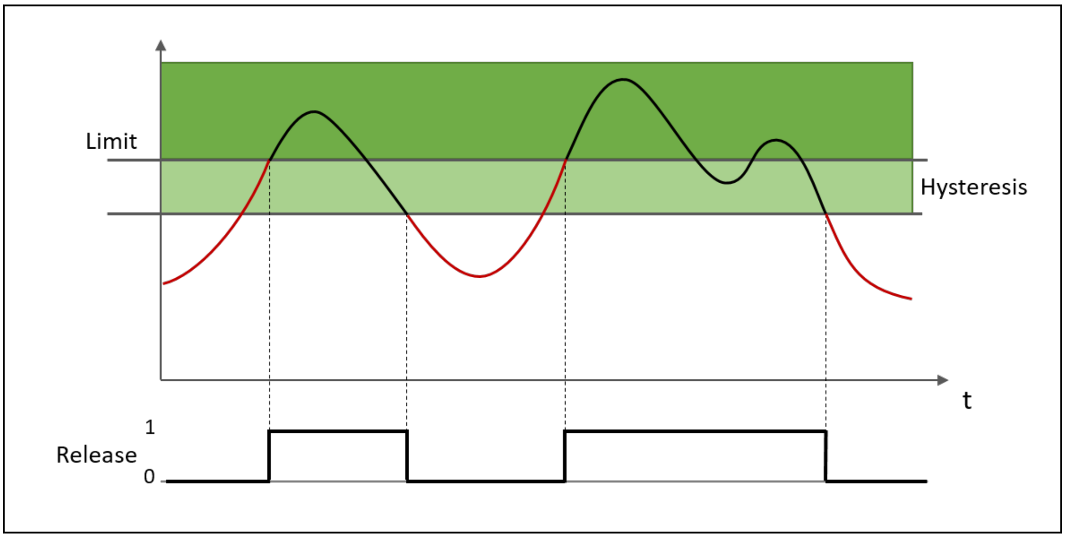


Illustration 189: Monitoring for "Lower limit exceeded"

8.12.4.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)
Number of limit values	1 – 4 (default: 1)

Dual Channel

Properties	Possible values
Activate dual channel capability (for the connected sensor elements)	• Without (default) • With

Dual channel evaluation

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Limit value

Limit value settings for each release output (1 – 4)

Properties	Possible values
Monitoring mode	• Undershoot (default)
Limit value	Input of limit value
Hysteresis type	• Absolute (default) • Relative
Hysteresis value	Input of hysteresis value
Release responds to mute	• Yes (default) • No
Release responds to bypass	• Yes (default) • No

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags

Properties	Possible values
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.12.4.4 Outputs

Release 1 – 4

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.12.5 Analog max flow

8.12.5.1 Function block diagram

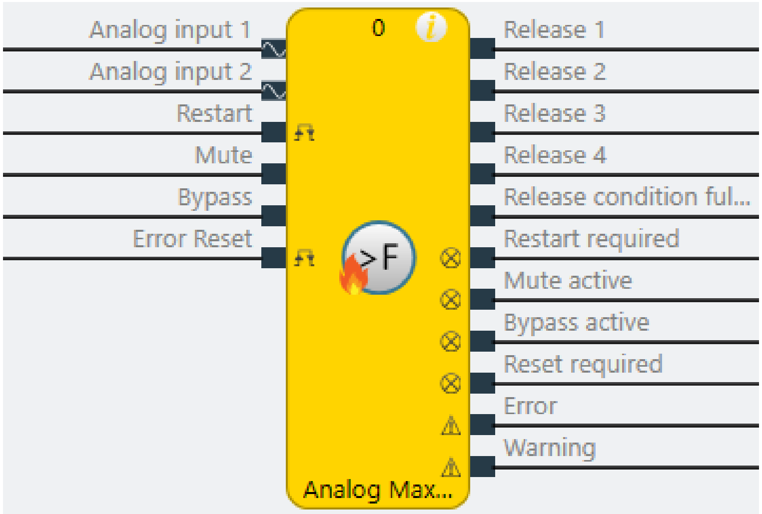


Illustration 190: Logical connections for the Analog max flow function block

8.12.5.2 General description

The function block allows the comparison of an analog actual value at the **Analog input** with up to 4 predefined limit values (setpoints) for the purpose of limit value monitoring.

It is also possible to monitor the consolidated value of two connected analog sensors (dual channel monitoring at analog input 1 and analog input 2). In this case, other settings must be configured (see “Analog value comparison“ parameter).

Limit value monitoring

With limit value monitoring, limit values are defined and then used only to evaluate pressure or flow transmitters in 0/4..20mA for analog maximum pressure monitoring. As a result, only “upper limit exceeded” can be selected as a monitoring mode.

Dual channel monitoring with manual restart is set by default.

Hysteresis:
Two threshold values are configured for each limit value. One threshold value (switch-on threshold) defines when the respective output is switched on. The second threshold value (switch-off threshold) defines when the output is switched off again.

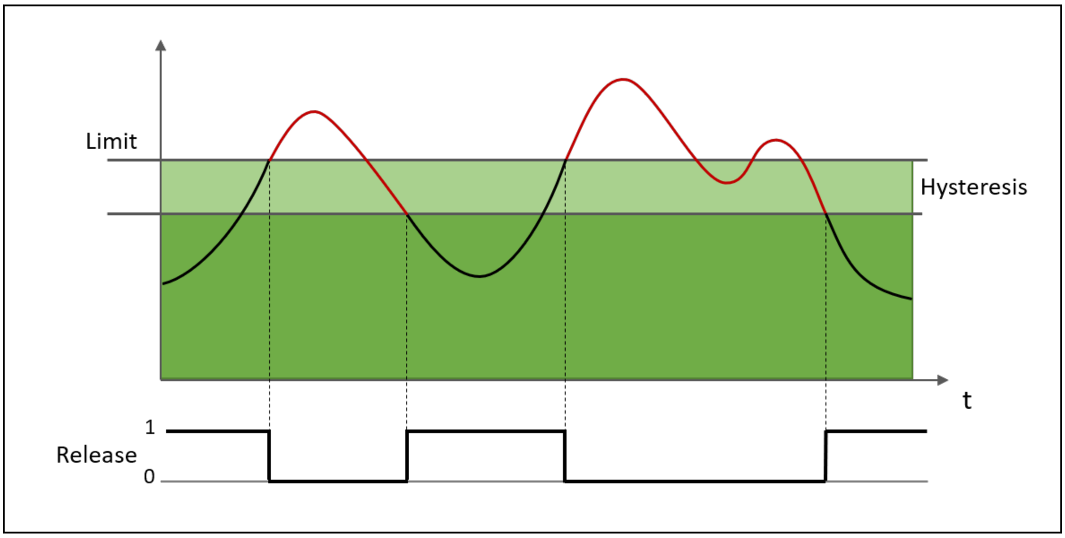


Illustration 191: Monitoring for “Upper limit exceeded”

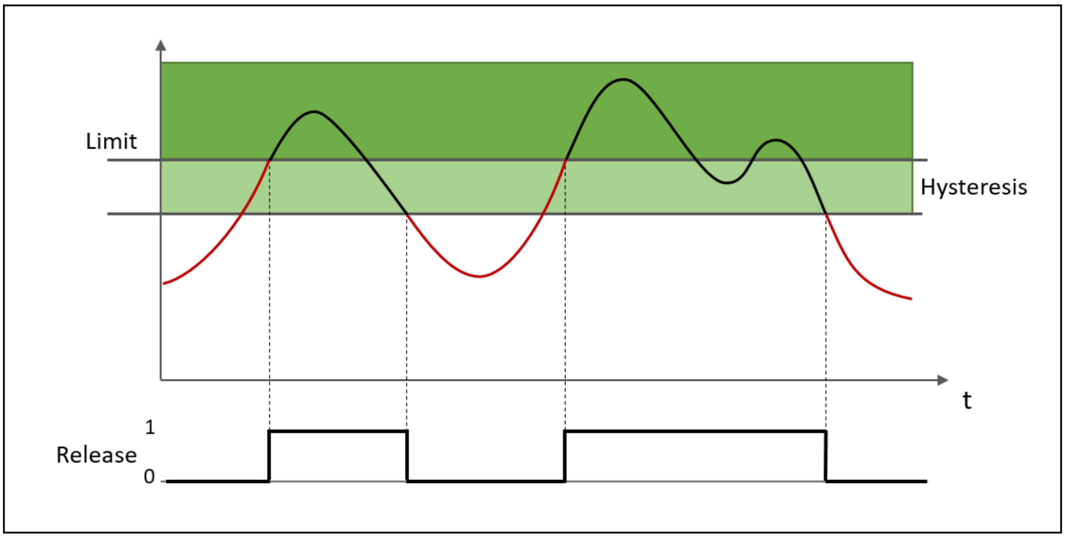


Illustration 192: Monitoring for "Lower limit exceeded"

8.12.5.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)
Number of limit values	1 – 4 (default: 1)

Dual Channel

Properties	Possible values
Activate dual channel capability (for the connected sensor elements)	• Without (default) • With

Dual channel evaluation

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Limit value

Limit value settings for each release output (1 – 4)

Properties	Possible values
Monitoring mode	• Value above limit (default)
Limit value	Input of limit value
Hysteresis type	• Absolute (default) • Relative
Hysteresis value	Input of hysteresis value
Release responds to mute	• Yes (default) • No
Release responds to bypass	• Yes (default) • No

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags

Properties	Possible values
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.12.5.4 Outputs

Release 1 – 4

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.12.6 Analog min temperature

8.12.6.1 Function block diagram

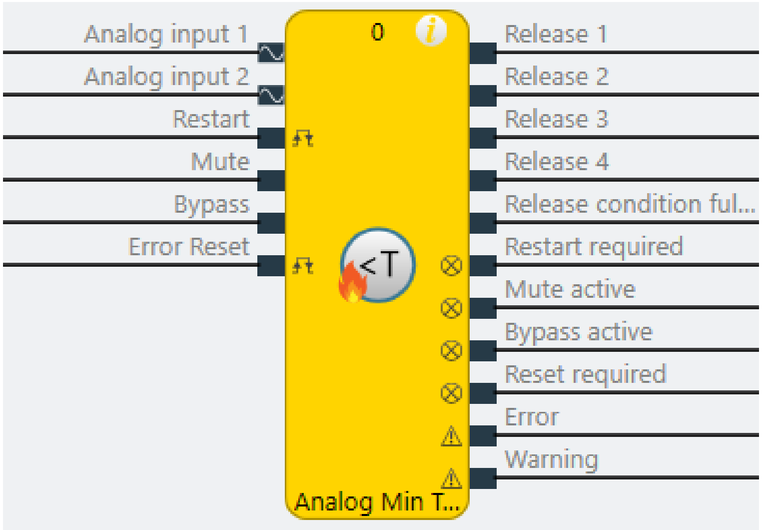


Illustration 193: Logical connections for the Analog min temperature function block

8.12.6.2 General description

The function block allows the comparison of an analog actual value at the **Analog input** with up to 4 predefined limit values (setpoints) for the purpose of limit value monitoring.

It is also possible to monitor the consolidated value of two connected analog sensors (dual channel monitoring at analog input 1 and analog input 2). In this case, other settings must be configured (see “Analog value comparison“ parameter).

Limit value monitoring

With limit value monitoring, limit values are defined and then used to perform analog minimum temperature monitoring via current transmitters for thermal elements or RTD sensors in 0/4..20mA as well as RTD sensors directly. As a result, only “lower limit exceeded” can be selected as a monitoring mode.

Dual channel monitoring with manual restart is set by default.

Hysteresis:
Two threshold values are configured for each limit value. One threshold value (switch-on threshold) defines when the respective output is switched on. The second threshold value (switch-off threshold) defines when the output is switched off again.

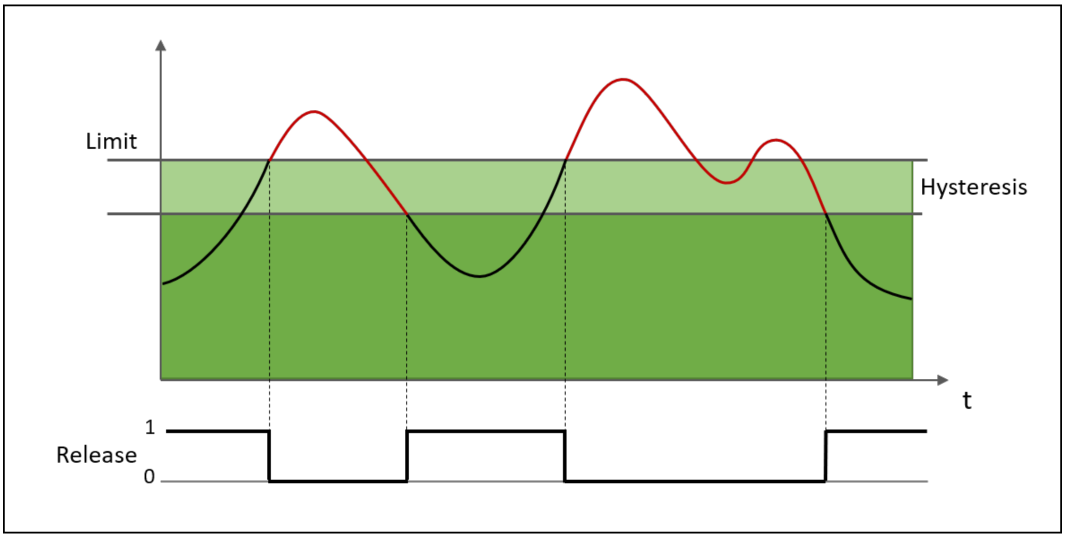


Illustration 194: Monitoring for “Upper limit exceeded”

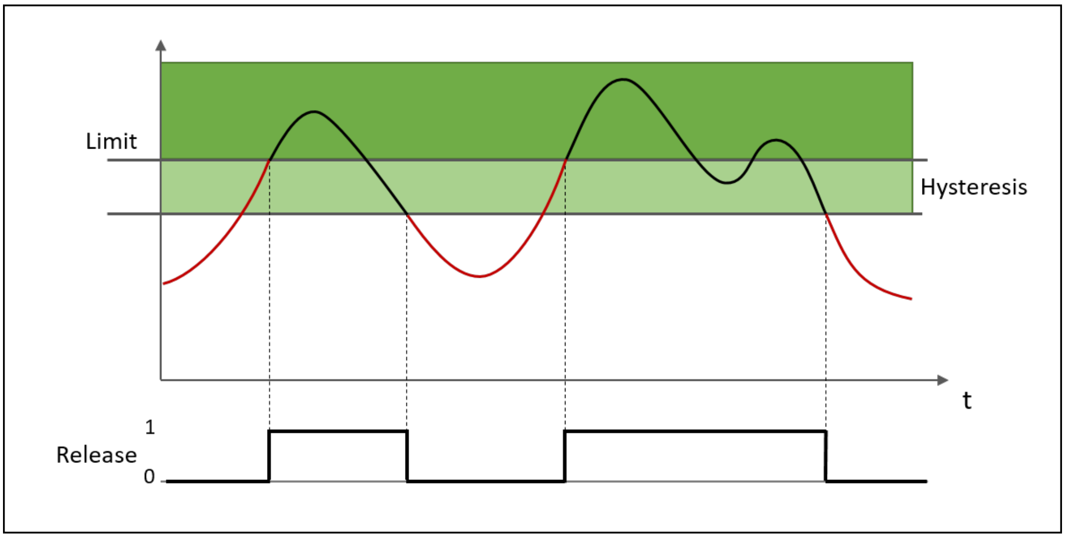


Illustration 195: Monitoring for "Lower limit exceeded"

8.12.6.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)
Number of limit values	1 – 4 (default: 1)

Dual Channel

Properties	Possible values
Activate dual channel capability (for the connected sensor elements)	• Without (default) • With

Dual channel evaluation

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Limit value

Limit value settings for each release output (1 – 4)

Properties	Possible values
Monitoring mode	• Undershoot (default)
Limit value	Input of limit value
Hysteresis type	• Absolute (default) • Relative
Hysteresis value	Input of hysteresis value
Release responds to mute	• Yes (default) • No
Release responds to bypass	• Yes (default) • No

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags

Properties	Possible values
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.12.6.4 Outputs

Release 1 – 4

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.12.7 Analog max temperature

8.12.7.1 Function block diagram

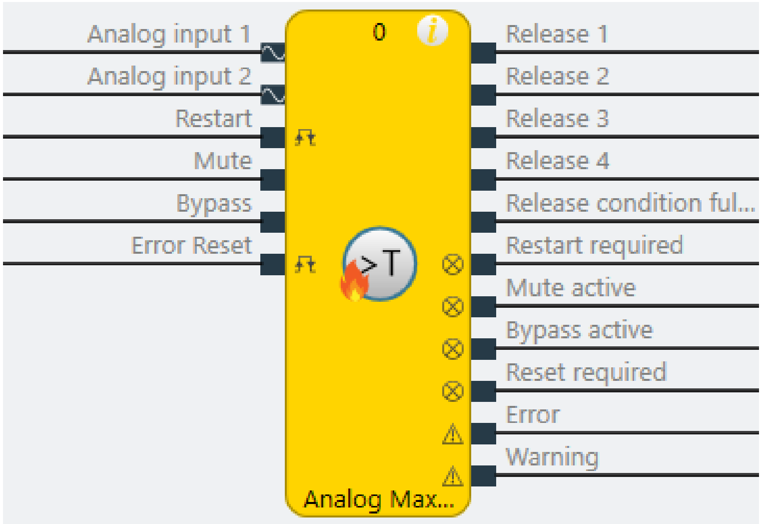


Illustration 196: Logical connections for the Analog max temperature function block

8.12.7.2 General description

The function block allows the comparison of an analog actual value at the **Analog input** with up to 4 predefined limit values (setpoints) for the purpose of limit value monitoring.

It is also possible to monitor the consolidated value of two connected analog sensors (dual channel monitoring at analog input 1 and analog input 2). In this case, other settings must be configured (see “Analog value comparison“ parameter).

Limit value monitoring

With limit value monitoring, limit values are defined and then used to perform analog maximum temperature monitoring via current transmitters for thermal elements or RTD sensors in 0/4..20mA as well as RTD sensors directly. As a result, only “upper limit exceeded” can be selected as a monitoring mode.

Dual channel monitoring with manual restart is set by default.

Hysteresis:
Two threshold values are configured for each limit value. One threshold value (switch-on threshold) defines when the respective output is switched on. The second threshold value (switch-off threshold) defines when the output is switched off again.

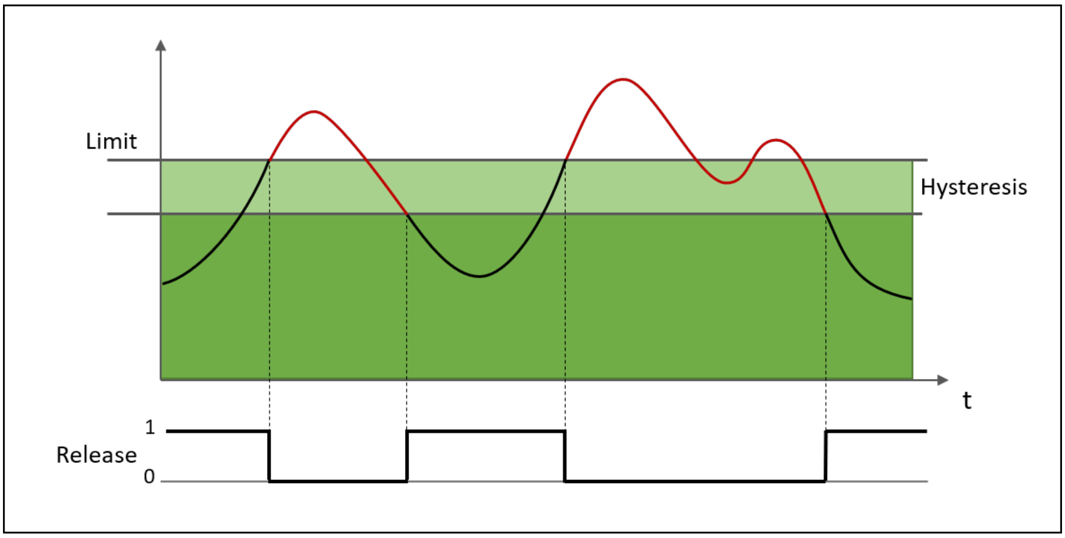


Illustration 197: Monitoring for “Upper limit exceeded”

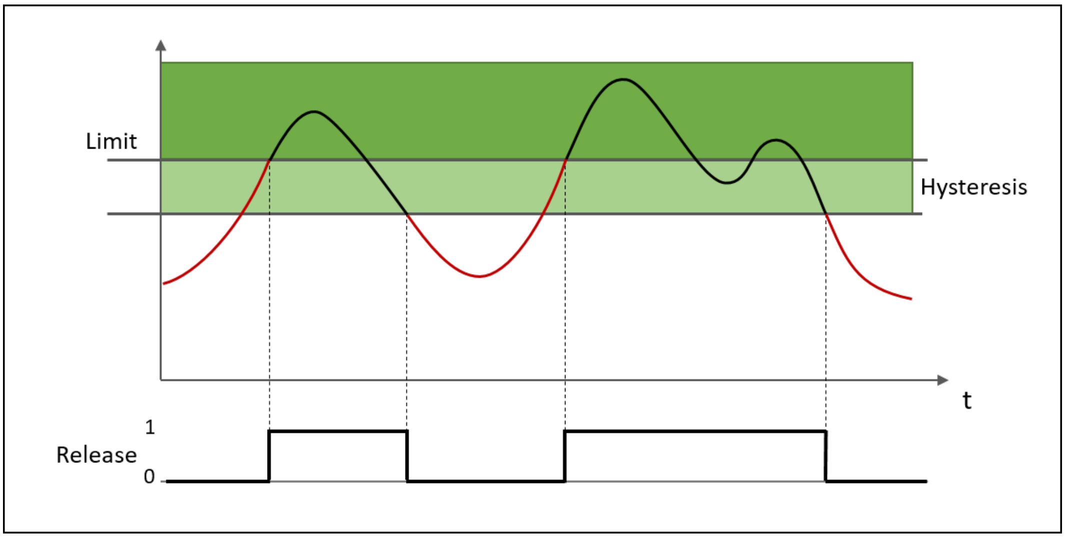


Illustration 198: Monitoring for "Lower limit exceeded"

8.12.7.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)
Number of limit values	1 – 4 (default: 1)

Dual Channel

Properties	Possible values
Activate dual channel capability (for the connected sensor elements)	• Without (default) • With

Dual channel evaluation

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Limit value

Limit value settings for each release output (1 – 4)

Properties	Possible values
Monitoring mode	• Value above limit (default)
Limit value	Input of limit value
Hysteresis type	• Absolute (default) • Relative
Hysteresis value	Input of hysteresis value
Release responds to mute	• Yes (default) • No
Release responds to bypass	• Yes (default) • No

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags

Properties	Possible values
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.12.7.4 Outputs

Release 1 – 4

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.12.8 Analog chimney draught

8.12.8.1 Function block diagram

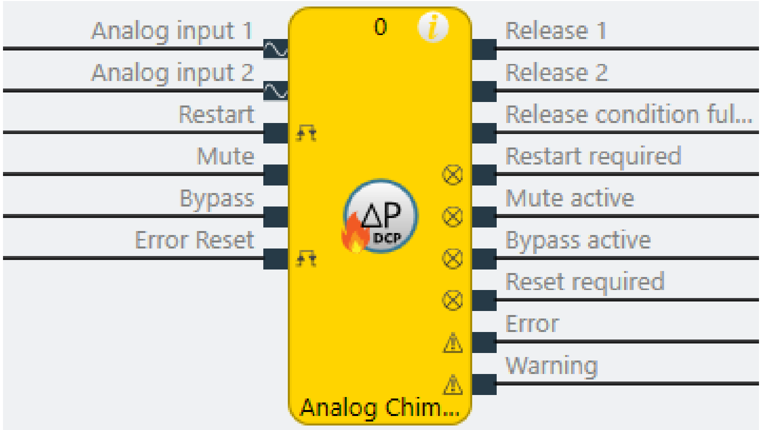


Illustration 199: Logical connections for analog chimney draught function block

8.12.8.2 General description

The function block allows a comparison to be performed to establish whether an analog actual value at the **analog output** is inside or outside a predefined range with 2 limit values (setpoints). One function block can monitor a maximum of two ranges. It is also possible to monitor the consolidated value of two connected analog sensors (dual channel monitoring at analog input 1 and analog input 2).

Range monitoring

With range monitoring, one lower and one upper limit value are defined. You can monitor whether the value is inside or outside this range.

In particular, the (differential) pressure or the flow in the chimney (chimney draught) of a firing facility should be evaluated here by way of pressure transmitters in 0/4..20mA.

Dual channel monitoring with manual restart is set by default.

Hysteresis:
Two threshold values are configured for each limit value. One threshold value (switch-on threshold) defines when the respective output is switched on. The second threshold value (switch-off threshold) defines when the output is switched off again.

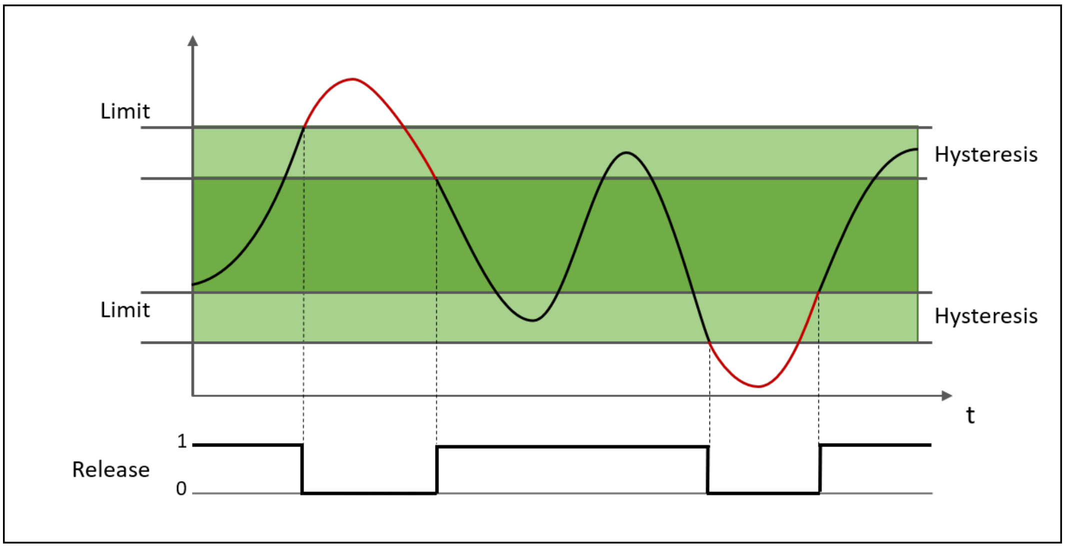


Illustration 200: Monitoring for “inside a range”

8.12.8.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)
Number of ranges	1 – 2 (default: 1)

Dual Channel

Properties	Possible values
Activate dual channel capability (for the connected sensor elements)	• Without (default) • With

Dual channel evaluation

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Range

Properties	Possible values
Monitoring mode	• Inside the window (default) • Outside the window
upper limit	• Input of upper limit value (default: 0)
lower limit	• Input of lower limit value (default: 0)
Hysteresis type	• Absolute (default) • Relative
Hysteresis value	Input of hysteresis value
Release responds to mute	• Yes (default) • No
Release responds to bypass	• Yes (default) • No

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.12.8.4 Outputs

Release 1 – 2

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.12.9 Analog furnace pressure

8.12.9.1 Function block diagram

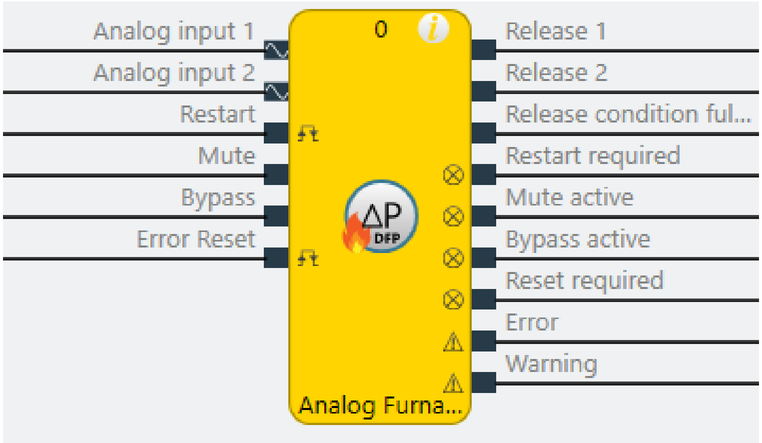


Illustration 201: Logical connections for the analog furnace pressure function block

8.12.9.2 General description

The function block allows a comparison to be performed to establish whether an analog actual value at the **analog output** is inside or outside a predefined range with 2 limit values (setpoints). One function block can monitor a maximum of two ranges. It is also possible to monitor the consolidated value of two connected analog sensors (dual channel monitoring at analog input 1 and analog input 2).

Range monitoring

With range monitoring, one lower and one upper limit value are defined. You can monitor whether the value is inside or outside this range.

In particular, the (differential) pressure in the combustion chamber of a firing facility should be evaluated here by way of pressure transmitters in 0/4..20mA.

Dual channel monitoring with manual restart is set by default.

Hysteresis:
Two threshold values are configured for each limit value. One threshold value (switch-on threshold) defines when the respective output is switched on. The second threshold value (switch-off threshold) defines when the output is switched off again.

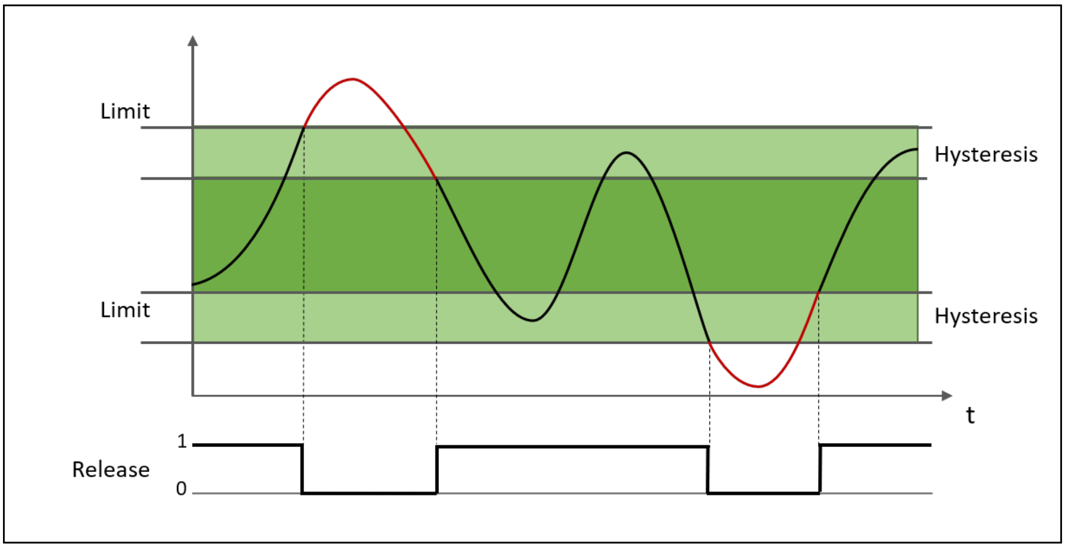


Illustration 202: Monitoring for “inside a range”

8.12.9.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)
Number of ranges	1 – 2 (default: 1)

Dual Channel

Properties	Possible values
Activate dual channel capability (for the connected sensor elements)	• Without (default) • With

Dual channel evaluation

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Range

Properties	Possible values
Monitoring mode	• Inside the window (default) • Outside the window
upper limit	• Input of upper limit value (default: 0)
lower limit	• Input of lower limit value (default: 0)
Hysteresis type	• Absolute (default) • Relative
Hysteresis value	Input of hysteresis value
Release responds to mute	• Yes (default) • No
Release responds to bypass	• Yes (default) • No

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.12.9.4 Outputs

Release 1 – 2

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.12.10 Analog ratio

8.12.10.1 Function block diagram

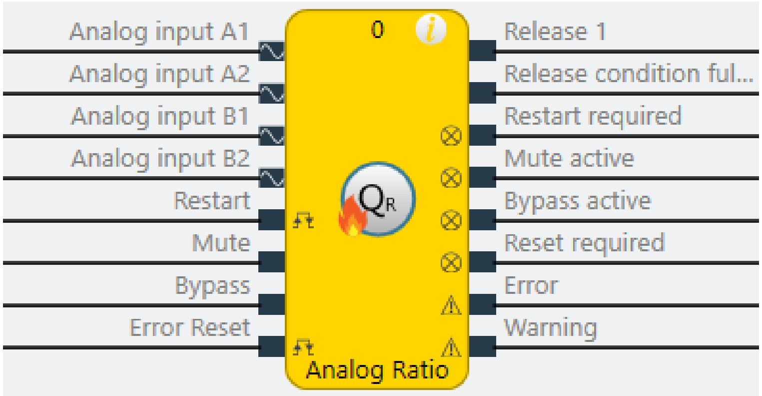


Illustration 203: Logical connections for the Analog Ratio function block

8.12.10.2 General description

The function block allows the comparison of two analog actual values at analog inputs A and B or monitoring to determine whether a predefined relation V of these two actual values is above or below a limit value or whether this relation is inside or outside a limit range.

Example:

V = a / b = analog input A / analog input B

*If defined parameter means upper limit is overshot: Analog input A * b > analog input B * a*

*If defined parameter means lower limit is undershot: Analog input A * b < analog input B * a*

If the parameterized condition is true (i.e. an overshoot or undershoot is present), the output changes from High to Low.

WARNING

The function block can only compare the same variables with one another, e.g. temperature with temperature or pressure with pressure.

In particular, a safe limit value ratio between two media, e.g. natural gas and air, should be monitored here by way of (differential) pressure transmitters, flow transmitters or volume transducers in 0/4…20mA in the respective combustion medium of a firing facility. With this type of limit value ratio monitoring, the system is not regulated based on the media, but the release outputs are set to Low based on safety requirements.

Dual channel monitoring with manual restart is set by default.

8.12.10.3 Function block properties

Parameters

Properties	Possible values
Restart mode	• Automatic start (default) • Manual start
Use Reset	• Without, i.e. automatic reset (default) • With, i.e. manual reset
Activate muting	• Without (default) • With (optional: time limit 1 – 7200 s)
Activate bypass	• Without (default) • With (optional: time limit 1 – 600 min)
Time limit for Mute/Bypass	• Without • With (default)
Active warning deactivates the release	• Warning does not deactivate the release output • Warning deactivates the release output (default)

Dual Channel

Properties	Possible values
Activate dual channel capability (for the connected sensor elements)	• Without (default) • With

Dual channel evaluation

These parameters only need to be defined if dual channel sensor elements are used or parameterized.

Properties	Possible values
Type of tolerance	• Absolute value • Relative value • Absolute or relative value • Absolute and relative value • No comparison (default)
Absolute tolerance value	Permissible parameterizable tolerance of two sensor inputs in relation to one another
Relative tolerance value	Tolerance specified as a percentage, based on the consolidated value
Tolerance time	Time during which the values can deviate from one another, i.e. a violation of the defined tolerance is permitted • 0…60000 ms
Type of consolidation	• Average • Input 1 • Input 2 • Higher value • Lower value

Relation

Properties	Possible values
Compare mode	• Overshoot • Undershoot (default) • Inside the window • Outside the window
Factor, input A	Input of whole value for a (default: 2)
Factor, input B	Input of whole value for b (default: 1)
Hysteresis value	Input of relative hysteresis value in % (default: 0 %)

I/O configuration

Properties	Possible values
Reset / Restart debounce time	• 1 ms • 100 ms (default) • 350 ms
Reset and Restart required flashing	• Reset / Restart are permanently High (default) • Reset / Restart flashing
Use fault flags	• Do not use fault flags (default) • Use fault flags
Use warning flags	• Do not use warning flags (default) • Use warning flags

8.12.10.4 Outputs

Release 1

The respective output is high if

- the result of the respective comparison is positive and forwarded according to the selected reset function,
- the respective comparison is successfully muted (muting active) **or**
- a bypass is active for the comparisons (bypass active).

Release condition fulfilled

The output becomes High if a minimum of one comparison of the respective FB is positive.

Restart required

The output exists if a manual reset has been parameterized. The output becomes High or flashes if the release condition is fulfilled but the respective release output is still Low. The output becomes Low if (with a positive comparison) the Restart input receives and forwards a High impulse or the release condition no longer applies.

Muting active

The output is High if the muting function has been successfully activated and the muting time has not yet elapsed.

Bypass active

The output becomes High if the bypass function has been successfully activated and the bypass time has not yet elapsed.

Reset required

The output flashes or has a permanent high signal to indicate that a monitoring error has occurred and has been eliminated by the user. The user will now be prompted to confirm with **Reset**.

Error

The output becomes high as long as a fault is present in the system component relevant for this part (e.g. an error in a connected sensor).

Warning

The output becomes high if the upper or lower limit of the monitoring range defined by the user is exceeded.

8.12.11 Digital min pressure

8.12.11.1 Function block diagram

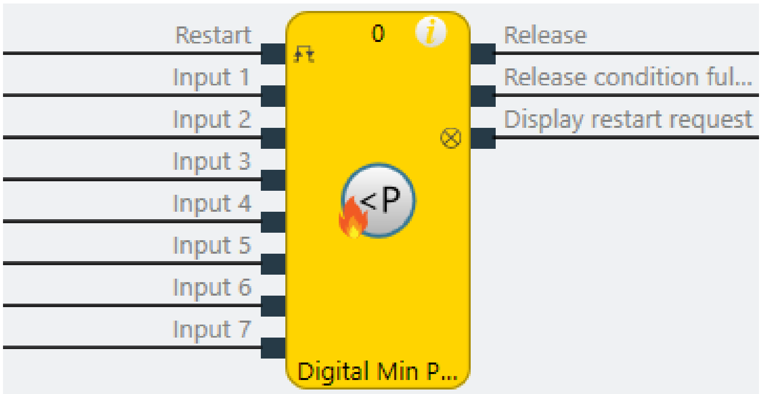


Illustration 204: Logical connections for the Digital min pressure function block

8.12.11.2 General description

The function block can be used to fulfill the standard requirements of safety applications for acknowledging a manual safety stop and the subsequent prompt for restarting the application. Typically, each safety logic function of a flexible safety controller based on samos® PRO contains this function block.

Unlike the “Analog min pressure” function block, a maximum of 7 potential-free pressure switches or pressure monitors and general potential-free contacts that already completely fulfill mechanical requirements for monitoring minimum pressure according to the relevant standards can be connected here. For example, here a type-tested pressure monitor for gas burners according to DIN EN 1854 can be monitored by evaluating the potential-free contact.

8.12.11.3 Function block properties

Parameters	Possible values
Min. reset pulse time	• 100 ms • 350 ms
Number of inputs	2 to 8 (= 1 to 7 release inputs activated)

8.12.11.4 Outputs

Release condition fulfilled output

The **Release condition fulfilled** output indicates the result of an AND link of all activated **Release** inputs. It is high when all activated **Release** inputs are high.

Reset required output

The **Reset required** output indicates, by pulsing at 1 Hz, that the function block is expecting a valid reset pulse at the **Reset** input, so that the **Release** output can go to high. This is the case when the **Release condition fulfilled** output is at high, i.e. all activated **Release** inputs are high, but the **Release** output is still low. Typically, this output is used to actuate an indicator lamp.

Release output

The **Release** output is at high when the **Release condition fulfilled** output is high and a valid reset pulse has been detected at the **Reset** input, provided all activated **Release** inputs remain high.

The **Min. reset pulse time** determines the minimum duration of the pulse at the **Reset** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

The **Release** output is low when one or more **Release** inputs go to low.

WARNING

Make sure that the transitions of the signals for reset meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Flow/Timing diagram

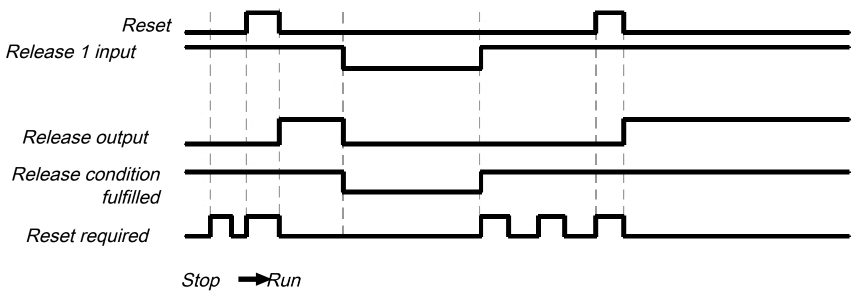


Illustration 205: Flow/Timing diagram for the function block

8.12.12 Digital max pressure

8.12.12.1 Function block diagram

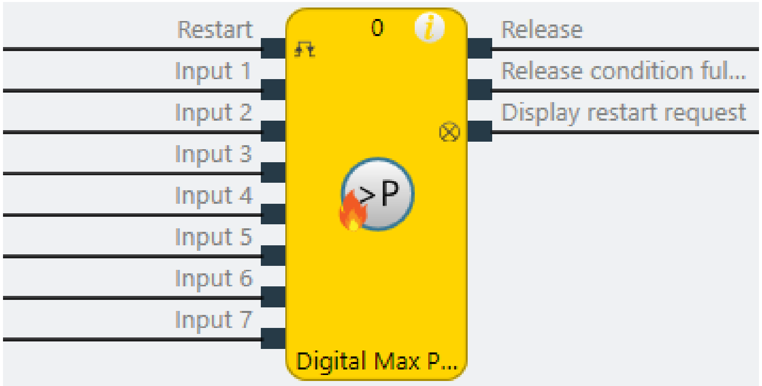


Illustration 206: Logical connections for the Digital max pressure function block

8.12.12.2 General description

The function block can be used to fulfill the standard requirements of safety applications for acknowledging a manual safety stop and the subsequent prompt for restarting the application. Typically, each safety logic function of a flexible safety controller based on samos® PRO contains this function block.

Unlike the “Analog max pressure” function block, up to a maximum of 7 potential-free pressure switches or pressure monitors and general potential-free contacts that already mechanically fulfill requirements for monitoring maximum pressure in full according to standards can be connected here. For example, here a type-tested pressure monitor for gas burners according to DIN EN 1854 can be monitored by evaluating the potential-free contact.

8.12.12.3 Function block properties

Parameters	Possible values
Min. reset pulse time	• 100 ms • 350 ms
Number of inputs	2 to 8 (= 1 to 7 release inputs activated)

8.12.12.4 Outputs

Release condition fulfilled output

The **Release condition fulfilled** output indicates the result of an AND link of all activated **Release** inputs. It is high when all activated **Release** inputs are high.

Reset required output

The **Reset required** output indicates, by pulsing at 1 Hz, that the function block is expecting a valid reset pulse at the **Reset** input, so that the **Release** output can go to high. This is the case when the **Release condition fulfilled** output is at high, i.e. all activated **Release** inputs are high, but the **Release** output is still low. Typically, this output is used to actuate an indicator lamp.

Release output

The **Release** output is at high when the **Release condition fulfilled** output is high and a valid reset pulse has been detected at the **Reset** input, provided all activated **Release** inputs remain high.

The **Min. reset pulse time** determines the minimum duration of the pulse at the **Reset** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

The **Release** output is low when one or more **Release** inputs go to low.

Make sure that the transitions of the signals for reset meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Flow/Timing diagram

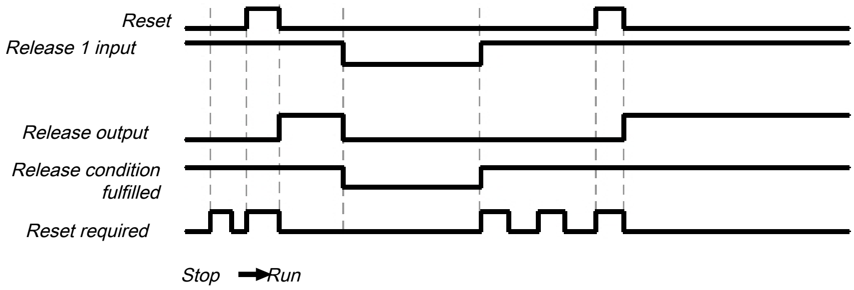


Illustration 207: Flow/Timing diagram for the function block

8.12.13 Digital min flow

8.12.13.1 Function block diagram

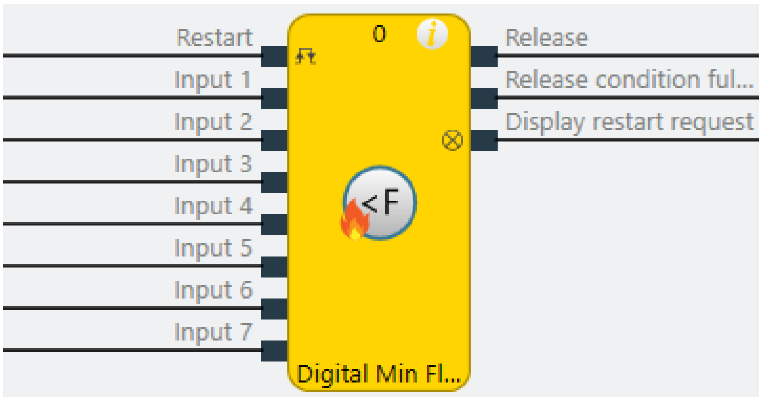


Illustration 208: Logical connections for the Digital min flow function block

8.12.13.2 General description

The function block can be used to fulfill the standard requirements of safety applications for acknowledging a manual safety stop and the subsequent prompt for restarting the application. Typically, each safety logic function of a flexible safety controller based on samos® PRO contains this function block.

Unlike the “Analog min flow” function block, a maximum of 7 potential-free pressure switches or pressure monitors or flow monitors and general potential-free contacts that already completely fulfill mechanical requirements for monitoring minimum pressure or flow according to the relevant standards can be connected here. For example, here a type-tested pressure monitor for gas burners according to DIN EN 1854 can be monitored by evaluating the potential-free contact.

8.12.13.3 Function block properties

Parameters	Possible values
Min. reset pulse time	• 100 ms • 350 ms
Number of inputs	2 to 8 (= 1 to 7 release inputs activated)

8.12.13.4 Outputs

Release condition fulfilled output

The **Release condition fulfilled** output indicates the result of an AND link of all activated **Release** inputs. It is high when all activated **Release** inputs are high.

Reset required output

The **Reset required** output indicates, by pulsing at 1 Hz, that the function block is expecting a valid reset pulse at the **Reset** input, so that the **Release** output can go to high. This is the case when the **Release condition fulfilled** output is at high, i.e. all activated **Release** inputs are high, but the **Release** output is still low. Typically, this output is used to actuate an indicator lamp.

Release output

The **Release** output is at high when the **Release condition fulfilled** output is high and a valid reset pulse has been detected at the **Reset** input, provided all activated **Release** inputs remain high.

The **Min. reset pulse time** determines the minimum duration of the pulse at the **Reset** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

The **Release** output is low when one or more **Release** inputs go to low.

WARNING

Make sure that the transitions of the signals for reset meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Flow/Timing diagram

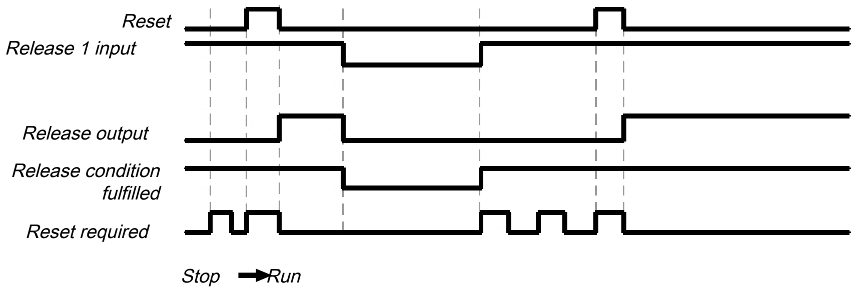


Illustration 209: Flow/Timing diagram for the function block

8.12.14 Digital max flow

8.12.14.1 Function block diagram

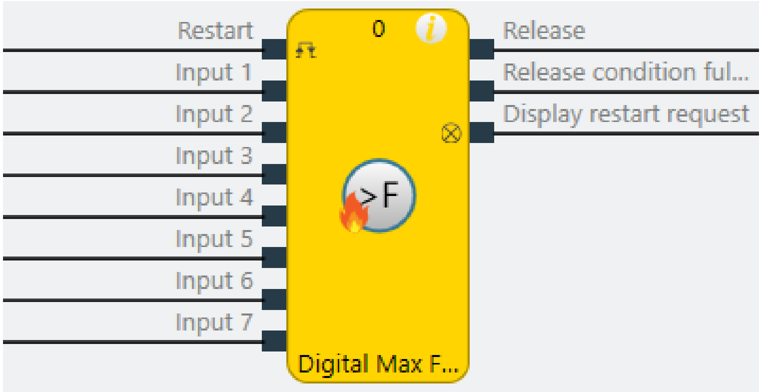


Illustration 210: Logical connections for the Digital max flow function block

8.12.14.2 General description

The function block can be used to fulfill the standard requirements of safety applications for acknowledging a manual safety stop and the subsequent prompt for restarting the application. Typically, each safety logic function of a flexible safety controller based on samos® PRO contains this function block.

Unlike the “Analog max flow” function block, a maximum of 7 potential-free pressure switches or pressure monitors or flow monitors and general potential-free contacts that already completely fulfill mechanical requirements for monitoring maximum pressure or flow according to the relevant standards can be connected here. For example, here a type-tested pressure monitor for gas burners according to DIN EN 1854 can be monitored by evaluating the potential-free contact.

8.12.14.3 Function block properties

Parameters	Possible values
Min. reset pulse time	• 100 ms • 350 ms
Number of inputs	2 to 8 (= 1 to 7 release inputs activated)

8.12.14.4 Outputs

Release condition fulfilled output

The **Release condition fulfilled** output indicates the result of an AND link of all activated **Release** inputs. It is high when all activated **Release** inputs are high.

Reset required output

The **Reset required** output indicates, by pulsing at 1 Hz, that the function block is expecting a valid reset pulse at the **Reset** input, so that the **Release** output can go to high. This is the case when the **Release condition fulfilled** output is at high, i.e. all activated **Release** inputs are high, but the **Release** output is still low. Typically, this output is used to actuate an indicator lamp.

Release output

The **Release** output is at high when the **Release condition fulfilled** output is high and a valid reset pulse has been detected at the **Reset** input, provided all activated **Release** inputs remain high.

The **Min. reset pulse time** determines the minimum duration of the pulse at the **Reset** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

The **Release** output is low when one or more **Release** inputs go to low.

WARNING

Make sure that the transitions of the signals for reset meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Flow/Timing diagram

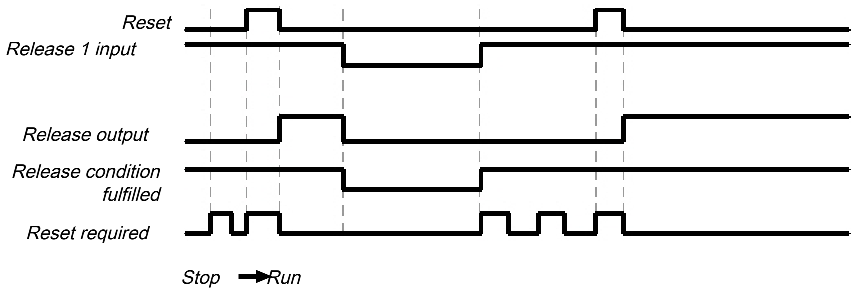


Illustration 211: Flow/Timing diagram for the function block

8.12.15 Digital min temperature

8.12.15.1 Function block diagram

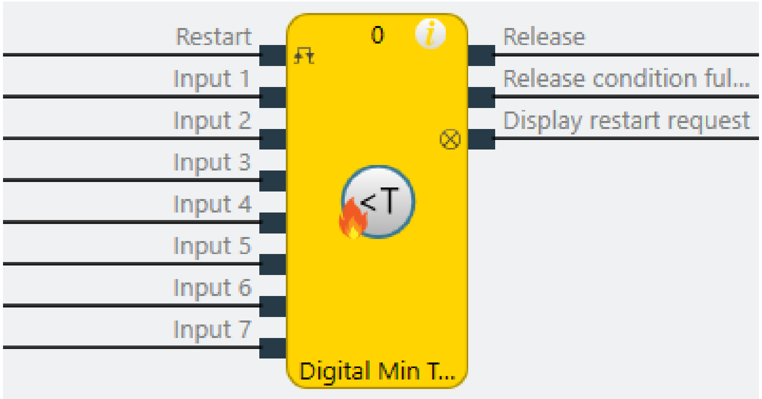


Illustration 212: Logical connections for the Digital min temperature function block

8.12.15.2 General description

The function block can be used to fulfill the standard requirements of safety applications for acknowledging a manual safety stop and the subsequent prompt for restarting the application. Typically, each safety logic function of a flexible safety controller based on samos® PRO contains this function block.

Unlike the “Analog min temperature” function block, a maximum of 7 potential-free contacts of safety temperature monitors or general potential-free contacts that already completely fulfill mechanical requirements for monitoring minimum temperature according to the relevant standards can be connected here.

8.12.15.3 Function block properties

Parameters	Possible values
Min. reset pulse time	• 100 ms • 350 ms
Number of inputs	2 to 8 (= 1 to 7 release inputs activated)

8.12.15.4 Outputs

Release condition fulfilled output

The **Release condition fulfilled** output indicates the result of an AND link of all activated **Release** inputs. It is high when all activated **Release** inputs are high.

Reset required output

The **Reset required** output indicates, by pulsing at 1 Hz, that the function block is expecting a valid reset pulse at the **Reset** input, so that the **Release** output can go to high. This is the case when the **Release condition fulfilled** output is at high, i.e. all activated **Release** inputs are high, but the **Release** output is still low. Typically, this output is used to actuate an indicator lamp.

Release output

The **Release** output is at high when the **Release condition fulfilled** output is high and a valid reset pulse has been detected at the **Reset** input, provided all activated **Release** inputs remain high.

The **Min. reset pulse time** determines the minimum duration of the pulse at the **Reset** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

The **Release** output is low when one or more **Release** inputs go to low.


WARNING

Make sure that the transitions of the signals for reset meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Flow/Timing diagram

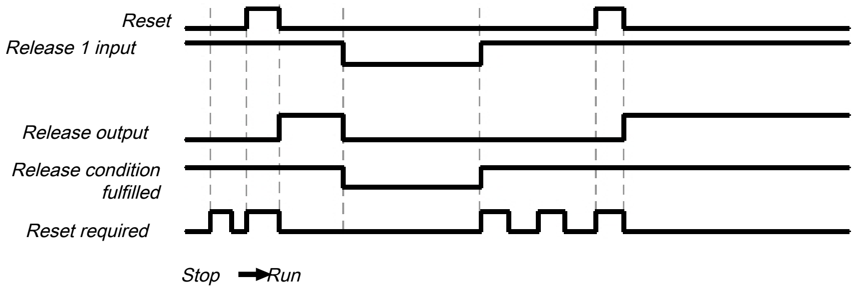


Illustration 213: Flow/Timing diagram for the function block

8.12.16 Digital max temperature

8.12.16.1 Function block diagram

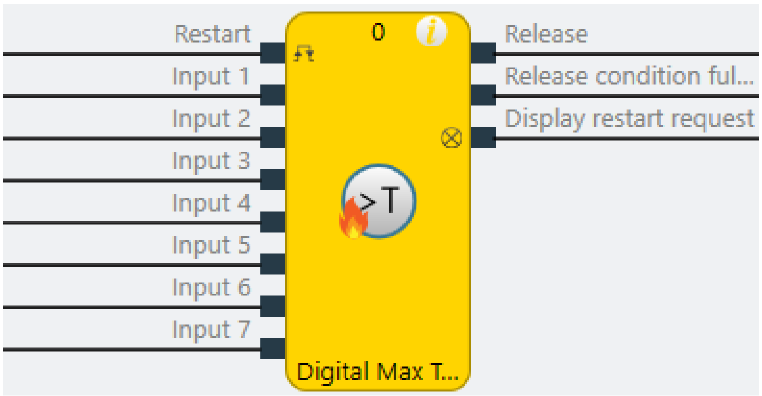


Illustration 214: Logical connections for the Digital max temperature function block

8.12.16.2 General description

The function block can be used to fulfill the standard requirements of safety applications for acknowledging a manual safety stop and the subsequent prompt for restarting the application. Typically, each safety logic function of a flexible safety controller based on samos® PRO contains this function block.

Unlike the “Analog max temperature” function block, a maximum of 7 potential-free contacts of safety temperature monitors or general potential-free contacts that already completely fulfill mechanical requirements for monitoring maximum temperature according to the relevant standards can be connected here.

8.12.16.3 Function block properties

Parameters	Possible values
Min. reset pulse time	• 100 ms • 350 ms
Number of inputs	2 to 8 (= 1 to 7 release inputs activated)

8.12.16.4 Outputs

Release condition fulfilled output

The **Release condition fulfilled** output indicates the result of an AND link of all activated **Release** inputs. It is high when all activated **Release** inputs are high.

Reset required output

The **Reset required** output indicates, by pulsing at 1 Hz, that the function block is expecting a valid reset pulse at the **Reset** input, so that the **Release** output can go to high. This is the case when the **Release condition fulfilled** output is at high, i.e. all activated **Release** inputs are high, but the **Release** output is still low. Typically, this output is used to actuate an indicator lamp.

Release output

The **Release** output is at high when the **Release condition fulfilled** output is high and a valid reset pulse has been detected at the **Reset** input, provided all activated **Release** inputs remain high.

The **Min. reset pulse time** determines the minimum duration of the pulse at the **Reset** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

The **Release** output is low when one or more **Release** inputs go to low.

WARNING

Make sure that the transitions of the signals for reset meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Flow/Timing diagram

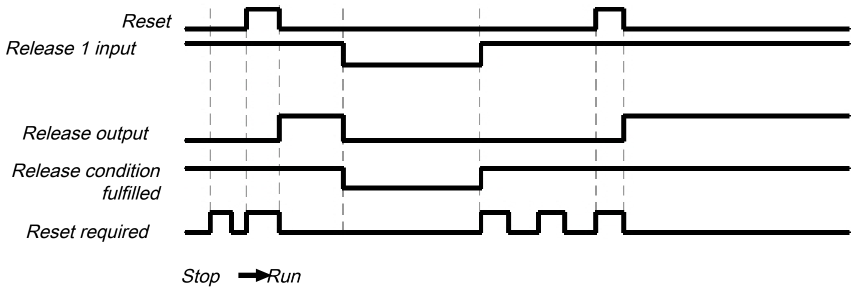


Illustration 215: Flow/Timing diagram for the function block

8.12.17 Digital chimney draught

8.12.17.1 Function block diagram

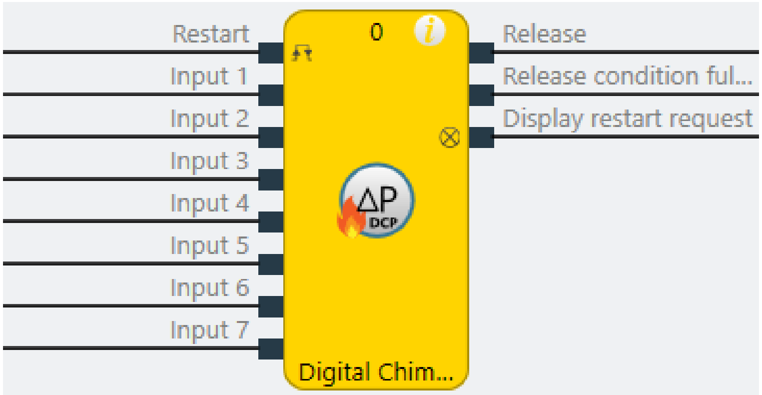


Illustration 216: Logical connections for the Digital chimney draught function block

8.12.17.2 General description

The function block can be used to fulfill the standard requirements of safety applications for acknowledging a manual safety stop and the subsequent prompt for restarting the application. Typically, each safety logic function of a flexible safety controller based on samos® PRO contains this function block.

Unlike the “Analog chimney draught” function block, a maximum of 7 potential-free contacts of (differential) pressure monitors or general potential-free contacts that already completely fulfill mechanical requirements for monitoring adequate flow or differential pressure in the chimney (chimney draught) according to the relevant standards can be connected here.

8.12.17.3 Function block properties

Parameters	Possible values
Min. reset pulse time	• 100 ms • 350 ms
Number of inputs	2 to 8 (= 1 to 7 release inputs activated)

8.12.17.4 Outputs

Release condition fulfilled output

The **Release condition fulfilled** output indicates the result of an AND link of all activated **Release** inputs. It is high when all activated **Release** inputs are high.

Reset required output

The **Reset required** output indicates, by pulsing at 1 Hz, that the function block is expecting a valid reset pulse at the **Reset** input, so that the **Release** output can go to high. This is the case when the **Release condition fulfilled** output is at high, i.e. all activated **Release** inputs are high, but the **Release** output is still low. Typically, this output is used to actuate an indicator lamp.

Release output

The **Release** output is at high when the **Release condition fulfilled** output is high and a valid reset pulse has been detected at the **Reset** input, provided all activated **Release** inputs remain high.

The **Min. reset pulse time** determines the minimum duration of the pulse at the **Reset** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

The **Release** output is low when one or more **Release** inputs go to low.

Make sure that the transitions of the signals for reset meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Flow/Timing diagram

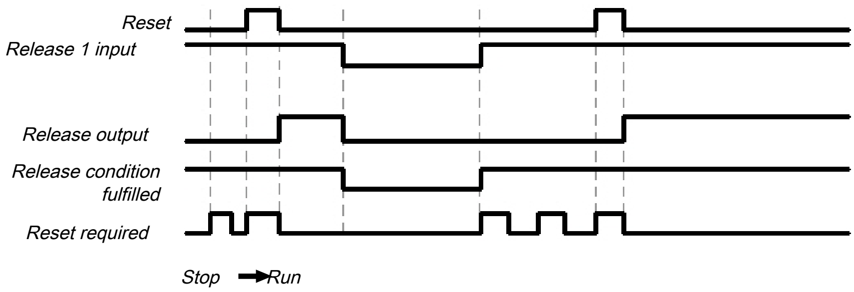


Illustration 217: Flow/Timing diagram for the function block

8.12.18 Digital furnace pressure

8.12.18.1 Function block diagram

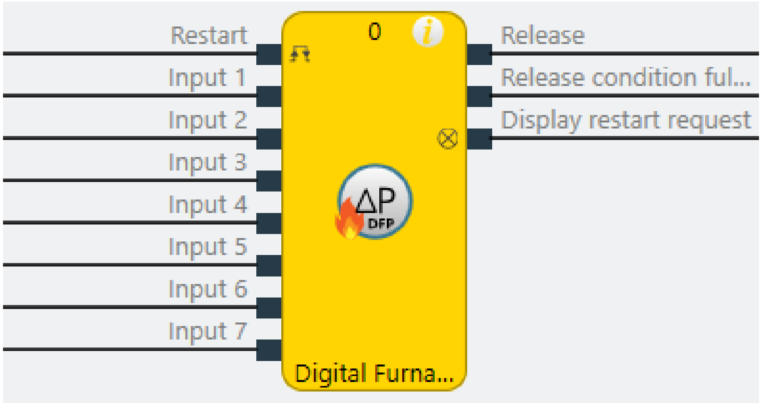


Illustration 218: Logical connections for the digital furnace pressure function block

8.12.18.2 General description

The function block can be used to fulfill the standard requirements of safety applications for acknowledging a manual safety stop and the subsequent prompt for restarting the application. Typically, each safety logic function of a flexible safety controller based on samos® PRO contains this function block.

Unlike the "Analog furnace pressure" function block, a maximum of 7 potential-free contacts of (differential) pressure monitors or general potential-free contacts that already completely fulfill mechanical requirements for monitoring differential pressure in the combustion chamber (furnace) according to the relevant standards can be connected here.

8.12.18.3 Function block properties

Parameters	Possible values
Min. reset pulse time	• 100 ms • 350 ms
Number of inputs	2 to 8 (= 1 to 7 release inputs activated)

8.12.18.4 Outputs

Release condition fulfilled output

The **Release condition fulfilled** output indicates the result of an AND link of all activated **Release** inputs. It is high when all activated **Release** inputs are high.

Reset required output

The **Reset required** output indicates, by pulsing at 1 Hz, that the function block is expecting a valid reset pulse at the **Reset** input, so that the **Release** output can go to high. This is the case when the **Release condition fulfilled** output is at high, i.e. all activated **Release** inputs are high, but the **Release** output is still low. Typically, this output is used to actuate an indicator lamp.

Release output

The **Release** output is at high when the **Release condition fulfilled** output is high and a valid reset pulse has been detected at the **Reset** input, provided all activated **Release** inputs remain high.

The **Min. reset pulse time** determines the minimum duration of the pulse at the **Reset** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

The **Release** output is low when one or more **Release** inputs go to low.

WARNING

Make sure that the transitions of the signals for reset meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Flow/Timing diagram

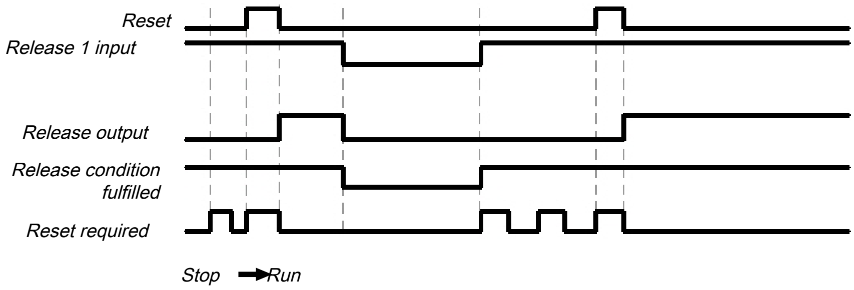


Illustration 219: Flow/Timing diagram for the function block

8.12.19 Digital fuel off

8.12.19.1 Function block diagram

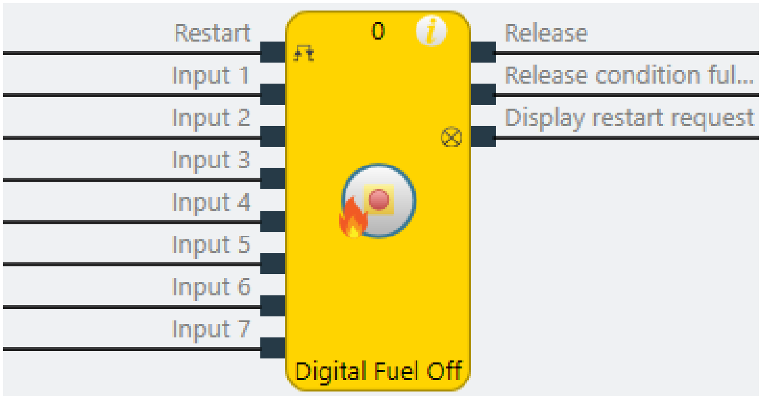


Illustration 220: Logical connections for the Digital fuel off function block

8.12.19.2 General description

The function block can be used to fulfill the standard requirements of safety applications for acknowledging a manual safety stop and the subsequent prompt for restarting the application. Typically, each safety logic function of a flexible safety controller based on samos® PRO contains this function block.

The “Digital fuel off” function block can be used to evaluate a maximum of 7 higher-level emergency stop/off switches or generally safe potential-free contacts (from safety relays for instance). As a result, it is possible to implement an overarching, clearly designed system emergency stop/off regardless of the firing type (fuel mixtures consisting of gases or oils containing air or oxygen, electrical heaters, alternative firing installations or systems).

8.12.19.3 Function block properties

Parameters	Possible values
Min. reset pulse time	• 100 ms • 350 ms
Number of inputs	2 to 8 (= 1 to 7 release inputs activated)

8.12.19.4 Outputs

Release condition fulfilled output

The **Release condition fulfilled** output indicates the result of an AND link of all activated **Release** inputs. It is high when all activated **Release** inputs are high.

Reset required output

The **Reset required** output indicates, by pulsing at 1 Hz, that the function block is expecting a valid reset pulse at the **Reset** input, so that the **Release** output can go to high. This is the case when the **Release condition fulfilled** output is at high, i.e. all activated **Release** inputs are high, but the **Release** output is still low. Typically, this output is used to actuate an indicator lamp.

Release output

The **Release** output is at high when the **Release condition fulfilled** output is high and a valid reset pulse has been detected at the **Reset** input, provided all activated **Release** inputs remain high.

The **Min. reset pulse time** determines the minimum duration of the pulse at the **Reset** input. Valid values are 100 ms and 350 ms. If the pulse duration is less than the configured minimum pulse time or longer than 30 seconds, then the pulse is ignored.

The **Release** output is low when one or more **Release** inputs go to low.

WARNING

Make sure that the transitions of the signals for reset meet the requirements!

When there is a short-circuit to high (to 24 V DC) at a physical input, the evaluated signal can have a pulse when the signal is reset as a result of short-circuit detection. If this type of pulse can lead to a hazard-inducing state in the machine, the following points should be noted:

- Ensure that the cable routing is protected for the signal lines (due to cross-connection with other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Flow/Timing diagram

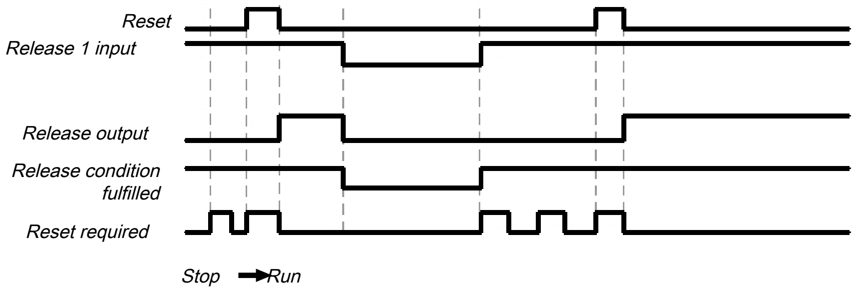


Illustration 221: Flow/Timing diagram for the function block

9 TECHNICAL COMMISSIONING

Before you start technical commissioning, the configuration of the samos® PRO system must be complete.

9.1 Wiring and supply voltage

WARNING

Note the technical data in the hardware manual when connecting the samos® PRO system!

- Connect the individual field devices to the corresponding signal connections and for each safety input, test/signal output, and safety output, check whether they are behaving as required for the application. You will support the diagnostic information of the samos® PRO LEDs when validating the individual field signals. Check whether the external wiring, the design of the wiring, the selection of the command encoder, and their arrangement on the machine meet the required safety level.
- Eliminate any malfunctions (e.g. incorrect wiring or crossed signals) at all safety inputs, test/signal outputs, or safety outputs before you proceed with the next step.
- Switch on the voltage supply. As soon as the power supply is present at the A1 and A2 connections of the SP-COPx controller module or the SP-SDIO module, the samos® PRO system will automatically implement the following steps:
  - Internal self-test
  - Loading of the stored configuration
  - Test of the loaded configuration for validity

The system will not transition into operation if the aforementioned steps cannot be completed successfully. If there are errors, a corresponding LED display will appear and the samos® PRO system will set all of the transmitted values to Low.

Further information: Hardware manual, "Error displays of the status LEDs"

9.2 Transferring the configuration

After you have configured the hardware and the logic in the samos® PRO system and checked it for correctness, transfer the configuration to the samos® PRO system via the samos® PLAN 6 software.

9.3 Technical check and commissioning

The machine or system that is being protected by a samos® PRO safety controller may only be commissioned after a successful technical check of all of the safety functions. The technical check may only be completed by a qualified person.

The technical check comprises the following test points:

- ➡ Mark all the connection lines and plug connectors on the samos® PRO system clearly to prevent mix-ups. Because the samos® PRO system has multiple connections with the same shape, make sure that connection lines that are disconnected are not connected back to the wrong connection.
- ➡ Verify the configuration of the samos® PRO system.
- ➡ Check the signal paths and the correct integration into higher-level controls.
- ➡ Check the correct data transmission from and to the samos® PRO safety controller.
- ➡ Check the logic program of the safety controller.
- ➡ Fully document the configuration of the entire system, the individual devices, and the results of the safety check.
- ➡ Check the safety functions of the machine or system completely and make sure that the safety functions are fully functioning.

10 TROUBLESHOOTING

If an error occurs, you can find additional information here:

- *Observing the device states of the system [ch. 6.10.1, p. 139]* (list of LED error displays)
- *List of all error messages, causes and aids [ch. 11.1, p. 408]* (Error codes, error causes and troubleshooting measures)
- Hardware manual

"Diagnostics" view

Error codes and error messages can also be displayed in the **Diagnostics** view if you have established a connection with the samos® PRO system.

For more information on how to perform diagnostics, please see the following: *Using the monitoring functions [ch. 6.10, p. 139]*

11 APPENDIX

11.1 List of all error messages, causes and aids

Table 134: Controller module error messages

Error No.	Error type	Logbook message	System behavior	Remedy
00000001	Info	Log generator info function block	System continues to run	---
00000002	Warning	Log generator warning function block	System continues to run	---
00000003	Error	Log generator error function block	System continues to run	---
10100001	Error	An unknown error occurred.	Disconnection	Support request
10100002	Error	An internal error occurred.	Disconnection	Support request
10100003	Error	Time exceeded when preparing a message for the control.	No connection	Check connection
10100004	Error	The value cannot be forced, because force mode is inactive.	Remains connected	Activate force mode
10100005	Error	The controller does not support the message type.	Disconnection	Support request
10100006	Error	The hash value of a read file is not valid.	Disconnection	Support request
10100007	Error	The header size in the message from the control is not plausible.	Disconnection	Support request
10100008	Error	The user data size in the message from the control is not plausible.	Disconnection	Support request
10100009	Error	The total data size does not match the number of received data.	Disconnection	Repeat Support request
1010000 A	Error	A data flow error in a segmented read message occurred.	No connection	Repeat Support request
1010000B	Error	The checksum in a message from the control is not valid.	Disconnection	Support request
1010000C	Error	Timeout when sending a message to the controller. Possible causes: There is already a communication link to the controller; The Ethernet or USB connection was interrupted.	Disconnection	Check connection support request
1010000D	Error	Timeout when receiving a message from the controller. Possible causes: There is already a communication link to the controller; The Ethernet or USB connection was interrupted.	Disconnection	Check connection support request
1010000E	Error	Unexpected message received.	Disconnection	Support request
1010000F	Error	The message from the control is corrupt.	Disconnection	Support request

Error No.	Error type	Logbook message	System behavior	Remedy
10100010	Error	The message from the control is corrupt.	Disconnection	Support request
10100011	Error	The message to the control could not be processed.	Disconnection	Repeat Support request
10100012	Error	The control could not positively respond to the request.	Remains connected	Repeat Repair SD card Support request
10100013	Error	The number of request retries has been exceeded.	Disconnection	Repeat Support request
10100015	Error	Communication to the control could not be established.	No connection	Check connection support request
10100016	Error	The password is not valid for the user to be logged on.	Remains connected	Check password
10100017	Error	The control could not accept the desired state.	Remains connected	Repeat Support request
10100018	Error	The memory card of the station is not plugged in.	Disconnection	Insert valid SD card
10200002	Error	The project on the control is invalid.	No connection	Transfer a new valid project
10200003	Error	The verification status of project and control is not the same.	No connection	Reverify the project
10200004	Error	The PC project and project on the control could not be synched.	No connection	Disconnect and reconnect support request
10200005	Error	The current user does not have authorization to communicate with the controller. Connection was disconnected.	No connection	Redefine the user rights
10200006	Warning	The project on the target does not match the module configuration.	Remains connected	Adjust hardware or project
10200007	Error	An error is reported by the control.	---	Support request
10200008	Error	The controller reports a different CRC of the project file.	---	Repeat of Support request work step
10200009	Error	The waiting time permitted for the project has been exceeded.	---	Repeat Support request
1020000 A	Info	The verification has been interrupted.	---	Repeat Support request
1020000B	Warning	The faulty project file is still in the station and must be replaced by the updated project file. Please reconnect and load the updated project on the station.	---	Update the device with the repaired project
10300001	Error	The logic analyzer data could not be saved.	---	Check Windows user privileges
10300002	Error	The logic analyzer data could not be loaded.	---	Repeat Support request

Error No.	Error type	Logbook message	System behavior	Remedy
10300003	Error	Input/output was not found.	---	Support request
10400001	Error	The log messages could not be saved.	---	Check Windows user privileges
10400002	Error	The file contains more than 64 log messages. Only the first 64 were imported.	---	Reduce the number of log messages
10400003	Error	The log messages could not be imported.	---	Support request
10500001	Error	Login to control failed.	---	Repeat Support request
10600001	Error	This user already exists. Please select a different name.	---	Use another name
10600002	Error	Could not import user list.	---	Repeat Support request
10600003	Warning	The following users were not imported, since they already exist.	---	---
10700001	Error	Project file could not be loaded. File format is not correct.	---	Search for a new program version: Main menu > via > Update, or support request
10700002	Error	Creating project from module configuration failed!	---	Search for a new program version: Main menu > via > Update, or support request
10700003	Error	Project file could not be saved!	---	Check Windows user privileges
10700004	Error	Project file could not be loaded. File format is not correct.	---	Search for a new program version: Main menu > via > Update, or support request
10700005	Error	Library file could not be loaded. File format is not correct.	---	Search for a new program version: Main menu > via > Update, or support request
10700006	Error	Faulty project structure.	---	Search for a new program version: Main menu > via > Update, or support request
10700008	Error	Setting data could not be loaded. Faulty file.	---	Search for a new program version: Main menu > via > Update, or support request
10700009	Error	Failed to import library, since corresponding elements already exist.	---	---
1070000 A	Error	File cannot be loaded, incorrect signature.	---	Search for a new program version: Main menu > via > Update, or support request

Error No.	Error type	Logbook message	System behavior	Remedy
1070000B	Error	The gateway configuration could not be opened. The configuration is for a different gateway type.	---	---
1070000C	Error	The version of the project file is not supported by this program version.	---	Search for a new program version: Main menu > via > Update, or support request
1070000D	Error	The configuration data for a module could not be correctly loaded.	---	Search for a new program version: Main menu > via > Update, or support request
10800001	Warning	Forcing more than 10 values is not permitted.	---	---
11000000	Error	HTML help could not be found. Please check whether it was installed correctly.	---	Reinstall or repair the program, Support request
12000000	Error	The version information was incorrect. Please contact support.	---	Support request
12000001	Error	No connection to the update server. Please check the Internet connection.	---	Check Internet connection
13000000	Error	The test gaps exceed half the maximum period.	---	Check the test parameters
13000001	Error	The test period exceeds the input's maximum test period.	---	Check the test parameters
13000002	Error	A test period with these minimum and maximum values cannot be configured.	---	Check the test parameters
13000003	Error	The test gaps exceed half the period.	---	Check the test parameters
13000004	Error	The required test parameters are not possible for at least one element on the module.	---	Check the test parameters
14000000	Error	Error in the logic configuration	---	Support request
14000001	Error	No enough space to insert elements on logic page.	---	Insert new logic page and reorganize function blocks
14000002	Warning	Elements could not be grouped.	---	---
14000003	Error	An element is only allowed for groupings.	---	---
14000004	Error	Maximum number of function blocks have already been created.	---	Simplify logic
14000005	Error	Failed to create residual memory.	---	Support request
14000006	Error	An element is not allowed for grouping.	---	---
14000007	Error	Function blocks are not compatible with the selected controller module.	---	If you use this controller module, the corresponding function blocks will be deleted.

Error No.	Error type	Logbook message	System behavior	Remedy
14000008	Error	Selection cannot be grouped because there are more than 8 connections to inputs.	---	---
14000009	Error	Selection cannot be grouped because there are more than 8 connections to outputs.	---	---
1400000 A	Error	No functional blocks have been selected to group.	---	---
15000001	Error	CRC calculation failed	---	Repeat Support request
15000002	Error	Report generation failed	---	Repeat Support request
22010140	Warning	Error in system configuration	System continues to run	Reload system configuration
220101F5	Warning	Error in system configuration	Config required	Reload system configuration
220101F6	Warning	Error in system configuration	Config required	Reload system configuration
220101F7	Warning	Error in system configuration	Config required	Reload system configuration
220101F8	Warning	Error in system configuration	Config required	Reload system configuration
220101F9	Warning	Error in system configuration	Config required	Reload system configuration
220101FA	Warning	Error in system configuration	Config required	Reload system configuration
220101FC	Warning	Error in system configuration	Config required	Reload system configuration
22010226	Warning	Error in system configuration	Config required	Reload system configuration
22010227	Warning	Error in system configuration	Config required	Reload system configuration
22010228	Warning	Error in system configuration	Config required	Reload system configuration
22010231	Warning	Pulse period 0 must have pulse length 0.	Configuration required	Change system configuration and reload
22010232	Warning	Pulse length must be <= pulse period/2.	Configuration required	Change system configuration and reload
22010233	Warning	Impermissible test period (permissible: 0,40,200,400,600,800,1000).	Config required	Change system configuration and reload
22010234	Warning	Pulse length must be 4..100ms in increments of 4ms	Configuration required	Change system configuration and reload
22010240	Warning	Maximum function block count or mapping exceeded	Configuration required	Change system configuration and reload
22010241	Warning	There is not an appropriate number of I/O modules for the project	Configuration required	Change system configuration and reload

Error No.	Error type	Logbook message	System behavior	Remedy
22010242	Warning	There is not an appropriate number of gateway modules for the project.	Configuration required	Change system configuration and reload
22010244	Warning	The type or major version of the I/O module is inappropriate for the project	Configuration required	Change system configuration and reload
22010245	Warning	The type or major version of the gateway module is inappropriate for the project	Configuration required	Change system configuration and reload
22010246	Warning	Version of analog module does not match the version of head module	Configuration required	Change system configuration and reload
2201024C	Warning	The Analog FBs are not supported by this device version	Configuration required	Change system configuration and reload
2201024D	Warning	Standstill "Lite" is no longer supported by this device version	Configuration required	Change system configuration and reload
2201024E	Warning	The Motion FBs of module version E are no longer supported by this device version	Configuration required	Change system configuration and reload
2201024F	Warning	The Motion FBs are not supported by this device version	Configuration required	Change system configuration and reload
22010250	Warning	The press function components are not supported by this device version	Configuration required	Change system configuration and reload
22010348	Warning	Internal error	Configuration required	Change system configuration and reload
22010349	Warning	Unknown sensor type	Configuration required	Change system configuration and reload
2201034 A	Warning	Sensor types 1/2 have different units	Configuration required	Change system configuration and reload
2201034B	Warning	Internal error	Configuration required	Change system configuration and reload
2201034C	Warning	Limit time for bypass exceeded	Configuration required	Change system configuration and reload
2201034D	Warning	Lower limit not less than upper limit	Configuration required	Change system configuration and reload
2201034E	Warning	Limit value with hysteresis is greater than the scope of application	Configuration required	Change system configuration and reload
2201034F	Warning	Comparison result is unknown	Configuration required	Change system configuration and reload
22010350	Warning	Absolute value outside the scope of application	Configuration required	Change system configuration and reload
22010351	Warning	Tolerance time > 60000ms	Configuration required	Change system configuration and reload
22010352	Warning	Relative value > 100%	Configuration required	Change system configuration and reload
22010353	Warning	Internal error	Configuration required	Change system configuration and reload
22010354	Warning	Sensor types 3/4 have different units	Configuration required	Change system configuration and reload

Error No.	Error type	Logbook message	System behavior	Remedy
22010355	Warning	Comparison function is unknown	Configuration required	Change system configuration and reload
22010356	Warning	Internal error	Configuration required	Change system configuration and reload
22010357	Warning	Limit time for bypass exceeded	Configuration required	Change system configuration and reload
22011243	Warning	Incorrect device name or safety category of the module	Configuration required	Change system configuration and reload
22012243	Warning	Incorrect module type	Configuration required	Change system configuration and reload
22013243	Warning	Incorrect number of inputs	Configuration required	Change system configuration and reload
22014243	Warning	Incorrect number of outputs	Configuration required	Change system configuration and reload
22015243	Warning	Incorrect manufacturer	Configuration required	Change system configuration and reload
22016243	Warning	Software version not supported	Configuration required	Change system configuration and reload
22017243	Warning	Software identification 'V' not found	Configuration required	Change system configuration and reload
2201xxxx	Warning	Error in the configuration	Configuration required	Change system configuration and reload
23010001	Warning	Sequence error at I1/I2	System continues to run	---
23010003	Warning	Sequence error at I3/I4	System continues to run	---
23010005	Warning	Sequence error at I5/I6	System continues to run	---
23010007	Warning	Sequence error at I7/I8	System continues to run	---
23010009	Warning	Sequence error at I9/I10	System continues to run	---
2301000B	Warning	Sequence error at I11/I12	System continues to run	---
2301000D	Warning	Sequence error at I13/I14	System continues to run	---
2301000F	Warning	Sequence error at I15/I16	System continues to run	---
23010011	Warning	Sequence error at IQ1/IQ2	System continues to run	---
23010013	Warning	Sequence error at IQ3/IQ4	System continues to run	---
2301xxxx	Warning	Sequence error at 2-channel input	System continues to run	---
23020001	Warning	Synchronization time error I1/I2	System continues to run	---

Error No.	Error type	Logbook message	System behavior	Remedy
23020003	Warning	Synchronization time error I3/I4	System continues to run	---
23020005	Warning	Synchronization time error I5/I6	System continues to run	---
23020007	Warning	Synchronization time error I7/I8	System continues to run	---
23020009	Warning	Synchronization time error I9/I10	System continues to run	---
2302000B	Warning	Synchronization time error I11/I12	System continues to run	---
2302000D	Warning	Synchronization time error I13/I14	System continues to run	---
2302000F	Warning	Synchronization time error I15/I16	System continues to run	---
23020011	Warning	Synchronization time error IQ1/IQ2	System continues to run	---
23020013	Warning	Synchronization time error IQ3/IQ4	System continues to run	---
2302xxxx	Warning	Synchronization time error at 2-channel input	System continues to run	---
23100100	Info	Sensor error rectified	System continues to run	---
23100201	Warning	Stuck-at at I13 .. I16	System continues to run	Check motion sensor
23100204	Warning	EMC malfunction	System continues to run	Check EMC environment, check sensor wiring, following wiring instructions, support request
23100205	Warning	EMC malfunction	System continues to run	Check EMC environment, following wiring instructions, support request
23100207	Warning	Error in system configuration	System continues to run	Change system configuration and reload
23100211	Warning	Frequency at I13 too high	System continues to run	Check motion sensor
23100212	Warning	Frequency at I14 too high	System continues to run	Check motion sensor
23100214	Warning	Frequency at I15 too high	System continues to run	Check motion sensor
23100218	Warning	Frequency at I16 too high	System continues to run	Check motion sensor
2310021x	Warning	Sensor frequency too high	System continues to run	Check motion sensor
23100221	Warning	Phase error on sensor 1	System continues to run	Check motion sensor

Error No.	Error type	Logbook message	System behavior	Remedy
23100222	Warning	Phase error on sensor 2	System continues to run	Check motion sensor
2310022x	Warning	Phase error, sensor signals A B	System continues to run	Check motion sensor
23100231	Warning	Error of inverted sensor signal at I13/I14	System continues to run	Check motion sensor
23100232	Warning	Error of inverted sensor signal at I13/I15	System continues to run	Check motion sensor
23100234	Warning	Error of inverted sensor signal at I14/I16	System continues to run	Check motion sensor
23100238	Warning	Error of inverted sensor signal at I15/I16	System continues to run	Check motion sensor
2310023x	Warning	Error of inverted sensor signals	System continues to run	Check motion sensor
23100241	Warning	Frequency difference of individual channels, sensor 1	System continues to run	Check motion sensor
23100242	Warning	Frequency difference of individual channels, sensor 2	System continues to run	Check motion sensor
2310024x	Warning	Frequency difference of individual channels on multichannel sensor	System continues to run	Check motion sensor
2310025x	Warning	EMC malfunction	System continues to run	Check EMC environment, following wiring instructions, support request
2310026x	Warning	Interruption at push/pull sensor output	System continues to run	Check motion sensor
23100270	Warning	EMC malfunction	System continues to run	Check EMC environment, following wiring instructions, support request
23100271	Warning	EMC malfunction	System continues to run	Check EMC environment, following wiring instructions, support request
2310030x	Warning	Stuck-at-low at I13 or I14	System continues to run	Check motion sensor
231003x0	Warning	Stuck-at-low at I15 or I16	System continues to run	Check motion sensor
23100401	Warning	Maximum position value exceeded	System continues to run	Check motion sensor
23100403	Warning	Maximum speed exceeded	System continues to run	Check motion sensor
23100404	Warning	No valid information on rotational direction	System continues to run	Check motion sensor
23100405	Warning	Speed comparison outside of limit	System continues to run	Check motion sensor

Error No.	Error type	Logbook message	System behavior	Remedy
23100406	Warning	Position comparison outside limit	System continues to run	Check motion sensor
23100407	Warning	Error in system configuration	System continues to run	Change system configuration and reload
23100408	Warning	Maximum position exceeded	System continues to run	Check motion sensor
23100409	Warning	Minimum position undershot	System continues to run	Check motion sensor
2310040 A	Info	Reset required (activation of the vibration filter at a standstill)	System continues to run	When activating from a standstill, the drive stop signal must be confirmed by a reset.
23100501	Info	No sensor signal	System continues to run	Check motion sensor
2310060x	Warning	Stuck-at at I13 or I14	System continues to run	Check motion sensor
231006x0	Warning	Stuck-at at I15 or I16	System continues to run	Check motion sensor
23200100	Info	Sensor error rectified	System continues to run	Check the analog sensor
23200801	Warning	Analog sensor warning	System continues to run	Check the analog sensor
23200810	Warning	Tolerance error in duel-channel monitoring system	System continues to run	Check the analog sensor
23200C00	Warning	Analog sensor error	System continues to run	Check the analog sensor
2320xxxx	Warning	Analog sensor error	System continues to run	Check the analog sensor
240A0000	Warning	Output error at Q1	System continues to run; affected outputs switch off	Check outputs
240A0001	Warning	Output error at Q2	System continues to run; affected outputs switch off	Check outputs
240A0002	Warning	Output error at Q3	System continues to run; affected outputs switch off	Check outputs
240A0003	Warning	Output error at Q4	System continues to run; affected outputs switch off	Check outputs
240A0004	Warning	Output error at IQ1	System continues to run; affected outputs switch off	Check outputs
240A0005	Warning	Output error at IQ2	System continues to run; affected outputs switch off	Check outputs

Error No.	Error type	Logbook message	System behavior	Remedy
240A0006	Warning	Output error at IQ3	System continues to run; affected outputs switch off	Check outputs
240A0007	Warning	Output error at IQ4	System continues to run; affected outputs switch off	Check outputs
240A0008	Warning	Output error at group Q1/Q2	System continues to run; affected outputs switch off	Check outputs
240A0009	Warning	Output error at group Q3/Q4	System continues to run; affected outputs switch off	Check outputs
240A000A	Warning	Output error at group IQ1/IQ2	System continues to run; affected outputs switch off	Check outputs
240A000B	Warning	Output error at group IQ3/IQ4	System continues to run; affected outputs switch off	Check outputs
240Axxxx	Error	Output error	System stop	Check outputs
240B0001	Info	Output error at Q1/Q2 rectified	System continues to run	---
240B0002	Info	Output error at Q3/Q4 rectified	System continues to run	---
240B0003	Info	Output error at IQ1/IQ2 rectified	System continues to run	---
240B0004	Info	Output error at IQ3/IQ4 rectified	System continues to run	---
240Bxxxx	Info	Output error rectified	System continues to run	---
240Dxxxx	Error	Error in system configuration	System stop	Reload system config-uration and restart
240Exxxx	Warning	Problem with force mode	System continues to run	Restart forcing
240Fxxxx	Warning	Problem with force mode	System continues to run	Restart forcing
2410xxxx	Warning	Problem with force mode	System continues to run	Restart forcing
2411xxxx	Warning	Problem with force mode	System continues to run	Restart forcing
2412xxxx	Warning	Problem with force mode	System continues to run	Restart forcing
2413xxxx	Warning	Problem with force mode	System continues to run	Restart forcing
2414xxxx	Warning	Problem with force mode	System continues to run	Restart forcing
2415xxxx	Warning	Problem with force mode	System continues to run	Restart forcing

Error No.	Error type	Logbook message	System behavior	Remedy
2416xxxx	Warning	Connection problem	System stop	Restart
2417xxxx	Warning	Force mode time expired	System continues to run	---
2418xxxx	Error	Internal error	System stop	Restart or make complaint
2419xxxx	Warning	Error in system configuration.	System continues to run	Reload system configuration
241Axxxx	Warning	Output error	System continues to run	Check outputs
241B0001	Warning	Stuck-at-high at Q1	System continues to run	Check outputs
241B0002	Warning	Stuck-at-high at Q2	System continues to run	Check outputs
241B0003	Warning	Stuck-at-high at Q3	System continues to run	Check outputs
241B0004	Warning	Stuck-at-high at Q4	System continues to run	Check outputs
241B0005	Warning	Stuck-at-high at IQ1	System continues to run	Check outputs
241B0006	Warning	Stuck-at-high at IQ2	System continues to run	Check outputs
241B0007	Warning	Stuck-at-high at IQ3	System continues to run	Check outputs
241B0008	Warning	Stuck-at-high at IQ4	System continues to run	Check outputs
241Bxxxx	Warning	Output error	System continues to run	Check outputs
241D0001	Warning	Test pulse error at I1	System continues to run	Check cabling
241D0002	Warning	Test pulse error at I2	System continues to run	Check cabling
241D0003	Warning	Test pulse error at I3	System continues to run	Check cabling
241D0004	Warning	Test pulse error at I4	System continues to run	Check cabling
241D0005	Warning	Test pulse error at I5	System continues to run	Check cabling
241D0006	Warning	Test pulse error at I6	System continues to run	Check cabling
241D0007	Warning	Test pulse error at I7	System continues to run	Check cabling
241D0008	Warning	Test pulse error at I8	System continues to run	Check cabling
241D0009	Warning	Test pulse error at I9	System continues to run	Check cabling

Error No.	Error type	Logbook message	System behavior	Remedy
241D000A	Warning	Test pulse error at I10	System continues to run	Check cabling
241D000B	Warning	Test pulse error at I11	System continues to run	Check cabling
241D000C	Warning	Test pulse error at I12	System continues to run	Check cabling
241D000D	Warning	Test pulse error at I13	System continues to run	Check cabling
241D000E	Warning	Test pulse error at I14	System continues to run	Check cabling
241D000F	Warning	Test pulse error at I15	System continues to run	Check cabling
241D0010	Warning	Test pulse error at I16	System continues to run	Check cabling
241D0011	Warning	Test pulse error at IQ1	System continues to run	Check cabling
241D0012	Warning	Test pulse error at IQ2	System continues to run	Check cabling
241D0013	Warning	Test pulse error at IQ3	System continues to run	Check cabling
241D0014	Warning	Test pulse error at IQ4	System continues to run	Check cabling
241Dxxxx	Warning	Check of test pulses returned an error	System continues to run	Check cabling
241Exxxx	Warning	Verification of project failed	System continues to run	Re-verification
241Fxxxx	Warning	Verification of project failed	System continues to run	Re-verification
2420xxxx	Warning	Verification of project failed	System continues to run	Re-verification
2421xxxx	Warning	Verification of project failed	System continues to run	Re-verification
2422xxxx	Warning	Verification of project failed	System continues to run	Re-verification
2423xxxx	Info	The verified project on the SD card has changed	System continues to run	---
2433xxxx	Warning	Problem during fast shut-off	System continues to run	---
2435Fx00	Warning	Safety mat cable break	System continues to run	Check cabling
2435Fx02	Warning	Safety mat cable break	System continues to run	Check cabling
2435Fx04	Warning	Safety mat cable break	System continues to run	Check cabling
2435Fx06	Warning	Safety mat cable break	System continues to run	Check cabling

Error No.	Error type	Logbook message	System behavior	Remedy
2435Fx08	Warning	Safety mat cable break	System continues to run	Check cabling
2435Fx0A	Warning	Safety mat cable break	System continues to run	Check cabling
2435Fx0C	Warning	Safety mat cable break	System continues to run	Check cabling
2435Fx0E	Warning	Safety mat cable break	System continues to run	Check cabling
2435Fx10	Warning	Safety mat cable break	System continues to run	Check cabling
2435Fx12	Warning	Safety mat cable break	System continues to run	Check cabling
2435Fxxx	Warning	Safety mat cable break	System continues to run	Check cabling
2435xxxx	Warning	Safety mat cable break	System continues to run	Check cabling
2436xxxx	Warning	Check of a safety feature	System continues to run	Unverification of project
2437xxxx	Warning	Check of a safety feature	System continues to run	Reduce the number of forced inputs to less than or equal to 10
2438xxxx	Warning	Configuration data faulty	System continues to run	Modify project data or make complaint
2439xxxx	Error	The configuration changed during execution of the application	System stop	Restart or make complaint
243Bxxxx	Warning	Configuration data faulty	System continues to run	Modify project data or make complaint
243CFx00	Warning	Stuck-at-high safety mat at I1	System continues to run	Check cabling
243CFx01	Warning	Stuck-at-high safety mat at I2	System continues to run	Check cabling
243CFx02	Warning	Stuck-at-high safety mat at I3	System continues to run	Check cabling
243CFx03	Warning	Stuck-at-high safety mat at I4	System continues to run	Check cabling
243CFx04	Warning	Stuck-at-high safety mat at I5	System continues to run	Check cabling
243CFx05	Warning	Stuck-at-high safety mat at I6	System continues to run	Check cabling
243CFx06	Warning	Stuck-at-high safety mat at I7	System continues to run	Check cabling
243CFx07	Warning	Stuck-at-high safety mat at I8	System continues to run	Check cabling
243CFx08	Warning	Stuck-at-high safety mat at I9	System continues to run	Check cabling

Error No.	Error type	Logbook message	System behavior	Remedy
243CFx09	Warning	Stuck-at-high safety mat at I10	System continues to run	Check cabling
243CFx0A	Warning	Stuck-at-high safety mat at I11	System continues to run	Check cabling
243CFx0B	Warning	Stuck-at-high safety mat at I12	System continues to run	Check cabling
243CFx0C	Warning	Stuck-at-high safety mat at I13	System continues to run	Check cabling
243CFx0D	Warning	Stuck-at-high safety mat at I14	System continues to run	Check cabling
243CFx0E	Warning	Stuck-at-high safety mat at I15	System continues to run	Check cabling
243CFx0F	Warning	Stuck-at-high safety mat at I16	System continues to run	Check cabling
243CFx10	Warning	Stuck-at-high safety mat at IQ1	System continues to run	Check cabling
243CFx11	Warning	Stuck-at-high safety mat at IQ2	System continues to run	Check cabling
243CFx12	Warning	Stuck-at-high safety mat at IQ3	System continues to run	Check cabling
243CFx13	Warning	Stuck-at-high safety mat at IQ4	System continues to run	Check cabling
243CFxxx	Warning	Stuck-at-high safety mat	System continues to run	Check cabling
243D0012	Warning	Error in system configuration	Config required	Reload system configuration
243D0034	Warning	Error in system configuration	Config required	Reload system configuration
243Fxxxx	Warning	Error in system configuration	Config required	Reload system configuration
24400000	Error	Internal error	System stop	Replace the device
2441xxxx	Error	Internal error	System stop	Replace the device
24420000	Warning	Error in system configuration	---	---
2443000x	Warning	Input I13-I16 only for motion sensors	Configuration required	Reload system configuration
24440000	Warning	Phase error A/B	System continues to run	Check AB phase sequence: 200us minimum distance!
2445xxxx	Error	Internal error	System stop	Avoid high-frequency signals at I13-I16 during power-up, otherwise replace the device
250100x1	Warning	Power supply A1 too low	System continues to run	Supply voltage must be set correctly

Error No.	Error type	Logbook message	System behavior	Remedy
250100x2	Warning	Power supply B1 too low	System continues to run	Supply voltage must be set correctly
250100x3	Warning	Power supply B2 too low	System continues to run	Supply voltage must be set correctly
2501xxxx	Warning	Power supply too low	System continues to run	Supply voltage must be set correctly
250200x1	Warning	Power supply A1 too high	System continues to run	Supply voltage must be set correctly
250200x2	Warning	Power supply B1 too high	System continues to run	Supply voltage must be set correctly
250200x3	Warning	Power supply B2 too high	System continues to run	Supply voltage must be set correctly
2502xxxx	Warning	Power supply too high	System continues to run	Supply voltage must be set correctly
2503xxx1	Error	Power supply A1 too low	System stop	Supply voltage must be set correctly
2504xxx1	Error	Power supply A1 too high	System stop	Supply voltage must be set correctly
2504xxx2	Error	Power supply B1 too high	System stop	Supply voltage must be set correctly
2504xxx3	Error	Power supply B2 too high	System stop	Supply voltage must be set correctly
2504xxxx	Error	Power supply too high	System stop	Supply voltage must be set correctly
250500x1	Info	Supply voltage A1 within normal range	System continues to run	---
250500x2	Info	Supply voltage B1 within normal range	System continues to run	---
250500x3	Info	Supply voltage B2 within normal range	System continues to run	---
2505xxxx	Info	Supply voltage within normal range	System continues to run	---
250900x1	Warning	Overcurrent at output group Q1/Q2	System continues to run	Check load current
250900x2	Warning	Overcurrent at output group Q3/Q4	System continues to run	Check load current
250900x3	Warning	Overcurrent at output group IQ1/IQ2	System continues to run	Check load current
250900x4	Warning	Overcurrent at output group IQ3/IQ4	System continues to run	Check load current
2509xxxx	Warning	Overcurrent at output	System continues to run	Check load current
250Axxxx	Error	Power supply at A1 too high	System stop	Check voltage at A1
250Bxxxx	Error	Power supply at A1 too high	System stop	Check voltage at A1

Error No.	Error type	Logbook message	System behavior	Remedy
2604xxxx	Warning	Internal/external S-bus error	System continues to run	Reduce the number of expansion modules
2609xxxx	Warning	Error in system configuration	System continues to run	Reload system config-uration
260Axxxx	Warning	Error in system configuration	System continues to run	Reload system config-uration
260Bxxxx	Error	Too many expansion modules plugged in	System stop	Check connection of modules
260Cxxxx	Error	Error from an I/O module	System stop	Check connection of modules
2733xxxx	Warning	Input discrepancy rectified	System continues to run	---
28020000	Info	Values were changed	System continues to run	---
2805xxxx	Warning	Communication interrupted	System continues to run	Restart or make com-plaint
2808xxxx	Warning	No SD card	Configuration required	Insert SD card
2809xxxx	Warning	Action not permitted	System continues to run	Execute correct action
280Axxxx	Warning	Ethernet connection too slow	System continues to run	---
2B0Exxxx	Warning	Time for logic processing exceeded	System continues to run	---
2Bxxxxxx	Warning	Internal error	System continues to run	---
3409xxxx	Warning	Invalid force request	System continues to run	---
340Axxxx	Warning	Invalid trace request	System continues to run	---
34290003	Warning	Synchronization time error I1/I2	System continues to run	---
3429000C	Warning	Synchronization time error I3/I4	System continues to run	---
34290030	Warning	Synchronization time error I5/I6	System continues to run	---
342900C0	Warning	Synchronization time error I7/I8	System continues to run	---
3429xxxx	Warning	Dual-channel synchronization time er-ror	System continues to run	---
342A0003	Warning	Sequence error at I1/I2	System continues to run	---
342A000C	Warning	Sequence error at I3/I4	System continues to run	---
342A0030	Warning	Sequence error at I5/I6	System continues to run	---

Error No.	Error type	Logbook message	System behavior	Remedy
342A00C0	Warning	Sequence error at I7/I8	System continues to run	---
342Axxxx	Warning	Sequence error at 2-channel input	System continues to run	---
36010001	Warning	External test pulse error at I1	System continues to run	---
36010002	Warning	External test pulse error at I2	System continues to run	---
36010004	Warning	External test pulse error at I3	System continues to run	---
36010008	Warning	External test pulse error at I4	System continues to run	---
36010010	Warning	External test pulse error at I5	System continues to run	---
36010020	Warning	External test pulse error at I6	System continues to run	---
36010040	Warning	External test pulse error at I7	System continues to run	---
36010080	Warning	External test pulse error at I8	System continues to run	---
3601xxxx	Warning	Error at external input test pulse	System continues to run	---
3602xxxx	Warning	Safety mat cable break	System continues to run	---
3702xxxx	Warning	Short circuit, stuck-at-low, VCC or GND break	System continues to run	---
37040003	Warning	Cross-point fault at Q1/Q2	System continues to run	---
3704000C	Warning	Cross-point fault at Q3/Q4	System continues to run	---
3704xxxx	Warning	Cross-point fault at the output	System continues to run	---
37050001	Warning	Stuck-at-high at Q1	System continues to run	---
37050002	Warning	Stuck-at-high at Q2	System continues to run	---
37050004	Warning	Stuck-at-high at Q3	System continues to run	---
37050008	Warning	Stuck-at-high at Q4	System continues to run	---
3705xxxx	Warning	Stuck-at-high at the output	System continues to run	---
3801xxxx	Error	Power supply error (logic voltage)	System stop; voltage OFF-ON required	---
3802xxxx	Error	Power pack monitoring	System stop; voltage OFF-ON required	---

Error No.	Error type	Logbook message	System behavior	Remedy
3803xxxx	Error	Output voltage error	System stop; voltage OFF-ON required	---
3806xxxx	Warning	GND break at A1 and A2	System continues to run	---
3807xxxx	Warning	Power supply A1 too low	System continues to run	---
3902xxxx	Warning	Error in system configuration	System continues to run	---
3903xxxx	Warning	Error in system configuration	System continues to run	---
3904xxxx	Warning	Error in system configuration	System continues to run	---
3905xxxx	Warning	Invalid value for synchronous time	System continues to run	Configure synchronous time with value 0 or a whole-number multiple of 4 ms
3906xxxx	Warning	Error in system configuration	System continues to run	---
3907xxxx	Warning	Error in system configuration	System continues to run	---
3908xxxx	Warning	Error in system configuration	System continues to run	---
3909xxxx	Warning	Error in system configuration	System continues to run	---
390Axxxx	Warning	Error in system configuration	System continues to run	---
390Bxxxx	Warning	Error in system configuration	System continues to run	---
390Cxxxx	Warning	Error in system configuration	System continues to run	---
390Dxxxx	Warning	Error in system configuration	System continues to run	---
390Exxxx	Warning	Error in system configuration	System continues to run	---
390Fxxxx	Warning	Error in system configuration	System continues to run	---
3910xxxx	Warning	Error in system configuration	System continues to run	---
3911xxxx	Warning	Error in system configuration	System continues to run	---
3945xxxx	Warning	Fast shut-off control signal faulty	System continues to run	---
4102xxxx	Warning	CRC error in the configuration	System continues to run	---
4103xxxx	Warning	Module type deviates	System continues to run	---

Error No.	Error type	Logbook message	System behavior	Remedy
4104xxxx	Warning	Module version deviates	System continues to run	---
4106xxxx	Warning	Service data object not processed	System continues to run	---
41070020	Warning	Empty gateway mapping for output data is not permitted	System continues to run	Correct the gateway mapping, empty mapping is not permitted for output data.
4107xxxx	Warning	Error in the configuration data	System continues to run	---
4208xxxx	Error	Internal error	System stop; voltage OFF-ON required	Check the gateway mapping, empty mapping is not permitted for output data.
4302xxxx	Info	Service data object not processed	System continues to run	---
4303xxxx	Info	Service data object not processed	System continues to run	---
4304xxxx	Info	Service data object not processed	System continues to run	---
4305xxxx	Info	Service data object not processed	System continues to run	---
4306xxxx	Info	Service data object not processed	System continues to run	---
4307xxxx	Info	Service data object not processed	System continues to run	---
4309xxxx	Info	Service data object not processed	System continues to run	---
430Bxxxx	Error	Gateway address is outside of the permissible range	System stop; voltage OFF-ON required	---
4501xxxx	Warning	Data loss in the reception memory due to very high bus load	System continues to run	---
4502xxxx	Warning	CAN controller TEC or REC >= 96	System continues to run	---
4503xxxx	Warning	CAN controller TEC or REC > 127	System continues to run	---
4504xxxx	Warning	CAN controller TEC > 255	System continues to run	---
4505xxxx	Warning	Transmission of a message was faulty	System continues to run	---
4506xxxx	Warning	Data loss in transmit buffer due to overload	System continues to run	---
4507xxxx	Error	Initializing was faulty	System stop; voltage OFF-ON required	---
4508xxxx	Warning	Lifeguarding faulty	System continues to run	---

Error No.	Error type	Logbook message	System behavior	Remedy
4601xxxx	Error	Faulty stack initializing	System stop; voltage OFF-ON required	---
4602xxxx	Error	A stack error occurred during runtime	System stop; voltage OFF-ON required	---
4603xxxx	Error	An AS protocol error occurred during runtime	System stop; voltage OFF-ON required	Read out the error log in the PLC and eliminate the corresponding protocol error
4604xxxx	Warning	An AS protocol error occurred during runtime	System continues to run	Read out the error log in the PLC and eliminate the corresponding protocol error
4605xxxx	Warning	Incorrect description file, a timeout occurred, or the PLC is not running.	System continues to run	Read out the error log in the PLC, check the cabling and the device description file, note the product code and revision in particular
50xxxxxx	Warning	Modbus/TCP error	System continues to run	---
51xxxxxx	Warning	PROFINET IO error	System continues to run	---
5201xxxx	Error	Too many Ethernet/IP connections	System continues to run	---
5202xxxx	Warning	Incorrect Ethernet/IP data format	System continues to run	---
5203xxxx	Warning	Incorrect Ethernet/IP data format	System continues to run	---
5204xxxx	Warning	Incorrect Ethernet/IP data size	System continues to run	---
5205xxxx	Warning	Incorrect Ethernet/IP command	System continues to run	---
5206xxxx	Warning	Ethernet/IP read error	System continues to run	---
5209xxxx	Warning	Incorrect Ethernet/IP data index	System continues to run	---
520C00xx	Error	Incorrect Ethernet/IP connection configuration	System continues to run	---
520Fxxxx	Warning	Ethernet/IP timeout	System continues to run	---
52xxxxxx	Warning	Ethernet/IP error	System continues to run	---
60000000	Info	Log file deleted	System continues to run	---
60000005	Info	Device is linked to a project file	System continues to run	---

Error No.	Error type	Logbook message	System behavior	Remedy
60000010	Info	Time was reset	System continues to run	---
60000020	Info	IPv4 address and gateway	System continues to run	---
60000030	Info	Log file replaced	System continues to run	---
60000031	Warning	Log file has reached maximum size	System continues to run	Delete log file
63xxxxxx	Warning	USB error	System continues to run	---
640A0001	Warning	SD card cannot be read	Configuration required	---
64xxxxxx	Warning	File system error on SD card	Configuration required	---
650A0001	Warning	IPv4 address conflict	System continues to run	Configure a different IPv4 address
65xxxxxx	Warning	Ethernet error	System continues to run	---
68080003	Warning	Device is linked to another project file	Configuration required	Use the appropriate project file
68080005	Error	Incorrect activation code	---	---
680A0001	Warning	Power supply A1 too low	Configuration required	---
680B0010	Error	Project file is not activated for this device	Configuration required	Use a different project file
690Fxxxx	Warning	Communication interrupted	System continues to run	---
6A020001	Warning	Communication (Ethernet/USB) disrupted	System continues to run	---
6A04xxxx	Warning	Communication (Ethernet/USB) disrupted	System continues to run	---
6A06xxxx	Warning	TCP socket error	System continues to run	---
6A0Cxxxx	Warning	TCP connection failed	System continues to run	---
6Axxxxxx	Warning	Communication error (Ethernet/USB)	System continues to run	---
6B010001	Error	Cannot read project file project.xml	Configuration required	Use a different project file
6B010002	Error	Cannot write project.xml	---	---
6B010010	Error	Cannot read metadata.xml	---	---
6B03000x	Error	Project file faulty	Configuration required	Use a different project file
6B04xxxx	Warning	Project file faulty	Configuration required	Use a different project file
6B0x001x	Error	metadata.xml faulty	---	---
6Bxxxxxx	Warning	File error	Configuration required	---

Error No.	Error type	Logbook message	System behavior	Remedy
7203xxxx	Warning	Module type deviation	Configuration required	---
7204xxxx	Warning	Software version discrepancy	Configuration required	---
7301xxxx	Warning	CRC8 of retrieved ADC value is incorrect	System continues to run	---
7302xxxx	Warning	Status of retrieved ADC value is incorrect	System continues to run	---
7412xxxx	Error	Internal temperature too high	System stop; voltage OFF-ON required	---
7413xxxx	Warning	Internal temperature too low	System continues to run	---
7416xxxx	Warning	Sensor 1: RTD excitation current deviation too high	System continues to run	---
7417xxxx	Warning	Sensor 2: RTD excitation current deviation too high	System continues to run	---
7418xxxx	Warning	Sensor 3: RTD excitation current deviation too high	System continues to run	---
7419xxxx	Warning	Sensor 4: RTD excitation current deviation too high	System continues to run	---
7440xxxx	Warning	Sensor 1: Value below lower input limit	System continues to run	---
7441xxxx	Warning	Sensor 2: Value below lower input limit	System continues to run	---
7442xxxx	Warning	Sensor 3: Value below lower input limit	System continues to run	---
7443xxxx	Warning	Sensor 4: Value below lower input limit	System continues to run	---
7444xxxx	Warning	Sensor 1: Below configured user range	System continues to run	---
7445xxxx	Warning	Sensor 2: Below configured user range	System continues to run	---
7446xxxx	Warning	Sensor 3: Below configured user range	System continues to run	---
7447xxxx	Warning	Sensor 4: Below configured user range	System continues to run	---
7448xxxx	Warning	Sensor 1: Above configured user range	System continues to run	---
7449xxxx	Warning	Sensor 2: Above configured user range	System continues to run	---
744Axxxx	Warning	Sensor 3: Above configured user range	System continues to run	---
744Bxxxx	Warning	Sensor 4: Above configured user range	System continues to run	---
744Cxxxx	Warning	Sensor 1: Value above upper input limit	System continues to run	---

Error No.	Error type	Logbook message	System behavior	Remedy
744Dxxxx	Warning	Sensor 2: Value above upper input limit	System continues to run	---
744Exxxx	Warning	Sensor 3: Value above upper input limit	System continues to run	---
744Fxxxx	Warning	Sensor 4: Value above upper input limit	System continues to run	---
7454xxxx	Warning	Sensor 1: Short-circuit at RTD input	System continues to run	---
7455xxxx	Warning	Sensor 2: Short-circuit at RTD input	System continues to run	---
7456xxxx	Warning	Sensor 3: Short-circuit at RTD input	System continues to run	---
7457xxxx	Warning	Sensor 4: Short-circuit at RTD input	System continues to run	---
7458xxxx	Warning	Sensor 1: RTD is disconnected	System continues to run	---
7459xxxx	Warning	Sensor 2: RTD is disconnected	System continues to run	---
745Axxxx	Warning	Sensor 3: RTD is disconnected	System continues to run	---
745Bxxxx	Warning	Sensor 4: RTD is disconnected	System continues to run	---
745Cxxxx	Warning	Sensor 1: RTD stuck at high	System continues to run	---
745Dxxxx	Warning	Sensor 2: RTD stuck at high	System continues to run	---
745Exxxx	Warning	Sensor 3: RTD stuck at high	System continues to run	---
745Fxxxx	Warning	Sensor 4: RTD stuck at high	System continues to run	---
7460xxxx	Warning	Sensor 1: Short-circuit at CUR input	System continues to run	---
7461xxxx	Warning	Sensor 2: Short-circuit at CUR input	System continues to run	---
7462xxxx	Warning	Sensor 3: Short-circuit at CUR input	System continues to run	---
7463xxxx	Warning	Sensor 4: Short-circuit at CUR input	System continues to run	---
7464xxxx	Warning	Sensor 1: CUR is disconnected	System continues to run	---
7465xxxx	Warning	Sensor 2: CUR is disconnected	System continues to run	---
7466xxxx	Warning	Sensor 3: CUR is disconnected	System continues to run	---
7467xxxx	Warning	Sensor 4: CUR is disconnected	System continues to run	---

Error No.	Error type	Logbook message	System behavior	Remedy
7468xxxx	Warning	Sensor 1: CUR stuck at high	System continues to run	Operate sensor within the work area
7469xxxx	Warning	Sensor 2: CUR stuck at high	System continues to run	Operate sensor within the work area
746Axxxx	Warning	Sensor 3: CUR stuck at high	System continues to run	Operate sensor within the work area
746Bxxxx	Warning	Sensor 4: CUR stuck at high	System continues to run	Operate sensor within the work area

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