MELSEC WS Series

Safety Controller

Operating Manual

WS0-CPU0
WS0-CPU1
SW1DNN-WS0ADR-B

Art. no.: SH(NA)-080856
02032010
Version B

Precautions regarding warranty and specifications

MELSEC-WS series products are jointly developed and manufactured by Mitsubishi and SICK AG, Industrial Safety Systems, in Germany.

Note that there are some precautions regarding warranty and specifications of MELSEC-WS series products.

<Warranty>

- The gratis warranty term of the product shall be for one (1) year after the date of delivery or for eighteen (18) months after manufacturing, whichever is less.
- The onerous repair term after discontinuation of production shall be for four (4) years.
- Mitsubishi shall mainly replace the product that needs a repair.
- It may take some time to respond to the problem or repair the product depending on the condition and timing.

<Specifications>

- General specifications of the products differ.

	MELSEC-WS	**MELSEC-Q, MELSEC-QS**
Operating ambient temperature	-25 to 55°C*1	0 to 55°C
Operating ambient humidity	10 to 95%RH	5 to 95%RH
Storage ambient temperature	-25 to 70°C	-25 to 75°C*2
Storage ambient humidity	10 to 95%RH	5 to 95%RH

*1 When the WS0-GCC100202 is included in the system, operating ambient temperature will be 0 to 55 °C.

*2 For the MELSEC-QS series programmable controller, storage ambient temperature will be -40 to 75°C.

- EMC standards that are applicable to the products differ.

	MELSEC-WS	**MELSEC-Q, MELSEC-QS**
EMC standards	EN61000-6-2, EN55011	EN61131-2

● SAFETY PRECAUTIONS ●

(Read these precautions before using this product.)

Before using this product, please read this manual, the relevant manuals, and the safety standards carefully and pay full attention to safety to handle the product correctly.
In this manual, the safety precautions are classified into two levels: "⚠WARNING" and "⚠CAUTION".

⚠WARNING	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠CAUTION	Indicates that incorrect handling may cause hazardous conditions, resulting in minor or moderate injury or property damage.

Under some circumstances, failure to observe the precautions given under "⚠CAUTION" may lead to serious consequences.
Observe the precautions of both levels because they are important for personal and system safety.
Make sure that the end users read this manual and then keep the manual in a safe place for future reference.

[Design Precautions]

⚠WARNING

- When the MELSEC-WS safety controller detects a fault in the external power supply or itself, it turns off the outputs. Configure an external circuit so that the connected devices are powered off according to the output status (off) of the MELSEC-WS safety controller. Incorrect configuration may result in an accident.
- When a load current exceeding the rated current or an overcurrent caused by a load short-circuit flows for a long time, it may cause smoke and fire. To prevent this, configure an external safety circuit, such as a fuse.
- For safety relays, configure an external circuit using a device such as a fuse or breaker to protect a short-circuit current.
- When changing data and operating status, and modifying program of the running MELSEC-WS safety controller from the PC, configure a safety circuit in the sequence program or external to the MELSEC-WS safety controller to ensure that the entire system operates safely.
  Before operating the MELSEC-WS safety controller, read the relevant manuals carefully and determine the operating procedure so that the safety can be ensured.
  Furthermore, before performing online operations for the MELSEC-WS safety controller from the PC, determine corrective actions to be taken for communication errors caused by failure such as a poor contact.
- Create an interlock program using a reset button to prevent the MELSEC-WS safety controller from restarting automatically after the safety function is activated and the safety controller turns off the outputs.

⚠ CAUTION

- Ensure that an entire system using the MELSEC-WS safety controller meets the requirements for the corresponding safety category.
- The life of safety relays in the safety relay output module depends on the switching condition and/or load. Configure a system satisfying the number of switching times of the safety relays in the module.
- Do not install the communication cables together with the main circuit lines or power cables. Keep a distance of 100 mm or more between them.
  Failure to do so may result in malfunction due to noise.
- **Observe the protective notes and measures.**
  Observe the following items in order to ensure proper use of the MELSEC-WS safety controller.
  - When mounting, installing and using the MELSEC-WS safety controller, observe the standards and directives applicable in your country.
  - The national/international rules and regulations apply to the installation, use and periodic technical inspection of the MELSEC-WS safety controller, in particular.
    - Machinery Directive 2006/42/EC
    - EMC Directive 2004/108/EC
    - Provisition and Use of Work Equipment Directive 89/655/EC
    - Low-Voltage Directive 2006/95/EC
    - The work safety regulations/safety rules
  - Manufacturers and owners of the machine on which a MELSEC-WS safety controller is used are responsible for obtaining and observing all applicable safety regulations and rules.
  - The notices, in particular the test notices of this manual (e.g. on use, mounting, installation or integration into the existing machine controller), must be observed.
  - The test must be carried out by specialised personnel or specially qualified and authorized personnel and must be recorded and documented and retraced at any time by third parties.
  - The external voltage supply of the device must be capable of buffering brief mains voltage failures of 20 ms as specified in EN 60204.
  - The modules of the MELSEC-WS safety controller conform to Class A, Group 1, in accordance with EN 55011. Group 1 encompasses all the ISM devices in which intentionally generated and/or used conductor-bound RF energy that is required for the inner function of the device itself occurs.
- **The MELSEC-WS safety controller fulfils the requirements of Class A (industrial applications) in accordance with the “Interference emission” basic specifications.**
  The MELSEC-WS safety controller is therefore only suitable for use in an industrial environment and not for private use.

[Installation Precautions]

⚠ WARNING
● Do not use the MELSEC-WS safety controller in flammable gas atmosphere or explosive gas atmosphere. Doing so may result in a fire or explosion due to such as an arc caused by switching the relays.

⚠ CAUTION
● Use the MELSEC-WS safety controller in an environment that meets the general specifications in this manual. Failure to do so may result in electric shock, fire, malfunction, or damage to or deterioration of the product. ● Latch the module onto the DIN rail. Incorrect mounting may cause malfunction, failure or drop of the module. ● To ensure full electromagnetic compatibility (EMC), the mounting rail has to be connected to functional earth (FE). Ensure that the earthling contact is positioned correctly. The earthling spring contact of the module must contact the DIN rail securely to allow electrical conductivity. ● Shut off the external power supply for the system in all phases before mounting or removing the module. Failure to do so may result in damage to the product. ● Do not directly touch any conductive part of the module. Doing so can cause malfunction or failure of the module. ● The MELSEC-WS safety controller is only suitable for mounting in a control cabinet with at least IP 54 degree of protection.

[Wiring Precautions]

⚠WARNING

- Shut off the external power supply for the system in all phases before wiring.
  Failure to do so may result in electric shock or damage to the product.
  The system could start up unexpectedly while you are connecting the devices.

⚠CAUTION

- Ground the FG and LG terminals to the protective ground conductor dedicated to the MELSEC-WS safety controller.
  Failure to do so may result in electric shock or malfunction.
- Check the rated voltage and terminal layout before wiring to the module, and connect the cables correctly.
  Connecting a power supply with a different voltage rating or incorrect wiring may cause a fire or failure.
- Tighten the terminal screw within the specified torque range.
  Undertightening can cause short circuit, fire, or malfunction. Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction.
- Prevent foreign matter such as dust or wire chips from entering the module.
  Such foreign matter can cause a fire, failure, or malfunction.
- Mitsubishi MELSEC-WS safety controllers must be installed in control cabinets. Connect the main power supply to the MELSEC-WS safety controller through a relay terminal block.
  Wiring and replacement of an external power supply must be performed by maintenance personnel who is familiar with protection against electric shock.
- Place the cables in a duct or clamp them.
  If not, dangling cable may swing or inadvertently be pulled, resulting in damage to the module or cables or malfunction due to poor contact.

[Startup and Maintenance Precautions]

⚠ WARNING

- Do not touch any terminal while power is on.
  Doing so will cause electric shock.
- Shut off the external power supply for the system in all phases before cleaning the module or retightening the terminal screws. Failure to do so may result in electric shock.
  Tighten the terminal screw within the specified torque range. Undertightening can cause short circuit, fire, or malfunction.
  Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction.
- **Safety-oriented devices must be suitable for safety related signals.**
  A function interruption of safety outputs results in a loss of the safety functions so that the risk of serious injury exists.
  Do not connect any loads that exceed the rated values of the safety outputs.
  Wire the MELSEC-WS safety controller so that 24 V DC signals cannot unintentionally contact safety outputs.
  Connect the GND wires of the power supply to earth so that the devices do not switch on when the safety output line is applied to frame potential.
  Use suitable components or devices that fulfill all the applicable regulations and standards. Actuators at the outputs can be wired single-channeled. In order to maintain the respective Safety Integrity Level the lines have to be routed in such a manner that cross circuits to other live signals can be excluded, for example by routing them within protected areas such as in a control cabinet or in separate sheathed cables.

⚠ CAUTION
● Before performing online operations (Force mode) for the running MELSEC-WS safety controller from the PC, read the relevant manuals carefully and ensure the safety. The online operations must be performed by qualified personnel, following the operating procedure determined at designing. Fully understand the precautions described in the Safety Controller Setting and Monitoring Tool Operating Manual before use. ● Do not disassemble or modify the modules. Doing so may cause failure, malfunction, injury, or a fire. Mitsubishi does not warrant any products repaired or modified by persons other than Mitsubishi or FA Center authorized by Mitsubishi. ● Shut off the external power supply for the MELSEC-WS safety controller in all phases before mounting or removing the module. Failure to do so may cause the module to fail or malfunction. ● After the first use of the product, do not mount/remove the module from/to the DIN rail, and the terminal block to/from the module more than 50 times (IEC 61131-2 compliant) respectively. Exceeding the limit of 50 times may cause malfunction. ● Before handling the module, touch a grounded metal object to discharge the static electricity from the human body. Failure to do so may cause the module to fail or malfunction.

[Disposal Precautions]

⚠ CAUTION
● When disposing of this product, treat it as industrial waste. Disposal of the product should always occur in accordance with the applicable country-specific waste-disposal regulations (e.g. European Waste Code 16 02 14).

● CONDITIONS OF USE FOR THE PRODUCT ●

(1) Although MELCO has obtained the certification for Product's compliance to the international safety standards IEC61508, EN954-1/ISO13849-1 from TUV Rheinland, this fact does not guarantee that Product will be free from any malfunction or failure. The user of this Product shall comply with any and all applicable safety standard, regulation or law and take appropriate safety measures for the system in which the Product is installed or used and shall take the second or third safety measures other than the Product. MELCO is not liable for damages that could have been prevented by compliance with any applicable safety standard, regulation or law.

(2) MELCO prohibits the use of Products with or in any application involving, and MELCO shall not be liable for a default, a liability for defect warranty, a quality assurance, negligence or other tort and a product liability in these applications.

1) power plants,

2) trains, railway systems, airplanes, airline operations, other transportation systems,

3) hospitals, medical care, dialysis and life support facilities or equipment,

4) amusement equipments,

5) incineration and fuel devices,

6) handling of nuclear or hazardous materials or chemicals,

7) mining and drilling,

8) and other applications where the level of risk to human life, health or property are elevated.

REVISIONS

*The manual number is given on the bottom left of the back cover.

Print date	*Manual number	Revision
September, 2009	SH(NA)-080856ENG-A	First edition
March, 2010	SH(NA)-080856ENG-B	Addition of description on CC-Link interface module

Japanese manual version SH-080853-B

CONTENTS

GENERIC TERMS AND ABBREVIATIONS

Generic term/abbreviation	Description
WS0-MPL	Abbreviation for the WS0-MPL00201 MELSEC-WS safety controller memory plug
WS0-CPU0	Abbreviation for the WS0-CPU000200 MELSEC-WS safety controller CPU module
WS0-CPU1	Abbreviation for the WS0-CPU130202 MELSEC-WS safety controller CPU module
WS0-XTIO	Abbreviation for the WS0-XTIO84202 MELSEC-WS safety controller safety I/O combined module
WS0-XTDI	Abbreviation for the WS0-XTDI80202 MELSEC-WS safety controller safety input module
WS0-4RO	Abbreviation for the WS0-4RO4002 MELSEC-WS safety controller safety relay output module
WS0-GETH	Abbreviation for the WS0-GETH00200 MELSEC-WS safety controller Ethernet interface module
WS0-GCC1	Abbreviation for the WS0-GCC100202 MELSEC-WS safety controller CC-Link interface module
CPU module	Generic term for the WS0-CPU0 and WS0-CPU1
Safety I/O module	Generic term for the WS0-XTIO and WS0-XTDI
Network module	Generic term for the WS0-GETH and WS0-GCC1

1. About this document

Please read this chapter carefully before working with this manual and the MELSEC-WS safety controller.

1.1 Function of this document

For the MELSEC-WS safety controller there are three manuals with clearly distinguished fields of application as well as User's Manuals (Hardware) for each module.

- This manual describes the software-supported configuration and parameterization of the MELSEC-WS safety controller. In addition, the manual contains the description of the diagnostics functions that are important for operation and detailed information for the identification and elimination of errors. Use the manual in particular for the configuration, commissioning and operation of MELSEC-WS safety controllers.
- The Safety Controller User's Manual describes all the MELSEC-WS modules and their functions in detail. Use this manual in particular to configure MELSEC-WS safety controllers (except for network modules).
  The manual instructs the technical staff of the machine manufacturer and/or of the machine operator on the safe mounting, electrical installation, commissioning as well as maintenance of the MELSEC-WS safety controller.
  The manual does not provide instructions for operating the machine in which the safety controller is, or will be, integrated. Information of this kind will be found in the manuals for the machine.
- The User's Manuals for each network module describe the important information on the configuration of the network modules.
- The User's Manuals (Hardware) are enclosed with each MELSEC-WS module. They inform on the basic technical specifications of the modules and contain simple mounting instructions. Use the User's Manuals (Hardware) when mounting the MELSEC-WS safety controller.

The following shows the relevant manuals.

Title	Number
Safety Controller User's Manual	WS-CPU-U-E (13JZ32)
Safety Controller Ethernet Interface Module User's Manual	WS-ET-U-E (13JZ33)
Safety Controller CC-Link Interface Module User's Manual	WS-CC-U-E (13JZ45)
Safety Controller Setting and Monitoring Tool Operating Manual	SW1DNN-WS0ADR-B-O-E (13JU67)
Safety Controller CPU Module User's Manual (Hardware)	WS-CPU-U-HW (13J200)
Safety Controller Safety I/O Module User's Manual (Hardware)	WS-IO-U-HW (13J201)
Safety Controller Safety Relay Output Module User's Manual (Hardware)	WS-SR-U-HW (13J202)
Safety Controller Ethernet Interface Module User's Manual (Hardware)	WS-ET-U-HW (13J203)
Safety Controller CC-Link Interface Module User's Manual (Hardware)	WS-CC-U-HW (13J209)

1.2 Scope

This manual applies to Setting and Monitoring Tool.

Available network modules depend on the version of Setting and Monitoring Tool. Upgrade your Setting and Monitoring Tool as necessary. (See Section 1.4.)

Setting and Monitoring Tool	WS0-GETH	WS0-GCC1
Version 1.2.0.60	○	-
Version 1.2.1.0	○	○

○: Available, -: Not available

1.3 Target group

This manual is addressed to the planning engineers, designers and operators of systems into which a MELSEC-WS safety controller is integrated. It also addresses persons who carry out initial commissioning or who are in charge of servicing or maintaining a safety controller.

This manual does not provide instructions for operating the machine or system in which a MELSEC-WS safety controller is integrated. Information of this kind will be found in the manuals for the machine or system.

1.4 Function and structure of this manual

This manual instructs the technical personnel of the machine manufacturer or machine operator in the software configuration, operation and diagnostics of a MELSEC-WS safety controller using the Setting and Monitoring Tool. It only applies in combination with the Safety Controller User's Manual.

Chapter 2 contains fundamental safety instructions. These instructions must be read.

Note For the acquisition of Setting and Monitoring Tool, please contact your local Mitsubishi representative.

1.4.1 Recommendations for familiarising your self with Setting and Monitoring Tool

We recommend the following procedure for users who want to familiarise themselves with Setting and Monitoring Tool for the first time:

- Read Chapter 4 to familiarise yourself with the graphical user interface and do the exercises for the configuration of example applications.

1.4.2 Recommendations for experienced users

We recommend the following procedure for experienced users who have already worked with Setting and Monitoring Tool:

- Familiarise yourself with the most recent version of the software by reading Section 1.4.
- The table of contents lists all the functions provided by Setting and Monitoring Tool. Use the table of contents to obtain information about the basic functions.

1.5 Symbols and notations used

Note Notes provide special information on a device or a software function.

ATTENTION

Warning!
An “ATTENTION” indicates concrete or potential dangers. These are intended to protect you from harm and help avoid damage to devices and systems.
Read warnings carefully and follow them!

Menus and commands The names of software menus, submenus, options and commands, selection boxes and windows are highlighted in **bold**.
Example: Click **Edit** in the **File** menu.

Key Keys are shown in uppercase.

Keys to be pressed sequentially are hyphenated with “-”.

Example: “CTRL+ALT+DEL” indicates to press these keys simultaneously. “F12-2” indicates to press these keys sequentially. The key names are based on the standard keyboard. Some users may use a keyboard with a different language layout such as German.

2. On safety

This chapter deals with your own safety and the safety of the equipment operators.

- Please read this chapter carefully before working with the MELSEC-WS safety controller.

2.1 Qualified safety personnel

The MELSEC-WS safety controller must be installed, configured, commissioned and serviced only by qualified safety personnel.
Qualified safety personnel are defined as persons who

- have undergone the appropriate technical training
  and
- have been instructed by the responsible machine operator in the operation of the machine and the current valid safety guidelines
  and
- have access to the MELSEC-WS manuals and have read and familiarised themselves with them.

2.2 Correct use

The Setting and Monitoring Tool is used to configure a MELSEC-WS safety controller consisting of modules of the safety controller.
The MELSEC-WS safety controller may only be used by qualified safety personnel and only at the machine at which it was mounted and initially commissioned by qualified safety personnel in accordance with the MELSEC-WS manuals.

ATTENTION

Mitsubishi Electric Corporation accepts no claims for liability if the software or the devices are used in any other way or if modifications are made to the software or the devices - even in the context of mounting and installation.

ATTENTION

Observe the safety instructions and protective measures of the Safety Controller User's Manual and this manual!

ATTENTION

When implementing a safety-relevant functional logic, ensure that the regulations of the national and international rules and standards are observed, in particular the controlling strategies and the measures for risk minimisation that are mandatory for your application.

Note

- When mounting, installing and using the MELSEC-WS safety controller, observe the standards and directives applicable in your country.
- The national and international rules and regulations apply to the installation and use as well as commissioning and periodic technical inspection of the MELSEC-WS safety controller, in particular:
  - Machinery Directive 2006/42/EC
  - EMC Directive 2004/108/EC,
  - Provision and Use of Work Equipment Directive 89/655/EEC and the supplementary Directive 35/63/EC,
  - Low-Voltage Directive 2006/95/EC,
  - Work safety regulations and safety rules.
- The Safety Controller User's Manual and this manual must be made available to the operator of the machine where the MELSEC-WS safety controller is used. The machine operator is to be instructed in the use of the device by qualified safety personnel and must be instructed to read the manuals.

3. Installation and removal

3.1 System requirements

Recommended system configuration:

- Windows XP, or Windows Vista
- .NET Framework 2.0
- 1 GHz processor
- 1 Gbyte work memory
- 1024 x 768 screen resolution
- 200 Mbytes free hard disk memory

Setting and Monitoring Tool is a .NET Framework application. It requires .NET Framework Version 2.0 or higher. Information on the current .NET Framework versions and supported operating systems is available on the Internet at

http://www.microsoft.com/

Microsoft .NET Framework Version 2.0 or higher and any other components that may be needed can also be downloaded from http://www.microsoft.com/downloads/.

Note Use a standard user account or higher in Windows Vista.

3.2 Installation

For the acquisition of Setting and Monitoring Tool (including information for installation), please contact your local Mitsubishi representative. Start the installation by running the setup.exe file and then follow the further instruction.

When an RS232-USB converter (WS0-UC-232A) is used, install a driver from the CD ROM provided with the converter.

3.3 Update

For the latest version of Setting and Monitoring Tool, please contact your local Mitsubishi representative. New software versions may contain new functions and support new MELSEC-WS modules.

Remove the old software version before installing a new one. The working directory in which the project data are stored is not overwritten during the new installation and is retained.

3.4 Removal

The software can be removed as follows:

- In the Windows Start menu, start **Uninstall Setting and Monitoring Tool** in the Setting and Monitoring Tool programme folder.

4. The graphical user interface

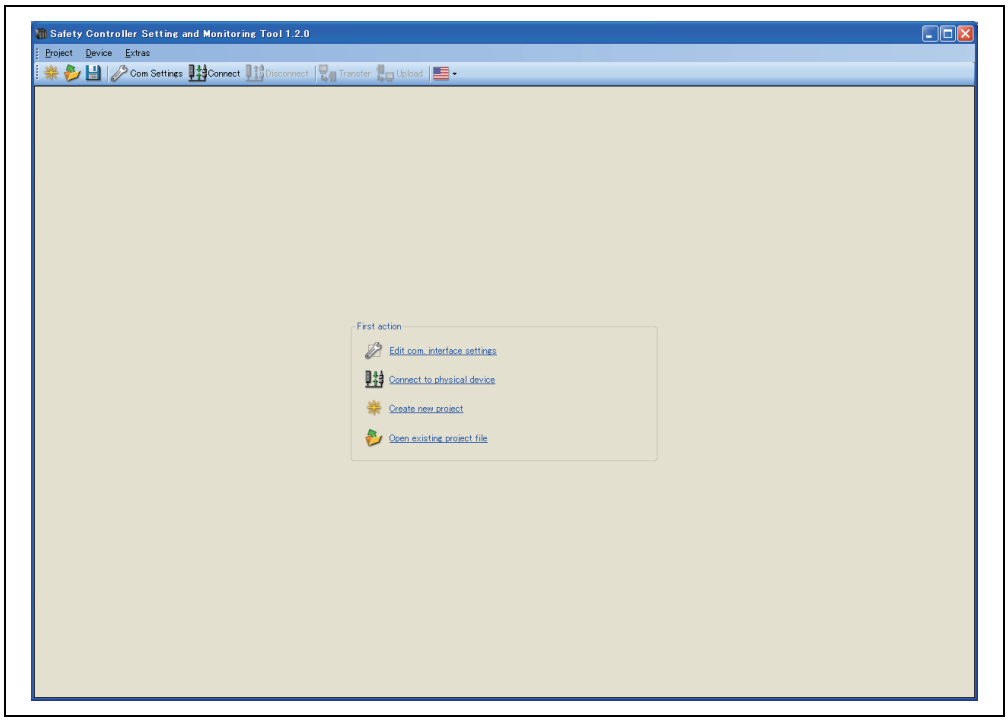
Note This chapter familiarises you with the basic elements of the graphical user interface as an introduction. This chapter does not give any information on the configuration of MELSEC-WS modules nor any instructions for logic programming. This chapter is only intended to explain the fundamental functioning of the Setting and Monitoring Tool on the basis of a small section of the functions. Experienced users of Setting and Monitoring Tool can skip this chapter.

4.1 Start view

After the Setting and Monitoring Tool has been started, the start view is displayed. The user can specify here with which of the following actions he wants to start:

- Adapting the parameters of the serial interface
- Establishing the connection to a physically connected device
- Creating a new project
- Opening an existing project file

Figure 1:
Start view with selection of the action



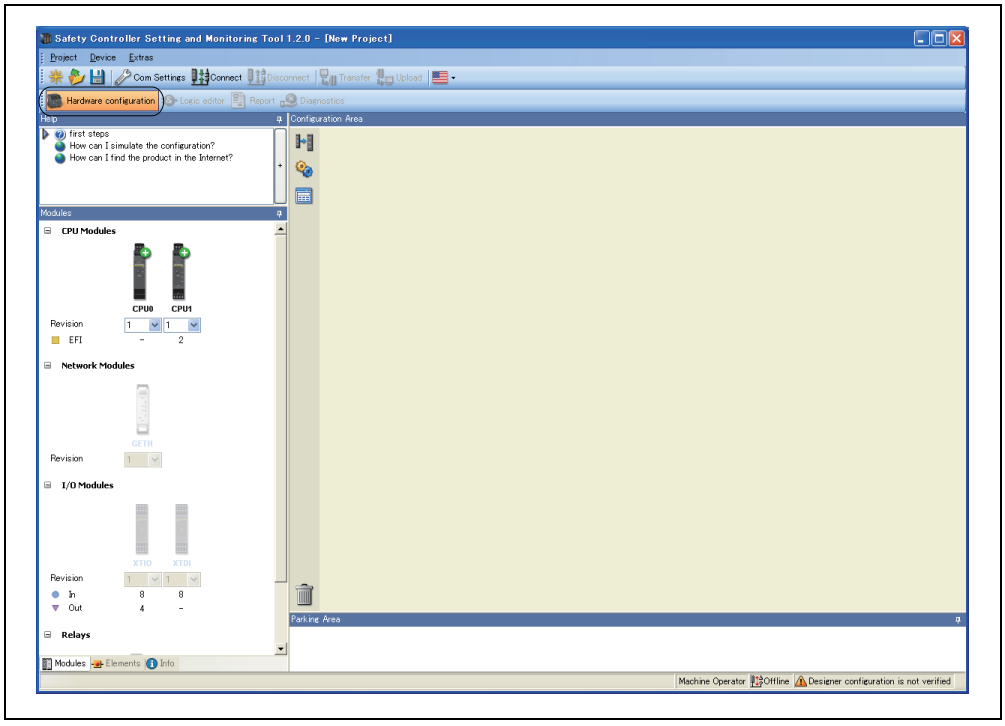
4.2 Setting the desired language

- Click the flag icon in the menu bar at the extreme right and select the desired language version.

4.3 Standard views

The Setting and Monitoring Tool has the following standard views that can be accessed via tabs below the menu bar.

Figure 2:
The view can be selected below the menu bar



- The structure of a MELSEC-WS safety controller consisting of various hardware modules as well as the configuration of the inputs and outputs and the connected elements are specified in the **Hardware configuration** view.
- The function logic can be configured by means of logic function blocks and application-specific function blocks in the **Logic editor** view. This view is not available unless a CPU module has been selected beforehand in the hardware configuration.
- If the project contains at least one network module, the **GETH Network Module [13]** view is available. Here you can configure the network module and the data that are transferred to and from the network.

Note Do not save the project data while Setting and Monitoring Tool is connected to the MELSEC-WS safety controller.
Before saving the project data, disconnect the PC from the MELSEC-WS safety controller.

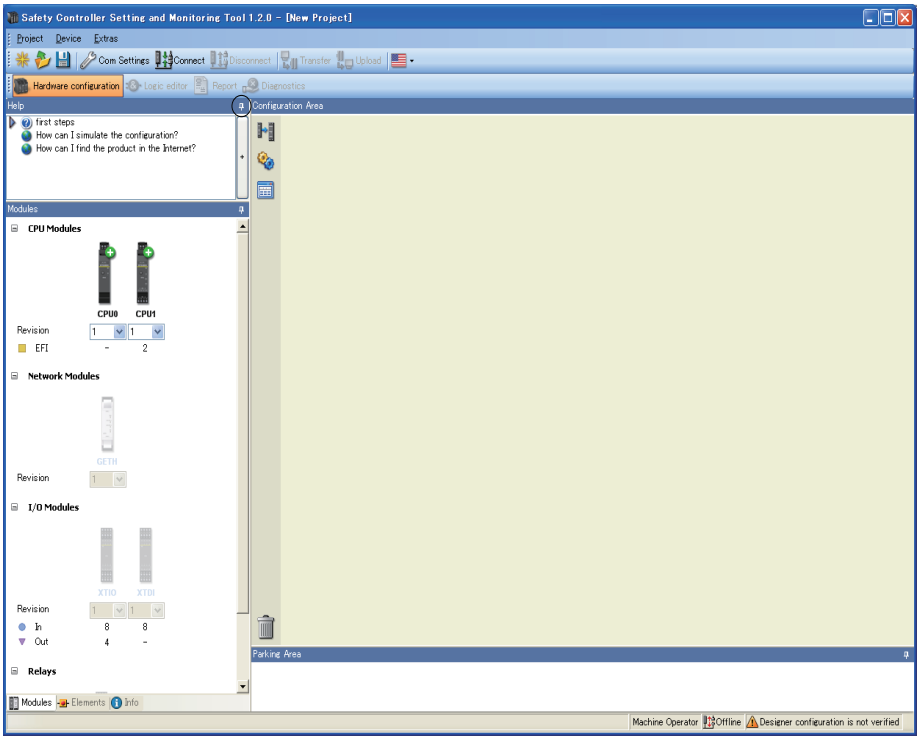
- Complete information on the currently loaded project and all the settings including the logic programming and wiring is available in the **Report** view. Furthermore, additional information on the project can be entered here. All the information can be saved in standard file formats and printed out. The scope of the report can be compiled individually depending on the selection.
- The stored error messages are displayed as a history of a connected MELSEC-WS safety controller in the **Diagnostics** view.

4.4 Positioning windows

Every view consists of several sub-windows that can be positioned freely. You can

- change the height, width and position of each sub-window by using the mouse to move the frame or title bar of the sub-window,
- convert a sub-window into a flyout window by clicking the “Hide” button (drawing pin symbol) on the right in the title bar. The flyout is then positioned on the left-hand margin of the Setting and Monitoring Tool window,
- move flyout windows back to their normal position by clicking the drawing pin icon in the flyout window again.

Figure 3:
Sub-windows can be converted to flyout menus



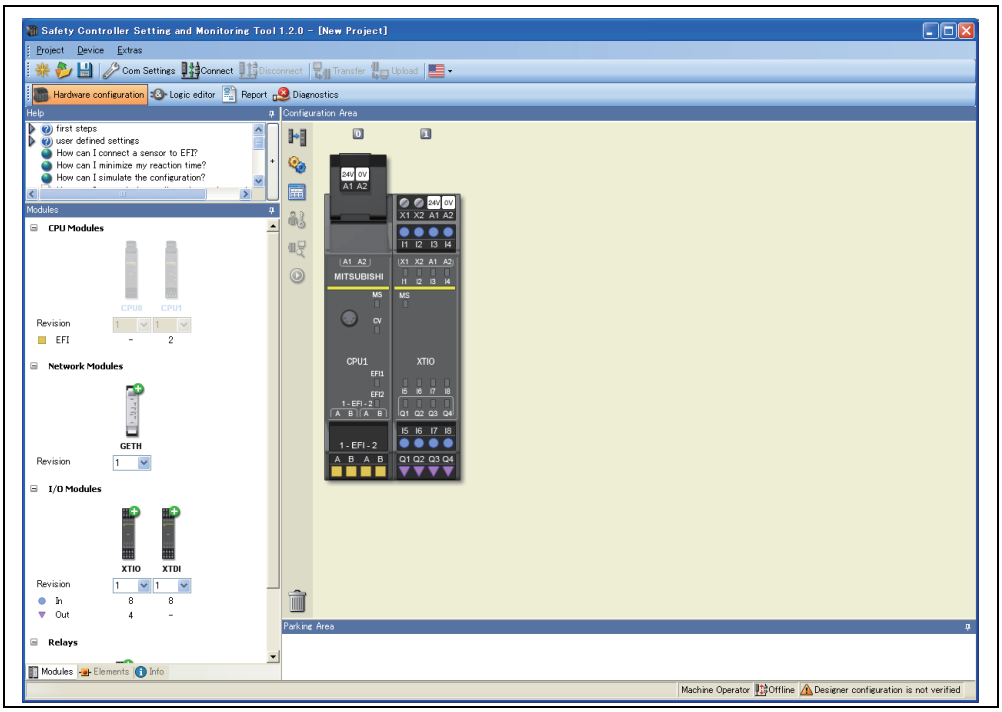
4.5 Hardware configuration standard view

The **Hardware configuration** window consists of the following sub-windows:

- Tabs for switching between the standard views **Hardware configuration**, **Logic editor**, **Report** and **Diagnostics**
- Menu bar with the menus **Project**, **Device**, **Extras**
- Toolbar with icons for rapid access to menus that are often used

- Selection window **Elements**; all devices (e.g. sensors/encoders or actuators/displays, etc.) that can be connected to a MELSEC-WS safety controller are listed here. The devices can be parameterized and renamed. In addition, user-defined devices can be created and stored. In addition to the elements, EFI elements can also be connected. They are dragged to the two EFI interfaces of the CPU module, provided that the CPU module (e.g. WS0-CPU1) provides EFI interfaces.
- **Parking Area**; here the user can compile a selection of devices for a concrete application and store them temporarily.
- Selection window **Modules**; all the MELSEC-WS modules that can be combined into a MELSEC-WS safety controller are listed here. The modules that cannot be selected at the current configuration are greyed out. Modules that can be added to the current configuration are identified by a green “+” symbol. The software version number of the respective module can be selected. The number of inputs, outputs and EFI connections is displayed for each module.
- **Configuration Area**; the entire hardware configuration of the MELSEC-WS safety controller and of the connected devices is created here and represented graphically. The individual modules and connected devices can be named, have a tag name assigned and can be parameterized. Icons for the functions are located on the left next to the positioned modules: **Switch view**, **Settings** and **Edit Tag names**. When a connection to a safety controller is established, further functions are also available: Logging in (changing the user group), verifying (reading in and comparing the configuration) and running or stopping the CPU module.

Figure 4:
The Hardware configuration standard view



4.5.1 Exercise for configuring the MELSEC-WS modules

Exercise

- Create a new project using **Project New**. All the MELSEC-WS modules are displayed in the **Modules** selection window. All the modules are greyed out with the exception of the CPU modules. Use the mouse to drag a CPU module (WS0-CPU0 or WS0-CPU1) into the **Configuration Area**. The CPU module is displayed magnified there. The inputs/outputs and terminals are visible. The CPU modules are now greyed out and the other modules (network modules, safety I/O modules) are displayed in the **Modules** selection window. Furthermore, the three tabs **Logic editor**, **Report** and **Diagnostics** are now displayed in the toolbar.
- Create further safety I/O modules in the **Configuration Area**. Green arrows indicate where the new module will be positioned. The CPU module is always located at the extreme left. The two optional network modules follow directly to the right of the CPU module. Only then do the safety I/O modules follow. The safety relay output modules have to be mounted at the extreme right.
- Right-click the individual modules and click **Edit…** in the context menu. Enter a new tag name (module name) for the respective module and close the window by clicking **OK**.
- Change the positions of the modules subsequently by using the mouse to drag them to a different position. Delete the modules by right-clicking the module and clicking **Remove module** in the context menu. Alternatively, use the mouse to drag the module to the recycle bin icon at the bottom left of the **Configuration Area**.

4.5.2 Exercise for configuring the connected devices

Exercise

- The selection structure in the **Elements** selection window can be expanded by means of a mouse click. Optional: Right-click a device and select **Edit current element** in the context menu. Assign a user-defined **Internal item number** if you want to. This **Internal item number** is stored for this device.
- Select some devices from the list and drag them into the **Parking Area**.

Note The **Parking Area** serves only to increase clarity. You can compile all the required devices here so that you do not forget any of them during the configuration. Alternatively, you can drag the devices directly from the **Elements** selection window into the **Configuration Area**.

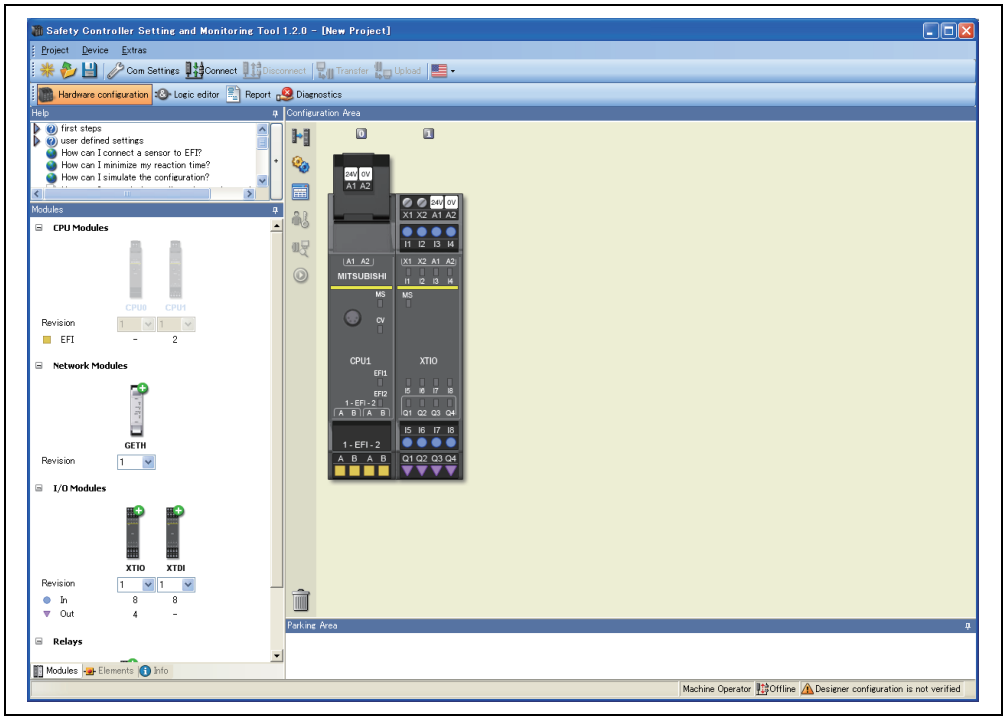
- Then drag a device from the **Parking Area** into the **Configuration Area**.
- If the **Configuration Area** does not contain a module with suitable free inputs/outputs, the device cannot be placed there. In this case, place at least one hardware module with inputs/outputs, e.g. WS0-XTIO or WS0-XTDI, in the **Configuration Area**.
- When the device is moved over suitable free inputs/outputs, they light up green. The software automatically considers the required number of inputs/outputs. Drop the device on a suitable position. The device icon is now displayed in the view at this point.
- Drag the device to other suitable inputs/outputs or back into the **Parking Area**.
- Delete the device by right-clicking the device icon and clicking **Remove…** in the context menu. Alternatively, use the mouse to drag the device to the recycle bin icon at the bottom left of the **Configuration Area**.
- A device can be parameterized when it is located in the **Parking Area** or in the **Configuration Area**. Right-click a device in the **Parking Area** or **Configuration Area** and select **Edit…** from the context menu or double-click a device. The **Element settings** window is opened. Depending on the type of device you can
  - assign a tag name (identifying name for the element)
  - set parameters of the device, for example discrepancy times, ON-/OFF-delay times, test pulse active/not active, etc.
- Close the **Element settings** window by clicking **OK**.

4.6 Logic editor standard view

The Setting and Monitoring Tool includes a graphical **Logic editor**. The function logic is programmed by using logic and application-specific function blocks. The inputs, function blocks and outputs are positioned on a worksheet definable in size and are connected correspondingly.

As soon as at least one MELSEC-WS CPU module is located in the **Configuration Area**, the **Logic editor** can be accessed via the tab of the same name.

Figure 5:
The Logic editor



The **Logic editor** window consists of the following sub-windows:

- Menu bar with the menus **Project**, **Device**, **Extras**
- Toolbar with icons for rapid access to menus that are often used
- Tabs for switching between the standard views **Hardware configuration**, **Logic editor**, **GETH Network Module [13]** (if the project contains at least one network module), **Report** and **Diagnostics**
- Specific menu bar of the logic editor with the functions **Add/Delete/Rename page**, **Copy/Cut/Paste/Delete elements, Undo/Redo last action, Open dialog to edit logic result markers, Show/Hide grid, Show grid of lines/dots, Show function block IO description**, **Start simulation mode** and **Start forcing mode**
- Selection window for **Function Block**, **Inputs** and **Outputs** respectively

- **FB Preview** window on the bottom left for displaying the important system resources such as the number of used/available function blocks or the current execution time (cycle time of the logic). When the cursor is moved over a function block in the worksheet, additional information on this function block is displayed in the **FB Preview** window.
- Worksheets (**Pages**) for creating the logic and **In/Out Summary Page** that can be selected alternatively by using tabs.

4.6.1 Exercise for using the Logic editor

Exercise

- In the **Hardware configuration** standard view combine a CPU module, at least one WS0-XTIO module and one element.
- Start the **Logic editor** by clicking the tab of the same name.
- In the selection window for **Inputs**, **Function Block** and **Outputs**, click **Inputs** and drag an input from the list onto the worksheet.
- In the selection window for **Inputs**, **Function Block** and **Outputs**, click **Function Block** and drag an application-specific or logic function block from the list onto the worksheet.
- In the selection window for **Inputs**, **Function Block** and **Outputs**, click **Outputs** and drag an output from the list onto the worksheet.
- Connect the node of the input with an input field of the function block (node) and an output (node) of the function block with the node of the output. To do so, click one node with the left mouse button, hold the left mouse button pressed and drag the cursor to the node with which the first node is to be connected.
- Mark the input, function block, output and the connections by clicking them or by dragging with the left mouse button pressed and then position as desired.
- In the selection window for **Inputs**, **Function Block** and **Outputs**, click **FB Preview**. A preview of the respective element or the details of a function block are displayed in the **FB Preview** window when you move the cursor over it.
- In order to delete an element right-click it and select the **Delete** command from the context menu.

4.7 Report standard view

Complete information on the respective project is summarised clearly in the **Report** standard view. This also includes detailed wiring information at the end of the report.

The information to be summarised in a report can be selected individually from an expandable selection list on the left-hand side. The selection is made by clicking the check boxes.

The toolbar in the **Report** standard view can be used to

- create a complete or partial documentation of a project.
- store this documentation in the .pdf format on a data medium.
- update the report.
- enter additional information on the project.

4.7.1 Exercise for the Report standard view

Exercise

- Start the report by clicking the tab of the same name.
- Click the check boxes of the components desired for the report in the selection list on the left-hand side. When a check mark is set or removed in the respective upper level, the subordinate levels are marked correspondingly.
- After you have completed all the changes in the selection list in the toolbar, click **Refresh Report**. The report is now drawn up in the right-hand window section. It can be saved and printed using the icons in the toolbar.
- The **Change Report structure** tab can be used to select two different views of the configuration information (hardware- or function-oriented).

Note Detailed information on using the wiring information at the end of the report is available in the Safety Controller User's Manual.

4.8 Diagnostics standard view

In the **Diagnostics** standard view, all the stored error messages are displayed as a history of a connected MELSEC-WS safety controller.

Note Change the safety controller to the Stop state before clearing the diagnostic results.

5. Connecting to the MELSEC-WS safety controller

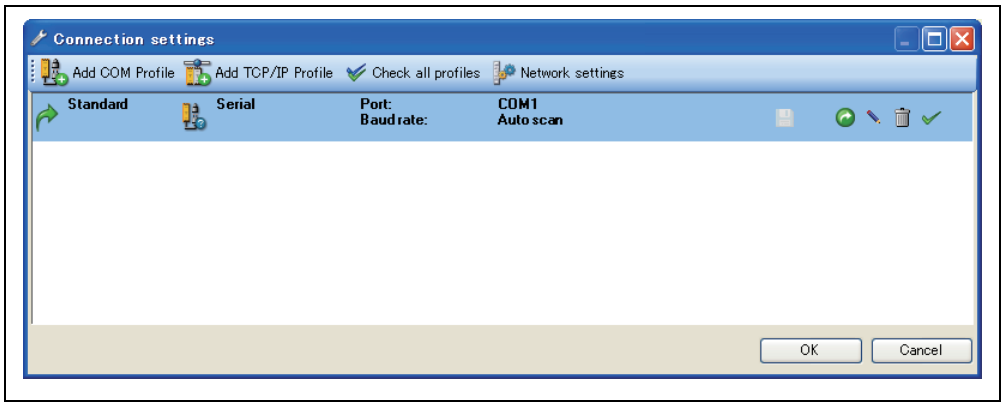
5.1 First steps for establishing a connection

This chapter describes how to establish a connection between the MELSEC-WS safety controller and a PC or notebook.

5.1.1 Connecting the PC to the MELSEC-WS safety controller via RS-232

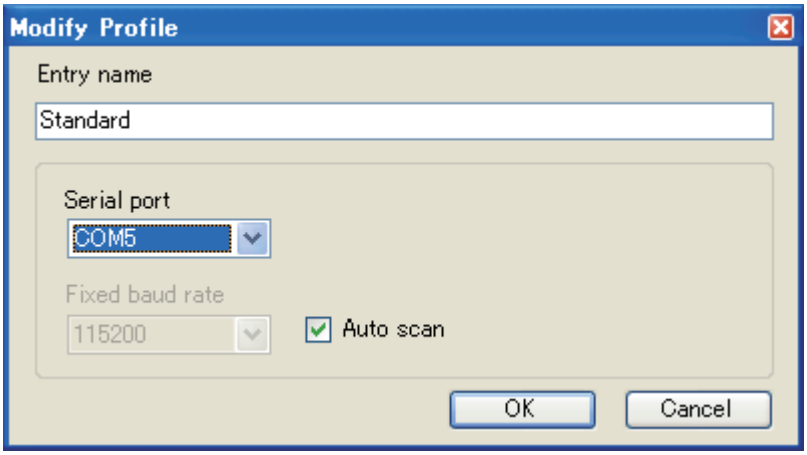
- Connect a PC or notebook to the RS-232 interface of the CPU module.
- Power on the MELSEC-WS safety controller.
- Open the Setting and Monitoring Tool installed on the PC.
- Click on **Com Settings** to ensure the correct communication interface has been selected. The following dialog appears:

Figure 6:
Com settings dialog



- To edit the settings click on the pencil icon to the right. The following dialog appears:

Figure 7:
Com Settings dialog

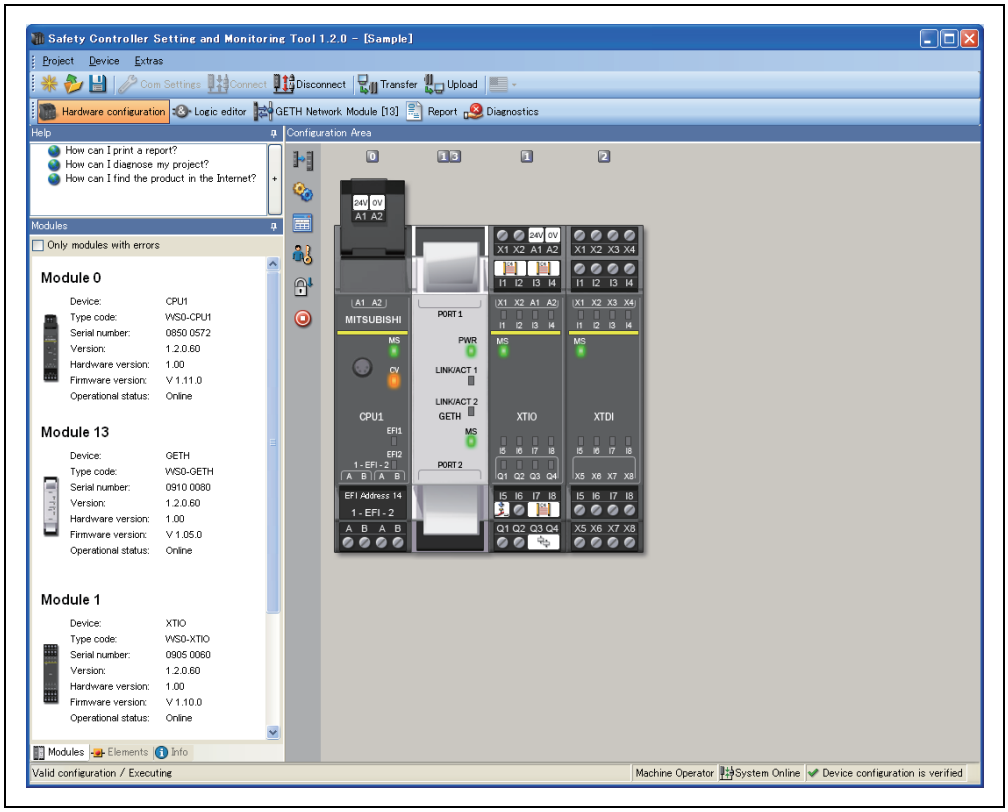


- Modify the settings if required.
- Click **OK**. The **Connection settings** dialog closes.

- Click on **Connect**. The Setting and Monitoring Tool will search for connected MELSEC-WS modules and load the hardware configuration into the **Hardware configuration** dialog. Once all modules have been identified, the Setting and Monitoring Tool will ask whether the configuration shall be uploaded.
- Click **Yes** to upload the configuration.

As an example, the following hardware configuration may appear:

Figure 8:
Hardware configuration dialog (example)



- Click **Disconnect** to go into the offline mode if you want to change the configuration of the MELSEC-WS modules.

Note

- Configuration and verification of devices that are connected to the MELSEC-WS safety controller is generally not carried out using the Setting and Monitoring Tool, even if they can be addressed via an RS-232 interface of a MELSEC-WS module. These devices have their own mechanisms for configuration and verification.
- An exception is EFI sensors connected to the WS0-CPU1 module (EFI elements from the elements window). These sensors can be configured directly in the Setting and Monitoring Tool by double-clicking the icon, or alternatively configured and verified locally at the sensor via the RS-232 interface. For this purpose, the SICK configuration and diagnostics software CDS is used. The SICK configuration and diagnostics software CDS included in Setting and Monitoring Tool is the product of SICK. For CDS, please contact your local SICK representative (see Annex, Section 12.3).
  http://www.sens-control.com

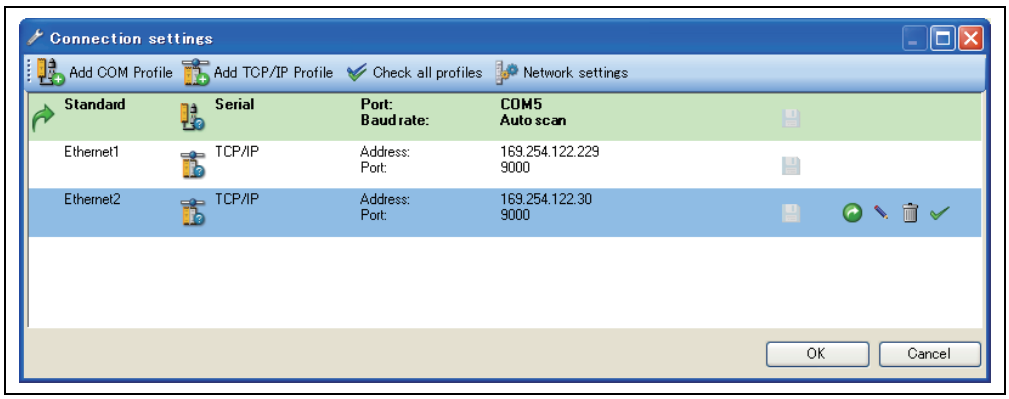
5.2 Editing the communication settings

Using the **COM Settings** command, you can edit and delete existing and create new connection profiles.

To edit the connection settings, the Setting and Monitoring Tool must be in offline mode.

- If you are in online mode, click on the **Disconnect** button to change into offline mode.
- Click on **COM Settings**. The dialog for editing the connection profiles is opened:

Figure 9: Connection settings dialog



All existing connection profiles are displayed here. The currently activated profile is marked light green and with bold typeface; the profile selected for editing is marked blue.

The symbols for editing the profiles have the following meaning:

Table 1: Symbols for editing the connection profiles in the Connection settings dialog

Symbol	Meaning
	Save profile with the current project
	Activate profile
	Edit profile
	Remove profile
	Check profile

How to add a COM profile (serial port):

- Click on the **Add COM Profile** button. The **Create new profile** dialog is opened.

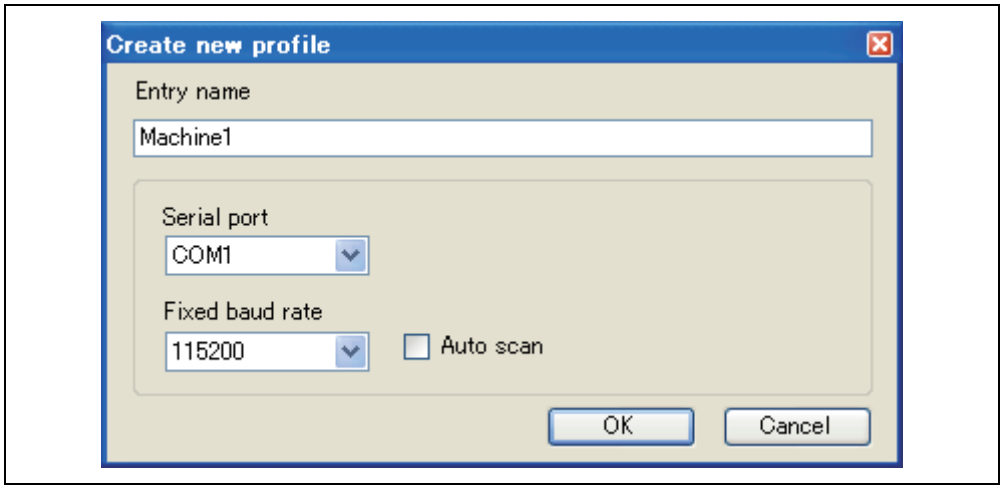


Figure 10:
Create new profile dialog (serial port)

- Enter a name for the new profile.
- Select the serial port for the new profile.
- Select a fixed baud rate or activate the **Auto scan** checkbox.
- Click **OK**. The dialog is closed and the new profile is displayed in the list.
- To activate the new profile, select it using the left mouse button and click on the green arrow symbol on the right. From now on, the Setting and Monitoring Tool will use this profile.

How to add a TCP/IP profile:

Note To create a TCP/IP profile it is necessary that your MELSEC-WS safety controller contains an Ethernet interface module (e.g. WS0-GETH) which must be configured with a valid IP address for your network. For detailed instructions on the Ethernet interface module configuration, please see the Safety Controller Ethernet Interface Module User's Manual.

- Click on the **Add TCP/IP Profile** button. The **Create new profile** dialog is opened.

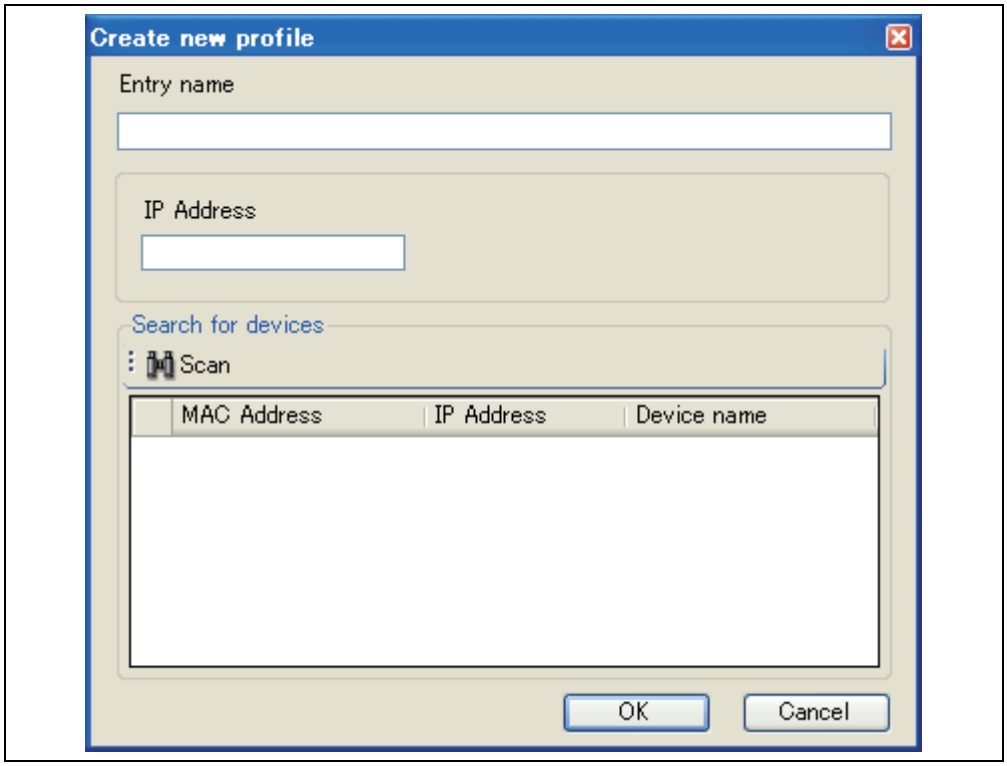
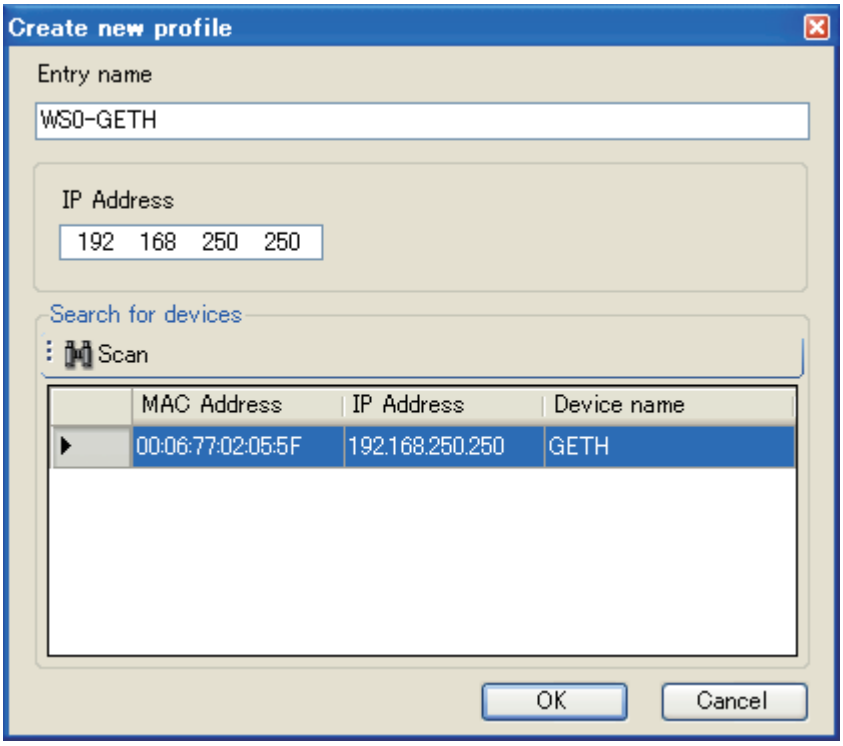


Figure 11: Create new profile dialog (TCP/IP)

- Click on the **Scan** button. Your network is scanned for connected network modules and the network modules found are displayed in the list.

Figure 12:
List of the found network modules



- Click on the desired network module. The IP address of the device is displayed in the **IP Address** field.
- Enter a name for the new profile.
- Click **OK**. The dialog is closed and the new profile is displayed in the list.
- To activate the new profile, select it using the left mouse button and click on the green arrow symbol at the right. From now on, the Setting and Monitoring Tool will use this profile.

How to check a profile:

- Click on the green tick on the right side of the profile to be checked.
- To check all profiles, click on the **Check all profiles** button.

The Setting and Monitoring Tool checks the connection settings and marks faulty profiles.

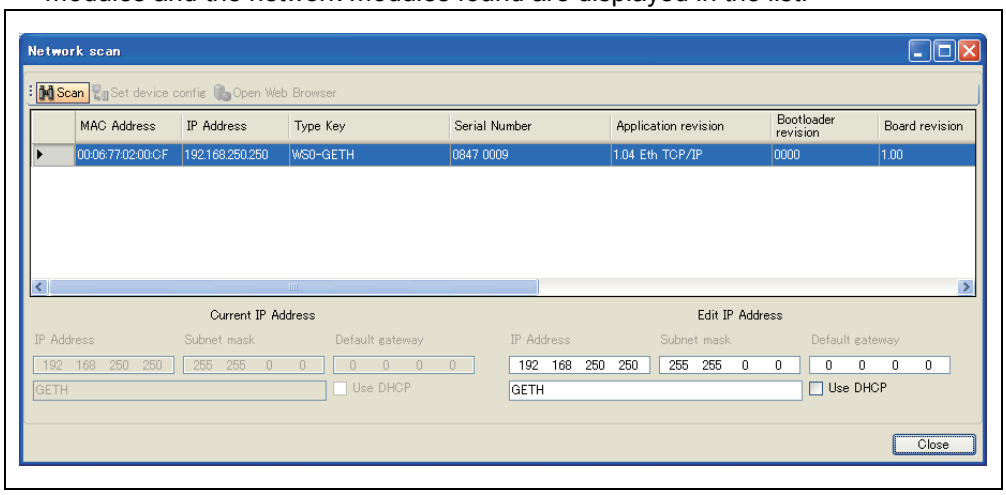
Table 2:
Status symbols for connection profiles

Profile type	Profile not checked	Profile OK	Profile faulty
Serial (COM)			
TCP/IP			

How to change the network settings of a network module:

- Click on the **Network settings** button. The **Network scan** dialog is opened.
- Click on the **Scan** button. Your network is scanned for connected network modules and the network modules found are displayed in the list.

Figure 13:
List of the found network module



- Click on the network module you want to edit.
- Enter the new settings in the **Edit IP Address** area.
- Click on the **Set device config** button to transfer the new settings to the device.

5.3 Establishing a connection with the MELSEC-WS safety controller

ATTENTION

Do not connect to the MELSEC-WS safety controller via the RS-232 and the Ethernet interface at the same time!
The MELSEC-WS safety controller can only communicate with one instance of the Setting and Monitoring Tool at one time. Connecting to the safety controller using multiple instances of the Setting and Monitoring Tool, either on a single PC or multiple PCs, may result in inconsistencies of the configuration and the diagnostics as well as in operational errors. This applies to both RS-232 and Ethernet connections equally.

- Click on the **Connect** button. The Setting and Monitoring Tool will try to connect to your MELSEC-WS safety controller using the currently activated connection profile.
- If a connection is established successfully, the Setting and Monitoring Tool goes into online mode and you can perform the following activities depending on your user level:
- Log in (see Section 5.4)
- Transfer the configuration to the device, upload it from the device or verify the configuration (see Chapter 7)
- Start or stop the CPU module (see Section 8.1.1)
- Start the force mode (see Section 6.11)

5.4 User levels in the Setting and Monitoring Tool

If the Setting and Monitoring Tool is connected to the devices in a project (i.e. is in online mode), you can switch to the user levels of the Setting and Monitoring Tool. These user levels have different authorisations for the transfer of configurations to the devices:

Table 3: User level authorisations

User level	Authorisation
Operator	May edit (necessary to edit a configuration offline). May not transfer.
Maintenance	May edit. May only transfer verified configuration.
Authorized client	May edit. May transfer.

ATTENTION

Switch to the user group Operator!

If you leave the PC connected to devices without personal attendance or supervision, you must log off from the user levels Maintenance or Authorized client and switch to the user level Operator to make sure that no unauthorized person can transfer configurations to the devices!

How to change the user level:

- In the **Hardware configuration** view, click on the **Log in** symbol on the left side of the **Configuration Area** while you are online. The **Change user group** dialog will open.
- Select the desired user level, enter the password and click on **Log On**.

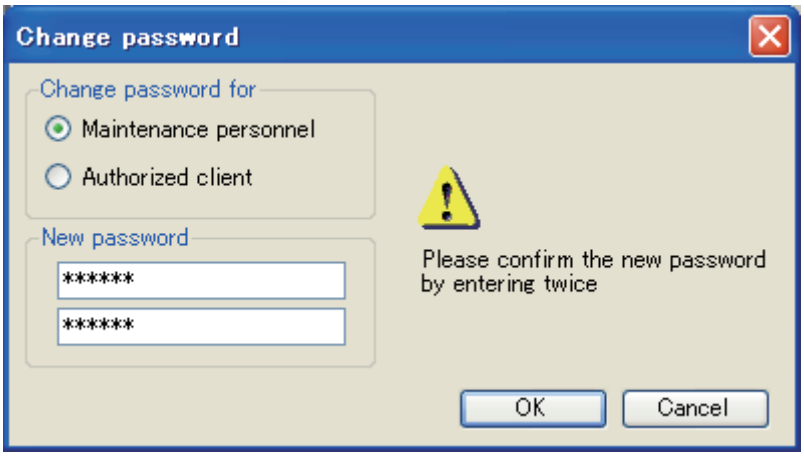
Note

- The default password for the user level Authorized client is “MELSECWS”.
- There is no default password for the Maintenance user level. In order to log in on this user level, you have to assign a password for it first.

How to change the password for a user level:

- Go into online mode.
- Open the **Hardware configuration** view.
- With the right mouse button, click on the CPU module.
- From the context menu, select the **Change password...** command. If you are not logged in as Authorized client, you will be prompted to log in now.
- In the **Change password** dialog, select the user level for which you want to change the password, enter the new password twice and confirm with **OK**.

Figure 14: Change password dialog



5.5 Identify project

The **Identify project** command is equivalent to the **Connect to physical device** command that can be executed upon program start of the Setting and Monitoring Tool.

- In the **Device** menu, choose the **Identify project** command. The current project will be closed.
- The Setting and Monitoring Tool will search for connected MELSEC-WS modules and load the hardware configuration into the **Hardware configuration** dialog. Once all modules have been identified, the Setting and Monitoring Tool will ask whether the configuration shall be uploaded.
- Click **Yes** to upload the configuration.

6. Logic programming - Function blocks

The function logic of the MELSEC-WS safety controller is programmed by using function blocks. These function blocks are certified for use in safety-relevant functions if all safety standards are observed during implementation. The following sections provide information on important aspects of using function blocks in the MELSEC-WS safety controller.

ATTENTION

Solely safety-relevant signals may be used in safety-relevant logic. Ensure that the application fulfils all the applicable standards and regulations!

If you use the function blocks described in this section in safety-relevant applications, you must observe all the safety standards. Safety-relevant signals have to be used for safety input and safety output signals in safety-relevant applications.

The user is responsible for checking that the right signal sources are used for these function blocks and that the entire implementation of the safety logic fulfils the applicable standards and regulations. Always check the mode of operation of the MELSEC-WS hardware and of the logic program in order to ensure that these behave in accordance with your risk reduction strategy.

6.1 Function block overview

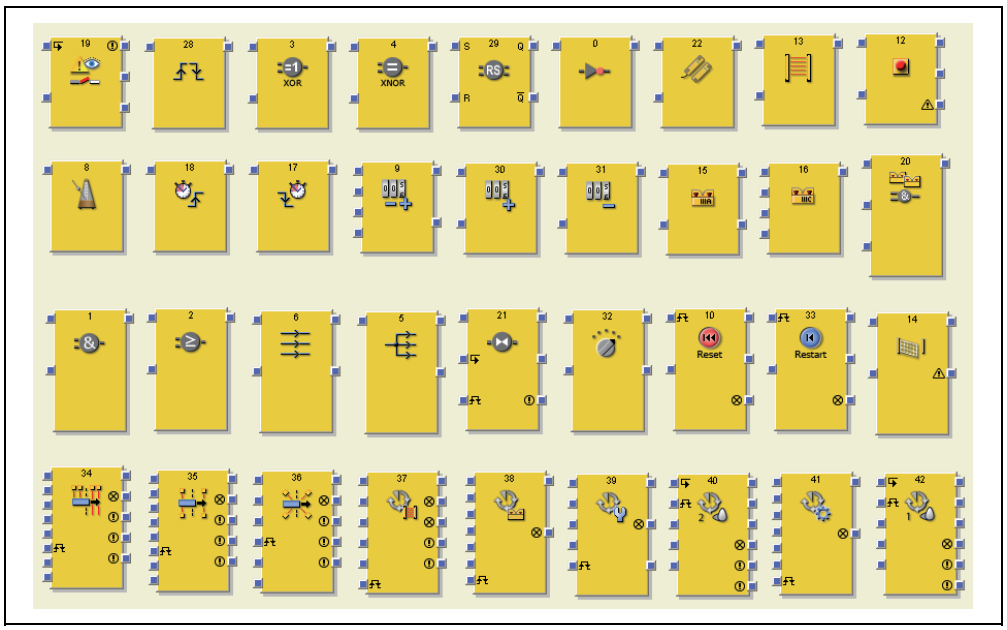
The MELSEC-WS safety controller uses function blocks to define the safety-oriented logic. A configuration can encompass a maximum of 255 function blocks. There are logic function blocks and application-specific function blocks. The following table summarizes all the function blocks available for WS0-CPU0 and WS0-CPU1:

Table 4: Overview of the function blocks

Logic function blocks	Application-specific function blocks
● AND	● Valve Monitoring
● OR	● User Mode Switch
● XOR	● Two Hand Control type IIIA
● XNOR	● Two Hand Control type IIIC
● Log Generator	● Restart
● Routing 1:N	● Reset
● Routing N:N	● On-Delay Timer
● RS Flip-Flop	● Off-Delay Timer
● NOT	● Multi Operator
● Fast Shut Off	● Event Counter (Up and Down)
● Edge Detection	● Event Counter (Up)
	● Event Counter (Down)
	● EDM
	● Clock Generator
	Function blocks for press applications
	● Universal Press Contact
	● Press Single Stroke
	● Press Setup
	● Press Automatic
	● N-Break
	● Eccentric Press Contact
	Function blocks for muting
	● Sequential Muting
	● Parallel Muting
	● Cross Muting
	Others
	● Safety Gate Monitoring
	● Magnetic Switch
	● Light Curtain Monitoring
	● E-Stop

The logic editor displays all the function blocks graphically. The following figure shows the graphic representation of the individual function blocks:

Figure 15:
Graphic representation of the function blocks in the logic editor



Logic function blocks have the following properties:

- One or more inputs
- Generally, exactly one result output of the logic
- Logic function blocks do not have any configurable parameters (except for Fast Shut Off and Edge Detection).
- Logic results can be used further at one or more inputs of other logic or application-specific function blocks.
- The **Routing 1:N** function block can be used to pass on one output to several outputs in the sense of a contact duplication.
- The **Routing N:N** function block can be used to pass on up to eight input signals to eight physical outputs directly in parallel.

Application-specific function blocks have the following properties:

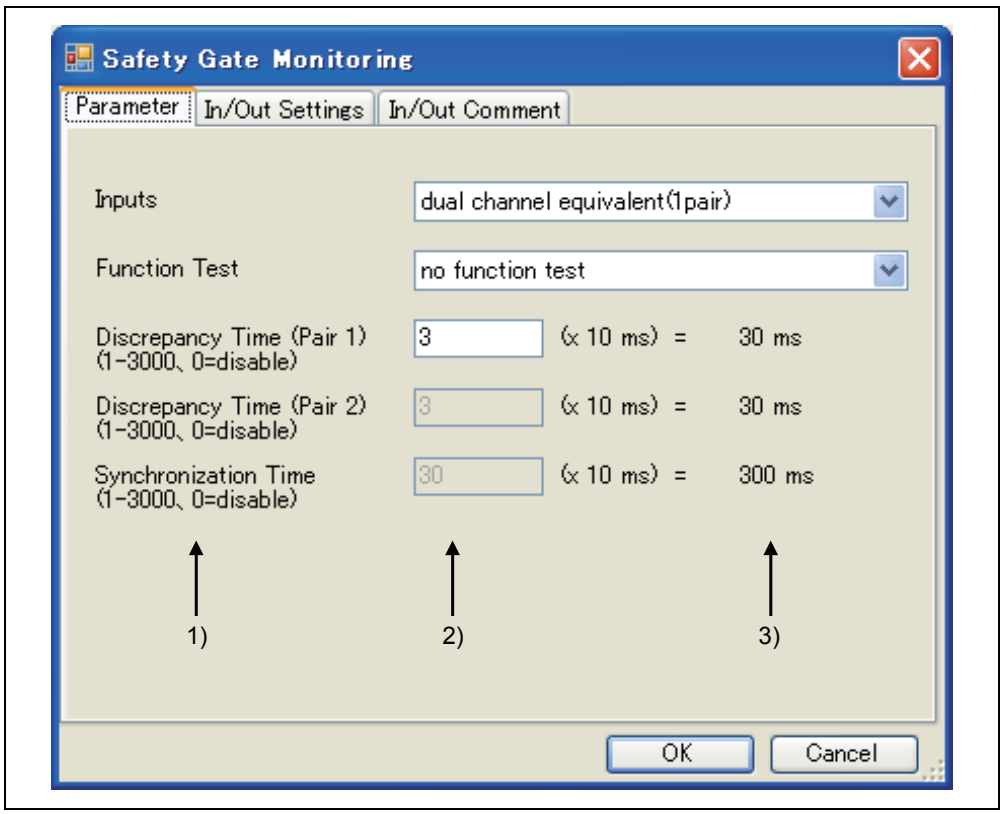
- One or more inputs
- One or more outputs, depending on the required functionality
- Configurable parameters
- Logic results can be used further at one or more inputs of other logic or application-specific function blocks.

The MELSEC-WS safety controller supports up to 255 function blocks in a specific application. The response time is influenced by the number of function blocks. Therefore, the number of function blocks in your application should be kept as low as possible.

6.2 Function block properties

Function blocks offer a number of different properties that you can use. The configurable parameters differ depending on the function block. You can double-click the function block to access the configurable parameters and select the tab with the desired properties. The following example shows the Safety Gate Monitoring function block:

Figure 16: Configurable parameters of function blocks



The number 1) to 3) for the time configuration parameters (of function block such as Safety Gate Monitoring and Valve Monitoring) indicate:

1) input range: an allowable range of an input value

2) input field: a field where a value is input within the input range

3) set parameter: a configured value. The value calculated as follows is displayed:

(Configured value) = (Value input to the input field) × (10 ms)

6.3 Input and output signal connections of function blocks

Note Some devices offer a pre-evaluation that makes the use of a special function block with the same evaluation function superfluous. Then, you do not have to carry out this evaluation again in the logic.

6.3.1 Function block input connections

The MELSEC-WS safety controller supports applications up to SIL3 (in accordance with EN 62061) and Performance Level (PL) e (in accordance with EN ISO 13849-1). Possible sources for function block inputs are one or two safety signals connected locally to the MELSEC-WS safety controller. You can choose between the following input evaluations (depending on the function block):

- Single-channel
- Dual-channel:
  - Dual-channel equivalent (1 pair)
  - Dual-channel complementary (1 pair)
  - Dual-channel equivalent (2 pairs)
  - Dual-channel complementary (2 pairs)

The following truth tables summarize the internal evaluation for the individual types of input signal evaluations of the MELSEC-WS safety controller.

Truth table

The following applies for the truth tables in this section:

“0” means logic Low or **Inactive**.

“1” means logic High or **Active**.

“x” means “any” = “0” or “1”.

Note The Fault Present is **active** when the logic processing of the MELSEC-WS safety controller detects an error in the combination or in the sequence of the input signals.

6.3.2 Single-channel evaluation

Figure 17: Function block for single-channel evaluation

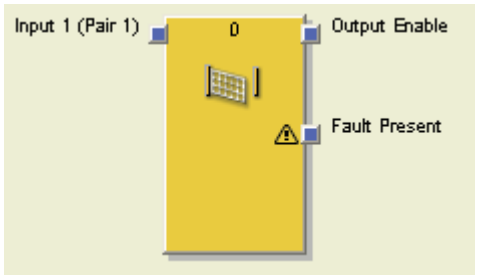


Table 5: Single-channel evaluation

Input 1 (Pair 1)	Fault Present	Output Enable
0	0	0
1	0	1
x	1	0

6.3.3 Dual-channel equivalent (1 pair) evaluation

Figure 18: Function block for dual-channel equivalent (1 pair) evaluation

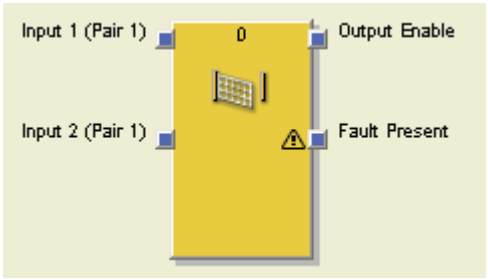


Table 6: Dual-channel equivalent (1 pair) evaluation

Input 1 (Pair 1)	Input 2 (Pair 1)	Fault Present	Output Enable
0	0	0	0
0	1	0	0
1	0	0	0
1	1	0	1
x	x	1	0

6.3.4 Dual-channel complementary (1 pair) evaluation

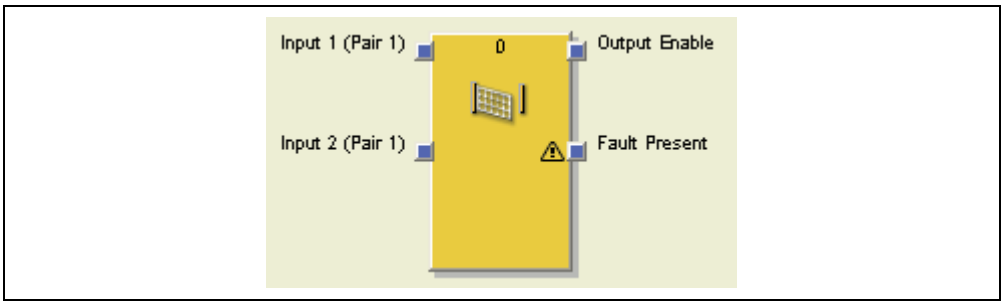


Figure 19:
Function block for dual-channel complementary (1 pair) evaluation

Table 7:
Dual-channel with complementary (1 pair) evaluation

Input 1 (Pair 1)	Input 2 (Pair 1)	Fault Present	Output Enable
0	0	0	0
0	1	0	0
1	0	0	1
1	1	0	0
x	x	1	0

6.3.5 Dual-channel equivalent (2 pairs) evaluation

Figure 20:
Function block for dual-channel equivalent (2 pairs) evaluation

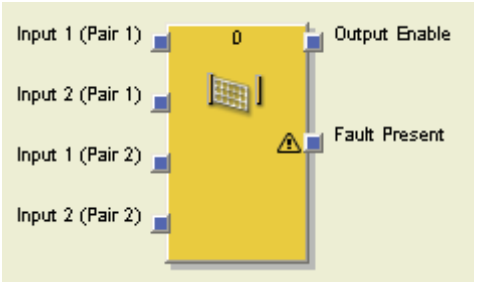


Table 8:
Dual-channel equivalent (2 pairs) evaluation

Input 1 (Pair 1)	Input 2 (Pair 1)	Input 1 (Pair 2)	Input 2 (Pair 2)	Fault Present	Output Enable
0	0	0	0	0	0
0	0	0	1	0	0
0	0	1	0	0	0
0	0	1	1	0	0
0	1	0	0	0	0
0	1	0	1	0	0
0	1	1	0	0	0
0	1	1	1	0	0
1	0	0	0	0	0
1	0	0	1	0	0
1	0	1	0	0	0
1	0	1	1	0	0
1	1	0	0	0	0
1	1	0	1	0	0
1	1	1	0	0	0
1	1	1	1	0	1
x	x	x	x	1	0

6.3.6 Dual-channel complementary (2 pairs) evaluation

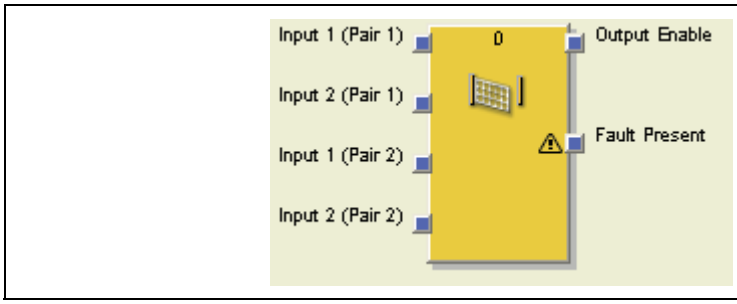


Figure 21: Function block for dual-channel complementary (2 pairs) evaluation

Table 9: Dual-channel complementary (2 pairs) evaluation

Input 1 (Pair 1)	Input 2 (Pair 1)	Input 1 (Pair 2)	Input 2 (Pair 2)	Fault Present	Output Enable
0	0	0	0	0	0
0	0	0	1	0	0
0	0	1	0	0	0
0	0	1	1	0	0
0	1	0	0	0	0
0	1	0	1	0	0
0	1	1	0	0	0
0	1	1	1	0	0
1	0	0	0	0	0
1	0	0	1	0	0
1	0	1	0	0	1
1	0	1	1	0	0
1	1	0	0	0	0
1	1	0	1	0	0
1	1	1	0	0	0
1	1	1	1	0	0
x	x	x	x	1	0

Note that a dual-channel evaluation can already have been carried out at some devices that have been integrated in the hardware configuration. In this case, the WS0-XTDI or WS0-XTIO module can transfer the result of this evaluation as a single bit via the internal FLEXBUS+ backplane bus. If there is such a pre-evaluation, you can configure the function block on a single-channel input.

Alternatively, you can apply this pre-evaluated input signal bit to both input channels of a function block with a dual-channel input configuration. Pre-evaluated signals can occur in the local input and output definition of the MELSEC-WS safety controller or in a protective device. If you apply a one-bit address to both inputs of the function block, the MELSEC-WS safety controller regards the first connection as the logic result and ignores the second connection.

The following function blocks generate the same output value for a dual-channel input signal that was pre-evaluated by the protective device.

ATTENTION

Connect the pre-evaluated signals correctly!

If inputs or outputs for a dual-channel evaluation were pre-evaluated, you have to ensure that the resulting pre-evaluated signal of the dual-channel evaluation is connected as shown in the following graphic. Do not connect both pre-evaluated signals to the function block except if the dual-channel evaluation is to be effected in the function block.

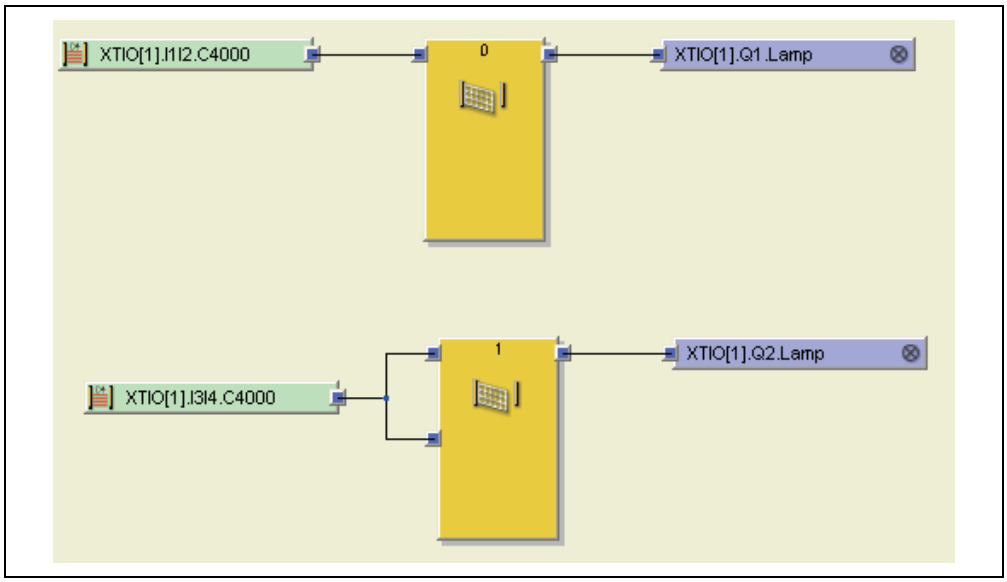


Figure 22: Dual-channel decentralised input with single-channel safety output

Status information can be available for input signals. In some applications an evaluation of this status information can be important in order to specify the behaviour of the logic functions of the MELSEC-WS safety controller. The input status specifies whether the data transferred from the protective device to the MELSEC-WS safety controller are:

- **Inactive**, because this is the state at the protective device or
- **Inactive**, because there is a fault at the protective device.

No category (in accordance with with EN 954-1[*1] or SIL or Performance Level (in accordance with EN 62061 or EN ISO 13849-1) is defined for the input behaviour of function blocks since the connection of the safety devices to the inputs is relevant for this purpose and not the connection to the function block itself. However, the following signals in accordance with EN 954-1[*1] can be realised if the connection is effected in accordance with the specified categories:

*1 Only valid for the assumption of conformity until 29.12.2009.
From then on it will only be allowed to use the successor EN ISO 13849-1.

- Input signals up to Category 3 if a dual-channel input with the same test pulse source for both input channels is used
- Input signals up to Category 4 if a dual-channel input with different test pulse sources for both input channels is used
- Input signals up to Category 4 if two dual-channel inputs with different test pulse sources for both input channel pairs is used
- Output signals up to Category 3 if single-channel safety outputs with or without test pulses are used and the necessary requirements for avoiding errors are fulfilled
- Output signals up to Category 4 if single- or dual-channel safety outputs with test pulses are used

ATTENTION

Consult the applicable bodies of rules and regulations as well as standards!
When implementing a safety-relevant functional logic, verify that the controlling strategy and measures for risk minimization fulfil the regulations of the national bodies of rules and regulations. Consult these bodies of rules and regulations as well as standards in order to determine the requirements that have to be fulfilled by your application.

6.3.7 Output connections of the function block

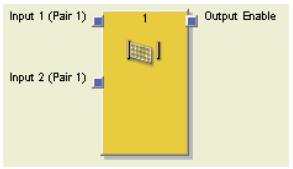
Function blocks provide various output signal connections for connecting to physical outputs or to other function blocks. Possible output signal connections are (depending on the function block):

- Output Enable
- Static Release
- Fault Present
- Discrepancy Error
- Synchronisation Error
- Function Test Required
- EDM Error (External Device Monitoring Error)
- Reset Required
- Restart Required
- Output Enable 1
- Output Enable 2

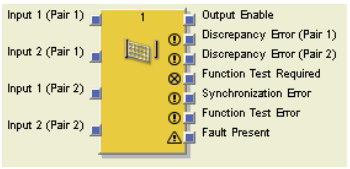
The output of a function block cannot be connected to several output elements (physical outputs or EFI outputs), but to several subordinate function blocks. If you want to control several physical outputs with a function block, use the Routing 1:N function block. The output behaviour of the outputs listed above is explained at the description of the individual function blocks.

You can choose whether error and diagnostics outputs are displayed. In the configuration basic setting of the function blocks only the Output Enable and some further outputs are selected (e.g. Reset Required). In order to display error and diagnostics outputs increase the number of outputs on the In/Out Settings tab of the function block properties.

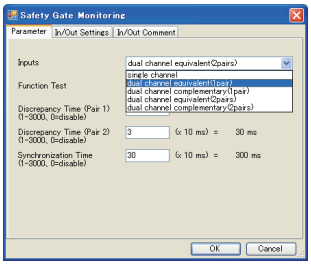
Figure 23:
I/O configuration of the Safety Gate Monitoring function block



Safety Gate Monitoring function block with configuration basic setting



Safety Gate Monitoring function block with all available inputs and outputs



In/Out Settings tab of the properties dialog for the Safety Gate Monitoring

6.4 Parameterisation of function blocks

In addition to the type of input (e.g. single-channel, dual-channel equivalent, etc.), function blocks can have further parameters that are defined on the properties page of the function block shown above.

Note The following has to be observed when selecting time monitoring functions for the discrepancy time, synchronisation time, pulse duration, muting time, etc.: The times

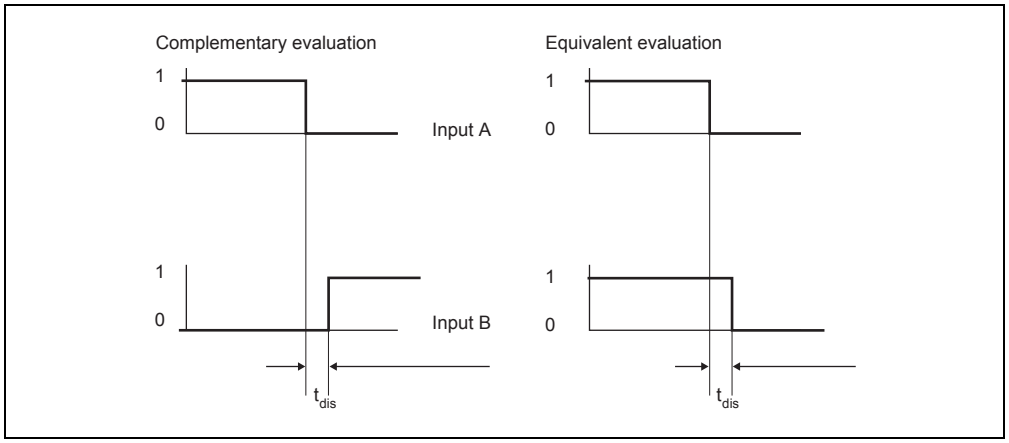
- can be selected in 10 ms steps
- have to be greater than the logic execution time
- have a precision of +/– 10 ms in the evaluation in addition to the logic execution time

The logic execution time depends on the number and type of the function blocks used and is displayed in the Setting and Monitoring Tool in the logic editor.

6.4.1 Discrepancy time

The discrepancy time t_{dis} is the maximum time for which the two inputs of a dual-channel evaluation may have invalid states without the safety-oriented logic evaluating this state as an error. At a dual-channel equivalent evaluation both inputs may not be complementary for longer than the configured discrepancy time. At a dual-channel complementary evaluation both inputs may not be equivalent for longer than the configured discrepancy time.

Figure 24:
Discrepancy time



Monitoring of the discrepancy time starts with the first state change of an input. After the discrepancy time has expired, the safety-oriented logic reports an error if both inputs of the connection …

- have not reached an equivalent state where required, or
- have not reached a complementary state where required.

The following truth table describes the discrepancy conditions for the dual-channel equivalent and the dual-channel complementary input evaluation:

Table 10:
Input signals and process image after the discrepancy time has expired

Dual-channel interface	Input signal		
	Input A	Input B	Status
Equivalent	0	0	**Inactive**
	0	1	Discrepant
	1	0	Discrepant
	1	1	**Active**
Complementary	0	0	Discrepant
	0	1	**Inactive**
	1	0	**Active**
	1	1	Discrepant

Input signals furthermore have to observe the following rules with regard to the discrepancy time:

- The discrepancy time cannot be monitored for a single-channel input (i.e. it is **Inactive**), irrespective of the parameter settings.
- In order to delete a discrepancy time error, the dual-channel evaluation of the input has to return to the **Inactive** status. The valid states are listed in the table above.
- If the state of an input of the input pair changes, the state of the other input also has to take a valid value before the discrepancy time expires.
- A dual-channel evaluation can only change from **Inactive** to **Active** if the discrepancy time has not expired.
- A dual-channel evaluation CANNOT change from **Active** to a discrepant state and then return to **Active**, irrespective of the discrepancy time. The dual-channel evaluation has to change from **Active** to **Inactive** before it can return to **Active**, whereby the requirements for the discrepancy time have to be fulfilled.
- Valid values for the discrepancy time: 0 (no monitoring of the discrepancy time), 10 ms to 30,000 ms in 10 ms steps. If used, the set discrepancy time has to be greater than the logic execution time of the MELSEC-WS safety controller.

If a discrepancy error occurs, the error is displayed by the following steps:

- Output Enable changes to **Inactive** (fail-safe) and
- Fault Present changes to **Active** and
- Discrepancy Error (Pair 1) is set to error (for input evaluation 1/2) or
- Discrepancy Error (Pair 2) is set to error (for input evaluation 3/4).

Note If signals of tested sensors are connected to WS0-XTDI and WS0-XTIO modules, the discrepancy time has to amount to at least the set test pulse time plus 12 ms, since a signal change at the input of the modules can be delayed by this time.

6.4.2 Synchronisation time

In the case of applications according to Category 4 in accordance with EN 954-1[*1] it may be necessary that two dual-channel input evaluations (e.g. dual-channel input 1/2 and dual-channel input 3/4) reach the same status within the specified time.

*1 Only valid for the assumption of conformity until 29.12.2009.
From then on it will only be allowed to use the successor EN ISO 13849-1.

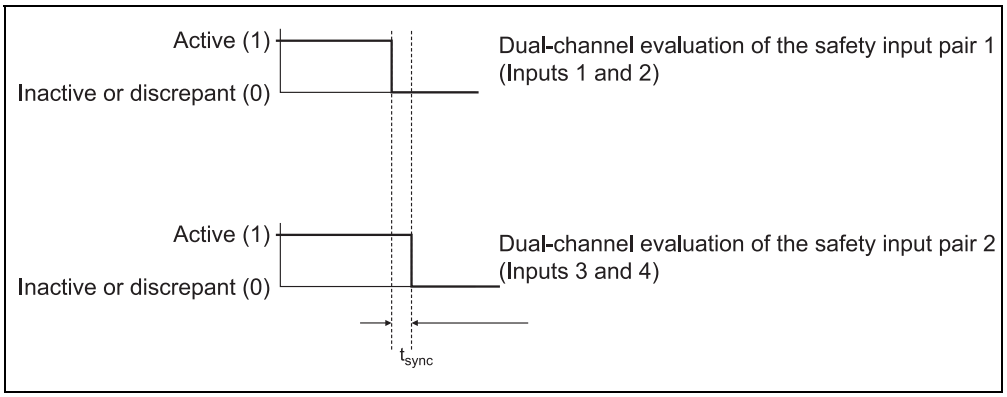
The synchronisation time differs from the discrepancy time: It evaluates the relationship between two dual-channel evaluations, whereas the discrepancy time refers to the individual channels of a dual-channel evaluation.

The input signal pairs have to observe the following rules with regard to the synchronisation time:

- If the status of a dual-channel input pair changes, the status of the other input pair has to adopt an equivalent status before the synchronisation timer expires.
- In the process, neither of the two dual-channel evaluations may have a discrepancy error or other errors.
- If the synchronisation time expires before the equivalence state is reached, the Synchronisation Error output changes to **Active**. In the case of function blocks with synchronisation time parameter (except for two-hand control) the Fault Present output also changes to **Active** when a synchronisation time error occurs.

Both input pairs have to return to the status **Inactive** in order to delete a synchronisation time error.

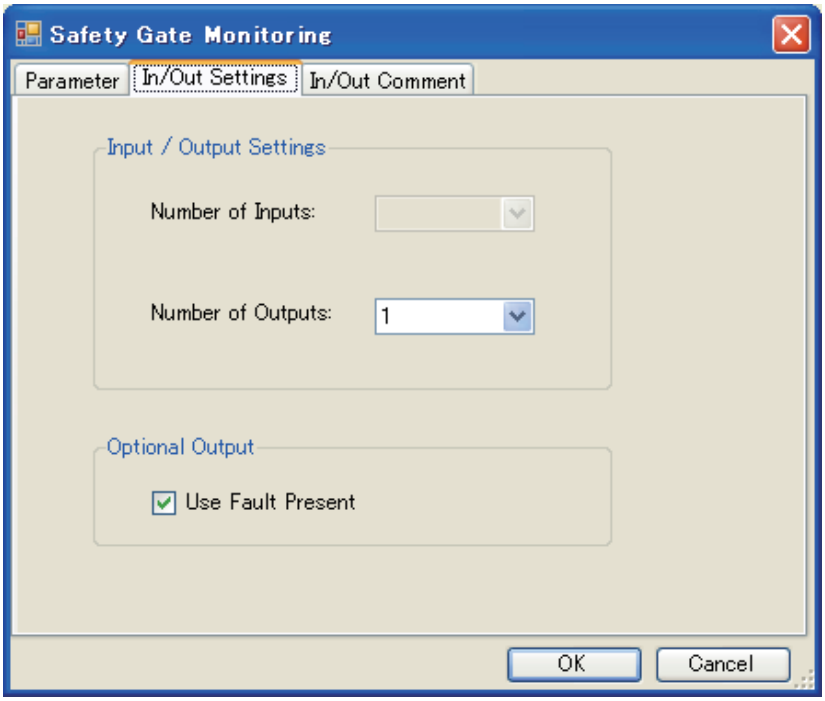
Figure 25:
Synchronisation time



6.4.3 Fault Present

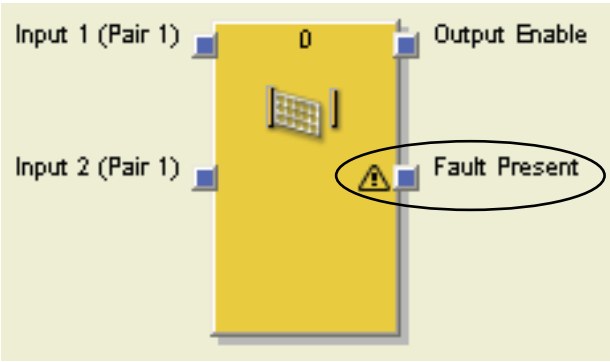
Various function blocks have the Fault Present diagnostics status bit. In order to use it, activate the check box on the In/Out Settings tab of the function block properties. When you activate the **Use Fault Present** check box, the additional output “Fault Present” is displayed in the function block.

Figure 26:
Activating the Fault Present



The Fault Present output informs you about the reason why an Output Enable signal has adopted the **Inactive** state (fail-safe).

Figure 27:
Fault Present output



The Fault Present changes to **Active** when an error has been detected on the basis of the configured function block parameters (e.g. Discrepancy Error, Function Test Error, Synchronisation Error, etc.).

When the Fault Present is **Active**, the Output Enable changes to **Inactive** (fail-safe).

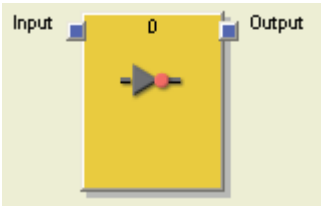
Deleting of the Fault Present output is described in the section of the respective function block.

6.5 Logic function blocks

6.5.1 Logic function block NOT

Function block diagram

Figure 28:
Function block diagram for the function block NOT



General description

The inverted state of input applies at the output. If, for example, the input is **Active**, the output is **Inactive**. This function block evaluates exactly one input.

ATTENTION

Never control safety output signals directly with a NOT function block!
Always ensure that the usage of a NOT function lies logically before a Reset function block in your application so that unintentional starting up is prevented.
Never control safety output signals directly with a NOT function block.

Truth table

The following applies for the truth tables in this section:

“0” means logic Low or **Inactive**.

“1” means logic High or **Active**.

“x” means “any” = “0” or “1”.

Truth table for NOT

Table 11:
Truth table for the function block NOT

Input	Output
0	1
1	0

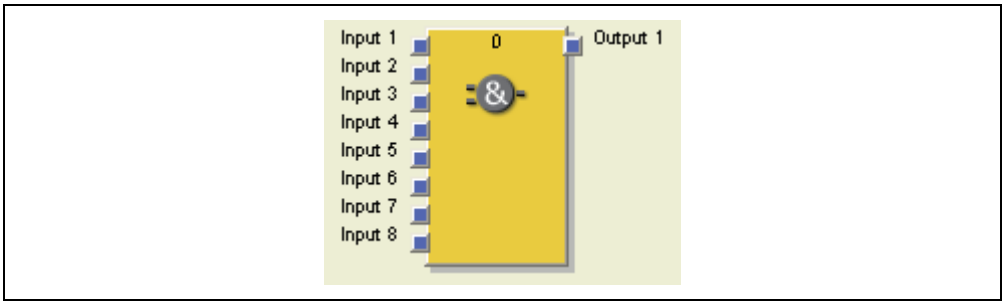
Error states and information on resetting

Logic functions do not carry out monitoring for error conditions.

6.5.2 Logic function block AND

Function block diagram

Figure 29:
Function block diagram for the function block AND



General description

The output is **Active** if all the evaluated inputs are **Active**. Up to eight inputs are evaluated.

Truth table

See below for truth tables for one to eight inputs. These truth tables use the following designations:

“0” means logic Low or **Inactive**.

“1” means logic High or **Active**.

“x” means “any” = “0” or “1”.

Truth table for AND evaluation with one input

Table 12:
Truth table for AND evaluation with one input

Input 1	Output 1
0	0
1	1

Truth table for AND evaluation with two inputs

Table 13:
Truth table for AND evaluation with two inputs

Input 1	Input 2	Output 1
0	x	0
x	0	0
1	1	1

Truth table for AND evaluation with three inputs

Table 14:
Truth table for AND evaluation with three inputs

Input 1	Input 2	Input 3	Output 1
0	x	x	0
x	0	x	0
x	x	0	0
1	1	1	1

Truth table for AND evaluation with four inputs

Table 15: Truth table for AND evaluation with four inputs

Input 1	Input 2	Input 3	Input 4	Output 1
0	x	x	x	0
x	0	x	x	0
x	x	0	x	0
x	x	x	0	0
1	1	1	1	1

Truth table for AND evaluation with five inputs

Table 16: Truth table for AND evaluation with five inputs

Input 1	Input 2	Input 3	Input 4	Input 5	Output 1
0	x	x	x	x	0
x	0	x	x	x	0
x	x	0	x	x	0
x	x	x	0	x	0
x	x	x	x	0	0
1	1	1	1	1	1

Truth table for AND evaluation with six inputs

Table 17: Truth table for AND evaluation with six inputs

Input 1	Input 2	Input 3	Input 4	Input 5	Input 6	Output 1
0	x	x	x	x	x	0
x	0	x	x	x	x	0
x	x	0	x	x	x	0
x	x	x	0	x	x	0
x	x	x	x	0	x	0
x	x	x	x	x	0	0
1	1	1	1	1	1	1

Truth table for AND evaluation with seven inputs

Table 18: Truth table for AND evaluation with seven inputs

Input 1	Input 2	Input 3	Input 4	Input 5	Input 6	Input 7	Output 1
0	x	x	x	x	x	x	0
x	0	x	x	x	x	x	0
x	x	0	x	x	x	x	0
x	x	x	0	x	x	x	0
x	x	x	x	0	x	x	0
x	x	x	x	x	0	x	0
x	x	x	x	x	x	0	0
1	1	1	1	1	1	1	1

Truth table for AND evaluation with eight inputs

Table 19:
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 1
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

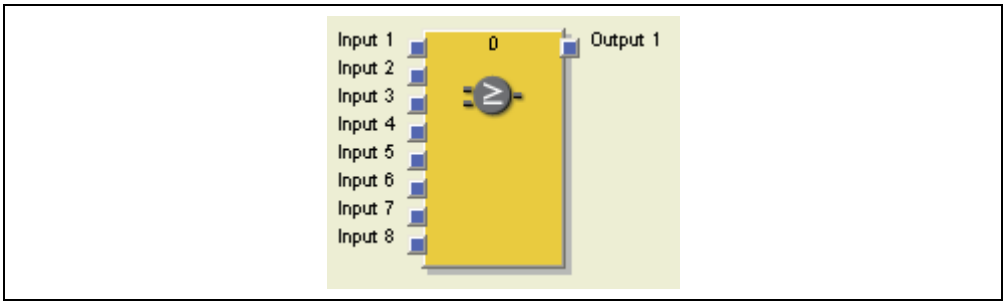
Error states and information on resetting

Logic functions do not carry out monitoring for error conditions.

6.5.3 Logic function block OR

Function block diagram

Figure 30:
Function block diagram for the function block OR



General description

The output is **Active** if **any one** of the evaluated inputs is **Active**. Up to eight inputs are evaluated.

Truth table

See below for truth tables for one to eight inputs. These truth tables use the following designations:

“0” means logic Low or **Inactive**.

“1” means logic High or **Active**.

“x” means “any” = “0” or “1”.

Truth table for OR evaluation with one input

Table 20:
Truth table for OR evaluation with one input

Input 1	Output 1
0	0
1	1

Truth table for OR evaluation with two inputs

Table 21:
Truth table for OR evaluation with two inputs

Input 1	Input 2	Output 1
0	0	0
1	x	1
x	1	1

Truth table for OR evaluation with three inputs

Table 22: Truth table for OR evaluation with three inputs

Input 1	Input 2	Input 3	Output 1
0	0	0	0
1	x	x	1
x	1	x	1
x	x	1	1

Truth table for OR evaluation with four inputs

Table 23: Truth table for OR evaluation with four inputs

Input 1	Input 2	Input 3	Input 4	Output 1
0	0	0	0	0
1	x	x	x	1
x	1	x	x	1
x	x	1	x	1
x	x	x	1	1

Truth table for OR evaluation with five inputs

Table 24: Truth table for OR evaluation with five inputs

Input 1	Input 2	Input 3	Input 4	Input 5	Output 1
0	0	0	0	0	0
1	x	x	x	x	1
x	1	x	x	x	1
x	x	1	x	x	1
x	x	x	1	x	1
x	x	x	x	1	1

Truth table for OR evaluation with six inputs

Table 25: Truth table for OR evaluation with six inputs

Input 1	Input 2	Input 3	Input 4	Input 5	Input 6	Output 1
0	0	0	0	0	0	0
1	x	x	x	x	x	1
x	1	x	x	x	x	1
x	x	1	x	x	x	1
x	x	x	1	x	x	1
x	x	x	x	1	x	1
x	x	x	x	x	1	1

Truth table for OR evaluation with seven inputs

Table 26: Truth table for OR evaluation with seven inputs

Input 1	Input 2	Input 3	Input 4	Input 5	Input 6	Input 7	Output 1
0	0	0	0	0	0	0	0
1	x	x	x	x	x	x	1
x	1	x	x	x	x	x	1
x	x	1	x	x	x	x	1
x	x	x	1	x	x	x	1
x	x	x	x	1	x	x	1
x	x	x	x	x	1	x	1
x	x	x	x	x	x	1	1

Truth table for OR evaluation with eight inputs

Table 27: 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 1
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

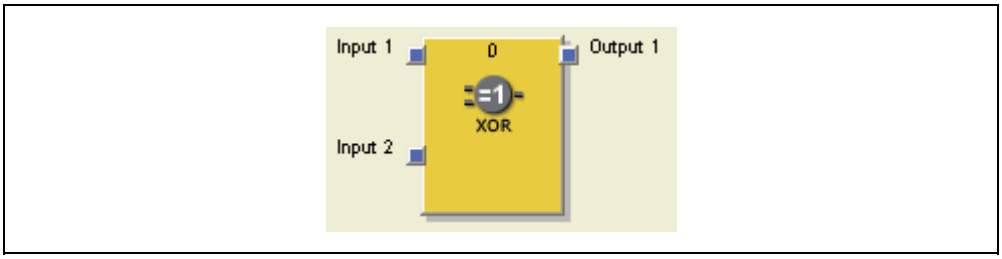
Error states and information on resetting

Logic functions do not carry out monitoring for error conditions.

6.5.4 Logic function block Exclusive OR (XOR)

Function block diagram

Figure 31:
Function block diagram for the function block Exclusive OR (XOR)



General description

The output is **Active** if the evaluated inputs are complementary (e.g. with contrary state: one input **Active** and one input **Inactive**). Exactly two inputs are evaluated.

Truth table

The truth table uses the following designations:

“0” means logic Low or **Inactive**.

“1” means logic High or **Active**.

“x” means “any” = “0” or “1”.

Truth table for XOR evaluation

Table 28:
Truth table for XOR evaluation

Input 1	Input 2	Output 1
0	0	0
0	1	1
1	0	1
1	1	0

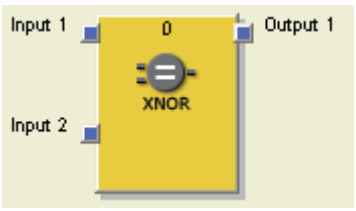
Error states and information on resetting

Logic functions do not carry out monitoring for error conditions.

6.5.5 Logic function block Exclusive NOR (XNOR)

Function block diagram

Figure 32:
Function block diagram for the function block Exclusive NOR (XNOR)



General description

The output is **Active** if the evaluated inputs are equivalent (e.g. being in the same state: both inputs **Active** or both inputs **Inactive**). Exactly two inputs are evaluated.

Truth table

The truth table uses the following designations:

“0” means logic Low or **Inactive**.

“1” means logic High or **Active**.

“x” means “any” = “0” or “1”.

Truth table for XNOR evaluation

Table 29:
Truth table for XNOR evaluation

Input 1	Input 2	Output 1
0	0	1
0	1	0
1	0	0
1	1	1

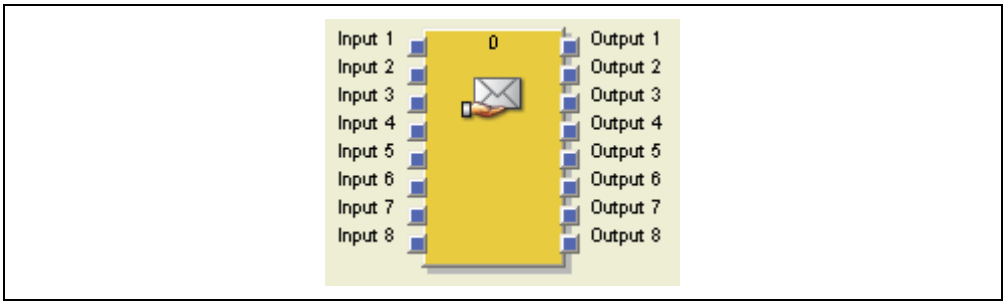
Error states and information on resetting

Logic functions do not carry out monitoring for error conditions.

6.5.6 Function block Log Generator

Function block diagram

Figure 33:
Function block diagram for the Log Generator function block



General description

The **Log Generator** function block monitors up to eight inputs. If a defined input condition is fulfilled at one of these inputs, the function block sets the corresponding output to **Active** for the duration of one logic cycle and adds a user defined text message to the diagnostics history which can be read out in online mode using the Setting and Monitoring Tool diagnostic function.

Note These text messages will be deleted when the voltage supply for the MELSEC-WS safety controller is interrupted.

Input parameters of the Log Generator function block

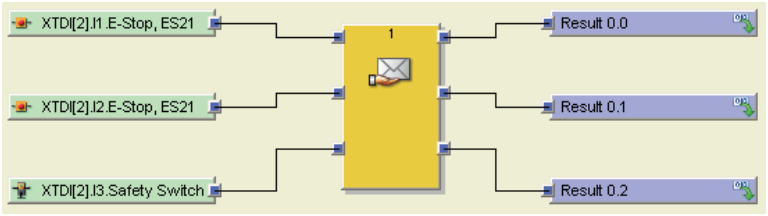
Table 30:
Input parameters of the Log Generator function block

Parameter	Possible values
Number of Inputs	Configurable from 1 to 8
Number of Outputs	Not configurable (= number of inputs)
Messages	Up to 64 user defined messages per project.
Input condition	● Rising edge (Positive) ● Falling edge (Negative) ● Rising and falling edge (Positive & Negative)

How to configure the Log Generator function block:

The following example shows the Log Generator function block with two emergency stop buttons and a safety switch attached.

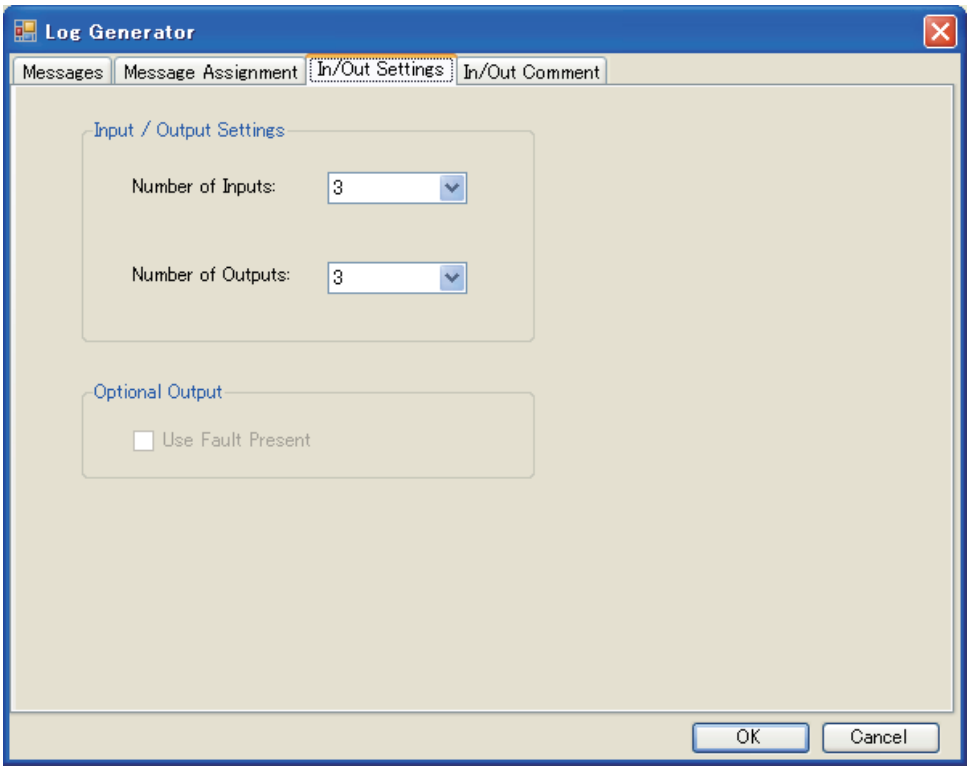
Figure 34:
Configuration example for Log Generator with two emergency stop buttons and a safety switch



To configure the Log Generator function block, proceed as follows:

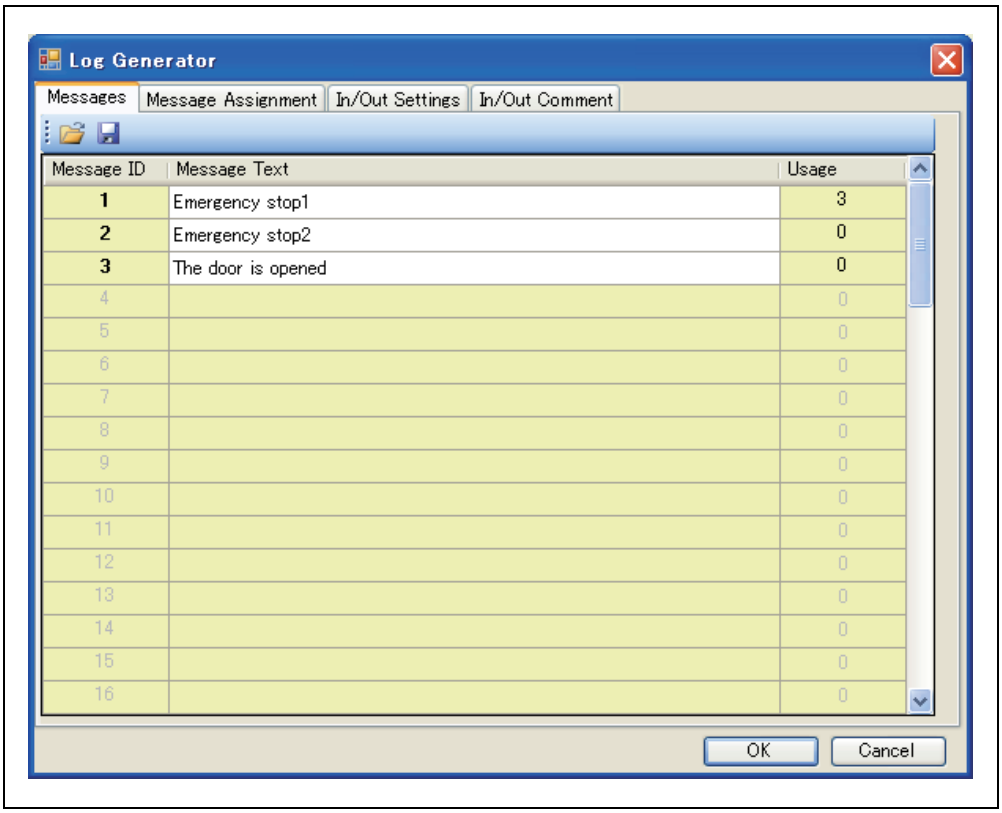
- Connect input elements to the function block. Double click on the function block to open the configuration dialog and click then on the **In/Out Settings** tab.

Figure 35:
In/Out settings for the Log Generator function block



- Choose the number of inputs that you wish to attach to the function block.
- Then click the **Messages** tab and enter the messages that shall be output in the diagnostics.

Figure 36: Messages of the Log Generator function block

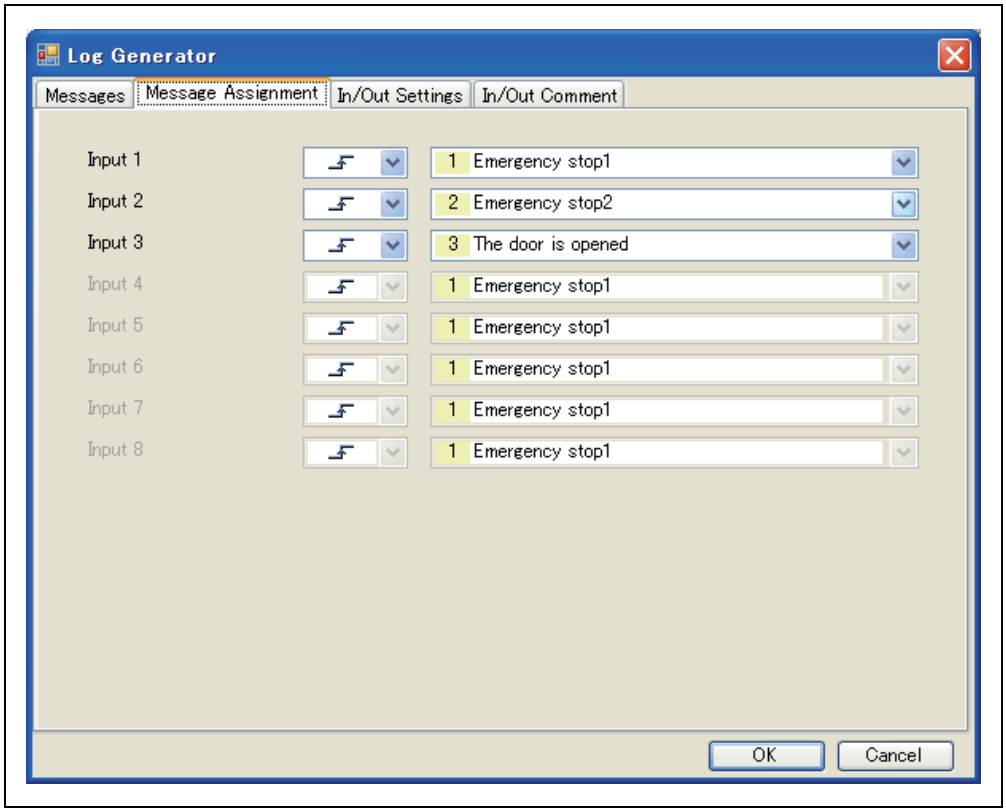


Note

- The messages entered are valid globally for all Log Generator function blocks used in a project.
- In a single project, you can enter up to 64 different messages with a length of up to 1,000 characters each.

- Then click the **Message Assignment** tab. Assign the desired message to each used input and choose the input condition that must be fulfilled for the related message to be sent (Edge=Positive, Negative or Positive & Negative).

Figure 37: Message Assignment for the Log Generator function block



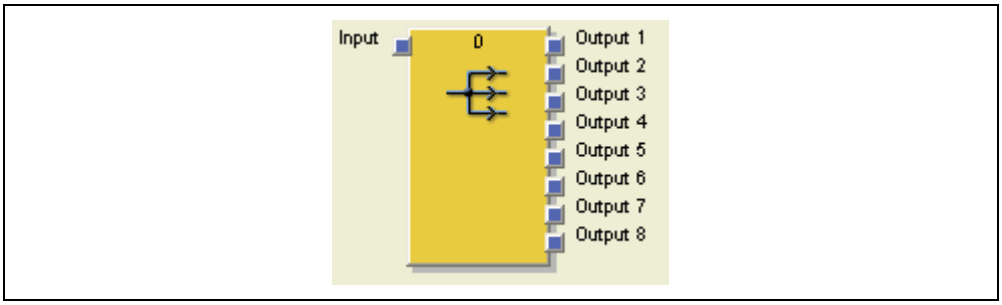
Error states and information on resetting

The function block Log Generator does not carry out monitoring for error conditions.

6.5.7 Logic function block Routing 1:N

Function block diagram

Figure 38:
Function block diagram for the function block Routing 1:N



General description

The function block Routing 1:N passes an input signal from a preceding function block to up to eight output signals. The input signal can originate from a preceding function block or directly from an input element.

Truth table

The truth table uses the following designations:

“0” means logic Low or **Inactive**.

“1” means logic High or **Active**.

“x” means “any” = “0” or “1”.

Truth table for the Routing 1:N evaluation

Table 31:
Truth table for the Routing 1:N evaluation

Input	Output 1	Output 2	Output 3	Output 4	Output 5	Output 6	Output 7	Output 8
0	0	0	0	0	0	0	0	0
1	1	1	1	1	1	1	1	1
x	0	0	0	0	0	0	0	0

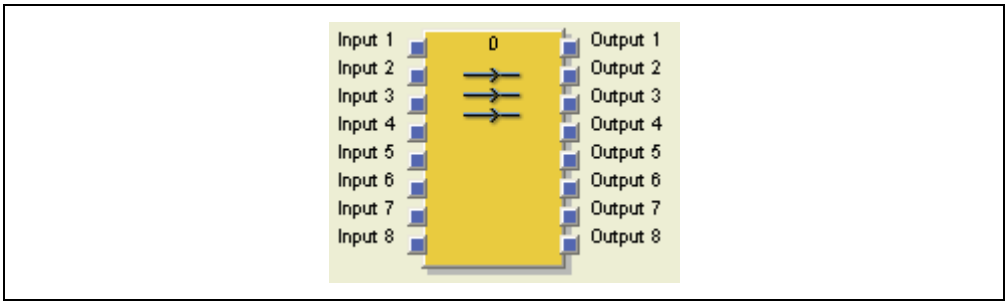
Error states and information on resetting

Logic functions do not carry out monitoring for error conditions.

6.5.8 Logic function block Routing N:N

Function block diagram

Figure 39:
Function block diagram for the function block Routing N:N



General description

The function block Routing N:N passes up to eight input signals parallel to up to eight outputs. The input signal can originate from a preceding function block or directly from a physical input.

Truth table

The truth table uses the following designations:

“0” means logic Low or **Inactive**.

“1” means logic High or **Active**.

Truth table for Routing N:N evaluation

Table 32:
Truth table for Routing N:N evaluation

Intput 1	Output 1	Input 2	Output 2	Input 3	Output 3
0	0	0	0	0	0
1	1	1	1	1	1

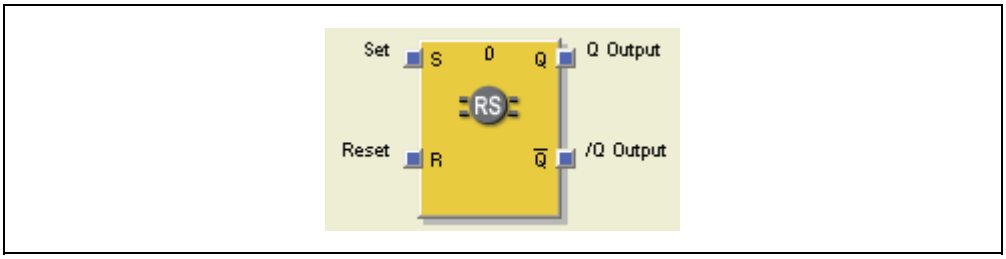
Error states and information on resetting

Logic functions do not carry out monitoring for error conditions.

6.5.9 Function block RS Flip-Flop

Function block diagram

Figure 40:
Function block diagram for the function block RS Flip-Flop



General description

The function block RS Flip-Flop stores the last value of the inputs Set or Reset. It is used as a single storage cell. The Reset signal has a higher priority than the Set signal. If Set was **Active** last, Q Output is **Active** and /Q Output (Q not Output) is **Inactive**. If the Reset input was Active last, Q Output is **Inactive** and /Q Output is **Active**.

Truth table for the function block RS Flip-Flop

The following applies for the truth table in this section:

“0” means logic Low or **Inactive**.

“1” means logic High or **Active**.

“n–1” references the preceding value.

“n” references the current value.

Table 33:
Truth table for the function block RS Flip-Flop

Set	Reset	Qn-1 Output	Qn Output	/Q Output
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	0	1
1	1	1	0	1

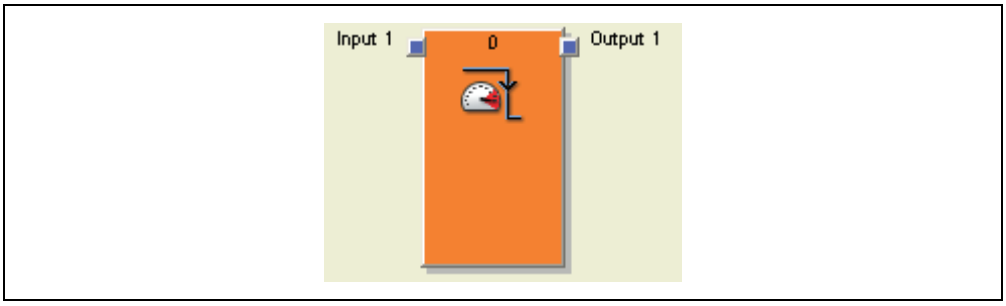
Error states and information on resetting

The function block RS Flip-Flop does not carry out monitoring for error conditions.

6.5.10 Function block Fast Shut Off

Function block diagram

Figure 41:
Function block diagram for the Fast Shut Off function block

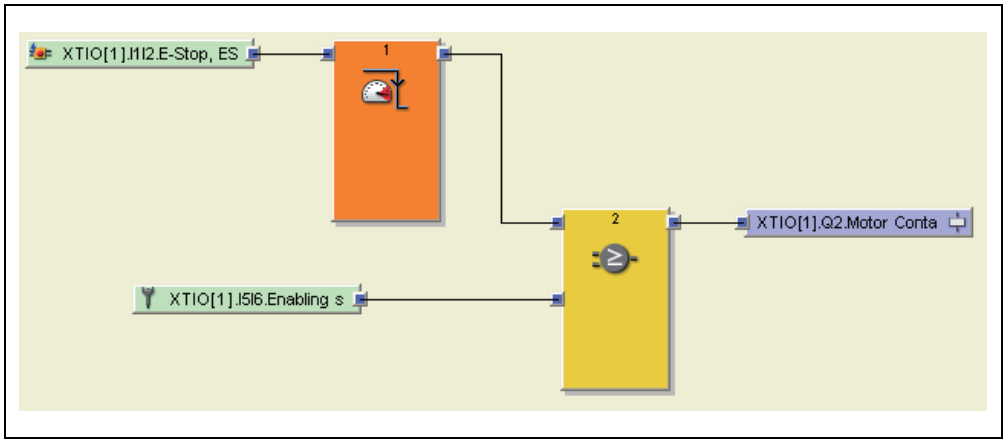


General description

The **Fast Shut Off** function block is used to minimize the response time of a safety switching path within the logic. In order for this block to be used, both the inputs and the output for the switching path must be connected to the same I/O module (i.e. WS0-XTIO). Furthermore, it acts as an interrupt in the logic editor since the CPU module is bypassed when the switch off command is given. The consequence of this is that logic between the Fast Shut Off input and Fast Shut Off output cannot hinder a switch off when the Fast Shut Off is activated.

Example: In the following logic example, the C4000 will switch off the Q2 motor.

Figure 42:
Fast Shut Off example



Simple logic such as this can be accomplished within the Fast Shut Off function block itself (see how to configure below).

Note

- The signal path from the output of the Fast Shut Off funciton block to the physical output that is selected in the Fast Shut Off function block must be configured in such a way that switching off of the output of the Fast Shut Off function block results in any case in a direct switching off of the physical output as well. Typically the AND, Restart or EDM function blocks can be used in the signal chain for this. An OR function block, on the other hand, does not comply to this rule.

- Once an input or output is attached to the Fast Shut Off function block, the output can no longer be moved in the hardware configuration and the input can only be moved to another position on the same safety I/O module.

ATTENTION

Always consider the total response time of the entire safety function!

The response time of the Fast Shut Off function block is not the same as the total response time of the entire safety function. The total response time includes multiple parameters outside of this function block. For a description of how to calculate the total response time of the MELSEC-WS safety controller, please see the Safety Controller User's Manual.

Input parameters of the Fast Shut Off function block

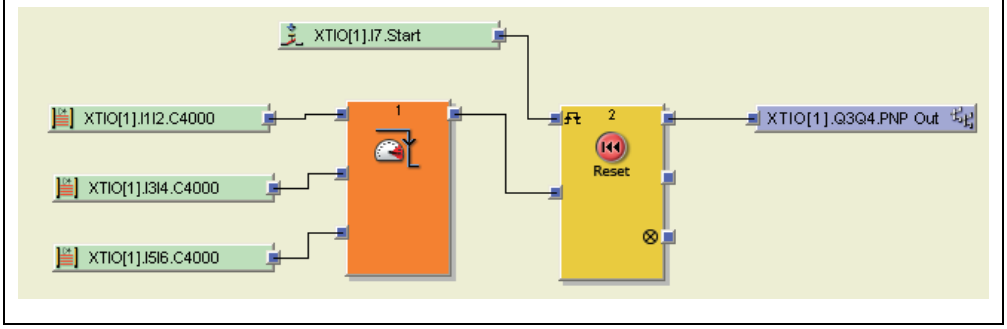
Table 34: Input parameters of the Fast Shut Off function block

Parameter	Possible parameter values	Default
Number of Inputs	Configurable from 1 to 8	1
Number of Outputs	Not configurable	1
Connect input elements to the function block.	Assigned by user. Once set, inputs cannot be moved in configuration view to another safety I/O module.	-
Select output for fast shut off.	Assigned by user. Once set, Once set, outputs cannot be moved in configuration view.	-

How to configure the Fast Shut Off function block:

The following example shows the function with three light curtains attached to a Fast Shut Off function block.

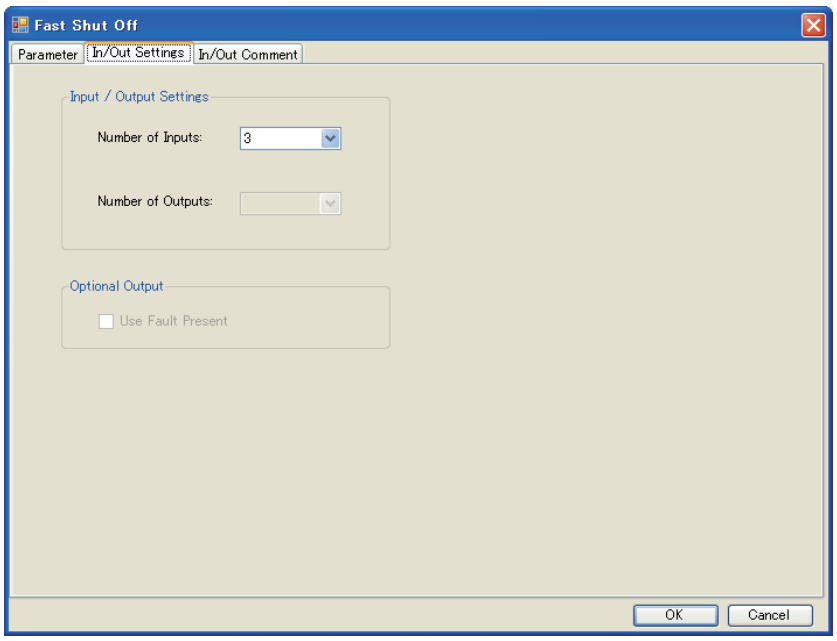
Figure 43: Configuration example for Fast Shut Off with three light curtains



To configure the Fast Shut Off function block perform the following steps:

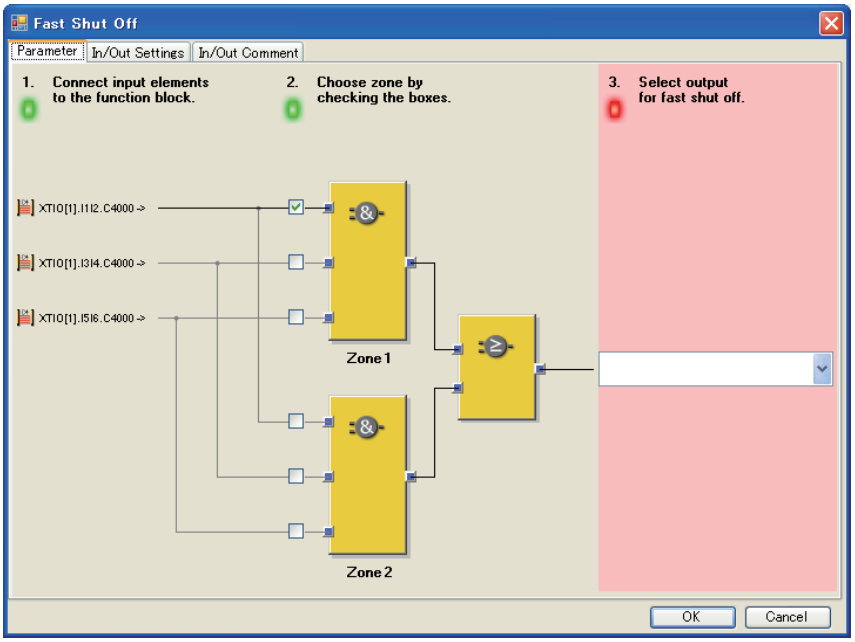
- Connect input elements to the function block. Double click the function block to open the configuration dialog and click the **In/Out Settings** tab.

Figure 44:
In/Out settings dialog for the Fast Shut Off function block



- Choose the number of inputs which you would like to attach to the function block.
- Then click the **Parameter** tab and choose the zone by checking the boxes.

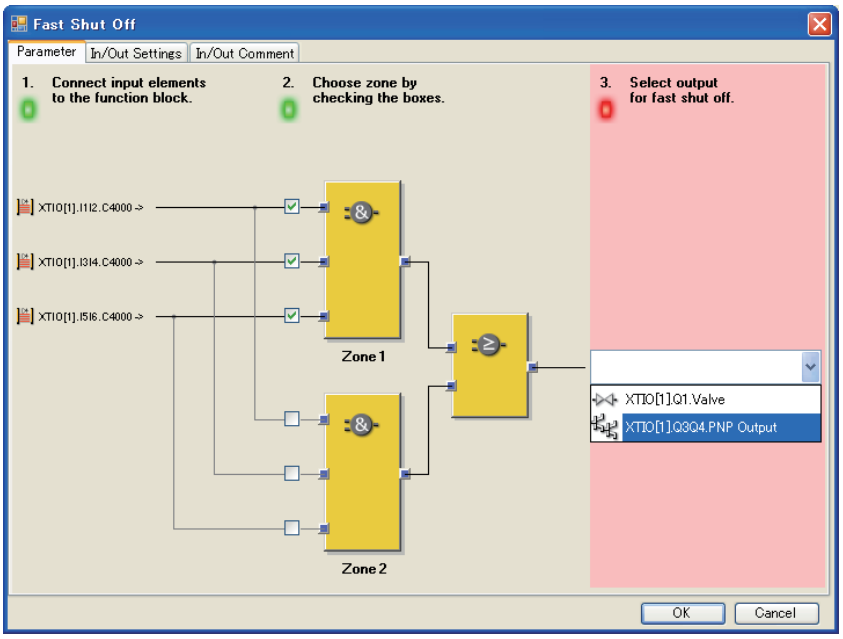
Figure 45:
Parameter settings dialog for the Fast Shut Off function block



Note If only AND logic is needed, leave the Zone 2 AND function block inputs unchecked. If additional logic is required in the application, the inputs can be combined using the Zone 1 and Zone 2 AND function blocks and subsequently connecting to the internal OR function block.

- Finally select the output for Fast Shut Off.

Figure 46:
Output selection for Fast Shut Off



At this point, the selected inputs and outputs are linked to each other such that the output cannot be moved to another position and the inputs must stay on the WS0-XTIO module in the hardware configuration. The elements which are linked are shown in the hardware configuration in peach.

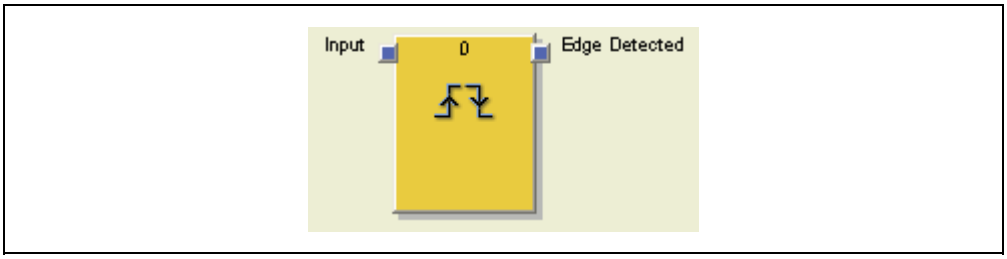
Figure 47:
Hardware configuration view of inputs and out-puts linked to Fast Shut Off

These links are broken when the Fast Shut Off function block is edited or deleted.

6.5.11 Function block Edge Detection

Function block diagram

Figure 48:
Function block diagram for the function block Edge Detection



General description

The function block Edge Detection is used to detect a rising or falling edge of the input signal. The function block can be configured to detect a rising edge, a falling edge or both. If an edge corresponding to the parameter settings is detected, the output **Edge Detected** changes to **Active** (High) for the duration of one control cycle.

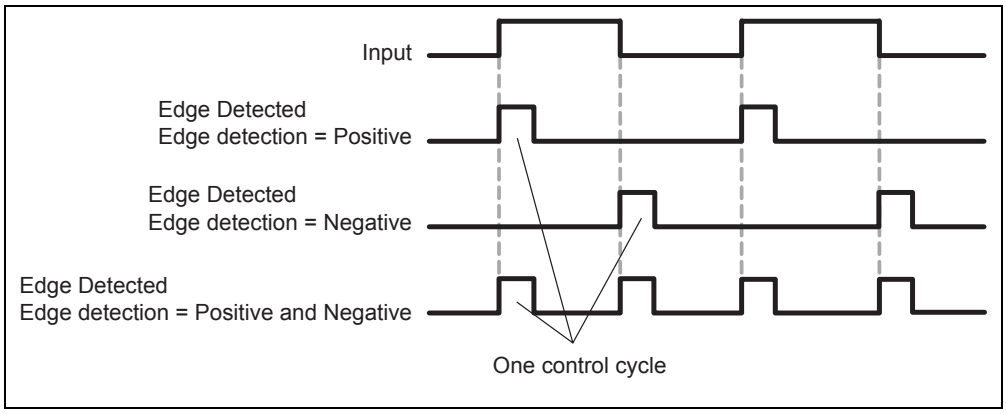
Input parameters of the function block

Table 35:
Input parameters of the function block Edge Detection

Parameter	Possible parameter values	Default
Edge Detection	● Positive ● Negative ● Positive and Negative	Positive

Sequence/timing diagram

Figure 49:
Timing diagram for the function block Edge Detection



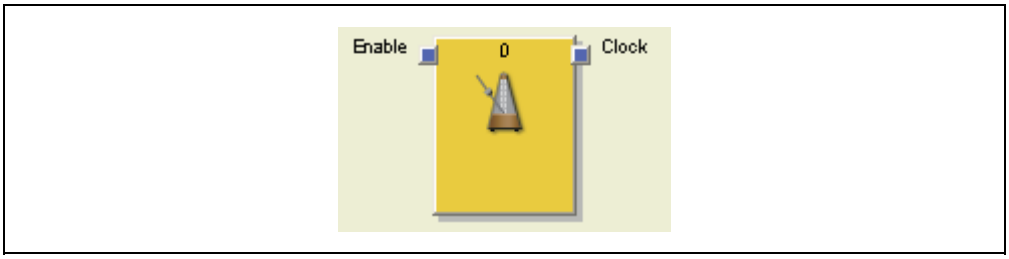
Error states and information on resetting

The function block Edge Detection does not carry out monitoring for error conditions.

6.5.12 Function block Clock Generator

Function block diagram

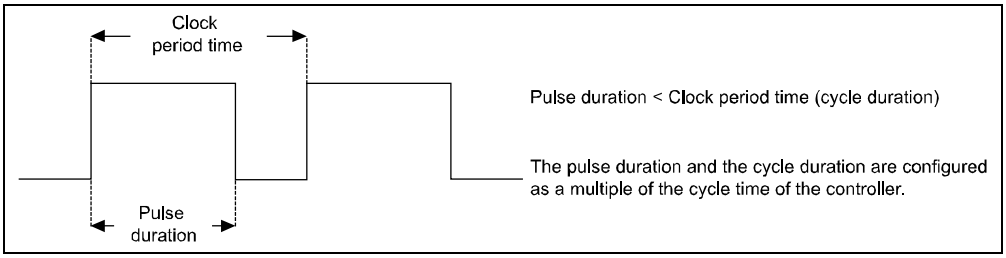
Figure 50:
Function block diagram for the function block Clock Generator



General description

The function block Clock Generator is used to define a pulsed cycle output. When Enable is **Active** (High), the Clock output pulses from **Inactive** (Low) to **Active** (High) in accordance with the parameter settings of the function block. When Enable is **Inactive** (Low), the Clock output becomes **Inactive** (Low) in accordance with the parameter settings of the function block.

Figure 51:
Parameter diagram for Clock Generator



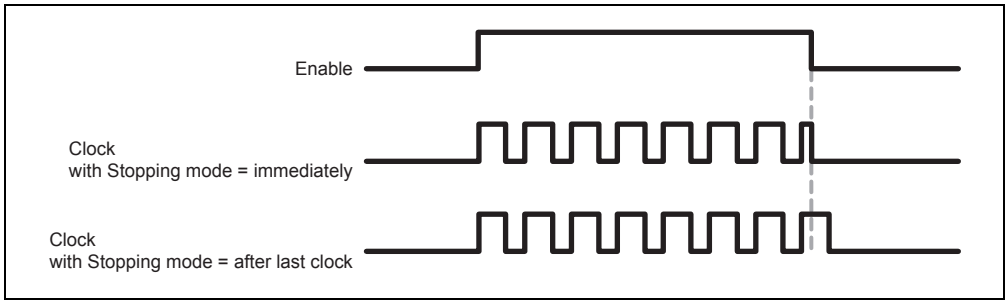
Input parameters of the function block

Table 36:
Input parameters of the function block Clock Generator

Parameter	Possible parameter values	Default
Stopping Mode	● immediately ● after last clock	immediately
Clock Period	Configurable parameter based on a multiple of the cycle time of the controller. The range lies between 2 and 65,535 control cycles.	2 control cycles
Pulse Time	Configurable parameter based on a multiple of the cycle time of the controller. The range lies between 1 and 65,534 control cycles. The pulse duration has to be lower than the cycle duration.	1 control cycle

Sequence/timing diagram

Figure 52:
Timing diagram for the function block Clock Generator



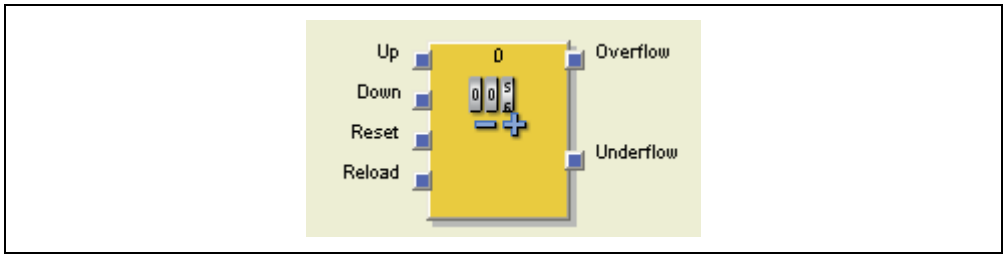
Error states and information on resetting

The function block Clock Generator does not carry out monitoring for error conditions.

6.5.13 Function blocks Event Counter (Up, Down, and Up and Down)

Function block diagram

Figure 53:
Function block diagram for the function blocks Event Counter (Up, Down, and Up and Down)



General description

Each of the function blocks Event Counter (Up), Event Counter (Down), and Event Counter (Up and Down) has an internal counter that counts upwards or downwards depending on the input states of the inputs Up or Down. During upwards counting, the Overflow output is set to **Active** (High) when the upper limit is reached. During downwards counting, the Underflow output is set to **Active** (High) when the internal counter has reached the value “0”. The parameter settings allow the user to determine whether the state of the internal counter is reset automatically to “0” or to a different value.

A transition from **Inactive** (Low) to **Active** (High), i.e., a “rising edge” at the input Up counter increases the value of the internal counter by “1”.

A transition from **Inactive** (Low) to **Active** (High), i.e., a “rising edge” at the input Down counter decreases the value of the internal counter by “1”.

If a transition from **Inactive** (Low) to **Active** (High), i.e., a “rising edge” at the input Up counter, as well as at the input Down counter, occurs (applies only to the function block Event Counter (UP and DOWN), the value of the internal counter remains unchanged.

Input parameters of the function block

Table 37:
Input parameter values for the function blocks Event Counter (Up, Down, and Up and Down)

Parameter	Possible parameter values	Default
Counter Reset	● Manual reset to “0” ● Automatic reset to “0”	Depends on the function block.
Counter Reload	● Manual reload to value ● Automatic reload to value	
Overflow Limit	Integer between 1 and 65,535. The value for the overflow limit has to be greater than or equal to the reload value.	
Reload Value	Integer between 1 and 65,535	
Min. restart pulse time	● 100 ms ● 350 ms	100 ms
Min. reload pulse time	● 100 ms ● 350 ms	100 ms

Counter Reset

The Counter Reset parameter determines what happens when the counter value reaches the overflow limit. If this parameter is configured to Automatic reset to “0”, and the internal counter equals the value of the overflow limit, the Overflow output becomes **Active** (High) for the duration of a control cycle. The value of the internal counter is reset to “0” subsequently.

If the Counter Reset parameter is configured to Manual reset to “0” and the overflow limit has been reached, the Overflow output is set to **Active** (High). If the input Reset changes from **Inactive** (Low) to **Active** (High) and back to **Inactive** (Low) in agreement with the parameter Min. restart pulse time, the counter value is reset to “0”. All the further Up counting pulses are ignored until a valid Reset input state occurs.

Note If the input Reset changes from **Inactive** (Low) to **Active** (High) to **Inactive** (Low) in agreement with the Min. restart pulse time, the counter value is reset to “0” irrespective of whether the overflow limit has been reached or not.

Counter Reload

The Counter Reload parameter determines what happens when the counter value reaches the value “0”. If this parameter is configured to Automatic reload to value and the internal counter equals “0”, the Underflow output becomes **Active** (High) for the duration of a control cycle. The value of the internal counter is subsequently reset to the value in Reload value.
If the Counter Reload parameter is configured to Manual reload to value and the lower limit, i.e. “0”, has been reached, the Underflow output is set to **Active** (High). If the input Reload value changes from **Inactive** (Low) to **Active** (High) and back to **Inactive** (Low) in accordance with the Min. reload pulse time, the value of the internal counter is reset to the value in Reload to value. All the further Down counting pulses are ignored until a valid Reload input state occurs.

Note If the input Reload changes from **Inactive** (Low) to **Active** (High) to **Inactive** (Low) in accordance with the Min. reload pulse time, the counter value is reset to the reload value, irrespective of whether “0” has been reached or not.

Overflow Limit

The Overflow Limit determines the upper limit of the internal counter. When the internal counter reaches the value of the overflow limit (i.e. the upper limit), the Overflow output changes to **Active** (High) until a valid reset sequence occurs. If the Counter Reset is configured to Automatic reset to “0”, the Overflow output becomes **Active** (High) for the duration of a control cycle. The controller cycle time is calculated by means of the Setting and Monitoring Tool. The valid values for the Overflow Limit lie between 1 and 65,535. The default is 1,000.

Reload Value

The Reload Value determines the initial value of the internal counter for applications in which counting is carried out downwards. When the internal counter reaches “0” (i.e., the lower limit), the Underflow output changes to **Active** (High) until a valid Reload sequence occurs. If the Counter Reload is configured to Automatic reload to value, the Underflow output becomes **Active** (High) for the duration of a control cycle. The controller cycle time is calculated by means of the Setting and Monitoring Tool. The valid values for the reload value lie between 1 and 65,535. The default is 1,000.

Min. restart pulse time and Min. reload pulse time

The Min. restart pulse time determines the minimum duration of the **Active** (High) share of an **Inactive**-to-**Active**-to-**Inactive** sequence that resets the value of the internal counter to “0”. Valid values are 100 ms and 350 ms. The default is 100 ms. The highest valid restart pulse duration amounts to 30 s (cannot be configured).

ATTENTION

Ensure that the transitions of the signals for resetting to "0" or value fulfil the requirements!

In case of 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 due to the short-circuit detection. If such a pulse can result in a hazardous state in the machine, the following points are to be observed:

- Ensure protected cable laying for the signal line (due to cross-circuiting to other signal lines).
- Do not reference for short-circuit detection, i.e. not test outputs.

Truth table for the function blocks Event Counter (Up, Down, and Up and Down)

The following applies for the truth table in this section:

- "0" means logic Low or Inactive.
- "1" means logic High or Active.
- "↑" means that a rising edge has been detected at the signal input.
- "n–1" references the preceding value.
- "n" references the current value.
- "Y" references the value of the internal counter.
- "X" means "any", e.g. Reset takes priority over the states of the Up counter and Down counter.

Table 38: Truth table for the function blocks Event Counter (Up, Down, and Up and Down)

Up	Down	Reset	Reload	Counter value$_{n-1}$	Counter value$_n$	Overflow	Under flow
↑	0	0	0	Y	Y+1	0	0
↑	1	0	0	Y	Y+1	0	0
↑	0	0	0	Y	Y+1= Overflow limit	1	0
↑	0	0	0	Y= Overflow limit	Y= Overflow limit	1	0
0	↑	0	0	Y	Y-1	0	0
1	↑	0	0	Y	Y-1	0	0
0	↑	0	0	Y	Y-1 = 0	0	1
0	↑	0	0	Y = 0	Y = 0	0	1
↑	↑	0	0	Y	Y	0	0
X	X	1	0	Y	Reset to "0"	0	0
X	X	0	1	Y	Reload set value	0	0
X	X	1	1	Y	Reset to "0"	0	0

Error states and information on resetting

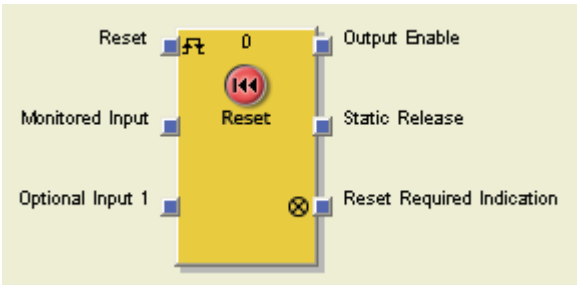
The function blocks Event Counter (Up, Down, and Up and Down) do not carry out monitoring for error conditions.

6.6 Application-specific function blocks

6.6.1 Application-specific function block Reset

Function block diagram

Figure 54:
Function block diagram for the function block Reset



General description

In order to fulfil the normative requirements for safety applications on acknowledging and cancelling a manual safety stop and the subsequent request to restart the application, each safety logic system of a MELSEC-WS safety controller should have a Reset function block.

The Reset signal is to be passed via an NO contact to a physical input.

The Monitored Input and Optional Input signals are combined internally. If any Monitored Input signal changes to **Inactive**, the Output Enable output also becomes **Inactive** and remains **Inactive** until a successful reset sequence occurs.

When all the Monitored Input signals (e.g. Safety gate monitoring and Emergency stop) return to **Active**, the Static Release and Reset Required Indication outputs change to **Active** and 1 Hz pulsed. By this means the function block indicates that it is waiting for a reset signal sequence.

A reset-signal sequence is successful when all the Monitored Input signals remain **Active** and the Reset signal changes from Low (e.g. logic “0”) to High (e.g. logic “1”) and back to Low (e.g. logic “0”) after the Reset Required Indication output has become **Active**. In this transition sequence the **Active** Reset signal has to fulfil the requirements of the set parameter for the minimum reset pulse duration (either 100 ms or 350 ms). The default is 100 ms.

ATTENTION

Ensure that the transitions of the signals for resetting fulfil the requirements!
In case of 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 due to the short-circuit detection. If such a pulse can result in a hazardous state in the machine, the following points are to be observed:

- Ensure protected cable laying for the signal line (due to cross-circuiting to other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

During a reset sequence, Output Enable changes to **Active** and the Reset Required Indication output changes to **Inactive**. The further specific behaviour of the reset sequence is described below. Each defined step has to occur in the specified sequence - the MELSEC-WS safety controller does not continue with the next step until the condition specified in the current step has been fulfilled.

Requests for resetting when the Monitored Input is inactive (e.g. logic “0”) or when the MELSEC-WS safety controller changes from the stop state to the Run state:

1. Output Enable changes to **Inactive**.
2. Static Release changes to **Inactive**.
3. Reset Required Indication changes to **Inactive**.
4. All the Monitored Input signals are **Active**.
5. Static Release changes to **Active**.
6. Reset Required Indication changes to **Active** (e.g. 1 Hz pulse).
7. A successful reset sequence is carried out (see previous sections).
8. Output Enable changes to **Active**.
9. Reset Required Indication changes to **Inactive**.

Sequence/timing diagram

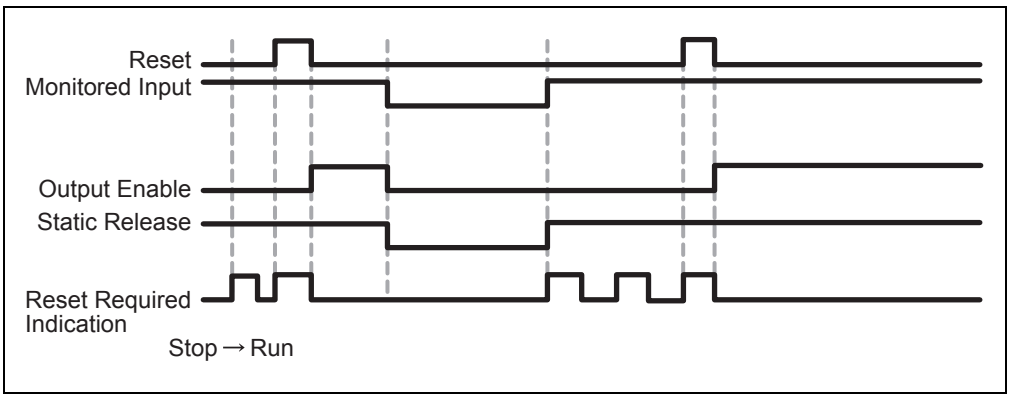


Figure 55: Sequence/timing diagram for the function block Reset

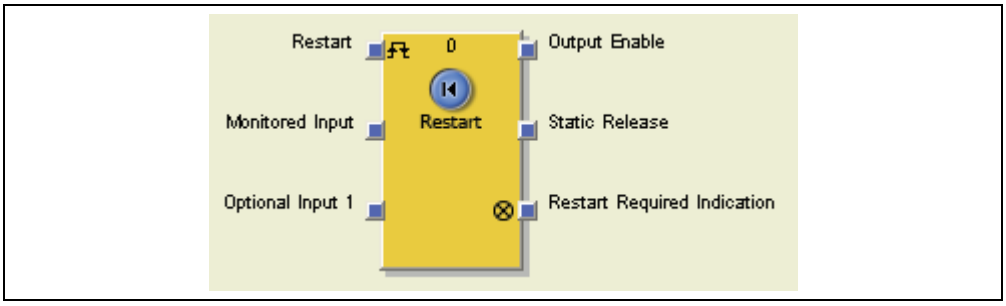
Error states and information on resetting

The function block Reset does not carry out monitoring for error conditions.

6.6.2 Application-specific function block Restart

Function block diagram

Figure 56:
Function block diagram for the function block Restart



General description

The internal logic of the Restart function block has the same functionality as that of the Reset function block. The Restart function block allows graphic differentiation between the function blocks with regard to the observation of application standards for acknowledging and cancelling a manual restart request.

The Restart signal is to be output via an NO contact.

The input signals of the Restart function block are interlinked internally. If any Monitored Input signal changes to **Inactive**, Output Enable also becomes **Inactive** until a successful reset sequence occurs.

When all the Monitored Input signals (e.g. outputs of the Reset function block) return to **Active**, the Static Release and Restart Required Indication outputs change to **Active** and 1 Hz pulsed. By this means the function block indicates that it is waiting for a restart signal sequence.

A restart signal sequence is successful when all the Monitored Input signals remain **Active** and the Restart signal changes from Low (e.g. logic “0”) to High (e.g. logic “1”) and back to Low (e.g. logic “0”) after the Restart Required Indication output has become **Active**. In this transition sequence the **Active** Restart signal has to fulfil the requirements of the set parameter for the Min. Restart Pulse Time (either 100 ms or 350 ms). The default is 100 ms and requires the usage of a test output that is referenced to the Restart input.

ATTENTION

Ensure that the transitions of the signals for restarting fulfil the requirements!

In case of 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 due to the short-circuit detection. If such a pulse can result in a hazardous state in the machine, the following points are to be observed:

- Ensure protected cable laying for the signal line (due to cross-circuiting to other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

When a restart sequence is successful, Output Enable changes to **Active** and the Restart Required Indication output changes to **Inactive**. The further specific behaviour of the restart sequence is described below. Each defined step has to occur in the specified sequence - the MELSEC-WS safety controller does not continue with the next step until the condition specified in the current step has been fulfilled.

Restart Required Indication when Monitored Input is **Inactive** or when the MELSEC-WS safety controller changes from the stop state to the Run state:

1. Output Enable changes to **Inactive**.
2. Static Release changes to **Inactive**.
3. Restart Required Indication changes to **Inactive**.
4. All the Monitored Input signals are **Active**.
5. Static Release changes to **Active**.
6. Restart Required Indication changes to **Active** (e.g. 1 Hz pulse).
7. A successful restart sequence is carried out (see previous sections).
8. Output Enable changes to **Active**.
9. Restart Required Indication changes to **Inactive**.

Sequence/timing diagram

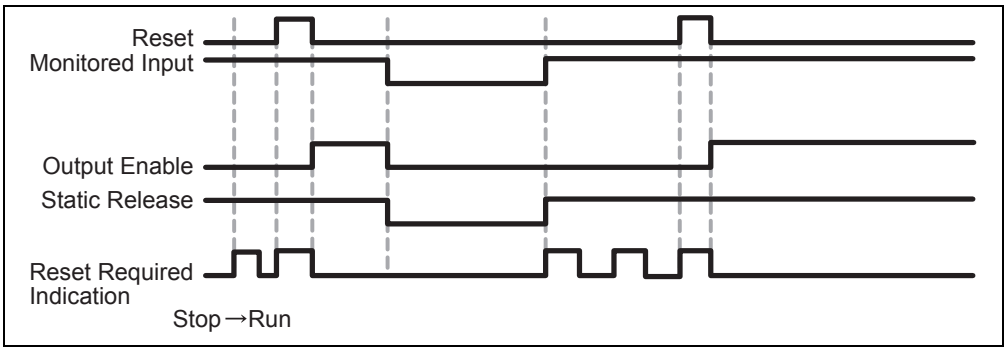


Figure 57: Sequence/timing diagram for the function block Restart

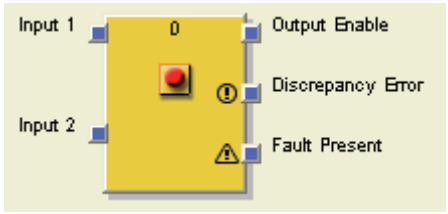
Error states and information on resetting

The function block Restart does not carry sout monitoring for error conditions.

6.6.3 Application-specific function block E-Stop

Function block diagram

Figure 58:
Function block diagram for the function block E-Stop



General description

The function block E-Stop allows the implementation of an emergency stop function with an emergency stop pushbutton.

If a corresponding dual-channel input element is configured in the hardware configuration of the Setting and Monitoring Tool, this function block is no longer required in the logic since the pre-evaluation is then carried out directly on the WS0-XTDI or WS0-XTIO module. But if the error output is required for further processing, the function block can be used to this purpose. To this purpose the two input signals are to be configured as single-channel signals and applied to the inputs of the function block.

If both inputs of a dual-channel input are connected to the same input bit, the function block evaluates this as an external dual-channel evaluation. In this case the function block behaves as follows:

- The value of the Input 2 is ignored.
- Any discrepancy time configured for the input pair is ignored.

In the case of emergency off pushbuttons, a Reset and/or Restart function block has to take over the processing of the reset/restart conditions for the safety chain when Output Enable is set to **Inactive**. This can also be necessary for emergency off pushbuttons with a combined push-/pull-to-unlatch mechanism.

In as far as configured, the Fault Present output can also be monitored by connection to the function block.

Input parameters of the function block

Table 39: Input parameters of the function block E-Stop

Parameter	Possible parameter values	Default
Inputs	● single channel ● dual channel equivalent ● dual channel complementary	dual channel equivalent
Discrepancy Time	Inactive (= 0 ms), 10 ms to 30,000 ms in 10 ms steps. If used, the set discrepancy time has to be greater than the execution time of the MELSEC-WS safety controller.	30 ms

For further information on these parameters, refer to Section 6.3 and Section 6.4.

Output of the function block

The following additional error outputs are available:

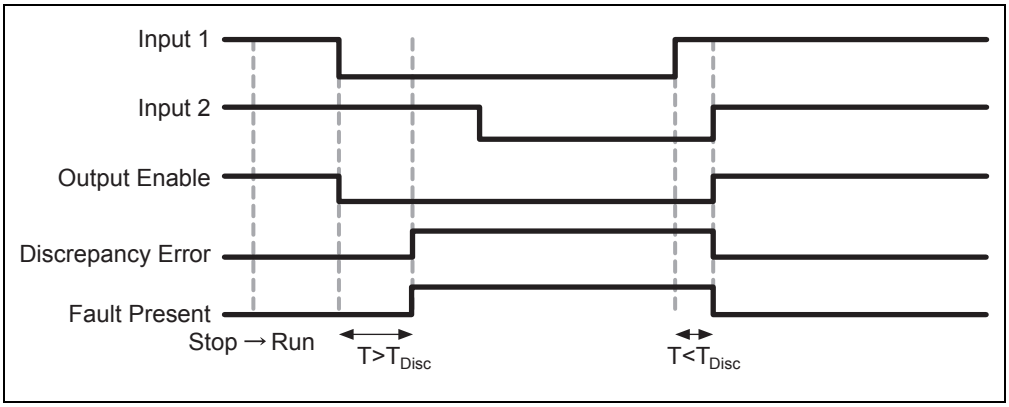
Table 40: Output of the function block E-Stop

Optional output connections of the function block
Discrepancy Error
Fault Present

In order to allow access to these output conditions, increase the number of outputs on the In/Out Settings tab of the function block properties.

Sequence/timing diagram

Figure 59: Sequence/timing diagram for the function block E-Stop



If the enable condition was already fulfilled at the state change of the MELSEC-WS safety controller from the stop state to the Run state, Output Enable does not change to Active. The input evaluation must have been Inactive beforehand.

Error states and information on resetting

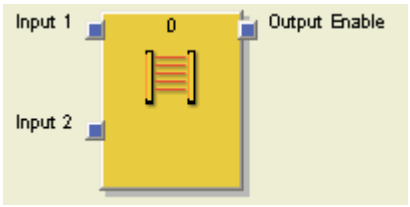
Table 41: Error states and information on resetting the function block E-Stop

Diagnostics outputs	Fault Present	Resetting the error state	Remarks
Discrepancy Error	**Active**	A Discrepancy Error cannot be reset until the dual-channel evaluation of the input has become **Inactive**. The Discrepancy Error returns to **Inactive** when both inputs return to **Active** and there is no error.	Output Enable changes to **Inactive** and the Fault Present changes to **Active**, if the Discrepancy Error is **Active**.

6.6.4 Application-specific function block Light Curtain Monitoring

Function block diagram

Figure 60: Function block diagram for the function block Light Curtain Monitoring



General description

The Light Curtain Monitoring function block allows the implementation of a semiconductor protective device functionality with ESPE devices.

The internal logic of the Light Curtain Monitoring function block corresponds to the functionality of the function block E-Stop, however with a limited parameter selection. The single-channel input type cannot be selected in the Light Curtain Monitoring function block.

Input parameters of the function block

Table 42: Input parameters of the Light Curtain Monitoring function block

Parameter	Possible parameter values	Default
Inputs	● dual-channel equivalent	dual-channel equivalent
Discrepancy Time	Inactive (= 0 ms), 10 ms to 500 ms in 10 ms steps. If used, the set discrepancy time has to be greater than the scan time of the MELSEC-WS safety controller.	30 ms

For further information on these parameters, refer to Section 6.3 and Section 6.4.

Output of the function block

The following additional error outputs are available:

Table 43: Output of the Light Curtain Monitoring function block

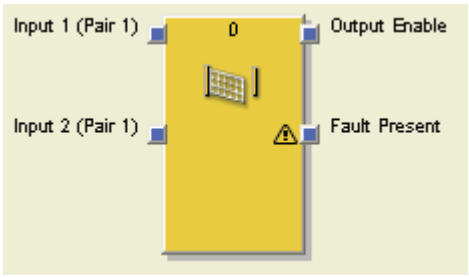
Optional output connections of the function block
Discrepancy Error
Fault Present

In order to allow access to these output connections, increase the number of outputs on the In/Out Settings tab of the function block properties.

6.6.5 Application-specific function block Safety Gate Monitoring

Function block diagram

Figure 61:
Function block diagram for the function block Safety Gate Monitoring



General description

In as far as configured, the Fault Present output can also be monitored by connection to the function block.

Input parameters of the function block

Table 44:
Input parameters of the Safety Gate Monitoring function block

Parameter	Possible parameter values	Default
Inputs	● single channel ● dual channel equivalent (1 pair) ● dual channel complementary (1 pair) ● dual channel equivalent (2 pairs) ● dual channel complementary (2 pairs)	dual channel equivalent (1 pair)
Function Test	● No function test ● Function test required	No function test
Discrepancy Time (Pair 1/Pair 2)	Can be set separately for the inputs 1/2 and 3/4. Values: Inactive (= 0 ms), 10 ms to 30,000 ms in 10 ms steps. If used, the set discrepancy time has to be greater than the scan time of the MELSEC-WS safety controller.	30 ms
Synchronization Time	Inactive (= 0 ms), 10 ms to 30,000 ms in 10 ms steps. If used, the set synchronization time has to be greater than the scan time of the MELSEC-WS safety controller.	300 ms

If both inputs of a dual-channel input are connected to the same input bit, the function block evaluates this as an external dual-channel evaluation by the distributed I/O device. In this case, the function block behaves as follows:

- The value of the Input 2 is ignored.
- Any discrepancy time configured for the input pair is ignored.

For further information on these parameters, refer to Section 6.3 and Section 6.4.

Output of the function block

The following additional error outputs are available:

Table 45: Output of the Safety Gate Monitoring function block

Optional output connections of the function block
Discrepancy Error (Pair1)
Discrepancy Error (Pair2)
Function Test Required
Synchronization Error
Function Test Error
Fault Present

In order to allow access to these output connections, increase the number of outputs on the In/Out Settings tab of the function block properties. For further information on these parameters, refer to Section 6.3 and Section 6.4.

Sequence/timing diagrams

Figure 62: Sequence/timing diagram for the Safety Gate Monitoring function block, Category 2, single-channel with function test

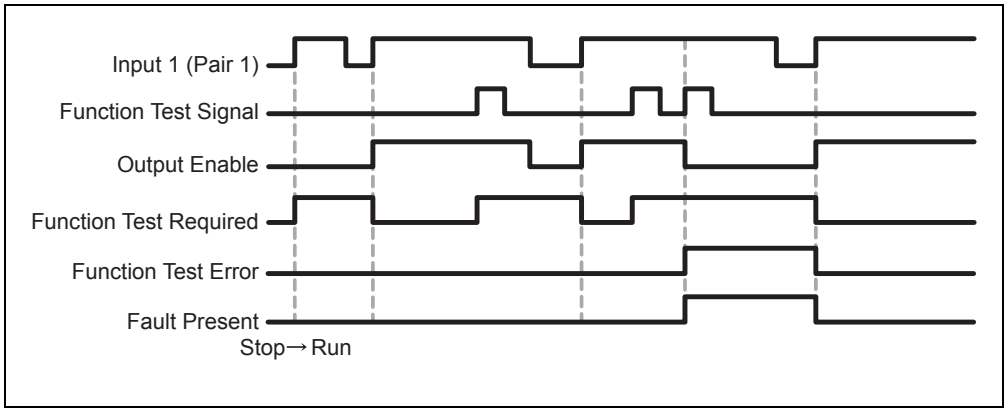


Figure 63: Sequence/timing diagram for the Safety Gate Monitoring function block, Category 4, dual-channel without function test

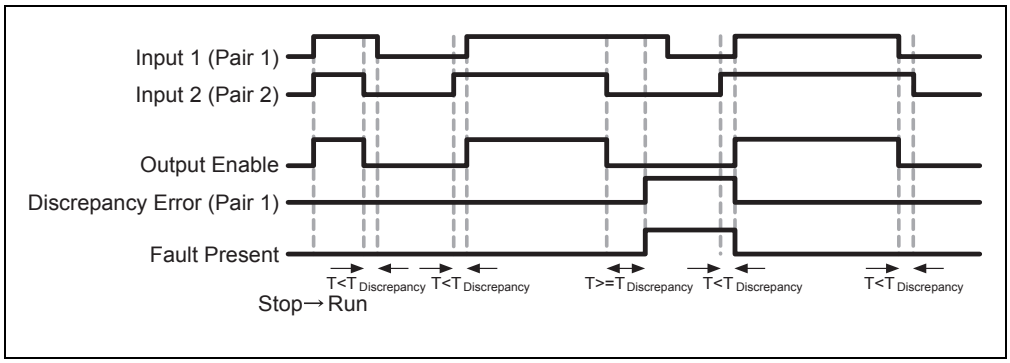
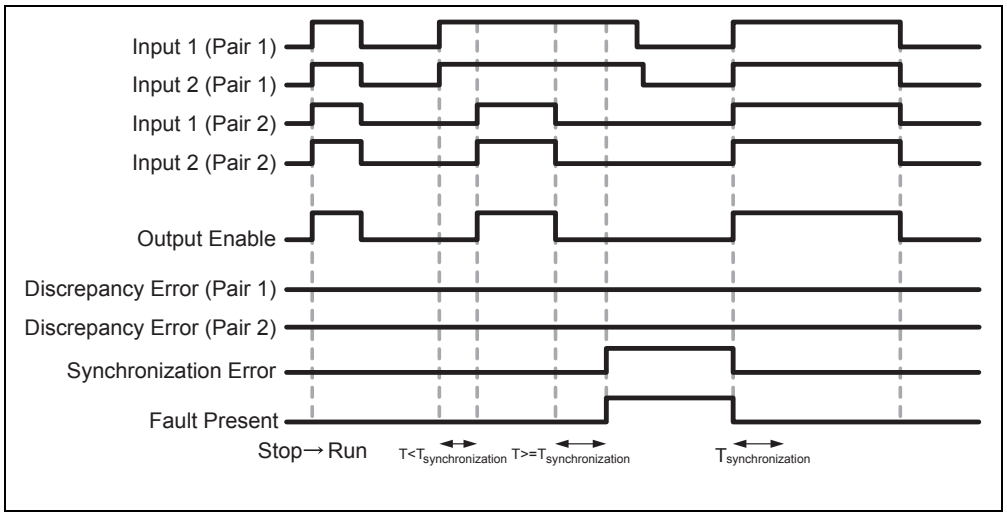


Figure 64: Sequence/timing diagram for the Safety Gate Monitoring function block, Category 4, dual-channel (2 pairs) without function test



Error states and information on resetting

Table 46:
Error states and information on resetting the Safety Gate Monitoring function block

Diagnostics outputs	Fault Present	Resetting the error state	Remarks
Discrepancy Error	**Active**	A Discrepancy Error cannot be reset until both inputs of the dual-channel input evaluation have become **Inactive**. The Discrepancy Error changes to **Inactive** when a sequence has been detected that sets Output Enable to **Active** and there is no error.	Output Enable changes to **Inactive** (fail-safe) and the Fault Present changes to **Active**, if the Discrepancy Error is **Active**.
Synchronization Error	**Active**	A Synchronization Error cannot be reset until the dual-channel evaluation of the input has become **Inactive**. The Synchronization Error changes to **Inactive** when a sequence has been detected that sets Output Enable to **Active** and there is no error.	Output Enable changes to **Inactive** (fail-safe) and the Fault Present changes to **Active**, if the Synchronization Error is **Active**.
Function Test Error	**Active**	The Function Test Error changes to **Inactive** when a sequence has been detected that sets Output Enable to **Active** and there is no error.	Output Enable changes to **Inactive** (fail-safe) and the Fault Present changes to **Active**, if the Function Test Error is **Active**.

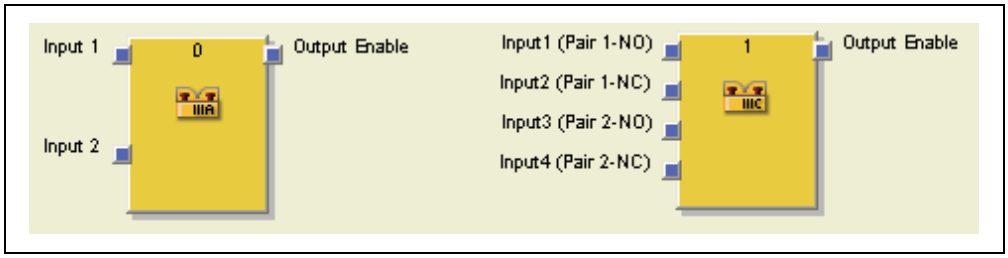
If the enable condition was already fulfilled at the state change of the MELSEC-WS safety controller from the stop state to the Run state, Output Enable does not change to **Active**. The input evaluation must have been **Inactive** beforehand.

When the MELSEC-WS safety controller changes from Stop to Run, all the errors are deleted and all the timers restarted. If the Function Test Required output is **Active** while any error state is detected, a High-Low-High sequence has to be carried out at the Function Test Signal input in order to delete the error, fulfil the Function Test Required and activate the output.

6.6.6 Application-specific function block Two Hand Control (type IIIA, type IIIC)

Function block diagram

Figure 65: Function block diagrams for the function block Two Hand Control



General description

The function block Two Hand Control provides the logic for monitoring the inputs of a two-hand control in accordance with EN 574.

The function block evaluates its input signals in pairs. Input 1 and Input 2 form a dual-channel evaluation and have to be complementary. Input 3 and Input 4 form a dual-channel evaluation and also have to be complementary. A discrepancy time can be specified for both input pairs.

The synchronisation time is the time during which a discrepancy of the input pairs is permissible. As specified in the standards and regulations, the synchronisation time for a two-hand switch evaluation may not exceed 500 ms (the synchronisation time is fixed and cannot be changed).

If both inputs of a dual-channel input pair are connected to the same input bit, the function block evaluates this as an external dual-channel evaluation by the distributed I/O device. In this case the function block behaves as follows:

- The value of the second input is ignored.
- Any discrepancy time configured for the input pair is ignored.

Output Enable only changes to **Active** if both dual-channel evaluations are effected within the synchronisation time of 500 ms. If the limit of 500 ms for the synchronisation time is exceeded, Output Enable remains **Inactive** until both dual-channel evaluations have returned to **Inactive** and subsequently both have changed to **Active** within the specifications for discrepancy time and synchronisation time.

A violation of the synchronisation time is **not** regarded as an error.

A violation of the discrepancy times is regarded as an error.

If the discrepancy time is exceeded or there is an input error, Output Enable changes to **Inactive** (fail-safe) and the Fault Present changes to **Active**.

If one of the two dual-channel evaluations changes to **Inactive**, Output Enable changes to **Inactive** and remains **Inactive** until both dual-channel evaluations have changed to **Inactive**. Output Enable does not change to **Active** until both dual-channel evaluations have changed from **Inactive** to **Active** within the specifications for the discrepancy time and synchronisation time.

The function block Two Hand Control requires a transition from **Inactive** to **Active** in order for Output Enable to change to **Active**. If one or both dual-channel evaluations are **Active** during a transition from Stop → Run, Output Enable does not change to **Active** until both dual-channel evaluations have taken on the state **Inactive** and have then changed to **Active** in accordance with the requirements of the function block Two Hand Control.

Input parameters of the function block

Table 47:
Input parameters of the function block Two Hand Control

Function block	Parameter	Possible parameter values	Default
Two Hand Control type IIIA	Inputs	dual channel equivalent	dual channel equivalent
	Discrepancy Time	Fixed specification with 500 ms	500 ms
Two Hand Control type IIIC	Discrepancy Time (Pair 1)	Inactive (= 0 ms), 10 ms to 500 ms in 10 ms steps. If used, the set discrepancy time has to be greater than the scan time of the MELSEC-WS safety controller.	100 ms
	Discrepancy Time (Pair 2)	Inactive (= 0 ms), 10 ms to 500 ms in 10 ms steps. If used, the set discrepancy time has to be greater than the scan time of the MELSEC-WS safety controller.	100 ms

For further information on these parameters, refer to Section 6.3 and Section 6.4.

Output of the function block

The following additional error outputs are available:

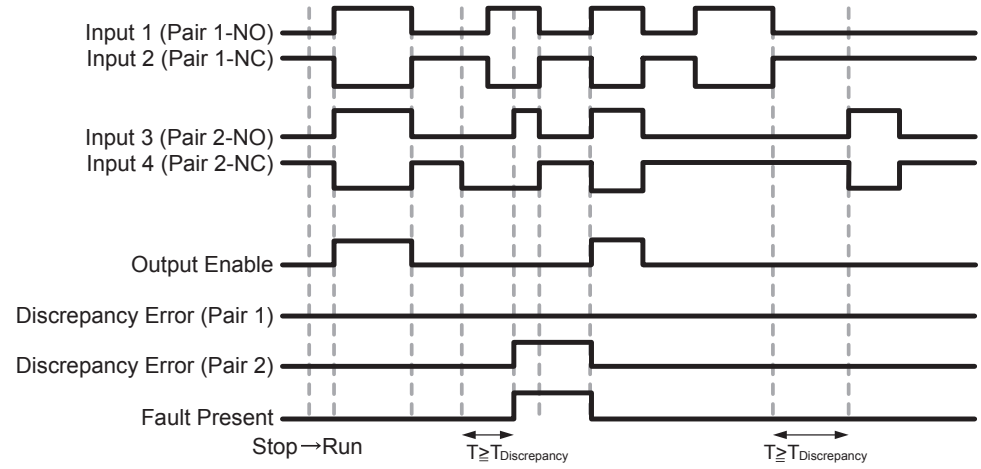
Table 48:
Output of the function block Two Hand Control

Optional output connections of the function block
Discrepancy Error (Pair1)
Discrepancy Error (Pair2)
Fault Present

In order to allow access to these output connections, increase the number of outputs on the In/Out Settings tab of the function block properties. For further information on these parameters, refer to Section 6.3 and Section 6.4.

Sequence/timing diagram

Figure 66:
Sequence/timing diagram for the function block Two Hand Control typeIIIC



Error states and information on resetting

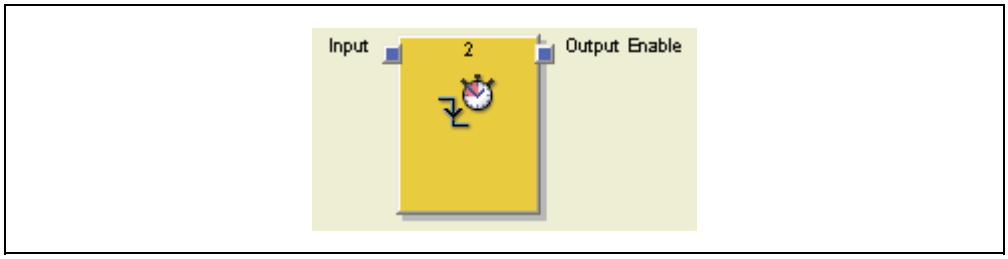
Table 49:
Error states and information on resetting the function block Two Hand Control

Diagnostics outputs	Fault Present	Resetting the error state	Remarks
Discrepancy Error	**Active**	A Discrepancy Error cannot be reset until the dual-channel evaluation of the input has become **Inactive**. The Discrepancy Error returns to **Inactive** when both inputs return to **Active** and there is no error.	Output Enable changes to **Inactive** and the Fault Present changes to **Active**, if the Discrepancy Error is **Active**.

6.6.7 Application-specific function block Off-Delay Timer

Function block diagram

Figure 67: Function block diagram for the function block Off-Delay Timer



General description

The function block Off-Delay Timer delays the switching-off of the Output Enable signal by a specified duration. The range for this delay amounts to 10 ms to 300 seconds, adjustable in steps of 10 ms. A delay period of 0 seconds is also valid and does not cause a delay. If used, the set delay time has to be greater than the execution time of the MELSEC-WS safety controller.

If Input is **Active**, the Output Enable output is also **Active** and remains **Active** until the Input changes to **Inactive** and the timer has expired after the defined period. In the case of an Off-Delay Timer, the timer begins with the delay sequence when a transition of the input from **Active** to **Inactive** occurs.

Input parameters of the function block

Table 50: Input parameters of the function block Off-Delay Timer

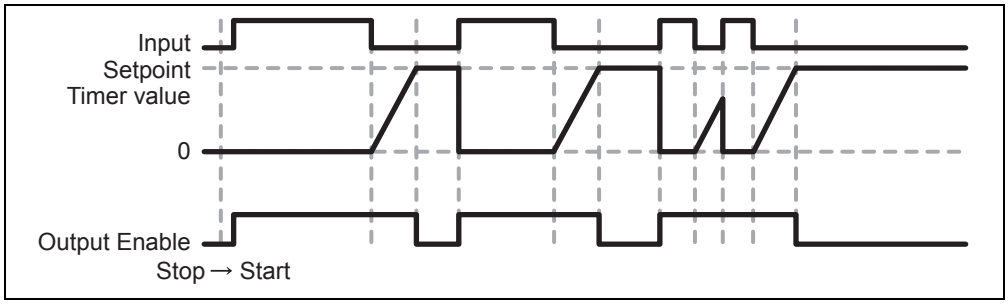
Parameter	Possible parameter values	Default
Delay Time	OFF delay time (t): 0 to 300,000 ms in steps of 10 ms. If used, the set OFF delay time has to be greater than the execution time of the MELSEC-WS safety controller.	0 ms

Output of the function block

No error outputs are available.

Sequence/timing diagram

Figure 68: Sequence/timing diagram for the function block Off-Delay Timer



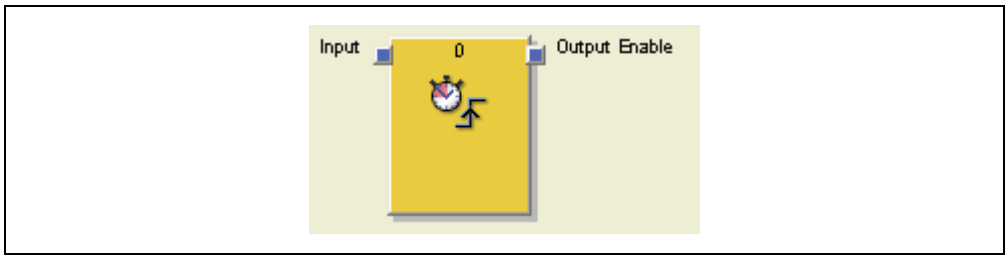
Error states and information on resetting

The function block Off-Delay Timer does not carry out monitoring for error conditions.

6.6.8 Application-specific function block On-Delay Timer

Function block diagram

Figure 69:
Function block diagram for the function block On-Delay Timer



General description

The function block On-Delay Timer delays the switching-on of the Output Enable signal by a specified duration. The range for this delay amounts to 10 ms to 300 seconds, adjustable in steps of 10 ms. A delay period of 0 seconds is also valid and does not cause a delay. If used, the set delay time has to be greater than the execution time of the MELSEC-WS safety controller.

In the case of an On-Delay Timer, the timer begins with the delay sequence when a transition of Input to **Active** occurs. After the delay sequence has expired, the Output Enable output changes to **Active** and retains this state until Input changes to **Inactive**.

Input parameters of the function block

Table 51:
Input parameters of the function block On-Delay Timer

Parameter	Possible parameter values	Default
Delay Time	ON delay time (t): 0 to 300,000 ms in steps of 10 ms. If used, the set ON delay time has to be greater than the execution time of the MELSEC-WS safety controller.	0 ms

Output of the function block

No error outputs are available.

Sequence/timing diagram

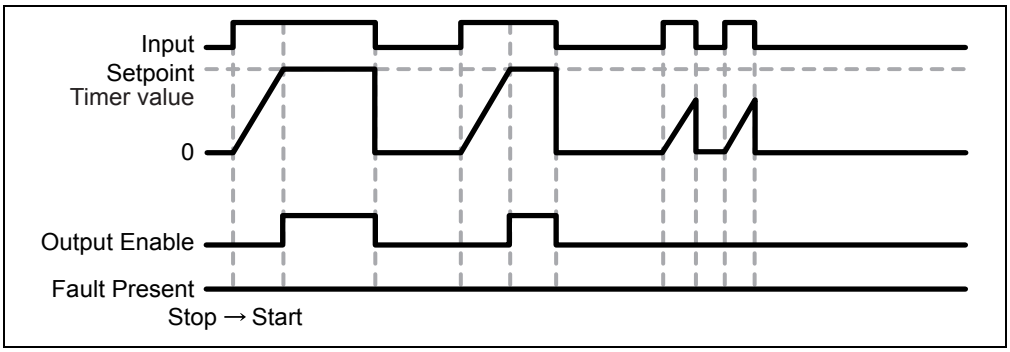


Figure 70: Sequence/timing diagram for the function block On-Delay Timer

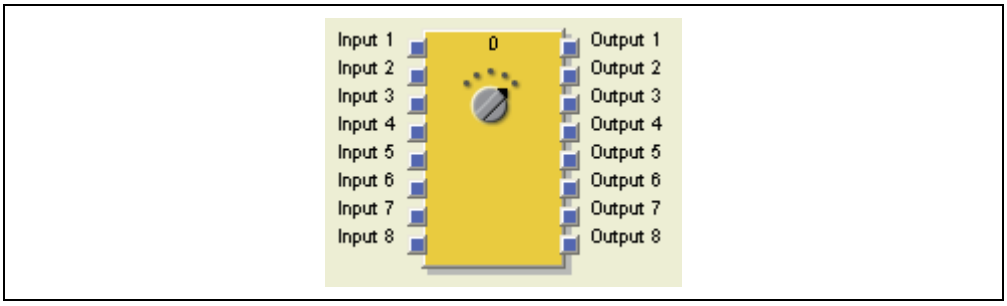
Error states and information on resetting

The function block On-Delay Timer does not carry out monitoring for error conditions.

6.6.9 Application-specific function block User Mode Switch

Function block diagram

Figure 71:
Function block diagram for the function block User Mode Switch



General description

The function block User Mode Switch selects an output depending on an input value. Output x is **Active** if Input x is **Active**.

The function block supports 2 to 8 inputs and the corresponding outputs.

Several inputs may not be **Active** simultaneously. If more than one input is **Active**, the input/output pair that was **Active** first is kept **Active** for two seconds. After two seconds, the Fault Present changes to **Active** and all the outputs change to **Inactive**. All the outputs remain **Inactive** when the MELSEC-WS safety controller changes from the Stop to the Run state and when several inputs are **Active** during the first function evaluation. After two seconds, the Fault Present then changes to **Active**.

Not all the inputs may be **Inactive** simultaneously. If all the inputs are **Inactive**, the input/output pair that was **Active** last is kept **Active** for two seconds. After two seconds, the Fault Present changes to **Active** and all the outputs change to **Inactive**.

In as far as configured, the Fault Present output can also be monitored by connection to the function block.

Truth table

The truth table uses the following designations:

“0” means logic Low or **Inactive**.

“1” means logic High or **Active**.

“x” means “any” = “0” or “1”.

Truth table for the function block User Mode Switch

Table 52: Truth table for the function block User Mode Switch

Input								Output								
1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	Fault Present
1	0	0	0	0	0	0	0	1	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	1	0	0	0	0	0	0	0	1	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	1	0	0	0	0	0	0	0	1	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	1	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
x	x	x	x	x	x	x	x	x	0	0	0	0	0	0	0	1

Input parameters of the function block

None.

Output of the function block

The following additional error outputs are available:

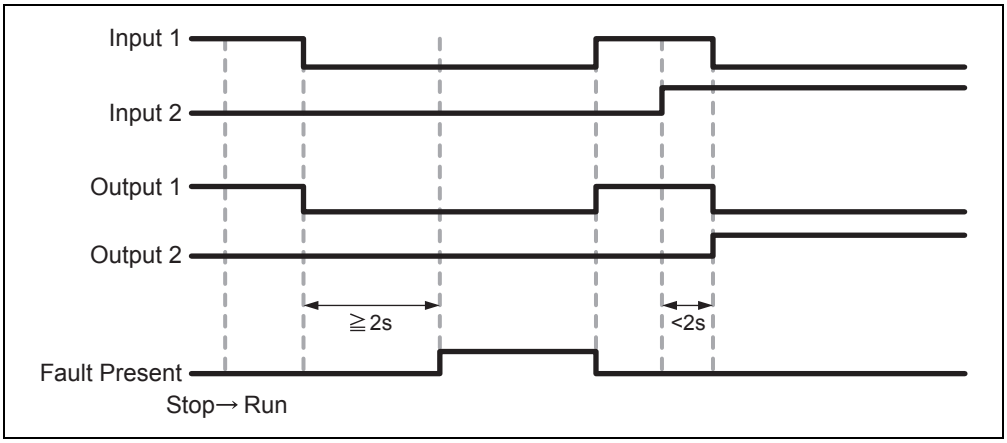
Table 53: Output of the function block User Mode Switch

Optional output connections of the function block
Fault Present

For further information on these parameters, refer to Section 6.3 and Section 6.4.

Sequence/timing diagram

Figure 72: Sequence/timing diagram for the function block User Mode Switch (Number of Inputs: 2)



Error states and information on resetting

Table 54: Error states and information on resetting the function block User Mode Switch

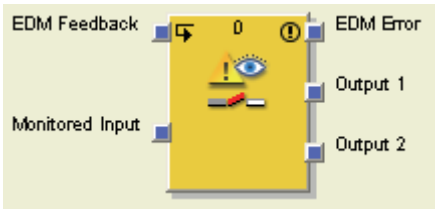
Diagnostics outputs	Fault Present	Resetting the error state	Remarks
Fault Present	More than one input **Active** for more than 2 seconds. Or: All the inputs **Inactive** for more than 2 seconds.	The Fault Present returns immediately to **Inactive** when the error state no longer exists.	When the Fault Present is **Active**, the output changes to **Inactive** (fail-safe).

Note In order to eliminate the input error at the **Active** input, you can for example briefly interrupt the corresponding input line or test output line. A change in the signal state (High-Low-High) also deletes an error state of an **Active** input.

6.6.10 Application-specific function block EDM (External Device Monitoring)

Function block diagram

Figure 73: Function block diagram for the function block EDM



General description

The function block EDM checks the feedback signal of an external device that is present at its EDM Feedback signal input and verifies that it corresponds to the state of its Output 1 and Output 2.

When the Fault Present is **Inactive**, Output 1 and 2 are set in accordance with the value at Monitored Input (e.g. of the Light Curtain Monitoring function block already described). When Monitored Input is **Active**, Output 1 and 2 are also **Active**. When Monitored Input is **Inactive**, Output 1 and 2 are also **Inactive**.

Output 1 and 2 control an external device (e.g. a contactor). When the state of Output 1 and 2 changes (e.g. from **Active** to Inactive), the EDM Feedback signal also has to be effected within a defined period (i.e. TEDM). This maximum EDM delay time amounts to 100 ms to 1,000 ms.

The EDM Feedback signal has to have the opposite state to that of Output 1 and 2:

- If Output 1 and 2 are **Active**, the EDM Feedback signal has to be **Inactive**.
- If Output 1 and 2 are **Inactive**, the EDM Feedback signal has to be **Active**.

If the EDM Feedback signal does not follow a state change of Output 1 and 2 within the specified time (T_{EDM}), then…

- the EDM Error output changes to **Active**,
- Fault Present changes to **Active**,
- Output 1 changes to **Inactive** (fail-safe),
- Output 2 changes to **Inactive** (fail-safe).

In as far as configured, the Fault Present output can also be processed in its logic by connection to the function block.

The Fault Present changes to **Active** if the EDM Feedback signal does not adopt the opposite state of Output 1 and 2 within the specified time.

Note If you require a delay of Output 1 and 2, realise the output delay with another function block before the EDM function block and not after it.

If delays of Output 1 and 2 are located behind the function block EDM, this can result in an EDM error message.

Input parameters of the function block

Table 55: Input parameters of the function block EDM

Parameter	Possible parameter values	Default
Discrepancy Time	EDM Feedback signal Maximum delay time (T_{EDM}): 100 ms to 1,000 ms in 10 ms steps. If used, the set delay time has to be greater than the execution time of the MELSEC-WS safety controller.	300 ms

Output of the function block

The following additional error outputs are available:

Table 56: Output of the function block EDM

Optional output connections of the function block
Fault Present

For further information on these parameters, refer to Section 6.3 and Section 6.4.

Sequence/timing diagram

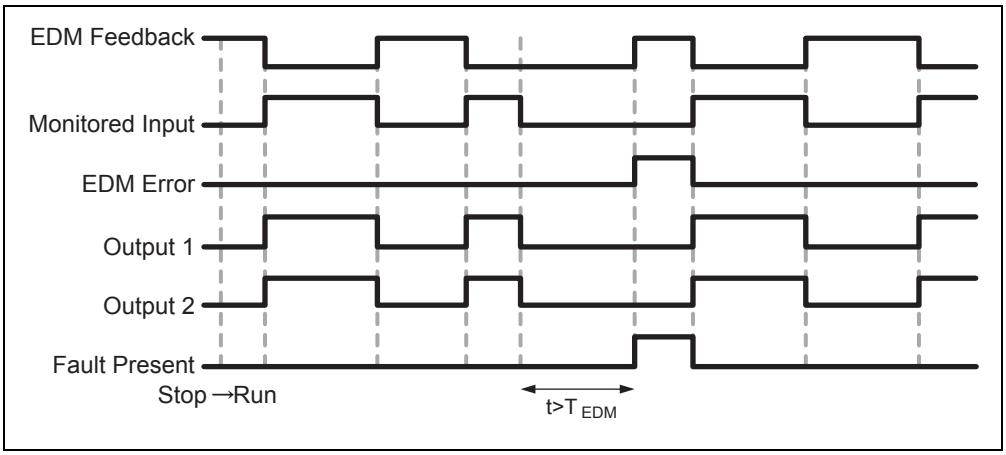


Figure 74: Sequence/timing diagram for the function block EDM

Error states and information on resetting

Table 57: Error states and information on resetting the function block EDM

Diagnostics outputs	Fault Present	Resetting the error state	Remarks
EDM Error	**Active**	The EDM Error changes to **Inactive** when the Monitored Input changes from **Inactive** to **Active** and there are no other errors.	Output 1 and Output 2 change to **Inactive** and the Fault Present changes to **Active** when the EDM Error is **Active**.

The EDM Feedback signal has to be **Active** during the OFF → ON sequence to delete the Fault Present or EDM Error, since Output1 and 2 are **Inactive**. After the fault has been eliminated and Output 1 and 2 have returned to **Active**, the EDM Feedback signal has to change to **Inactive** within the specified EDM delay time (TEDM), otherwise another error occurs in the EDM.

If the EDM Feedback signal has a fault, the required state change from Inactive to **Active** can be triggered by two methods:

- Change from the Stop to the Run state. This resets the logic.
  Or:
- Briefly interrupt the EDM Feedback signal at the source.

6.6.11 Function block Multi Operator

Function block diagram

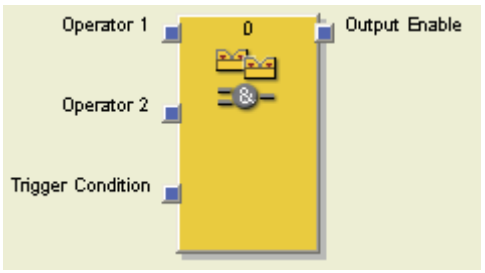


Figure 75:
Function block diagram for the function block Multi Operator

General description

The function block Multi Operator is used to monitor simultaneous operation of up to three two-hand controls. For example, several two-hand controls or foot switches can be necessary in a press application with more than one operator in order to trigger the downward movement of the press together. The reactivation condition forces the reactivation of the Operator inputs after a rising or falling edge has been detected at the Trigger Condition input.

The Static Release inputs (e.g. safety light curtains) can be connected optionally in order to ensure that the assigned devices are **Active** (High) before Output Enable can become **Active** (High). Resetting and restarting are handled independently of this function block.

ATTENTION

The Operator and Static Release inputs have to be pre-evaluated signals!
A safety-relevant evaluation of the inputs of a two-hand control has to be effected either by a different function block (e.g. Two Hand Control or Light Curtain) or as a part of the configuration of the safety inputs (e.g. configuration of the inputs with dual-channel evaluation).

The following sequence has to be effected so that Output Enable changes to **Active** (High):

1. All the Static Release inputs have to be **Active** (High).
2. All the Operator inputs have to be **Inactive** (Low).
3. All the Operator inputs have to change to **Active** (High).
4. All the Operator inputs and Static Release inputs have to remain **Active** (High). This causes Output Enable change to **Active** (High).
5. The reactivation condition changes depending on the configuration of the function block (e.g. detection of falling edge or rising edge). The reactivation condition allows Output Enable to become **Inactive** (Low).
6. All the Operator inputs have to change to **Inactive** (Low). Every Operator input is considered independently of the others. For example, it is possible that Operator 1 changes to **Inactive** (Low) and then back to **Active** (High) before Operator 2 has returned to **Inactive** (Low). However, all the Operator inputs first have to change to **Inactive** (Low) and then back to **Active** (High) before Output Enable can be reset to **Active** (High).
7. Go to item 4 above.

Input parameters of the function block

The following parameters of the function block can be configured:

Table 58:
Input parameters for the function block Multi Operator

Parameter	Possible parameter values	Default
Trigger Condition	● rising edge ● falling edge	rising edge
Number of operators	● 2 operators ● 3 operators	2 operators
Number of Static Releases	● no static release ● 1 static release ● 2 static release	no static release

Error states and information on resetting

The function block Multi Operator does not carry out monitoring for error conditions.

Sequence/timing diagram

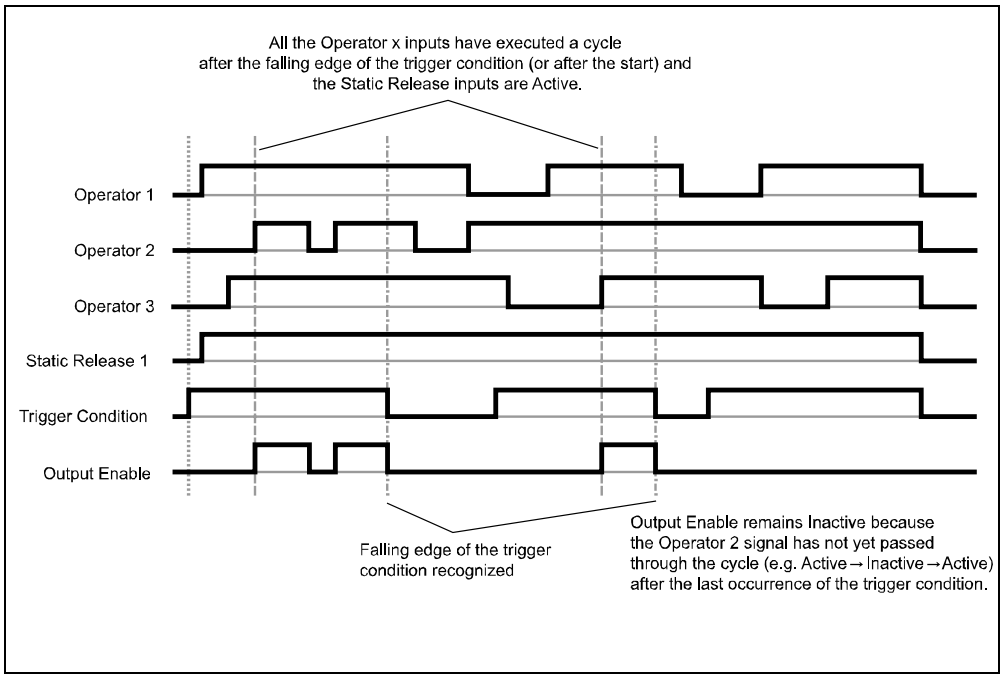
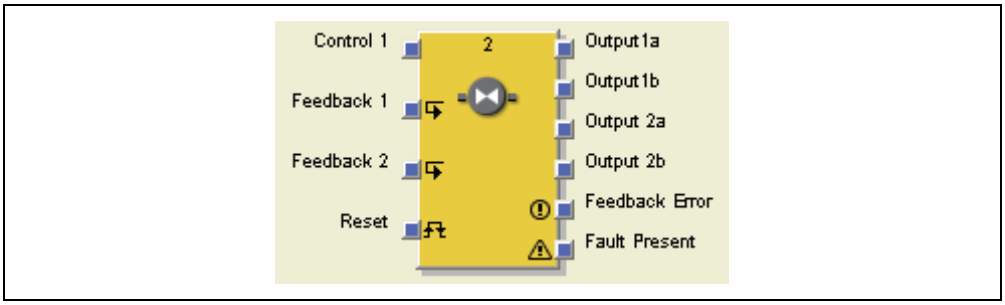


Figure 76: Sequence/timing diagram for the function block Multi Operator

6.6.12 Function block Valve Monitoring

Function block diagram

Figure 77:
Function block diagram for the function block Valve Monitoring, for double valve



General description

The function block Valve Monitoring allows the control and monitoring of outputs for valve control depending on the Control input values. When a state changes at the valve control outputs, the function block checks the Feedback input for a state change in order to ensure that the change has taken place at the valve. The status change at the Feedback input has to accord with the configuration settings for the ON delay (T_ON) and OFF delay (T_OFF). Three different valve types are available: Single valves, double valves and directional valves.

The number of Control and Feedback inputs depends on the set valve type:

- The single valve encompasses Control 1 and Feedback 1.
- The double valve encompasses Control 1 as well as Feedback 1 and Feedback 2.
- For directional valves, Control 1, Control 2, Feedback 1 and Feedback 2 are used.

ATTENTION

Connect the feedback signals correctly!

The signals for Feedback 1 and Feedback 2 have to be protected against short-circuits to the outputs (e.g. Output 1a, 1b, 2a and 2b) as well as against each other (e.g. by means of protected wiring or wiring of these signals solely within the control cabinet).

The number of outputs depends on the set Valve mode:

- The single valve encompasses Output 1a (Output 1b is optional)
- Double valves and directional valves encompass: Output 1a and Output 2a (Output 1b and Output 2b are optional)
- Output 1b is always identical with Output 1a
- Output 2b is always identical with Output 2a

The function block Valve Monitoring supports both manual and automatic resetting. If manual resetting is configured, a valid reset sequence **Inactive** (Low) to **Active** (High; at least 100 ms or 350 ms, maximum 30 s) to **Inactive** (Low) has to be carried out in order to reset the function block in case of an error state (e.g. Feedback Error or Directional Valve Error). The outputs are not reactivated automatically after an error and a valid reset sequence (manual or automatic) has occurred, if at least one Control input is **Active** (High) at the respective moment. All the Control inputs concerned must first change to **Inactive** (Low) before the outputs can be reactivated (i.e. that all the Control inputs have to be **Inactive** (Low) and all the Feedback inputs have to be **Active** (High)).

ATTENTION

Ensure that the transitions of the signals for resetting fulfil the requirements of the safety standards and regulations!

In case of 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 due to the short-circuit detection. If such a pulse can result in a hazardous state in the machine, the following points are to be observed:

- Ensure protected cable laying for the signal line (due to cross-circuiting to other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

The components of the valve monitoring check whether the Feedback input signals follow the Control inputs in accordance with the configuration for the ON delay (T_ON) and OFF delay (T_OFF). If the Feedback signals do not follow the signals of the Control inputs in accordance with the configured parameters, the outputs of the function block are deactivated.

If an **Active** (High) signal is present at a Control input for a shorter period than the configured ON delay, the output(s) is/are only **Active** (High) as long as the Control input is **Active** (High) and the Feedback are not checked.

If an **Inactive** (Low) signal is present at a Control input for a shorter period than the OFF delay, the output(s) become(s) **Inactive** (Low) and are interlocked until the Feedback signal has changed its state, thus reflecting the **Inactive** (Low) state of the Control input. The output(s) can be reactivated to **Active** (High) when the Control input(s) change(s) from **Inactive** (Low) to **Active** (High).

If both Control inputs are **Active** (High) at the directional valve type, the outputs change to **Inactive** (Low).

A Feedback Error occurs under the following circumstances:

- If one or more Control inputs change their state and the corresponding Feedback input does not change within the configured ON/OFF delay. The Feedback input has to be **Active** (High) when the corresponding Control input is **Inactive** (Low) or the Feedback input has to be **Inactive** (Low) when the corresponding Control input is **Active** (High).
- If one or more Feedback inputs are **Active** (High) while the corresponding Control inputs are also **Active** (High) and the Continuous Monitoring when valve is active parameter is set to “yes”.
- If the Feedback input is **Inactive** (Low) while the Control input changes to **Active** (High).

A Directional Valve Error occurs under the following circumstances:

- Both Control inputs are **Active** (High).

If a Feedback Error or Directional Valve Error is detected, the following steps have to be carried out in the correct sequence in order to reset the error state:

- A valid reset sequence (manual or automatic) has to be carried out.
- The Control input(s) has/have to change to **Inactive** (Low).
- The corresponding Feedback input(s) has/have to change to **Active** (High).

Input parameters of the function block

Table 59:
Input parameters of the function block Valve Monitoring

Parameter	Possible parameter values	Default
Reset Condition	● manual reset ● auto reset	manual reset
Continuous Monitoring when valve is active	● without ● yes	without
Valve mode	● Single ● Double ● Directional	Single
Max. switch-on feedback delay time (T_ON)	Parameterisable from 50 ms to 3,000 ms in steps of 10 ms. If used, the set ON feedback delay time has to be greater than the execution time of the MELSEC-WS safety controller.	50 ms
Max. switch-off feedback delay time (T_OFF)	Parameterisable from 50 ms to 3,000 ms in steps of 10 ms. If used, the set OFF feedback delay time has to be greater than the execution time of the MELSEC-WS safety controller.	50 ms
Min. reset pulse time	● 100 ms ● 350 ms	100 ms

Output of the function block

- Feedback Error output (For double valve and directional valve)
- Directional Valve Error, depending on the configuration (For directional valve)

Sequence/timing diagrams

Figure 78: Sequence/timing diagram for single valve in manual reset mode

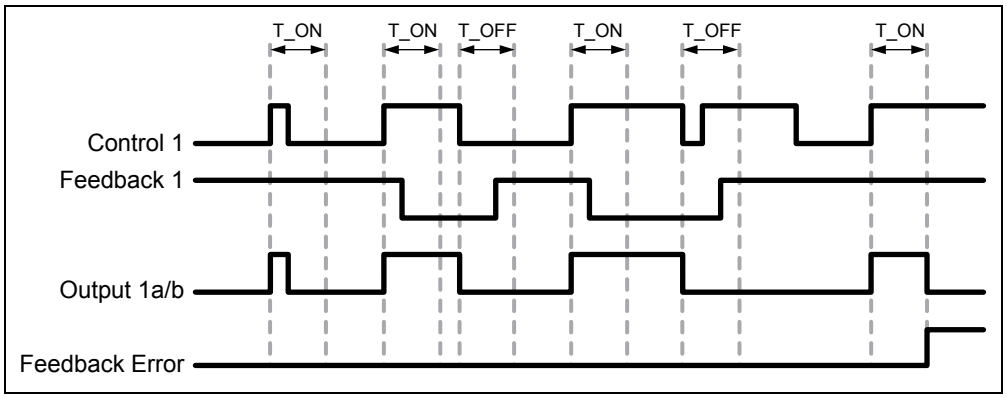


Figure 79: Sequence/timing diagram for double valve in manual reset mode

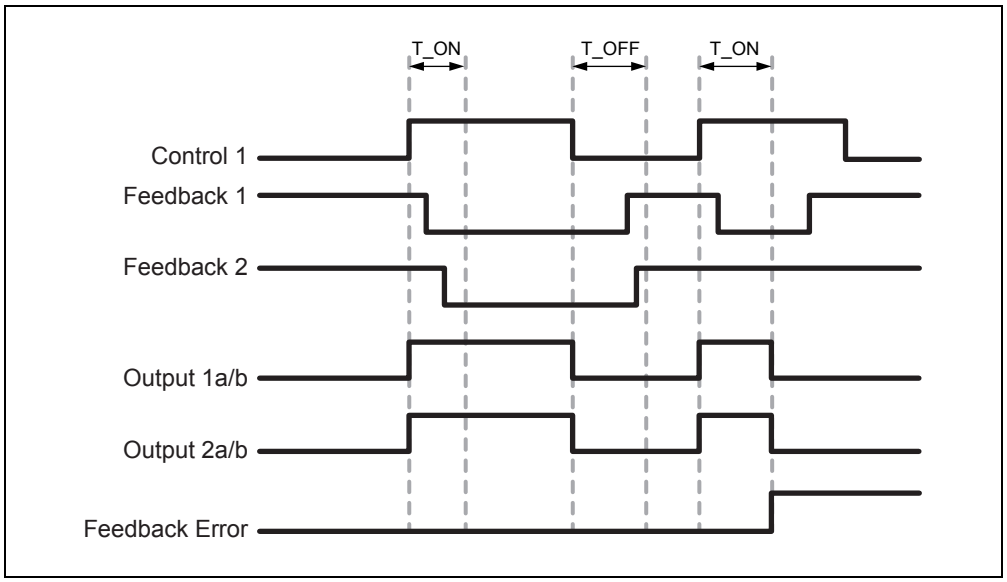
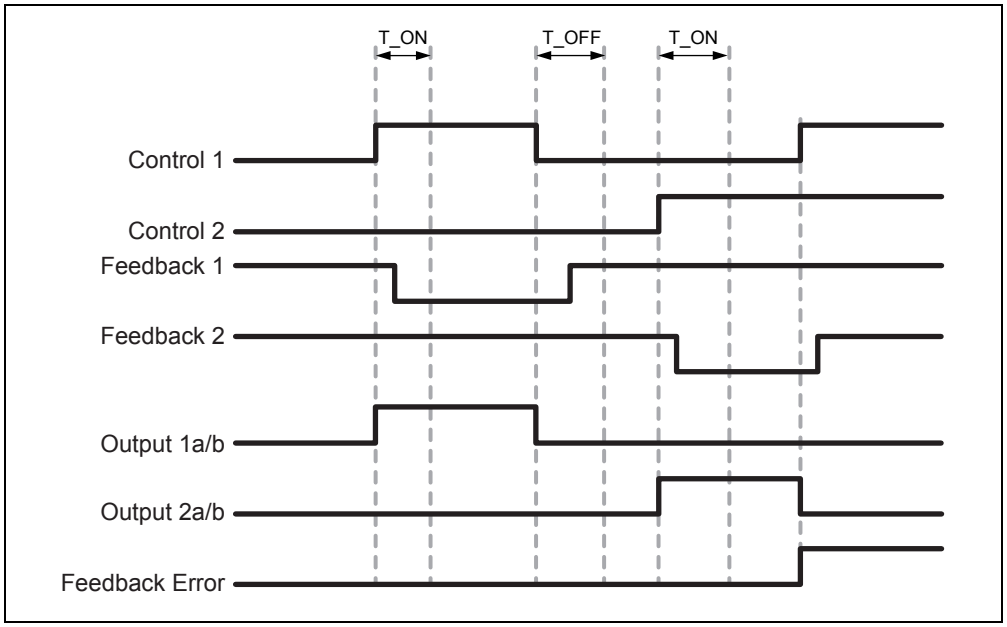


Figure 80: Sequence/timing diagram for directional valve



Error states and information on resetting

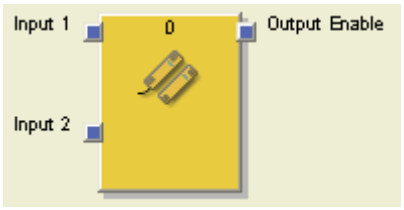
Table 60:
Error states and information on resetting for the function block Valve Monitoring

Diagnostics outputs	Fault Present	Resetting the error state	Remarks
Feedback Error Directional Valve Error	**Active**	If manual resetting is configured, a valid reset sequence **Inactive** (Low) to **Active** (High; > 100 ms or 350 ms, < 30 s) to **Inactive** (Low) has to be carried out in order to reset the function block in case of an error state (e.g. Feedback Error or Directional Valve Error). The outputs are not reactivated automatically after an error and a valid reset sequence (manual or automatic) have occurred, if at least one Control input is **Active** (High) at the respective moment. All the Control inputs concerned must first change to **Inactive** (Low) before the outputs can be reactivated (i.e. all the Control inputs have to be **Inactive** (Low) and all the Feedback inputs have to be **Active** (High)).	Output (1a, 1b, 2a, 2b) changes to **Inactive** and the Fault Present output changes to **Active**, if Feedback Error or Directional Valve Error is **Active**.

6.6.13 Function block Magnetic Switch

Function block diagram

Figure 81:
Function block diagram for the function block Magnetic Switch



General description

The internal logic of the Magnetic Switch function block corresponds to the functionality of the E-Stop function block, only with a limited parameter selection. The function block allows graphic differentiation in accordance with the application.

The Magnetic Switch function block is a predefined function block for non-contacting solenoid sensors or other complementary sensors for which discrepancy time monitoring is required. When the evaluation of the complementary inputs is Active (High), Output Enable is **Active** (High).

Input parameters of the function block

Table 61:
Input parameters of the Magnetic Switch function block

Parameter	Possible parameter values	Default
Inputs	● dual channel complementary ● dual channel equivalent	dual channel complementary
Discrepancy Time	10 to 3000 ms	800 ms

Output of the function block

The following additional error outputs are available:

Table 62:
Output of the Magnetic Switch function block

Optional output connections of the function block
Discrepancy Error
Fault Present

In order to allow access to these output connections, increase the number of outputs on the In/Out Settings tab of the function block properties.

Error states and information on resetting

Table 63:
Error states and information on resetting the Magnetic Switch function block

Diagnostics outputs	Fault Present	Resetting the error state	Remarks
Discrepancy Error	**Active**	A Discrepancy Error cannot be reset until the dual-channel evaluation of the input has become **Inactive**. The Discrepancy Error returns to **Inactive** when both inputs return to the **Active** and there is no error.	Output Enable changes to **Inactive** and the Fault Present changes to **Active**, if the Discrepancy Error is **Active**.

6.7 Function blocks for muting with parallel sensors, sequential sensors and sensors with crossed layout

6.7.1 General description

Muting is the automatic temporary bypassing of all the safety-oriented functions of the control system or of the safety device. Muting is used when certain objects, e.g. pallets with material, may be moved into the hazardous area. During this transportation through electro-sensitive protective equipment (ESPE), e.g. a safety light curtain, the muting function suppresses monitoring by the ESPE.

Muting sensors monitor the presence of the material while it is being transported. Careful selection of the type and layout of the sensors makes it possible to differentiate between objects and persons.

In combination with the muting sensors and the ESPE the transported object generates an exactly defined signal sequence while it is moved through the hazardous area. They have to ensure that all dangers are excluded when a person enters an area protected by the ESPE (i.e. any state entailing danger has to be terminated immediately). It has to be impossible for a person to generate the same signal sequence as a transported object.

The placement of the muting sensors is determined by the form of the object to be detected. To this purpose the following options are, amongst others, available with differing numbers of sensor input signals:

- two sensors
- two sensors and an additional signal C1
- four sensors (two sensor pairs)
- four sensors (two sensor pairs) and an additional signal C1

Three different function blocks are available for muting:

- muting with two sensors with crossed layout
- muting with four sensors with a parallel layout of two sensor pairs
- muting with four sensors with a sequential layout of two sensor pairs

Since muting bypasses the safety functions of a protective device, several requirements have to be fulfilled, as shown below, in order to ensure the safety of the application.

Note

- The muting cycle is the specified sequence of all processes that are executed during muting.
- The cycle begins when the first muting sensor is activated. The cycle ends depending on the configuration in the function block for the muting end condition. It is not possible to activate muting again until the preceding muting cycle has been terminated.
- Material can be transported several times within one muting cycle if the muting conditions are maintained permanently in the process, meaning that at least one pair of sensors remain activated permanently.

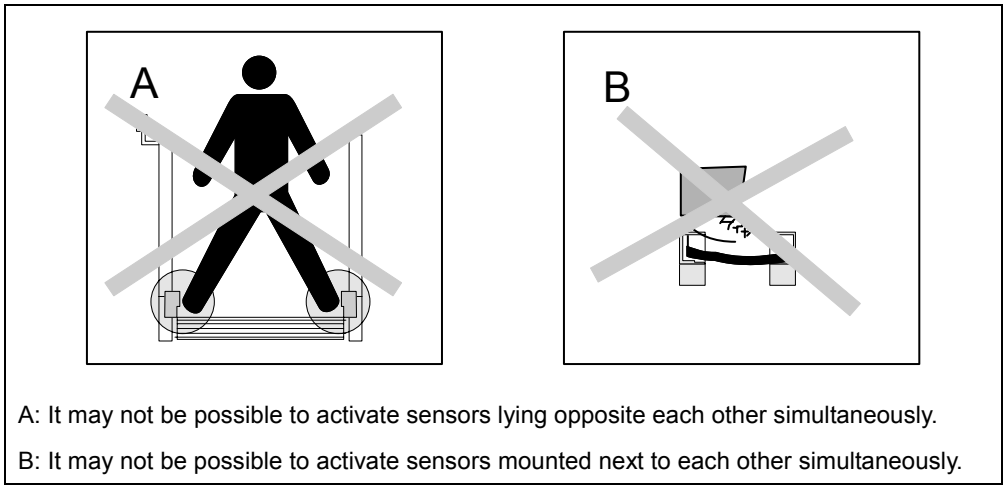
ATTENTION

The general safety regulations and protective measures have to be observed!
If you use muting, be sure to observe the following information about the correct use of muting:

- Access to the hazardous area has to be detected reliably by the ESPE or be excluded through other measures. It has to be impossible for a person to pass by, pass over, pass under or cross the ESPE without being detected. Observe the manual of the ESPE for the correct installation and use of the device.
- Always observe the valid applicable local, regional and national regulations and standards applying to your application. Ensure that your application conforms to an appropriate risk analysis and avoidance strategy.
- Muting may never be used to transport a person into the hazardous area.
- Mount the control devices for resetting and overriding outside the hazardous area so that they cannot be actuated by a person located in the hazardous area. Furthermore, when operating a control device, the operator must have full visual command of the hazardous area.
- The muting sensors have to be located in such a way that the hazardous area can only then be accessed after an intervention in the protective field, if the state causing the hazard has been terminated beforehand. One condition here is that the required safety distances defined in EN 999 are observed. At least two muting signals that are independent of each other are required.
- Muting may only be activated for the period in which the object that triggered the muting condition blocks access to the hazardous area.
- Muting has to be carried out automatically, but may not depend on a single electrical signal.
- The material to be transported has to be detected along the entire length, meaning that an interruption of the output signals may not occur (see Sensor signal gap monitoring).

- Muting must be triggered by at least two independently wired signals (e.g. by muting sensors) and may not depend completely on software signals (e.g. from a programmable controller).
- The muting condition has to be terminated immediately after the passage of the object so that the protective device returns to its normal state that was bypassed by muting (i.e. so that it comes back into force).
- The muting sensors have to be positioned in such a way that muting cannot be triggered unintentionally by anyone (see Figure 82).

Figure 82:
Safety when mounting the muting sensors

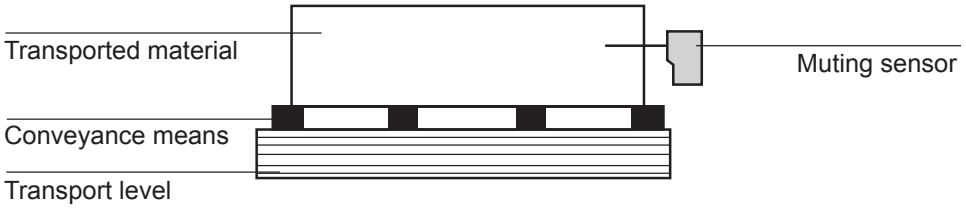


A: It may not be possible to activate sensors lying opposite each other simultaneously.

B: It may not be possible to activate sensors mounted next to each other simultaneously.

- Always position the muting sensors in such a way that only the material is detected and not the conveyance means (pallet or vehicle).

Figure 83:
Detection of material during muting



- Always position muting sensors in such a way that the material can pass unimpeded, but persons are detected reliably.
- Always position the muting sensors in such a way that a minimum distance to the detection area of the ESPE (e.g. to the light beams of a light curtain) is observed while the material is being detected.
- It has to be ensured that no persons are within the hazardous area before and during the activation of an override.
- Before you activate the override ensure that the equipment is in a perfect condition, in particular the muting sensors (visual inspection).
- When it has been necessary to activate an override, subsequently check whether the equipment functions properly and the layout of the muting sensors.

- During long muting cycles (i.e. longer than 24 hours) or during longer machine downtimes check that the muting sensors function correctly.
- A muting and/or override lamp has to be used in order to signal that the muting or override function is active. It is possible to use an external muting/override lamp or one that is integrated in the protective device (ESPE).
- Always position the muting or override lamp so that it can be seen well! It must be possible to see the muting or override lamp from all the positions around the hazardous area and for the system operator.
- If safety-relevant information (i.e. distributed safety input values and/or safety output values) is transferred via a safety field bus network, always take the corresponding delay times into account. These delay times can influence both the system behaviour as well as the requirements for the minimum safety distances that are connected to the response times.
- When an Override input is configured, test pulse outputs may not be used for the configuration of the safety inputs.
- Separate lines have to be used for the sensor signals A1 and A2 (B1 and B2).
- A line that is independent of other input signals has to be used for the signals for Reset and Reset required in order to exclude unintentional resetting of the system. The line must furthermore be laid protected.
- The total muting time cannot be set to indefinite (**Inactive**) without additional precautions being taken. If the total muting time is set to **Inactive**, additional measures have to be taken to ensure that no one can access the state entailing the hazard connected with the muting condition.

6.7.2 Muting sensors

Muting sensors detect material and supply the signals required by the control system. When the muting conditions are fulfilled, the control system can mute the protection device on the basis of the sensor signals.

Muting sensor signals can be generated by the following external sensors:

- optical sensors
- inductive sensors
- mechanical switches
- signals from the control system

If you use optical sensors for muting applications, use sensors with a background suppression in order to ensure that only the transported material fulfils the muting condition. These sensors detect material only up to a specific distance. Objects that are further away can therefore not fulfil the input conditions of the muting sensors.

6.7.3 Muting/override lamp

A muting and/or override lamp has to be used in order to signal that the muting or override function is active. It is possible to use an external muting/override lamp or one that is integrated in the protective device (ESPE).

Note It may be necessary to monitor the muting/override lamp(s) depending on your local, regional and national regulations and standards.

ATTENTION

Always position the muting or override lamp so that it can be seen well!
It must be possible to see the muting or override lamp from all the positions around the hazardous area and for the system operator.

6.7.4 Input parameters of the function block

The following (function-block-specific) parameters provide additional configuration possibilities for the muting function.

Table 64: Input parameters of the function blocks for muting

Parameter	Possible parameter values:	Default
Direction Detection	● disabled– movement in both directions ● forward – Input pair A1/A2 must switch first ● backward – Input pair B1/B2 must switch first	disabled
Muting Start Condition	● after all muting sensors are off ● if last muting sensor is active	Depends on the function block.
Muting End	● after last muting sensor ● after ESPE is clear of obstruction	after last muting sensor
Muting Total Time	Inactive, 5 s to 3600 s, resolution 1 s	5 sec
Add. Muting Time when ESPE is clear	0 ms, 200 ms, 500 ms, 1000 ms	0 ms
Concurrency monitoring time	Inactive, 10 ms to 3000 ms, resolution 10 ms. If used, the value of this parameter has to be greater than the execution time.	0 ms
Sensor signal gap monitoring	Inactive, 10 ms to 1000 ms, resolution 10 ms. If used, the value of this parameter has to be greater than the execution time.	100 ms
Sequence Monitoring	● enabled ● disabled	Depends on the function block.
C1 Input	● with ● without	with
Override Input	● with ● without	with
Conveyer Input	● with ● without	with
Min. Override Pulse Time	● 100 ms ● 350 ms	100 ms

Note All the input parameters of the function block can be accessed by double-clicking the function block and then clicking the selection field belonging to the respective parameter.

Direction Detection

Direction Detection is used when the transported material has to be moved in a specific direction. The Direction Detection depends on the sequence in which the muting sensors are activated. The default is “disabled”.

If Direction Detection is disabled, the material to be transported can be moved in both directions in order to fulfil the muting conditions. In this case it is not relevant which sensor pair is activated first.

If “forward” was selected as the direction, the muting sensor pairs have to be activated in the sequence (A1/A2) before (B1/B2). Muting is not possible in the opposite direction. Muting is terminated by a transition from four active sensors to an inactive sensor pair “B” (0 or 1 sensor active).

If “backward” was selected as the direction, the muting sensor pairs have to be activated in the sequence (B1/B2) before (A1/A2). Muting is not possible in the forward direction. Muting is terminated by a transition from four active sensors to an inactive sensor pair “A” (0 or 1 sensor active).

Muting Start Condition

The Muting Start Condition parameter determines when a valid muting sequence can begin. The Muting Start Condition can be defined for one of the following conditions:

- All the muting sensors have changed to **Inactive** (Low) together or individually and the OSSDs of the protective device (e.g. safety light curtain) are **Active** (High) (i.e. the protective field is free).
  or
- All the muting sensors except the last muting sensor are **Inactive** (Low) and the OSSDs of the protective device (e.g. safety light curtain) are **Active** (High) (i.e. the protective field is free).

If a higher throughput is required, it can be advantageous to allow the beginning of the next muting sequence as soon as the transported material has passed the protective device as well as all the muting sensors with the exception of the last one (i.e. “if last muting sensor is active”). The default is “if last muting sensor is active”.

Muting End

Similarly to the Muting Start Condition parameter, the Muting End parameter determines when a valid muting state ends. You can choose when the Muting End occurs:

- When a muting sensor of the last muting sensor pair changes to **Inactive** (Low; sensor free)
  or
- When the OSSDs of the protective device (e.g. safety light curtain) indicate that the protective field is no longer violated, i.e., the protective field is free, and the OSSDs return to the **Active** (High) state.

If after the muting end the OSSD input of the ESPE becomes **Inactive** (e.g. by a violation of the protective field of the ESPE) before the next valid muting sequence has begun, the Output Enable signal of the function block becomes **Inactive**. The next muting cycle cannot begin until the Muting End has been fulfilled. The default is “after last muting sensor”.

Muting Total Time

The Muting Total Time is used in order to limit the maximum duration of the muting sequence. If the set value for the Muting Total Time is exceeded, the Muting Error and Fault Present outputs change to **Active** (High) and Output Enable changes to **Inactive** (Low).

The timer for the Muting Total Time begins when the muting function is activated, indicated by the transition of the Muting Status output to Active (High). The timer for the Muting Total Time is stopped and reset to zero when the muting function changes to Inactive. If the optional Conveyer Input parameter is used, the timer for the Muting Total Time pauses when the Conveyer input is **Active** (High), indicating that the conveyor belt has stopped.

The values for the Muting Total Time lie between 0 and 3600 seconds. If the Muting Total Time is set to “0”, monitoring is not carried out. The default is 5 seconds.

Add. Muting Time when ESPE is clear

The “Add. Muting Time when ESPE is clear” parameter is used when the Muting End parameter has been configured as “after ESPE is clear of obstruction”. If the ESPE does not always detect the muting end exactly because of irregularities in the material or the transport means, you can increase the availability of the machine by configuring an additional muting period up to 1000 ms. Only in this case does the “Add. Muting Time when ESPE is clear” parameter determine the additional muting period after the OSSDs of the ESPE have returned to **Active** (High), i.e. that the safety light curtain is no longer interrupted. Valid values are 0 ms, 200 ms, 500 ms and 1000 ms. The default is 0 ms.

Concurrency monitoring time

The Concurrency monitoring time is used to check whether the muting sensors are activated simultaneously. This value specifies the maximum duration for which the two dual-channel evaluated muting sensor inputs may have invalid states without this being evaluated as an error. For example, (A1 and A2) or (B1 and B2) must have adopted an equivalent state before the concurrency monitoring time has expired.

Concurrence monitoring begins with the first state change of an input of a muting sensor. If the Concurrency monitoring time has expired and the two inputs of the connection have not adopted an equivalent state, an error occurs.

If the concurrence monitoring determines an error for at least one input pair, the function block indicates this error by setting the Muting Error output to **Active** (High).

The range of values for Concurrency monitoring time lies between 0 and 3000 seconds. If the Concurrency monitoring time is set to “0”, concurrence monitoring does not take place (is inactive). If the Concurrency monitoring time is not equal to “0”, the value is valid for both muting sensor pairs (A1/A2 and B1/B2) and has to be higher than the execution time of the MELSEC-WS safety controller.

Sensor signal gap monitoring

Occasional Fault Present in the output signals of muting sensors that are not relevant for muting sometimes occur. The configuration of a value for Sensor signal gap monitoring allows these brief Fault Present to be filtered out without muting being interrupted.

When Sensor signal gap monitoring is activated, an **Inactive** (Low) signal from a muting sensor input is ignored for the duration of the set value for Sensor signal gap monitoring. The function block continues to interpret this signal as an uninterrupted **Active** (High) as long as only one sensor per pair A1/A2 or B1/B2 has a signal gap. If a signal gap has been detected at a sensor, the simultaneous occurrence of a further signal gap at another sensor results in the termination of muting.

The value for Sensor signal gap monitoring can be configured within the range of 0 ms to 1000 ms. This parameter is deactivated when the value is set to “0”. If used, the set time for Sensor signal gap monitoring has to be greater than the execution time of the MELSEC-WS safety controller.

Sequence Monitoring

Sequence Monitoring is used to define a special mandatory sequence in which the muting sensors have to be **Active**. Table 65 shows the valid sequence for muting sensor input signals. This parameter is only available for configurations with four muting sensors, for example for Parallel Muting or Sequential Muting.

Table 65: Requirements for Sequence Monitoring

Direction Detection	Requirement for the muting sensor signal inputs for Sequence Monitoring:
disabled	A1 before A2 before B1 before B2 or B2 before B1 before A2 before A1
forward	A1 before A2 before B1 before B2
backward	B2 before B1 before A2 before A1

This parameter depends on the function block. Deviation from the sequence shown above result in a muting error, indicated by the status bit for muting errors. In order to avoid machine standstills the configured time for the Sensor signal gap monitoring should furthermore be shorter than the time span that the transported object requires to pass a muting sensor pair (e.g. A1/A2 or B1/B2).

C1 Input

C1 Input is used as an additional measure to avoid manipulations. If C1 Input is used, a transition from **Inactive** (Low) to **Active** (High) has to take place before the first muting sensor pair becomes **Active** (High). Signal C1 must then remain **Active** (High) until both sensors of the muting sensor pair are **Active** (High) so that a valid muting condition can arise. If this condition is not fulfilled, this results in a muting error, indicated by the status bit for muting errors. Input signal C1 subsequently has to return to **Inactive** (Low) again before the subsequent muting cycle is permitted.

Override/Override Required

An Override input signal is used to remove transported objects that have remained in the protective field of the protective device (e.g. safety light curtain) after power failures, triggering of an emergency off, muting errors or similar circumstances.

Override Required changes to **Active** (High) with a pulse of 2 Hz under the following conditions:

- Muting is currently **Inactive** (i.e. Muting Status is **Inactive** (Low)).
- At least one muting sensor is **Active** (High).
- The OSSDs of the ESPE are **Inactive** (e.g. safety light curtain is interrupted).
- Output Enable is **Inactive**.

If the conditions for the Override Required output are fulfilled and the Override input changes from **Inactive** (Low) to **Active** (High; **>** min. Override Pulse Time (100 ms or 350 ms), but < 3 s) and back again to **Inactive** (Low), the Output Enable signal becomes **Active** (High), as if the muting conditions were fulfilled. When all the muting sensors return to the **Inactive** (Low) state and the OSSD input of the ESPE is **Active** (High) (e.g. indicating that the protective field of a safety light curtain is now free), the next valid muting cycle is expected. If the next object does not fulfil the conditions for a muting cycle, but the conditions for the Override Required output, a further override cycle can be used in order to remove the transported material. The number of override cycles is limited.

Note A reset button can also be suitable for the override function. Check the requirements of your application in order to ensure that the safety-relevant logic fulfils the requirements of the local, regional, national and international regulations.

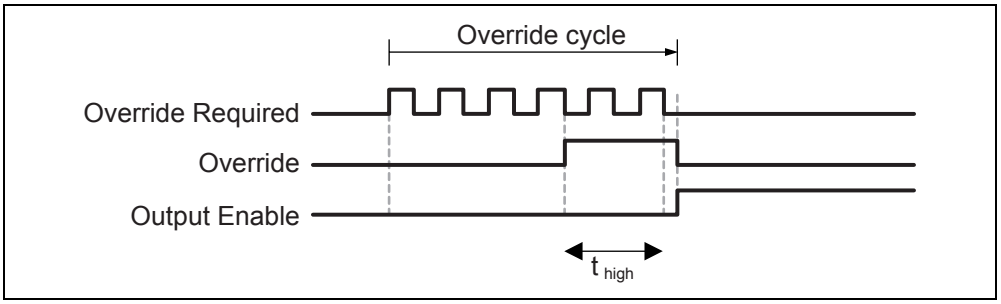
Table 66 provides information about the Override Required and when override is possible under the shown conditions and when not.

Table 66: Conditions for Override Required and Override possible

Muting Status	At least one muting sensor is Active (High).	OSSDs of the ESPE are Active (High).	Override Required	Override possible
0	No	0	No	No
0	No	1	No	No
0	Yes	0	Flashes, 2 Hz	Yes, if 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

Figure 84 shows an example sequence for Override and Override Required.

Figure 84: Logic diagram for Override and Override Required



Note t_{high} has to be equal to or greater than the min. Override Pulse Time (100 ms or 350 ms), but less than or equal to 3 s. If t_{high} is greater than 3 s, the Override input is ignored.

ATTENTION

If you use Override, check whether the system is in a safe state!
The Override function is used to activate the safety output (i.e. Output Enable) of the muting function block although the safety device (e.g. a safety light curtain) signals that state an entailing danger may exist. The Override input should only be used when the hazardous area has been checked visually and nobody is in the hazardous area or has access to the hazardous area while the Override input is being used.
When an Override input is configured, test pulse outputs may not be used for the configuration of the safety inputs.

During an override cycle, Output Enable is set to **Active** (High) like during a valid muting sequence. The number of permissible override cycles is limited in order to prevent excessive use of the override function. The number of permissible override cycles depends on the value for the Muting Total Time and is generally determined by the following equation:

Number of override cycles = 60 minutes/set time for Muting Total Time

The following exceptions apply for the number of permissible override cycles:

If the value for the Muting Total Time is less than or equal to 10 s, the number of permissible override cycles amounts to 360.

If the value for the Muting Total Time is greater than or equal to 15 minutes, the number of permissible override cycles amounts to 5.

Table 67 summarises the number of permissible override cycles:

Table 67:
Number of permissible override cycles

Muting Total Time	Number of override cycles	Remarks
5 s	360	The maximum number of cycles for the Muting Total Time < 10 s amounts to 360.
10 s	360	
20 s	180	The maximum number of permissible cycles varies as specified.
30 s	120	
1 min	60	
5 min	12	
15 min	5	The maximum number of cycles for the Muting Total Time > 15 min amounts to 5.
30 min	5	
60 min	5	
Inactive (unlimited)	5	

The number of override cycles is stored in the control system. This number is controlled by the Override Required output. The value is reset to “0”, after a valid muting cycle has taken place, after a system reset (e.g. using the Setting and Monitoring Tool) or after a transition from the Stop state to the Run state.

After the Override Required output has become **Active** (pulsing with 2 Hz) and a subsequent Override signal has become **Active** (High), muting begins again and Output Enable becomes **Active** (High).

If the muting cycle is stopped because of a faulty input signal of a muting sensor, Override Required changes to **Active** (High) for the duration of one cycle, provided that the remaining conditions for Override Required are fulfilled. If the faulty input of the muting sensor returns to **Active** (High) and subsequently to **Inactive** (Low), the muting cycle is stopped again and Override Required becomes **Active** (High), provided that the remaining conditions for Override Required are fulfilled.

During a valid override state, the muting direction, sequence monitoring (depending on the function block) and concurrence monitoring are not monitored for the duration of an override cycle.

Conveyer Input

If the movement is stopped during the muting cycle, it is possible to exceed the Muting Total Time and other parameters that can result in a Muting Error. This can be avoided by using the Conveyer input. This input is used to stop time-critical functions connected with muting when the material to be transported does not move further.

The input for monitoring the conveyer belt has to fulfil EN 61131 and has the following properties:

0 V DC = conveyor belt stopped, e.g. **Inactive** (Low)
24 V DC = conveyor belt running, e.g. **Active** (High)

The following timer functions are influenced by the input value of the conveyer belt monitoring:

Table 68:
Effects of the conveyer belt monitoring on the timer functions

Monitoring of the Muting Total Time	● If a belt stop is detected, the timer function pauses. ● If the conveyor belt starts up again, the timer continues its function with the value stored before the pause plus 3 additional seconds.
Concurrency monitoring time	

Note Sensor signal gap monitoring is not influenced by a belt stop.

Min. Override Pulse Time

The Min. Override Pulse Time determines how long the Override input has to be **Active** (High) at least in order for the Override signal to be effective. It can be set to 100 ms or 350 ms. If the Override input is **Active** (High) for a shorter time than the set Min. Override Pulse Time or for longer than 3 s, the Override input is ignored.

Output value: Muting Status

The Muting Status output indicates the state of the muting function in accordance with the following table:

Table 69: Output values for Muting Status

Condition	Muting Status
Muting cycle inactive, no error	0
Muting cycle active, no error	1
Muting error detected	0
Override active, no error	1

Output value: Muting Lamp Control

The Muting Lamp Control output is used in order to indicate an active muting cycle. The value for the Muting Lamp Control output depends directly on the value for the muting status as shown in the following table:

Table 70: Output values for the Muting Lamp Control

Condition	Muting Lamp Control
Output value of Muting Status is “0”	0
Output value of Muting Status is “1”	1
Override cycle active	1
Override Required	Flashes with 2 Hz

Output value: Muting Error

The Muting Error output is used to indicate that an error connected to the muting function block has been detected. In order to reset a Muting Error it is necessary that all the muting sensors return to **Inactive** (Low) and that the ESPE OSSD signal is **Active** (High). The value for the Muting Error is **Active** (High) when any muting error is detected.

Output value: Output Enable

Output Enable is **Active** (High) if a valid muting condition exists, a valid override cycle occurs or if the ESPE OSSD is free and no error/error state is active.

6.7.5 Information on wiring

If muting functions are to be implemented, possible errors in the wiring have to be taken into consideration. If certain signal combinations are to be transferred in a common wire, additional precautions have to be taken in order to ensure that the respective signals are correct. Suitable organisational measures have to be taken (e.g. protected wiring) in order to ensure that errors cannot arise through this wiring.

Table 71: Wiring combinations for muting and prerequisites

Signal description	A1	A2	B1	B2	C1	Conveyer	ESPE OSSD	Reset	Override	Reset/Override	Reset Required Indication	Muting Lamp Control	Muting Status	Override Required	Output Enable
A1	–	A	B	B	A	A	A	A	A	A	C	C	A	A	A
A2	A	–	B	B	A	A	A	A	A	A	C	C	A	A	A
B1	B	B	–	A	A	A	A	A	A	A	C	C	A	A	A
B2	B	B	A	–	A	A	A	A	A	A	C	C	A	A	A
C1	A	A	A	A	–	A	A	A	A	A	A	C	C	C	A
Conveyer	A	A	A	A	A	–	C	A	A	A	C	C	C	C	A
ESPE OSSD	A	A	A	A	A	C	–	A	C	A	C	C	C	C	A
Reset	A	A	A	A	A	A	A	–	A	–	C	C	C	C	A
Override	A	A	A	A	A	A	C	A	–	–	C	A	C	A	A
Reset/Override	A	A	A	A	A	A	A	–	–	–	C	A	C	A	A
Reset Required Indication	C	C	C	C	A	C	C	C	C	C	–	C	C	C	A
Muting Lamp Control	C	C	C	C	C	C	C	C	A	A	C	–	C	–	A
Muting Status	A	A	A	A	C	C	C	C	C	C	C	C	–	–	A
Override Required	A	A	A	A	C	C	C	C	A	A	C	–	–	–	A
Output Enable	A	A	A	A	A	A	A	A	A	A	A	A	A	A	–

A The specified signals may not be installed in a common wire unless protected wiring is used.
B The specified signals may not be installed in a common wire unless protected wiring or sequence monitoring is used.
C The specified signals may be installed in a common wire.
– Not applicable

Note The signals for Reset (resetting), Reset/Override (combined input for Reset and Override) and Reset Required Indication (resetting required) are only available if a Reset function block is used together with the Muting function block.

6.7.6 State transition from Stop to Run

If the system changes from the Stop state to the Run state, the following behavioural patterns can be realised, depending on the state of the muting sensors and of the ESPE OSSDs of the sensors (e.g. safety outputs of a safety light curtain). Table 72 shows details of the system behaviour during the transition from Stop to Run.

Table 72: Stop-to-Run transition behaviour for muting functions

State after the switch-on procedure:		System behaviour:	
ESPE OSSD	**State of the muting sensors**	**Start**	**Next action**
Active (High) (e.g., no object in the protective field)	All the muting sensors are **Inactive** (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 the muting sensors have to return to **Inactive** (Low), before the ESPE OSSDs of the sensors become **Inactive** (Low). If the ESPE OSSDs of the sensors become **Inactive** (Low) before all the muting sensors have become **Inactive** (Low), Override has to be used.
	The muting condition is partially fulfilled.		
Inactive (Low) (e.g., object detected)	All the muting sensors are **Inactive** (Low).	Muting is blocked.	The sensor ESPE OSSDs have to become **Active** (High) before muting can take place.
	The muting condition is partially fulfilled.	Override is required, if configured.	Either transition to normal behaviour (in case of a cyclically correct sequence of sensor states) or the total override time is exceeded.
	The muting condition is partially fulfilled.		

6.7.7 Error states and information on resetting

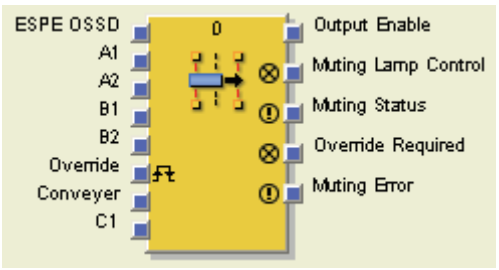
Table 73: Error states and information on resetting for Muting function blocks

Diagnostics outputs	Fault Present	Resetting the error states	Remarks
Muting Error	**Active**	A complete valid muting cycle has to take place before any muting error can be reset. To this purpose either Override has to be used or all the muting sensors and the ESPE OSSDs have to be free and a subsequent valid muting sequence has to be passed through completely. If one of these two conditions is fulfilled, the Muting Error output returns to **Inactive**, provided that no other error cause exists.	Output Enable changes to **Inactive** and the Fault Present changes to **Active**, if a muting-specific error is **Active**.
Error in the concurrency monitoring function			
Error in the muting total time monitoring			
Error in the direction detection			
Sequence error detected			
Error in the sensor signal gap monitoring			

6.7.8 Parallel Muting

Function block diagram

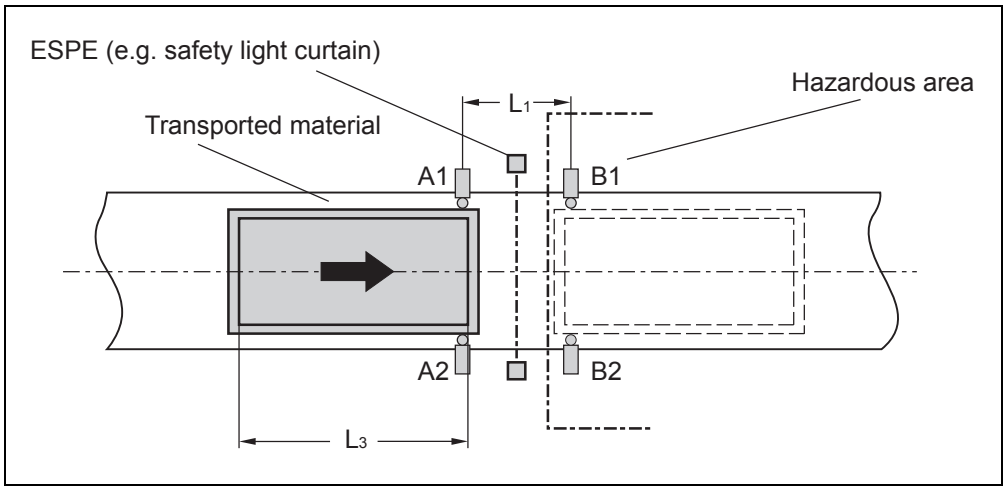
Figure 85: Function block diagram for the function block Parallel Muting



Representation of the application

Figure 86 shows an example of the placement of sensors for muting with two parallel muting sensor pairs.

Figure 86:
Muting with two parallel sensor pairs



In this example the material moves from the left to the right. As soon as the first muting sensor pair A1 & A2 is activated, the protective effect of the protective device (ESPE) is muted. The protective effect remains muted until the muting sensor pair B1 & B2 is free again.

Input conditions for muting sensors

Table 74:
Conditions for muting with two parallel sensor pairs

Condition	Description
A1 & A2 (or B1 & B2)	Starts the muting cycle. The first sensor pair is activated depending on the direction of transportation 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 second sensor pair is activated depending on the direction of transportation of the material.

Equations and prerequisites for calculating the distance:

$L_1 \geq v \times 2 \times T_{IN\ Muting\ sensor}$

$v \times t > L_1 + L_3$

$L_1 < L_3$

$T_{IN\ Light\ curtain} < T_{IN\ Muting\ sensor}$

Where ...

L_1 = Distance between the sensors
(layout symmetrical to the detection area of the ESPE)

L_3 = Length of material in conveyor direction

v = Velocity of the material (e.g. of the conveyor belt)

t = Set Muting Total Time [s]

$T_{IN\ Light\ curtain}$, $T_{IN\ Muting\ sensor}$ = Response time of the light curtain or the muting sensors in the MELSEC-WS safety controller (see the Safety Controller User's Manual)

Note

- The material can be moved in both directions or a fixed direction of transportation can be defined for it as follows:
  - With the optional signal C1. If used, signal C1 always has to be activated before both muting sensors of the first sensor pair (e.g. A1 and A2) become **Active**.
  - By means of the Direction Detection parameter
- In parallel layout, the position of the muting sensors also determines the width of the permissible object. The objects always have to pass the muting sensors with an identical width.
- Optical probes and all types of non-optical sensors can be used for this application. Use sensors and probes with background suppression.
- Avoid mutual interference of the sensors.
- Increase the protection against manipulation and the safety level by using the following configurable functions:
  - Concurrency monitoring
  - Monitoring of the muting total time
  - Muting end via ESPE
- The wiring of devices is described in Section 6.7.5.

The function block requires that a valid muting sequence takes place. Figure 87 shows an example of a valid muting sequence based on the parameter basic setting for this function block.

Sequence/timing diagram

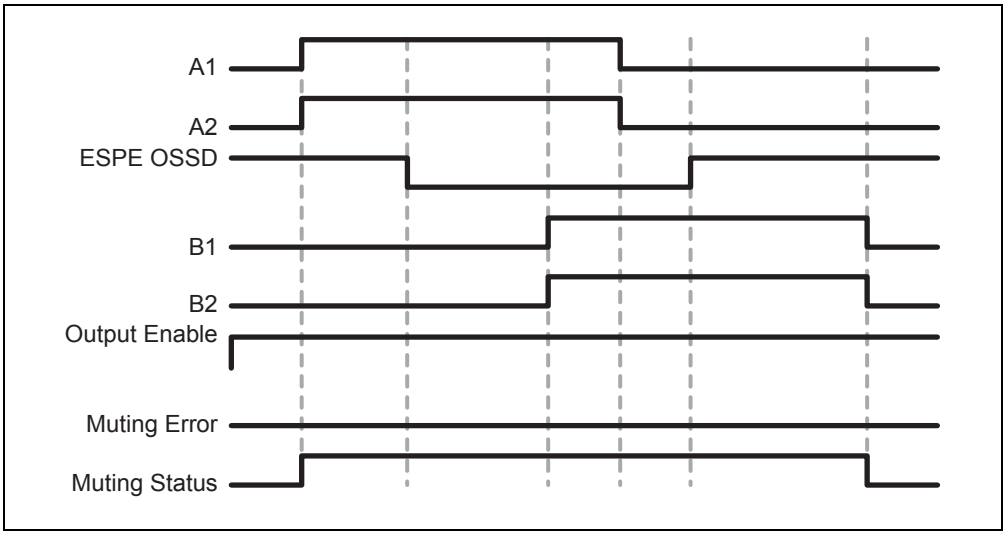
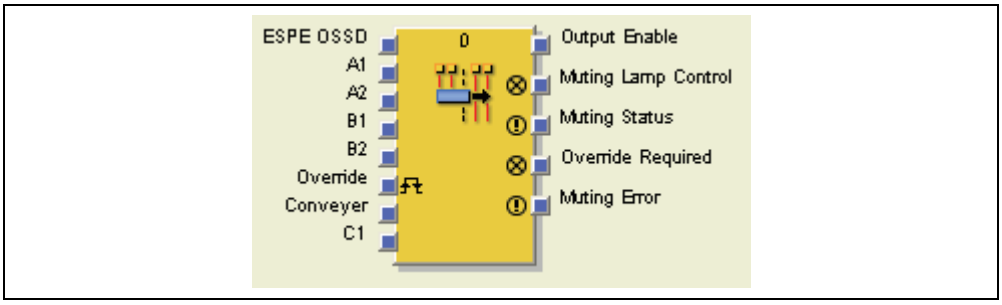


Figure 87:
Valid muting sequence using the configuration basic setting
(C1 Input: without
Override Input: without
Conveyer Input: without)

6.7.9 Sequential Muting (Muting with sequential layout of sensor pairs)

Function block diagram

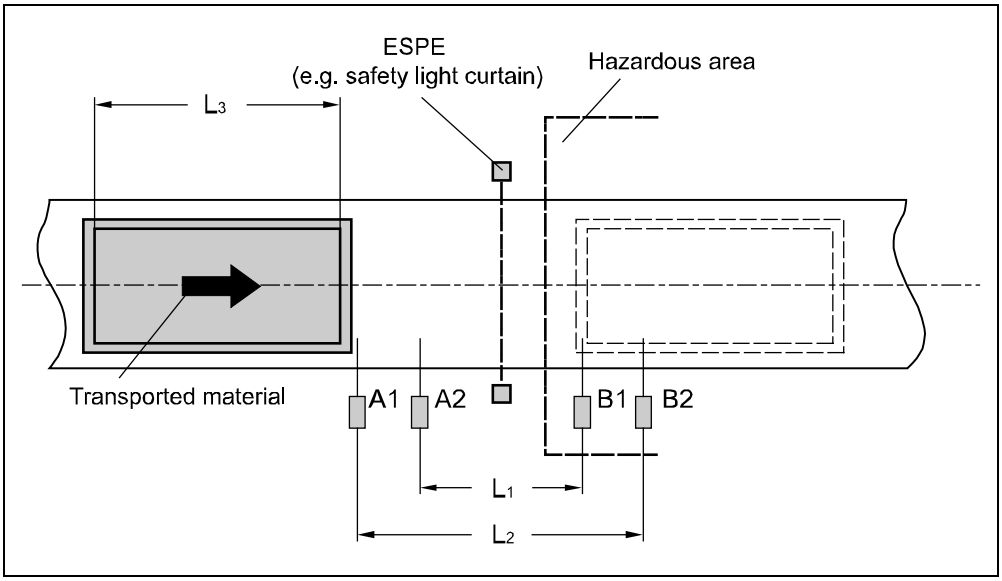
Figure 88: Function block diagram for the function block Sequential Muting



Representation of the application

Figure 89 shows an example of the placement of sensors using the function block Muting with a sequential layout of sensor pairs.

Figure 89: Example of the sequential layout of muting sensors



In the example, the material moves from the left to the right. As soon as the muting sensors A1 & A2 are activated, the protective effect of the protective device (ESPE) is muted. The protective effect remains muted until a sensor of the muting sensor pair B1 & B2 becomes free again.

Input conditions for muting sensors

Table 75: Conditions for muting with two sequential sensor pairs

Condition	Description
A1 & A2 (or B1 & B2)	Starts the muting cycle. The first sensor pair is activated depending on the direction of transportation 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 second sensor pair is activated depending on the direction of transportation of the material.

Equations and prerequisites for calculating the distance:

$L_1 \geq v \times 2 \times T_{IN\ Muting\ sensor}$

$v \times t > L_1 + L_3$

$L_2 < L_3$

$T_{IN\ Light\ curtain} < T_{IN\ Muting\ sensor}$

Where ...

L_1 = Distance between the inner sensors
(layout symmetrical to the detection area of the ESPE)

L_2 = Distance between the outer sensors
(layout symmetrical to the detection area of the ESPE)

L_3 = Length of the material in conveyor direction

v = Velocity of the material (e.g. of the conveyor belt)

t = Set Muting Total Time [s]

$T_{IN\ Light\ curtain}$, $T_{IN\ Muting\ sensor}$ = Response time of the light curtain or the muting sensors in the MELSEC-WS safety controller (see the Safety Controller User's Manual)

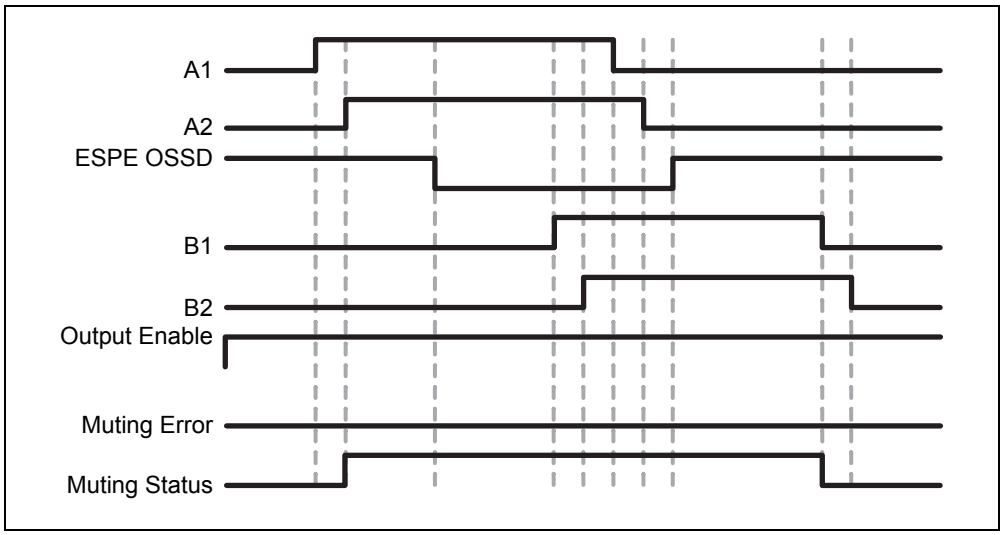
Note

- In this example the material can either be moved in both directions or a fixed direction of transportation can be defined as follows:
  - With the optional signal C1. If used, signal C1 always has to be activated before both muting sensors of the first sensor pair (e.g. A1 and A2) become **Active**.
  - By means of the Direction Detection parameter
- The sensor layout shown in this example is suitable for all types of sensors.
- Avoid mutual interference of the sensors.
- Increase the protection against manipulation and the safety level by using the following configurable functions:
  - Concurrency monitoring
  - Monitoring of the muting total time
  - Muting end via ESPE
  - Sequence monitoring
- The wiring of devices is described in Section 6.7.5.

Sequence/timing diagram

The function block requires that a valid muting sequence takes place. Figure 90 shows an example of a valid muting sequence based on the parameter basic setting for this function block.

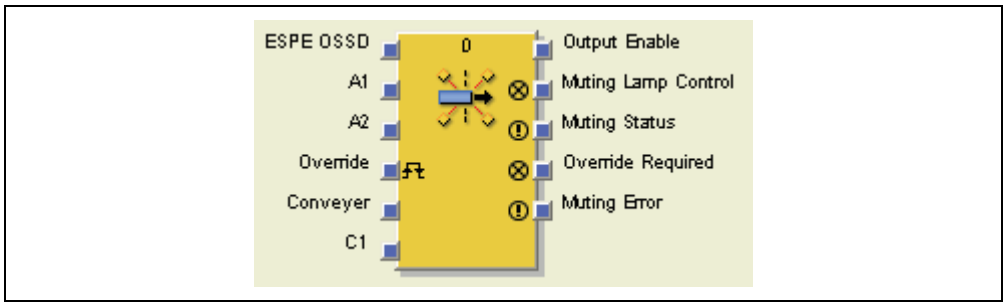
Figure 90:
Valid muting sequence using the configuration basic setting
(C1 Input: without
Override Input: without
Conveyer Input: without)



6.7.10 Function block Cross Muting - Direction of movement only forwards or backwards

Function block diagram

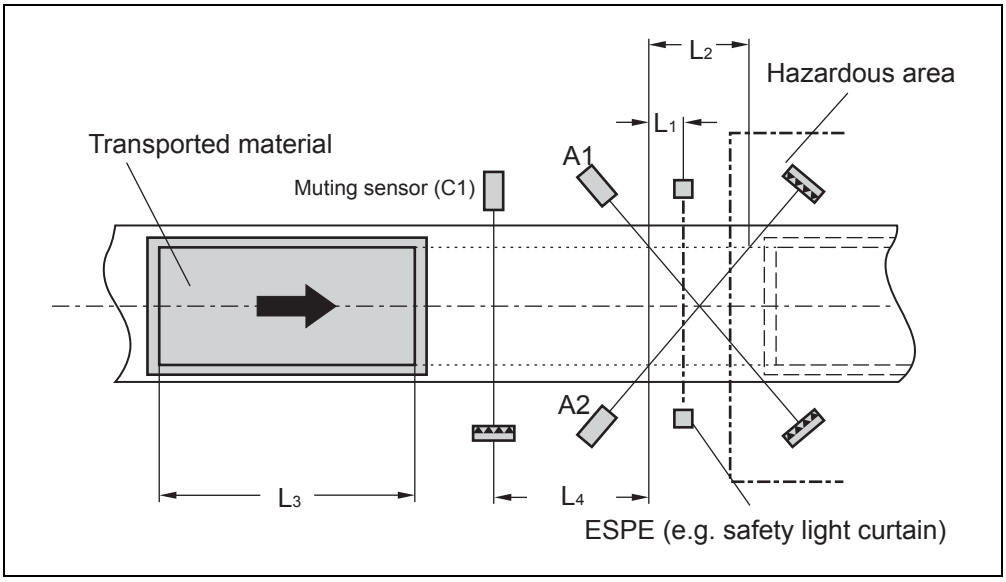
Figure 91:
Function block diagram for the function block Cross Muting (forwards or backwards direction)



Representation of the application

Figure 92 shows an example of the sensor layout for the function block Cross Muting. The optional signal C1 is used as an additional protection for the muting system against manipulation.

Figure 92:
Example of 2-sensor muting (with crossed layout sensors) and the optional signal C1



The protective effect of the protective device is muted when the muting sensors are operated in a defined sequence. The muting sensor (signal C1) always has to be activated before **both** muting sensors of the first sensor pair (e.g. A1 and A2) become **Active**.

Input conditions for muting sensors

Table 76:
Conditions for muting with two sensors and optional signal C1, crossed layout of the sensors

Condition	Description
C1 & A1 & A2	Signal C1 always has to be activated before both muting sensors of the first sensor pair (e.g. A1 and A2) become **Active**.
A1 & A2	Muting applies as long as this condition is fulfilled and the requirement mentioned above existed.

Equations and prerequisites for calculating the distance:

$L_1 \geq v \times T_{IN\ Muting\ sensor}$

$v \times t > L_2 + L_3$

$L_3 > L_4$

$T_{IN\ Light\ curtain} < T_{IN\ Muting\ sensor}$

Where ...

L_1 = Minimum distance between the detection line of the ESPE and the detection by A1, A2

L_2 = Distance between the two detection lines of the sensors (sensors activated/sensors free)

L_3 = Length of material in conveyor direction

L_4 = Maximum distance between C1 and the detection line of A1, A2

v = Velocity of the material (e.g. of the conveyor belt)

t = Set Muting Total Time [s]

$T_{IN\ Light\ curtain}$, $T_{IN\ Muting\ sensor}$ = Response time of the light curtain or the muting sensors in the MELSEC-WS safety controller (see the Safety Controller User's Manual)

Note

- Material flow is only possible in one direction in this example.
- In order to move material in both directions (i.e. bidirectionally), place the intersection directly in the light beams of the ESPE (see Section 6.7.11).
- The sensor layout shown in this example is suitable for both through-beam photoelectric switches and photoelectric reflex switches.
- Avoid mutual interference of the sensors.
- Increase the protection against manipulation and the safety level by using the following configurable functions:
  - Concurrency monitoring
  - Monitoring of the muting total time
  - Muting end via ESPE
- The wiring of devices is described in Section 6.7.5.

Sequence/timing diagram

The function block requires that a valid muting sequence takes place. Figure 93 shows an example of a valid muting sequence based on the parameter basic setting for this function block. The optional signal C1 is not contained in the sequence shown below.

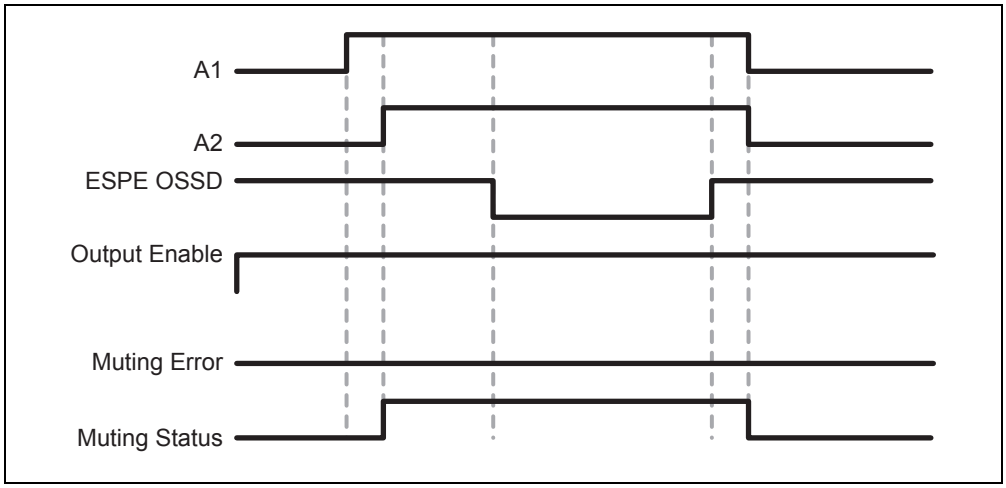
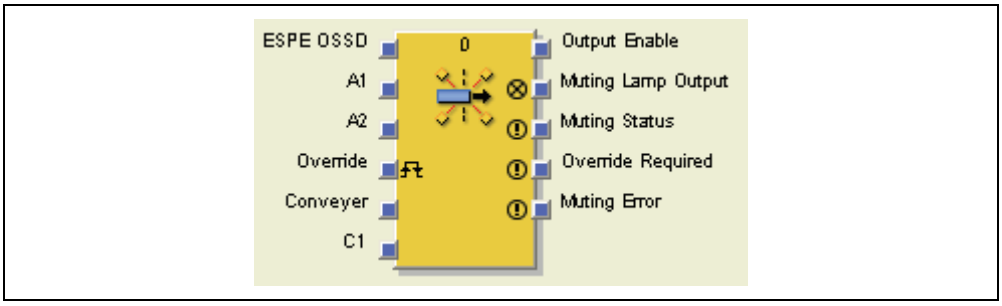


Figure 93:
Valid muting sequence using the configuration basic setting
(C1 Input: without
Override Input: without
Conveyer Input: without)

6.7.11 Function block Cross Muting - Material transport in both directions

Function block diagram

Figure 94:
Function block diagram for the function block Cross Muting (both-directions)



Representation of the application

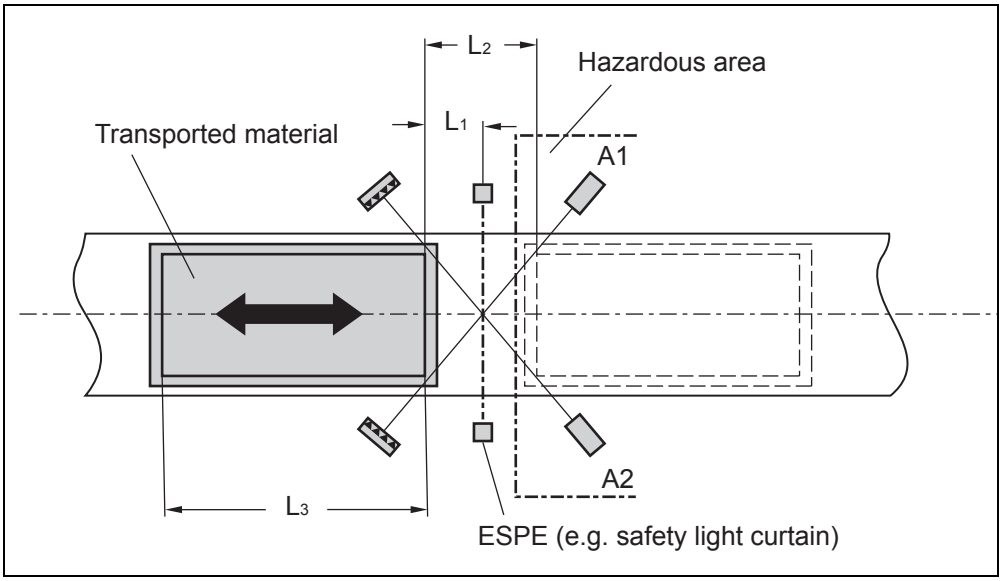
The sensors can be located as follows in the case of muting applications with 2 crossed sensors in which the material has to be moved in both directions. The optional signal C1 is not used in this application example.

ATTENTION

Ensure that the muting sensors detect only the moved material!

Ensure that the muting sensors are positioned in such a manner that no one can enter the hazardous area by fulfilling the muting conditions (meaning that they activate both muting sensors and thus create the required conditions for muting).

Figure 95:
2-sensor muting (with crossed sensors) for bidirectional movement of material



Input conditions for muting sensors

Table 77: Conditions for muting with two sensors and optional signal C1, crossed layout of the sensors

Condition	Description
A1 & A2	Muting applies as long as this condition is fulfilled and, furthermore, the requirements mentioned above existed.

Equations and prerequisites for calculating the distance:

$L_1 \geq v \times T_{IN\ Muting\ sensor}$

$v \times t > L_2 + L_3$

$T_{IN\ Light\ curtain} < T_{IN\ Muting\ sensor}$

Where ...

L_1 = Minimum distance between the detection line of the ESPE and the detection by A1, A2

L_2 = Distance between the two detection lines of the sensors (sensors activated/sensors free)

L_3 = Length of material in conveyor direction

v = Velocity of the material (e.g. of the conveyor belt)

t = Set Muting Total Time [s]

$T_{IN\ Light\ curtain}$, $T_{IN\ Muting\ sensor}$ = Response time of the light curtain or the muting sensors in the MELSEC-WS safety controller (see the Safety Controller User's Manual)

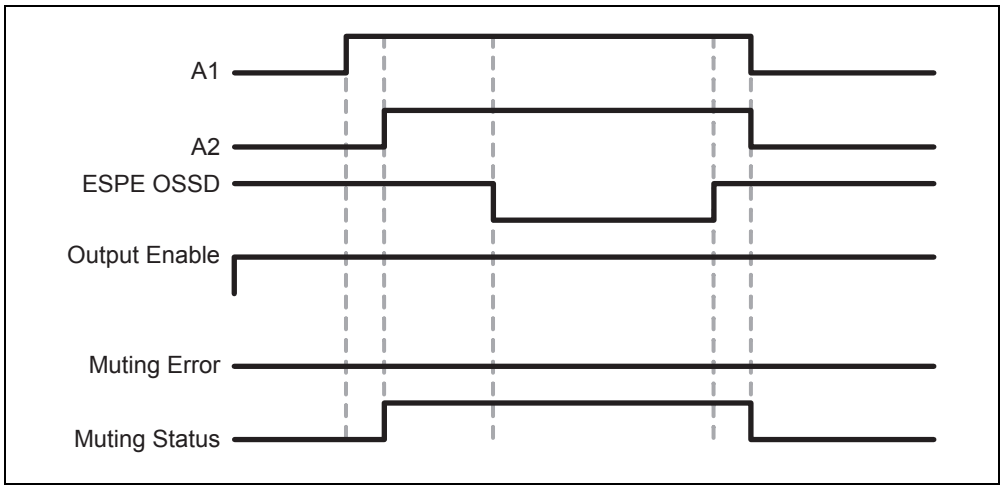
Note

- Material flow is possible in both directions in this example.
- In order for materials to be moved in both directions, place the intersection of the muting sensors exactly in the course of the light beams of the ESPE.
- In order to move material in one direction only, place the intersection, with regard to the direction of the transport, behind the light beams of the ESPE (see Section 6.7.10).
- The sensor layout shown in this example is suitable for both through-beam photoelectric switches and photoelectric reflex switches.
- Avoid mutual interference of the sensors.
- Increase the protection against manipulation and the safety level by using the following configurable functions:
  - Concurrency monitoring
  - Monitoring of the muting total time
  - Muting end via ESPE
- The wiring of devices is described in Section 6.7.5.

Sequence/timing diagram

The function block requires that a valid muting sequence takes place. Figure 96 shows an example of a valid muting sequence based on the parameter basic setting for this function block.

Figure 96:
Valid muting sequence using the configuration basic setting
(C1 Input: without
Override Input: without
Conveyer Input: without)

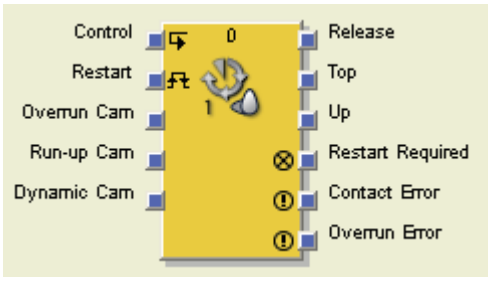


6.8 Function blocks for press applications

6.8.1 Function block Eccentric Press Contact

Function block diagram

Figure 97:
Function block diagram for the function block Eccentric Press Contact



General description

The function block Eccentric Press Contact is used to monitor the Cam input signals of mechanical or eccentric presses.

If no error was detected, the Release signal of the function block Eccentric Press Contact is **Active** (High). Normally the Release signal of this function block is connected to the next press element (e.g. Press Setup function block or function block Press Single Stroke).

The Release signal of the subsequent function block (e.g. Press Setup function block or function block Press Single Stroke) is then used both for actuator control and as a feedback for the Control input of this function block.

The minimum configuration requires an Overrun Cam and the Run-up Cam. Optionally, a Dynamic Cam input can also be connected.

The function block Eccentric Press Contact monitors the Overrun Cam and the correct Cam signal sequence of presses. If any discrepancy is detected, the Release output changes to **Inactive** (Low) and the corresponding error output changes to **Active**.

Input parameters of the function block

Table 78:
Input parameters of the function block Eccentric Press Contact

Parameter	Possible parameter values	Default
Dynamic Cam	● with ● without	with
Min. restart pulse time	● 100 ms ● 350 ms	100 ms
Restart Input	● with ● without	with
Disable Monitoring Input	● without ● with	without

ATTENTION

Ensure that the transitions of the signals for restarting fulfil the requirements of the safety standards and regulations!

In case of 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 due to the short-circuit detection. If such a pulse can result in a hazardous state in the machine, the following points have to be observed:

- Ensure protected cable laying for the signal line (due to cross-circuiting to other signal lines)
- No short-circuit detection, i.e. do not reference to test outputs.

Input signals of the function block

The function block Eccentric Press Contact supports the following input signals:

- Control
- Restart
- Overrun Cam
- Run-up Cam
- Dynamic Cam
- Disable Monitoring

Depending on your risk analysis and avoidance strategy, the inputs for each of these signals can be evaluated as single-channel or dual-channel.

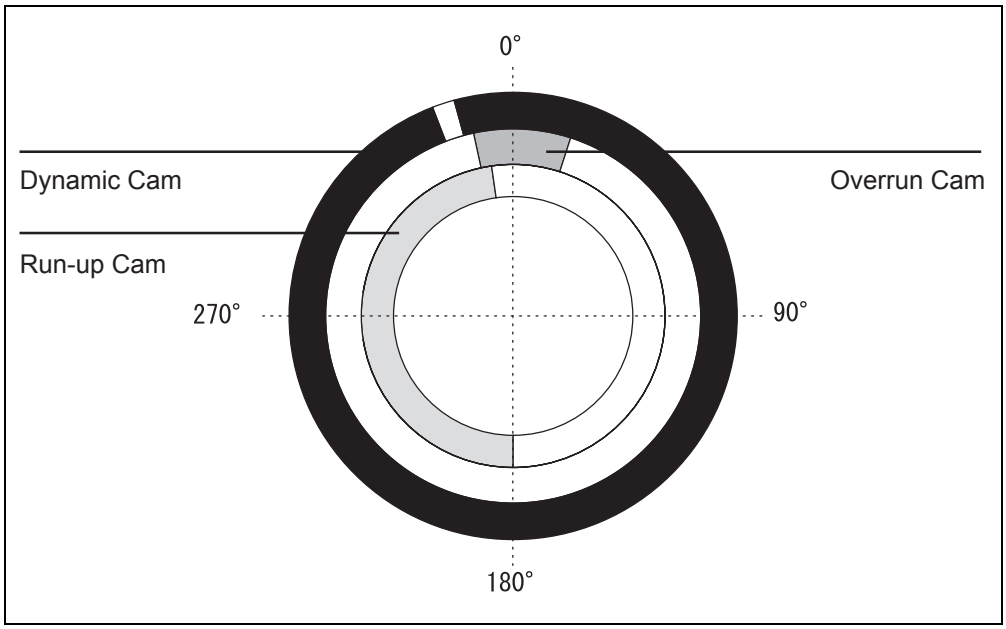
ATTENTION

The Run-up Cam signals have to conform to your risk analysis!
If a single-channel signal (with or without testing) is used for the Run-up Cam, an error can cause an **Active** (High) signal. You can avoid this by using two Overrun Cam signals and evaluating these as a dual-channel input (with discrepancy time monitoring). If you use this signal, take the standards and regulations to be applied into consideration in accordance with your risk analysis and avoidance strategy.

A different test pulse signal has to be used for each monitored input.

The input signals for the Overrun Cam, Run-up Cam and Dynamic Cam have to accord with Figure 98.

Figure 98:
Press cycle diagram for the function block Eccentric Press Contact



Overrun Cam

The signal of the Overrun Cam allows the function block to monitor the overrunning of the press. When the press reaches the top dead center (indicated by the transition of the Overrun Cam signal to **Active** (High)), the corresponding Top output signal stops the press. An Overrun Error occurs when the press has not started again (i.e. the Control input remains **Inactive** (Low)) and the Overrun Cam changes from **Active** (High) to **Inactive** (Low) (i.e. falling edge). An Overrun Error can only be reset by a valid restart sequence.

Run-up Cam

The rising edge of the Run-up Cam indicates the beginning of the Run-up part of the press cycle. This Up signal ends with a rising edge (i.e. the transition of the Overrun Cam from **Inactive** (Low) to **Active** (High)).

For safety reasons, there must not be a Run-up Cam signal, in case the press starts while the Run-up Cam is **Active** (High) (e.g. in the first cycle after switching on or after an error). The second cycle begins when the Overrun Cam changes from **Active** (High) to **Inactive** (Low).

Dynamic Cam

Dynamic Cam is an optional input signal that determines how the output signals for the press cycle are determined. The input signal for Dynamic Cam can both change its state several times as well as not at all during a single press cycle.

If Dynamic Cam changes from **Active** (High) to **Inactive** (Low) (i.e. falling edge), the Top output becomes **Active** (High) and the Up output becomes **Inactive** (Low). The Top output remains **Active** (High) until Overrun Cam changes from **Active** (High) to **Inactive** (Low). If this happens, the Top output becomes **Inactive** (Low). This means that a second transition of Dynamic Cam from **Active** (High) to **Inactive** (Low) does not have any influence of the signal state of the Top output.

Disable Monitoring

Using this optional input, it is possible to deactivate the monitoring functionality under certain conditions. This might be useful e.g. during the setup of the machine or when the press moves backwards.

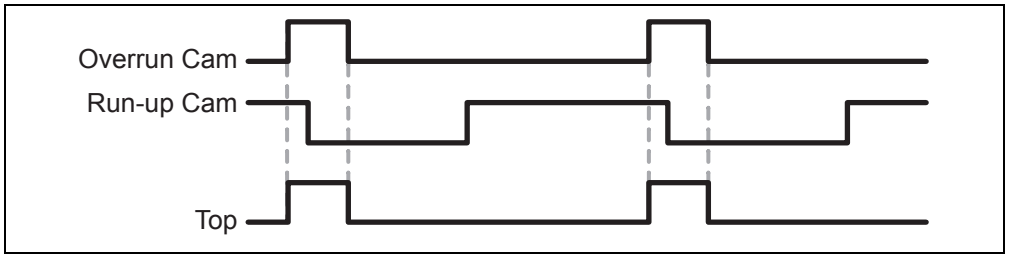
If the Disable Monitoring input is Active (High), the Release signal of the function block Eccentric Press Contact is **Inactive** (Low).

Output signals of the function block

Top output

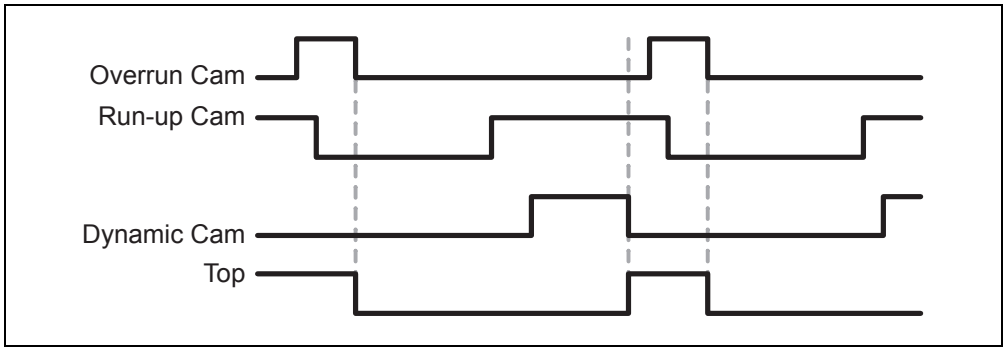
If this function block is configured without Dynamic Cam, the Top output signal is based on the Overrun Cam input signal. Figure 99 shows a logic diagram for the Top output.

Figure 99: Sequence/timing diagram for Top output without Dynamic Cam (Control input is Active)



If this function block is configured with an input for Dynamic Cam and Dynamic Cam changes from **Active** (High) to **Inactive** (Low) (i.e. falling edge), the Top output changes to **Active** (High). The Top output remains **Active** (High) until Overrun Cam changes from **Active** (High) to **Inactive** (Low). When this happens the Top output becomes **Inactive** (Low). This means that a second transition of Dynamic Cam from **Active** (High) to **Inactive** (Low) does not have any influence of the signal state of the Top output.

Figure 100: Sequence/timing diagram for Top dead center output with Dynamic Cam (Control input is Active)



Up output

The rising edge of the Run-up Cam input indicates the beginning of the Run-up part of the press cycle. This Up signal ends with a rising edge (i.e. the transition from **Inactive** (Low) to **Active** (High) of the Overrun Cam).

For safety reasons, there must not be a Up signal, in case the press starts, while the Run-up Cam is **Active** (High) (e.g. in the first cycle after switching on or after an error). The second cycle begins when the Overrun Cam changes from **Active** (High) to **Inactive** (Low).

Figure 101: Sequence/timing diagram for Up output without Dynamic Cam (Control input is Active)

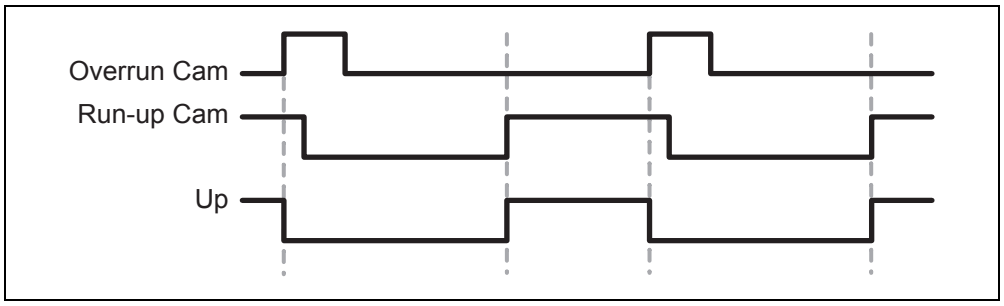
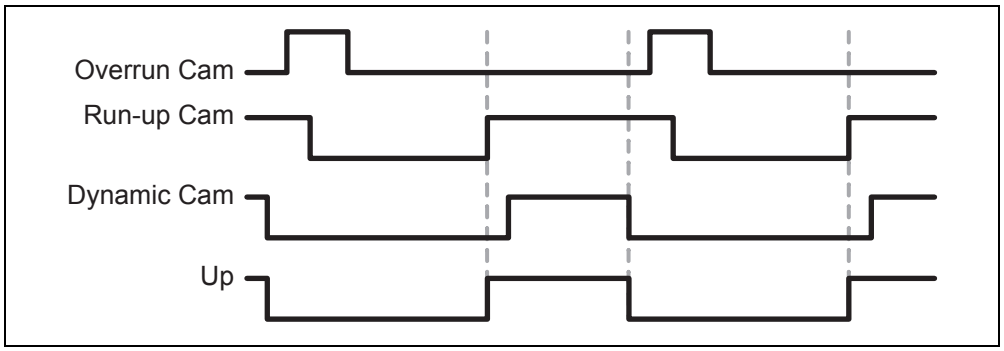


Figure 102: Sequence/timing diagram for Up output with Dynamic Cam (Control input is Active)



Note The run-up cycle is terminated when Dynamic Cam changes from **Active** (High) to **Inactive** (Low). This is indicated by the transition of Up to **Inactive** (Low).

Error outputs

The following additional error outputs are available:

Table 79: Error outputs for the function block Eccentric Press Contact

Optional output connections of the function block
Contact Error
Overrun Error
Fault Present

Contact Error output

Several conditions apply for the Overrun Cam and Run-up Cam input signals. These are:

- When Overrun Cam changes from **Inactive** (Low) to **Active** (High), Run-up Cam has to be **Active** (High) or just have changed to **Inactive** (Low) during the current cycle.
- When Overrun Cam changes from **Active** (High) to **Inactive** (Low), Run-up Cam has to be **Inactive** (Low).
- When Run-up Cam changes from **Inactive** (Low) to **Active** (High), Overrun Cam has to be **Inactive** (Low).
- When Run-up Cam changes from **Active** (High) to **Inactive** (Low), Overrun Cam has to be **Active** (High).

If one of the above-mentioned conditions is not fulfilled during operation, the Release becomes **Inactive** (Low; fail-safe) and the Contact Error output becomes **Active** (High). The Release cannot be reset until a valid restart sequence has taken place (i.e. transition from **Inactive** (Low) to **Active** (High; at least 100 ms or 350 ms, maximum 30 s) to **Inactive** (Low)).

Overrun Error output

When Overrun Cam changes from **Active** (High) to **Inactive** (Low), the function block Eccentric Press Contact checks whether the Control input signal is **Active** (High). If the Control input signal is **Inactive** (Low), there is an Overrun Error.

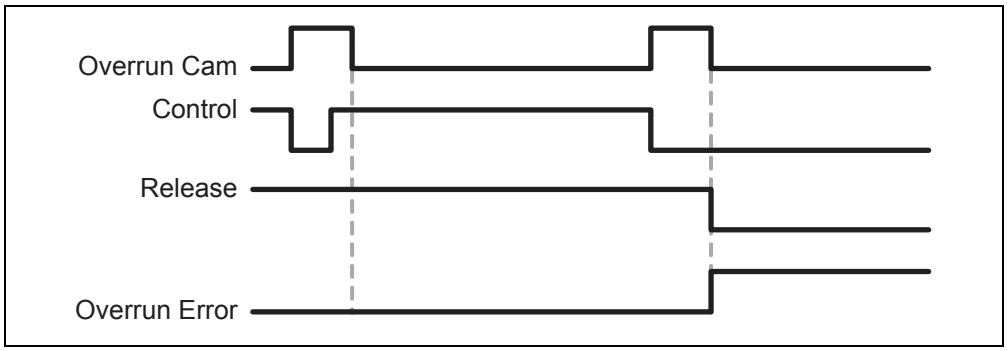
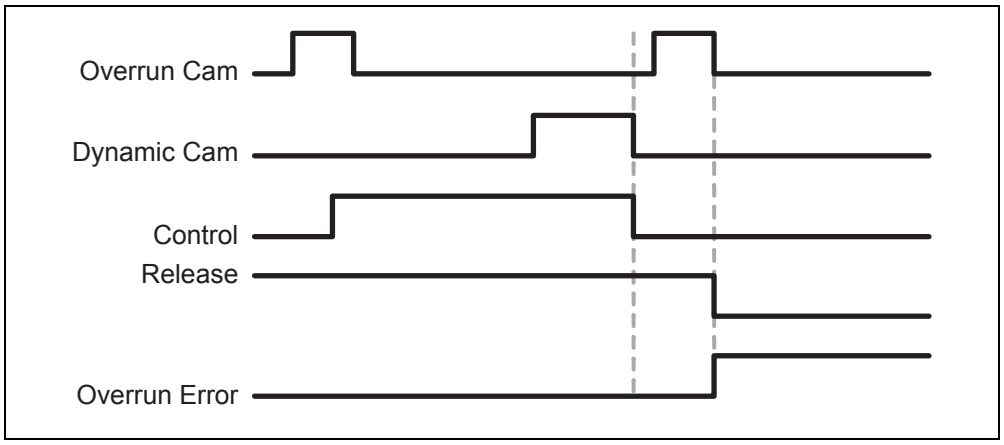


Figure 103: Example of a sequence/timing diagram for Overrun Error without Dynamic Cam

Figure 104: Example of a sequence/timing diagram for Overrun Error with Dynamic Cam



Error states and information on restarting

Table 80: Error states and information on restarting for the function block Eccentric Press Contact

Diagnostics outputs	Fault Present	Resetting the error state	Remarks
Contact Error Overrun Error	**Active**	When Contact Error or Overrun Error is **Active**, the Restart Required output is **Active**. A valid restart sequence sets the error state (i.e. Contact Error or Overrun Error) to **Inactive**.	Release changes to **Inactive** and the Fault Present changes to **Active**, if either Contact Error or Overrun Error is **Active**.

ATTENTION

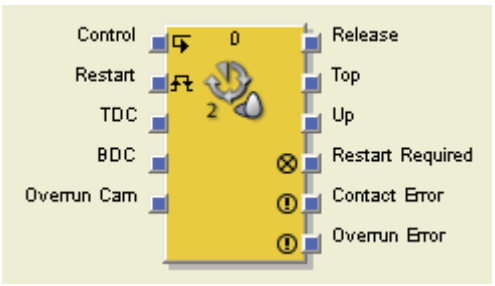
Safety-relevant signals have to conform to standards and regulations to be applied!

Always take the valid national, regional and local regulations and standards into consideration for your application. Type C standards such as EN 692 and EN 693 contain requirements how safety-relevant signals have to be used. For example, the restart signal has to be protected by suitable means in case of overrun errors (e.g. by a key switch or in a closed control cabinet).

6.8.2 Function block Universal Press Contact

Function block diagram

Figure 105:
Function block diagram for the function block Universal Press Contact



General description

The function block Universal Press Contact is used to monitor press contacts of different press types (e.g. hydraulic presses and eccentric presses (i.e. mechanical presses)).

If no errors were detected, the Release signal of the function block Universal Press Contact is **Active** (High). Normally, the Release signal of this function block is connected to the next press element (e.g. Function block Press Setup or Function block Press Single Stroke).

The Release signal of the subsequent function block (e.g. Press Setup function block or function block Press Single Stroke) is then used both for actuator control and as a feedback for the Control input of this function block.

The minimum configuration requires only TDC. Optionally, the BDC and Overrun Cam inputs can be connected. If BDC is not used, the Up output is not available.

This function block monitors the overrunning of the press and the correct sequence of TDC, BDC and Overrun Cam. If any discrepancy is detected, Release changes to **Inactive** (Low) and the corresponding error output changes to **Active**.

If BDC and Overrun Cam are not used, a plausibility check is not possible for the function block. In this case, a check for overrunning cannot be carried out. The only remaining function in this case is the provision of the TDC signal.

Input parameters of the function block

Table 81:
Input parameters of the function block Universal Press Contact

Parameter	Possible parameter values	Default
Overrun Cam input	● with ● without	with
BDC	● with ● without	with
Number of BDC signals per cycle	● 1 (e.g. eccentric press) ● 0-2 (e.g. hydraulic press)	1 (e.g. eccentric press)
Min. restart pulse time	● 100 ms ● 350 ms	100 ms
Restart Input	● with ● without	with
Disable Monitoring Input	● with ● without	without

Note If the number of BDC signals per press cycle is set to 0-2 (e.g. hydraulic press), it may not be possible to detect certain errors such as a short-circuit to Low (i.e. short-circuit to 0 V DC) or an **Inactive** (Low) signal that was caused by an error detected at the BDC input signal.

ATTENTION

Ensure that the transitions of the signals for restarting fulfil the requirements of the safety standards and regulations!

In case of 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 due to the short-circuit detection. If such a pulse can result in a hazardous state in the machine, the following points have to be observed:

- Ensure protected cable laying for the signal line (due to cross-circuiting to other signal lines)
- No short-circuit detection, i.e. do not reference to test outputs.

Input signals of the function block

The function block Universal Press Contact supports the following input signals:

- Control
- Restart
- TDC (Top Dead Center)
- BDC (Bottom Dead Center)
- Overrun Cam
- Disable Monitoring

The input signals for TDC, BDC and Overrun Cam have to use separate test pulse outputs and accord with Figure 106 below. Depending on your risk analysis and avoidance strategy and the standards and regulations to be applied (e.g. EN 692 or EN 693) the TDC, BDC and Overrun Cam input can be evaluated using single-channel or dual-channel configurations.

ATTENTION

The BDC signals have to conform to your risk analysis!

If a single-channel signal (with or without testing) is used for BDC, an error can cause an **Active** (High) signal. You can avoid this by using two BDC signals and evaluating these as a dual-channel input (with discrepancy time monitoring). If the number of BDC signals per press cycle was configured to 0-2, two BDC signals have to be used. If you use this signal, take the applicable standards and regulations into consideration in accordance with your risk analysis and avoidance strategy.

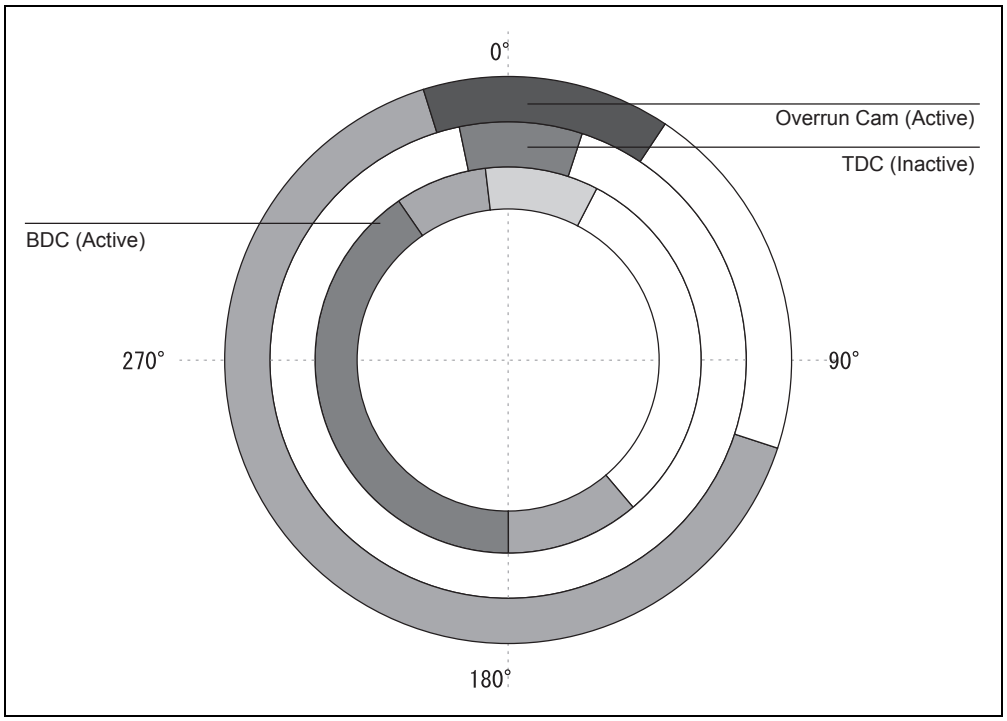


Figure 106:
Press cycle diagram for the Universal Press Contact function block

For a complete cycle of 360°, the following conditions apply for the TDC, BDC and Overrun Cam signals:

- TDC (middle ring) has to be triggered at or near 0°. TDC has to be **Inactive** (Low) in the filled section of the middle ring. During the remaining period of the press cycle, TDC is **Active** (High). Only one **Inactive** (Low) signal is permissible for TDC per press cycle.
- The signal for BDC (innermost ring) should be triggered at or near 180°. The filled section of the innermost ring shows the ideal BDC signal. The hatched section shows other possible values for BDC. BDC is **Active** (High) in the filled and in the dark hatched section of the innermost ring. The bright hatched section is only permissible if all three contacts (TDC, BDC and Overrun Cam input) are used. BDC should be **Inactive** (Low) during the remaining press cycle. The rising edge (i.e. the transition from **Inactive** (Low) to **Active** (High)) may not be effected before the falling edge (i.e. the transition from **Active** (High) to **Inactive** (Low)) of the Overrun Cam input has occurred in the preceding press cycle.

The falling edge (i.e. the transition from **Active** (High) to **Inactive** (Low)) of BDC has to occur under one of the following conditions:

  – Before or while the TDC signal changes to **Inactive** (Low), if Overrun Cam is configured as not used, or
  – Before, during or after the TDC signal changes to **Inactive** (Low), but before the falling edge (i.e. transition from **Inactive** (Low) to **Active** (High)) of the Overrun Cam input, if the latter is configured as used.

- The rising edge (i.e. transition from **Inactive** (Low) to **Active** (High)) of the Overrun Cam (outermost ring) has to occur before the TDC becomes **Inactive** (Low). The falling edge (i.e. the transition from **Active** (High) to **Inactive** (Low)) has to occur after the TDC signal has changed to **Active** (High). The filled section of the outermost ring shows the ideal Overrun Cam signal. The hatched section shows other possible values for the Overrun Cam. The Overrun Cam input is **Active** (High) in the filled and hatched section of the outermost ring. Overrun Cam input should be **Inactive** (Low) during the remaining press cycle. Only one **Active** (High) signal is permissible for Overrun Cam input per press cycle.

If one of the above-mentioned conditions is not fulfilled correctly during operation, Release becomes **Inactive** (Low; fail-safe) and the Contact Error output becomes **Active** (High). A valid restart sequence is necessary before Release can return to **Active** (High).

Disable Monitoring

Using this optional input it is possible to deactivate the monitoring functionality under certain conditions. This might be useful e.g. during the setup of the machine or when the press moves backwards.

If the Disable Monitoring input is Active (High), the Release signal of the function block Universal Press Contact is **Inactive** (Low).

Output signals of the function block

The following table describes the outputs that can be available depending on the configured input signals.

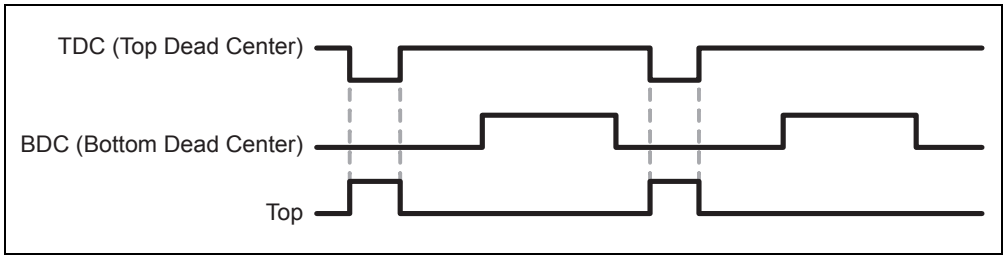
Table 82: Possible output signals for the function block Universal Press Contact

Contacts	Outputs					
	Release	TOP	Up	Restart Required	Contact Error	Overrun Error
TDC	■	■		■		
TDC + Overrun Cam	■	■		■	■	■
TDC + BDC	■	■	■	■	■	
TDC + Overrun Cam + BDC	■	■	■	■	■	■

Top output

The signal of the Top output is **Active** (High), when the TDC signal is **Inactive** (Low). BDC and Overrun Cam contact do not have any effect on the Top output signal. Figure107 shows a logic diagram for the Top output.

Figure 107: Top signal



Up output

If BDC is configured and used, it acts directly on the Up output. This output signal can be used in combination with other function blocks, e.g. for Upstroke muting. If BDC is **Active** (High) during the system start-up, the Up output remains **Inactive** (Low) until BDC returns to **Inactive** (Low) and afterwards changes to **Active** (High). The following situations are possible:

Figure 108:
Up output when TDC and BDC do not superimpose

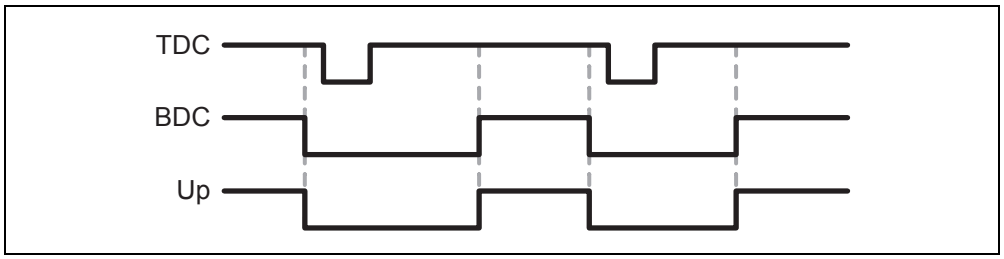


Figure 109:
Up output when TDC and BDC superimpose

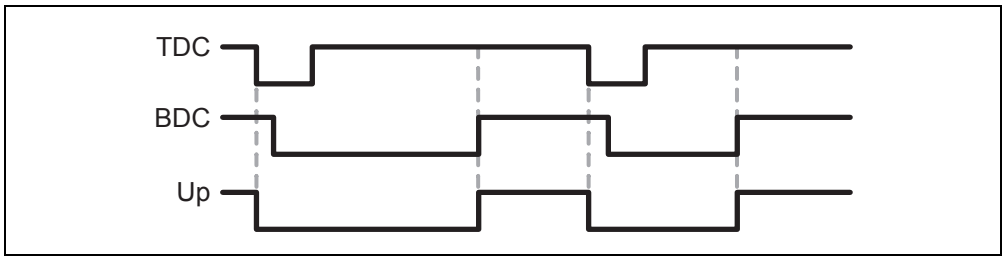
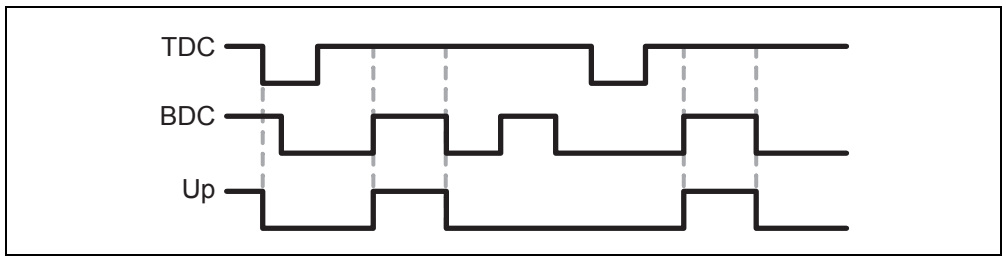


Figure 110:
Up output at two BDC signals per press cycle



Error outputs

The following additional error outputs are available:

Table 83:
Error outputs of the function block Universal Press Contact

Optional output connections of the function block
Contact Error
Overrun Error
Fault Present

Contact Error output

Several conditions apply for the use of the TDC, BDC and Overrun Cam signal inputs. These are:

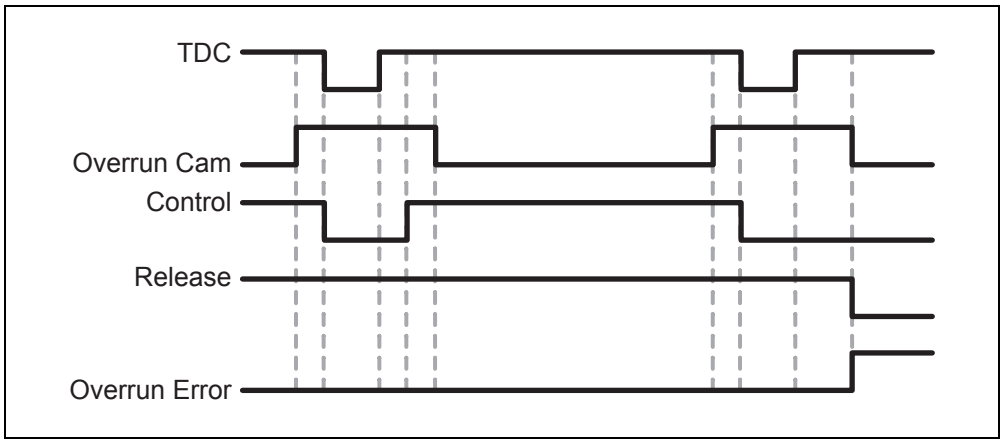
- If BDC is used and the number of the BDC signals per press cycle is set to 1, one BDC per cycle is required.
- If Overrun Cam is set to “without”, the falling edge has to occur at the BDC (i.e. a transition from **Active** (High) to **Inactive** (Low)), before TDC changes from **Inactive** (Low) to **Active** (High).
- If Overrun Cam is set to “with”, the BDC signal may become **Inactive** (Low) after the TDC has changed from **Inactive** (Low) to **Active** (High). However, it has to change from **Active** (High) to **Inactive** (Low) before Overrun Cam input changes from **Active** (High) to **Inactive** (Low).
- Only one TDC signal is allowed per press cycle (this can only be detected if BDC and Overrun Cam are also used).
- If it is used, only one Overrun Cam signal per cycle is allowed.
- The rising edge (i.e. the transition from **Inactive** (Low) to **Active** (High)) at the BDC may not occur before the falling edge (i.e. the transition from **Active** (High) to **Inactive** (Low)) of the Overrun Cam of the preceding cycle.
- The rising edge (i.e. **Inactive** (Low) to **Active** (High)) of the Overrun Cam input has to occur before the TDC signal changes from **Inactive** (Low) to **Active** (High).
- The falling edge (i.e. **Active** (High) to **Inactive** (Low)) of the Overrun Cam input has to occur after the TDC signal has changed from **Inactive** (Low) to **Active** (High).

If one of the above-mentioned conditions is not fulfilled during operation, Release becomes **Inactive** (Low, fail-safe) and the Contact Error output becomes **Active** (High). Release cannot be reset until after a valid restart sequence has taken place (i.e. transition from **Inactive** (Low) to **Active** (High; > 100 ms or 350 ms < 30 s) to **Inactive** (Low)).

Overrun Error output

If the Overrun Cam input is defined and used, the function block monitors the overrunning of the press. If the Overrun Cam input changes from **Active** (High) to **Inactive** (Low) and the Control input remains **Inactive** (Low) (i.e. the press has not started), there is an overrun error and the Overrun Error output becomes **Active** (High).

Figure 111: Example of a sequence/timing diagram for Overrun Error



Error states and information on restarting

Table 84: Error states and information on restarting for the function block Universal Press Contact

Diagnostics outputs	Fault Present	Resetting the error state	Remarks
Contact Error Overrun Error	**Active**	When Contact Errors or Overrun Errors are **Active**, the Restart Required output is **Active** (pulsing with 1 Hz). A valid restart sequence sets the error state (i.e. Contact Error or Overrun Error) to **Inactive**.	Release changes to **Inactive** and the Fault Present changes to **Active**, if either the Contact Error or Overrun Error is **Active**.

ATTENTION

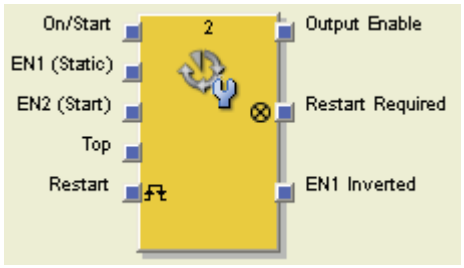
Safety-relevant signals have to conform to the applicable standards and regulations to be applied!

Always take the valid national, regional and local regulations and standards into consideration for your application. Type-C standards such as EN 692 and EN 693 contain requirements how safety-relevant signals have to be used. For example, the restart signal has to be protected by suitable means in case of overrun errors (e.g. by a key switch or in a closed control cabinet).

6.8.3 Function block Press Setup

Function block diagram

Figure 112:
Function block diagram for the function block the Press Setup function block



General description

The Press Setup function block is generally used together with the function block Universal Press Contact or the Eccentric Press Contact function block in order to set up the press and in order to provide the information of the Top output as input for this function block. The Top output is required for single-stroke operation. Control of the press can, for example, be effected by means of a two-hand control.

Input parameters of the function block

Table 85:
Input parameters of the function block Press Setup

Parameter	Possible parameter values	Default
Restart Interlock	● without ● when On/Start or EN1 is inactive ● when Top is active or EN1 inactive ● always	always
EN2 input	● with ● without	with
Single Stroke Protection	● with ● without	with
Min. restart pulse time	● 100 ms ● 350 ms	100 ms

ATTENTION

Ensure that the transitions of the signals for restarting fulfil the requirements!

In case of 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 due to the short-circuit detection. If such a pulse can result in a hazardous state in the machine, the following points have to be observed:

- Protected cable laying for the signal line (due to cross-circuiting to other signal lines)
- No short-circuit detection, i.e. do not reference to test outputs.

Input signals of the function block

The function block Press Setup supports the following input signals:

On/Start

The On/Start input signal is used to indicate the beginning and the end of the press movement. A rising edge (i.e. transition from **Inactive** (Low) to **Active** (High)) at the On/Start input signals a start of the press. An **Inactive** (Low) On/Start input signals a stop of the press. If Restart Interlock is set to “When On/Start or EN1 is inactive”, a valid restart sequence is required after a stop that was caused by an **Inactive** (Low) On/Start input signal.

EN1 (Static)

The input signal EN1 (Static) is mandatory. Output Enable always changes immediately to **Inactive** (Low), if EN1 (Static) is **Inactive** (Low).

If this function block is used together with a press contact function block (e.g. Eccentric Press Contact or Universal Press Contact), the Output Enable signal of this press contact function block must be connected with the EN1 (Static) input of the Press Setup function block.

EN2 (Start)

The input signal EN2 (Start) is optional. If EN2 (Start) is configured, Output Enable can only change to **Active** (High) (e.g. during switching on), if EN2 (Start) is **Active** (High). If Output Enable is **Active** (High), EN2 (Start) is no longer monitored.

Top

The Top input signal is used in order to determine the end of the press cycle (i.e. the press has reached the top dead centers. This input signal is available at the function blocks Universal Press Contact or Eccentric Press Contact. The Top input signal is used for single-stroke protection. When the Single Stroke Protection parameter is set to “with”, Output Enable changes to **Inactive** (Low) when the Top input signal changes from **Inactive** (Low) to **Active** (High).

Restart

If the Restart Interlock parameter has been set to “without”, a Restart signal is not required in order to restart the press after any kind of stop. The Restart Interlock parameter can also be set to the following values:

- when On/Start or EN1 Inactive is inactive
- when top is Active or EN1 inactive
- always

This parameter determines when a Restart signal is expected as input signal for the function block. Provide the Restart signal using the Restart function block so that a valid restart sequence will occur.

If Output Enable changes to **Inactive** (Low) because of the above-mentioned settings of the configuration parameters for Restart Interlock, Output Enable can only be reset after a valid restart sequence has been carried out (i.e. the Restart input changes from **Inactive** (Low) to **Active** (High; 100 ms or 350 ms < 30 s) and back to **Inactive** (Low)).

Output signals of the function block

Restart Required

The Restart Required output is **Active**, when a valid restart sequence is expected at the Restart input.

Output Enable

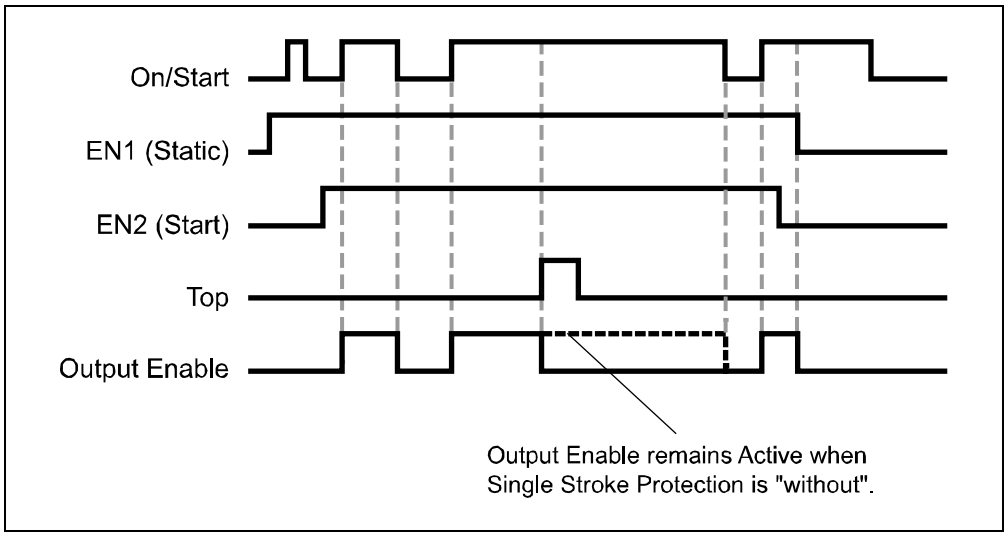
Output Enable is **Active** (High), when Restart Required is **Inactive** (Low) (i.e. restart is not required) and the following conditions are fulfilled:

- When Single Stroke Protection is set to “without”, EN1 (Static) is **Active** (High) and EN2 (Start) (if necessary) is **Active** (High); and a rising edge (i.e. transition from **Inactive** (Low) to **Active** (High)) is detected at the On/Start input; or
- If Single Stroke Protection is set to “with”, On/Start changes from **Inactive** (Low) to **Active** (High), EN1 (Static) is **Active** (High) and EN2 (Start) (if necessary) is **Active** (High). In this case, Output Enable changes to **Inactive** (Low) when the Top input signal changes from **Inactive** (Low) to **Active** (High).

EN1 inverted

The EN1 inverted output signals whether an enable signal for the Press Setup function block is present. If EN1 (Static) is **Active** (High), EN1 inverted is **Inactive** (Low) and vice versa.

Figure 113: Sequence/timing diagram for the Press Setup function block



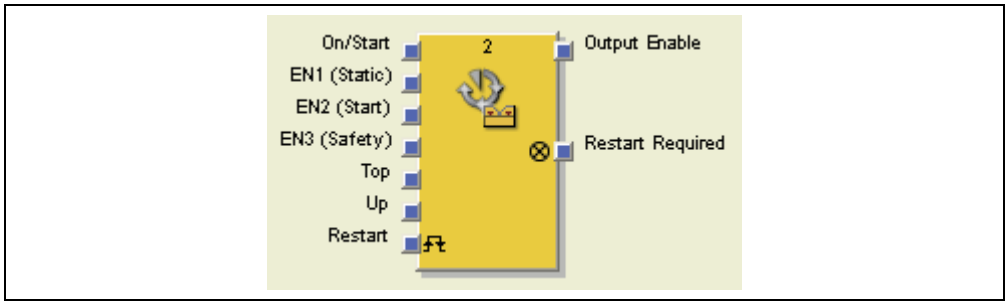
Error conditions

The function block Press Setup does not carry out monitoring for error conditions.

6.8.4 Function block Press Single Stroke

Function block diagram

Figure 114:
Function block diagram for the function block Press Single Stroke



General description

The function block Press Single Stroke is generally used together with the function block Universal Press Contact or the function block Eccentric Press Contact in order to provide the information of the Top and Up outputs as input for this function block. The Top output is required for single-stroke operation. Controlling of the press can, for example, be implemented by means of a two-hand control or by means of a N-Break function block in connection with a safety light curtain.

Single-stroke securing is always Active and cannot be configured. This means: When the signal of the Top input changes to **Active** (High), Output Enable is always set to **Inactive** (Low). The requirements for a restart depend of the configuration of the parameters for Restart Interlock.

Input parameters of the function block

Table 86:
Input parameters of the function block Press Single Stroke

Parameter	Possible parameter values	Default
Restart Interlock	● without ● when On/Start, EN1 or EN3 is inactive ● when Top is active or EN1 or EN3 inactive ● always ● when EN1 or EN3 is inactive	always
EN2 input	● with ● without	with
EN3 input	● with ● without	with
On/Start Mode	● stepping ● start Only	stepping
Up-stroke muting of On/Start	● with ● without	without
Max. Up-Stroke Muting time	Can be configured in the range of 0 to 7200 s (120 min). When the Max. Up-Stroke Muting time is set to 0, upstroke muting is not possible and nothing can be connected to the Up input.	30 s
Min. restart pulse time	● 100 ms ● 350 ms	100 ms
Disable Restart Interlock (for EN3) on Top	● Yes ● No	No

ATTENTION

Ensure that the transitions of the signals for restarting fulfil the requirements of the safety standards and regulations!

In case of 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 due to the short-circuit detection. If such a pulse can result in a hazardous state in the machine, the following points have to be observed:

- Ensure protected cable laying for the signal line (due to cross-circuiting to other signal lines)
- No short-circuit detection, i.e. do not reference to test outputs.

Input parameters and input signals of the function block

The function block Press Single Stroke supports the following input signals:

On/Start

The On/Start input signal is used to indicate the beginning and the end of the press movement. A rising edge (i.e. transition from **Inactive** (Low) to **Active** (High)) at the On/Start input signals a start of the press. An **Inactive** (Low) On/Start input signals a stop of the press. If the On/Start Mode parameter is set to “start Only”, the press cannot be stopped by the On/Start input signal.

If the On/Start Mode parameter is set to “stepping” and Restart Interlock to “when On/Start, EN1 or EN3 is inactive” or “always”, a valid restart sequence is required after a stop that was caused by an **Inactive** (Low) On/Start input signal.

The Output Enable signal of a two-hand control or of a N-Break function block is particularly suitable for connection to the On/Start input.

EN1 (Static)

The input signal EN1 (Static) is mandatory. Output Enable always changes immediately to **Inactive** (Low), if EN1 (Static) is **Inactive** (Low).

If this function block is used together with a press contact function block (e.g. Eccentric Press Contact or Universal Press Contact), its Output Enable signal must be connected with the EN1 (Static) input of this function block.

EN2 (Start)

The input signal EN2 (Start) is optional. If EN2 (Start) is configured, Output Enable can only change to **Active** (High) (e.g. during switching on), if EN2 (Start) is **Active** (High). If Output Enable is **Active** (High), EN2 (Start) is no longer monitored.

EN3 (Safety)

The EN3 (Safety) input signal is an optional signal. Output Enable can only change from **Inactive** (Low) to **Active** (High) if EN3 (Safety) is **Active** (High). If EN3 (Safety) is **Inactive** (Low) and Up is **Inactive** (Low), Output Enable is set to **Inactive** (Low) and a restart sequence has to occur in accordance with the settings.

If EN1 (Static) and Up are **Active** (High) and the Max. Up-Stroke Muting time is configured to a value higher than 0, the EN3 (Safety) signal is muted.

Upstroke muting of On/Start

If the Max. Up-Stroke Muting time is not set to 0, the Up input has to be connected. We advise using the Up output signal of a press contact function block (e.g. Eccentric Press Contact or Universal Press Contact).

In this case, the EN3 (Safety) and On/Start input signals are muted (muting of the On/Start input depends on the parameter settings) when the Up input is **Active** (High). This function block does not carry out a plausibility check of the Up input signal. If the Up input is **Active** (High) several times during a single press cycle, it is possible to mute the corresponding input of the function block several times. If a signal shall not be muted, it should be connected to the EN1 (Static) input by means of an AND gate together with other signals that have to be connected to the EN1 (Static) input.

Max. Up-Stroke Muting time

The Max. Up-Stroke Muting time can be configured. This time begins with the rising edge of the signal at the Up input (i.e. the transition from **Inactive** (Low) to **Active** (High)). If the timer reaches the configured Max. Up-Stroke Muting time before a falling edge occurs at the Up input (i.e. a transition from **Active** (High) to **Inactive** (Low)), the function block interrupts the muting of the EN3 (Safety) and On/Start inputs. If at this moment one of these two inputs is **Inactive** (Low), Output Enable is also set to **Inactive** (Low).

The Max. Up-Stroke Muting time lies in the range of 0 to 7,200 s and is specified in seconds. If this parameter is set to “0”, upstroke muting is deactivated.

Restart input

If the Restart Interlock configuration parameter has been set to “without”, a Restart signal is not required in order to restart the press after any kind of stop. The Restart Interlock parameter can also be set to the following values:

- when On/Start, EN1 or EN3 is inactive
- when Top is active or EN1 or EN3 inactive
- always
- when EN1 or EN3 is inactive

This parameter determines when a Restart Interlock signal is expected as input signal for the function block. Provide the Restart signal using the Restart function block so that a valid restart sequence will occur.

If Output Enable changes to **Inactive** (Low) because of the above-mentioned settings of the configuration parameters for Restart Interlock, Output Enable can only be reset after a valid restart sequence has been carried out (i.e. the Restart input changes from **Inactive** (Low) to **Active** (High; 100 ms or 350 ms < 30 s) and back to **Inactive** (Low)).

Disable Restart Interlock (for EN3) on Top

The **Disable Restart Interlock (for EN3) on Top** parameter prevents the restart interlock being activated if the EN3 (Safety) input changes to **Inactive** (Low) during a regular stop of the press. This means that if the Disable Restart Interlock (for EN3) on Top parameter is configured as **Yes** and the Output Enable output changes to **Inactive** (Low) as a result of the Top input changing to **Active** (High), then the Restart Required output will not change to **Active** (High) if the EN3 (Safety) input changes to **Inactive** (Low) as long as the press has not been restarted.

Output signals of the function block

Restart Required

The Restart Required output is **Active**, when a valid restart sequence is expected at the Restart input.

Sequence/timing diagram for Output Enable

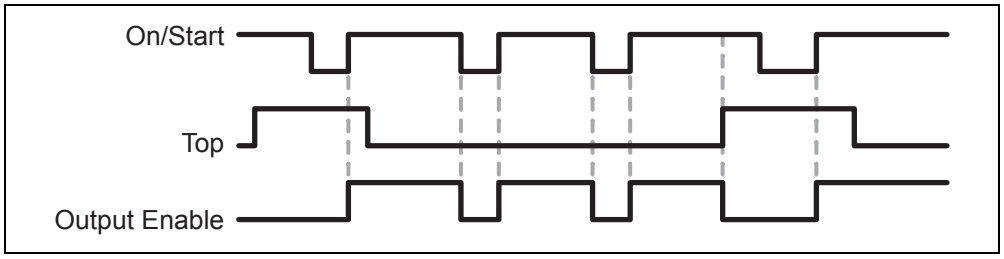


Figure 115: Sequence/timing diagram for the function block Press Single Stroke when On/Start is configured in stepping mode

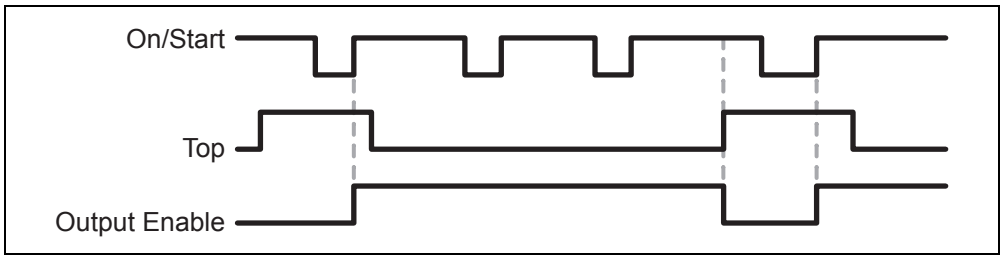


Figure 116: Sequence/timing diagram for the function block Press Single Stroke when On/Start is configured in start Only mode

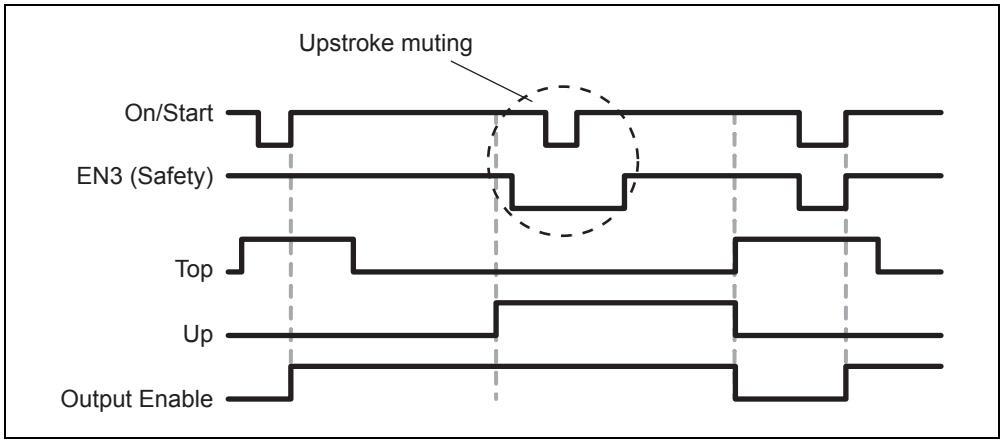


Figure 117: Sequence/timing diagram for the function block Press Single Stroke with upstroke muting of On/Start and EN3 (Safety)

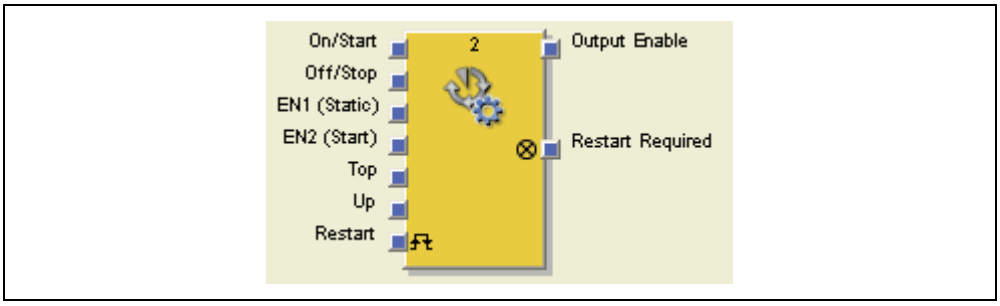
Error conditions

The function block Press Single Stroke does not carry out monitoring for error conditions.

6.8.5 Function block Press Automatic

Function block diagram

Figure 118:
Function block diagram for the function block Press Automatic



General description

The function block Press Automatic is used in connection with press applications in which the workpieces are moved automatically to and from the press, but where a manual tool change is still required, for which, for example, a safety door has to be opened.

The function block can generate a stop signal for the press (i.e. Output Enable changes to **Inactive** (Low)) and enable the gate after a stop has been carried out in a position in which the tool can be changed easily (e.g. in the top position).

Input parameters of the function block

Table 87:
Input parameters of the function block Press Automatic

Parameter	Possible parameter values	Default
Restart Interlock after stop condition	● with ● without	with
Stop request	● with Off/Stop input active ● with On/Start input inactive	with Off/Stop input active
Up input	● with ● without	with
EN2 input	● with ● without	with
Min. restart pulse time	● 100 ms ● 350 ms	100 ms

ATTENTION

Ensure that the transitions of the signals for restarting fulfil the requirements of the safety standards and regulations!
In case of 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 due to the short-circuit detection. If such a pulse can result in a hazardous state in the machine, the following points have to be observed:

- Ensure protected cable laying for the signal line (due to cross-circuiting to other signal lines)
- No short-circuit detection, i.e. do not reference to test outputs.

Input parameters and input signals of the function block

Stop request

The “Stop request” parameter determines the stop mode of the function block Press Automatic. If this parameter is configured as “with On/Start input inactive”, the On/Start input signal is used to control the Output Enable signal directly. If configured to “with Off/Stop input active”, Output Enable changes to **Inactive** (Low), when the Off/Stop input signal is **Active** (High).

In both cases Output Enable changes to **Active** (High), when the following conditions are fulfilled:

- A transition from **Inactive** (Low) to **Active** (High) occurs at the On/Start input; and
- the Off/Stop input is **Inactive** (Low), if it is connected; and
- no other reason is present that would normally trigger a stop signal, e.g. EN1 (Static) is **Inactive** (Low).

Up input

If the Up input parameter is configured as “with”, the connection of an **Active** (High) signal to this input allows the press to stop both during the downstroke and in the top position. If this parameter is set to “without”, regular stops are only possible in the top position.

On/Start

The On/Start input signal is used to provide signals for the beginning and end of the press movement. If a rising edge (i.e. a transition from **Inactive** (Low) to **Active** (High)) is detected at the On/Start input, Output Enable becomes **Active** (High), provided that the Off/Stop input is **Inactive** (Low) and no other reason is present that would normally trigger a stop signal, e.g. EN1 (Static) is **Inactive** (Low). A valid restart sequence can be required before a signal transition of On/Start if the “Restart Interlock after stop condition” parameter is set to “with”. If you connect a command device (e.g. a two-hand control) to the On/Start input, you must ensure that unintentional restarting is not possible.

Off/Stop

If the “Stop request” parameter at Off/Stop is set to **Active**, the Off/Stop input signal is used to signal a stop to the press. When the Off/Stop input is **Active** (High), Output Enable is set to **Inactive** (Low).

This input should only be used if the “Stop request” parameter has been set to Off/Stop **Active**. The Off/Stop input is not used when the “Stop request” parameter has been set to On/Start **Inactive**. A valid restart sequence can be required before a signal transition of On/Start when the “Restart Interlock after stop condition” parameter is set to “with”. The Off/Stop input is designed for the connection of signals that are not safety-relevant (e.g. from a programmable logic controller). Safety-relevant signals may only be connected to the EN1 (Static) input, not to the Off/Stop input.

EN1 (Static)

The input signal EN1 (Static) is mandatory. Output Enable always changes immediately to **Inactive** (Low), if EN1 (Static) is **Inactive** (Low).

If this function block is used together with a press contact function block (e.g. Eccentric Press Contact or Universal Press Contact), its Output Enable signal must be connected with the EN1 (Static) input of this function block.

EN2 (Start)

The input signal EN2 (Start) is optional. When EN2 (Start) is configured, Output Enable can only change to **Active** (High) (e.g. during switching on), when EN2 (Start) is **Active** (High). When Output Enable is **Active** (High), EN2 (Start) is no longer monitored.

Restart

If the Restart Interlock after stop condition parameter has been set to “without”, a Restart signal is not required in order to restart the press after any kind of stop.

If the Restart Interlock after stop condition has been set to “with” and Output Enable changes to **Inactive** (Low), Output Enable can only be reset after a valid restart sequence has been carried out (i.e. the Restart input changes from **Inactive** (Low) to **Active** (high; > 100 ms or 350 ms < 30 s) and back to **Inactive** (Low)).

Output signals of the function block

Restart Required

The Restart Required output is **Active**, when a valid restart sequence is expected at the Restart input.

Sequence/timing diagram for Output Enable

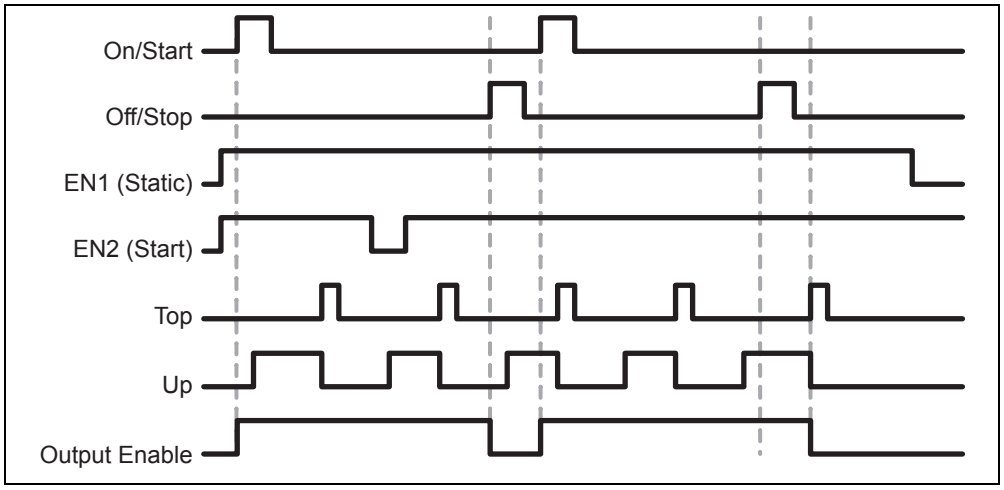


Figure 119: Sequence/timing diagram for the function block Press Automatic with the Off/Stop and Up inputs

Error conditions

The function block Press Automatic does not carry out monitoring for error conditions.

6.8.6 Function block N-Break (Press with N-PSDI mode)

Function block diagram

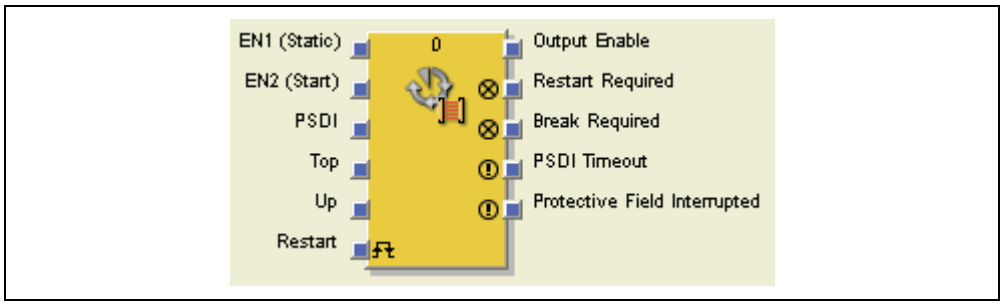


Figure 120: Function block diagram for the N-Break function block

General description

The N-Break function block is used for press applications with PSDI mode.

ATTENTION

Conform to the safety regulations for PSDI mode!

The requirements for PSDI mode are specified in local, regional, national and international standards. Always implement PSDI applications in conformity with these standards and regulations as well as in conformity with your risk analysis and avoidance strategy.

If more than one mode is set up in which the ESPE (e.g. safety light curtain) is not used, the ESPE has to be deactivated in this mode so that it is clear that the ESPE is currently not active in protective operation.

If more than one ESPE (e.g. safety light curtain) is used in an application that uses the N-PSDI functions, only one of the ESPEs may be used to fulfil the requirements for N-PSDI mode.

In conformity with EN 692 and EN 693 for press applications, the number of breaks is limited to 1 or 2. Other applications depend on the applicable standards.

Prevent access to movements entailing hazards!

Press systems with a configuration that would allow a person to enter, to cross through and to leave the protective field of an ESPE are not permitted for PSDI mode.

This function block defines a specific sequence of events that trigger a press cycle. “Breaks” are defined as the transition from **Active** (High) to **Inactive** (Low) to **Active** (High) of the PSDI input signal. In PSDI mode of a press an indirect manual triggering of a press cycle is carried out based on a predefined number of “breaks” in the ESPE. If the ESPE (e.g. safety light curtain) detects that the operating movements of the operator related to the insertion or removal of parts have ended and that the operator has withdrawn all body parts from the protective field of the ESPE, the press may trigger automatically.

The N-Break function block can be used in connection with the function blocks Universal Press Contact or Press Single Stroke and an input for a safety light curtain. The Output Enable signal of this function block controls, for example, the On/Start input of a function block Press Single Stroke.

The N-Break function block checks whether the start sequence is valid and when the break counter or the function block have to be reset.

Input parameters of the function block

Table 88:
Input parameters of the N-Break function block

Parameter	Possible parameter values	Default
Number of breaks	Parameterisable, from 1 to 8	1
Mode	● standard ● Sweden	standard
Max. Up-stroke Muting time	Parameterisable from 0 to 7200 s. When the Max. Up-stroke Muting time is set to 0, upstroke muting is not possible and nothing can be connected to the Up input.	30 s
PSDI Time Monitoring	Parameterisable, from 0 to 500 s	30 s
EN2	● without ● only necessary for first starts ● necessary for every start	necessary for every start
Release	● limited ● not limited	limited
Restart Interlock	● always ● deactivation on upstroke (only for PSDI) ● without	always
Min. restart pulse time	● 100 ms ● 350 ms	100 ms
Start Position	● everywhere ● only on top	everywhere
Min. break pulse time	● 100 ms ● 350 ms	100 ms

ATTENTION

Ensure that the transitions of the signals for restarting fulfil the requirements!

In case of 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 due to the short-circuit detection. If such a pulse can result in a hazardous state in the machine, the following points have to be observed:

- Ensure protected cable laying for the signal line (due to cross-circuiting to other signal lines).
- No short-circuit detection, i.e. do not reference to test outputs.

Input parameters and input signals of the function block

standard/Sweden mode

The standard/Sweden mode parameter specifies the complete start sequence for the N-Break function block. The standard mode requires that the configured number of breaks is carried out, followed by a valid restart sequence.

The Sweden mode first requires a valid restart sequence, followed by the configured number of breaks.

Requirements for the start sequence

If Output Enable changes to **Inactive** (Low) because of one of the following conditions, a complete start sequence can be necessary:

- EN1 (Static) is **Inactive** (Low).
- The Protective Field Interrupted output is **Active** (High), while Cycle = 0 and there is no active upstroke muting and no stop at the Top dead center.
- In case of a PSDI Timeout
- After the safety controller has been switched on

If the Protective Field Interrupted output is **Active** (High) and Output Enable is **Inactive** (Low) and the PSDI input is also **Inactive** (Low) and the Restart Interlock is set to “without”, a restart is possible without a complete restart sequence. This can also apply during the press run-up if the Restart interlock is set to “deactivation on upstroke (only for PSDI)”.

The Min. break pulse time at the PSDI input amounts to 100 ms or 350 ms. Shorter breaks are not evaluated as valid. If the EN2 parameter is configured as “only necessary for first starts” or as “necessary for every start”, it also has to be **Active** (High) if a complete start sequence is required.

Figure 121: Sequence/timing diagram for a complete start sequence in standard mode in two-cycle mode

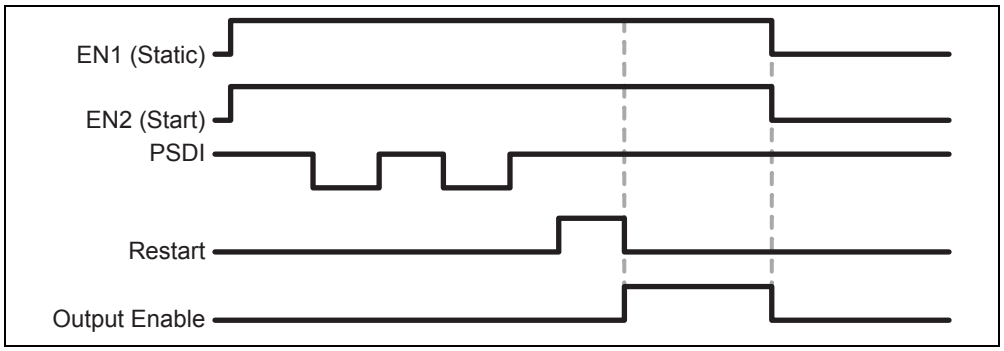
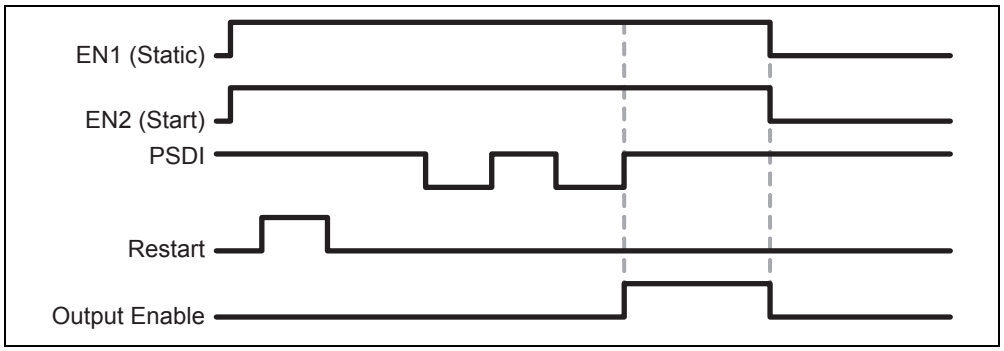


Figure 122: Sequence/timing diagram for a complete start sequence in Sweden mode in two-cycle mode



After the initial complete start sequence has been completed and the press has completed a press cycle, the Top input has to indicate that the press has currently reached the Top dead center. This is indicated by a rising edge of the Top input (i.e. the transition from **Inactive** (Low) to **Active** (High)). When this happens, the internal break counter is reset.

A cycle start sequence is required in order to trigger a subsequent cycle. In this case, Output Enable is set to **Active** (High) when the configured number of breaks has occurred and the remaining configured conditions have been fulfilled (e.g., EN2 parameter can be configured as necessary for every start).

PSDI Time Monitoring

The PSDI Time Monitoring parameter specifies the required time both for a complete start sequence and for a cycle start sequence. If the PSDI time is exceeded, the PSDI Timeout output changes to **Active** (High). In this case, a complete start sequence is necessary so that Output Enable can return to **Active** (High) (e.g. in order to start the press). The PSDI timer starts when the press is stopped at the Top dead center (i.e. the Top input changes from **Inactive** (Low) to **Active** (High)) and after all the other stop conditions have been fulfilled.

The default for the PSDI time amounts to 30 s in accordance with the maximum PSDI time allowed for eccentric presses (defined in DIN EN 692). If the PSDI time = 0, PSDI Time Monitoring is deactivated.

Release

The Release parameter determines under which circumstances a break is regarded as valid. If the Release parameter is set to “not limited”, breaks are valid when the rising edge (i.e. the transition from **Inactive** (Low) to **Active** (High) at the PSDI input) occurs after the Top input has changed to **Active** (High). The beginning of the break (i.e. falling edge; transition from **Active** (High) to **Inactive** (Low) at the PSDI input) may occur before the Top input is **Active** (High).

If the Release parameter is set to “limited”, breaks are only valid when the rising edge (i.e. the transition from **Inactive** (Low) to **Active** (High) at the PSDI input) occurs after the Top input has changed to **Active** (High). The beginning of the break (i.e. falling edge; transition from **Active** (High) to **Inactive** (Low) at the PSDI input) may not occur before the Top input is **Active** (High).

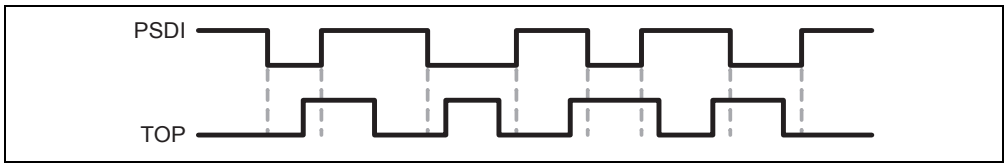


Figure 123:
Valid breaks when the Release paramter is set to “not limited”

Upstroke muting and Max. Up-Stroke Muting time

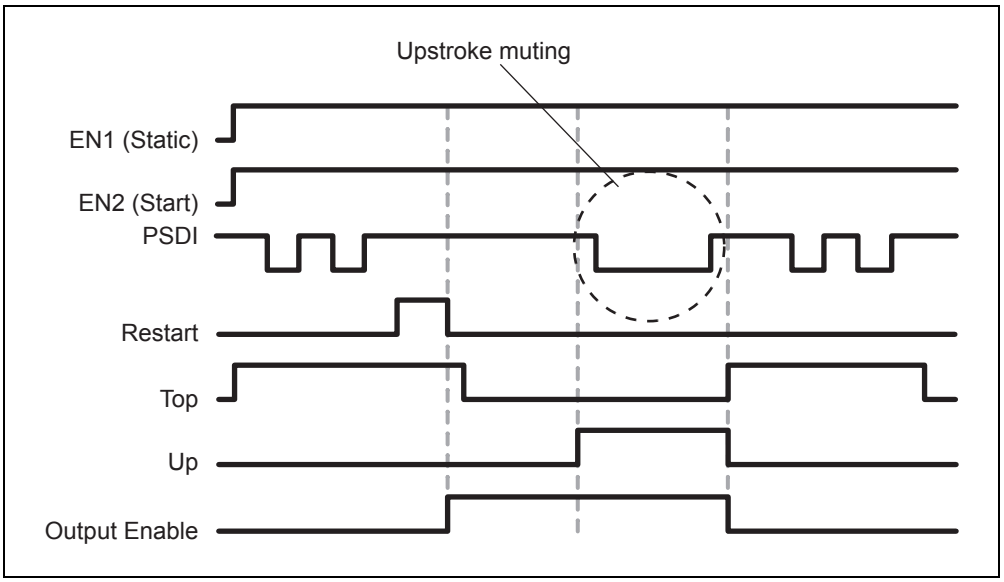
Upstroke muting allows bypassing of the PSDI input (e.g. the OSSDs of a safety light curtain) during the upstroke of the press cycle. Upstroke muting is activated when the Max. Up-Stroke Muting time parameter is set to a value greater than 0. Upstroke muting is deactivated when the Max. Up-Stroke Muting time parameter is set to 0.

When upstroke muting is activated…

- it is imperative that the Up input is connected to a suitable signal. This can be the Up output e.g. of the Eccentric Press Contact function block or of the Universal Press Contact function block.
- the PSDI input of the function block is bypassed if the Up input is **Active** (High) and the Top input remains **Inactive** (Low).

The function block does not check the Up input for plausibility. This means that it is possible to bypass the PSDI input several times if the Up input is activated several times during a single press cycle.

Figure 124: Sequence/timing diagram for Upstroke muting in standard mode in two-cycle mode



The Max. Up-Stroke Muting time can be configured. The Max. Up-Stroke Muting time begins with the rising edge (i.e. the transition from **Inactive** (Low) to **Active** (High)) of the signal at the Up input. If the timer reaches the configured Max. Up-Stroke Muting time before a rising edge occurs at the Up input, upstroke muting is interrupted and, if the PSDI input is **Inactive** (Low), Output Enable is set to **Inactive** (Low). When a second rising edge occurs, upstroke muting begins again. The Max. Up-Stroke Muting time can be configured in a range of 0 to 7,200 s. If the value is set to “0”, upstroke muting is deactivated.

Start Position

If the Start Position parameter is set to “only on top”, a restart of the press in another position than at the top dead center is prevented. If the press has been stopped e.g. by interruption of the light curtain during a downstroke, you must change the operating mode (e.g. to press setup mode) and move the press back to the top position in the other operating mode. Only then a restart of the press in PSDI mode will be possible by a complete start sequence.

If the Start Position parameter is set to “only on top”, the optional Control input must be connected in order to monitor whether the press is currently running or has been stopped. This must be the signal which directly controls the press. Typically Control input will be connected via a loop-back connection to the logic editor signal which is connected to the physical output for the press.

If Output Enable changes to **Inactive** (Low) as a result of either the EN1 (Static) input or the PSDI input has changed to **Inactive** (Low), the diagnostic output Start Here Not Possible changes to **Active** (High). A restart of the press is prevented until the Top input has changed back to **Active** (High) and no restart in another operating mode has occurred.

EN1 (Static)

The input signal EN1 (Static) is mandatory. Output Enable always changes immediately to **Inactive** (Low), if EN1 (Static) is **Inactive** (Low).

If this function block is used together with a press contact function block (e.g. Eccentric Press Contact or Universal Press Contact), its Output Enable signal must be connected with the EN1 (Static) input of this function block.

EN2 (Start)

The input signal EN2 (Start) is optional. If EN2 (Start) is configured, the Output Enable signal can only change to **Active** (High) (e.g. during switching on), when EN2 (Start) is **Active** (High). When Output Enable is **Active** (High), EN2 (Start) is no longer monitored.

Restart

If the Restart Interlock parameter has been set to “without”, a Restart signal is not required in order to restart the press after Output Enable has changed to **Inactive** (Low).

If the Restart Interlock has been set to “always” and Output Enable changes to **Inactive** (Low), Output Enable can only be reset after a valid restart sequence has been carried out (i.e. the Restart input changes from **Inactive** (Low) to **Active** (high; > 100 ms or 350 ms < 30 s) and back to **Inactive** (Low)). The only exception to these rules is formed by the cycle beginning. In this case the Restart Interlock parameter does not have any effect on the function block.

If the Restart Interlock has been set to “always” and the Max. Up-Stroke Muting time parameter has been configured as “without”, an **Inactive** (Low) signal at the PSDI input during the startup sets Output Enable immediately to **Inactive** (Low).

If the Restart Interlock has been set to “always” and the Upstroke muting parameter is **Active** (High), Output Enable remains **Active** (High) until Top becomes **Active** (High), thus indicating that the press cycle has been completed. In this case, a complete restart sequence is required.

If the Restart Interlock has been set to “deactivation on upstroke (only for PSDI)” and the Upstroke muting parameter is **Active** (High), Output Enable remains **Active** (High) until Top becomes **Active** (High), thus indicating that the press cycle has been completed. In this case, a cycle start sequence is required.

If the PSDI input changes to **Active** (High) during this time, Output Enable also changes back to **Active** (High). The setting for this parameter does not have any effect when the Restart and Up input signals remain unconnected.

Figure 125: Sequence/timing diagram, when the PSDI input is Inactive (Low), Upstroke muting is disabled and the Restart interlock is set to “always”

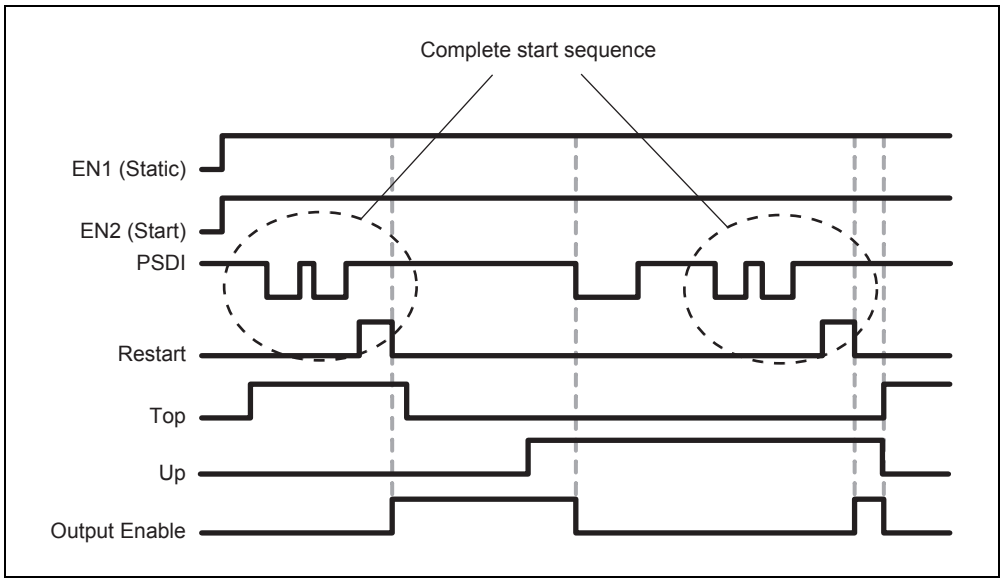
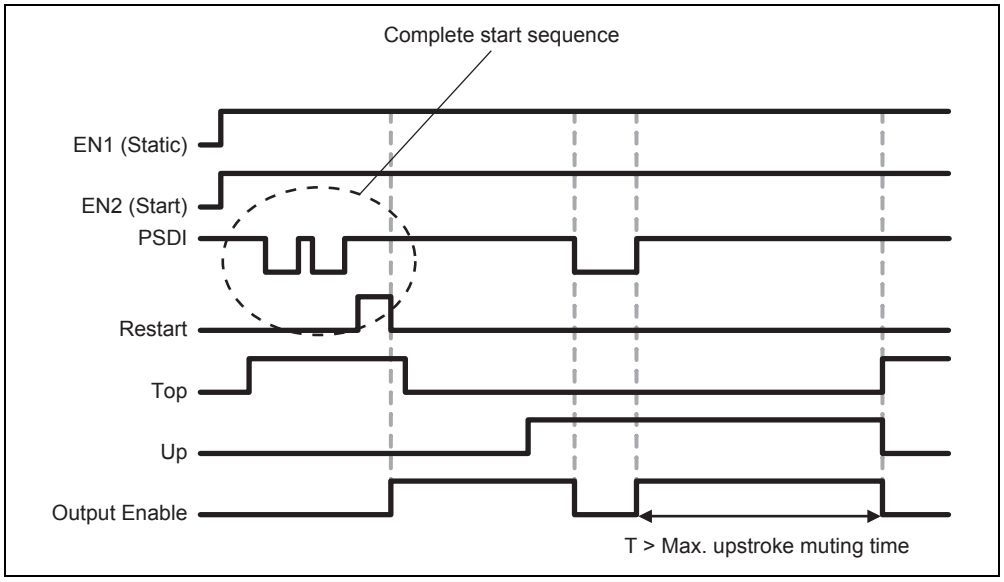


Figure 126: Sequence/timing diagram when the PSDI input is Inactive (Low), Upstroke muting is disabled (Max upstroke muting time: 0=disabled) and the Restart interlock is set to “deactivation on upstroke (only for PSDI)”



Output signals of the function block

Restart Required

The Restart Required output is **Active** (High), when a valid restart sequence is expected at the Restart input.

Break Required

The Break Required output is **Active** (High), when a break is expected at the Restart input.

Protective Field Intrrupted

The Protective Field Interrupted output is **Active** (High) when a valid start sequence has been carried out and the PSDI input changes from **Active** (High) to **Inactive** (Low) while no muting is **Active** and no break is expected. If Protective Field Interrupted is **Active** (High), a valid restart sequence generally has to be carried out before Output Enable can be set to **Active** (High).

If the Protective Field Interrupted output is **Active** (High) and Output Enable is **Inactive** (Low) and the PSDI input is also **Inactive** (Low) and the Restart Interlock is set to “without”, a restart is possible without a complete restart sequence. This can also apply during the press run-up if the Restart Interlock is set to “deactivation on upstroke (only for PSDI)”.

Error states and information on resetting

Table 89:
Error states and information on resetting for the N-Break function block

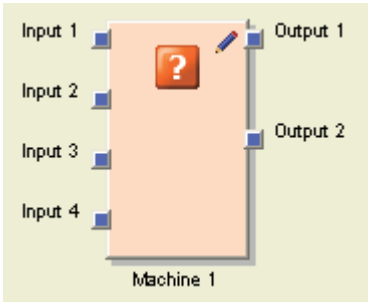
Diagnostics	Fault Present	Resetting the error state	Remarks
Protective Field Interrupted	**Active**	If an interruption of the protective field occurs, the PSDI input generally has to return to **Active**, followed by a valid restart sequence, in order to reset the error. If the Protective Field Interrupted output is **Active** (High) and Output Enable is **Inactive** (Low) and the PSDI input is also **Inactive** (Low) and the Restart Interlock is set to “without” or “deactivation on upstroke (only for PSDI)”, a restart is possible without a complete restart sequence. For PSDI timeout the error is reset by a valid restart sequence.	Output Enable changes to **Inactive** and the Fault Present changes to **Active**, if Protective Field Interrupted or PSDI Timeout is **Active**.
PSDI Timeout			

6.9 User defined function blocks

6.9.1 Grouped Function Block

Function block diagram

Figure 127: Function block diagram for the Grouped Function Block



You can select groups of function blocks in order to create a single Grouped Function Block. The typical purpose of a grouped function block is to simplify the re-use of groups of logic and to reduce the number of function blocks on a page.

A Grouped Function Block has the following characteristics:

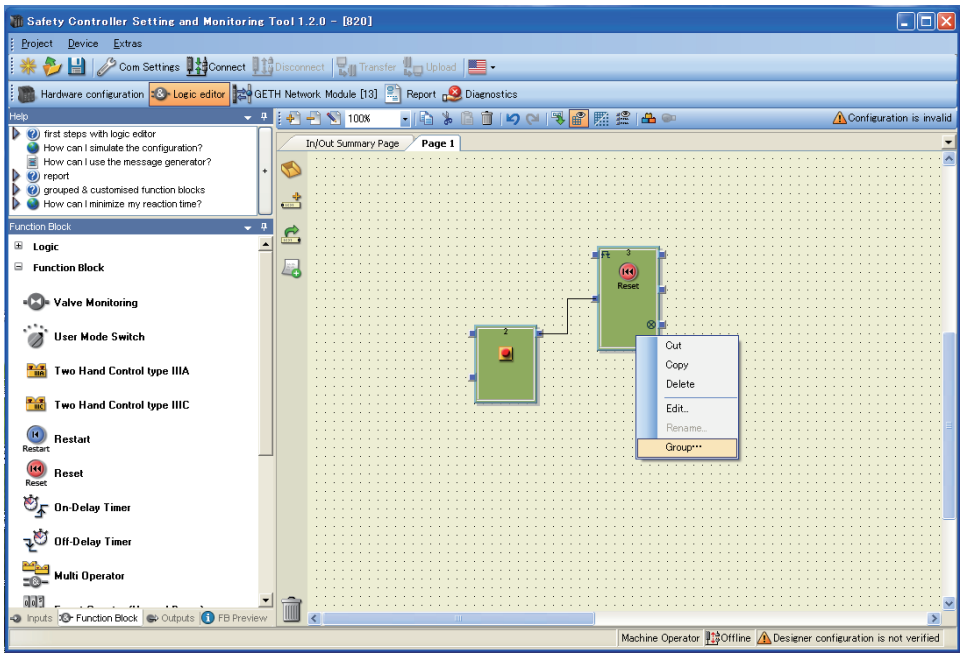
- It can have a maximum of 8 inputs and 8 outputs.
- It cannot contain the Fast Shut-off function block nor another Grouped or Customized Function Block.
- The icon representing the Grouped Function Block is chosen from a fixed library within the Setting and Monitoring Tool.
- It is created within the logic editor, but is not listed in the function block list.
- It is saved with the project file. Upon re-opening the project file on another PC, the Grouped Function Block will be displayed.
- It can be saved as a Customized Function Block.

Note When determining the total number of function blocks within a project, the Grouped Function Block is not counted as a single function block, but rather the total number of blocks used within it.

How to create a Grouped Function Block:

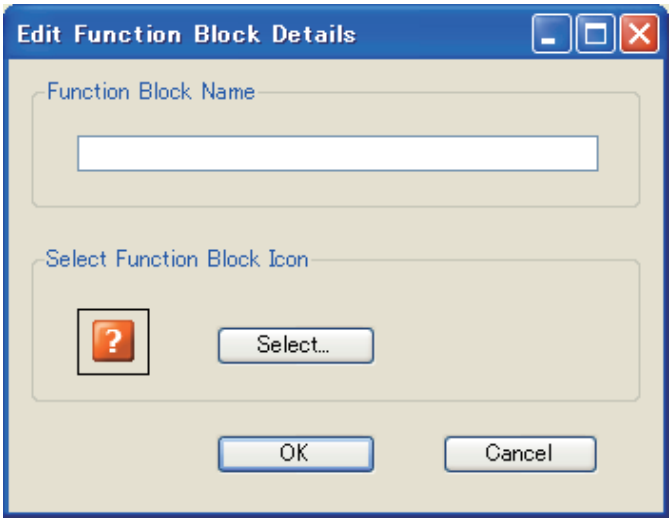
- Select the function blocks which are to be grouped.
- Right click on one of the selected function blocks to call up the context menu.

Figure 128:
Creating a Grouped Function Block



- Click on **Group**. The **Edit Function Block Details** dialog opens.

Figure 129:
Edit Function Block Details dialog for the Grouped Function Block

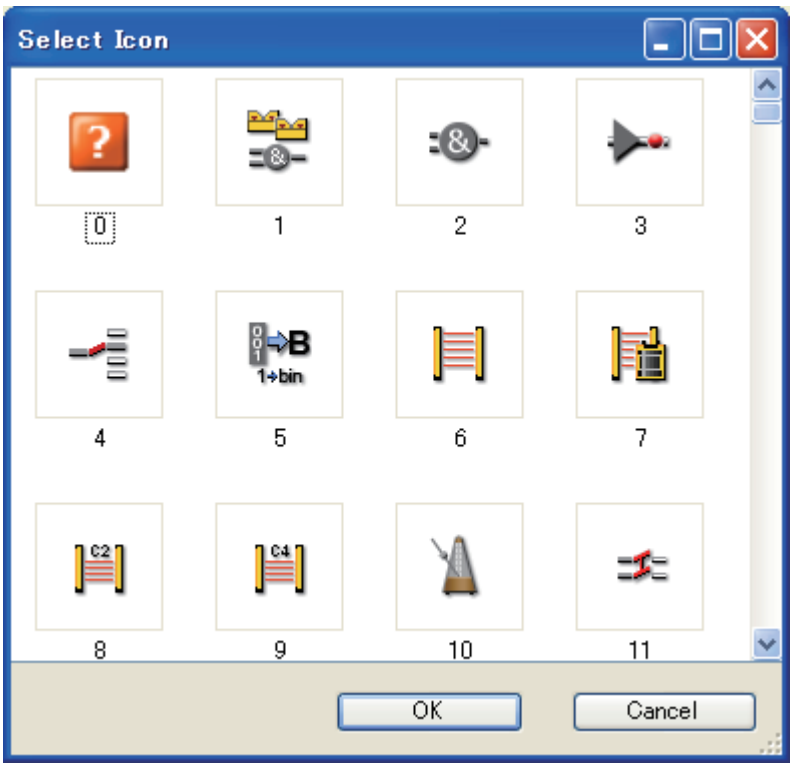


- Enter a name for the new Grouped Function Block.

Note Do not enter the same name used in any existing Grouped Function Block for the new Grouped Function Block.

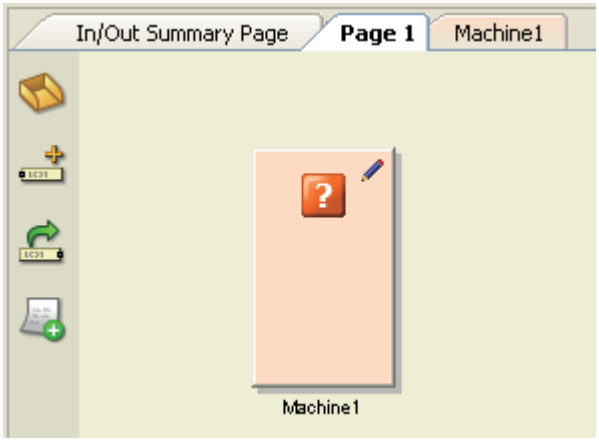
- If you want to assign another icon to the new Grouped Function Block, click on **Select...** to open the **Select Icon** dialog. You can choose the icon from a fixed library.

Figure 130:
Select Icon dialog for the Grouped Function Block



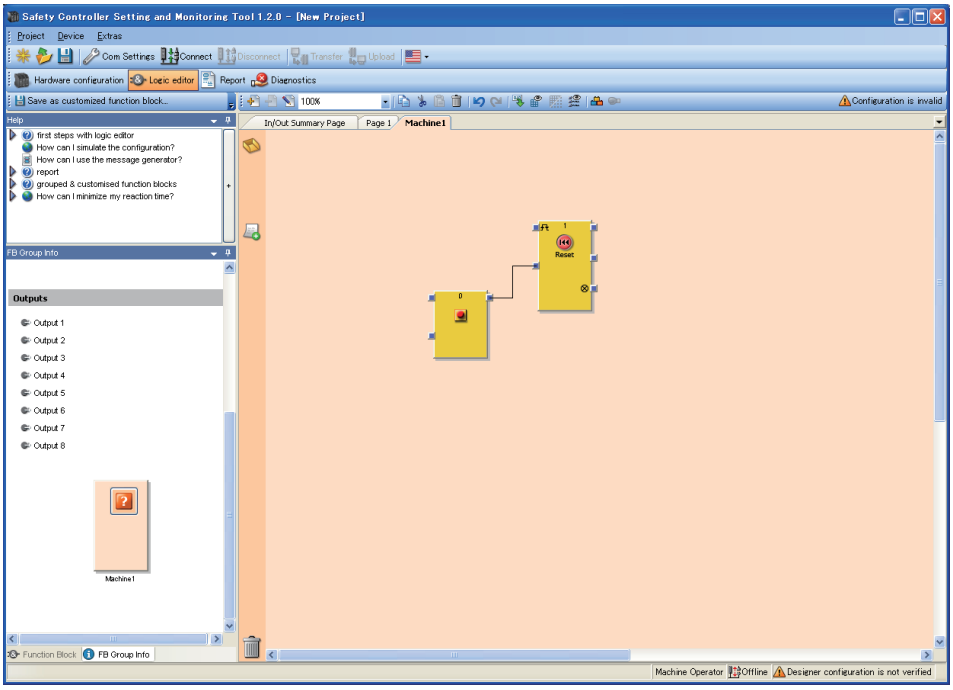
- Select the desired icon and click **OK**.
- Back in the **Edit Function Block Details** dialog, click **OK** to confirm your changes and to leave the dialog. The selected function blocks will be reduced to a single Grouped Function Block on the worksheet for the main program.

Figure 131:
New Grouped Function Block on the worksheet



The content of the new Grouped Function Block is stored on a new page. In the example, the name of the new Grouped Function Block is Machine 1. The worksheet for the Grouped Function Block is displayed orange.

Figure 132:
New logic editor page for the new Grouped Function Block



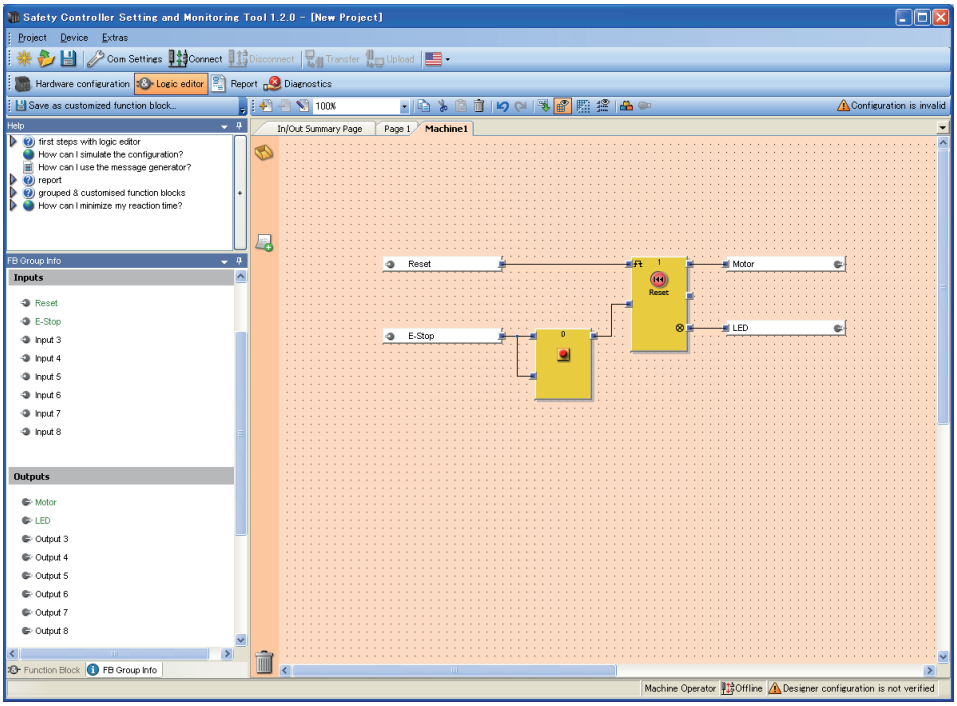
Note The name and the icon associated with a Grouped Function Block can be edited here by clicking on the function block's icon in the **FB Group Info** view.
By clicking on the associated tab (here: Machine 1), you can edit the Grouped Function Block.

How to add inputs and outputs to a Grouped Function Block:

- Click on the tab for the Grouped Function Block.
- Switch to the **FB Group Info** view on the left side of the screen.
- Drag and drop inputs or outputs onto the function block worksheet and attach them within the logic as needed.
- Double click on an input or output to edit its tag name.

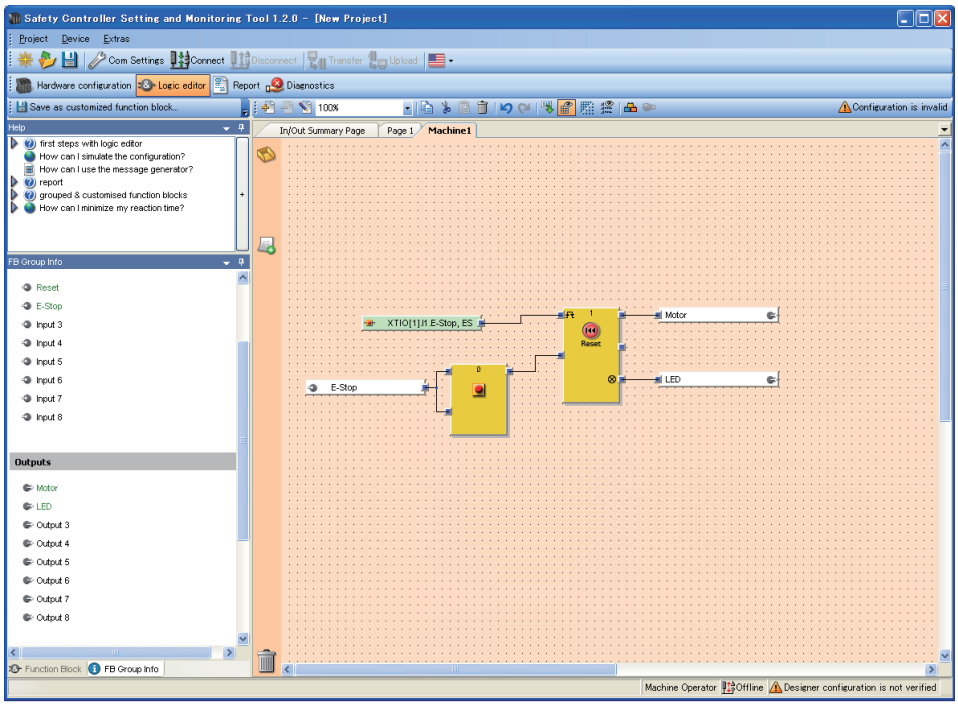
Note Do not use "space" in the tag name for inputs or outputs of the Grouped Function Block, nor leave the tag name blank.

Figure 133: Adding inputs and outputs to a Grouped Function Block



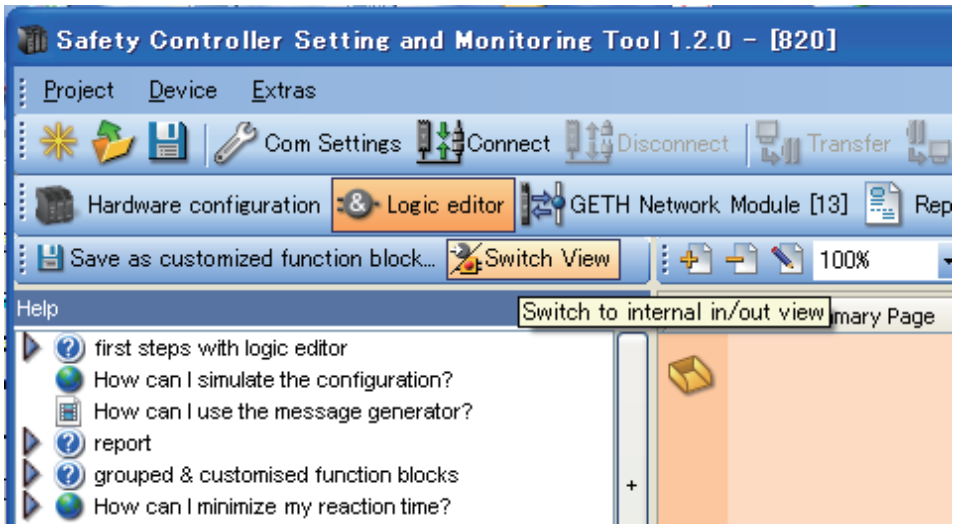
The inputs and outputs that have been added to the Grouped Function Block will appear on the function block itself in the main program and devices can be attached to them. Once a device is attached, it will be displayed in the logic of the Grouped Function Block when the view is switched to external view.

Figure 134: Grouped Function Block with devices attached



To switch between the internal tag names of the Grouped Function Block (internal view) and the external I/O descriptions (external view), click on **Switch View** in the toolbar.

Figure 135: Switching between internal and external view



- The internal view shows the Grouped Function Block's tag names for its inputs and outputs.
- The external view shows what is connected to the Grouped Function Block.

How to transfer a grouped function block to another PC:

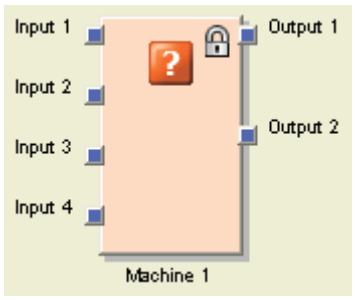
- Save the project file and open it on the other PC. Grouped Function Blocks contained in the project will be imported automatically.

6.9.2 Customized Function Block

Once a Grouped Function Block is created, it is possible to lock and import it into the function block selection field for use in future project files. The resulting function block is called a Customized Function Block.

Function block diagram

Figure 136: Function block diagram for the Customized Function Block



A Customized Function Block has the following characteristics:

- It can have a maximum of 8 inputs and 8 outputs.
- It cannot contain the Fast Shut-off function block nor another Grouped or Customized Function Block.
- The icon representing the Customized Function Block may either be user defined or chosen from a fixed library within the Setting and Monitoring Tool.
- It is created within the logic editor, will be listed with the other function blocks in the function block list and will be available in all new projects on the same PC.
- Upon opening a project file containing Customized Function Blocks on another PC, you have the following options:
  - You can import the Customized Function Blocks into the function block listing on the new PC for further use in new projects.
  - Or you can import the Customized Function Blocks for this project only. In this case, they will not be listed in the function block list.

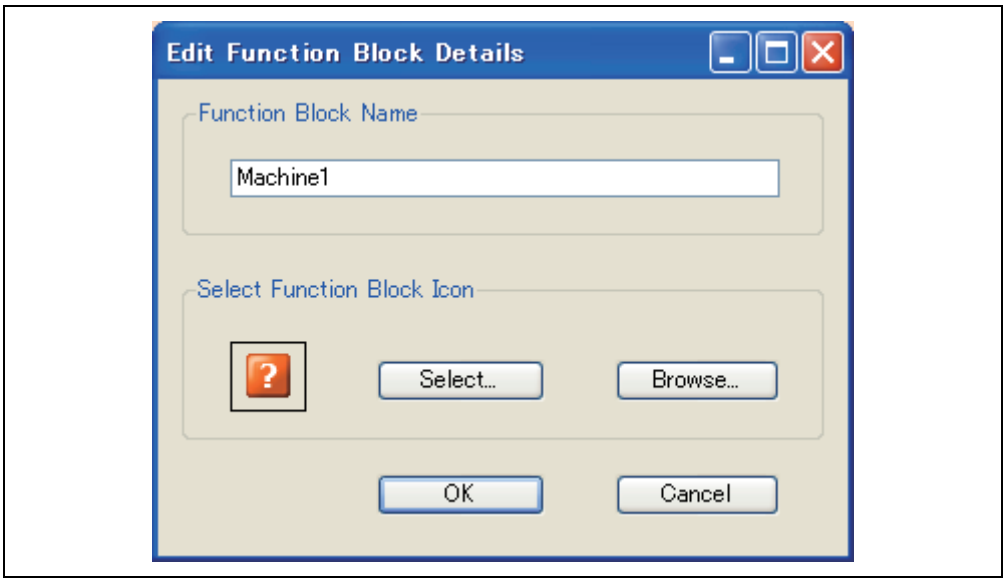
Note When determining the total number of function blocks within a project, the Customized Function Block is not counted as a single function block, but rather the total number of blocks used within it.

How to create a Customized Function Block:

In order to create a Customized Function Block, you must have already created it as a Grouped Function Block (see Section 6.9.1).

- Open the Grouped Function Block view by clicking on its tab,
- Click on **Save as CFB...** in the toolbar. The **Edit Function Block Details** dialog opens.

Figure 137:
Edit Function Block Details dialog for the Customized Function Block

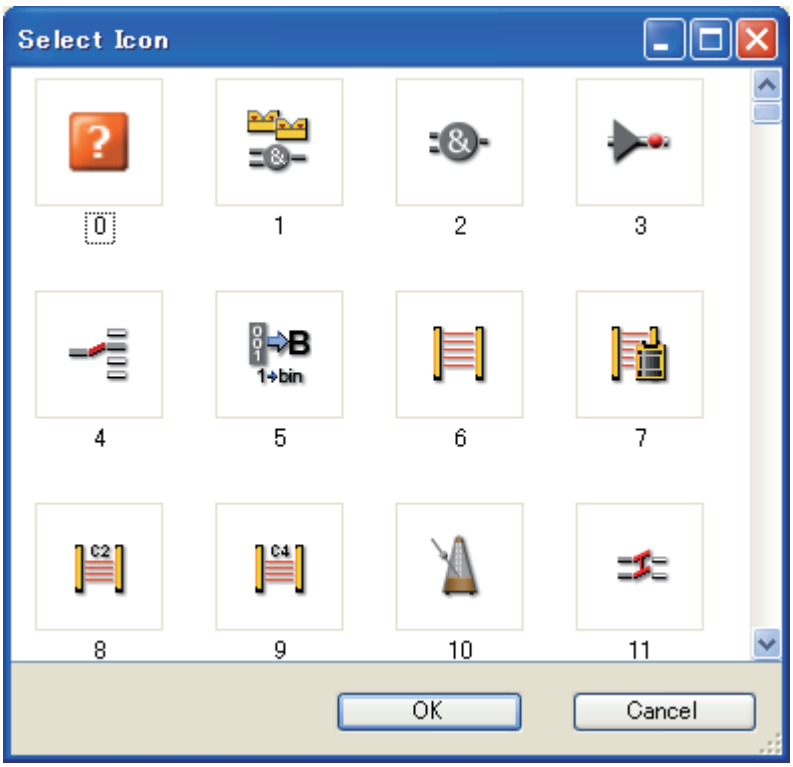


- Enter a name for the new Customized Function Block.

Note Do not enter the same name used in any Function Block for the new Customized Function Block.

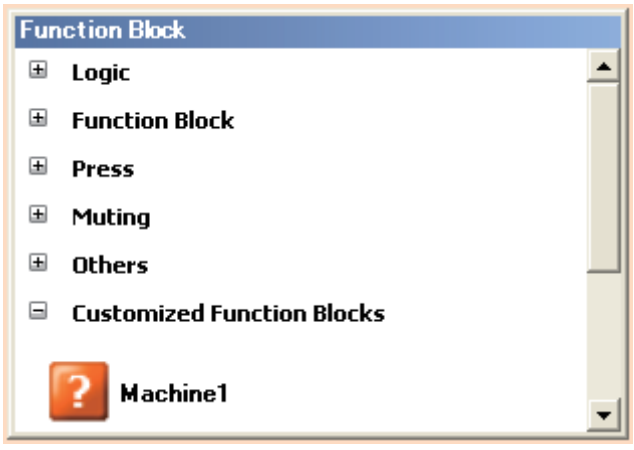
- If you want to assign another icon to your new Customized Function Block, you have two possibilities:
  - Click on **Browse...** to choose a user defined icon.
  - Or click on **Select...** to open the **Select Icon** dialog. You can choose the icon from a fixed library.

Figure 138:
Select Icon dialog for the Customized Function Block



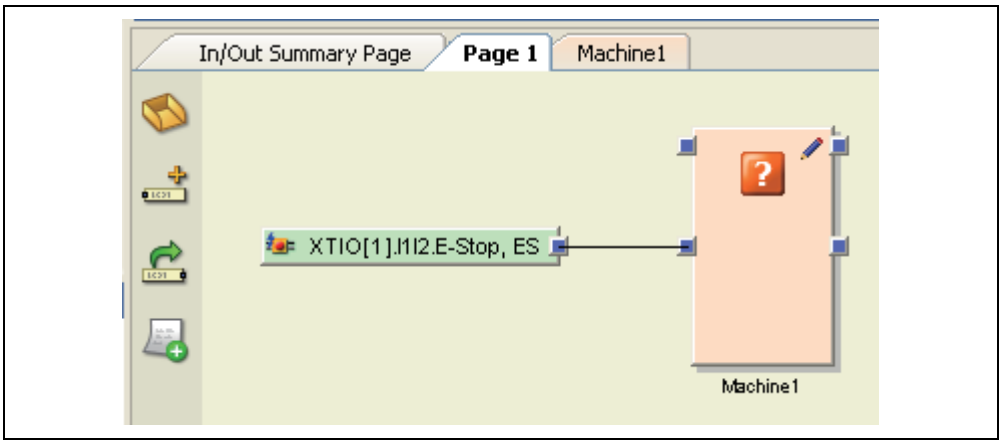
- Select the desired icon and click **OK**.
- Back in the **Edit Function Block Details** dialog, click **OK** to confirm your changes and to leave the dialog. The selected Grouped Function Block will appear in the function block list as a Customized Function Block and will be available in all new projects on the same PC.

Figure 139:
New Customized Function Block in the function block list



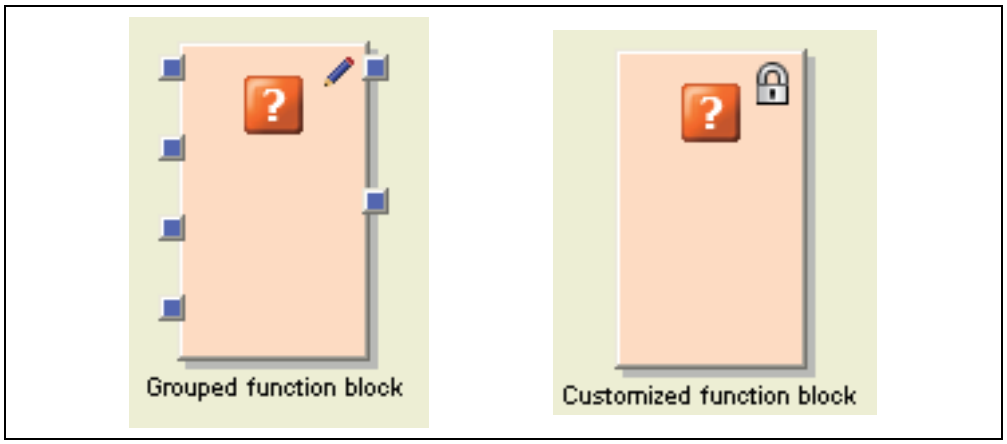
Once a Customized Function Block has been placed on the worksheet, its content is displayed on a new page. In the example, the name of the Customized Function Block is Machine 1. The worksheet for the Customized Function Block is displayed orange. The Customized Function Block can not be edited.

Figure 140:
Page created for the new Customized Function Block



Note A Grouped Function Block contains a small pencil icon in the upper right corner indicating that it can be edited. The Customized Function Block contains a padlock indicating that it is locked against modification.

Figure 141:
Icons for the Grouped Function Block and for the Customized Function Block



How to edit a Customized Function Block:

- Open the Customized Function Block's page by clicking on its tab,
- Click on **Edit...** in the toolbar. You will be prompted for confirmation. If you click on Yes, the Customized Function Block will be transformed to a Grouped Function Block which can be edited (see Section 6.9.1).
- In order to make the modified function block available for re-use in the function block list, save it again as a Customized Function Block by clicking **Save as CFB...** in the toolbar.

How to transfer Customized Function Blocks to another computer:

- Adding Customized Function Blocks to the function block list
  - Drag and drop the desired Customized Function Blocks into the logic editor and save the project file.
  - Open the project file on another computer. You will be prompted to accept an import of all Customized Function Blocks used in the project file.
  - Click on **Yes** to import the Customized Function Blocks. They will be listed in the function block list and will be available in all new projects on the same PC.
- Not adding Customized Function Blocks to the function block list
  - Click on **No** to import the Customized Function Blocks as grouped function blocks only. In this case, they will not be listed in the function block list and will be available for the current project only.

Note If a Customized Function Block to be imported has the same name as another Customized Function Block saved in the PC, the imported Customized Function Block will be added under the same name.

How to delete a Customized Function Block permanently from your PC:

- Delete all instances of the Customized Function Block from your project or transform each of them to a Grouped Function Block by clicking **Edit...** in the toolbar.
- In the function block list, right click on the Customized Function Block you want to delete. The context menu opens.
- Choose **Delete Custom Function Block....**

Note

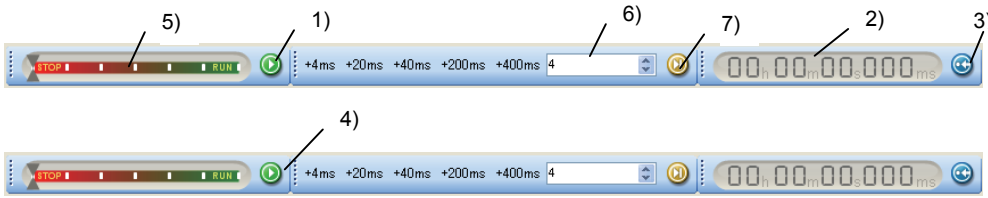
- You cannot undo this action.
- Other projects containing Customized Function Blocks that have been deleted can still be used. When opening an older project that contains Customized Function Blocks that have been deleted from your PC, it will be treated like a project that has been transferred from another PC. You will be prompted whether you want to import the Customized Function Blocks contained in the project permanently as Customized Function Blocks or as Grouped Function Blocks for use in the current project only.

6.10 Simulation of the configuration

Within the logic editor, it is possible to simulate the programmed logic offline.

- Click on the **Start simulation mode** icon ( ) in the toolbar to activate the simulation mode. The background of the logic editor will change to green and the simulation toolbar will appear.

Figure 142: Simulation toolbar



To start a simulation of the logic, click the green **Play** button (1)) for simulation at full speed (near to real time). The timer (2)) keeps track of the elapsed time. The timer can be reset using the blue **Reset** button (3)). To stop a simulation, click the red **Stop** button (4)).

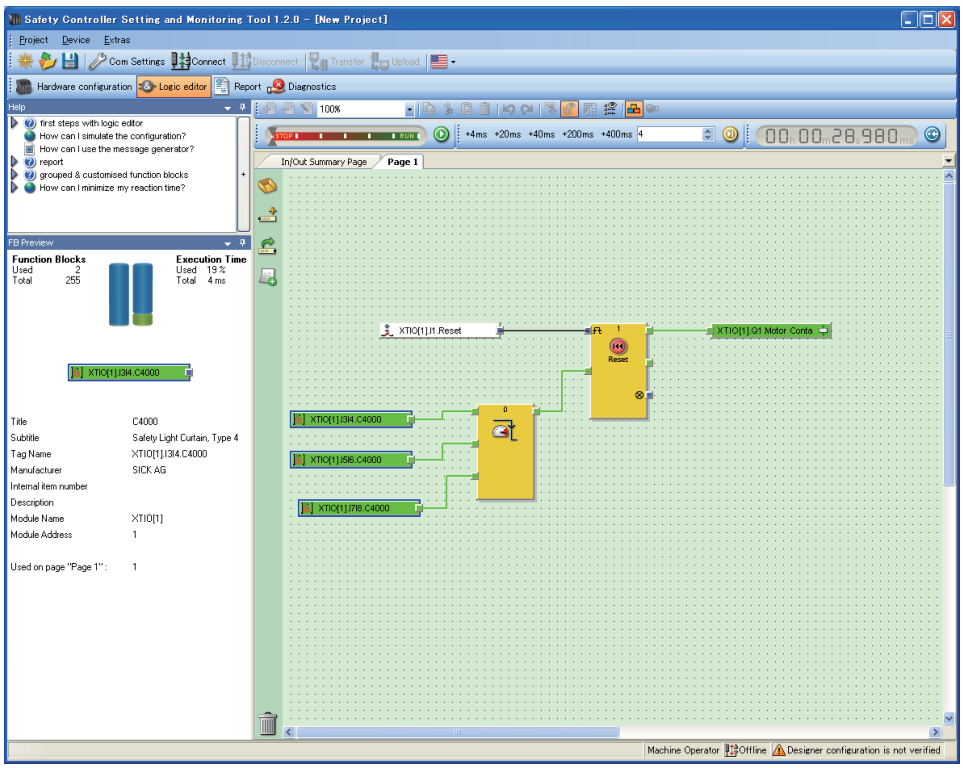
Time control of the simulation

For logic processes which are too fast to see at normal speed there are two possibilities:

- Use the sliding bar (5)) to slow the simulated passage of time.
- It is possible to execute a simulation in time increments. To do so, stop the simulation by clicking on the red **Stop** button and click on one of the time increment buttons to the right of the sliding bar (5)). The following time periods are available by default: +4 ms, +20 ms, +40 ms, +200 ms and +400 ms. These values will be adapted automatically respective to the size of the programmed logic since they represent multiples of the execution time. By clicking on one of these time buttons, the simulation jumps forward by the specified time increment.
  Additionally, the input field on the right (6)) allows you to enter a user specific time period in ms, by which the simulation will jump forward when the yellow button (7)) beside the input field is pressed. By entering a large number such as 40000 (40 s) into this field, you can jump forward in order to avoid waiting for timers to complete their cycle, for example.

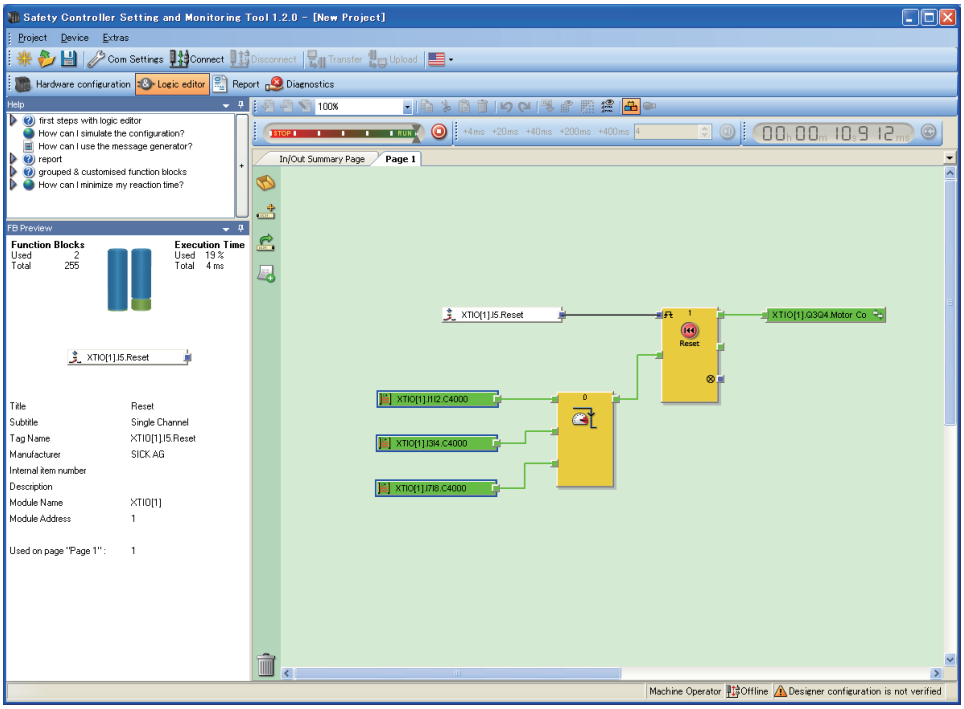
Note The entered time will be rounded to the nearest possible cycle time.

Figure 143: Simulation mode started, simulation off



While the simulation is running you can activate an input by clicking on it. Activated inputs will be displayed green with a blue frame. Another click will deactivate the input again. Multiple inputs can be selected and deselected in this way.

Figure 144: Simulation mode started, simulation running



When the simulation is stopped, it is possible to select inputs to switch at the next possible moment. When clicking on an input in stopped mode, a blue box will appear around it denoting that it is ready to switch at the next cycle of the simulation. This makes it possible to switch one or more elements at the same time and see their direct effect on the logic.

After activation of the desired inputs, the simulation must be continued either by pressing the green **Start** button or by using one of the time increment buttons in order for the logic and outputs to switch accordingly.

Note If the EDM or the Valve Monitoring function block is being used, it is recommended to remove them from the logic before simulating. These function blocks expect a high signal on their feedback input within 300 ms of their associated output being activated. This can only be simulated by using small increments and not in real time.

6.11 Force mode

In force mode you can set the inputs of a MELSEC-WS safety controller via Setting and Monitoring Tool to **High** or **Low** independently of their actual status while the system is online. The safety controller and the programmed logic will react exactly as if the inputs concerned were actually in the respective state.

This enables you e.g. during commissioning or maintenance to test the wiring of your system and the function of your programmed logic in online operation.

You can force only the inputs of a safety controller directly, but not outputs or logic results as function blocks or jump addresses.

Exclude any danger for persons or equipment!

In force mode you can freely influence the status of the safety inputs. As a result thereof, the safety function of your safety equipment can be impaired and a dangerous state may occur.

- Ensure that no person is present in the dangerous area of your machine or system before activating force mode.
- Ensure that no person can intrude into the dangerous area of the machine or system while force mode is active.

Do not use force mode from several PCs simultaneously!

- When using force mode, ensure that no person activates the force mode from a second PC. Otherwise, a dangerous state may occur.

How to activate the force mode:

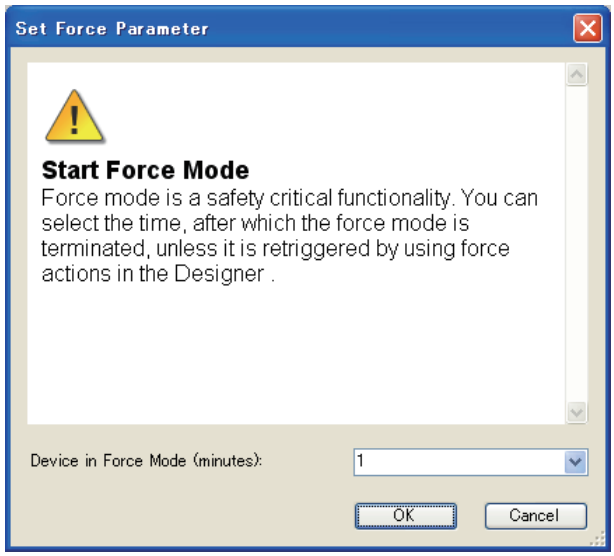
The following requirements must be met in order to use the force mode:

- You must be logged in to the system as Authorized client.
- Your PC must be connected to the MELSEC-WS safety controller via the COM (RS-232) interface. Forcing via an Ethernet connection is not possible.
- The configuration of your safety controller project may not be validated.

Note If you try to activate the force mode although the configuration has been already verified, a dialog appears that allows you to reset the status to Not verified.

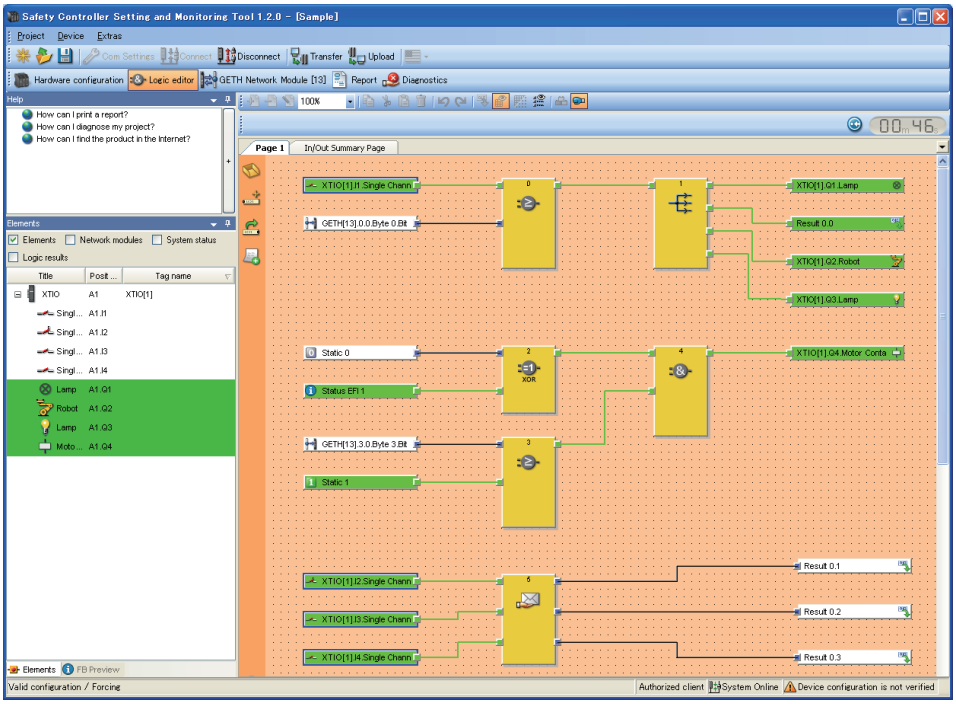
- Click on **Connect** to establish a connection to your MELSEC-WS safety controller.
- In the **Hardware configuration** view, click on the **Start application** button. If you have not yet logged in as Authorized client, you will be prompted now to do so.
- Go to the **Logic editor** view and click on the **Start force mode** button. A dialog is opened where you can enter the time after which the force mode will be automatically left if no actions are taken.

Figure 145:
Dialog window when starting force mode



- Choose the desired time span from the drop box list and click **OK**. Force mode will be activated and the background colour of the logic editor changes to orange.

Figure 146:
Logic editor with force mode activated



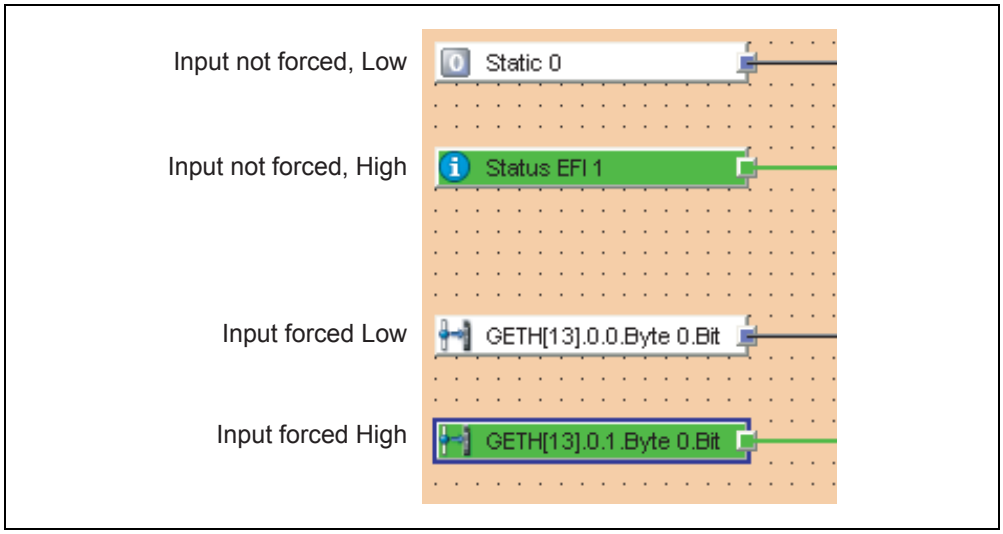
Note While force mode is active, it is not possible to logout, to upload and compare a configuration or to stop the safety controller.

How to force an input:

- Click on an input with the left mouse button. A context menu with the following options will appear:
  - **Force low**: The MELSEC-WS safety controller will evaluate the input independently of its actual physical state as **Low**.
  - **Force high**: The safety controller will evaluate the input independently of its actual physical state as **High**.
  - **Remove force**: The safety controller will evaluate the input with its actual physical state.

A forced input is marked with a blue frame. An active input (**High**) is displayed green, an inactive input (**Low**) is displayed white.

Figure 147:
Forced and not forced inputs



Note

- The actual state of a forced input is not displayed in the logic editor but only in the **Hardware conficuration** view.
- Force mode always applies to the complete project. This means for logic programs using more than one page in the logic editor, that a forced input will be set to the same value on each page of the logic editor where it is used, not only on the currently displayed page.
- If forcing an input in a logic program causes more than 16 outputs to switch at the same time, then some of these outputs will be switched with a delay of one or more execution times due to the limited transmission capacity of the RS-232 interface. The execution time depends on the size of your logic program. It is calculated automatically in the logic editor and is displayed in the top right corner of the **FB preview** window.
- Unlike the simulation mode, the force mode allows you to use the **EDM** or **Valve monitoring**, if corresponding devices are connected that will send the required feedback signal when the outputs are activated.

- When using an Ethernet interface module, please note that the process image of the Ethernet interface module always reflects the actual physical state of the inputs and outputs of the connected devices and not the (virtual) forced state of an input in the logic program. If by forcing of an input in the logic program (e.g. from **High** to **Low**) the state of an output is changed (e.g. from **High** to **Low)**, the actually changed state of the output (in the example **Low**) will be transferred to the programmable controller in the process image, but not the forced **Low** state of the input in the logic program but still the actual physical state of the input on the device (in the example **High**). Take this into account when you evaluate the transferred data in the programmable controller.

Leaving force mode

The force mode can be left in the following ways:

- Manually through the user
- Automatically after the defined time delay
- Automatically after 30 seconds if the MELSEC-WS safety controller detects an error (e.g. if the connection to the PC is interrupted)

When the force mode is left, the safety controller switches all outputs to **Low** and the active application is stopped.

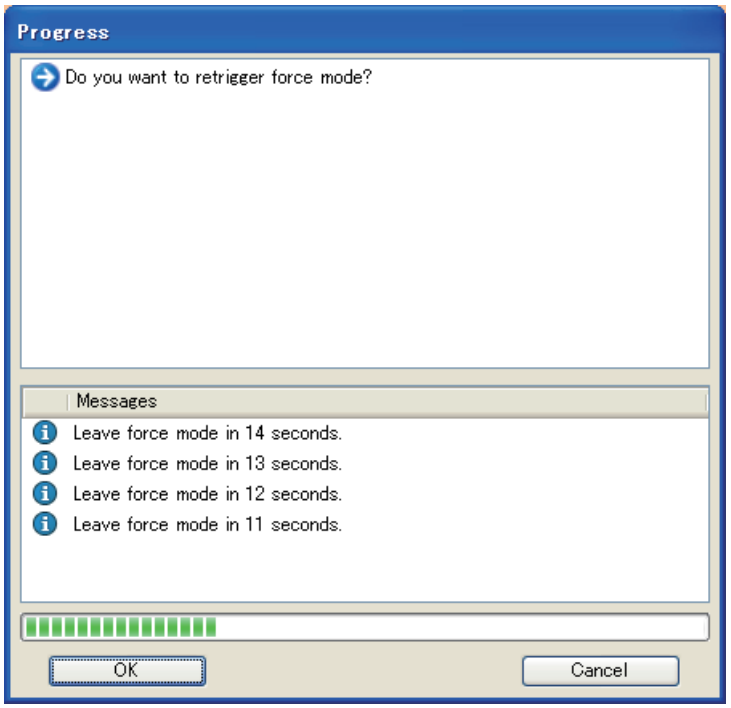
ATTENTION

Ensure that no dangerous situation can occur when leaving force mode!

- Ensure that your machine or system is transferred to a safe state when leaving force mode and can not be damaged.
- While force mode has been active, the actual state of an input may have changed (e.g. button pressed, safety door opened etc.). Ensure that this can not cause any dangerous situation before restarting your machine or system.

- Click on the **Stop force mode** button. A safety message will appear. Click on **Yes** to confirm and leave the force mode or click on **No** to keep the force mode active.
- After the time defined on starting the force mode has expired, force mode will be automatically left if no force action (e.g. forcing of an input) has taken place. In force mode, a timer in the top right corner shows the time remaining until force mode is automatically left. Each action resets this timer. You can also reset the timer using the **Trigger force mode** button on its left. A dialog is displayed that reminds you of the imminent leaving of the force mode 15 seconds before the timer will expire.

Figure 148:
Dialog before automatically leaving the force mode



- If you ignore this dialog, the force mode will be left after the defined time delay has expired.

  Or:

- Click on **Cancel**. The dialog will close and the force mode will be left after the defined time delay has expired.

  Or:

- Click **OK** in order to close the dialog, reset the timer and keep the force mode active.

7. Transferring the system configuration

Initially, the configuration of the MELSEC-WS safety controller only exists as a project, meaning as a MELSEC-WS configuration file. The configuration has to be transferred via the memory plug to the CPU module.

Note The memory plug and the CPU module communicate via an internal interface. Direct connection of a PC to the memory plug is not possible. Data can only be loaded to the memory plug or read from it via a compatible CPU module.

The configuration data are checked for compatibility during transfer to the CPU module and can subsequently be verified (through reading and comparing) and optionally have a write protection assigned to it.

With the memory plug the project data can be transferred without further processing using the Setting and Monitoring Tool to any number of MELSEC-WS safety controllers. The configuration data are copied exactly in the process, including the verification and any write-protection information that were set during the configuration of the first safety controller with these data.

Note Before using standby, hibernation, or sleep mode of PC, disconnect the PC from the MELSEC-WS safety controller.

Note Before removing the RS-232 USB converter (WS0-UC-232A), disconnect the PC from the MELSEC-WS safety controller.

7.1 Transferring project data to the safety controller

After the transfer, the configuration data are read back from the memory plug if the verification has been activated in the Setting and Monitoring Tool (see Section 7.3).

Note The reading back of the configuration data from the memory plug requires some time. The memory plug may not be removed during this time. The Setting and Monitoring Tool displays a corresponding warning as long as the process takes.

7.2 Compatibility check

The configuration data contain an electronic type code and a version code for each module that is to be configured. During the transfer each module checks whether it is compatible with the configuration data. The compatibility check only applies to the functional part of the respective module, not to the hardware variant, the implementation of the terminals, for example, remains unconsidered.

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

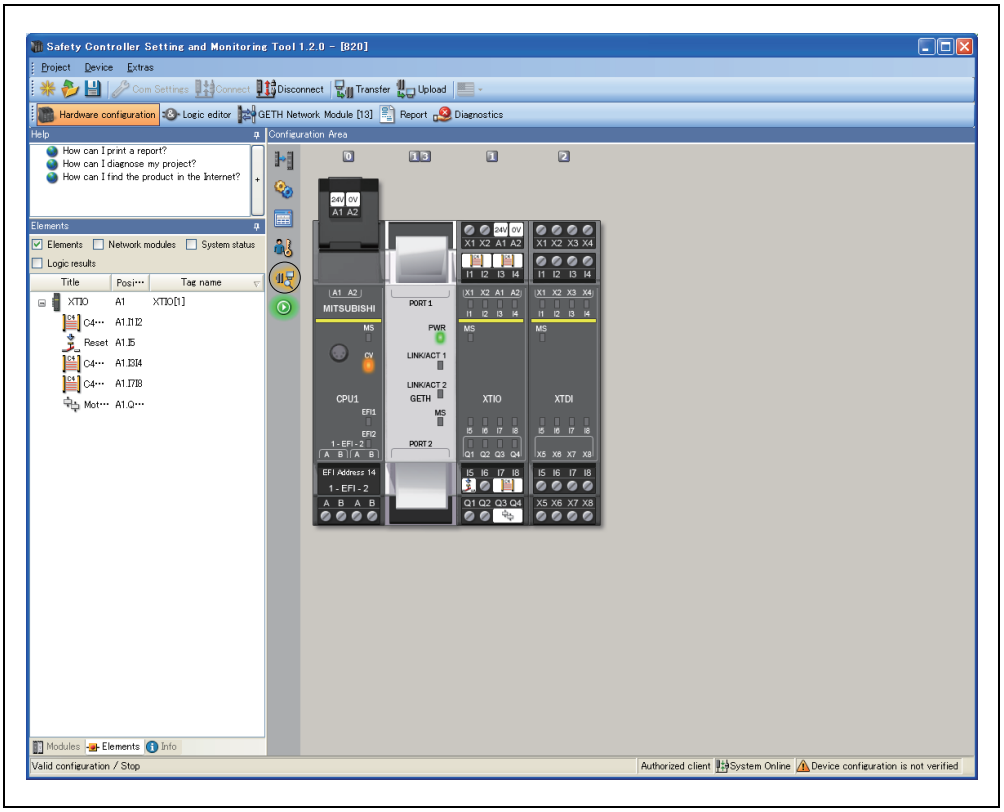
Note In Setting and Monitoring Tool, different version numbers are assigned to some modules so that a compatible module can be selected from a list below the module.

7.3 Verification of the configuration

After the configuration has been downloaded to the MELSEC-WS safety controller, the safety controller can be verified. To this purpose, the downloaded configuration data are read back out from the safety controller and compared with the project data. If they match, the data are displayed in a report. If the user confirms that they are correct, the safety controller is considered to be verified.

- Click the icon Receive and compare the configuration.

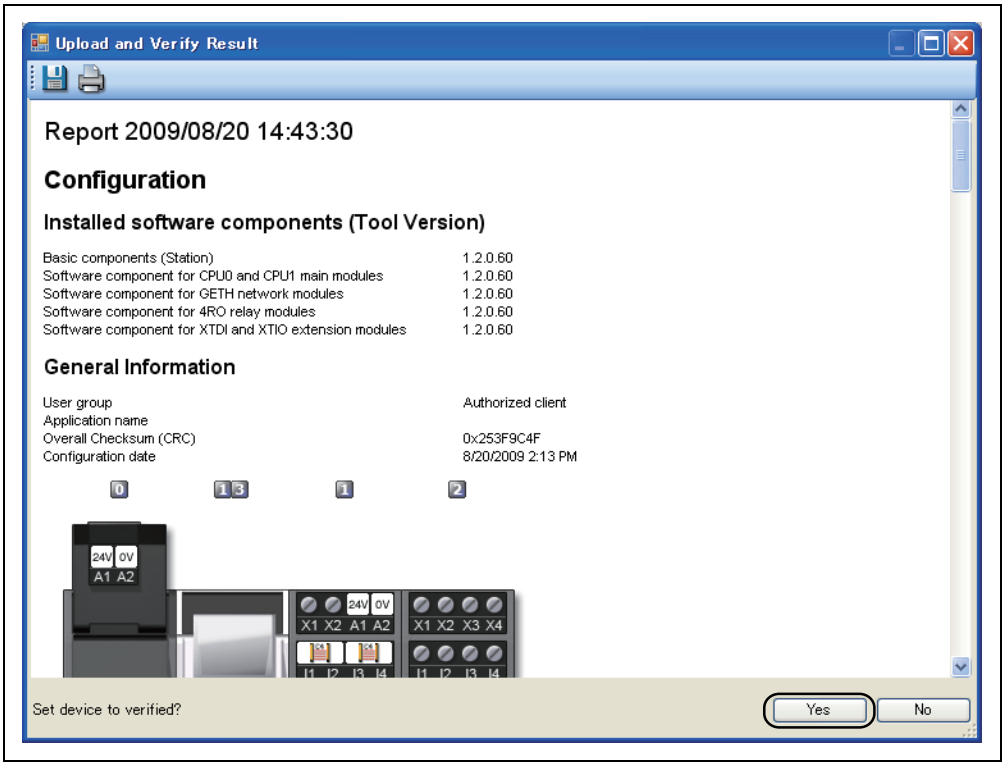
Figure 149: Icon Receive and compare



- The Read and compare window is opened. Click **Yes** below at the question **Set device to verified?** if the displayed configuration is the expected configuration. The safety controller is then considered to be verified.

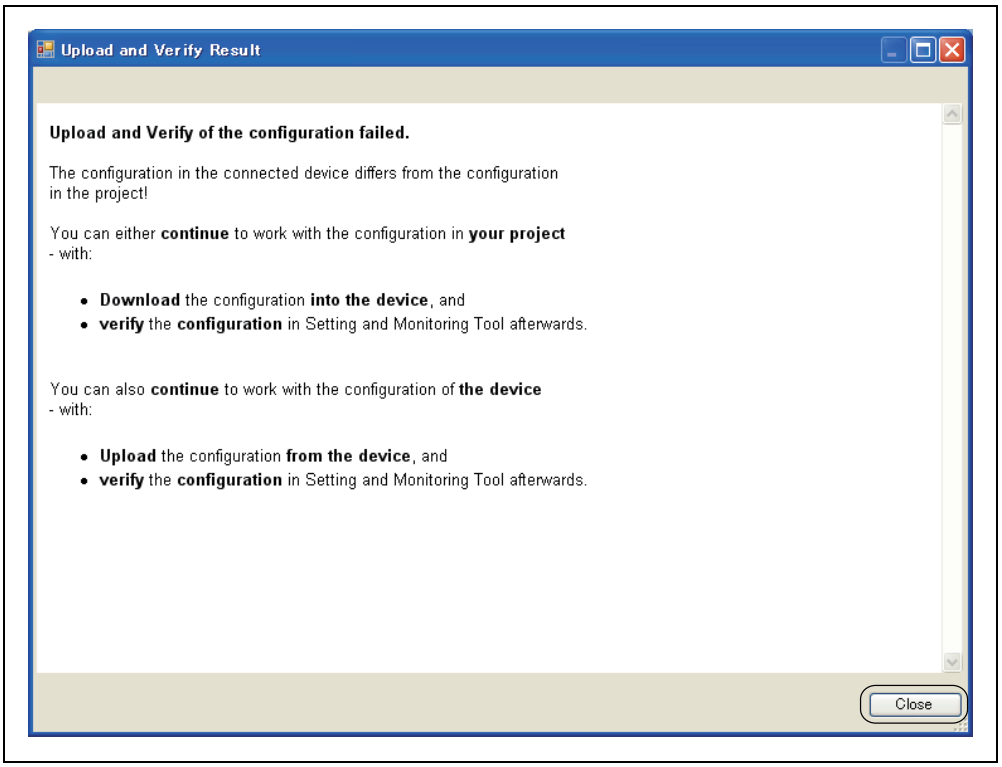
Note The configuration of the connected elements, for example EFI sensors, is not included in the process. Their verification is carried out in the same way as the configuration and verification via the serial interfaces of the devices.

Figure 150:
Marking a device as verified



- If differences between the project data and the read-back configuration data are detected, a corresponding message including information about possible actions is displayed. Verification of the configuration is not possible then. Observe the information in the error message for the further procedure. Terminate the dialog box by clicking **Close**.

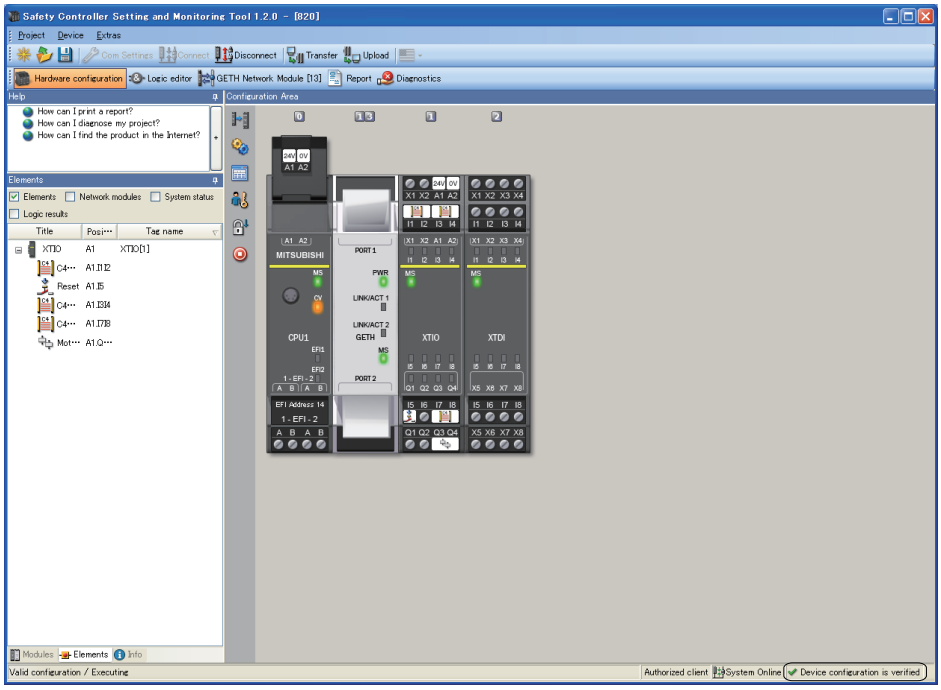
Figure 151:
Verification failed



- If the verification is completed successfully, a “Read in and compare” report that provides the most important project information is created subsequently. You can print out or store this report.

The query whether the device is to be marked as verified is displayed in the lower part of the report window. Only if the device and the corresponding configuration have been marked as verified, the “Auto RUN mode” in the configuration of the CPU module is active. Logging in as an Authorized client is required in order to mark the device as “verified”. The status verified/not verified is indicated in the lower right-hand corner of the Setting and Monitoring Tool and by the CV LED of the CPU module turning on.

Figure 152:
Verification successful



The verification flag is included in copying when the data are read back into the memory plug and are also transferred automatically to each safety controller to which the configuration data are duplicated.

The safety controller is also ready to use when the configuration is only validated and not verified or does not have a write protection. The “Auto RUN mode” function sof the CPU module, i.e., the automatic program start after the voltage supply has been switched on, is not possible then.

Note The dialog box for verification is only displayed after a request by the user in order to ensure that the verification process does not have to be passed through every time the configuration is changed or new project data uploaded.

In order to validate the MELSEC-WS safety controller, the safety functions at the machine or system have to be checked completely and have to function perfectly. With regard to its content, the validation is identical to the technical test taking place when the safety controller is commissioned.

7.4 Activating the write protection of the configuration in the safety controller

A verified configuration can be protected against accidental changes by activating the write protection. The write protection can be set and deactivated in the Setting and Monitoring Tool by using the lock symbol in the hardware configuration to the left of the CPU module.

The write protection is included in copying when the data are transferred to the memory plug and are also transferred automatically to each safety controller to which the configuration data are duplicated.

8. Device states of the MELSEC-WS safety controller

The MELSEC-WS safety controller knows different device states during operation. Some device states require a user intervention, e.g. the change in the state from **Stop** to **Run** using the Setting and Monitoring Tool. Other states are based on the internal self-test of the safety controller, e.g. **Internal error**. The following table summarises the device states of the safety controller.

Table 90:
Device status and LED displays on the CPU module

MS LED	Meaning
○	Supply voltage lies outside range.
● Red/green (1 Hz)	A self test is being carried out or the system is being initialized.
☀ Green (1 Hz)	System is ready for operation.
● Green	Application is being carried out.
☀ Red (1 Hz)	Correctable error either in the CPU module or one of the safety I/O modules
☀ Red (2 Hz)	Module has caused internal system error.
● Red	Critical error in the system

CV LED	Meaning
○	Configuration required
☀ Yellow (2 Hz)	Storing of configuration data in the non-volatile memory Supply voltage may not be interrupted until the storage process has been completed.
☀ Yellow (1 Hz)	Valid but unverified configuration
● Yellow	Valid and verified configuration

Symbol description:

○: LED off, ●: LED lights up, ☀: LED flashes

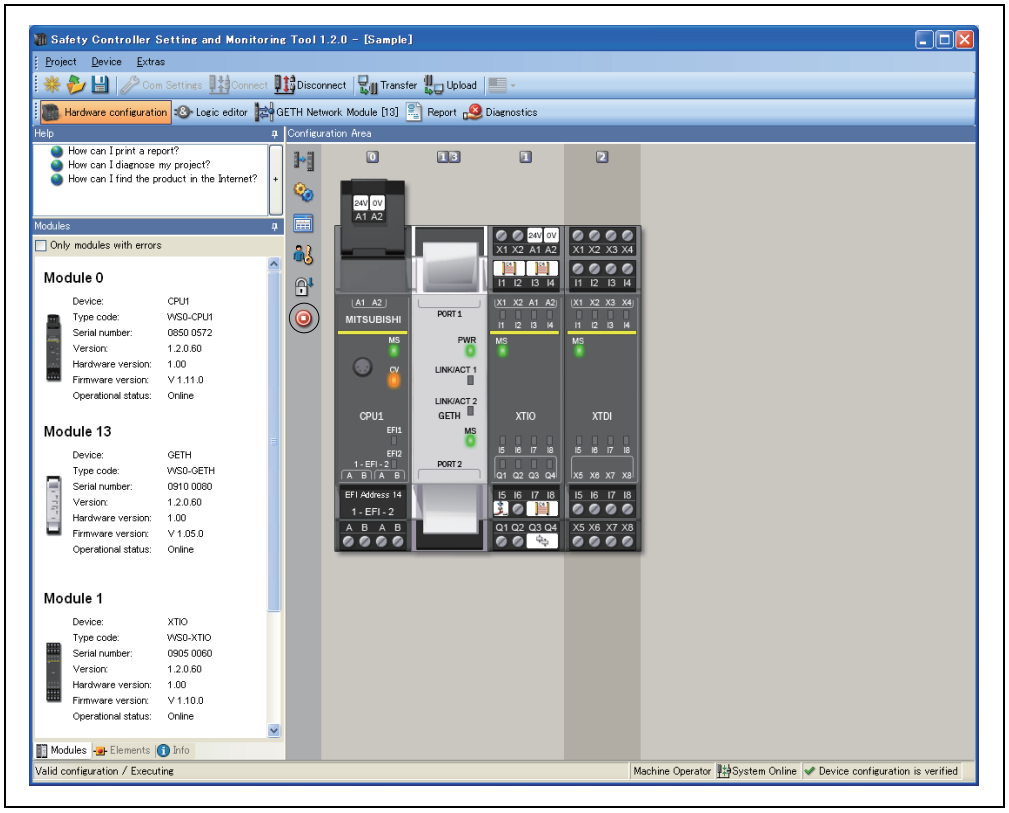
8.1.1 Change in the device state

Specific state changes in the MELSEC-WS safety controller are carried out manually in the Setting and Monitoring Tool. These changes in the device state are:

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

In order to change the device state, use the **Stop** and **Run** icon next to the representation of the modules in the hardware configuration.

Figure 153: Stop-Run icon



8.1.2 Auto RUN mode and normal state

The MELSEC-WS safety controller can adopt the Run state directly after the supply voltage has been switched on if the required conditions are fulfilled. This automatic transition is called the Auto RUN mode. The following conditions have to be fulfilled for the Auto RUN mode:

- A user configuration with regard to the software and hardware configuration has been created and downloaded successfully to a corresponding hardware.
- The configuration has been uploaded back to the device and verified using “Read in and compare”.
- The Auto RUN mode in the configuration is activated (activated in the basic setting). The Auto RUN mode is switched on or off in the hardware configuration by double-clicking the CPU module in the Settings tab.

In an unverified state, the MELSEC-WS safety controller waits for a command from the Setting and Monitoring Tool for the transition from the Stop to the Run state. The Start Up Test state has to have been completed successfully for this command.

Note When the Auto RUN mode is deactivated, the MELSEC-WS safety controller does not change automatically to the Run state after the Start Up Test state after an interruption of the voltage supply in the Stop state has occurred. Then, you have to change to the Run mode manually in order to start the system.

9. Report and diagnostics

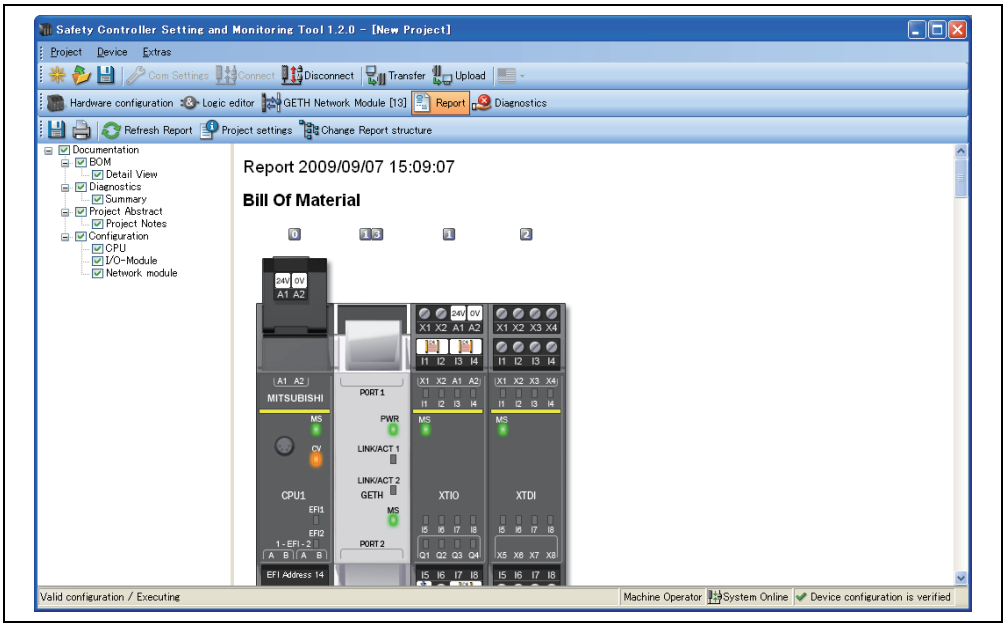
9.1 Creating a report

In the **Report** standard view, a comprehensive report on the current project and all configuration settings including the logic program and the wiring is available. You can individually configure the contents of the report. Additionally, you can enter notes on your project.

How to create a report:

- Click on the **Report** button to open the **Report** standard view.

Figure 154:
Report standard view



- Select in the left part of the window, which information shall be included in the report by activating or deactivating the checkboxes for the individual report modules.
- Using the **Change report structure** you can choose between a topic related report and a report on the connected hardware.
- Now click on the **Refresh Report** button. The report will be created and displayed on the right of the window.
- In order to edit notes on your project, click on the **Project settings** button. A dialog is opened where you can enter a project name and a customer name if required and add or delete notes.

How to save or print a report:

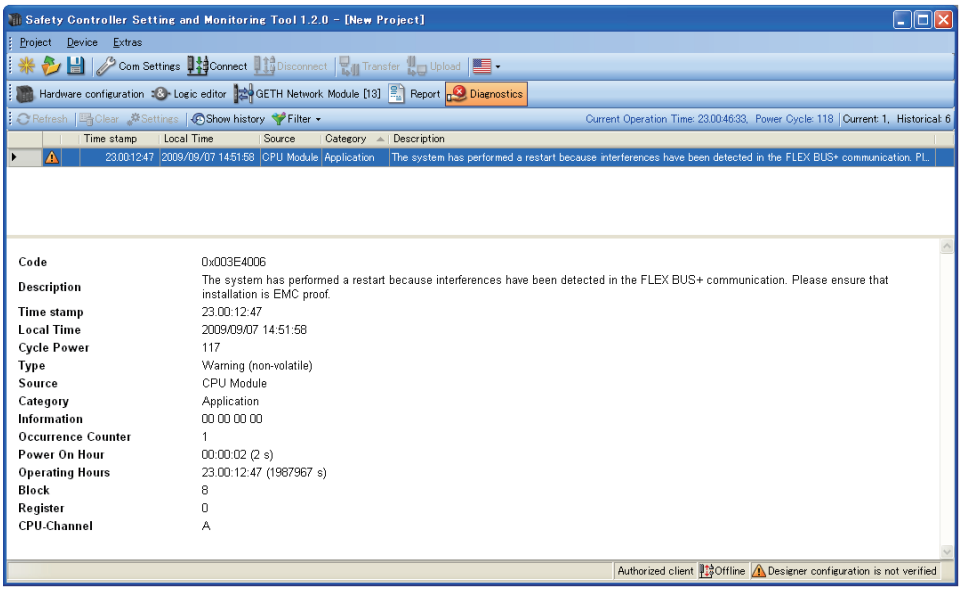
The report can be printed or saved as PDF.

- To save the report as PDF, click on the **Save** button.
- To print the report, click on the **Print** button. A PDF preview of the report will be created that you can subsequently print.

9.2 Diagnostics

Once you have completed your project and are connected to your MELSEC-WS safety controller, you can perform a diagnostics on your system. In the diagnostics view, a complete list of all messages, informations, warnings and error messages of your system is available in the upper part of the window. If you click on one of the entries in the list, details on the selected message are displayed in the lower part of the window.

Figure 155: Diagnostics standard view



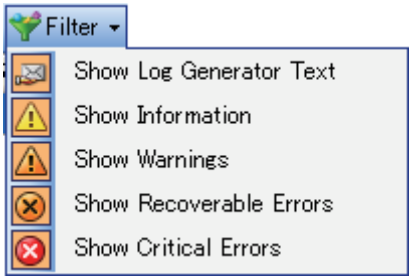
How to perform diagnostics:

- Click on the **Diagnostics** buton in the menu bar to open the **Diagnostics** standard view. In the toolbar, the following commands are available:

Figure 156: Toolbar in the diagnostics standard view

- Click on **Refresh** to read the current message list from the system.
- Using the **Clear** button you can delete all messages stored in the system. You must be logged in as Authorized client.
- Under **Settings** you can configure an automatic refresh of the diagnostics and the time interval. In the **Diagnostic Settings** dialog, activate the **Automatic Refresh** checkbox and enter the desired refresh interval in seconds.
- Using the **Show history** button, you can display or hide older messages still stored in the MELSEC-WS safety controller.
- The **Filter** pull-down menu enables you to display or hide different types of messages at will. In the menu, click on the different message types to activate or deactivate them.

Figure 157: Filtering the diagnostics messages



Note To save or print the diagnostic messages you can use the Report function (see Section 9.1).

10. Technical commissioning

The configuration of the MELSEC-WS safety controller has to be completed before you begin with the technical commissioning.

10.1 Wiring and voltage supply

ATTENTION

When connecting the MELSEC-WS safety controller, observe the technical data in the Safety Controller User's Manual.

- Connect the individual field devices to the corresponding signal connections and check for each safety input, test/signal output and safety output whether these behave as required for the application. Diagnostics information from the MELSEC-WS module's LEDs support you in validating the individual field signals. Check whether the external circuit, the realisation of the wiring, the choice of the pick-ups and their location at the machine fulfil the required safety level.
- Eliminate any faults (e.g. incorrect wiring or crossed signals) at each safety input, test/signal output or safety output before you continue with the next step.
- Switch on the voltage supply. As soon as the supply voltage is applied to the connections A1 and A2 of the WS0-CPU0/WS0-CPU1 module or the WS0-XTIO modules, the MELSEC-WS safety controller automatically carries out the following steps:
  - internal self-test
  - loading of the saved configuration
  - testing of the loaded configuration for validity

The system does not start up if the steps described above could not be carried out successfully. If there is an error, this is indicated correspondingly by an LED (see the Safety Controller User's Manual) and the safety controller only transfers **Inactive** (failsafe) values.

10.2 Transferring the configuration

After you have configured the hardware and the logic in the MELSEC-WS safety controller and have checked whether they are correct, transfer the configuration to the safety controller via the Setting and Monitoring Tool.

10.3 Technical test and commissioning

The machine or system that is protected by a MELSEC-WS safety controller may only be started up after a successful technical check of all the safety functions. The technical test may only be performed by qualified safety personnel.

The technical test includes the following test items:

- Clearly mark all the connection cables and plugs at the safety controller in order to avoid confusion. Since the MELSEC-WS safety controller has several connections of the same design, ensure that loosened connection cables are not connected back to the wrong connection.
- Verify the configuration of the MELSEC-WS safety controller.
- Check the signal paths and the correct inclusion in higher-level controllers.
- Check the correct data transfer from and to the MELSEC-WS safety controller.
- Check the logic program of the safety controller.
- Completely document the configuration of the system, the individual devices and the result of the safety check.
- Check the safety functions of the machine or system completely and ensure that the safety functions function perfectly.
- In order to prevent unintentional overwriting of the configuration, activate the write protection of the configuration parameters of the MELSEC-WS safety controller. Modifications are only possible if the write protection has been deactivated.

11. Troubleshooting and error elimination

Table 91: Errors and error elimination

Error / Error message	Cause	Remedy
When Setting and Monitoring Tool is started, the following or a similar error message is displayed: “DLL not found - the Dynamic Link Library “mscoree.dll” was not found in the specified path. Specify the registration key HKLM\Software\Microsoft\ NET Framework\InstallRoot so that it refers to the installation location of the .NET Framework.”	Microsoft .NET Framework is not installed on the PC.	Install a suitable version of Microsoft.NET Framework. Ask your system administrator if appropriate. NET Framework is available for downloading on the internet pages of Microsoft. **Note:** Install .NET Framework 2.0 or later for Windows XP and Windows Vista.

12. Annex

12.1 List of function block status in simulation mode

Table 92 lists the function block status displayed in the **FB Preview** window.

Table 92: List of function block status in simulation mode

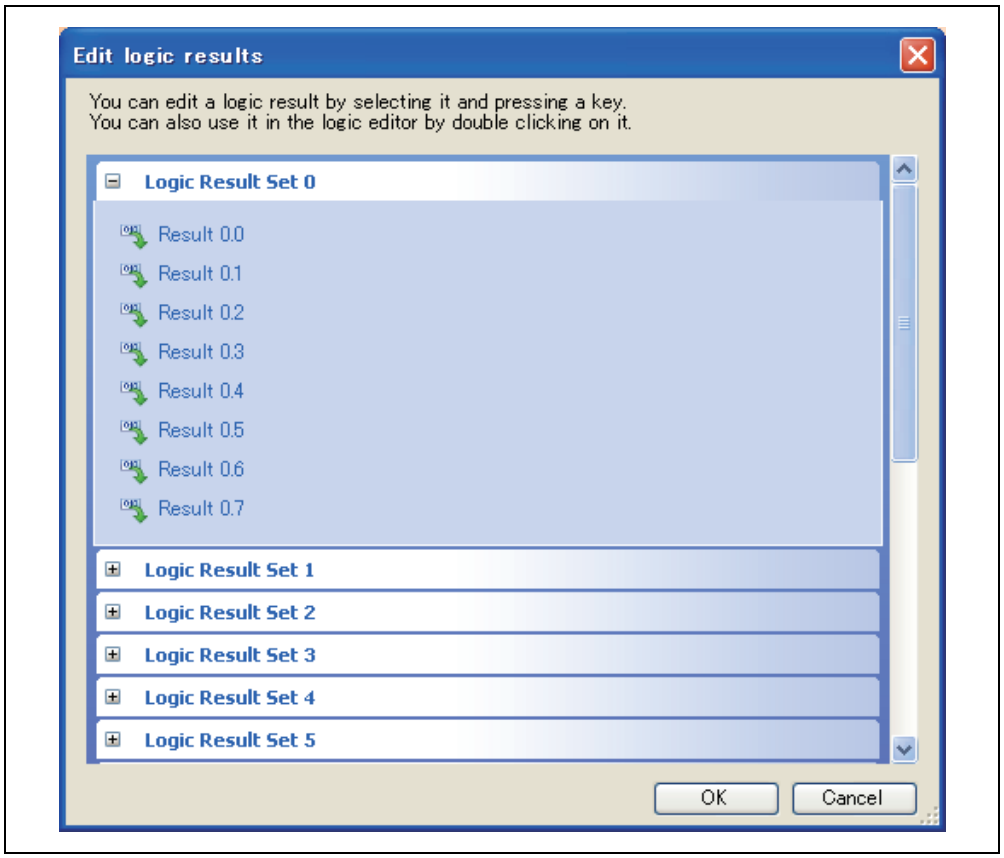
Function block status
Bottom dead center (BDC) left first time
Bottom dead center (BDC) reached first time
Bottom dead center (BDC) left second time
Bottom dead center (BDC) reached second time
Active
Discrepancy error
Edge detected
Error
Wait for function test
Inactive
Monitoring disabled
Muting active
No edge detected
Off delay
On delay
OK
Upper counter limit reached
Overrun Cam left
Overrun Cam reached
Override Required
Wait for reset/restart pulse
Output Enable is active
Wait for all monitored inputs becoming active
Drive is enabled
Run-up Cam reached
Drive stopped
Top dead center (TDC) left
Top dead center (TDC) reached
User mode is changing
User mode is valid
Lower counter limit reached
Valve 1 is active
Valve 2 is active
Wait for feedback
Drive is coasting

12.2 Precautions

(1) Edit a CSV file exported from Setting and Monitoring tool in a text editor.

(2) To edit a logic result in the **Edit logic results** dialog, select a logic result you want to edit and press the F2 key.

Figure 158:
Edit logic results dialog



12.3 SICK contact

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MEMO

WARRANTY

1. Limited Warranty and Product Support.

a. Mitsubishi Electric Company ("MELCO") warrants that for a period of eighteen (18) months after date of delivery from the point of manufacture or one year from date of Customer's purchase, whichever is less, Mitsubishi Safety Controller (the "Products") will be free from defects in material and workmanship.

b. At MELCO's option, for those Products MELCO determines are not as warranted, MELCO shall either repair or replace them or issue a credit or return the purchase price paid for them.

c. For this warranty to apply:

(1) Customer shall give MELCO (i) notice of a warranty claim to MELCO and the authorized dealer or distributor from whom the Products were purchased, (ii) the notice shall describe in reasonable details the warranty problem, (iii) the notice shall be provided promptly and in no event later than thirty (30) days after the Customer knows or has reason to believe that Products are not as warranted, and (iv) in any event, the notice must given within the warranty period;

(2) Customer shall cooperate with MELCO and MELCO's representatives in MELCO's investigation of the warranty claim, including preserving evidence of the claim and its causes, meaningfully responding to MELCO's questions and investigation of the problem, grant MELCO access to witnesses, personnel, documents, physical evidence and records concerning the warranty problem, and allow MELCO to examine and test the Products in question offsite or at the premises where they are installed or used; and

(3) If MELCO requests, Customer shall remove Products it claims are defective and ship them to MELCO or MELCO's authorized representative for examination and, if found defective, for repair or replacement. The costs of removal, shipment to and from MELCO's designated examination point, and reinstallation of repaired or replaced Products shall be at Customer's expense.

(4) If Customer requests and MELCO agrees to effect repairs onsite at any domestic or overseas location, the Customer will pay for the costs of sending repair personnel and shipping parts. MELCO is not responsible for any re-commissioning, maintenance, or testing on-site that involves repairs or replacing of the Products.

d. Repairs of Products located outside of Japan are accepted by MELCO's local authorized service facility centers ("FA Centers"). Terms and conditions on which each FA Center offers repair services for Products that are out of warranty or not covered by MELCO's limited warranty may vary.

e. Subject to availability of spare parts, MELCO will offer Product repair services for (4) years after each Product model or line is discontinued, at MELCO's or its FA Centers' rates and charges and standard terms in effect at the time of repair. MELCO usually produces and retains sufficient spare parts for repairs of its Products for a period of four (4) years after production is discontinued.

f. MELCO generally announces discontinuation of Products through MELCO's Technical Bulletins. Products discontinued and repair parts for them may not be available after their production is discontinued.

2. Limits of Warranties.

a. MELCO does not warrant or guarantee the design, specify, manufacture, construction or installation of the materials, construction criteria, functionality, use, properties or other characteristics of the equipment, systems, or production lines into which the Products may be incorporated, including any safety, fail-safe and shut down systems using the Products.

b. MELCO is not responsible for determining the suitability of the Products for their intended purpose and use, including determining if the Products provide appropriate safety margins and redundancies for the applications, equipment or systems into which they are incorporated.

c. Customer acknowledges that qualified and experienced personnel are required to determine the suitability, application, design, construction and proper installation and integration of the Products. MELCO does not supply such personnel.

d. MELCO is not responsible for designing and conducting tests to determine that the Product functions appropriately and meets application standards and requirements as installed or incorporated into the end-user's equipment, production lines or systems.

e. MELCO does not warrant any Product:

(1) repaired or altered by persons other than MELCO or its authorized engineers or FA Centers;

(2) subjected to negligence, carelessness, accident, misuse, or damage;

(3) improperly stored, handled, installed or maintained;

(4) integrated or used in connection with improperly designed, incompatible or defective hardware or software;

(5) that fails because consumable parts such as relay, batteries, backlights, or fuses were not tested, serviced or replaced;

(6) operated or used with equipment, production lines or systems that do not meet applicable and commensurate legal, safety and industry-accepted standards;

(7) operated or used in abnormal applications;

(8) installed, operated or used in contravention of instructions, precautions or warnings contained in MELCO's user, instruction and/or safety manuals, technical bulletins and guidelines for the Products;

(9) used with obsolete technologies or technologies not fully tested and widely accepted and in use at the time of the Product's manufacture;

(10) subjected to excessive heat or moisture, abnormal voltages, shock, excessive vibration, physical damage or other improper environment; or

(11) damaged or malfunctioning due to Acts of God, fires, acts of vandals, criminals or terrorists, communication or power failures, or any other cause or failure that results from circumstances beyond MELCO's control.

f. All Product information and specifications contained on MELCO's website and in catalogs, manuals, or technical information materials provided by MELCO are subject to change without prior notice.

g. The Product information and statements contained on MELCO's website and in catalogs, manuals, technical bulletins or other materials provided by MELCO are provided as a guide for Customer's use. They do not constitute warranties and are not incorporated in the contract of sale for the Products.

h. These terms and conditions constitute the entire agreement between Customer and MELCO with respect to warranties, remedies and damages and supersede any other understandings, whether written or oral, between the parties. Customer expressly acknowledges that any representations or statements made by MELCO or others concerning the Products outside these terms are not part of the basis of the bargain between the parties and are not factored into the pricing of the Products.

i. THE WARRANTIES AND REMEDIES SET FORTH IN THESE TERMS ARE THE EXCLUSIVE AND ONLY WARRANTIES AND REMEDIES THAT APPLY TO THE PRODUCTS.

j. MELCO DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

3. Limits on Damages.

a. MELCO'S MAXIMUM CUMULATIVE LIABILITY BASED ON ANY CLAIMS FOR BREACH OF WARRANTY OR CONTRACT, NEGLIGENCE, STRICT TORT LIABILITY OR OTHER THEORIES OF RECOVERY REGARDING THE SALE, REPAIR, REPLACEMENT, DELIVERY, PERFORMANCE, CONDITION, SUITABILITY, COMPLIANCE, OR OTHER ASPECTS OF THE PRODUCTS OR THEIR SALE, INSTALLATION OR USE SHALL BE LIMITED TO THE PRICE PAID FOR PRODUCTS NOT AS WARRANTED.

b. Although MELCO has obtained the certification for Product's compliance to the international safety standards IEC61508 and EN954-1/ISO13849-1 from TUV Rheinland, this fact does not guarantee that Product will be free from any malfunction or failure. The user of this Product shall comply with any and all applicable safety standard, regulation or law and take appropriate safety measures for the system in which the Product is installed or used and shall take the second or third safety measures other than the Product. MELCO is not liable for damages that could have been prevented by compliance with any applicable safety standard, regulation or law.

c. MELCO prohibits the use of Products with or in any application involving power plants, trains, railway systems, airplanes, airline operations, other transportation systems, amusement equipments, hospitals, medical care, dialysis and life support facilities or equipment, incineration and fuel devices, handling of nuclear or hazardous materials or chemicals, mining and drilling, and other applications where the level of risk to human life, health or property are elevated.

d. MELCO SHALL NOT BE LIABLE FOR SPECIAL, INCIDENTAL, CONSEQUENTIAL, INDIRECT OR PUNITIVE DAMAGES, FOR LOSS OF PROFITS, SALES, OR REVENUE, FOR INCREASED LABOR OR OVERHEAD COSTS, FOR DOWNTIME OR LOSS OF PRODUCTION, FOR COST OVERRUNS, OR FOR ENVIRONMENTAL OR POLLUTION DAMAGES OR CLEAN-UP COSTS, WHETHER THE LOSS IS BASED ON CLAIMS FOR BREACH OF CONTRACT OR WARRANTY, VIOLATION OF STATUTE, NEGLIGENCE OR OTHER TORT, STRICT LIABILITY OR OTHERWISE.

e. In the event that any damages which are asserted against MELCO arising out of or relating to the Products or defects in them, consist of personal injury, wrongful death and/or physical property damages as well as damages of a pecuniary nature, the disclaimers and limitations contained in these terms shall apply to all three types of damages to the fullest extent permitted by law. If, however, the personal injury, wrongful death and/or physical property damages cannot be disclaimed or limited by law or public policy to the extent provided by these terms, then in any such event the disclaimer of and limitations on pecuniary or economic consequential and incidental damages shall nevertheless be enforceable to the fullest extent allowed by law.

f. In no event shall any cause of action arising out of breach of warranty or otherwise concerning the Products be brought by Customer more than one year after the cause of action accrues.

g. Each of the limitations on remedies and damages set forth in these terms is separate and independently enforceable, notwithstanding the unenforceability or failure of essential purpose of any warranty, undertaking, damage limitation, other provision of these terms or other terms comprising the contract of sale between Customer and MELCO.

4. Delivery/Force Majeure.

a. Any delivery date for the Products acknowledged by MELCO is an estimated and not a promised date. MELCO will make all reasonable efforts to meet the delivery schedule set forth in Customer's order or the purchase contract but shall not be liable for failure to do so.

b. Products stored at the request of Customer or because Customer refuses or delays shipment shall be at the risk and expense of Customer.

c. MELCO shall not be liable for any damage to or loss of the Products or any delay in or failure to deliver, service, repair or replace the Products arising from shortage of raw materials, failure of suppliers to make timely delivery, labor difficulties of any kind, earthquake, fire, windstorm, flood, theft, criminal or terrorist acts, war, embargoes, governmental acts or rulings, loss or damage or delays in carriage, acts of God, vandals or any other circumstances reasonably beyond MELCO's control.

5. Choice of Law/Jurisdiction.

These terms and any agreement or contract between Customer and MELCO shall be governed by the laws of the State of New York without regard to conflicts of laws. To the extent any action or dispute is not arbitrated, the parties consent to the exclusive jurisdiction and venue of the federal and state courts located in the Southern District of the State of New York. Any judgment there obtained may be enforced in any court of competent jurisdiction.

6. Arbitration.

Any controversy or claim arising out of, or relating to or in connection with the Products, their sale or use or these terms, shall be settled by arbitration conducted in accordance with the Center for Public Resources (CPR) Rules for Non-Administered Arbitration of International Disputes, by a sole arbitrator chosen from the CPR's panels of distinguished neutrals. Judgment upon the award rendered by the Arbitrator shall be final and binding and may be entered by any court having jurisdiction thereof. The place of the arbitration shall be New York City, New York. The language of the arbitration shall be English. The neutral organization designated to perform the functions specified in Rule 6 and Rules 7.7(b), 7.8 and 7.9 shall be the CPR.

SH(NA)-080856ENG-B

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