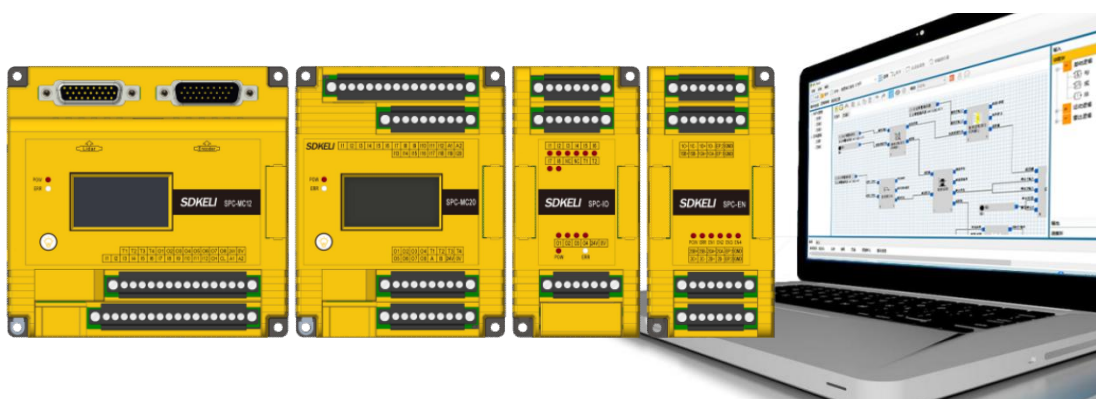




Safety Programmable Controller Configuration Software SPCTool

User Manual

(26002)



JiningKeli Photoelectronic Industrial Co., Ltd

Catalogue

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Introduction

Programmable Security Controller, abbreviated as SPC.

SPCTool User Manual for Configuring Software, guiding machine manufacturers or machine operators' technicians in using the SPCTool software to configure, operate, and diagnose the SPC system.

This manual primarily introduces the installation and uninstallation of the SPCTool software, its features, related application examples, common issues, and solutions.

Users must carefully read this manual before configuring the SPC and use the SPCTool software correctly.

The SPCTool software is not applicable to other types of products from our company or similar functional products manufactured by other companies.

Jining KeLi Photoelectronic Industrial Co., Ltd.. assumes no responsibility for any injuries and losses caused by the incorrect use of the SPCTool software.

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1 Version and Compatibility

Different firmware versions or SPCTool configuration software versions provide different features for SPC products. This section mainly introduces which firmware version and/or which version of the SPCTool configuration software is required to implement specific functions/applications.

Table 1-1 Compatible versions

Sn	Functions/Applications	Minimum firmware version	Minimum SPCTool version
1	Hardware configuration, basic logic operation blocks, and specific function blocks	V1.0. 0.0	V1.0. 0
2			
3			

2 Installation

2.1 System Requirements

The following system requirements must be met to use the SPCTool software, as shown in Table 2-1.

Table 2-1 Minimum system requirements

Project	Description	
Computer	CPU	Dual core or higher processor
	Memory	512M or larger
	Free hard disk space	400M or larger
	Mouse, keyboard	Equipped
	Multimedia driver	CD-ROM
Compatible Systems	Microsoft Windows 10 32/64 bit	
	Microsoft Windows 11 32/64 bit	
Display	16-bit color and above, resolution 800 * 600 and above	

The correct installation and use of the SPCTool software cannot be guaranteed in the following system environments:

- Operating systems other than those listed in Table 2-1.
- Multi-monitoring environment.
- Multi-OS environment.
- Personal assembly computer.



Attention

1. If the .NET Framework is not installed on the computer, it will be automatically installed when you install the SPCTool software.
2. Even if all system requirements are met, it cannot be guaranteed that the SPCTool software can be installed and used on all computers.

2.2 Software Installation and Uninstallation

2.2.1 Install

a) Start Windows and find the folder [SPC Configuration Software Installer], and double-click setup.exe under this folder.

b) Follow the prompts to complete SPC Configure the installation of the software.



Attention

- If you encounter anti-virus software blocking during installation, please select Allow installation.
- If the installation is unsuccessful, it is recommended to temporarily close the antivirus software and then reinstall it.

- SPC The default installation location for the configuration software is:"C:\ Program Files (x86)\ SDKELI\ SPC\". If you want to be safe Install to a different folder, please select the location to install at the time of installation.

2.2.2 Uninstall

Method 1: Uninstall from the Start menu.

- Click on the Windows [Start] menu button and select [All Programs].
- In **SPC** Select in the folder[Uninstall SPC Configuration Software] 。
- When the "Are you sure you want to uninstall this product?" Dialog box appears, click "Yes" to uninstall from your computer SPC Configure the software.

Method 2: Uninstall from Control Panel.

- Click on the Windows [Start] menu button and then click on [Control Panel].
- Click [Uninstall program].
- Right-click“SPCTool Setup”, and click [Uninstall] to uninstall from the computer SPC Configure the software.

2.3 Launching and Exiting SPCTool Software

2.3.1 Launch

The SPCTool software can be launched through the following methods::

- (1) Connect one end of the Ethernet cable to the SPC programmable safety controller and the other end to the computer's Ethernet port.
- (2) On the computer's taskbar, click on Start → All Programs → SPC → SPCTool.
- (3) Alternatively, double-click the shortcut  of the SPCTool software on the desktop.

After the SPCTool software is launched, the start interface shown in Figure 2.1 will pop up.

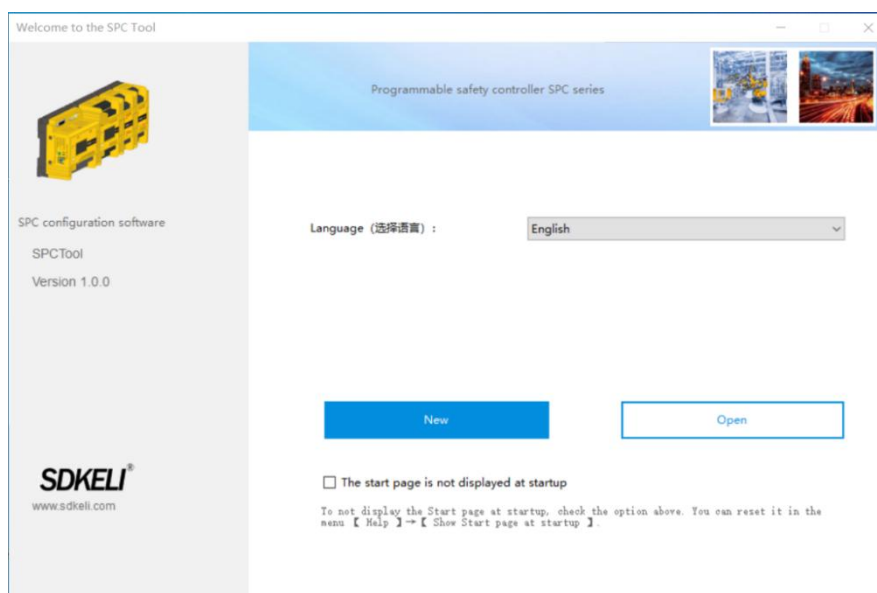


Figure2.1 Start Window

2.3.2 Exit

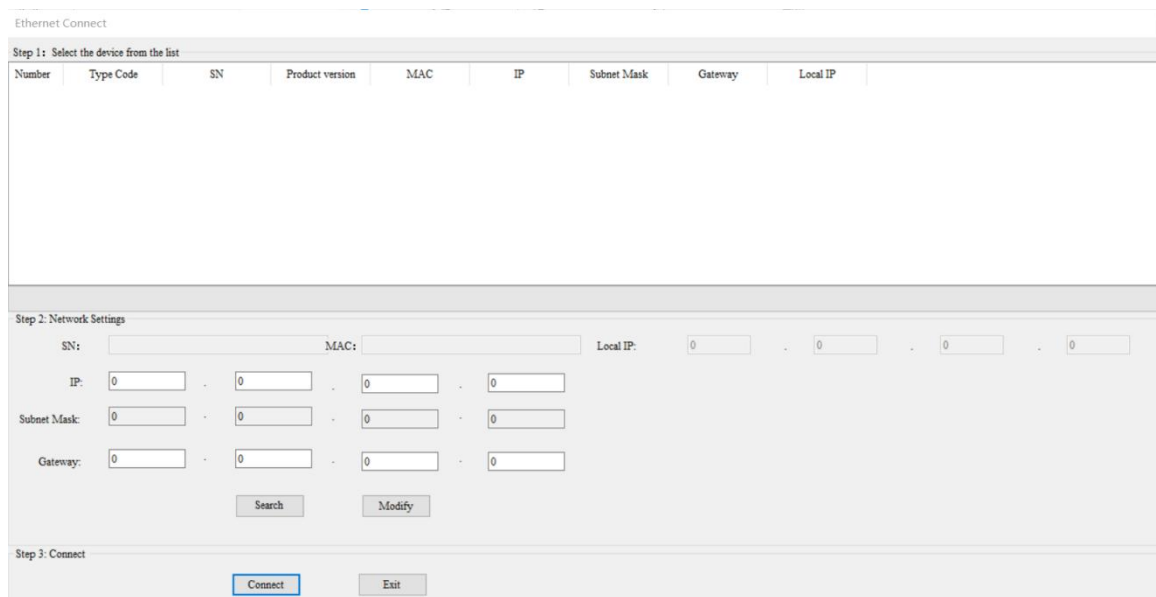
- If you are on the start window, click the [Close] button located at the top right corner of the interface.
- If you are on the main interface, click the [Close] button located at the top right corner of the interface, or select [Exit] from the [Project] menu.

3 Establish a connection

The SPC programmable safety controller establishes a connection with the SPCTool software via Ethernet.

3.1 Ethernet connection

After connecting to the computer's network port with an Ethernet cable, select "Ethernet" for the configuration interface and click the [Connect] button in the toolbar. The system will then pop up a connection settings window.



The screenshot shows the 'Ethernet Connect' window. It is divided into three main sections: Step 1, Step 2, and Step 3.

Step 1: Select the device from the list

Number	Type Code	SN	Product version	MAC	IP	Subnet Mask	Gateway	Local IP
--------	-----------	----	-----------------	-----	----	-------------	---------	----------

Step 2: Network Settings

SN: MAC: Local IP: . . .

IP: . . .

Subnet Mask: . . .

Gateway: . . .

Step 3: Connect

Figure 3.1 Network Parameter Settings Interface

3.1.1 Equipment search

When the Connection Settings window pops up, it will automatically search for devices, or you can click on Device Search within the window.

Devices found will be displayed in the device list.

Select a row in the device list, and the device information and network parameters for that row will be displayed in the text boxes below the list.

3.1.2 Modify network settings

According to the actual network environment, follow these steps to modify the network settings.

- (1) As shown in Figure 3.2, in the device list, click to select the device line to be modified.
- (2) In the IP address editing area, the factory default IP address of the device is 192.168. 6.5, and you can do it by your self Enter a new IP address. According to the local IP address displayed, set a valid IP address for the device that is in the same network segment as the computer IP.
- (3) Click the [Modify Network] button to transfer the new settings to the device.

Ethernet Connect

Step 1: Select the device from the list

Number	Type Code	SN	Product version	MAC	IP	Subnet Mask	Gateway	Local IP
1	SPC-MC1284AL...		1.0.0.0	A002643E003E	192.168.0.5	255.255.255.0	192.168.0.1	192.168.0.111

Step 2: Network Settings

SN: MAC: Local IP: . . .

IP: . . .

Subnet Mask: . . .

Gateway: . . .

Step 3: Connect

Figure 3.2 Modifying the network

Establish a connection with the device

- (1) Select the device you want to connect to in the device list in the connection settings window.
- (2) Click the button [Connect], and the SPCTool attempts to establish a connection with the device using the network parameters of the currently selected device.
- (3) Click [Cancel] to close the current connection settings window and return to the main interface.

If the connection can be established, the user can further perform operations such as reading configuration or issuing configuration.

3.1.1 Serial port connection

After connecting the USB Type-C to the COMPUTER USB port, select "Serial port" in the configuration interface and click the button in the toolbar. The system will pop up a serial port connection setting window.

Step 1: Search for the device

Number	Device name	SN	Product version	Port number	Baudrate /bps
--------	-------------	----	-----------------	-------------	---------------

Research

Step 2: Establish the connection

ConnectQuit

Figure 3.3 Connect pages in series

3.1.2 Equipment search

When the Connection Settings window pops up, it will automatically search for devices, or you can click on Device Search within the window.

Devices found will be displayed in the device list.

3.1.3 Establish a connection with the device

- (1) Select the device you want to connect to in the device list in the connection settings window.
- (2) Click the button [Connect], and the SPCTool attempts to establish a connection with the device using the network parameters of the currently selected device.
- (3) Click [Cancel] to close the current connection settings window and return to the main interface.

If a connection can be established, the user can further perform operations such as reading configuration or sending configuration, and the baudrate must be ≥ 230400 .

3.2 User privileges

If a connection has been established with the device, a different user login can be made. There are three types of users, namely: super administrator, administrator and operator. Different users have different permissions. See Table 3-1 below for specific permission division.

TABLE3-1 Users permissions

User	Password	Permissions
Super	Password required	Allow configuration to be created and edited offline
Administrator	Initial password: 123456	Allow connection to system

		Allow delivery configuration not confirmed Allow reading configuration Allow to modify your own password Allow enabling/deactivating administrator accounts Allow modifying administrator passwords Allow starting or stopping the application Allow activating Force Mode
Administrator	Password required Set a password when enabling this user	Allow configuration to be created and edited offline Allow connection to system Allow delivery configuration confirmed Allow reading configuration
Operator	No password required	Allow configuration to be created and edited offline Allow connection to system Allow reading configuration



Tips

During configuration transmission, configurations that have been confirmed are considered confirmed configurations; all others are unconfirmed configurations..

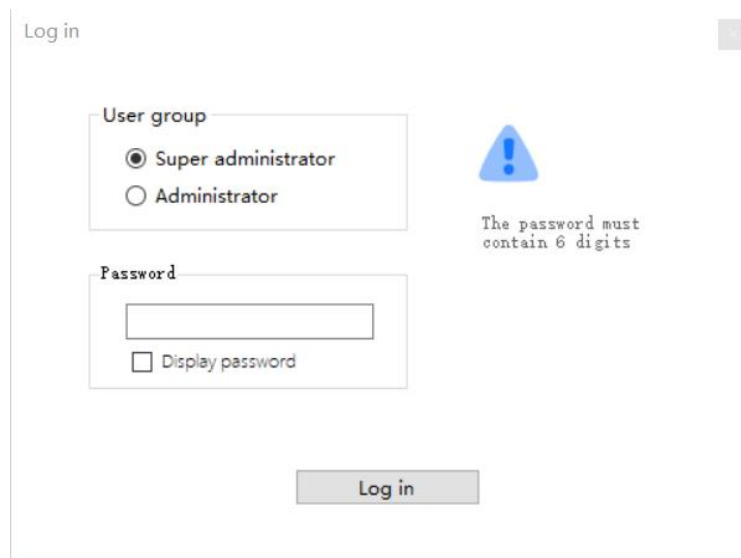


Attention

1. If users need to leave the computer, please log out of the current login in time to prevent unauthorized personnel from issuing the configuration to the device.
2. The Super Administrator must change the password immediately upon first login..
3. The password consists of 6 numeric digits. Ensure it is securely stored.

3.2.1 Switch Users

After establishing a connection with the device, on the main interface, click on the right side of the menu bar  and select the drop-down menu option [Log in]. This will pop up a login dialog box, as shown in the following figure.



Log in

User group

☒ Super administrator

☐ Administrator

Password

☐ Display password

The password must contain 6 digits

Log in

Figure 3.4 Login

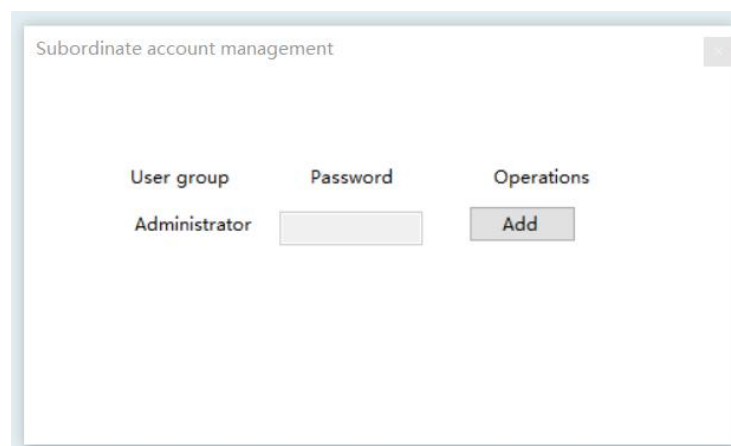
In the login dialog box, select the desired user group, enter the password and click [Login].

Check [Display password] to display the password as plain text, otherwise use "*" instead.

3.2.2 Activation/deactivation of administrator account

The administrator account requires activation by the super administrator before it can be used.

After logging in with the super administrator account, select [Subordinate account management] from the drop-down menu, and the subordinate account management dialog box will pop up, as shown in the following figure:



Subordinate account management

User group	Password	Operations
Administrator		Add

Figure 3.5 Subordinate Account Management

In the popped subordinate account management dialog box, click on **【Add】**, and in the subsequent dialog box, enter the pre-set administrator password twice and click **【OK】** to activate the administrator account.

If the administrator account has already been activated, you can delete the account within the subordinate account management dialog box, thereby deactivating the administrator account.

3.2.3 Change password

After logging in, the super administrator  can select **【Change password】** from the drop-down

menu, and a password change dialog box will pop up, as shown in the following figure.

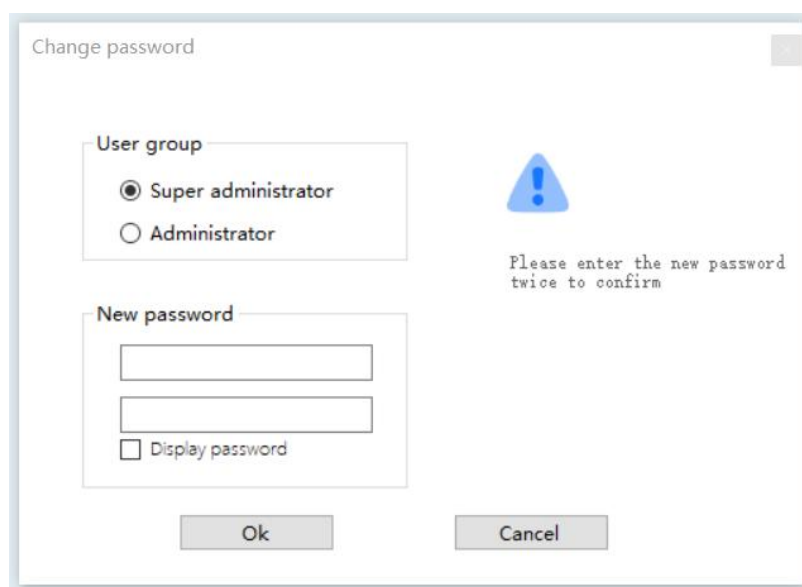
A dialog box titled "Change password" with a close button in the top right corner. It contains two sections: "User group" with radio buttons for "Super administrator" (selected) and "Administrator"; and "New password" with two text input fields and a checkbox labeled "Display password". To the right of these sections is a blue warning triangle icon and the text "Please enter the new password twice to confirm". At the bottom are "Ok" and "Cancel" buttons.

Figure 3.6 Modifying password

In the password change dialog box, select the user group whose password you wish to modify, enter the new password twice in the new password field, and click **【OK】** to change the password.

If the administrator account is not yet activated, only the super administrator will be displayed here.

The password for an administrator can only be changed by the super administrator; the administrator does not have permission to modify it.

3.2.4 Reset password

If you have forgotten the super administrator password, you can reset it by following these steps:

(1) Establishing a connection with the device;

(2) In  Select Reset Password from the drop-down menu, and a password reset dialog box will pop up

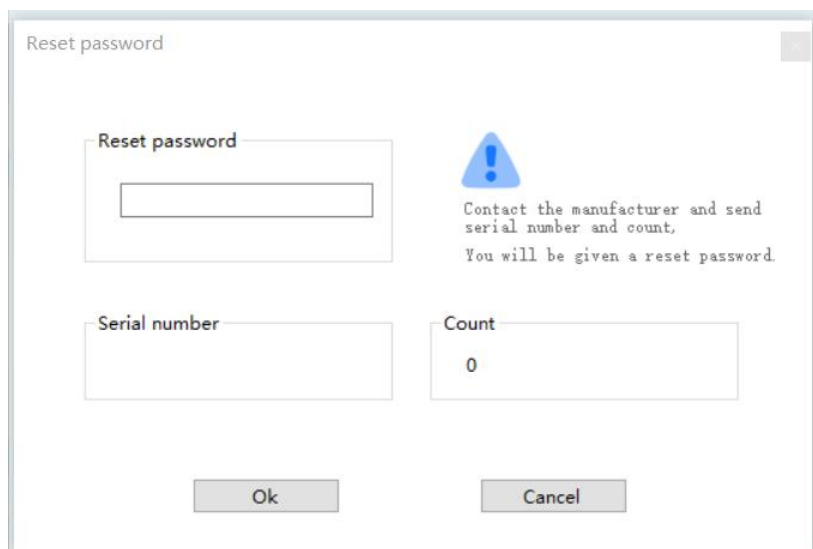
A dialog box titled "Reset password" with a close button in the top right corner. It contains a "Reset password" section with a text input field. Below this are two sections: "Serial number" and "Count", each with a text input field. The "Count" field contains the value "0". To the right of these sections is a blue warning triangle icon and the text "Contact the manufacturer and send serial number and count, You will be given a reset password." At the bottom are "Ok" and "Cancel" buttons.

Figure 3.7 Resetting Password

(3) Contact the manufacturer and provide them with the **Serial number** and Count value displayed in the dialog box. The manufacturer will then supply the corresponding reset password. The user should enter the obtained reset password in the designated field within the dialog box.

(4) Click [OK] and the password will be reset.

Reset the password and the super admin will be reset and the password is changed to the initial password: 123456.

4 Software user interface

The user interface of the SPCTool configuration software primarily consists of the Start-up Screen and the Main Interface.

4.1 Start interface

After starting the software, the start interface appears, as shown in Figure 4.1.

Select Language In the menu.

Here you can select which of the following actions you want to start with:

- Open an existing project file
- Create a new project

 **Tips**

[New] and [Open] will both enter the main interface. As shown in Figure 4.2, the main interface opened by clicking [New].

In addition, the [The start page is not displayed at startup] option can set whether the start page is displayed at startup of the program.

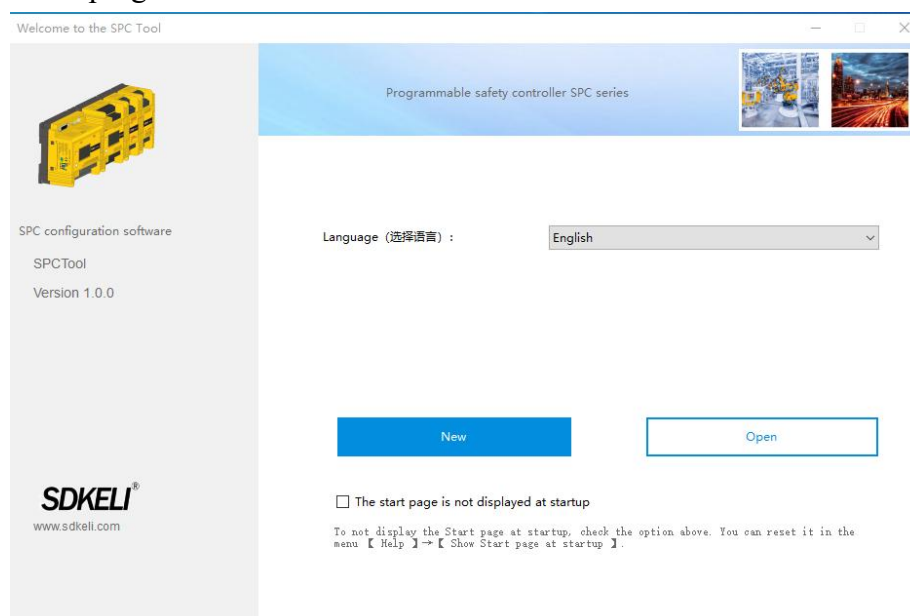


Figure 4.1 Start interface

4.2 Main interface

The main window is comprised of the following 9 sections: ①-Menu Bar、②-Toolbar,③-Status Box,④-Hardware Selection Interface,⑤-Configure Error Panel,⑥-Name Editing Interface, ⑦-Logic Editing Interface, ⑧-Status Query, ⑨-Fault Log Query, as shown in Figures 4.2 to 4.6.

- **Menu Bar** Provides some software functions to users through a menu-driven interface, such as **Open, Save, Connect**, etc.。

- On the **Toolbar**, users can use some frequently used functions by clicking buttons, such as **New**, **Open**, **Connect**, etc.
- The **Status Box** contains the following sections arranged left to right: **Current User Display** and **User Management**, **System Status** and **Configuration Status**. The System Status indicates the current status. Operational State when connected to and reading device configurations; Editing State otherwise.
- **Hardware configuration** Interface, displays the structure of SPC system composed of various hardware modules, as well as the configuration of input/output and connected components.
- Name Editing Interface allows for customizing and modifying the identifier names of various types of inputs and outputs.
- **Logic Editing** Interface, you can use Logic Function Blocks and Special Function Blocks to configure functional logic. After selecting the main module in Hardware Configuration, you can use this view to configure logic.
- **Configuration Error Panel** is used to display logic configuration check results and prompt the error for the current setup. The Internal Query tab shows **system check sums** and **software check sums** read from the device.
- In **Status Query** Interface, it is used to query the real-time input and output status of SPC.
- In **Fault Log Query Interface**, it is used to query current faults and historical faults recorded in the SPC system.

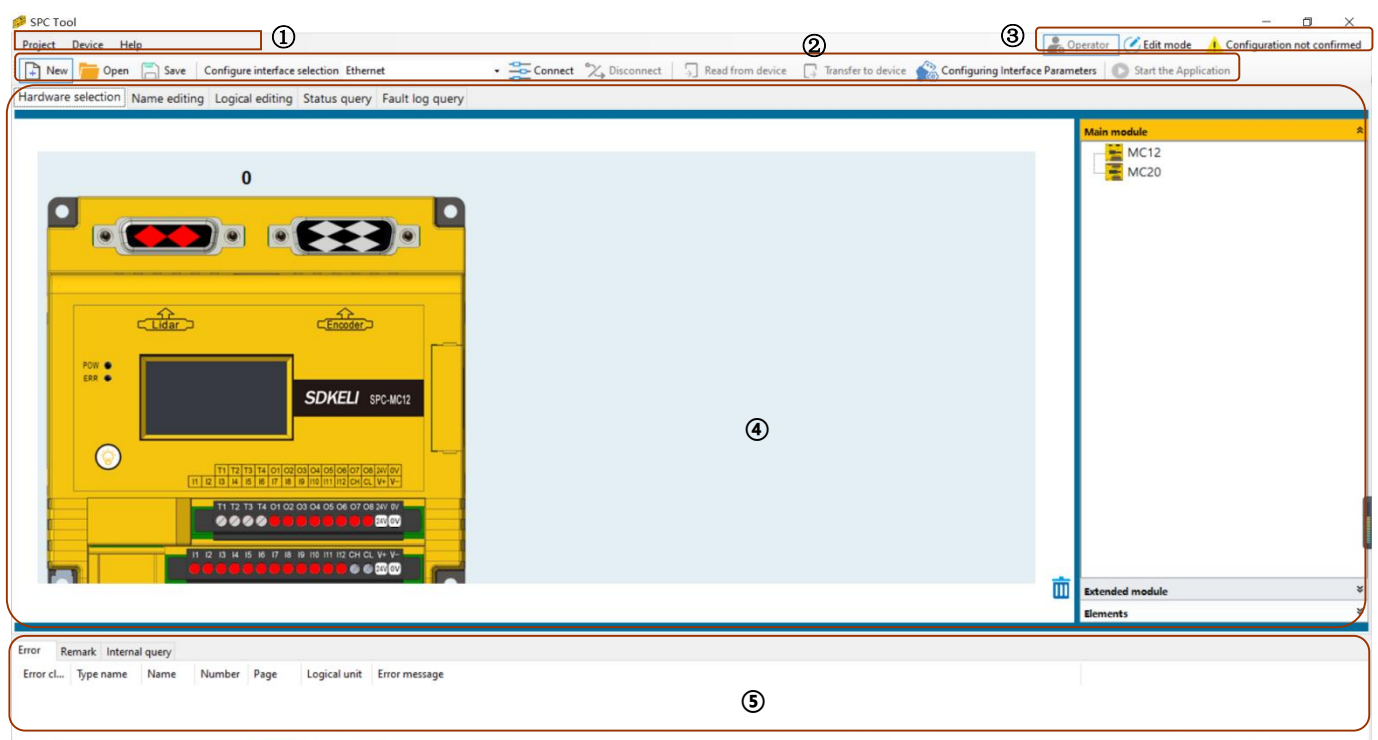


Figure 4.2 Hardware Configuration Interface

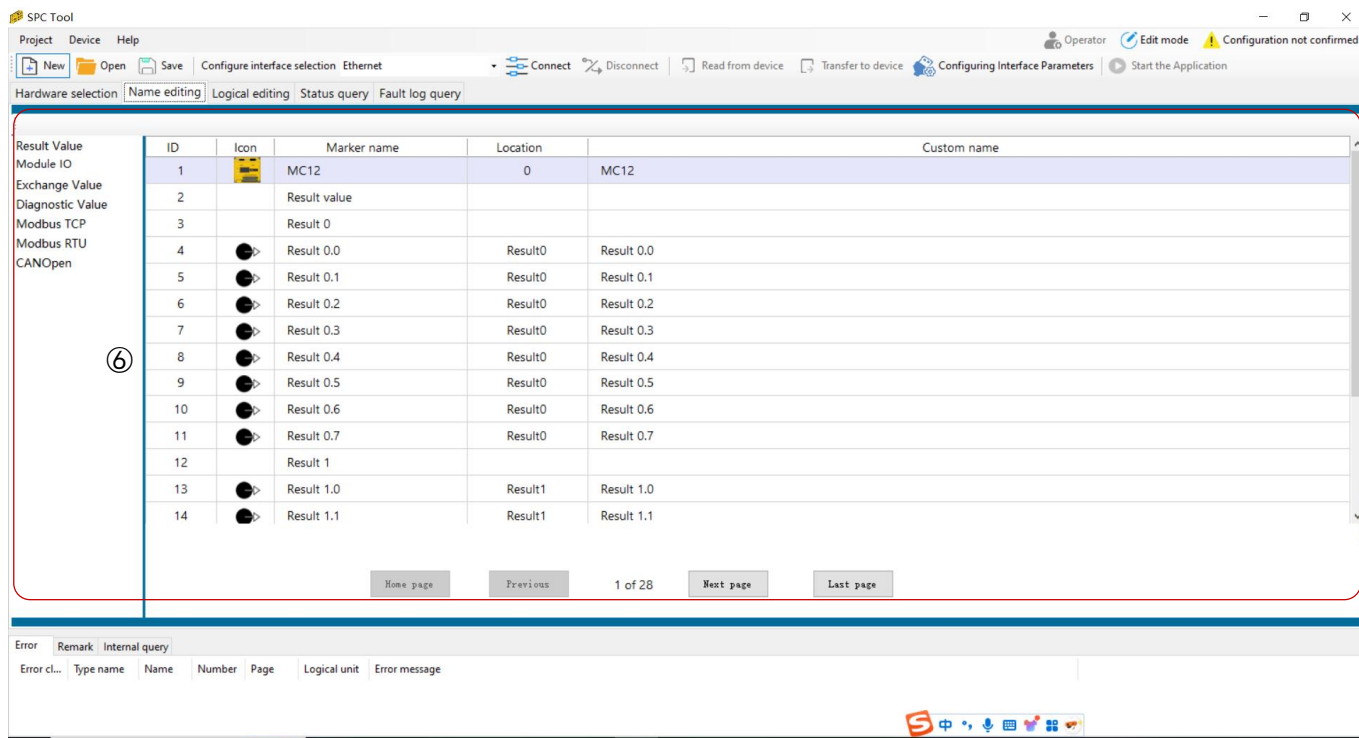


Figure 4.3 Name Editing Interface

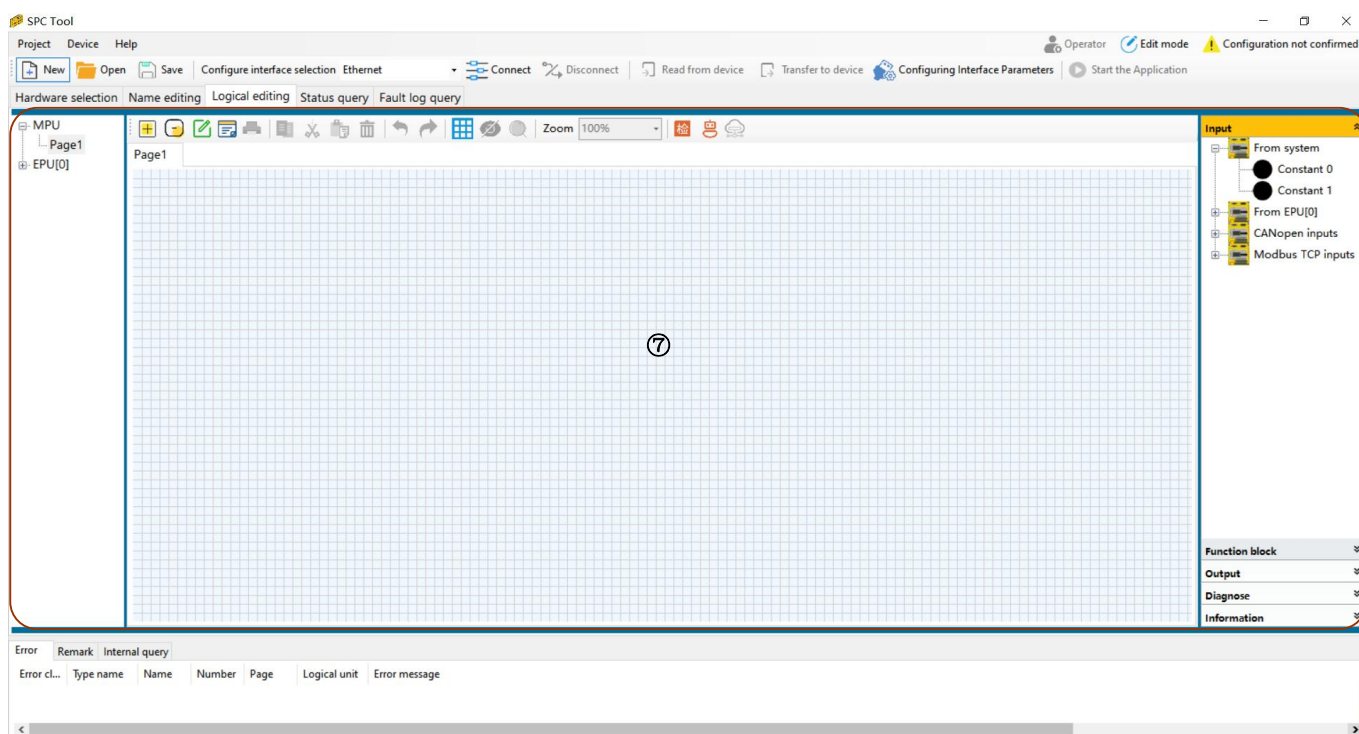


Figure 4.4 Logic Editing Interface

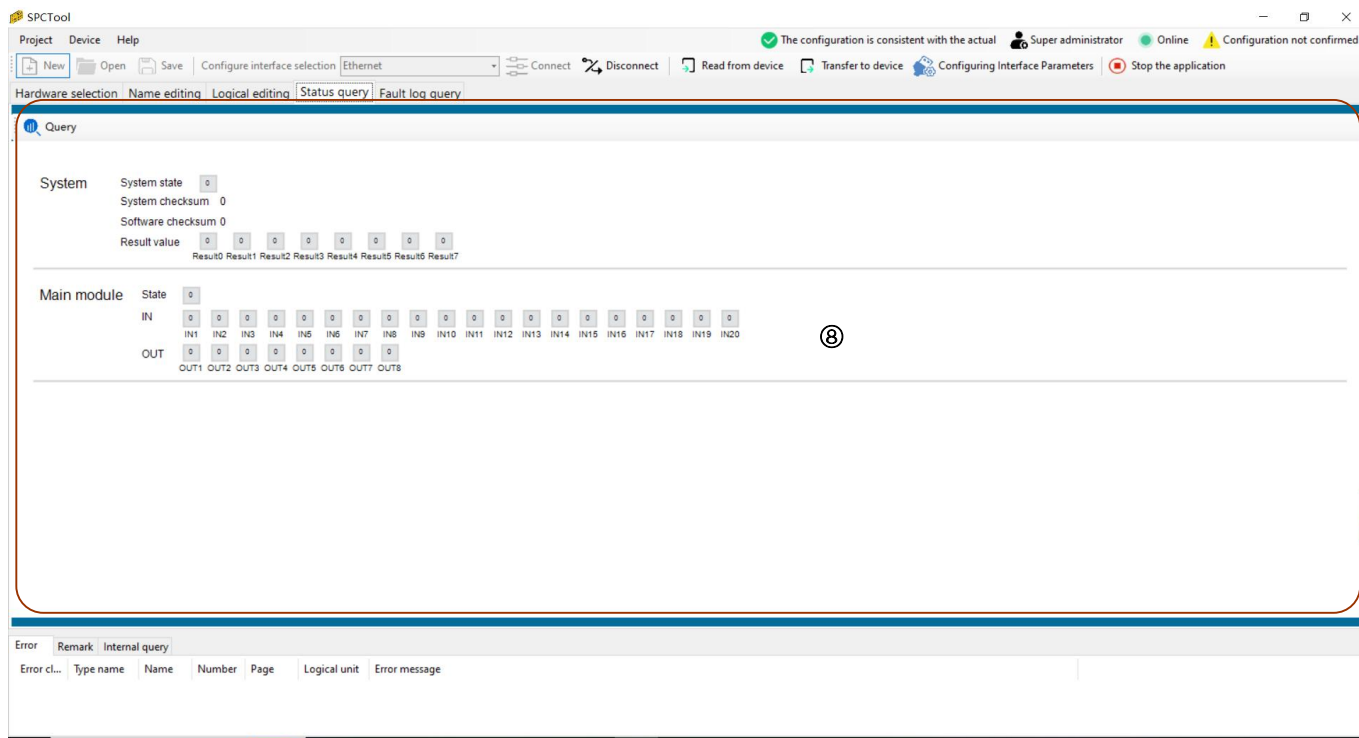


Figure 4.5 Status Query Interface

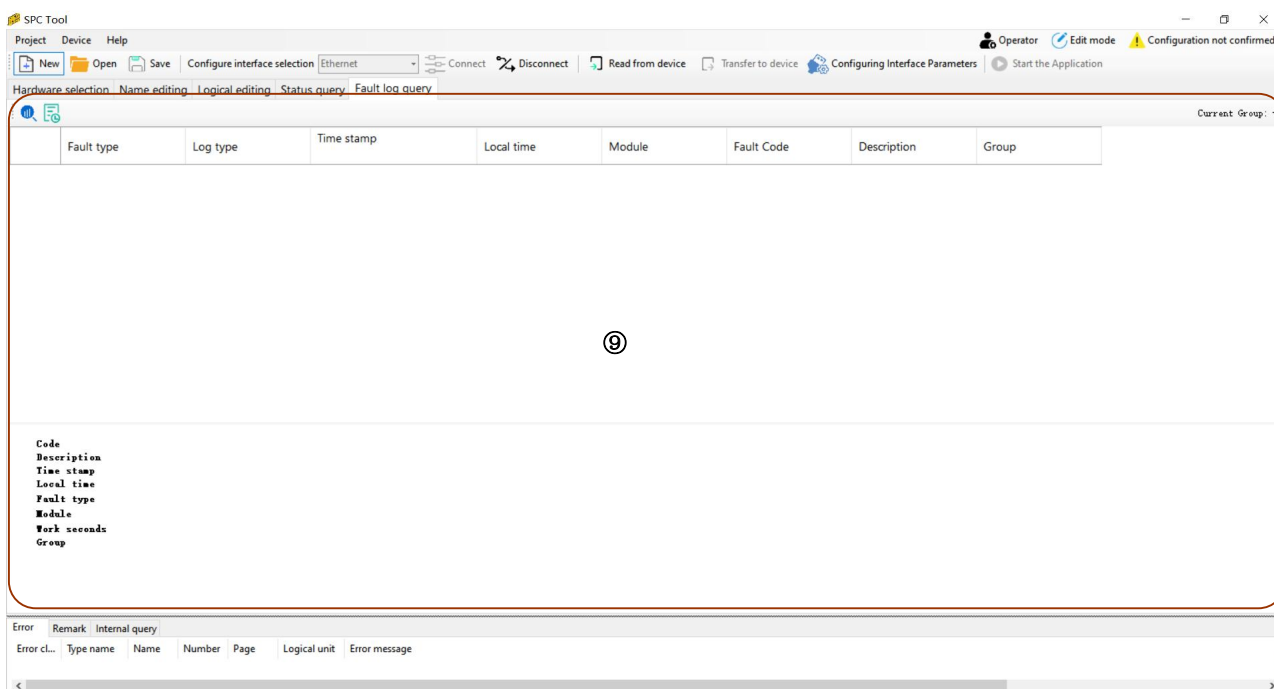


Figure 4.6 Fault Log Query Interface



Tips

You can view the configuration software manual and hardware manual by navigating to [Help]>[View the manual] in the menu bar.

4.3 Hardware configuration

The Hardware Configuration window consists of the following elements:

- **Main control module** Selection panel: All SPC main modules that can be combined into a safety controller SPC are displayed here. Currently it includes the MC12 and MC20 series. Refer to Area ② in Figure 4.7.
- **Expansion module** Selection panel: All SPC expansion modules that can be combined into the safety controller SPC are displayed here. Currently, this includes the EN0000 and IO0842 series. (Refer to Area ② in Figure 4.7.)
- **Element** Selection panel: All devices that can be connected to the inputs and outputs of the safety controller SPC, such as sensors, encoders, etc., are listed here. The device can be parameterized. As shown on Area ② in Figure 4.7.
- **Configuration area**: Here create the entire hardware configuration of the safety controller SPC and display it graphically, as shown on Area ① in Figure 4.7. The information of each module can be viewed by double-clicking the corresponding module. Connected devices can also be view and configure parameters by double-clicking. Configured modules and devices can be dragged to the Trash icon to delete.

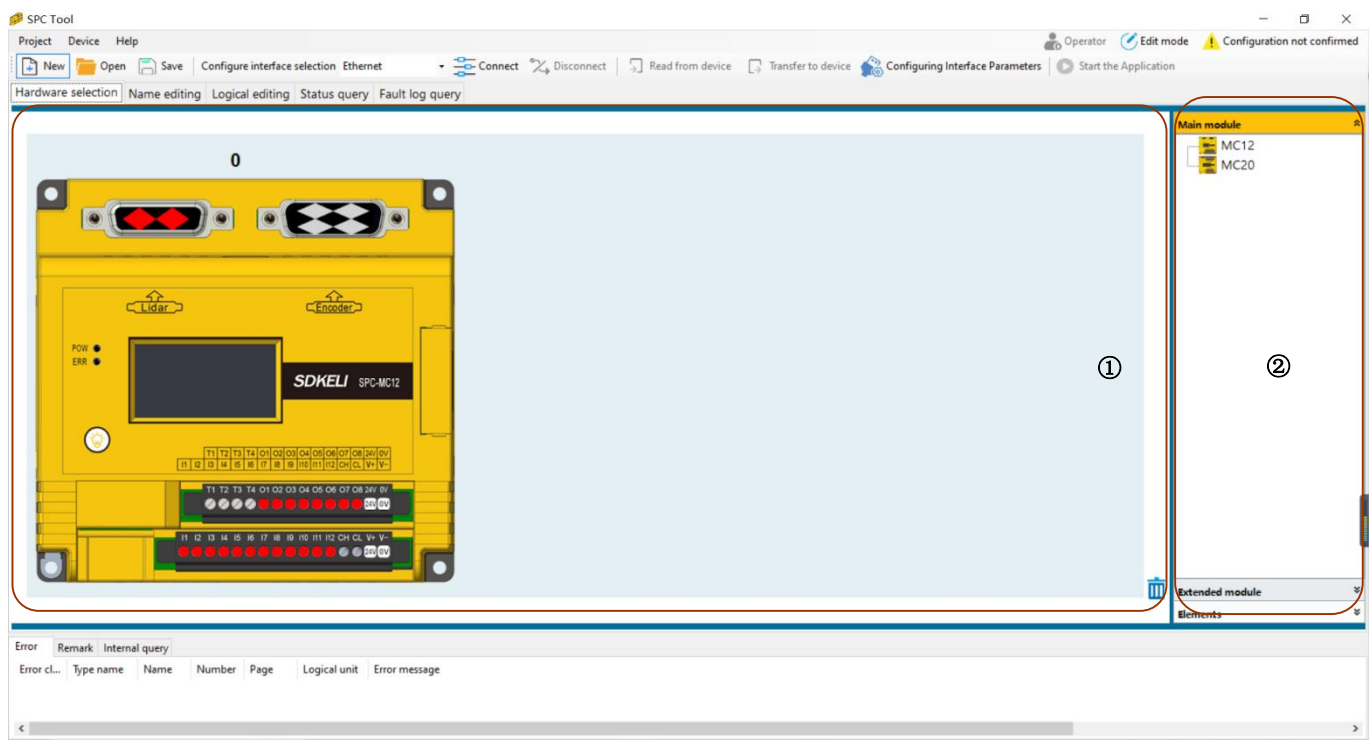


Figure 4.7 Hardware Configuration Interface structure

4.3.1 Configuration module

The operations supported by the module configuration are as follows:

- (1) Create a new project (by clicking the **New** button on the start interface). The default main module is MC12.
- (2) Right-click on the main module and select **Replace the main module**. If the current main

module is MC12, it will be replaced with MC20.

(3) Double-click MC20 to set the multi-master mode. Select [Enable the multi-master mode] to set the number of master stations and the current module master station number, which will be displayed on MC20. You can also select whether to configure RS485 baud rate.

(4) In the Expansion Module Selection Panel, drag the expansion module you wish to configure into the configuration area with your mouse, and release the mouse to see the expansion module displayed behind the main module in the configuration area..

(5) Depending on actual needs, select more expansion modules and drag them into the configuration area. These newly added expansion modules can be placed at the end or between any two modules. The main module is always on the far left.

(6) Module positions can be changed by dragging with the mouse.

Drag the module to the bottom right corner icon  with the mouse to remove it from the configuration area.



Tips

- 1、 Up to 14 expansion modules can be connected on one main module.
- 2、 Each EN0000S000 module occupies the position of two IO expansion modules.
- 3、 In the multi-master mode, $2 \leq \text{number of master mode} \leq 16$, $0 \leq \text{current module master mode number} < \text{number of master stations}$, RS485 baud rate ≥ 230400 .

4.3.2 Component Categories

All supported components are displayed in the **Component Selection Panel**, categorized into four major types: Inputs, Outputs, Encoders and Zone-switching Radars. Figure 4.8 lists all the components.

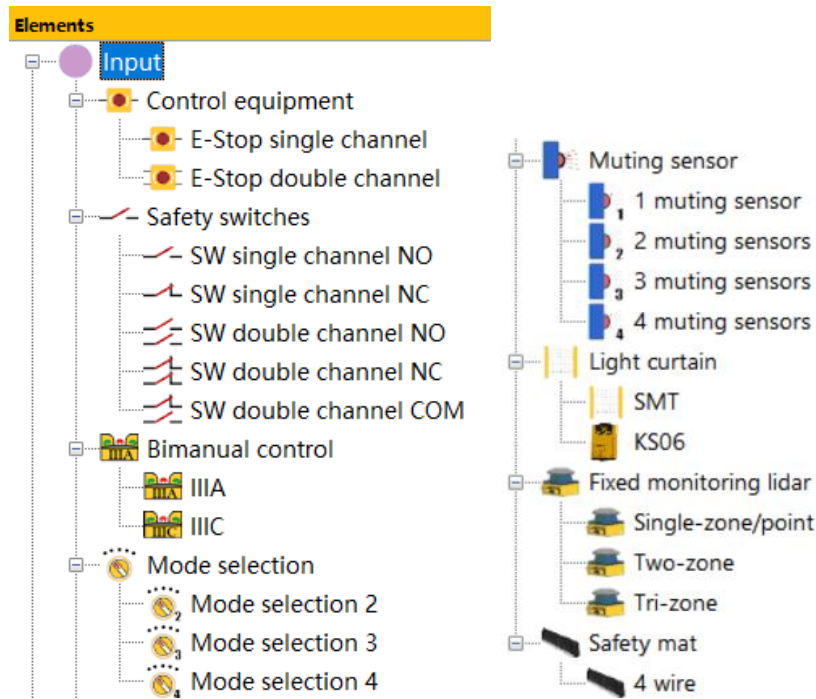
Input-type components are further classified based on device types, with a total of 8 subcategories comprising 22 component types. Among these, **Two-Hand Controls**, **Mode Selectors**, and **Muting Sensors** can be composed of a set of two or more sub-components, making them composite components.

There are a total of 6 types of output components.

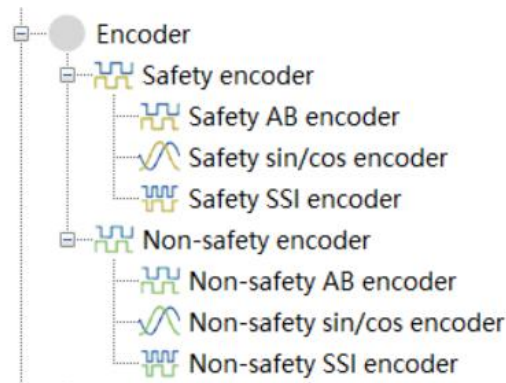
Encoders are divided into safety encoders and non-safety encoders, with a total of 6 types of encoders.

There are two types of components in the Lidar element for zone switching.

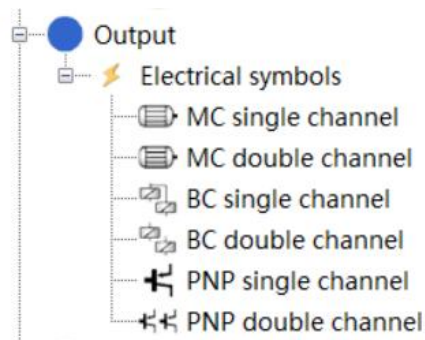
Safety mat components are only available in the 4 wire.



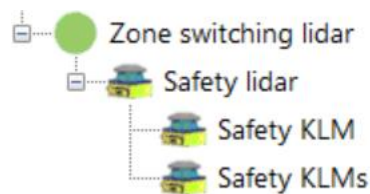
(1) Input element



(2) Encoder Element



(3) Output element



(4) Zone switching lidar element

Figure 4.8 Component List



Tips

1. The mouse hover function on the Hardware Configuration Interface displays key component information.

4.3.3 Connecting element

The connecting elements are used as follows:

(1) Drag the required components from the **Component Selection Panel (right sidebar)**, onto the target module in the configuration area..

(2) If the module does not have any suitable free inputs or outputs, it is not possible to place a component on this module.

(3) If the module has appropriate free inputs or outputs, release the mouse at the desired location, and the software will automatically select the nearest point to where the mouse was lifted to place the component, and automatically determine the number of interfaces required by the component..

(4) By dragging the component with the mouse, you can move the component between free inputs or outputs within the same module.

(5) Each sub-component of Two-Hand Controls, Mode Selectors, and MutingSensors components can be dragged separately.

(6) Delete components by dragging to the Trash Bin icon (lower-right corner). Dragging sub-components of Two-Hand, Mode Selector, and MutingSensors components for deletion will remove the entire corresponding graphic element, meaning sub-elements cannot be deleted individually.

(7) For components that are already connected to a module, double-clicking the component will open the component property configuration window, allowing you to view and set the component's configuration. See section 4.3.4 "Configuration of Connected Components" for details.



Tips

The encoder element and module have the following limitations

- 1、 Only incremental encoder or sine/cosine encoder is allowed to be connected to the main module. Only one type of sine/cosine encoder and incremental encoder is allowed, and SSI encoder is not supported.
- 2、 EN1 and EN4 on the expansion module EN0000S000 only support the connection of SSI encoder, while EN2 and EN3 support the connection of incremental encoder and sine/cosine encoder. Only one type of sine/cosine encoder and incremental encoder is allowed..

4.3.4 Configuration of connected elements

If a component is already in the **Configuration Area**, double-clicking the component will pop up a configuration window, allowing you to configure the properties of the component. Depending on the type of component, the configurable attributes may vary. See Section 5 for details on component parameter settings.

4.3.5 Location

For components other than the Encoder and the Lidar, if the corresponding variables have been used in the logical editing, then by right-clicking and selecting the "Jump to" menu item from the pop-up menu, the component can be navigated to its variable symbol on the program diagram, and the variable symbol will be highlighted.

4.3.6 Rename

For the components that have been configured onto the module, the names can be customized. Double-click on the component of the module, and in the pop-up configuration window, the label name will display the current name. You can edit it as needed.

4.4 Name editing

The Name Editing Interface provides users with a way to customize and modify the names of input and output identifiers.

As shown in Figure 4.9, all customizable input and output quantities available under the current configuration are displayed by category. After selecting the category in the left **Navigation Panel**, you can locate the data row to be modified in the right **Configuration Table**, in the "Custom Name" column cells, you can edit the name according to your actual needs. The names of the input and output quantities corresponding to the **Hardware Configuration** and **Logic Editing** will be synchronized and updated to the new names and displayed.

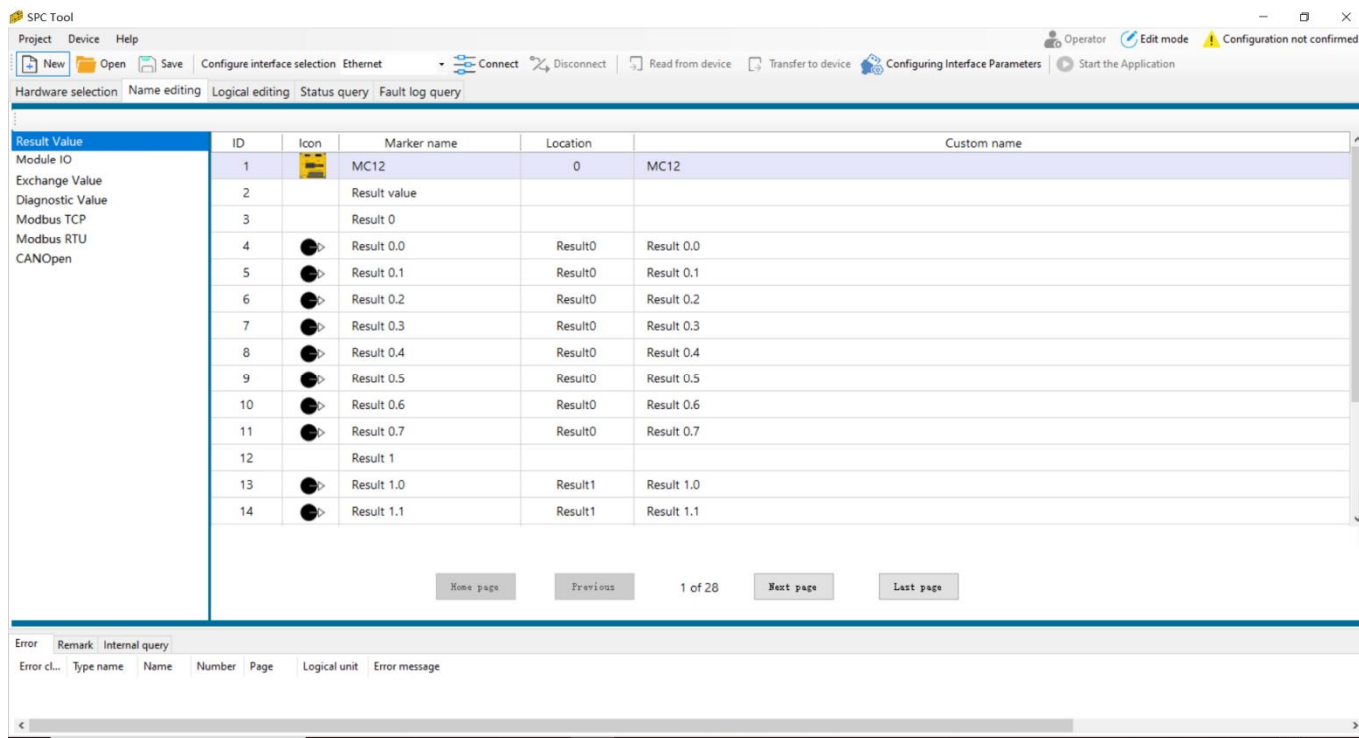


Figure 4.9 The composition of the Name Editing Interface

4.5 Logic editing

The Logic Editing Interface provides users with a graphical interactive method for ease of use. Users can program the functional logic using **Basic Logic Blocks** and **Specific Function Blocks** to design programs that meet their own needs. By clicking on the tab **【Logical Editing】** on the main interface, you can switch to the Logic Editing Interface.

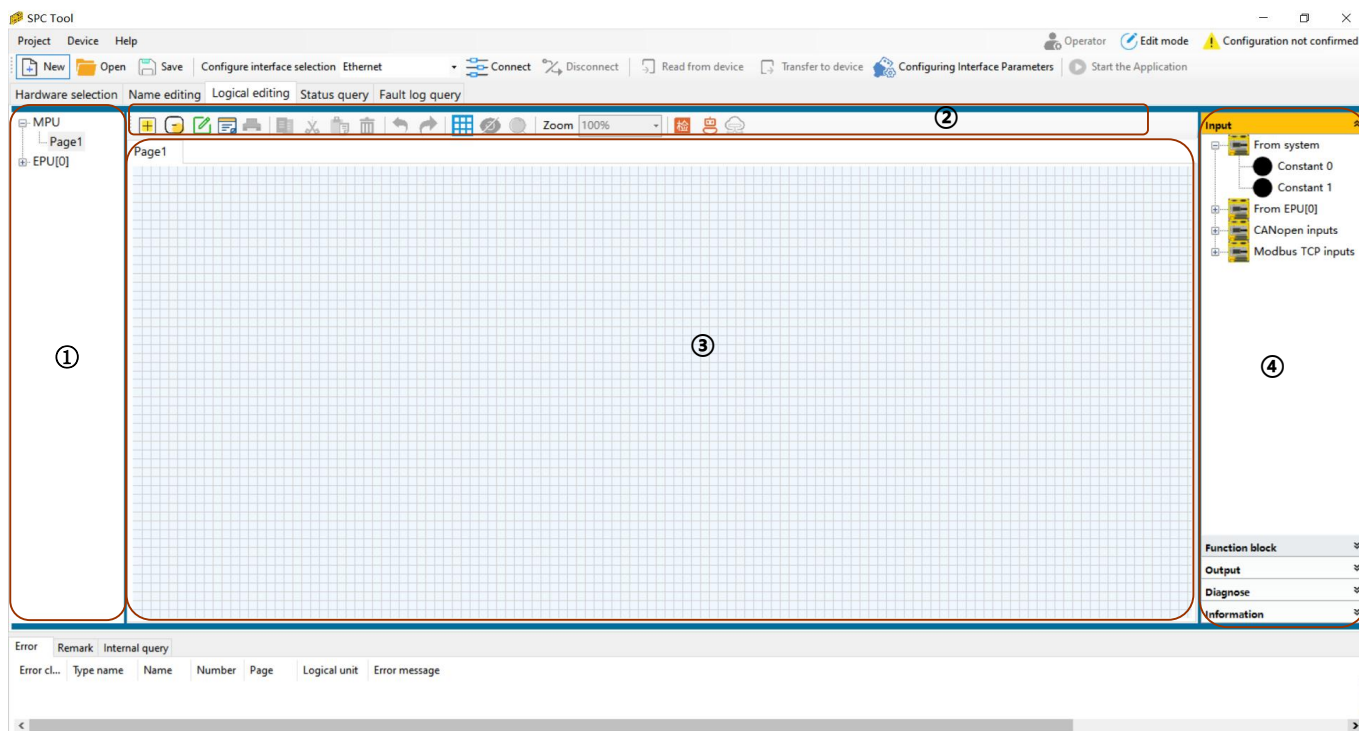


Figure 4.10 Logic Editing Interface Composition

As shown in Figure 4.10, the Logic Editing Interface is composed of the following elements:

- **Logic unit page tree:** Corresponding to Area①. Here is a list of logical units that can be programmed at the moment and their pages. The type of logic unit is related to the module selected by the hardware configuration.
- **Toolbar:** A collection of function buttons that can be used on logical editing. At present, the functions supported by the toolbar are: adding pages, deleting pages, renaming pages, recording pages, displaying/hiding grid, program error checking, logic simulation and forced mode as shown in Area ②.
- **Workspace:** Here supports displays user-configured logic programs, parameter configuration for function blocks, and allows modification of wire connections between blocks, As shown Area ③.
- **Input, Output, and Function Block Selection Panel:** Shows all available inputs, outputs, and function blocks except the jump address, as shown in Area ④.
- **Right-click menu:** On **Workspace**, activated via right-click. There are two types of right-click menus: one is about jump address creation and jump, and the other is about the operation of logical primitives.

4.5.1 Using the logic editing

The premise of using logical editing is that at least the main module already exists in the **Hardware Configuration**, and switch To **Logic editing** Interface.

(1) In **Input, Output, and Function Block Selection Panel** Switch to **Input panel**, select an input and drag it to **Workspace**, release the mouse in the blank space and the input element is placed there. The same method can be dragged in other inputs.

(2) In **Input, Output, and Function Block Selection Panel** Switch to **Function block panel**, select a function block, drag it to **Workspace** and release the mouse in the blank space and the function block entity is placed in that position. As long as all of the inputs of a function block are not connected, the function block is displayed in orange-red.

(3) In **Input, Output, and Function Block Selection Panel** Switch to **Output panel**, the same method can be used to drag an output to **Workspace**.

(4) If you want to cancel the drag-in, during drag operation, press the **ESC key** to cancel. When you release the mouse, the element does not appear.

(5) Connect input and function blocks. In **Workspace**, **click and hold** the terminal of the input element, drag wire to the input terminal of the function block, and release the left button, then a straight line or poly line appears between the two terminals connecting the input and function block.

(6) Connect the output with the function block. In **Workspace**, **click and hold** the terminal of the output element, drag wire to the output terminal of the function block, and release the left button, then a straight line or poly line appears between the two ends to connect the output and function block.

(7) Element selection. Click the left mouse button on input, function block, output, or connection line primitives to select a single primitive. Hold down the **Ctrl** key and click on various primitives one by one, or hold down the **Shift** key and drag a selection box in **Workspace** to enclose multiple primitives, enabling the selection of multiple primitives.

(8) After selecting an element, hold down the left mouse button and drag the element to move in **Workspace**.

(9) Element deletion. In **Workspace**, first select one or multiple primitives, then right-click. In the pop-up menu, click [**Delete**], or directly press the **Delete** key to delete the selected one or multiple primitives.

(10) Function Block Property Edit. In **Workspace**, select a function block element first, then right-click it. In the pop-up menu, click [**Edit**] or simply **double-click the function block primitive** to view or modify the parameters of the function block.

 Tips
The use of input and output elements on logical editing is limited as follows.
1. An output can only be used once.
2. One input can be used multiple times.
3. The input cannot be directly wired to outputs, and inputs cannot be connected to the output terminals of the function block.
4. The output cannot be connected to the input terminals of the function block.

4.5.2 Inputs and outputs from components

Inputs and outputs from **Elements**, refer to the corresponding indicators on the Logical Editing of **Elements** connected to the modules in hardware configuration.



Figure 4.11 Input primitive corresponding to emergency stop element connected to IO module



Figure 4.12 Connect to the corresponding output primitive of the motor contactor on the MC12 main module

➤ In the hardware configuration, on the IO expansion module numbered 1, I3 is connected to a

single-channel emergency stop, and I5 and I6 are connected to a dual-channel emergency stop. Correspondingly, in the logic editing area, the **MPU Logic Input Selection Panel** will have two nodes: **Emergency Stop.IO0842[1].I5I6** and **Emergency Stop.IO0842[1].I3**. After dragging them into the **Workspace**, they will be displayed in the workspace as shown in Figure 4.11. The blue terminal on the right side is the connection point for linking with function blocks.

- On the main module MC12 in the hardware configuration, O3O4 is connected to a dual-channel motor contactor, and O1 is connected to a single-channel motor contactor. Correspondingly, in the logic editing area, the **MPU Logic Output Selection Panel** will have two nodes: **Motor Contactor.MC12[0].O3O4** and **Motor Contactor.MC12[0].O1**. After dragging them into the **Workspace**, they will be displayed in the Workspace as shown in Figure 4.12. The blue terminal on the left side is the connection point for linking with function blocks..

4.5.3 Constant 0, Constant 1



Figure 4.13 Constant 0, Constant 1

- **Constant 0**, refers to an input that is always 0; **Constant 1**, refers to an input that is always 1.
- When a function block has an input that must be connected but is not used in the program, you can choose to connect it with either **Constant 0** or **Constant 1** based on the functional logic.
- **Constants 0** and **1** can be used multiple times.

4.5.4 Exchangeable results

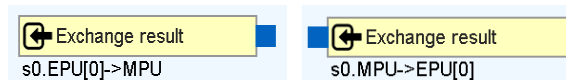


Figure 4.14 Example of Exchangeable Results

Unlike MPU logic units, EPU logic units perform more complex signal preprocessing and logic programming, so data exchange is required between modules. The inputs and outputs of such uses are called **Exchangeable Results**. The MPU may send up to 8 bytes of result data to the EPU, and the EPU may send up to 8 bytes of result data to the MPU.

- The **Exchangeable Results** from EPU to MPU are displayed in the **Output Selection Panel** of the EPU logic unit and the **Input Selection Panel** of the MPU logic unit.
- The **Exchangeable Results** from MPU to EPU are displayed in the **Input Selection Panel** of the EPU logic unit and the **Output Selection Panel** of the MPU logic unit.

4.5.5 Master station results

The **Master Station Result** is a class of logical input/output corresponding to **Multi-Master Function** enabled by MC20 (refer to Section 8).



Figure 4.15 Example of Master-Station results

The other master stations each provide 8 inputs to the current master station, and the current master station has 8 outputs.

- The inputs from other master stations appear in the **Input Selection Panel** of the **MPU Logic Unit**.
- The outputs of the current master station appear in the **Output Selection Panel** of the **MPU Logic Unit**.

4.5.6 Running results

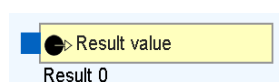


Figure 4.16 Example of Running Results

Running results are a type of output that only exists in the **Output Selection Panel** of the **MPU Logic Unit**. They can be used to transmit the results of logic programs to other devices, with a maximum capacity of 480 outputs (8 outputs per group).

4.5.7 Communication input Dataset

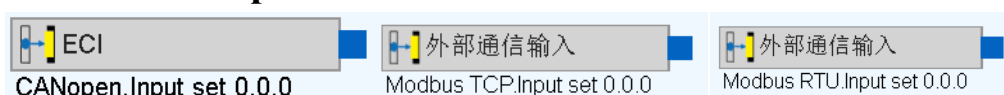


Figure 4.17 Example of communication input data

Communication Input Dataset exists only in the **Input Selection Panel** of the **MPU Logic Unit**, providing the input transmitted by other devices through communication. These elements appear as gray non-safety elements in the **Logic Editing Interface**.

The MC12 module has two kinds of communication input datasets, CANopen and Modbus TCP, each of which is $12 \times 8 = 96$.

The MC20 module has two kinds of communication input datasets, Modbus RTU and Modbus TCP, each with $12 \times 8 = 96$.

4.5.8 Diagnostic data

Diagnostic data includes **Diagnostic Input** and **Diagnostic Output**, which are used as input and output respectively in the logic editor. Only **EPU Logic Units** have diagnostic output.



Figure 4.18 Main module diagnostic input diagram

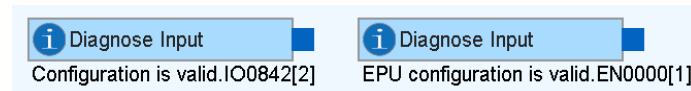


Figure 4.19 Expansion module diagnostic input diagram

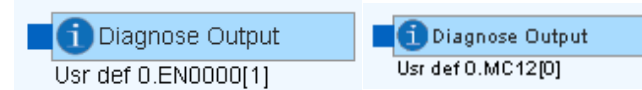


Figure 4.20 EPU logical diagnostic output diagram

- When the main module is the MC12 module, correspondingly, in the logic editing section, the diagnostic panel of the MPU logic will have the diagnostic input nodes of MC12, while the diagnostic panel of the EPU[0] logic will have the diagnostic output node of MC12. After dragging and dropping these components into the **Workspace**, they will be displayed as shown in the left of Figures 4.18 and 4.20 respectively.
- When the main module is MC20 module, accordingly, in the logic editing section, the diagnostic panel of MPU logic will have the diagnostic input node of MC20. After dragging and dropping it into the **Workspace**, it will be displayed in the style shown on the right of Figure 4.18.
- When the hardware configuration numbered 1 is the IO extension module, correspondingly, in the logical editing section, the diagnostic panel of the MPU logic will have this IO diagnostic input node. After dragging and dropping it into the **Workspace**, it will be displayed in the style shown on the left of Figure 4.19.
- When the hardware configuration numbered 2 is the EN expansion module, correspondingly, in the logic editing section, the diagnostic panel of the MPU logic will have this EN diagnostic input node, while the diagnostic panel of the EPU[2] logic will have this EN diagnostic output node. After dragging and dropping these nodes into the **Workspace**, they will be displayed in the styles as shown in Figure 4.19 right and Figure 4.20 right respectively.

4.5.9 Jump address

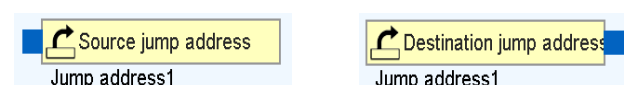


Figure 4.21 Jump Address Example

Jump addresses consist of **Source Jump Addresses**(logic outputs) and **Destination Jump Addresses** (logic inputs).

Usage of Source Jump Addresses:

- In an empty area of a page in the **Workspace**, right-click, and select [Add source jump address] from the context menu that appears to pop up a naming dialog box..

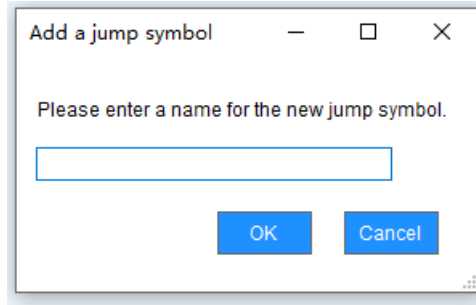


Figure 4.22 Adding Source Jump Address window

- Enter the name of the jump address in the dialog box above and click **[OK]**. The name must be unique within this logic unit.
- A source jump address will be created at the position where you right-clicked the mouse earlier.
- The source jump address can be connected to the output of any function block.

Use of destination jump address

- In an empty area of a page in the **Workspace**, right-click, and from the context menu that appears, select [Create destination jump address from]. A submenu will appear displaying all the source jump addresses within this logic unit. Click on one of them to select it.

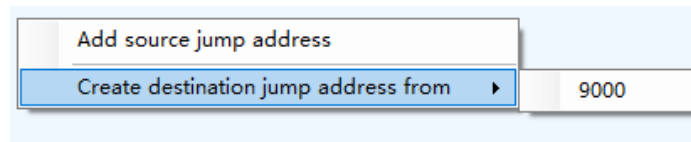


Figure 4.23 Create a menu for destination jump address

- Right-clicking will create a destination jump address with the same name as its source jump address.
- A source jump address can create multiple destination jump addresses.
- The destination jump address is typically connected to the **Function block input terminals**.
- The same set of jump addresses can only connect the same type of input and output. For example, if the source jump address srcJmp01 is connected to the "speed value" output terminal of the function block, the destination jump address of srcJmp01 can only be connected to the "speed value" type input terminal.

Logic Loopback

When the input of a functional block is connected to a destination jump address and its source jump

address is connected to the output of the functional block or the output of a functional block executed after the functional block, a **Logic loopback occurs**. For example, there is a logical loopback in Figure 4.24.

 Attention
When a logical loopback occurs, the logical result of the current logical cycle at the destination jump address can only be used in the next logical cycle. At this time, it is delayed by one logical cycle..

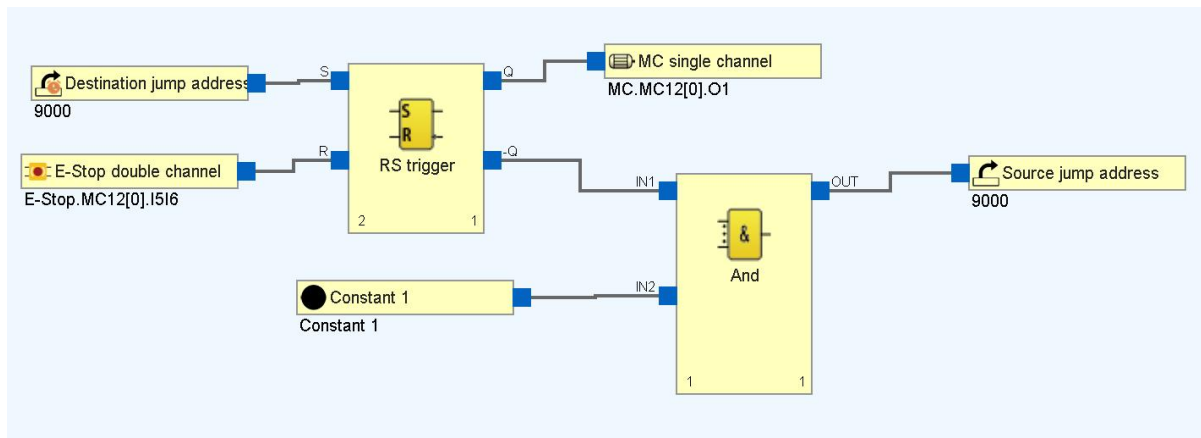


Figure 4.24 Forming a logical loopback

4.5.10 Function block

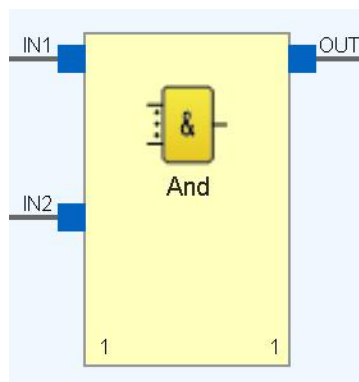


Figure 4.25 Function block style diagram

Function blocks encapsulate safety-related logic operations. For example, function block **And**, which performs logical **AND** operation on all inputs and outputs the operation result.

According to its logical characteristics and practical application, the software divides the functional blocks into categories. Each category will be described in detail in subsequent sections.

- The functional block exists in the logical unit **Function Block Selection Panel**.
- Like input and output, from **Function Block Selection Panel** You can drag in the function block to **Workspace**.
- Function blocks displayed in the **Workspace**, as shown in Figure 4.1 above, the left terminal is

the input of the functional block, and the right terminal is the output of the functional block. The text near the terminal is the name of the input and output of the function block. There are two numbers below: the number on the left is the sorting of the functional block among all functional blocks in this logical unit; The number on the right is the ranking of the functional block among the same functional blocks in the logical unit.

4.5.11 Connection Style

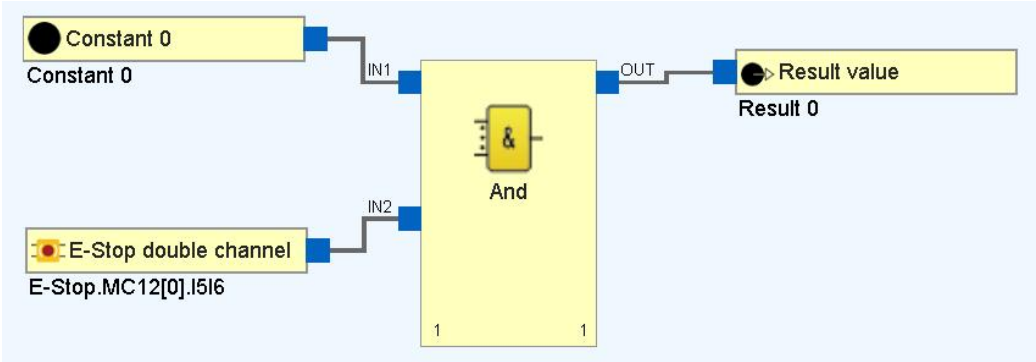


Figure 4.26 Logical connection

The figure above shows a basic logical connection style. One is connected to the **IN1** input of the function block with a **Constant 0**, the **IN2** input is connected to an **Emergency stop signal**, and the **OUT** is connected to a **Running result**.

The straight line or polygonal lines linking terminals are termed **Connection Lines**.

- The **Connection Lines** can be selected or deleted.
- Deleting the elements on either side of the **Connection Lines**, automatically removes associated **Connection Lines**. So when a function block is deleted, all connections connected to it will be deleted.
- The path of the **Connection Lines** is automatically generated by the configuration software.

4.5.12 Logic program check

The configuration software automatically checks the logic program for errors. If an error is detected, the elements affected are displayed in orange-red highlighting.

Also, clicking **Toolbar button** 检 checks a page-specific validation, and the checked errors will be displayed in the **Error List panel** below.

The following table gives the types of error detected by the configuration software.

Table 4-1 Error Types

Serial number	Error description	Cause of error
1	Function block input connection is incomplete	Some inputs on the function block are not connected

2	Special function block not available (not active)	(Lidar zone switch, Lidar output detection) function block is not connected to Lidar or Speed monitor function block .
3	Function Block Property Configuration Wrong	Function block parameters are not configured correctly.
4	Inputs and outputs from hardware are not available	Elements corresponding to input and output are deleted.
	Orphaned destination jump address	Destination jump address used as input has no source jump address connected to any function block output

4.5.13 Logic simulation

The configuration software provides **offline simulation** for the **MPU logic unit**, enabling functional

validation by applying input values to simulate function block execution. Click the toolbar button  to start or terminate the simulation.

4.5.14 Location

In terms of **Logical editing**, variable elements of input, output and diagnostic types can all be located. The method is as follows:

- Right-click on the right node, and select the desired destination from the pop-up menu.
- Right-click on the input type graphic element on the program diagram, and select the desired destination from the pop-up menu.

4.5.15 Rename

On the program diagram of logical editing, apart from types as **Constant 0**, **Constant 1**, **Diagnostic data** with fixed meanings, and **Master station result**, other input and output quantities can also be renamed.

Right-click on the input or output graphic element on the program diagram, then select the menu item **[Rename]** from the pop-up menu. This will open the renaming window. Enter the new name in the editing field and you can complete the renaming.

5 Component parameter settings

5.1 Single/Dual-channel input elements & Composite Input elements

Applicable input elements are shown in Table 5-1 below:

Table 5-1 Single/Dual-Channel Input Elements and Composite Input Elements

ID	Element Name	Position
1	Emergency stop single-channel	Hardware Selection Interface->Right
	Emergency stop dual-channel	Panel->Elements->Input->Control equipment
2	Switch single-channel NO,	Hardware Configuration Interface->Right
	Switch single-channel NC	Panel->Elements->Input->Safety switches
	Switch dual-channel NO	
	Switch dual-channel NC	
	Switching dual-channel complementary	
3	IIIA	Hardware Configuration Interface->Right
	IIIC	Panel->Elements->Input->Bimanual control
4	Mode selector (2/3/4-path)	Hardware Configuration Interface->Right
		Panel->Elements->Input->Mode Selection
5	Muting sensor (1/2/3/4 sensors)	Hardware Configuration Interface->Right
		Panel->Elements->Input->Muting sensor
6	SMT	Hardware Configuration Interface->Right
	KS06	Panel->Elements->Input->Light Curtain
7	Single-zone/point	Hardware Configuration Interface->Right
	Dual Zone	Panel->Elements->Input->Fixed monitoring lidar
	Triple zone	
8	4 wire	Hardware Configuration Interface->Right
		Panel->Elements->Input->Safety mat

Taking the Dual-channel emergency stop as an example, the configuration items are as follows:

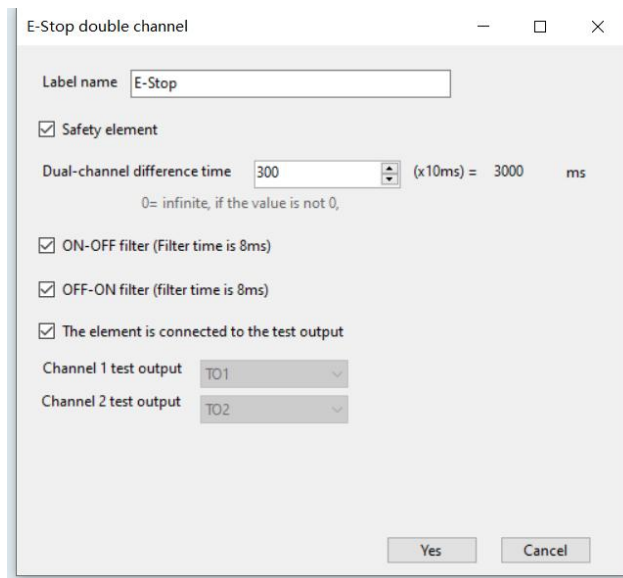


Figure 5.1 Setup window for dual-channel emergency stop



Tips

1. Input components are divided into safety elements and non-safety elements. The attribute "**Safety element**" needs to be checked in the property editing interface. In logical editing, the primitive background colors corresponding to safety elements and non-safety elements are different. (Note: Light yellow indicates safety, light gray indicates non-safety).
2. When connecting the test outputs, check "**The element is connected to the test output**".

Dual-channel discrepancy time

- Configurable parameter for dual-channel element.
- Defining maximum allowable time difference between channel state changes

ON-OFF/OFF-ON filters

- The ON-OFF/OFF-ON filter can be enable/disable via property checkbox.
- The filtering time cannot be customized and is fixed at 8ms.



Tips

1. For those with non-equivalent values (i.e. with opposite values, one input is **High** and the other input Enter **Low**) dual-channel elements analyzed, the corresponding filter (ON-OFF or OFF-ON) is always based on the main channel (A dual-channel consists of adjacent odd + even inputs, with odd numbers being the main channel, such as 1 (1, 2); 3 (3, 4)), Filters of the complementary channel is automatically enabled.

Elements are connected to test outputs

Test Output

- (1) This option enables testing of elements:

- It can be identified that the sensor wiring that hinders the shutdown condition is shorted to 24V.

- The electronic sensor can be tested by a test input.
- (2) Enable/disable via "**The element is connected to the test output**" checkbox in property editor.
- (3) When enabled, assign to specific Test Output Pins for **Channel 1 Test Output** and **Channel 2 Test Output**.

Channel 1 Test Output, Channel 2 Test Output

- The main module provides 4 test outputs, TO1 ~ TO4; The Expansion IO module provides 2 test outputs, TO1 ~ TO2.
- Single-channel elements correspond to 1 test output; Dual-channel elements correspond to 2 test outputs.
- Multiple elements can share same test output pin. Test outputs already allocated to 4 wire components cannot be used by other components, and test outputs occupied by other components are not available for use by 4 wire components.
- If enable "**The element is connected to the test output**", You must configure the test output for it.

5.2 Output Element Parameter Configuration

The parameter configuration described in this section applies to all output elements.

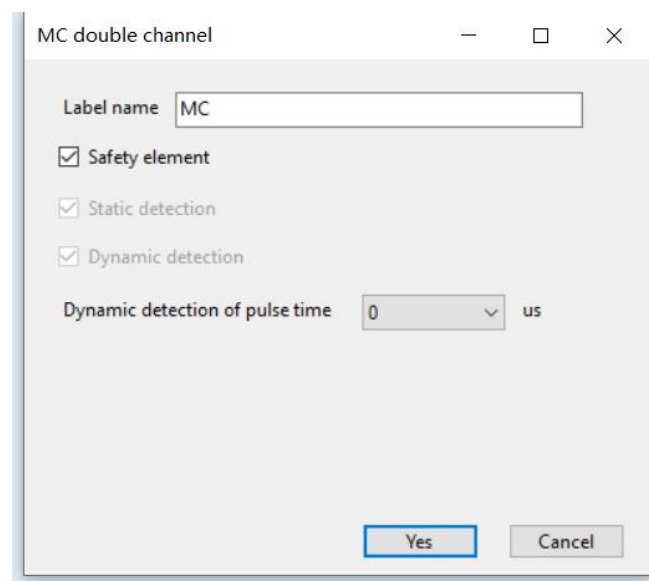


Figure 5.2 Dual-Channel Motor Contactor Configuration Window

Taking the dual-channel motor contactor as an example, the configuration items are as follows:

Safety element

- If set to safety element, [Static/Dynamic detection] are enabled automatically.
- If this option is not checked, there is no static detection and no dynamic detection.

Static detection

- As long as it is set as a safety element, static detection is turned on.

Dynamic detection

- As long as it is set as a safety element, dynamic detection is turned on.

Dynamic detection pulse time

- After turning on dynamic detection, you can set the pulse time. The setting range is 0us, 300us, 600us and 1000us.

5.3 Encoder element parameter setting



Tips

1. Safety encoders and non-safety encoders of the same class have the same configuration parameters, For example: the safety incremental encoder has the same parameters as the non-safety incremental encoder.
2. The configurable parameters of the incremental encoders and sin/cos encoder are the same.
3. The main module MC12 does not support configuring SSI encoders, and the EN module supports sin/cos encoders, incremental encoders and SSI encoders.
4. On a main module MC12 or an EN module, Only one type of sin/cos encoder and incremental encoder is allowed.
5. On an EN0000S000 module, the supply voltage setting of all encoders must be the same.
6. In the **Hardware selection interface**, light yellow indicates safety and light gray indicates non-safety.

Incremental Encoder & Sin/Cos Encoder Configuration

Taking the safety incremental encoder as an example, the configuration items are:

Supply Voltage

- Select to set the supply voltage of the encoder through the drop-down box. The options are: **Disable**, **5V**, **24V**..

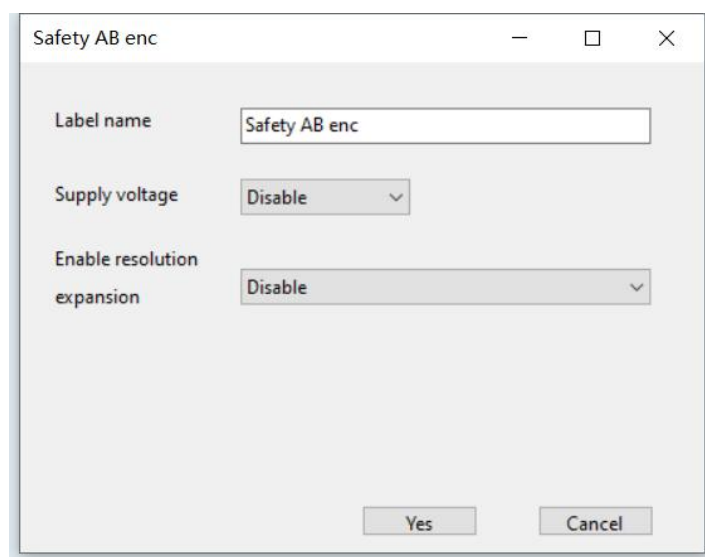


Figure 5.3 Safety incremental encoder Settings window

SSI Encoder Configuration

Taking the safety SSI encoder as an example, the configuration items are as follows:

Supply Voltage

- Select to set the supply voltage of the encoder through the drop-down box. The options are: **Disable**, **5V**, **24V**.

The power supply voltage for all encoders on the same EN module must be the same.

Coding method

- Binary, Gray code

Total number of bits of protocol framework

- The setting range is an integer from 8 to 32.

Initial number of bits of protocol framework structure

- The setting range is an integer from 0 to 24.

Number of Position data bits of protocol framework structure

- The setting range is an integer from 8 to 32.

Baud rate of protocol framework

- The setting range is 100 to 500 KBaud, with a step of 50 KBaud.

Error bit evaluation

- Monitor the error bits provided by the SSI encoder protocol framework structure. Each non-position data bit can be individually configured to indicate an error state with either 1 or 0.

Safety SSI enc

Label name:

Supply voltage:

Encoding mode

☒ Binary system

☐ Gray code

Protocol framework structure

Total bit:

Initial bit:

Location data bits:

Baud rate: KBaud

Error bit evaluation

	1	10
0Error	☒	☐
1Error	☐	☐

Figure 5.4 Safety SSI Encoder Settings Window

5.4 Lidar element parameter configuration

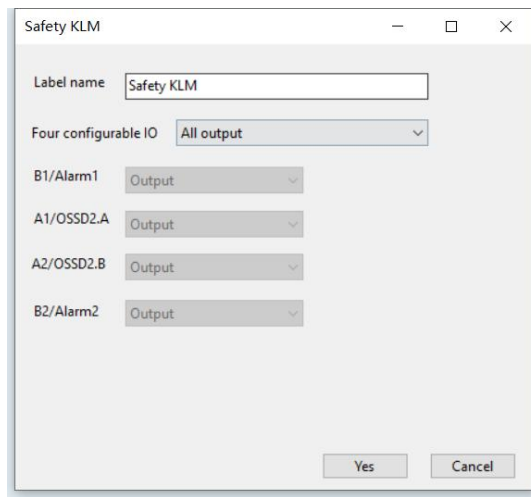


Figure 5.5 Lidar element Settings window

4-way configurable I/O

- 4 ways configurable I/O of Lidar can be set as **input**, **output**, or **Disabled**.
- 6 options available:
 - All outputs
 - Only Alarm1 as input
 - Only Alarm2 as input
 - Alarm1+Alarm2 as input
 - 1 OSSD pair as input
 - Alarm1+Alarm2+Fault as input

The meaning of each option is shown in the table below.

Table 5-2 Properties of Lidar elements

4-way \	B1/Alarm1	A1/OSSD2.A	A2/OSSD2.B	B2/Alarm2	Zone Groups
All outputs	Output	Output	Output	Output	16/32/64
Only Alarm1 as input	Input	Output	Output	Disabled	16/32
Only Alarm2 as input	Disabled	Output	Output	Input	
Alarm1+Alarm2 as input	Input	Output	Output	Input	
1 OSSD pair as input	Output	Input	Input	Output	16/32
Alarm1+Alarm2+Fault as input	Input	Input	Disabled	Input	16



Attention

- The parameter settings here are only for KLM Lidar.
- KLM series safety radar requires one set of OSSD1 to be enabled.
- KLM series safety radar supports up to 6 sets of I/O (each set is a differential signal) for zone switching, with a maximum of 64 zone groups. Among these, 2 sets (4 channels) can be configured.
- All configured as outputs: 4 configurable I/O channels are used for radar zone switching, allowing up to 64 zone groups.
- Only Alarm1 as input: Radar General-I/O 01 enables Alarm1 or Fault output function, and another configurable I/O set is used for radar zone switching, allowing up to 32 zone groups.
- Only Alarm2 as input: Radar General-I/O 04 enables Alarm2 or Fault output function, and another configurable I/O set is used for radar zone switching, allowing up to 32 zone groups.
- Both Alarm1 and Alarm2 as inputs: Radar enables Alarm1, Alarm2, or Alarm1 with Fault, or Alarm2 with Fault output functions, and another configurable I/O set is used for radar zone switching, allowing up to 32 zone groups.
- One set of OSSD as input: Enable one set of OSSD2, and another configurable I/O set is used for radar zone switching, allowing up to 32 zone groups.
- Alarm1, Alarm2, and Fault as inputs: Radar enables Alarm1, Alarm2, and Fault (the radar side will assign General-I/O 02 as Fault) output functions, allowing up to 16 zone groups.

6 MPU Logic Programming

MPU (Main Processing Unit), that is, the Main Processing Unit.

The functional logic of the SPC system is programmed using function blocks.

6.1 Precautions

Delay Caused by Jump Addresses

Jump Addresses may extend the logical execution time and thus increasing the system response time. The concept of logical loopback is described in Section 4.5.9. If a logic loopback occurs, the input is not the output value of the current logic cycle, but the output value of the previous logic cycle. For functionality, users need to consider the implications of this when designing logic.

6.2 Overview of Functional Blocks in MPU

Functional blocks in the **MPU logic unit** are divided into **Basic logic operation blocks** and **Specific functional blocks**. The latter are divided in detail according to their practical applications. The following table lists all available functional blocks in the MPU:

Table 6-1MPU Function Blocks

Basic Logic	
● AND ● OR ● NOT ● XOR ● XNOR ● RS Trigger	● Delayer ● Route 1: N ● Route N: N ● Multiple Release ● Multiple Memory ● Single-pulse Generator
Common Applications	
● Emergency Stop ● Restoration ● EDM ● Light Curtain Monitoring	● IIA Monitoring ● IIIC Monitoring ● Mode Selection
Muting	
● Parallel Muting ● Sequential Muting ● Position detection Muting	● Cross Muting ● L-Type Muting
Edge	
● Edge detection	
Counter	
● Event Counter (Up) ● Event Counter (Down) ● Event Counter (Up/ down)	● Clock Generator

A logic unit can contain up to 255 functional blocks.

6.3 Function Block Configuration

Most function blocks have configurable parameters. Depending on the respective functional block, these parameters vary.

Select a function block, right-click, and select **[Edit]** to open the **Property Configuration Window** of the function block. The following example shows the **Property Configuration Window** for the function block **Light Curtain Monitoring**:

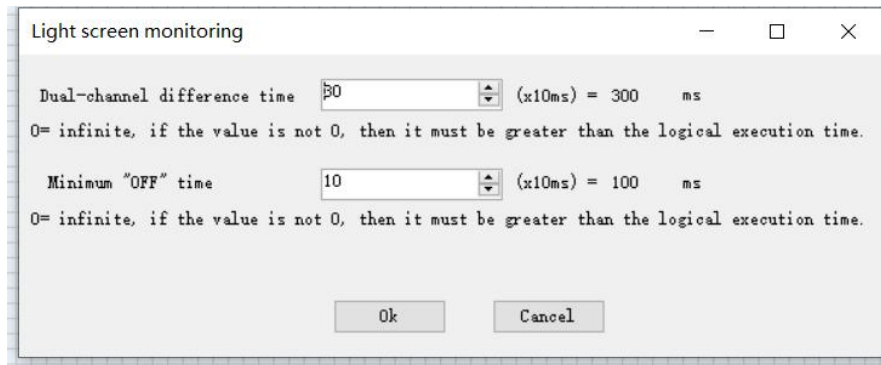


Figure 6.1 Property Configuration Window

The property configuration window displays all the attributes of this function block.



Tips

Function blocks **NOT**、**XOR**、**XNOR**、**Single-pulse Generator** have no property configuration window.

6.3.1 Function Block Input

The function block inputs come from the following three sources:

- (1) Input components listed in the MPU right-side selection tree
- (2) Outputs from function blocks
- (3) Jump Addresses

6.3.2 Input Inversion

Blocks supporting input inversion:

- AND
- OR
- RS Trigger

When inverting the input, the value 1 is treated as 0 and the value 0 is treated as 1.

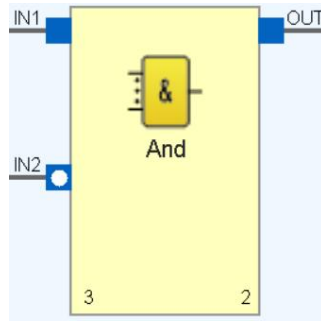


Figure 6.2 And Block with IN2 Inverted

Take **AND** function block as an example, The steps for using input inversion are as follows:

- (1) Select the block and right-click to select **[Edit]** Menu.
- (2) In the property window, such as Figure 6.3 below, click the check box **[Input2]**.
- (3) Click **[OK]**. Input IN2 of the function block AND is now marked as inverted (Figure 6.3).

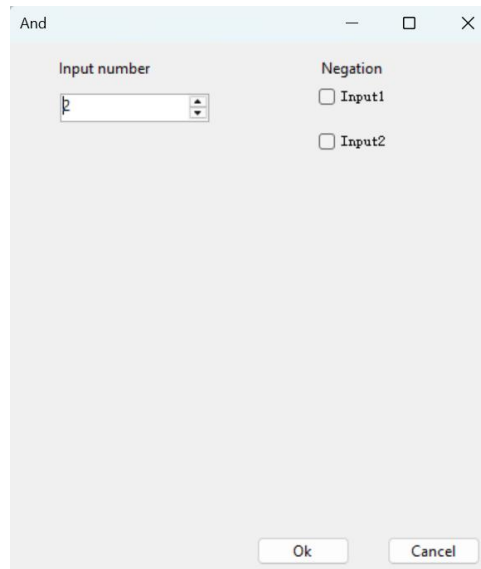


Figure 6.3 AND Block Property Window

6.3.3 Function Block Output

The outputs of the functional blocks may be connected to physical outputs and outputs of other functional blocks.

A output of a function block can be connected to multiple successor function blocks, but only one output element can be connected. As shown in the figure below, the **Q** output of an **RS Trigger** are connected: Single-Channel **Motor Contactor**, and also connected **the IN input of a NOT Block**, As well as the **IN1 input of an OR Block**.

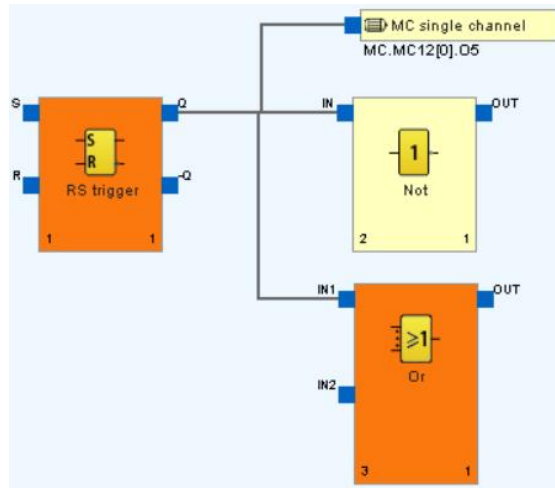


Figure 6.4 Multi-Connections

6.4 Basic Logic Function Block

6.4.1 AND

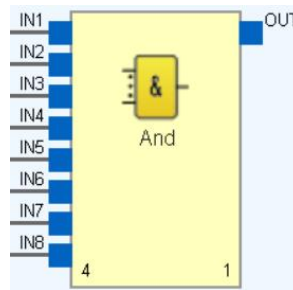


Figure 6.5 Functional Block Symbol

Functional Description

The output is 1 only if all inputs are 1, otherwise outputs 0.

Maximum Inputs: 8.

Function block parameters

Table 6-2 AND Block Parameters

Parameter	Description
Number of Inputs	Configurable, range 2 ~ 8.
Inversion of input	Each input can be reversed. 1 → Treated as 0 0 → Treated as 1

Truth table

The truth table is suitable for function block configurations that do not use inversion.

Table 6-3 2-Input AND Truth Table

IN1	IN2	OUT
0	Arbitrary	0
Arbitrary	0	0
1	1	1

Table 6-4 8-Input AND Truth Table

IN1	IN2	IN3	IN4	IN5	IN6	IN7	IN8	OUT
0	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	0
Arbitrary	0	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	0
Arbitrary	Arbitrary	0	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	0
Arbitrary	Arbitrary	Arbitrary	0	Arbitrary	Arbitrary	Arbitrary	Arbitrary	0
Arbitrary	Arbitrary	Arbitrary	Arbitrary	0	Arbitrary	Arbitrary	Arbitrary	0
Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	0	Arbitrary	Arbitrary	0
Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	0	Arbitrary	0
Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	0	0
1	1	1	1	1	1	1	1	1

6.4.2 OR

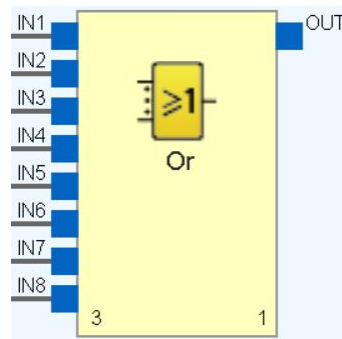


Figure 6.6 Function Block Symbol

Functional Description

Outputs 1 if any input is 1; outputs 0 only if all inputs are 0.

Maximum Inputs: 8.

Function block parameters

Table 6-5 OR Block Parameters

Parameter	Description
Number of Inputs	Configurable ,range 2 ~ 8.
Inversion of input	Each input can be inverted: 1 → Treated as 0 0 → Treated as 1

Truth table

The truth table is suitable for function block configurations that do not use inversion.

Table 6-6 2-Input OR Truth Table

IN1	IN2	OUT
0	0	0
1	Arbitrary	1
Arbitrary	1	1

Table 6-7 8-Input OR Truth Table

IN1	IN2	IN3	IN4	IN5	IN6	IN7	IN8	OUT
0	0	0	0	0	0	0	0	0
1	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	1
Arbitrary	1	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	1
Arbitrary	Arbitrary	1	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	1
Arbitrary	Arbitrary	Arbitrary	1	Arbitrary	Arbitrary	Arbitrary	Arbitrary	1
Arbitrary	Arbitrary	Arbitrary	Arbitrary	1	Arbitrary	Arbitrary	Arbitrary	1
Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	1	Arbitrary	Arbitrary	1
Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	1	Arbitrary	1
Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary	1	1

6.4.3 NOT

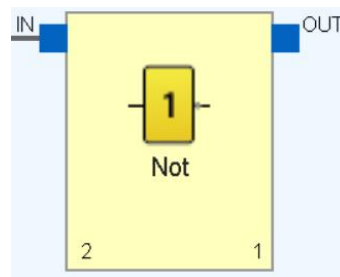


Figure 6.7 Function Block Symbol

Functional Description

If the input is 1, then the output is 0, and vice versa.

Truth table

Table 6-8 NOT Block Truth Table

IN	OUT
0	1
1	0

6.4.4 XOR

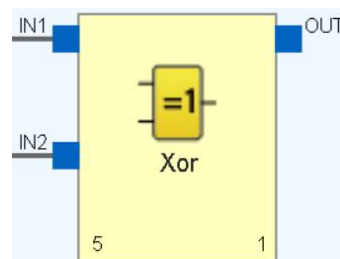


Figure 6.8 Function Block Symbol

Functional Description

Outputs 1 only if inputs differ; outputs 0 when inputs are identical.

Truth table

Table 6-9 XOR Block Truth Table

IN1	IN2	OUT
0	0	0
1	1	0
0	1	1
1	0	1

6.4.5 XNOR

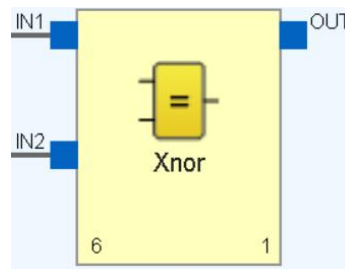


Figure 6.9 Function Block Symbol

Functional Description

Outputs 1 only if inputs are identical; outputs 0 when inputs differ.

Truth table

Table 6-10 XNOR Block Truth Table

IN1	IN2	OUT
0	0	1
1	1	1
0	1	0
1	0	0

6.4.6 RS

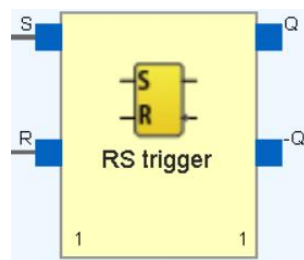


Figure 6.10 Function Block Symbol

Functional Description

The RS Trigger is a simple memory unit with two input terminals **R (Reset)** and **S (Set)**, and two complementary output terminals **Q** and **-Q**. The block is to store the last value of the input on **S** or **R**, and the priority of **R** is higher than that of **S**. When using it, Input Inversion can be configured for per input.

Function block parameters

Table 6-11 RS Trigger Parameters

Parameter	Description
S inversion	1 → Treated as 0

	0 → Treated as 1
R inversion	1 → Treated as 0 0 → Treated as 1

Truth table

The truth table is suitable for function block configurations that do not use inversion.

Table 6-12 RS Trigger Truth Table

S	R	Q	-Q	Status
0	0	Output hold	Output hold	No change
0	1	0	1	Reset
1	0	1	0	Set
1	1	0	1	Reset Dominant

6.4.7 Delayer

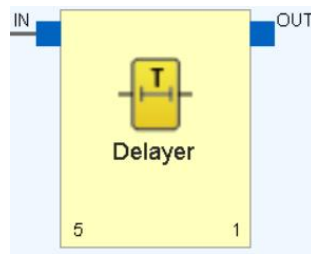


Figure 6.11 Function Block Symbol

Functional Description

Be equipped with “ON-OFF” and “OFF-ON” two kinds of delay functions, the user can and can only choose to enable one of the delay functions at a time, which can be set Delay Time.

ON-OFF Delay function delays the turn-off of the output by a configured time, OFF-ON Delay function delays the turn-on of the output by a configured time.

Function block parameters

Table 6-13 Timer Block Parameters

Parameter	Description
Enable ON-OFF Delay	Check to indicate enabled; If not checked, it means it is not enabled.
ON-OFF Delay Time	If ON-OFF delay is enabled, the delay time can be configured. In 10ms steps, units; ms.
Enable OFF-ON Delay	Check to indicate enabled; If not checked, it means it is not enabled.
OFF-ON Delay time	If the OFF-ON delay is enabled, the delay time can be configured. In 10ms steps, units: ms.

Function block input appears from 1 to 0(0 to 1)When converting, the internal timer starts working, after configured delay time, the output becomes 0(1). the premise that this function performs is: within delay time, the input is always hold at 0(1). When the input at any moment becomes 1(0), then the output immediately becomes 1(0), and the timer is reset.

6.4.8 Route 1: N

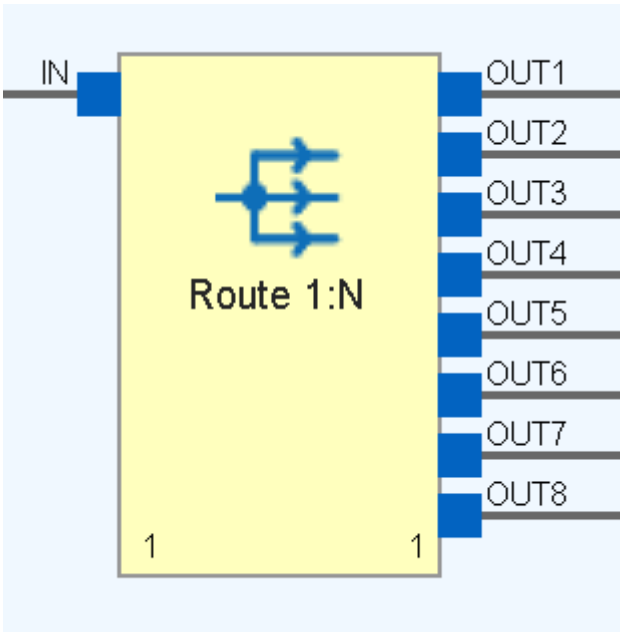


Figure 6.12 Function Block Symbol

Functional description

Route 1: N distributes an single input signal to up to eight output channels with zero logical processing delay.

Function block parameters

Table 6-14 Route 1: N

Parameter	Description
Number of inputs	Configurable (1-8 outputs)

Timing Diagram

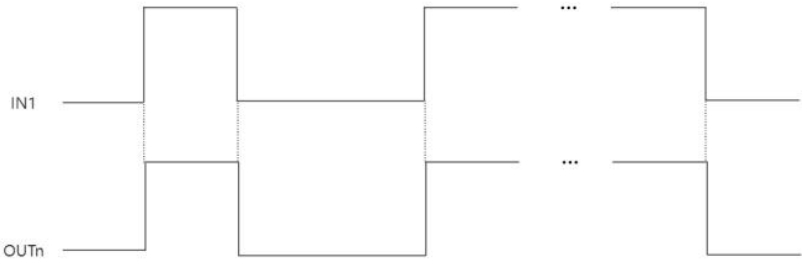


Figure 6.13 Routing 1: N Timing Diagram

6.4.9 Route N: N

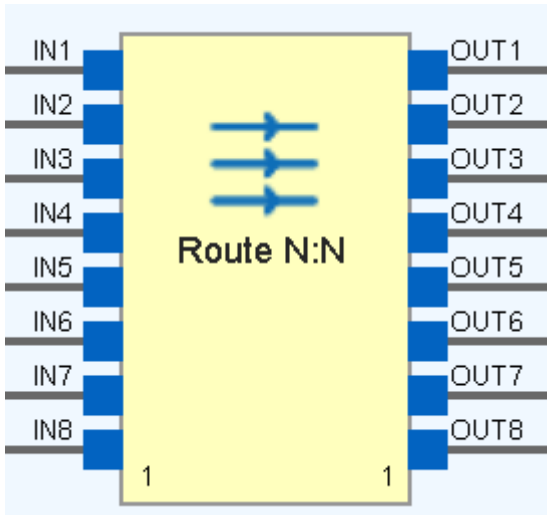


Figure 6.14 Function Block Symbol

Functional description

Route N: N routes up to 8 input signals in parallel to up to 8 output channels.

Function block parameters

Table 6-15 Route N:N Parameters

Parameter	Description
Number of inputs or output	Configurable , range 1 to 8.
Input Inversion	Each input can be inverted: 1 → Treated as 0 0 → Treated as 1

Timing Diagram

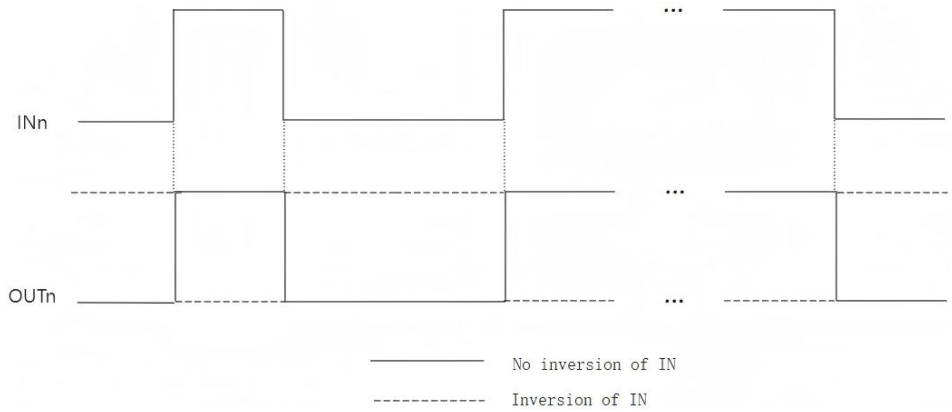


Figure 6.15 Routing N: N Timing Diagram

6.4.10 Multiple Release

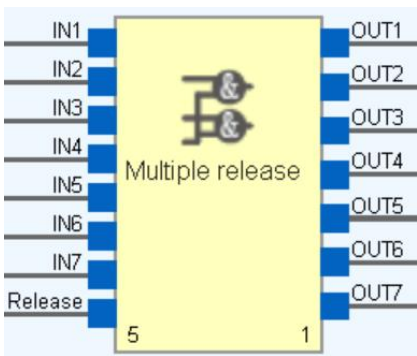


Figure 6.16 Function Block Symbol

Functional description

Multiple release Routes one of 7 input signals to a single output based on a channel selection signal..

Function block parameters

Table 6-16 Multiple Release Parameters

Parameters	Description
Number of inputs or output	Optional, range 1 to 7.
Input Inversion	Each input can be reversed: 1 → Treated as 0 0 → Treated as 1

Timing Diagram

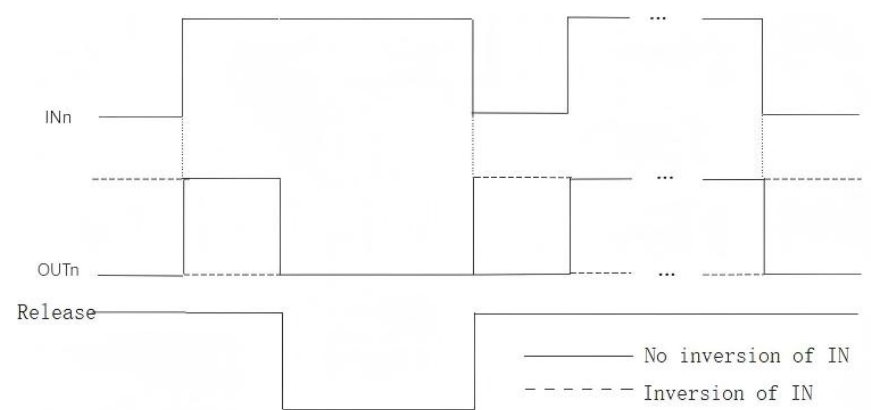


Figure 6.17 Multiple Release Timing Diagram

Truth table

Table 6-17 Multiple Release Truth Table

Release Input	OUT
0	0
1	Input X

6.4.11 Multiple Memory

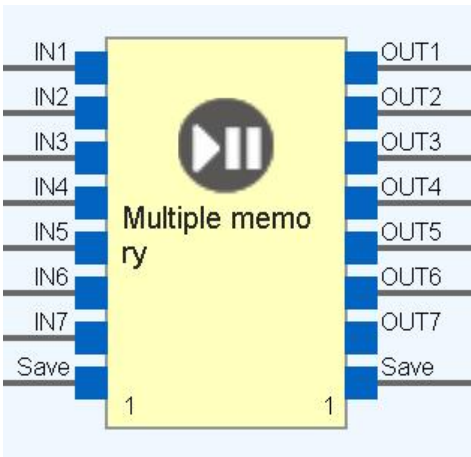


Figure 6.18 Function Block Symbol

Function Block Description

The block can transmit or save up to 7 input states to corresponding output terminals based on the

Save input.

When the **Save input** is set to 0, states 1-7 are consistently forwarded to **Outputs 1-7**.

If the **Save input** changes from 0 to 1, the current states of inputs 1-7 are stored and output to **Outputs 1-7** as long as the **Save input** remains at 1. During this period, state transitions of **Inputs 1-7** do not affect **Outputs 1-7**.

If the **Save input** is already set to 1 during the first cycle when transitioning from a stopped state to an operational state, this behavior functions similarly to setting it from 0 to 1: the current states of **Inputs 1-7** are stored and output to **Outputs 1-7** as long as the **Save input** stays at 1.

If the **Save input** remains unchanged, the **Save output** states always match the **Save input**.

If **Save input** is inverted, the **Save output** states consistently align with the inverted **Save input**.

Function block parameters

Table 6-18 Multiple Release Parameters

Parameters	Description
Number of inputs or output	Optional, range 1 to 7.
Save Inversion	When reversed, 1 is treated as 0 and 0 as 1.
Input Inversion	Each input can be reversed. When an input is reversed, 1 is treated as 0 and 0 as 1.

Timing Diagram

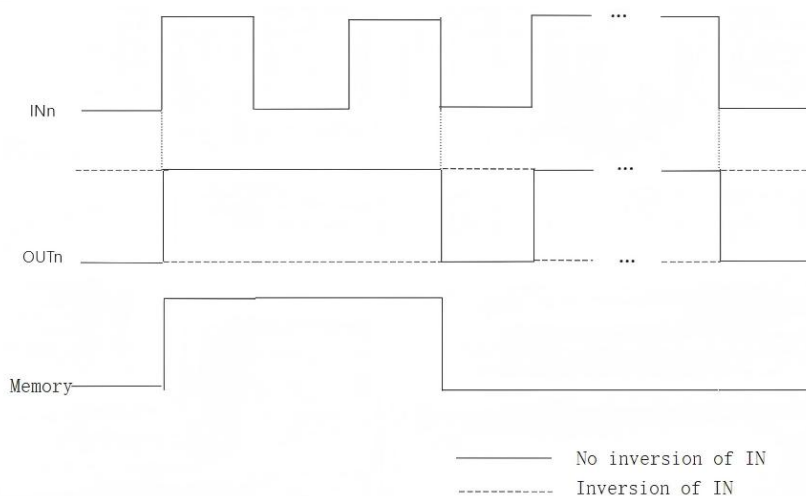


Figure 6.19 Multi-Memory Timing Diagram

Truth table

Table 6-19 Multiple Memory True Table

Save Input	Save Output	X _n Output
0	0	X Input
↑	↑	X Output
1	1	X _{n-1} Output

6.4.12 Single-pulse generator

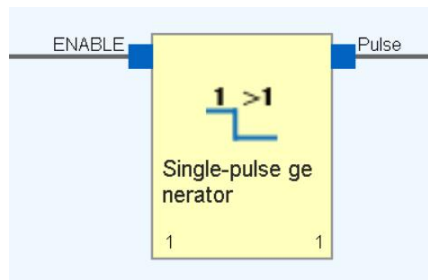
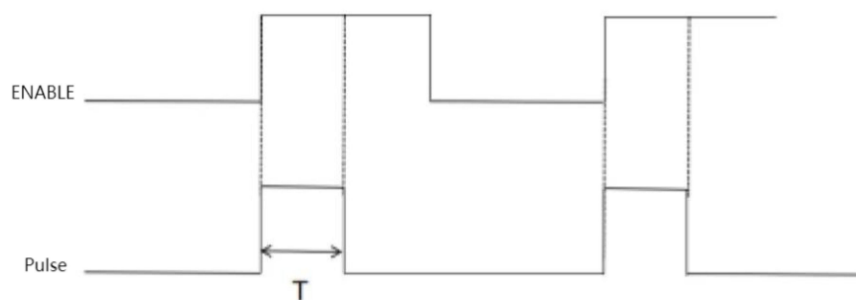


Figure 6.20 Function Block Symbol

Function Block Description

When the enable signal is high, it outputs a one-cycle high pulse for resetting certain devices.

Timing diagram



T:Logical execution cycle

Figure 6.21 Single-pulse Generator Timing Diagram

6.5 General Application Function Block

6.5.1 Emergency Stop

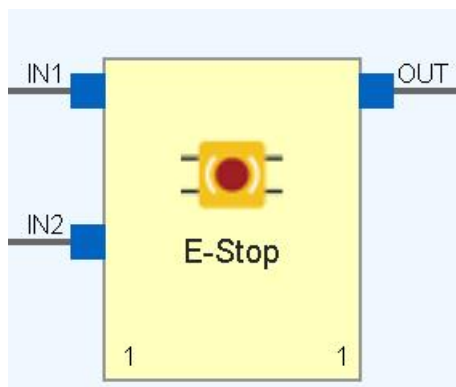


Figure 6.22 Functional block Symbol

Functional Description

Emergency stop function block monitor the status of the emergency stop button, output the status signal of the emergency stop button, and provide the user with a trigger safety stop signal. The user can set the input type (single-channel, dual-channel leading) and dual-channel difference time (0 ~ 3000ms, in 10ms step, 0 = disabled). Using the emergency stop function block, the emergency stop function can be realized by the emergency stop button.

When emergency stop button is closed, the block outputs 1, other status Outputs 0. When

dual-channel input signal difference time super pass the set value, the function block output is 0.

FAULT is a fault signal. When the time difference between the two channels exceeds, the output of **FAULT** is 1; when detects the two channels are consistent, the fault recovery occurs and the output of **FAULT** is 0.

Function block parameters

Table 6-20 Emergency Stop Parameters

Parameter	Description
Input Type	● Single channel ● Dual channel equivalent ● Two-channel non-equivalent
Discrepancy Time	Unit ms, stepped in 10ms.
Enable Fault Output	Check to enable Fault output; otherwise, disable it.

Timing diagram

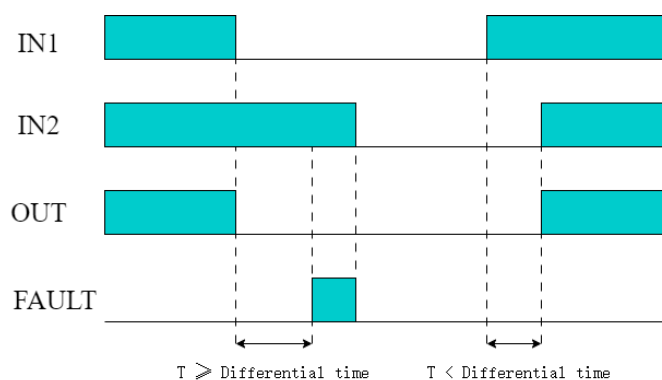


Figure 6.23 Dual-Channel Equivalent Timing Diagram

6.5.2 Reset

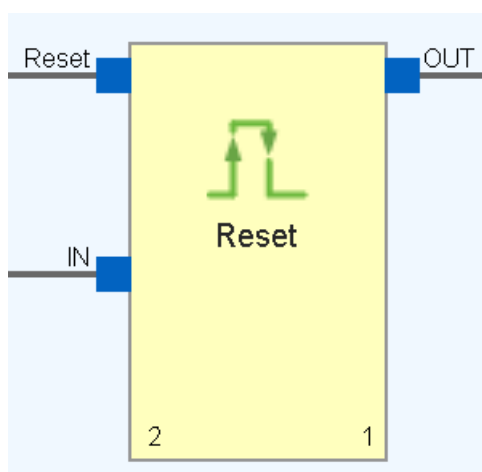


Figure 6.24 Function block

Functional Description

Monitors the state of the reset button, judges the validity of the reset signal according to the input state of the reset button, and outputs the reset signal. Minimum reset pulse time (100ms, 350ms) and maximum effective duration (0.5 ~ 30S).

The **Reset** function block can be used to meet specification requirements for safety applications,

confirm manual safety stops, and meet requirements for application restarts. Generally, each safety logic of the SPC contains a reset function block.

When **Reset input** is high and exceeds the maximum valid duration, the **FAULT** output is high and **OUT** is low. When **Reset input** is low, the fault recovery occurs and the **FAULT** output is low.



Attention

When the physical input is shorted to high, it may cause an unexpected reset, and if not careful, the dangerous state may not end or end in time.

Ensure that the conversion of the reset signal meets the requirements of safety standards and regulations:

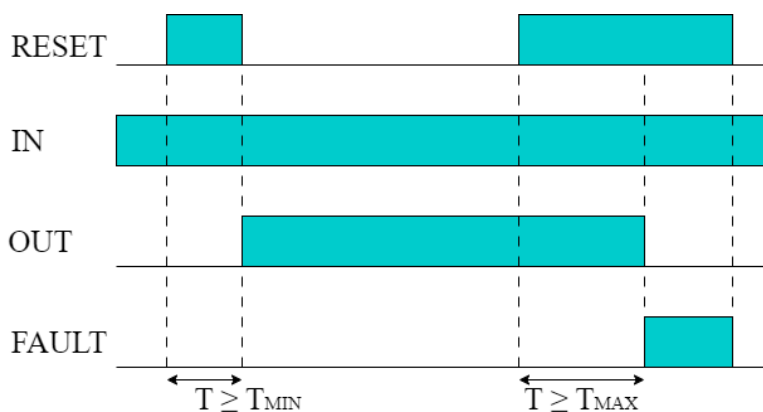
- Provide protection for signal cable laying.
- The reset signal has no short circuit detection, i.e. no test output is connected.

Function block parameters

Table 6-21 Reset BlockParameters

Parameter	Description
Minimum Reset Pulse Time	● 100ms ● 350ms
Maximum Active Duration	The unit is ms, stepped in 500ms, with a range of 500-30,000ms.
Enable Fault Output	Check to enable Fault output; otherwise, disable it.

Timing diagram



T_{MIN} is the minimum reset pulse time set by the user

T_{MAX} is the maximum effective duration set by the user

Figure 6.25 Reset Timing Diagram

6.5.3 EDM

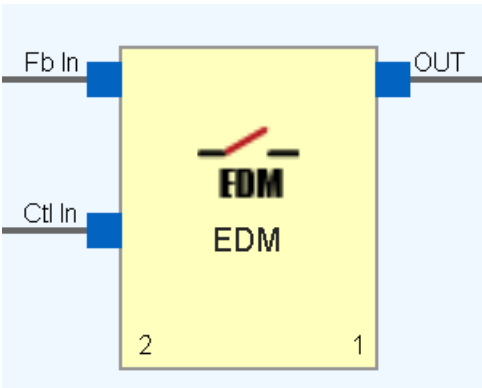


Figure 6.26 Function Block Symbol

Functional Description

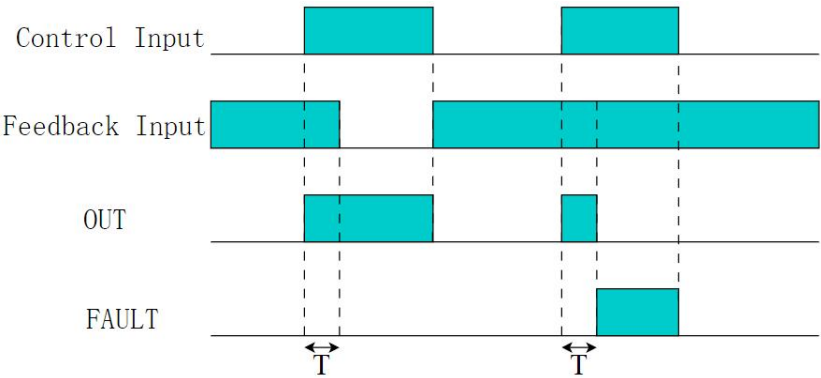
The **EDM** function block can monitor external devices (such as relays) and use their feedback signals to check whether they switch as expected. In the application, the external device is required to be connected to the output of the function block, the feedback signal is connected to the feedback input of the function block, and the logic signal that requires the external device to reach the specified state is connected to the control input.

Function Block Parameters

Table 6-22 EDM Block Parameters

Parameter	Description
Feedback Delay	The unit is ms, stepped in 10ms, ranging from 10 to 60000ms.
Enable Fault Output	Check to enable Fault output; otherwise, disable Fault output.

Timing diagram



T is the feedback delay time set by the user

Figure 6.27 EDM Timing Diagram

6.5.4 Light Curtain Monitoring

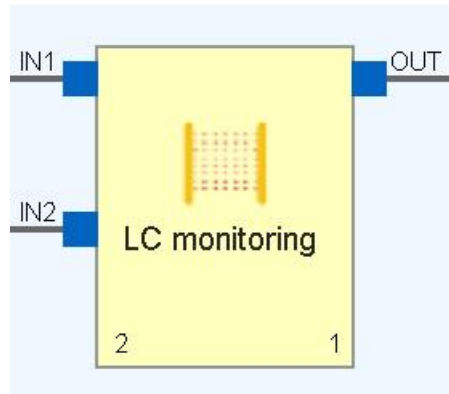


Figure 6.28 Function Block Symbol

Functional Description

Monitors the state of the safety light curtain signals, outputs the state signal of the safety light curtain, provides the trigger safety stop signal for the user, and the user can set the dual-channel difference time (0 ~ 3000ms, in 10ms step, 0 = disabled), set the minimum "OFF" time monitoring (10-1000ms, stepped in 10ms, 0 = unlimited).

When the light screen is ON, the function block outputs "1", and outputs 0 in other states. When the difference time between the dual-channel input signals exceeds the set value, the function block outputs 0.

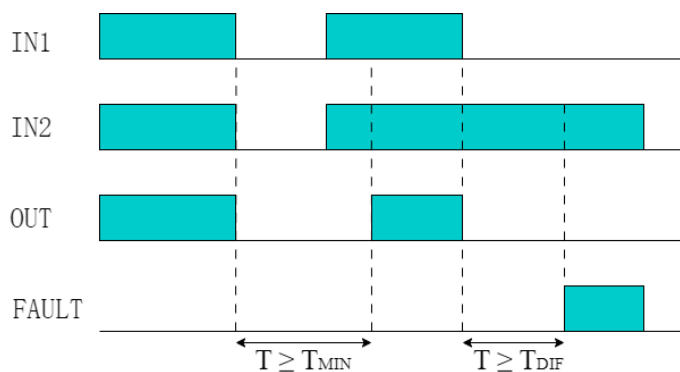
FAULT is a fault signal. When the time difference between the two channels exceeds, the output of FAULT is 1; when the two channels are consistent, the fault recovery is detected and the output of FAULT is 0.

Function block parameters

Table 6-23 Light Curtain Monitoring Parameters

Parameter	Description
Dual-channel Discrepancy Time	0 means infinite, 10-3000ms (10ms steps)
Minimum OFF Time	0 means infinite, 10-1000 ms (10ms steps)
Enable Fault Output	Check to enable FAULT output; otherwise, disable it.

Timing diagram



T_{MIN} is the minimum OFF time set by the user

T_{DIF} is the dual-channel differential time set by the user

Figure 6.29 Light Curtain Monitoring Timing Diagram

6.5.5 IIIA Monitoring

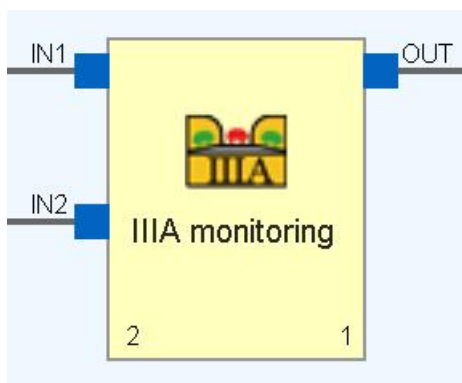


Figure 6.30 Function Block Symbol

Functional Description

Monitors the state of the two-hand control signals, output the state signal, and provide a trigger start signal for the user, **IIIA Monitoring** block analyzes the difference time of the dual-channel equivalent input signals. Differential time monitoring is used to monitor type IIIA bi manual control (According to EN ISO 13851) step operation.

The internal logic of the **IIIA Monitoring** block is similar to the operation mode of the **Emergency Stop** function block, but the parameter selection is limited.

When the dual-channel input signals are equal and the input signal is 1, the output is 1.

Table 6-24 IIIA Monitoring Parameters

Parameter	Description
Enable the FAULT output	Check to enable FAULT output; otherwise, disable it.

Timing diagram

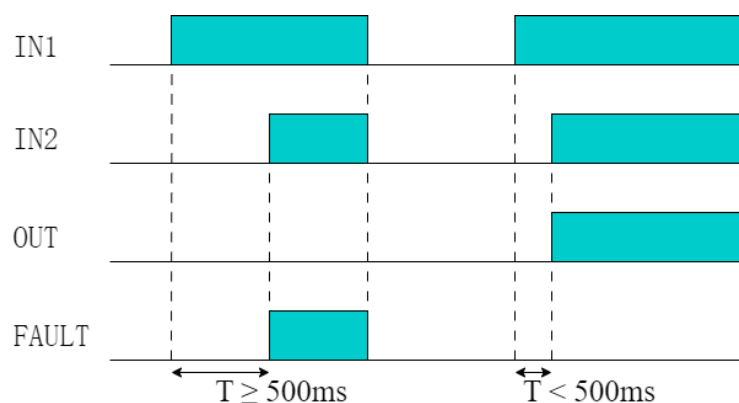


Figure 6.31 IIIA Monitoring Function Block Timing Diagram

6.5.6 IIIC Monitoring

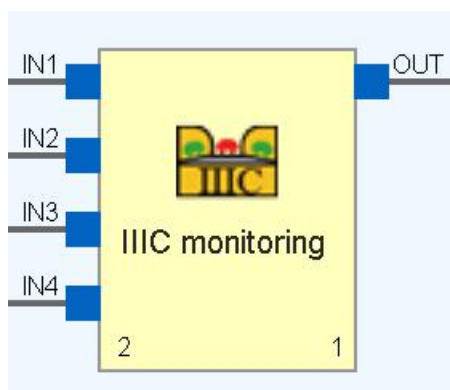


Figure 6.32 Function Block Symbol

Functional Description

IIIC Monitoring Contains two dual-channel input pairs, each input pair contains a NO contact and a NC contact, the discrepancy time of the dual-channel input pair is ≤ 500 ms, full performance up to Cat.4 (ISO 13849-1). Output = 0 if any pair exceeds discrepancy time.

Fault detection:

FAULT = 1 on:

- Inter-pair sync failure (>500ms)
- Intra-pair discrepancy > configured time

FAULT = 0 upon recovery.

Function block parameters

Table 6-24 IIIC Monitoring Parameters

Parameter	Description
Discrepancy Time Pair 1	0 means infinite, 10-500ms (10ms steps)
Discrepancy Time Pair 2	0 means infinite,, 10-500ms (10ms steps)
Enable Fault Output	Check to enable Fault output; otherwise, disable it.

IIIC Monitoring function blocks analyze their input signals in pairs, each input pair is subjected to dual-channel non-equivalent analysis, and the discrepancy time can be set for either of the two input pairs.

Timing diagram

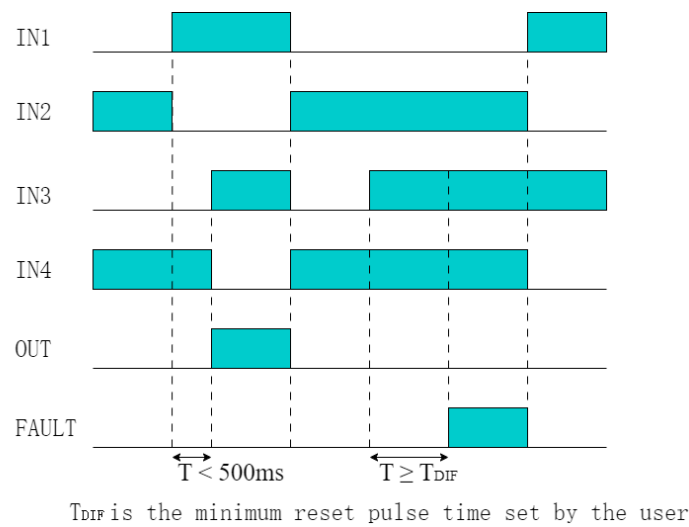


Figure 6.33 IIC Monitoring Function Block Timing Diagram

6.5.7 Mode selection

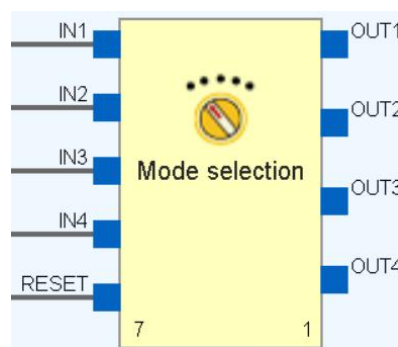


Figure 6.34 Functiona Block Symbol

Functional Description

Monitors the state of the mode switch signal, output the state signal of the mode switch, and monitor the correctness of the user mode switch. The number of input signals can be selected (2-4 channels), the discrepancy time of input signals can be set (0-10s, step by 10ms), whether reset is enabled can be selected, and the output quantity is the same as that of input.

Only one input can be "1" at any time. When the input X is "1", when there is no or more than one input "1", the output of the original output "1" will remain "1" within the set discrepancy time. After the discrepancy time is exceeded, the output will be "0" and an error signal will be output.

FAULT is a fault signal. When the discrepancy time is exceeded, the output of FAULT is 1; when the input is restored to high fault recovery for only one path, the output of FAULT is 0.

Function block parameters

Table 6-26 Mode Selection Parameters

Parameter	Description
Enable Reset	Checked means enabled, unchecked means not enabled.
Number of Input	Optional, range 2 ~ 4.
Discrepancy time	0 means infinite, in 10 steps, ranging from 10 to 10000, in ms.
Enable Fault Output	Check to enable Fault output; otherwise, disable it.

Mode selection with reset function: When the input signal is normal and there is no fault, an effective excitation signal appears on the reset input, and the corresponding output is turned on.



Attention

Limited cross-circuit checks when using test outputs, if not attentive, the dangerous state may not end or end in time.

Troubleshoot the crossover circuit of the input, such as to provide protection for the laying of signal lines and cables.

- If the input is connected to the test output and a crossover circuit fault is detected, causing the output to shut down, the crossover circuit problem must be resolved first.
- If the input is connected to the test output, only crossover faults between the inputs used can be detected when any input channel is activated.

Timing diagram

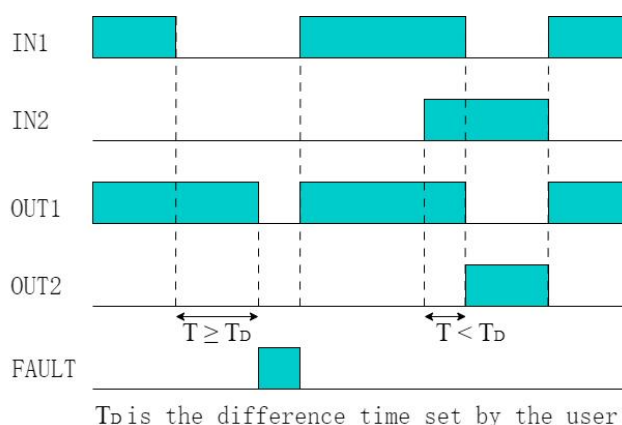


Figure 6.35 Mode Selection Timing Diagram

6.6 Muting Function Block

Function Description

1) Muting Sequence

- **Person-Object Separation:** During material transportation, muting sensors monitor the presence of material. By sensor selection and arrangement, realizing the distinction of materials and personal. When materials enter hazardous areas, muting sensor and ESPE interact to generate precise signal sequences, different muting types require different signal sequences (refer to the timing diagrams of each type).

- **Position Detection:** During the machine operating cycle, the safety sensor monitors the position of the machine's moving parts. Through the selection and arrangement of sensors, the detection of non-hazardous positions of the machine (e.g., the top dead center position of the press slider) is achieved.

2) Muting Type

Includes:

Parallel Muting, Sequential Muting, Cross Muting, L-Type Muting and Position detection Muting.

3) Muting period

A muting period includes all the sequences during the muting process: Start, Hold and End. Each sequence is unique, depending on the selected muting type and configuration, all sequences are monitored to ensure correct operation..

The muting period starts when the first muting sensor activates. The period ends based on user configuration. A new period can only begin after the previous period ends.

4) Period Hold

Maintains the muting period state:

- Parallel/Cross Muting: Requires at least one sensor pair (A1/A2 or B1/B2) always active.
- Sequential Muting: Requires at least one sensor (A1 or B2) always active.
- In the L-Type Muting and Position detection Muting functions, if a pair of muting sensors (A1 and A2) remains activated (refer to the timing diagrams for different muting types), multiple material transports or entries into the hazardous area (only applicable in the Position detection Muting function) can be carried out within a single muting period.

During the hold state, the muting output remains 1 even if the ESPE input is 0, allowing multiple material transports per period .

Function block Parameter

Table 6-27 Muting Function Block Parameters

Signal	Type	Description
ESPE Input	Input	Monitor the status of the safety zone
A1, A2	Input	Muting sensor signals for Parallel Muting, Sequential Muting, Cross Muting, L-Type Muting and Position detection Muting.
B1, B2	Input	Muting sensor signals used only for Parallel Muting and Sequential Muting.
Override Input	Input	Optional input. for triggering override function-The override function is used to remove material stuck in the protected area or enables the machine run (usually caused by power outage, triggered emergency stop, muting error, etc.); When the override function is activated, the muting output can be activated even if no valid muting signal is detected and the ESPE input indicates that there may be danger in the defense zone; <i>(Note: The override input can only be used if the hazardous area has been visually inspected before, and there is no one in the hazardous area and no one can enter the hazardous area when the override is used)</i> During the override period, synchronous monitoring, direction monitoring and sequence monitoring are no longer carried out; The number of times the override is used is limited by the total muting time, see Table 6-31 Override Cycle Number Limit.
Conveyor Belt Signal	Input	Optional input. which is used to count the total pause muting time and synchronous monitoring time when the material stops

		transporting in the muting period; If the material stops during the muting period transfer, then it is possible causing an fault, such as total masking time time out, at this time the Transfer Signal can be used to avoidance; Conveyor belt signal 0: Conveyor system is stopped; Conveyor belt signal is 1: Conveyor system is running; For Parallel Muting, Sequential Muting, Cross Muting and L-Type Muting.
C1 (Muting Enable)	Input	Optional inputs. muting sensor inputs for tamper-resistant protection; When enabled, C1 becomes 0 at the end of the previous masking cycle and becomes 1 at the latest when the first set of masking sensors in the next cycle becomes 1, causing a masking error if this condition is not met; C1 is no longer functional after the start of the muting period; For Parallel Muting, Sequential Muting, Cross Muting and Position detection Muting. In Position detection Muting, it is called Muting Enable.
Muting Output	Output	If one of the following conditions is met, muting output is 1: (1) The input ESPE is 1 and no error; (2) Valid muting conditions exist (correct sequence). (3) A valid override period is active. Outputs 0 otherwise.
Muting Indication	Output	Used for Show active muting period, which the output value is directly dependent on the muting state, override quest and override state: (1) the muting state output is 0, muting indicator outputs 0; (2) the muting state output is 1 or the Override state output is 1, muting indicator outputs 1; (3) if Override Request output is 1, pulses at 2 Hz. For Parallel Muting, Sequential Muting, Cross Muting and L-Type Muting.
Muting State	Output	Display the status of the muting function: (1) muting period stopped, error-free, OR (2) a muting error is detected, muting state outputs 0, (3) muting period activated, none error, OR (4) Override activated, error-free, muting state outputs 1
Override Request	Output	The override state output is 1 and the override request output pulses at a frequency of 2 Hz if all of the following conditions are met, Position detection Muting output is 1:

		(1) The mask state output is 0; (2) At least one of the muting sensor inputs A1, A2, B1, B2 is 1; (3) ESPE input is 0; (4) Mask output is 0.
Override State	Output	Show status of Override function
Muting Fault	Output	Used for show detected any error, includes: (1) Total muting time monitoring error; (2) Simultaneity monitoring error; (3) Direction detection error; (4) Sequence monitoring error; (5) Error in state transition from stop to run; (6) If ESPE The input is 0 and any masking error is detected, then the muting malfunction output is 1
Timeout Output	Output	Only for Position detection Muting. The duration of shielding or override exceeds the specified time and outputs a high level.

Safety/Tamper protection

Table 6-28 Muting Monitoring Function block Parameters

ID	Monitoring	Parallel Muting	Sequential Muting	Cross-Muting	L-Type Muting	Position detection Muting
1	Sequence monitoring	√	√			
2	Direction detection	√	√			
3	Input C1	√	√	√		√
4	Sync monitoring	√		√	√	
5	Total Muting Time Monitoring	√	√	√	√	√
6	ESPE-End Recognition	√	√	√	√	

The process of Muting function from stop to start

Table 6-29 Muting function enabling and stopping process

From stopping to Activate State of		Action	
ESPE input	Muting Sensor Status	Open action	Next action
Tall	All Muting sensor inputs are low	Satisfy the normal muting sequence	Activated correctly Of After the muting sequence, the muting begins.
	Partial muting condition is satisfied		At least one muting, the sensor must be in ESPE Of OSSD Is low Before
	Satisfy the muting condition		Become high Level.

			Once ESPE Of OSSD Get Low, must be in all muting sensors are all become use before low level override.
Low	All muting sensor inputs are low	muting stop	In activate the muting function before, ESPE of OSSD must for tall.
	Partial muting condition is satisfied	Override Request	Either Regression To normal Status, either The number of overrides exceeds the limit.
	Satisfy the muting condition		

Muting applications and precautions

1) Application Classification

Table 6-30 Classification of Muting applications

ID	Category	Application-1	Application-2	Notes
1	4 muting sensors	Parallel Muting	In/Out Bidirectional	
2		Sequential Muting		
3	2 muting sensors	Cross-Muting		
4		L-Type Muting	Exit Unidirectional	Only for exit from hazardous area
5		Position detection Muting	Position Detection	
6	No sensors	Process-Based Muting		

2) Muting sensors considerations:

Selection/classification

Installation distance

3) Pay attention to wiring requirements

4) C1 Application

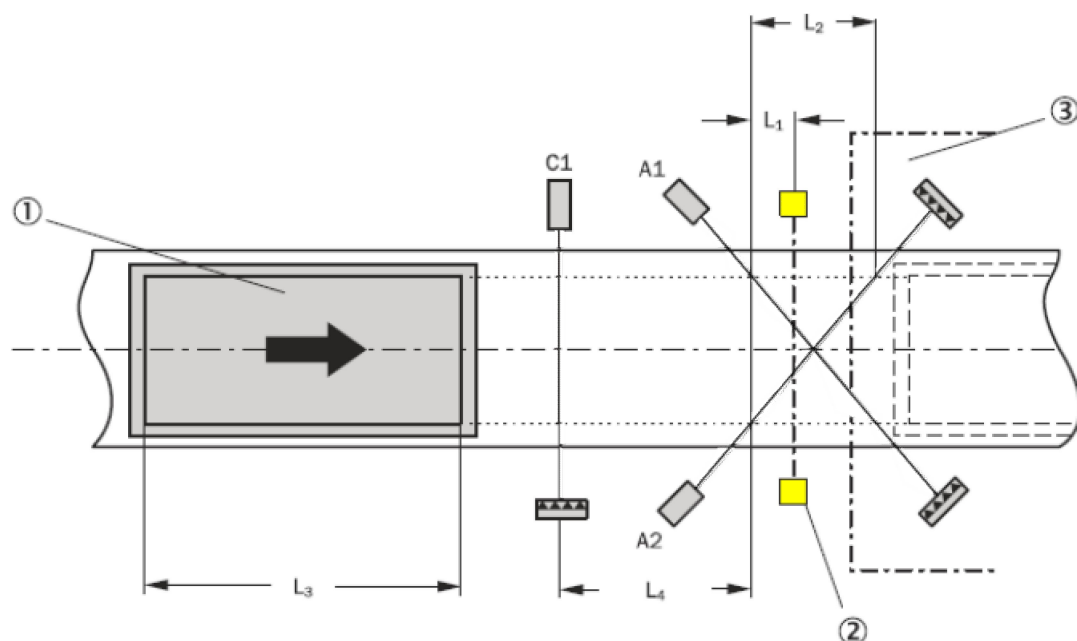


Figure 6.36 Cross Muting with Optional C1

①: Materials transported

②: ESPE

③: Hazardous area

Note: $L3 > L4$

5) Number of override cycles

Table 6-31 Override Cycle Limits

Total masking time	Max Override Cycles	Notes
5s	360	Max = 360
10s	360	
20s	180	Quantity = 60min/MutingTime
30s	120	
1min	60	
5min	12	
15min	5	Min = 5
Disabled	5	

6.6.1 Parallel Muting

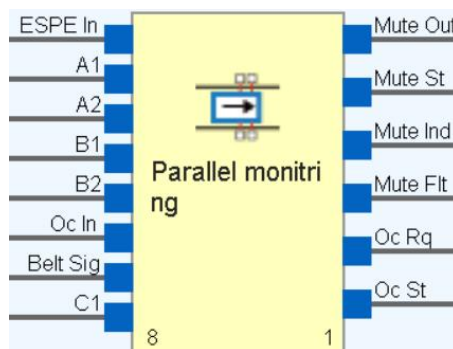


Figure 6.37 Function Block Symbol



Attention

Safety is limited when muting is active. the hazardous state may not end or may end in time if not properly considered.

Follow the prompts in muting application guidelines.

Parallel Muting sensor arrangement

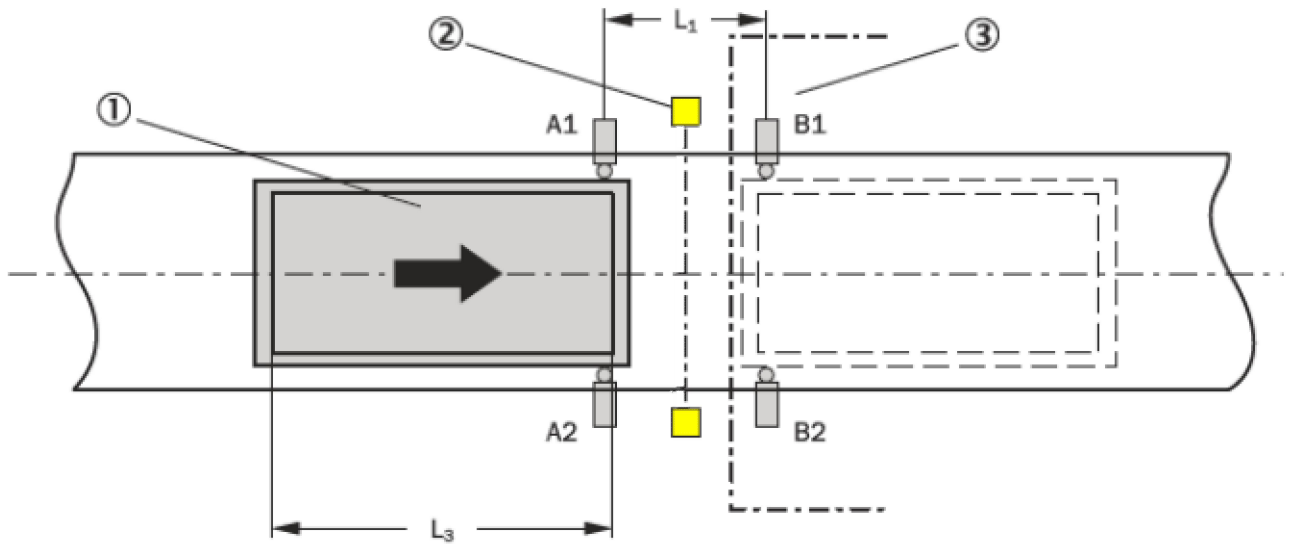


Figure 6.38 Parallel Muting Example

①: Materials transported

②: ESPE

③: Hazardous area

Calculate the distance of L_1 according to the following formulas:

- $L_1 \geq V \times 2 \times T_{in \text{ muting sensor}}$
- $V \times t > L_1 + L_3$
- $L_1 < L_3$
- $T_{in \text{ ESPE}} < T_{in \text{ muting sensor}}$

Where L_1 = sensor spacing

L_3 = length of material in transport direction

V = Material Speed

t = Total masking time set (s)

$T_{in \text{ muting sensor}}$ = muting sensor response time

$T_{in \text{ ESPE}}$ = Contact less protection Sensor(ESPE) Of Response time

Timing diagram

As shown in the above figure, the material moves from left to right. Once the muting sensors A1 & A2 are obscured, the protection provided by the ESPE is muted. Protection remains muted until the sensor pair B1 & B2 is restored. The signal timing is shown in the figure below:

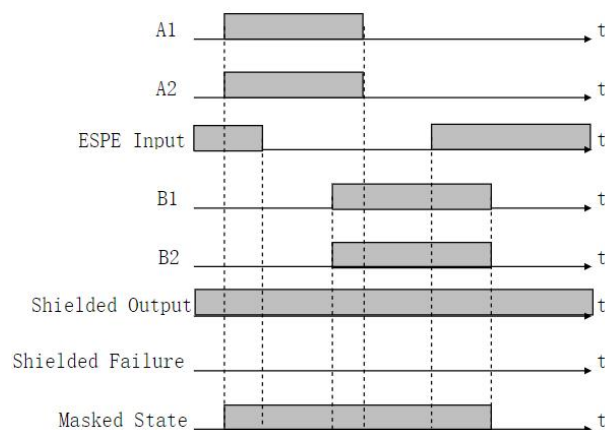


Figure 6.39 Parallel Muting Timing Diagram

Table 6-32 Parallel Muting Sensor Input Conditions

Condition	Description
A1 & A2(B1 & B2)	When starting the muting sequence, the first sensor pair is activated based on the material's transport direction.
A1 & A2 & B1 & B2	The second sensor pair is activated simultaneously.
B1 & B2 (A1 & A2)	The second sensor pair is activated based on the material's transport direction.

Function block parameters

Table 6-33 Parallel Muting Function Block Parameters

Parameter	Description
Direction detection	● Disable ● Forward (A1/A2 first) ● Backward (B1/B2 first)
Muting Start condition	● All shielded sensor signals are reset to zero:All shielded sensor inputs are set to 0, and the ESPE device is in a safe state. ● All shielded sensors except the last one are reset to zero:All shielded sensor inputs except the last one are set to 0, while the ESPE device remains in a safe state.This configuration helps increase the conveyor belt cycle time.
Mutin End Condition	● According to the muting sensor:When one sensor in the last shielding pair is at high level. ● Triggered by ESPE device:When the ESPE returns to logic 1
Additional Muting Time after ESPE Secured	When the shielding end condition is set to additional shielding time triggered by the ESPE device returning to logic 1. ● 0ms ● 200ms ● 500ms ● 1000ms
Total Muting time	Checked to enable the total muting time, unchecked to not enable. If enabled, the value range is 1 ~ 900s, and 0 means infinite.
Synchronous monitoring of muting sensors	Indicates the synchronization time between the shielding sensor pairs.The value range is 10 ~ 3000ms, and 0 means infinite.
Sensor signal debounce	Off filtering time for a single shielding sensor.The value range is 10 ~ 1000ms, and 0 means infinite.
Enable Override Input	The super control function can be used to remove goods stuck on the conveyor belt due to power failure, emergency stop, or shielding faults from the protected area. Checked means override input is turned on, unchecked means not enabled.
Enable Conveyor Signal	The function associated with the total shielding time can be disabled via the

	conveyor belt signal when goods transport stops. After the conveyor belt restarts, the total shielding time monitoring resumes operation based on the value stored before the stop. If this is the first occurrence, the total shielding time is increased by 5 seconds immediately. Checked to turn on the conveyor belt signal, unchecked to not enable.
Enable C1 Input	Additional tamper-proof input. This input must be set to 0 after the end of the previous shielding cycle, and set to 1 before both shielding sensors go high. Failure to meet this condition will result in incorrect shielding triggering Checked means C1 input is turned on, unchecked means not enabled.
Minimum Override Pulse Time	On-filtering time of override input ● 100ms ● 350ms

Application Considerations

Four muting sensors with the same response time are required. The two muting sensor pairs are symmetrical, i.e. installed at the same spacing as the ESPE protected area. Configurations different from this need to be considered separately;

Materials can either move in both directions, or only one transportation direction can be allowed through direction detection configuration parameters;

When arranged in parallel, the allowable object width can be additionally checked by the position of the muting sensor. Objects should always pass the shielded sensor at the same width;

If optical sensors are used for parallel muting, a probe with a background suppression function is usually used here to prevent a person from inadvertently activating both sensors simultaneously.

6.6.2 Sequential Muting

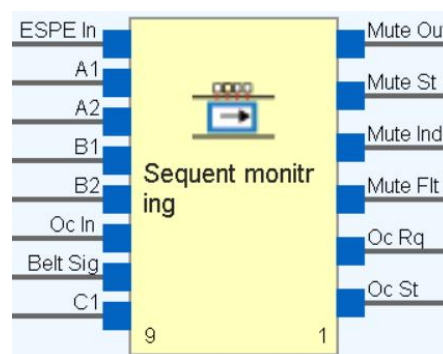


Figure 6.40 Functional Block Symbol



Attention

Safety is limited when muting is active. If not properly considered, hazardous states may not end or may not end in a timely manner.

Follow the prompts in Muting App Safety Considerations.

Sequential Muting Sensor Arrangement

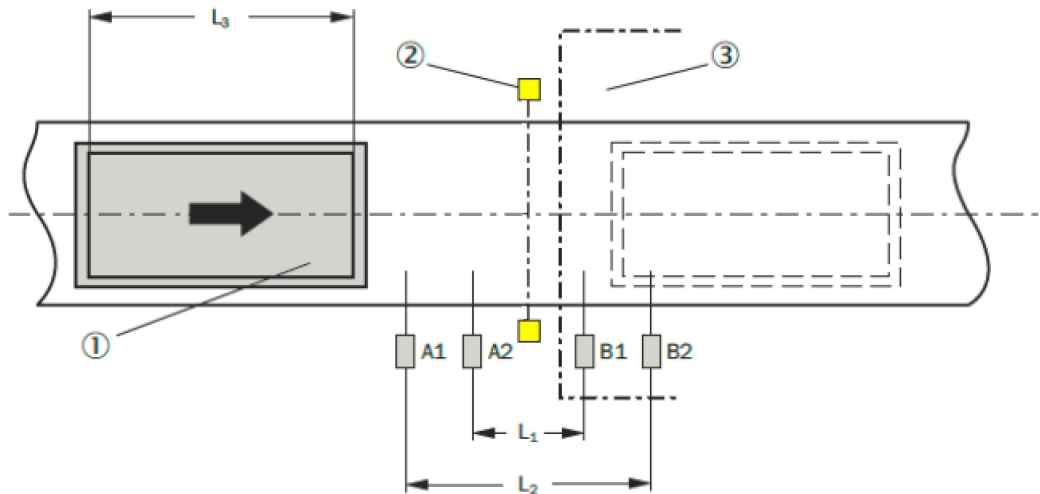


Figure 6.41 Sequential Muting Example

①: Materials transported

②: ESPE

③: Hazardous area

Calculate the distance of L1 according to the following formula:

- $L1 \geq V \times 2 \times T_{in \text{ muting sensor}}$

- $V \times t > L1 + L3$

- $L2 < L3$

- $T_{in \text{ ESPE}} < T_{in \text{ muting Sensor}}$

Where L1 = Medial side Sensor spacing

L2=Lateral side Sensor spacing

L3 = length of material in transport direction

V = Material Speed

t= Total muting time set (s)

$T_{in \text{ muting sensor}}$ = Muting sensor response time

$T_{in \text{ ESPE}}$ =Contact less protection Sensor(ESPE) Of Response time

As shown, the material moves from left to right. Once the muting sensors A1 & A2 are blocked, the protective effect of the ESPE is muted. The protection remains muted until the sensor group is muted until B1 & B2 are restored to light. The signal timing is shown in the figure below:

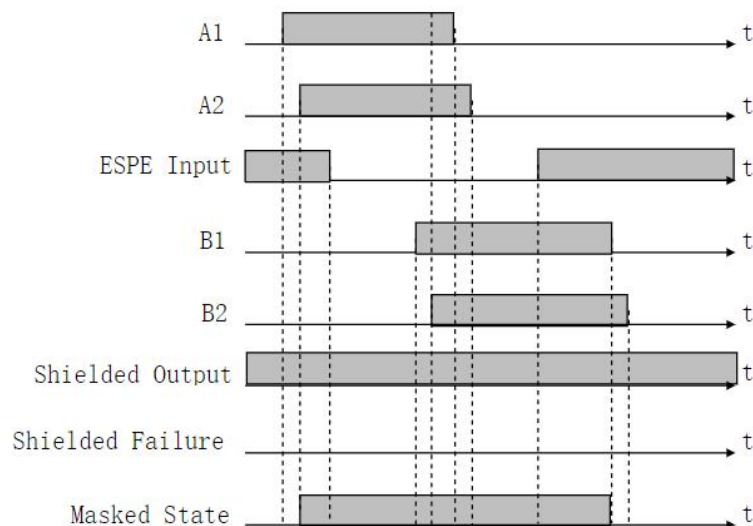


Figure 6.42 Sequence Muting Function Block Timing Diagram

Table 6-34 Sequential Muting Sensor Input Conditions

Condition	Description
A1 & A2 (B1 & B2)	When starting the muting sequence, the first sensor pair is activated sequentially based on the material's transport direction.
A1 & A2 & B1 & B2	The second sensor pair is activated simultaneously.
B1 & B2 (A1 & A2)	The second sensor pair is activated sequentially based on the material's transport direction.

Function block parameters

Table 6-35 Sequential Muting Function Block Parameters

Parameter	Description
Direction detection	● Disabled ● Forward ● Backward
Muting Start Condition	● All muting sensor signals are cleared: All shielded sensor inputs are set to 0, and the ESPE device is in a safe state. ● All muting sensors cleared except the last one: All shielding sensor inputs are 0 except for the last one, and the ESPE device remains in a safe state. This configuration improves the conveyor cycle time.
Muting End Condition	● According to the muting sensor: When one sensor in the last shielding pair is at high level. ● According to ESPE equipment: When the ESPE returns to logic 1.
Additional Muting Time after ESPE Secured	When the shielding end condition is set to additional shielding time triggered by the ESPE device returning to logic 1. ● 0ms

	● 200ms ● 500ms ● 1000ms
Total Muting Time	Checked to enable the total muting time, unchecked to not enable. If enabled, the value range is 1 ~ 900s, and 0 means infinite.
Sensor Signal Debounce	Off filtering time for a single shielding sensor. The value range is 10 ~ 1000ms, and 0 means infinite.
Enable Override Input	The super control function can be used to remove goods stuck on the conveyor belt due to power failure, emergency stop, or shielding faults from the protected area. Checked means override input is turned on, unchecked means not enabled.
Enable Conveyor Signal	The function associated with the total shielding time can be disabled via the conveyor belt signal when goods transport stops. After the conveyor belt restarts, the total shielding time monitoring resumes operation based on the value stored before the stop. If this is the first occurrence, the total shielding time is increased by 5 seconds immediately. Checked to turn on the conveyor belt signal, unchecked to not enable.
Enable C1 Input	Additional tamper-proof input. This input must be set to 0 after the end of the previous shielding cycle, and set to 1 before both shielding sensors go high. Failure to meet this condition will result in incorrect shielding triggering. Checked means C1 input is turned on, unchecked means not enabled.
Minimum Override Pulse Time	On-filtering time of override input ● 100ms ● 350ms

The input information, output information and parallel muting are exactly the same. The difference between configuration information and parallel muting is:

(1) In direction detection, the direction detection of sequential muting is stricter: when the direction selection is forward, the detection sequence is $A1 \rightarrow A2 \rightarrow B1 \rightarrow B2$; When the direction selection is backward, the detection sequence is $B2 \rightarrow B1 \rightarrow A2 \rightarrow A1$; When direction detection is disabled, the detection order is $A1 \rightarrow A2 \rightarrow B1 \rightarrow B2$ Or $B2 \rightarrow B1 \rightarrow A2 \rightarrow A1$.

(2) Muting begins Condition, containing except the last 1 Except, all muting sensors clearing.

Application Considerations

Material can be moved in both directions, or only one transport direction can be allowed by direction detection configuration parameters.

6.6.3 Cross Muting

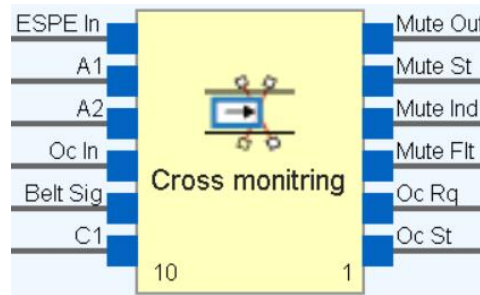


Figure 6.43 Functional Block Symbol



Attention

Safety is limited when muting is active. If not properly considered, hazardous states may not end or may not end in a timely manner.

Follow the prompts in Muting App Safety Considerations.

Cross Muting sensor arrangement

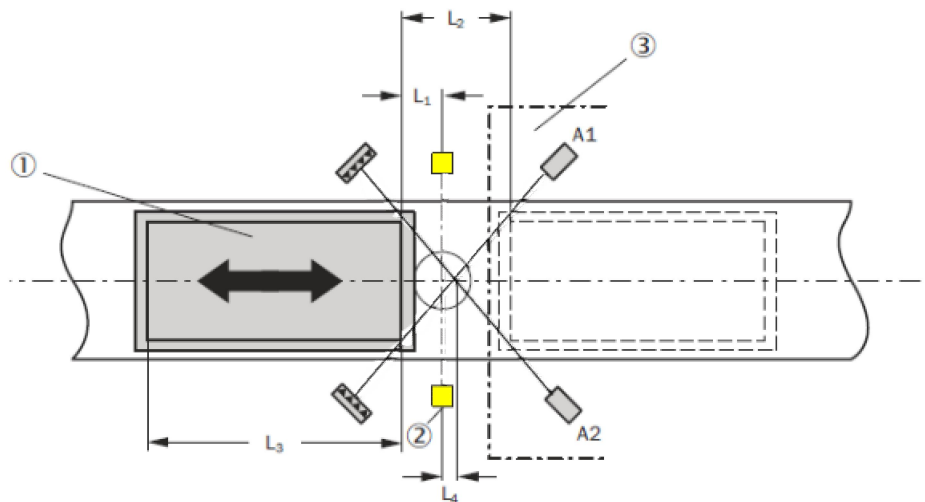


Figure 6.44 Cross Muting Example

①: Materials transported

②: ESPE

③: Hazardous area

Calculate the distance of L1 according to the following formulas:

- $L1 \geq V \times T_{in \text{ muting sensor}}$
- $V \times t > L2 + L3$
- $L4 \geq 0$

Where L1 =Minimum distance between detection through A1, A2 and ESPE detection line

L2=The distance between the two detection lines of A1 and A2

L3 = length of material in transport direction

L4=Distance between the ESPE detection line and the intersection of the muting sensor

V = Material Speed

t= Total muting time set (s)

T_{in muting sensor} = Muting sensor response time

As shown in the figure above, the material can move in two directions. Once the muting sensors A1 & A2 are blocked, the protective effect of the ESPE will be blocked.

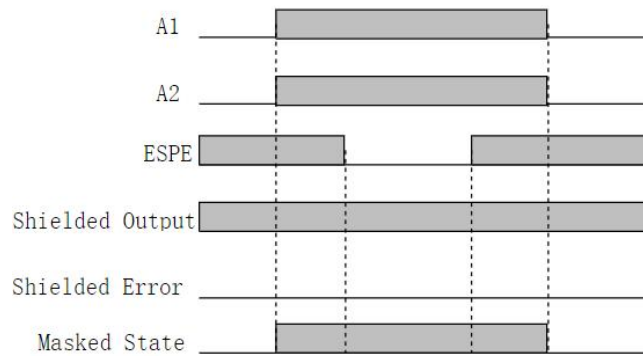


Figure 6.45 Cross Muting Example

Function block parameters

Table 6-36 Cross Muting Function Block Parameters

Parameter	Description
Muting End Condition	- According to the muting sensor: When either of the last shielding pair sensors is high. - According to ESPE equipment: When the ESPE returns to logic 1.
Additional Muting Time after ESPE Secured	When the shielding end condition is set to additional shielding time triggered by the ESPE device returning to logic 1. 0ms 200ms 500ms 1000ms
Total Muting Time	Checked to enable the total muting time, unchecked to not enable. If enabled, the value range is 1 ~ 900s, and 0 means infinite.
Muting Sensor Synchronization Monitoring	Indicates the synchronization time between the shielding sensor pairs. The value range is 10 ~ 3000ms, and 0 means infinite.
Sensor Signal Debounce	Off filtering time for a single shielding sensor. The value range is 10 ~ 1000ms, and 0 means infinite.
Enable Override Input	The super control function can be used to remove goods stuck on the conveyor belt due to power failure, emergency stop, or shielding faults from the protected area. Checked means override input is turned on, unchecked means not enabled.
Enable Conveyor Signal	The function associated with the total shielding time can be disabled via the conveyor belt signal when goods transport stops. After the conveyor belt restarts, the total shielding time monitoring resumes operation based on the value stored before the stop. If this is the first occurrence, the total shielding time is increased by 5 seconds immediately.

	Checked to turn on the conveyor belt signal, unchecked to not enable.
Enable C1 Input	Additional tamper-proof input. This input must be set to 0 after the end of the previous shielding cycle, and set to 1 before both shielding sensors go high. Failure to meet this condition will result in incorrect shielding triggering. Checked means C1 input is turned on, unchecked means not enabled.
Minimum Override Pulse Time	On-filtering time of override input ● 100ms ● 350ms

Application Considerations

The intersection of the muting sensors should be placed behind the beam of the ESPE in the hazardous area. If this is not possible, place the intersection of the muting sensor just on the beam path of the ESPE, but never in front of the beam;

When the goods/pallets are relatively short, cross-muting is often used;

Figure 6.44, the sensor shown in the illustration. The arrangement is suitable not only for through-beam photo sensors but also for reflective photo sensors.

As shown in the figure below, note that people/objects with a diameter of less than 500mm cannot trigger the muting function.

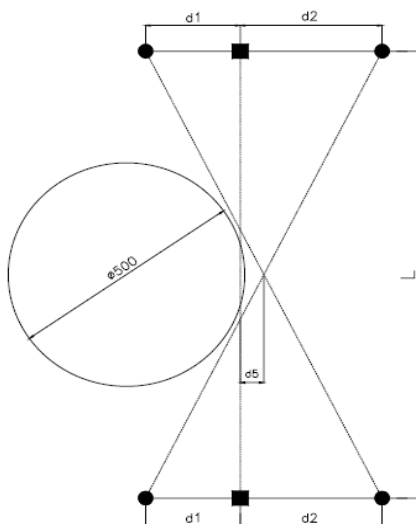


Figure 6.46 Schematic Diagram

d1, d2: The distance between the two muting sensors and the ESPE detection zone should be such that a cylindrical object with a diameter of 500 mm and an axis parallel to the protected zone cannot activate the muting function when moving to any point of the gate at a speed of 1.6 m/s. For example: if $d1 = 200$ mm and $d2 = 300$ mm, the requirement that the dimension L is greater than 1000 mm is met, in this case $d5 = 50$ mm.

6.6.4 L-Type Muting

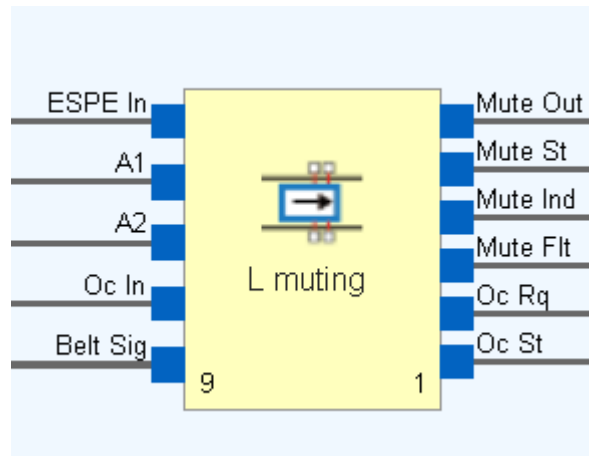


Figure 6.47 Functional Block Diagram



Attention

Safety is limited when muting is active. If not properly considered, hazardous states may not end or may not end in a timely manner.

Follow the prompts in Muting App Safety Considerations.

Type Muting Sensor Arrangement

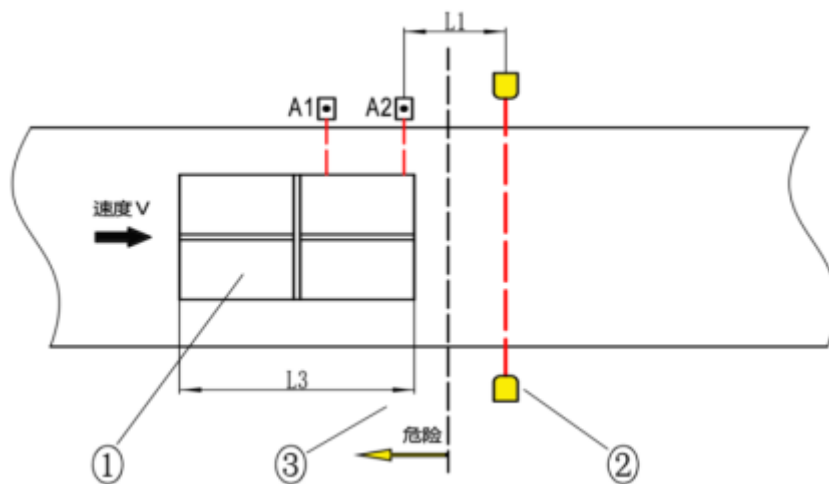


Figure 6.48 L-Type Muting Example

①: Materials for transportation

②: ESPE

③: Hazardous area

The distance of L1 is calculated according to the following formulas:

- $L1 \geq V \times (Td + 0.5 \times Tin_{espe} + 0.004)$
- $V \times t > L1 + L3$

Where L1 is the minimum distance between the muting sensor and the ESPE detection line, < 200mm.

L3=The length of the material in the direction of transport

V=Material velocity

t=Set the total shielding time (s)

Tin muting sensor=Muting sensor response time

Td=SPC Input delay

$T_{in\ espe}$ =Response time of the non-contact protective sensor (ESPE)

The muting sensor is located on the side of the dangerous area. When the material moves from left to right and successively blocks the muting sensors A1 and A2, the protection function of ESPE will be muted. This will continue until the configured muting duration (0.5s...4s) ends or the protection device is not unblocked.

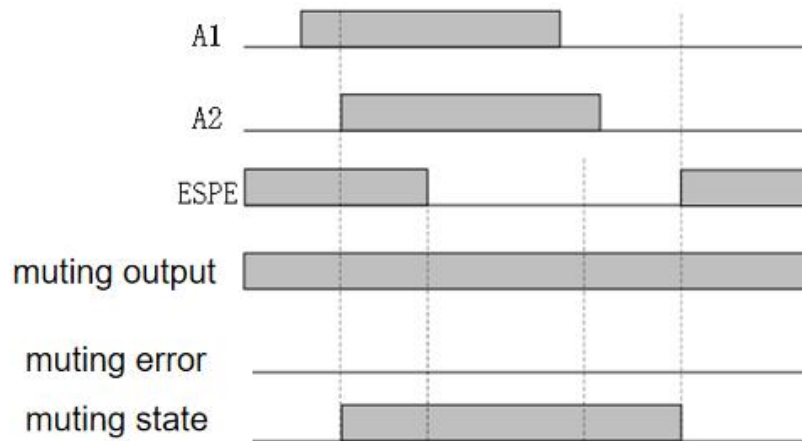


Figure 6.49 L-Type Muting Example

Function block parameter

Table 6-37 L-Type Muting Parameters

Parameters	Description
Additional Muting Time after ESPE Secured	When the shielding end condition is set to additional shielding time triggered by the ESPE device returning to logic 1. ● 0ms ● 200ms ● 500ms ● 1000ms
Total muting time	Check to enable the total muting time, and uncheck to disable it. If enabled, the value ranges from 1 to 900s, and 0 means unlimited.
Muting Sensor Synchronization Monitoring	Indicates the synchronization time between the shielding sensor pairs. The value range is 10 ~ 3000ms, and 0 means infinite.
Sensor Signal Debounce	Off filtering time for a single shielding sensor. The value range is 10 ~ 1000ms, and 0 means infinite.
Enable Override Input	The super control function can be used to remove goods stuck on the conveyor belt due to power failure, emergency stop, or shielding faults from the protected area. Checked means override input is turned on, unchecked means not enabled.
Enable Conveyor Signal	The function associated with the total shielding time can be disabled via the conveyor belt signal when goods transport stops. After the conveyor

	belt restarts, the total shielding time monitoring resumes operation based on the value stored before the stop. If this is the first occurrence, the total shielding time is increased by 5 seconds immediately. Checked to turn on the conveyor belt signal, unchecked to not enable.
Minimum Override Pulse Time	On-filtering time of override input ● 100ms ● 350ms

Application precautions:

- Objects can only exit from the hazardous area;
- Two muting sensors are installed on one side of the hazardous area;
- This arrangement is suitable for use with single-beam and retro-reflective light curtains.
- Prevent mutual interference between sensors;
- When activating the output monitoring function, activate the ESPE to terminate muting or configure total muting time;
- Direction recognition and sequence monitoring are mandatory;
- The vertical distance between the bottommost protective point of the grating and the conveying plane must not exceed 300mm. Muting sensors should detect material rather than pallets or conveyor units. Avoid excessive material edge clearance from grating (recommended no more than 200mm) to prevent personnel from entering hazardous areas during material muting. If adjustment is impossible, adding baffles to reduce this gap is a common solution when feasible.

6.6.5 Position Detection Muting

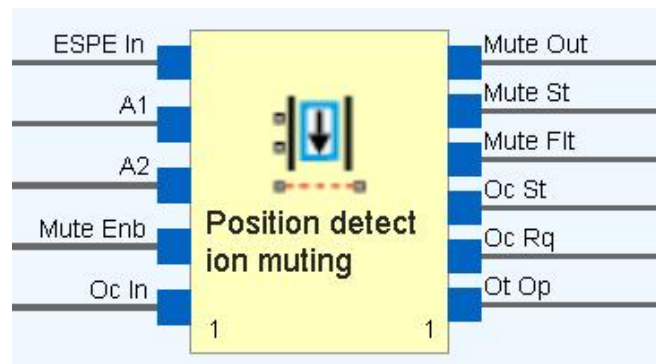


Figure 6.50 Function Block Symbol

 Attention
Safety is limited when muting is active. If not properly considered, hazardous states may not end or may not end in a timely manner. Follow the prompts in Muting App Safety Considerations.

Position detection Muting Sensor Arrangement

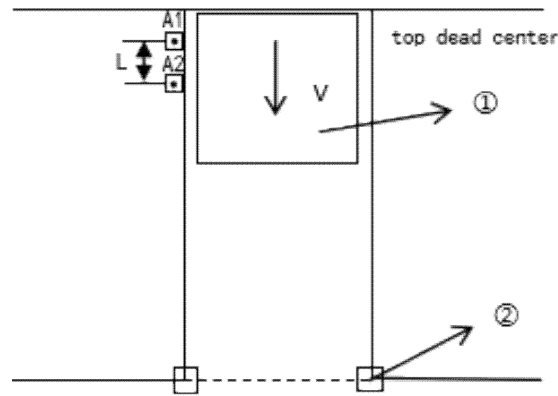


Figure 6.51 Position Detection Muting Example

①: Press Ram

②: ESPE

Calculate the distance of L according to the following formula:

- $L < V \times (T_{\text{sensor}} + T_{\text{syncmon}})$
- $L > V \times (T_{\text{sensor}} + T_{\text{scan}})$ (Allow muting sensors to be on at the same time is not enabled)

Where L = the distance between two muting sensors.

V = ram speed

T_{sensor} = muting sensor response time

T_{syncmon} = Synchronization monitoring time of muting sensors

T_{scan} = System scanning cycle

The muting sensors are located at the top dead center position of the slider. When the press ram moves from top to bottom, it sequentially releases the shielding sensors A1 and A2, activating the protective function of the ESPE. When the press ram moves from bottom to top, it sequentially blocks the muting sensors A2 and A1, thereby shielding the protective function of the ESPE. This process continues until the configured muting hold time (1 s...60 s) elapses or the protective device is not blocked.

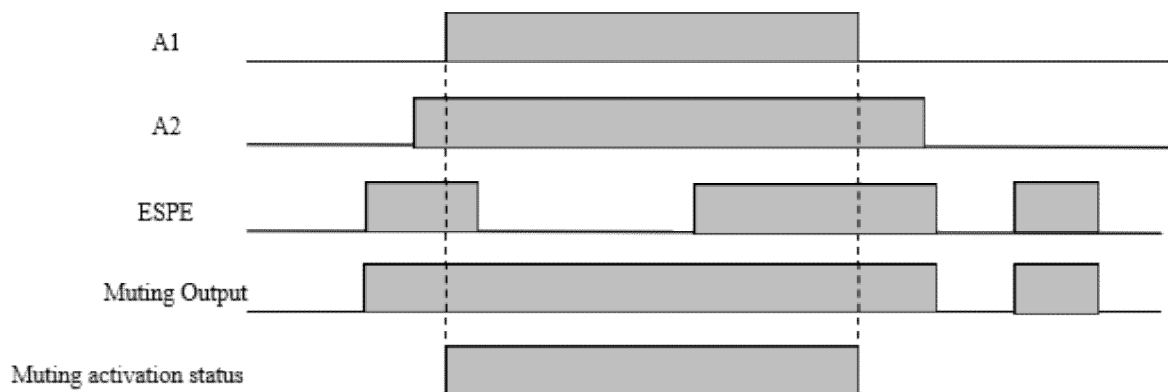


Figure 6.52 Position Detection Muting Example

Function block parameter

Table 6-38 Position Detection Muting Function Block Parameters

Parameters	Instructions
Muting sensor synchronization time	The value range is 10ms-30000ms, with increments of 10ms

The synchronization time for the muting sensor is unlimited	Ticking indicates that the synchronization time of the muting sensor will not be monitored, while not ticking indicates that it will not be enabled. Enabling this function requires enabling the muting enable input function
muting enable input	Ticking indicates that the muting state can only be entered when the enable input is on. Not ticking indicates that it is not enabled
Allow muting sensors to input ON at the same time	Ticking indicates that allow the muting sensor to become on within the same sampling period; Not ticking indicates that it is not enabled
Allow muting at startup	Ticking indicates that the device is allowed to enter a muting state if two muting sensors are in the on state at startup. Not ticking indicates that it is not enabled. When this function is enabled, it does not meet the muting requirements specified in IEC61496-1 and IEC62046 for "muting".
Total muting time	The value range is 1s-60min, with increments of 100ms
The total muting time is unlimited	Ticking indicates indicate that there is no upper limit for muting time, Not ticking indicates that it is not enabled. Enabling this feature requires enabling the muting enable input function
Override input	Ticking indicates indicate that enable override input, Not ticking indicates that it is not enabled.
Total override time	The value range is 1s-60min, with increments of 100ms
Sensor signal interval suppression	The value range is 1s-60min, with increments of 100ms
Shield activation status	Ticking indicates indicate that enable Shield activation status, Not ticking indicates that it is not enabled.
Muting fault	Ticking indicates indicate that enable Muting fault, Not ticking indicates that it is not enabled.
Override state	Ticking indicates indicate that enable override state, Not ticking indicates that it is not enabled.
Override request	Ticking indicates indicate that enable override request, Not ticking indicates that it is not enabled.
Timeout state	Ticking indicates indicate that enable Timeout state, Not ticking indicates that it is not enabled.

Application Considerations:

- a. Two muting sensors are installed on the side of the top dead center;
- b. This arrangement is suitable for use with single-beam and retro-reflective light curtains;
- c. Prevent mutual interference between sensors;
- d. The two muting sensors do not monitor the sequence.

6.7 Edge Function Block

6.7.1 Edge Detection

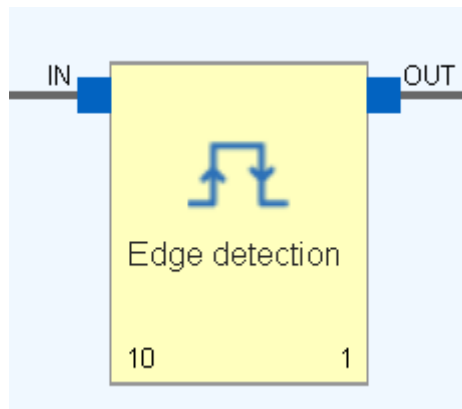


Figure 6.53 Function Block Symbol

Function block description

The Edge Detection function block can detect the positive (rising) or negative (falling) edge of an input signal. If the corresponding edge is detected, it outputs 1 only in the current cycle.

Function block parameters

Table 6-39 Edge Detection Function Block Parameters

Parameter	Description
Signal edge detection type	● Positive ● Negative ● Positive + Negative

Timing Diagram

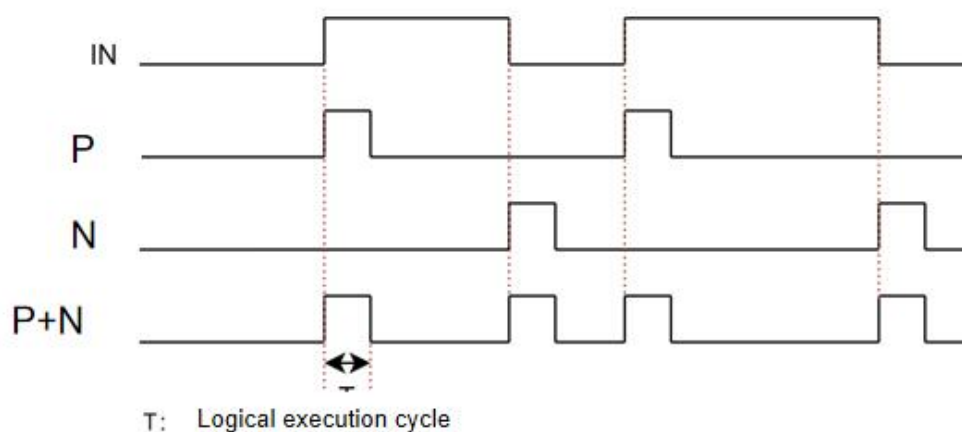


Figure 6.54 Timing Diagram

6.8 Counter Function Block

Function block description

The Counter function blocks can optionally count events rising and/or falling, and output when a preset overflow value is reached. There are Event counter (up), Event counter (down), and Event counter (up/down) function blocks.

The rising edge of the rising signal input (0-1) increases the value of the internal counter by "1".

Lower the rising signal edge of the input (0-1) and reduce the value of the internal counter by "1".

If an upward signal edge (0-1) occurs on the rising and falling input (only for event counters (upward & downward)), the value of the internal counter remains unchanged. That is, the event counters (upward & downward) share a common internal counter.

For an upward internal counter, the output is high when the count value is equal to or greater than the overflow value. For a downward internal counter, the output is high when the count value is equal to 0.

Reset or Set

There are two reset or setting modes: manual and automatic. **Manual mode** requires minimum reset time. If the level duration is longer than the configured minimum time, it will take effect. The effective value is 100 ms and 350ms.

Set the overflow value and initial value

An overflow value can be set for an upward internal counter, and an initial value can be set for a downward internal counter.

Output

For manual reset: After overflow, the output remains high until reset. For automatic reset: After overflow, the output stays high during the current cycle and turns low in the next cycle. For event counters (up/down): Even with manual reset enabled, the output stays high after overflow. If the counter no longer meets overflow conditions within the next cycle, the corresponding output turns low.

6.8.1 Event counter (up)

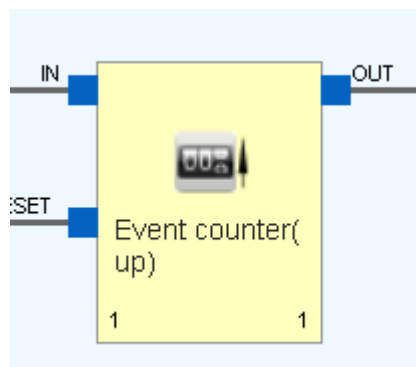


Figure 6.55 Function Block Symbol

Function block parameters

Table 6-40 Event Counter (Up) Function Block Parameters

Parameters	Description
Reset to 0 after Overflow	● automatic ● manual
Overflow Value	1~65535
Minimum Pulse Time for Reset to 0	● 100ms ● 350ms

Time Diagram

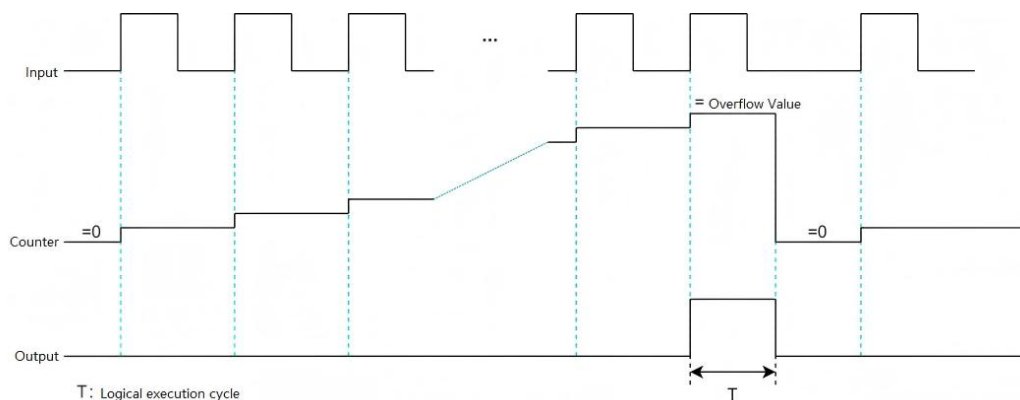


Figure 6.56 "Reset to 0 after Overflow" configured to Automatic

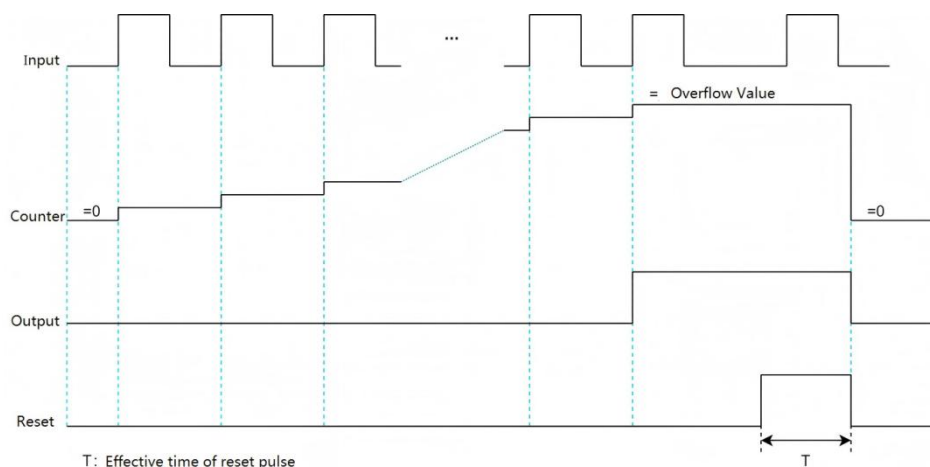


Figure 6.57 "Reset to 0 after Overflow" configured to Manual

6.8.2 Event Counter (Down)

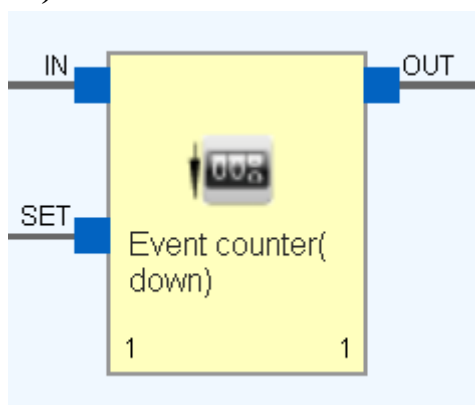


Figure 6.58 Function Block Symbol

Function block parameters

Table 6-41 Event Counter (Down) Function Block Parameters

Parameters	Description
Reset to Initial Value after Underflow	● Automatism ● Manual
Initial Value	1~65535
Minimum Pulse Time to Set to Initial Value	● 100ms ● 350ms

Timing Diagram

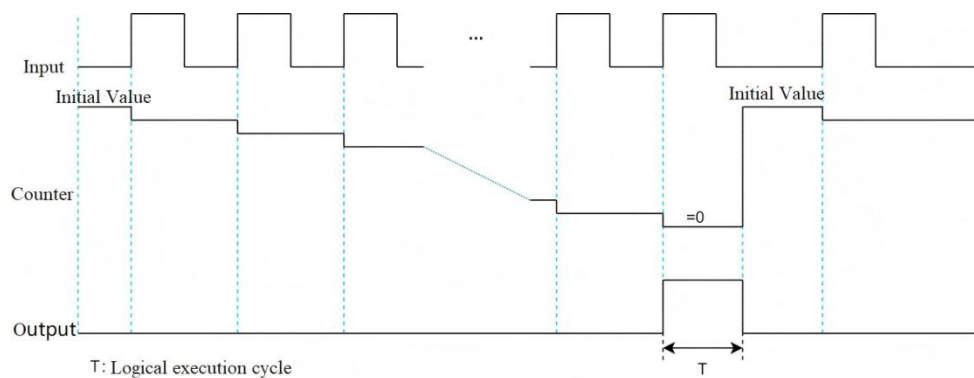


Figure 6.59 "Reset to Initial Value after Underflow" configured to Automatic

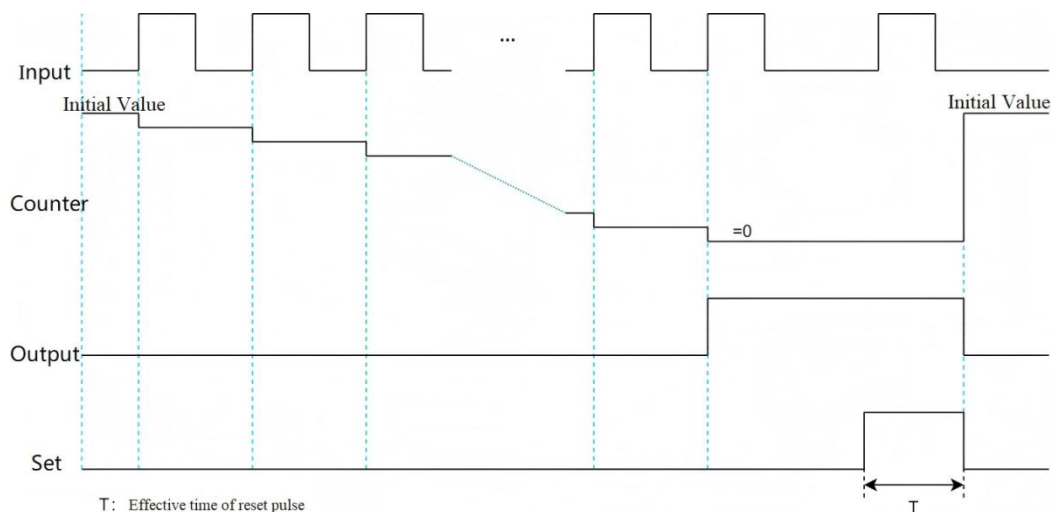


Figure 6.60 "Reset to Initial Value after Underflow" configured to Manual

6.8.3 Event Counter (Up &Down)

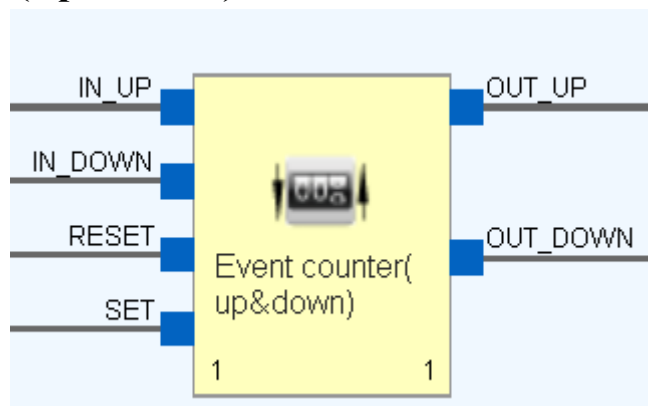


Figure 6.61 Function Block Symbol

Function block parameters

Table 6-42 Event Counter (Up & Down) Function Block Parameters

Parameters	Description
Reset to 0 after Overflow (Up)	● Automatic ● Manual
Set to Initial Value after Underflow (Down)	● Automatic ● Manual
Overflow Value	1~65535
Initial Value	1~65535

Minimum Pulse Time for Reset to 0	● 100ms ● 350ms
Minimum Pulse Time for Set to Initial Value	● 100ms ● 350ms

Sequence table

Table 6-43 Both "reset to 0 after overflow" and "set to initial value after overflow" are set to automatic

IN_UP	IN_DOWN	Previous Counter Value	Current Counter Value	OUT_UP	OUT_DOWN
↑	Any state except ↑	n (n < Escape value)	n+1 (n+1 < Escape value)	0	0
↑	Any state except ↑	Escape value-1	Escape value	1	0
free position	Any state	Escape value	0	0	0
Any state except ↑	↑	n (n > 1)	n-1	0	0
Any state except ↑	↑	1	0	0	1
state	state	0	initial value	0	0
↑	↑	n (0 < n < Escape value)	n	0	0

Table 6-44 Both "reset to 0 after overflow" and "set to initial value after overflow" are set to manual

IN_UP	IN_DOWN	RESET	SET	Previous Counter Value	Current Counter Value	OUT_UP	OUT_DOWN
↑	Any state except ↑	0	0	n (n < Escape value)	n+1 (n+1 < Escape value)	0	0
↑	Any state except ↑	0	0	Escape value-1	Escape value	1	0
↑	Any state except ↑	0	0	Escape value	Escape value	1	0
Any state	Any state	1	0	Escape value	0	0	0
Any state except ↑	↑	0	0	Escape value	Escape value-1	0	0
Any state except ↑	↑	0	0	n (n > 1)	n-1	0	0

Any state except ↑	↑	0	0	1	0	0	1
Any state except ↑	↑	0	0	0	0	0	1
Any state	Any state	0	1	0	initial value	0	0
↑	Any state except ↑	0	0	0	1	0	0
Any	Any	1	1	Any value	0	0	0
Any	Any	1	0	Any value	0	0	0
Any state	Any state	0	1	Any value	initial value	0	0

6.8.4 Clock Generator

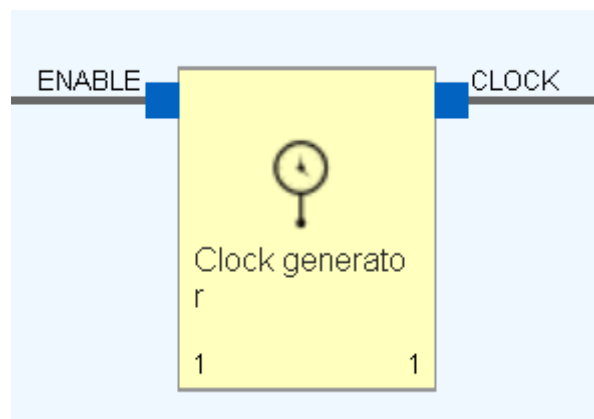


Figure 6.62 Function Block Symbol

Function block description

The Clock Generator function block can generate a pulse signal. If ENABLE is 1, the output clock signal will be generated according to the parameter setting of the function block. If ENABLE is 0, the clock output will be 0.

Timing Diagram

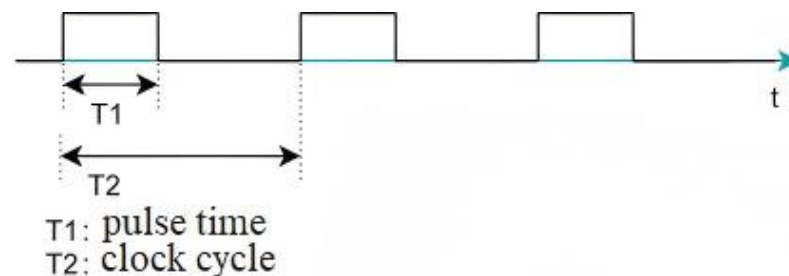


Figure 6.63 Timing Diagram



Attention

If the system scan time is adjusted, the clock period and pulse time will change. If this is not properly considered, hazardous states may not end or may not end in a timely manner.

The entire application's functionality should be checked after any configuration change.

Function block parameters

Table 6-45 Clock Generator Function Block Parameters

Parameters	Description
Clock Stop Condition	● Stop immediately ● After Current Clock Cycle Completes
Clock Period	● 2~65,535 times, according to the multiple of the operation cycle.
Pulse Length	● 1~65,534 times, according to the multiple of the operation cycle.

Timing Diagram

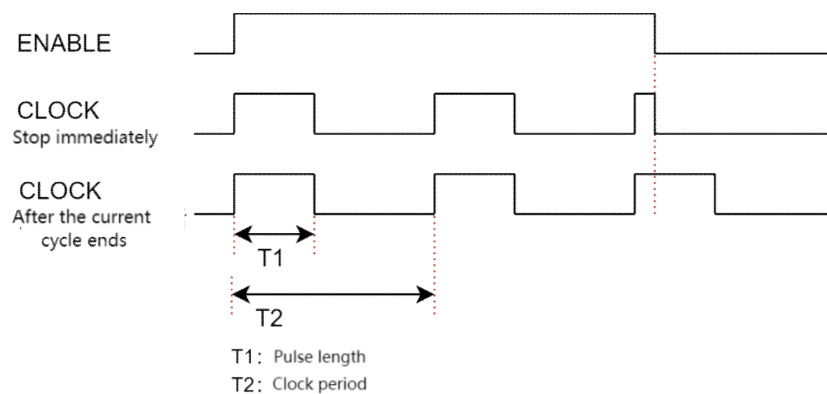


Figure 6.64 Timing Diagram

6.9 Offline simulation

In the MPU logic unit, the programmed logic can be simulated offline.

You can set the input to 1 or 0 and then observe the resulting output switch.

Click the button  in the toolbar to enable simulation mode. The background of the logic edit area changes color and a simulation toolbar appears, thus entering offline simulation mode.

Tips

Offline simulation can be started only when the configuration logic is correct.

Start continuous simulation

Click the button  on the simulation toolbar to start the continuous simulation. The time counter shows the elapsed time.



Figure 6.65 Toolbar before simulation start

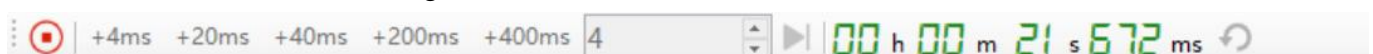


Figure 6.66 Toolbar after simulation start

Switch input values

Click on the logical input, and all of these input values in the MPU logic unit will be switched.

During simulation, you can also change the value of an input by clicking on it.

Stop continuous simulation

Click the button  on the simulation toolbar to pause the continuous simulation. The time counter stops counting.

Reset

Click the button  on the simulation toolbar to reset the simulation. The time counter starts from 0 and the logic program diagram also returns to its initial state.

Single-Step Simulation



Figure 6.67 Single-step simulation toolbar

On the simulation toolbar, there are 5 digital buttons: 4ms, 20ms, 40ms, 200ms and 400ms. Clicking the digital button will perform single-step simulation according to the duration. The value selection control on the right side can input a value, and click  will perform single-step simulation according to the value.

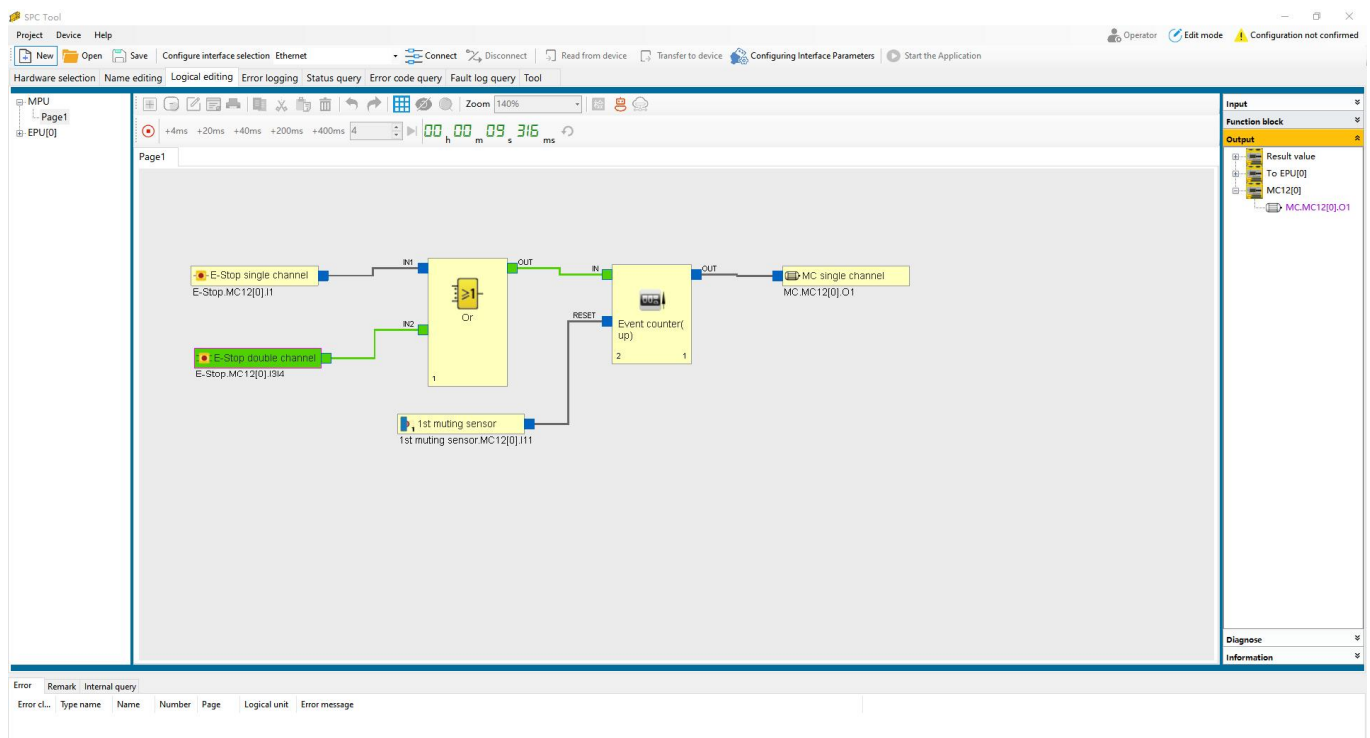


Figure 6.68 Simulation Running

The figure above shows the state during simulation. Clicking on an input switches its value to observe the logic change. When the simulation stops, you can also click on the input to switch the input value, and when the simulation starts, you can observe the direct effect on the logic.



Tips

- 1.If the **EDM** (External Device Monitoring) function block is used, it is recommended to remove these function blocks from the logic before simulation, because intermittent external excitation is required and real-time simulation is not possible.
- 2.The functional blocks including Delayer, Parallel Muting, Sequential Muting, Cross Muting, L-Type Muting, Position Detection Muting, Event counter (up), Event counter (down), and Event counter (up&down) can display additional information at the bottom right corner of their symbols. All other functional blocks without additional information will not show such content.

7 EPU Logic Programming

7.1 General Description

EPU (Encoder Processing Unit), an Encoder Processing Unit. Main module MC1284ALEC type and expansion module EN0000S000 have internal Movement Logic processing power, with its own independent logic editor. MC208400E4 main module is not inside Movement Logic processing capabilities, i.e. no **EPU logic editor**. If a project contains MC1284ALEC or EN0000S000 containing at least one, then its logic editor can be opened through the logic unit page tree on the left side of the logic editing interface.

The functional blocks described in this chapter include three categories: **Basic logic**, **Motion logic** and **Lidar logic**. **Motion logic** and **Lidar logic** part is an encoder and Lidar Monitor functional blocks, these functional blocks may set up Lidar, Monitor speed, position or stop and brake functions.

7.2 Safety Precautions

Delay caused by Jump Address

In **EPU logic**, there are also delays caused by jump addresses. Please refer to Section 6.1 for details.

7.3 Function Block Configuration

7.3.1 Function Block Input

At the EPU, the function block input comes from the following 3 places:

- Select all input elements listed in the tree on the right side of the EPU: constant 0, constant 1; An exchangeable result from the MPU; An encoder element; Lidar elements. Among them, the encoder configured on EN0000S00, It can be used either on its own EPU or on EPU[0], and you can choose one of the two.
- All the outputs of the function block
- Destination jump address

7.3.2 Function Block Output

At the EPU, The outputs to which the output of the function block can be connected are:

- Select all output elements listed in the tree on the right side of the EPU: exchangeable results to the MPU; Lidar elements.
- All the outputs of the function block
- Source jump address

7.3.3 Data Types within EPU Logic

Different data types can be processed within the EPU, not only single-byte data, but also double-byte

data.

Functional blocks with double-byte input or output are as follows:

Table 7-1 Functional blocks with 4-byte input and output

Serial number	Function block	Input	Output
1	Speed reading and direction judgment 1	Encoder input	Velocity value
2	Speed reading and direction judgment 2	Encoder input 1 Encoder input 2	Velocity value
3	Speed monitoring	Velocity value	——
4	Differential direction measurement	Speed 1 (revolver) Speed 2 (right wheel)	Corrected speed
5	Differential direction measurement2	Speed 1 (revolver) Speed 2 (right wheel)	Corrected speed
6	Steering wheel + proximity switch steering measurement	Angle encoder input	——
7	Angle reading and monitoring	Angle encoder input 1 Angle encoder input 2	Angle value
8	Speed comparison	Speed value 1 Speed value 2	——

7.4 Overview of Functional Blocks within the EPU

The functional blocks in the **EPU logic unit** are divided into **Basic logic**, **Motion logic** and **Lidar logic**. The following table lists all available functional blocks within the EPU:

Table 7-2 EPU Function Block List

Basic logic	
● And ● Or	● Not
Motion logic	
● Speed reading and direction judgment 1 ● Speed reading and direction judgment 2 ● Differential direction measurement ● Differential direction measurement2 ● Speed monitoring	● Angle reading and monitoring ● Steering wheel + proximity switch steering measurement ● Speed comparison ● Safety stop

Lidar logic	
● Lidar output detection	● Lidar zone switching
	● Lidar zone switching2
Coder-Encoder	
● UI8 to Bool	● Bool to UI8

The maximum number of packets can be included in a logical unit contains 40 function blocks。

7.5 Basic Logic Function Block

7.5.1 And

It has the same "And" function block as the MPU. Please refer to Section 6.4.1.

7.5.2 Or

It has the same "Or" function block as the MPU. Please refer to Section 6.4.2.

7.5.3 Not

It has the same "Not" function block as the MPU. Please refer to Section 6.4.3.

7.6 Motion Logic Function Block

Movement by reading the external encoder signal and the motion parameters set by the user, the logic function block realizes the following Monitoring function: Safe Direction (SDI), Safe Speed Monitoring (SSM), Safe Speed Range (SSR), Safe Speed Limit (SLS), Safe Operation Stop (SOS), Safe Acceleration Limit (SLA), Safe Stop 1 (SS1), Safe Stop 2 (SS2)、Safety Brake Control (SBC)、Safety Limit (SLP)。

In the hardware configuration interface, the user selects the type of encoder according to the application, including incremental encoder, sine and cosine encoder, and SSI encoder. Each type of encoder is divided into safe type or non-safe type. Different types of encoders set different component parameters. Refer to Section 5.3 for details.

After the hardware configuration is completed, the user configures the function block logic according to the axis driving mode. See the following function blocks for details.

7.6.1 Speed reading and direction judgment 1

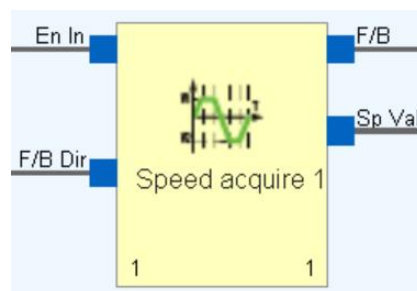


Figure 7.1 Functional block diagram

Functional Description

The speed read and direction judgment 1 function block is used to pulse the safety encoder signal convert to speed. At the same time, according to the forward/backward direction information configured by the user, the rotation direction of the motor shaft is determined.

Function block parameters

Table 7-3Speed reading and direction judgment 1 Function block input information

Serial number	Information	Configurability	Description
1	Encoder Input	Fixed	Counts pulse signals (pulses/s) and converts them to speed values (mm/s or r/s).
2	Advance/Retreat Direction	Fixed	For safe direction monitoring of motor shafts 0: Forward; 1: Retreat

Table 7-4 Speed reading and direction judgment 1 Function block output information

Serial number	Information	Configurability	Description
1	Forward/Backward	Fixed	Outputs the actual rotation direction of the motor shaft. 0: Forward; 1: Retreat
2	Velocity value	Fixed	Speed value calculated from encoder pulse signals. Example: Speed (mm/s) = Pulse frequency (pulses/s) / Resolution (pulses/mm)
3	Monitoring status	Optional	Monitors whether the actual rotation direction of the encoder matches the user-configured direction. 0: Not conforming; 1: Compliant

Table 7-5 Speed reading and direction judgment 1 Function block configuration parameters

Serial number	Parameter	Information	Description
1	Shaft connection	● Rotational motion ● Linear motion	The shaft connection type determines the type of velocity value: rotational motion-angular velocity; Linear motion-linear velocity;
2	Velocity resolution	● Shaft connection type is available for rotary motion. Speed resolution ranges from 1 to 65535, in units of pulses/revolution or revolution/pulse. ● Shaft connection can be configured for linear motion. Speed resolution ranges from 1 to 65535,	For configuration, calculations must be performed using encoder resolution, wheel circumference, and motor-to-wheel reduction ratio parameters. Example: $Resolution(pulses/mm) = \frac{Encoder\ resolution \times Reduction\ ratio}{Wheel\ circumference}$

		in units of pulses/mm or mm/pulse.	
3	Counting direction	● Normal ● Reverse direction	Adjusts the counting direction of the encoder. If the encoder rotation direction is inconsistent with the equipment travel direction, reverse direction can be selected.
4	Enable forward and backward monitoring	Tick indicates enabled; Unchecked means not enabled.	User chooses whether to enable forward and backward monitoring



Attention

The input terminal of the function block **Encoder input** should come from the safety encoder element, not the output of the function block and others.

7.6.2 Speed reading and direction judgment 2

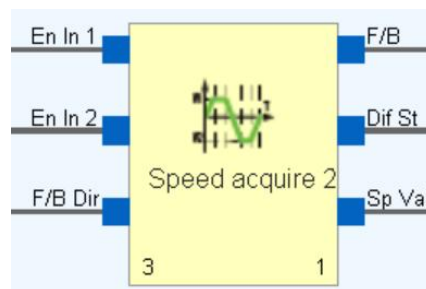


Figure 7.2 Functional block diagram

Functional Description

The Speed reading and direction judgment2 function block is used to convert the two encoder pulse signals into safe speed values while determining the rotation direction of the motor shaft based on the user-configured forward/reverse direction information.

Function block parameters

Table 7-6 Speed reading and direction judgment 2 Function block input information

Serial number	Information	Configurability	Description
1	Encoder Input 1	Fixed	Performs counting and diagnostics on the dual-channel pulse signals, and converts the validated pulses into a safe speed value.
2	Encoder Input 2	Fixed	
3	Advance/Retreat Direction	Fixed	For safe direction monitoring of motor shafts 0: Forward; 1: Retreat

Table 7-7 Speed reading and direction judgment 2 Function block output information

Serial number	Information	Configurability	Description
1	Forward/Backward	Fixed	Outputs the actual rotation direction of the motor shaft. 0: Forward; 1: Retreat
2	Differential status	Fixed	Determines whether the speeds of the two encoders are consistent. A safety stop is triggered if they are inconsistent. 0: There is a difference, 1: There is no difference
3	Velocity value	Fixed	Speed values derived from the two non-safe encoder pulse signals.
4	Monitoring status	Optional	Monitors whether the actual rotation direction of the encoder matches the user-configured direction. 0: Not conforming; 1: Compliant

Table 7-8 Speed reading and direction judgment 2 Function block configuration parameters

Serial number	Parameter	Information	Description
1	Shaft connection	● Rotational motion ● Linear motion	The shaft connection type determines the type of velocity value: rotational motion-angular velocity; Linear motion-linear velocity;
2	Velocity resolution	● Shaft connection type is available for rotary motion.Speed resolution ranges from 1 to 65535, in units of pulses/revolution or revolution/pulse. ● Shaft connection can be configured for linear motion. Speed resolution ranges from 1 to 65535, in units of pulses/mm or mm/pulse.	For configuration, calculations must be performed using encoder resolution, wheel circumference, and motor-to-wheel reduction ratio parameters. Example: $Resolution(pulses/mm) = \frac{Encoder\ resolution \times Reduction\ ratio}{Wheel\ circumference}$
3	Counting	● Normal	Adjusts the counting direction of

	direction	Reverse direction	the encoder. If the encoder rotation direction is inconsistent with the equipment travel direction, reverse direction can be selected.
4	Enable forward and backward monitoring	Tick indicates enabled; Unchecked means not enabled	User chooses whether to enable forward and backward monitoring
5	Encoder tolerance value	- Absolute tolerance, value range 0 ~ 32767 - Relative tolerance, value range 0 ~ 100%	The two encoder speeds are deemed consistent within the tolerance range. Absolute tolerance: =ABS(Encode1-Encode2) Relative tolerance $\frac{ABS(Encode1 - Encode2)}{MAX(Encode1 - Encode2)}$
6	Tolerance time	0 ~ 60s, in 4 steps, where, 0 means no restriction	Outputs a discrepancy status when the value exceeds the tolerance limit and the duration exceeds the tolerance time
7	Output correction parameter	- Average of encoders 1, 2 - Higher value of speed in encoders 1, 2 - Value of Encoder 1 - Value of Encoder 2	



Attention

The input terminal of the function block **Encoder input 1**、**Encoder input 2**, should come from non-safe encoder elements, cannot be the output of functional blocks and others.

7.6.3 Differential direction measurement

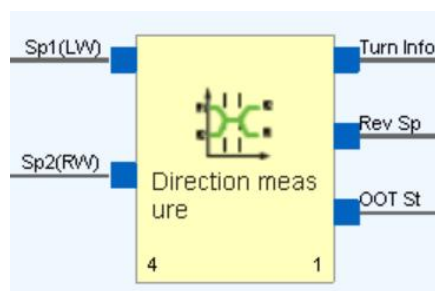


Figure 7.3 Functional block diagram

Functional Description

Differential direction measuring function block is applied to differentially driven AGV, and the walking direction of AGV trolley is determined by comparing the speed difference between two driving wheels.

Function block parameters

Table 7-9 Differential speed measurement direction Function block input information

Serial number	Information	Configurability	Description
1	Speed 1(Revolver)	Fixed	Judge steering information according to the difference between two speeds
2	Speed 2(right wheel)	Fixed	

Table 7-10 Differential speed measurement direction Function block output information

Serial number	Information	Configurability	Description
1	Steering information	Fixed	0: Go straight; 1: Turn left 1; 2: Turn left 2; 3: Turn left 3; 4: Turn right 1; 5: Turn right 2; 6: Turn right 3. Can be used for speed monitoring and Lidar zone switching
2	Corrected velocity value	Fixed	For speed monitoring
3	Out-of-tolerance state	Fixed	Detect whether the steering angle is beyond the set range, and trigger the safety stop function when it is out of tolerance 0: Out of tolerance; 1: Normal

Table 7-11 Differential speed measurement direction Function block configuration parameters

Serial number	Parameter	Information	Description
1	Allowable tolerance values for two speeds	● Absolute tolerance, value range 0 ~ 32767 ● Relative tolerance, value range 0 ~ 100%	Determined to be straight within the tolerance range
2	Tolerance time	0 ~ 60s, stepped in 4ms, 0 = unlimited	Outputs straight-line status when within straight-line tolerance and the duration exceeds the tolerance time.
3	Range of speed difference	● Absolute tolerance ● Relative tolerance Whether it is absolute tolerance or relative	Judge the corresponding left turn or right turn according to the difference

	corresponding to left turn/right turn	tolerance, three ranges can be set for left turn and right turn respectively. And the three interval ranges are continuous, for example, the upper limit of left turn 1 is the lower limit of left turn 2.	range
4	Duration	0 ~ 60s, stepped in 4ms, 0 = unlimited	When the value remains within the current difference range for longer than the specified time, the corresponding steering information is output.
5	Output correction parameter	● Average of Encoder 1 and Encoder 2(Signed Operation) ● Higher value of speed in Encoder 1 and Encoder 2 ● Value of Encoder 1 ● Value of Encoder 2 ● Average of Encoder 1 and Encoder 2(Unsigned Operation)	



Attention

The input terminal of the function block **Speed 1 (revolver)**、**Speed 2 (right wheel)**, should come from the function block **Speed reading and direction judgment 1** or **Speed reading and direction judgment 2** output of **Velocity**。

7.6.4 Differential direction measuremen2

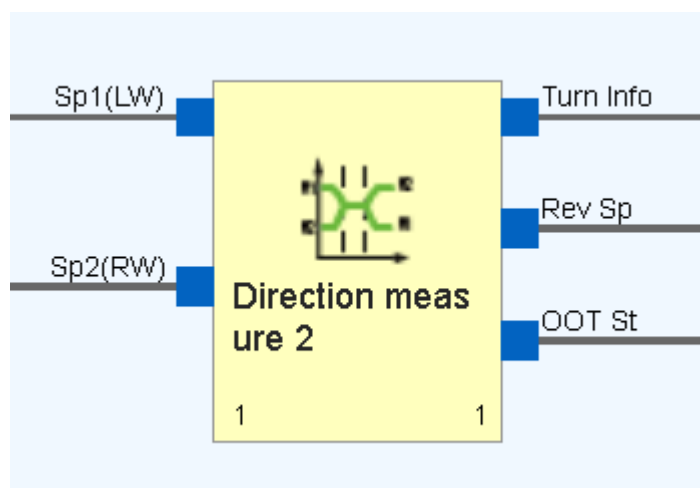


Figure 7.4 Functional block diagram

Function block description

The Differential direction measurement2 is designed for differential-drive AGVs. It determines the cart's movement direction by comparing the speed difference between its two drive wheels. Unlike the standard differential speed direction function block, this enhanced version not only identifies forward motion but also detects backward movement.

Function block parameters

Table 7-12 The differential speed measurement direction 2 function block inputs information

number	information	configurational	description
1	Speed 1 (left wheel)	Fixed	The steering information is determined according to the difference between the two speeds
2	Speed 2 (right wheel)	Fixed	

Table 7-13 The differential speed measurement direction 2 function block outputs information

number	information	Configurational	description
1	Switch to information	Fixed	Turning instructions. 0: Go straight ahead; 1: Turn left front 1; 2: Turn left front 2; 3: Turn left front 3; 4: Turn right front 1; 5: Turn right front 2; 6: Turn right front 3; 7: Retreat straight; 8: Turn left rear 1; 9: Turn left rear 2; 10: Turn left rear 3; 11: Turn right rear 1; 12: Turn right rear 2; 13: Turn right rear 3. It can be used for speed monitoring and Lidar zone switching
2	The revised speed value	Fixed	Used for speed monitoring
3	Out of sync	Fixed	Check whether the steering Angle exceeds the set range, and trigger the safety stop function when exceeding the limit; 0: beyond the limit; 1: normal

Table 7-14 The differential speed measurement direction 2 function block configuration parameters

number	information	Configurational	description
1	Tolerance values for both speeds	● Absolute tolerance, value range 0~32767 ● Relative tolerance, value range 0~100%	It is judged as straight within the tolerance range
2	Time margin	0~60s, with 4ms step, 0= no limit	When the value remains within the current

			difference range for longer than the specified time, the corresponding steering information is output.
3	The range of speed difference corresponding to front left turn/back left turn/front right turn/back right turn	● Absolute tolerance ● Relative tolerance Whether it is absolute tolerance or relative tolerance, three ranges can be set for front left turn, rear left turn, front right turn and rear right turn respectively. And the three intervals are continuous, for example, the upper limit of front left turn 1 is the lower limit of front left turn 2.	According to the difference range, the corresponding front/back left turn or front/back right turn is determined, and the difference range of front/back turns is symmetrical
4	Duration	0 ~ 60s, with a step of 4ms, 0= unlimited	When the value remains within the current difference range for longer than the specified time, the corresponding steering information is output.
5	Export the correction parameters	● The average of encoder 1 and encoder 2(Signed Operation) ● The higher speed value in encoder 1 and encoder 2 ● The value of encoder 1 ● The value of encoder 2 ● Average of Encoder 1 and Encoder 2(Unsigned Operation)	



Attention

The input **Speed 1 (left wheel)** and **Speed 2 (right wheel)** of the function block should come from the output speed of the function block **Speed read and direction judgment 1** or **Speed read and Direction judgment 2**.

7.6.5 Speed monitoring

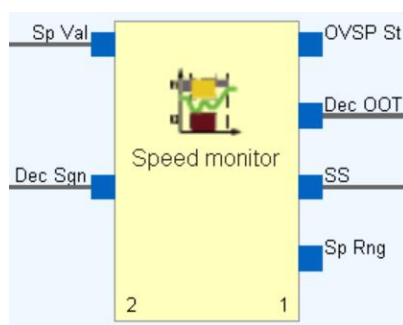


Figure 7.5 Functional block diagram

Functional Description

Monitor the speed value, and when the speed value exceeds the maximum speed break range set by the user, output an over speed state signal for triggering a safe stop.

The speed values are converted into different speed segments, and the range of speed segments is set by the user.

Monitor the deceleration process of the encoder/motor to ensure that the deceleration process is controlled. When the deceleration exceeds the user set range, trigger a safety stop.

Function block parameters

Table 7-15 Speed monitoring Function block input information

Serial number	Information	Configurability	Description
1	Velocity value	Fixed	It is usually a corrected speed value, which is used to determine whether the speed exceeds the range set by the user
2	Deceleration sign	Optional	Trigger deceleration limit monitoring and set the deceleration limit according to the maximum condition. 0: Invalid; 1: Effective.

Table 7-16 Speed monitoring Function block output information

Serial number	Information	Configurability	Description
1	Overspeed state	Fixed	Perform overspeed monitoring and trigger safety stop when overspeed 0: Overspeed; 1: Not speeding
2	Deceleration out of tolerance	Fixed	Used to trigger safety stop when deceleration is out of tolerance 0: Out of tolerance; 1: Not out of tolerance
3	Stationary state	Fixed	Determine the stationary state of the trolley 0: Not stationary; 1: Stationary
4	Velocity segment	Fixed	According to the speed range set by the user, the actual speed of the trolley is divided into several speed sections, up to 12

Table 7-17 Speed monitoring Function block configuration parameters

Serial number	Parameter	Information	Description
1	Stationary speed	Value range: 0 ~ 32766mm/s。 Note: The stationary speed must be less than the maximum speed	Judging stationary by speed
2	Rest duration	Value range: 0 ~ 248ms, step by 4ms	The redundancy time for static judgment, together with the static position tolerance, serves as the criterion for determining a stationary state.
3	Static Position Tolerance-Allowable Range	Value range: 0 ~ 2000000, unit mm	Judging stationary by position change
4	Maximum speed	Value range: 0 ~ 32767mm/s	
5	Speed range	Up to 12 speed ranges can be set. Enter a value in the Value button control of the Speed Range and click + button, add a speed interval. There is a delete button on the right side of the speed interval -, the speed interval can be deleted.	The speed segment range cannot exceed the maximum speed
6	Deceleration monitoring	● Check to turn on deceleration monitoring If deceleration monitoring is turned on, you can set: ● Delay time, starting from 0, in 4 steps, with an upper limit of 248, in ms. 0 means no delay. ● Deceleration limit, 1 ~ 10000mm/s²。 ● Unchecked means deceleration monitoring is not turned on	



Attention

The input of this function block **Velocity value**, usually from functional blocks **Differential directional** output **Corrected speed**。

7.6.6 Steering wheel + proximity switch steering measurement

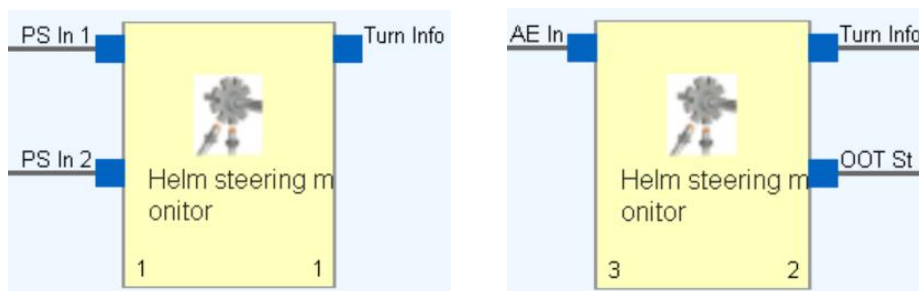


Figure 7.6 Functional block diagram

Functional Description

The Steering wheel + proximity switch function block is applied to the steering wheel-driven AGV. Users can obtain accurate angle information by reading the angle encoder signal, and can also roughly judge the angle information through the proximity switch signal.

Function block parameters

Table 7-18 Steering wheel + steering direction measurement Function block input information

Serial number	Information	Configurability	Description
1	Angle encoder input	Optional	According to the angle encoder signal,details of judging steering angle
2	Proximity switch input 1	Optional	According to Proximity switch Signals,rough judgment of steering angle information
3	Proximity switch input 2	Optional	

Table 7-19 Steering wheel + steering direction measurement Function block output information

Serial number	Information	Configurability	Description
1	Steering information	Fixed	0: Go straight; 1: Turn left 1; 2: Turn left 2; 3: Turn left 3; 4: Turn right 1; 5: Turn right 2; 6: Turn right 3 Acquired angular information,can be used as a condition for speed monitoring and Lidar standoff
2	Out-of-Tolerance State	Optional	Input Selection: Angle Encoder.If selected, the output terminal indicates an "Out-of-Limit" status. Monitors whether the steering angle exceeds the set range and triggers a safety stop function upon detecting an out-of-tolerance condition. 0: Out of Tolerance; 1: Normal

Table 7-20 Steering wheel + steering direction measurement Function block configuration parameters

Serial number	Parameter	Information	Description
---------------	-----------	-------------	-------------

1	Minimum straight angle range	0~360°	Determined to be straight within the tolerance range
2	Straight Angle Range Maximum	0~360°	
3	Duration of straight travel	Start from 0, in 4 steps, up to 60000, in ms.	Outputs straight-line status when within straight-line tolerance and the duration exceeds the tolerance time.
4	Level 1 Left Turn Range Min	0~360°	Turn left/right respectively for Level 3,the angle range of each level set by the user should be continuous and should not overlap
5	Level 1 Left Turn Range Max	0~360°	
6	Level 2 Left Turn Range Min	0~360°	
7	Level 2 Left Turn Range Max	0~360°	
8	Level 3 Left Turn Range Min	0~360°	
9	Level 3 Left Turn Range Max	0~360°	
10	Level 1 Right Turn Range Min	0~360°	
11	Level 1 Right Turn Range Max	0~360°	
12	Level 2 Right Turn Range Min	0~360°	
13	Level 2 Right Turn Range Max	0~360°	
14	Level 3 Right Turn Range Min	0~360°	
15	Level 3 Right Turn Range Max	0~360°	
16	Turn duration	Start from 0, in 4 steps, up to 60000, in ms.	Outputs corresponding steering information when within the current angle range and the duration exceeds the turn time.
17	Input Selection	When the proximity switch is	

		selected, the input terminal displays "proximity switch input 1" and "proximity switch input 2"; Angle Encoder is selected and the input terminal displays "Angle Encoder Input".	
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Attention

The function block's input terminal **Angle encoder input (AE In)**, is derived from the output terminal **Angle value (Agl)** of **Angle reading and monitoring**, or from an external encoder input, and an absolute encoder is typically used for this purpose.

7.6.7 Angle reading and monitoring

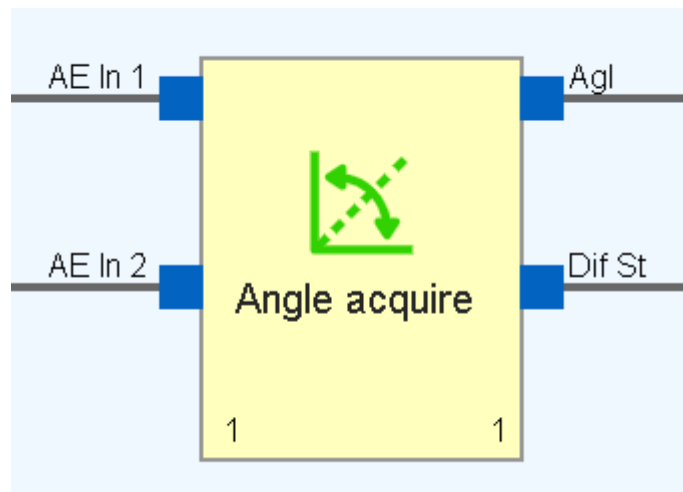


Figure 7.7 Functional block diagram

Function block description

The Angle Read and Monitor function block is used to convert the Angle signals of two non-safe SSI encoders into safe Angle values, and output the final calculated Angle values according to the output correction parameters configured by the user.

Function block parameters

Table7-21 Angle reading and monitoring Function block input information

Number	Information	Configurational	Description
1	Angle encoder input 1	Fixed	The signal of the dual-channel SSI encoder is diagnosed, and the unsafe SSI encoder Angle information is converted into a safe Angle value
2	Angle encoder input 2	Fixed	

Table7-22 Angle reading and monitoring Function block output information

Number	Information	Configurational	Description
1	Angle value	Fixed	The Angle value is obtained by converting the Angle signal from two non-safe SSI encoders
2	State of difference	Fixed	Determine whether the angles of two non-safe SSI encoders are consistent. If not, trigger safe stop 0: there is a difference, 1: no difference

Table7-23 Angle reading and monitoring Function block configuration parameters

Number	Parameter	Information	Description
1	Encoder tolerance value	● Absolute tolerance, range 0 to 360 ● Relative tolerance, value range 0~100%	The angle values of the two SSI encoders are judged to be consistent within the tolerance range.
2	Margin time	0 ~60s, in 4 steps, where 0 means no restriction	A discrepancy status is output when the value exceeds the tolerance limit and the duration exceeds the tolerance time.
3	Export the correction parameters	● The average of encoders 1 and 2 ● The higher Angle values in encoders 1 and 2 ● The value of encoder 1 ● The value of encoder 2	



Attention

The input end of the function block **Angle Encoder Input 1** and **Angle Encoder Input 2** should come from non-safe SSI encoder components, not from the output of the function block or others.

7.6.8 Speed comparison

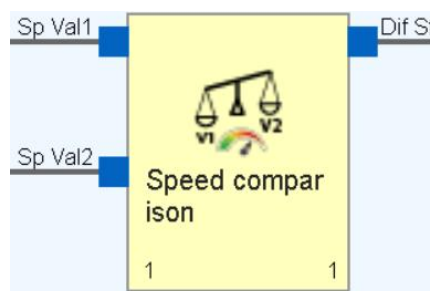


Figure7.8 function block diagram

Function block description

The speed comparison function block is used to compare the absolute speed values of two different signal sources, which can enhance the safety level.

Function block parameters

Table 7-24 Speed compare Function block input information

Number	Information	Configurational	Description
1	Speed value 1	Fixed	Absolute value of speed
2	Speed value 2	Fixed	

Table 7-25 Speed compare Function block output information

Number	Information	Configurational	Description
1	Differential status	Fixed	Check whether the two speed values exceed the set difference value 0: There is a difference, 1: There is no difference

Table 7-26 Speed compare Function block configuration parameters

Number	Parameter	Information	Description
1	Encoder tolerance value	Absolute tolerance range: 0~32767 Relative tolerance range: 0~100%	The two speeds are judged to be identical within the tolerance value.
2	Tolerance time	Starting from 0, increment by 4, with the upper limit at 60,000, in units of milliseconds. 0 indicates no restriction.	A discrepancy status is output when the value exceeds the tolerance limit and the duration exceeds the tolerance time.

7.6.9 Safety stop

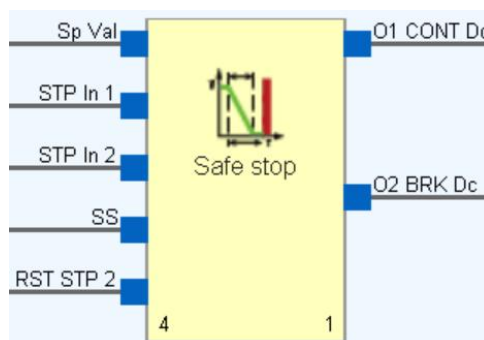


Figure 7.9 Functional block diagram

Functional Description

The safety stop function block is used to trigger and monitor the safety stop of the drive/motor shaft, ensuring that the drive/motor shaft is closed in a controlled manner. Therefore, the output of the

functional block can be connected to the contactor and brake that stops the drive/motor shaft, so that it is stopped in a shorter time, preventing the occurrence of uncontrollable stops.

Since the stop ramp of the drivetrain is generally unsafe, the safety stop function block monitors the actual speed decline process until the drivetrain is stationary.

Function block parameters

Table 7-27 Input information for the safety stop Function block

Serial number	Information	Configurability	Description
1	Velocity value	Fixed	
2	Stop 1 Input	Fixed	Falling edge trigger
3	Stop 2 Input	Fixed	Falling edge trigger
4	Stationary state	Fixed	0: Not stationary, 1: Stationary
5	Reset Class2 Stop	Optional use	Rising edge trigger

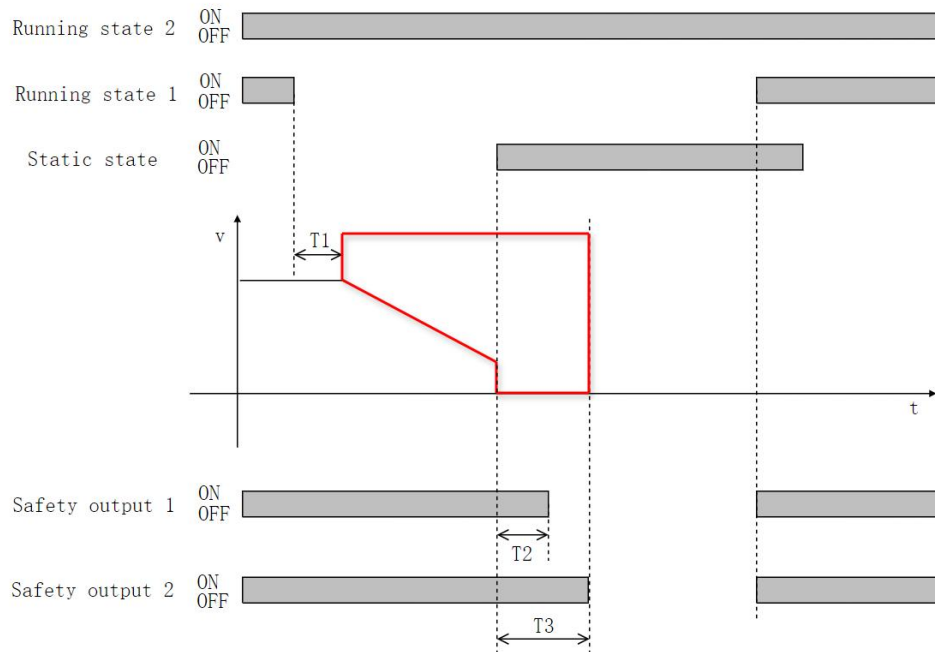
Table 7-28 Output information of safety stop Function block

Serial number	Information	Configurability	Description
1	O1 contactor open	Fixed	0: OFF, 1: Pulled in
2	O2 brake disconnected	Fixed	0: OFF, 1: Pulled in

Table 7-29 Safety stop Function block configuration parameters

Serial number	Parameter	Information	Description
1	Contactor opening delay	Starting from 0, in 4 steps, the upper limit is 248, in ms. 0 means no delay	
2	Brake disconnection delay	Starting from 0, in 4 steps, the upper limit is 248, in ms. 0 means no delay	
3	Stop 2 reset mode	● Automatic reset ● Manual reset	0: Automatic, 1: Manual
4	Deceleration monitoring delay	Starting from 0, in 4 steps, the upper limit is 248, in ms. 0 means no delay	
5	Deceleration limit for deceleration to 0	Value range: 1 ~ 10000mm/s ²	Deceleration monitoring, directly close contactor and brake when out of tolerance

Timing diagram

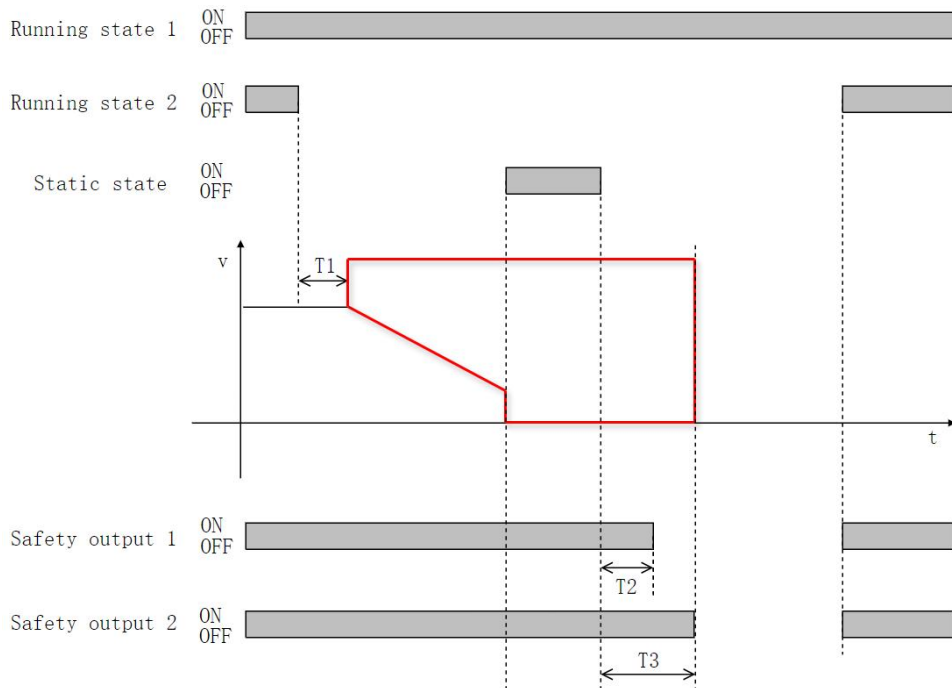


T1: Delay time before starting deceleration process monitoring;

T2: Safety output 1 shutdown delay;

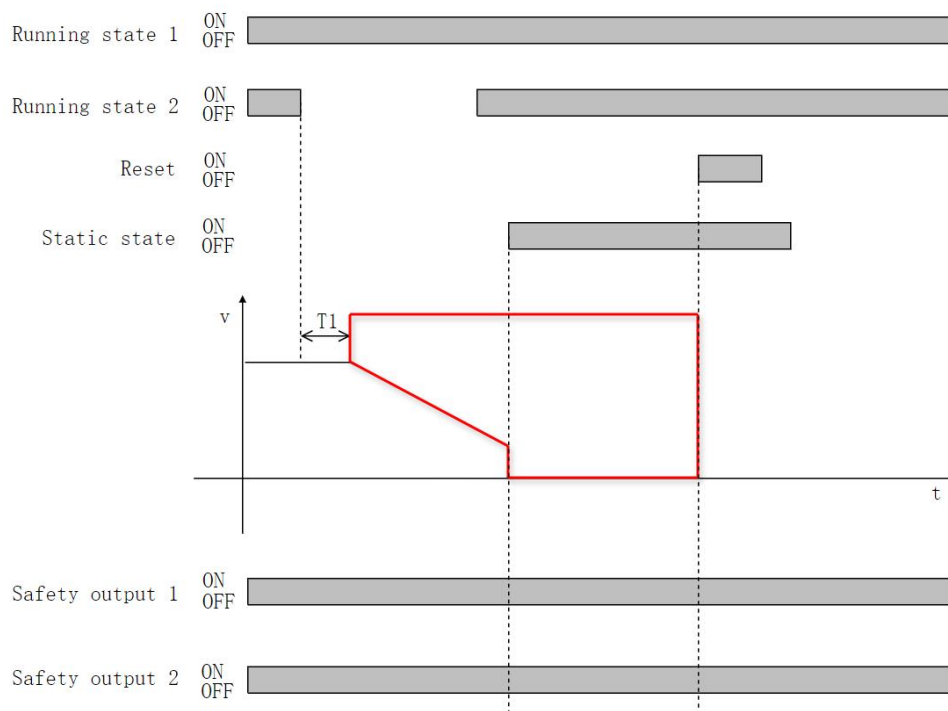
T3: Safety output 2 shutdown delay; Red box: Monitoring triggered by input 1

Figure 7.10 Timing diagram of stop function triggered by input 1 (including self-reset)



T1: Delay time before starting deceleration process monitoring; T2: Safety output 1 shutdown delay; T3: Safety output 2 shutdown delay; Red box: Monitoring triggered by input 2

Figure 7.11 Timing diagram of stop function triggered by input 2 (including self-reset)



T1: Delay time before starting deceleration process monitoring; T2: Safety output 1 shutdown delay; T3: Safety output 2 shutdown delay; Red box: Monitoring triggered by input 2

Figure 7.12 Timing diagram 2 of stop function triggered by input 2 (manual reset)

7.6.10 UI8 to Bool

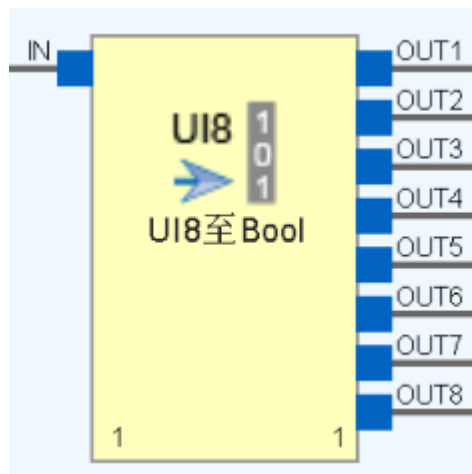


Figure 7.13 Function block diagram

Function block description

The UI8 to Bool function block converts the input 8-bit integer value (Uint8) into a bool value. The output 1-8 is converted into a bool value.

Function block parameters

Table 7-30 Input information to the UI8 to Bool function block

Number	Information	Configurational	Data Type	Description
1	IN	Fixed	Uint8	

Table 7-31 UI8 outputs information to the Bool function block

Number	Information	Configurational	Data Type	Description
1	OUT1-OUT8	Optional	Bit: Bool	You can configure the number of binary outputs

Table 7-32 UI8 to Bool function block configuration parameters

Number	Parameter	Information	Description
1	Number of outputs	Range1~8	

Truth table

Table 7-33 UI8 to Bool truth table (using eight outputs as an example)

IN1	OUT8	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	1	0
3	0	0	0	0	0	0	1	1
...	...	...	...	...	...	...	...	...
254	1	1	1	1	1	1	1	0
255	1	1	1	1	1	1	1	1

7.6.11 Bool to UI8

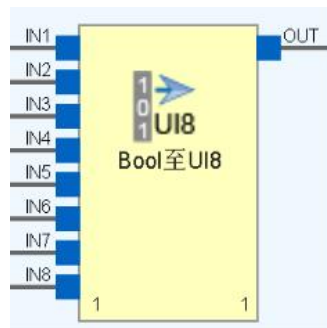


Figure 7.14 Function block diagram

Function block description

The Bool-to-Ui8 function block converts an 8-bit bool value (1-8) to an integer value (Uint8), and outputs the integer output conversion value.

Function block parameters

Table 7-34 Bool inputs information to the UI8 function block

Number	Information	Configurational	Data Type	Description
1	IN1-IN8	Optional	bit: Bool	You can configure the number of binary inputs

Table 7-35 Bool outputs information to the UI8 function block

Number	Information	Configurational	Data Type	Description
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1	OUT	Fixed	Uint8	
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Table 7-36 Enable UI8 function block configuration parameters

Number	Parameters	Information	Description
1	Input digit,Input number	Range 1~8	

Truth table

Table 7-37 Bool to UI8 truth table (using eight inputs as an example)

IN8	IN7	IN6	IN5	IN4	IN3	IN2	IN1	OUT1
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1
0	0	0	0	0	0	1	0	2
0	0	0	0	0	0	1	1	3
...	...	...	...	...	...	...	...	...
1	1	1	1	1	1	1	0	254
1	1	1	1	1	1	1	1	255

7.7 Lidar Logic Function Block

The Lidar logic function block is used for Lidar zone monitoring and zone handover.

Lidar logic combined with motion logic can realize the automatic switching of the defense zone following the speed of the AGV: when the Lidars warning area detects an obstacle, the AGV begins to slow down. As the speed decreases, the Lidars defense zone continues to shrink. When the obstacle invades the Lidar when protecting the area, the SPC immediately turns off the safety output to prevent the AGV from colliding.

SPC Most Multi With 2 Lidars, in the hardware configuration interface, users need to first Selected Lidar Element, determine Lidar Quantity Used, then determine the number of defense zones (groups) of Lidar by configuring 4 configurable IOs And number of Alarm signals.After the hardware configuration is completed,according to the Lidar interface Application mode, configure Lidar logic function block.

7.7.1 Lidar output detection

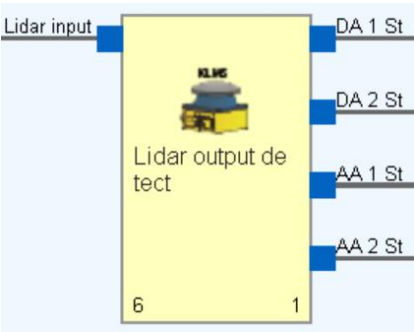


Figure 7.15 Functional block diagram

Functional Description

The Lidar output detection function block is used to detect the defense zone 1 status signal (OSSD1),

defense zone 2/fault status signal (OSSD2/fault),alarm zone 1/Fault status signal(Alarm1/fault), alarm zone 2/Fault status signal(Alarm2/fault) output by the Lidar in which the defense zone status signal is a safety signal and needs to be used in pairs, the alarm and fault signal is a non-safety signal and needs to be used in a single channel.

When the input signal detects the OFF state, the corresponding function block output also outputs the OFF state.

When the zone state signal (OSSD 1/2) checks and detects that the difference time has expired, the corresponding zone state output is OFF.

Function block parameters

Table 7-38 Lidar output detection function block input information

Serial number	Information	Configurability	Description
1	Lidar input	Fixed	Monitor the zone signal of Lidar; Alarm signal of monitoring Lidar:According to the six configuration modes of Lidar area (group), when IO1 ~ IO4 are used as inputs, only some interfaces can be enabled at the same time

Table 7-39 Lidar output detection function block outputs information

Serial number	Information	Configurability	Description
1	defense Zone 1 status	Fixed	0: OFF; 1: ON.
2	defense Zone 2/fault status	Fixed	Depending on the configuration limitations of the Lidar,only one can be enabled in defense Zone 2, Alarm Zone and fault,Alarm zone and fault can be enabled simultaneously Alarm zone and fault output shall not be used for safety functions.
3	Alarm Zone 1/fault status	Fixed	
4	Alarm Zone 2/fault status	Fixed	

Table 7-40 Lidar output detection function block configuration parameters

Serial number	Parameter	Information	Description
1	Difference time between two OSSD input signals in defense zone 1	0 ~ 500ms, in 4ms step, 0 = disabled	When out-of-tolerance, Zone 1 status output OFF
2	Difference time between two OSSD input signals in defense zone 2	0 ~ 500ms, in 4ms step, 0 = disabled	This item can only be set when Zone 2 is enabled; Zone 2 state output OFF when out-of-tolerance



Attention

The input terminal of the function block **LidarInput**, should come from the Lidar component, not the output of the function block and others.

7.7.2 Lidar zone switching

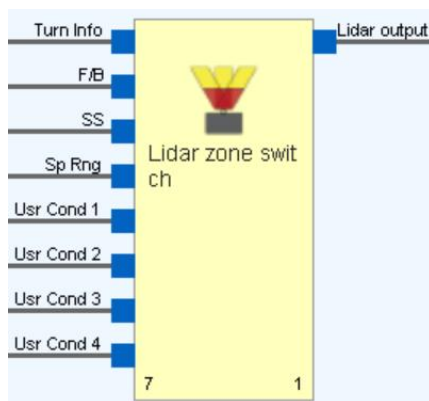


Figure 7.16 Functional block diagram

Functional Description

The Lidar defense zone switching function block realizes the automatic switching of Lidar defense zones according to user conditions. The number of defense zones that users can configure varies under different conditions.

The user conditions include the stationary, turning, and straight driving of the car. Among them, turning is divided into left turn and right turn, and up to 3 defense zones can be set in each turning direction; straight driving is divided into backward driving and forward driving. Up to one defense zone can be set for backward driving. Under forward driving conditions, users can activate an additional 4 user conditions and 12 speed ranges for switching defense zones during forward driving. For detailed information, please refer to the table below.

Table 7-41 Different AGV status monitoring case settings

AGV Operational status	User Settings Information1		User Settings Information2	Combination Quantity	Default Defense zone
Stationary	Select Enable first, and then set the range after enabling		Select a defense zone	1	Defense zone1
Turn left	Select Enable first, and then set the range after enabling	Turn leftScope1	Selected Corresponding Defense zone	3	Defense zone2
		Turn leftScope2			Defense zone3
		Turn leftScope3			Defense zone4
Turn right	Select Enable first, and then	Turn rightScope1	Selected Corresponding	3	Defense zone5

	set the range after enabling	Turn rightScope2					Defense zone		Defense zone6
		Turn rightScope3							Defense zone7
Backward	Select Enable first, and then set the range after enabling					Select a defense zone		1	Defense zone8
Forward	Select Enable first, and then set the range after enabling, User criteria are optional, you need to select enabled, and set the range after enabled	User Conditions4	User Conditions3	User Conditions2	User Conditions1	Velocity segment	Selected Corresponding Defense zone	12	-
		0	0	0	0	1~12			Defense zone9~Defense zone20
		0	0	0	1	1~12			Defense zone21~Defense zone32
		0	0	1	0	1~12			Defense zone33~Defense zone44
		0	0	1	1	1~12			Defense zone45~Defense zone X
		0	1	0	0	1~12			

The total number of Lidar defense zones is limited by the configuration of Lidar components. For details, see Table 5-2.

Function block parameters

Table 7-42 Lidar zone switching Function block input information

Serial number	Information	Configurability	Description
1	Steering information	Optional	Steering Conditions for Zone Switching
2	Forward/Backward	Optional	Straight Travel Conditions for Zone Switching
3	Stationary state	Fixed	Stationary Conditions for Zone Handover
4	Velocity segment	Optional	Speed Conditions for Zone Switching when going straight forward, a total of 12 speed segments

5	User Condition 1	Optional	User conditions for zone handover when going straight forward, up to 4 user conditions are enabled
6	User Condition 2	Optional	
7	User Condition 3	Optional	
8	User Condition 4	Optional	

Table7-43 The Lidar zone switching Function block outputs information

Serial number	Information	Configurational	Description
1	Lidar Output	Fixed	Lidar element

Table 7-44 Lidar zone switching Function block configuration parameters

Serial number	Parameter	Information	Description
1	Enable A	The default is not enabled, and the output port of this function block is enabled when it is connected to the Lidar	
2	Enable B	The default is not enabled, and the output port of this function block is enabled when it is connected to the Lidar	
3	Enable C	Checked to enable static input C, unchecked to disable	
4	Enable D	Checked to enable static input D, unchecked to disable	
5	Enable E	Checked to enable static input E, unchecked to disable	
6	Enable F	Checked to enable static input F, unchecked to disable	
7	Enable steering	Check to indicate that the steering configuration item needs to be configured. There are 6 pieces of corresponding steering zone switching data in the upper table of the zone switching attribute interface, namely: turn left 1, turn left 2, turn left 3, turn right 1, turn right 2, turn right 3. Similarly, users can set its defense zone. If not checked, these 6 items will not be displayed	
8	Enable back	Checked to enable back, unchecked to disable	
9	Forward zone configuration	You need to check Enable Forward before you can configure the forward defense zone	If none of the user conditions 1-4 are

		- Click the button . You can add a zone handover case in the table below in the zone handover attribute box interface - A delete button is provided in the last column of the table , click to delete the case - Each zone handover case can be configured as follows: whether conditions 1 to 4 are on, speed segment, values of A to F and remark.	enabled, the "All" option cannot be selected for the speed range.
--	--	--	---

 **Attention**

The output of the function block **LidarOutput**, should be connected to Lidar components, not the input of functional blocks and others.

In all logic program pages, there can only be a maximum of 2 Lidar zone switching function blocks(Lidar Zone Switching and Lidar Zone Switching 2).

7.7.3 Lidar zone switching2

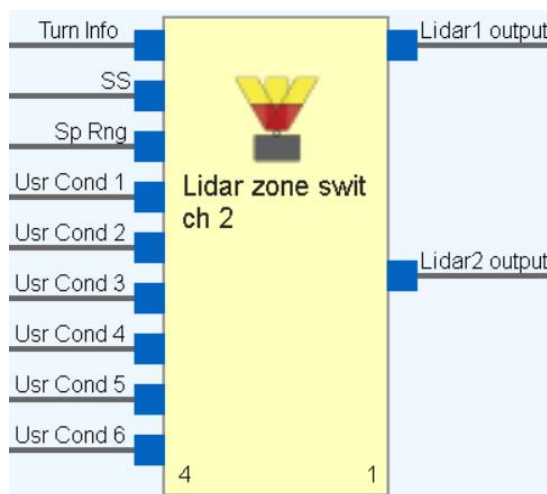


Figure 7.17 Function block diagram

Function block description

The Lidar zone switching 2 function block realizes the automatic switching of dual Lidar zones following user conditions. Under different conditions, the number of zones that users can configure is different.

The input configuration encompasses both stationary vehicle positioning and turning maneuvers. Turning operations are categorized into left/forward and right/forward rotations, with up to three defense zones configurable per direction. Straight driving modes include forward and reverse travel, each offering 6 additional user-defined conditions and 12 speed ranges. Notably, the speed ranges for forward and reverse driving are symmetrically designed to facilitate zone switching during these maneuvers. The Lidar Zone Switching 2 functional block simultaneously evaluates straight driving and turning operations in both directions, enabling synchronized dual Lidar zone switching.

Function block parameters

Table7-45 Lidar zone switching 2 Function block input information

Number	Information	Configurational	Description
1	Switch information	Optional	Turning conditions for zone switching
2	Stationary state	Fixed	Static conditions for zone switching
3	Speed segment	Fixed	There are 12 speed segments for the speed condition of zone switching when going straight ahead
4	User conditions 1	Optional	The user conditions for zone switching when going straight ahead can be enabled for a maximum of 6 users
5	User conditions 2	Optional	
6	User conditions 3	Optional	
7	User conditions 4	Optional	
8	User conditions 5	Optional	
9	User conditions 6	Optional	

Table 7-46 The lidar zone switching 2 Function block outputs information

Number	Information	Configurational	Description
1	Lidar1 Output	Fixed	Lidar element
2	Lidar2 Output	Fixed	Lidar element

Table 7-47 Lidar zone switching 2 Function block configuration parameters

Nummber	Parameters	Information	Description
1	Enable A	The default is not enabled, and the output port of this function block is enabled when it is connected to the Lidar	
2	Enable B	The default is not enabled, and the output port of this function block is enabled when it is connected to the Lidar	
3	Enable C	Checked to enable static input C, unchecked to disable	
4	Enable D	Checked to enable static input D, unchecked to disable	
5	Enable E	Checked to enable static input E, unchecked to disable	
6	Enable F	Checked to enable static input F, unchecked to disable	
7	Enable steering	Check the box to enable the turn zone settings for forward and backward driving; uncheck it to disable them.	

8	Non-straight-line defense zone configuration	It includes stationary zone configuration and turning zone configuration. Among them, the turning zone configuration includes turning when moving forward and turning when moving backward.	
9	Straight-line defense zone configuration	You can set a straight-line defense zone for forward driving, and also a straight-line defense zone for backward driving. Click button  to add a zone switching example in the table below the zone switching attribute box interface In the last column of the table, a delete button  is provided to delete the case Each zone switching case can be configured as follows: whether condition 1~6 is enabled, speed segment, values of A~F and remark.	If none of the user conditions 1-6 are enabled, the "All" option cannot be selected for the speed range.



Attention

The output terminals **Lidar1 Output** and **Lidar2 Output** of this function block should be connected to the Lidar element, rather than to the input and other functions of the function block.

In all logical program pages, there can be at most one Lidar zone switching function block(Lidar Zone Switching and Lidar Zone Switching 2).

8 Multi-Master Function

Multi-Master Function enables multiple master modules to be interconnected via a SPC Line bus. The MC208400E4 model is the only master module supporting this feature, with a maximum capacity of 16 interconnected master modules. Each main module provides 8 output channels for Master result, serving as master outputs.

The SPCTool software facilitates configuration and activation of Multi-Master Function. During logical programming, the system automatically generates input/output configurations for each master based on the specified number and IDs, allowing users to utilize these results according to their programming requirements.

Enable Multi-Master Function

In the hardware selection interface, select MC208400E4 as the main module. Double-click the main module to pop up the [Module information] window. Select the [Settings] tab and check the enabled Multi-master mode to further configure the relevant parameters of Multi-master mode, as shown in the figure below.

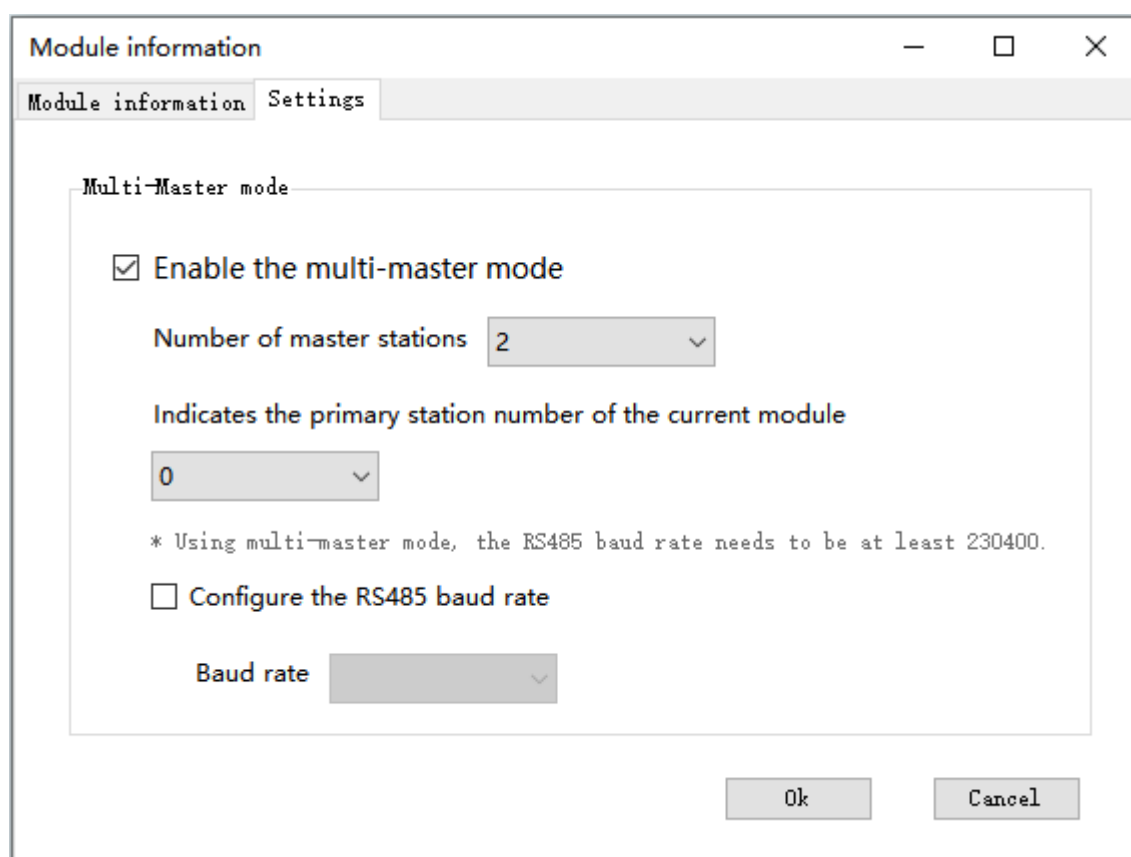


Figure 8.1 Multi-Master Function configuration interface

Close Multi-Master Function

On the interface in Figure 8.1, uncheck [Enable the multi-master mode].

Multi-master Mode Parameter Settings

In the hardware selection interface, select the main module as MC208400E4. Double-click the main module to open the [Module Information] window. Select the [Settings] tab and check the "Enable the Multi-master mode" option to configure related parameters for this mode, as shown in the figure below.

The number of masters can be configured by setting the number of main modules connected via SPC Line (range: 2-16).

The current module's master number is assigned as the serial number for the active master module, with a range of 0-15.



Attention

If Multi-Master Function is used, the port rate of RS485 interface must be ≥ 230400 .

If the baud rate of the RS485 interface in the current module does not meet the above requirements, the Settings can be made on the interface shown in Figure 8.1. The Settings will be downloaded to the SPC along with the configuration during the configuration download.

After the configuration is completed, click the button[Ok] to complete the multi-master mode parameter setting.

If Multi-Master Function is enabled, the main module will display its master number, as shown in Figure 8.2.

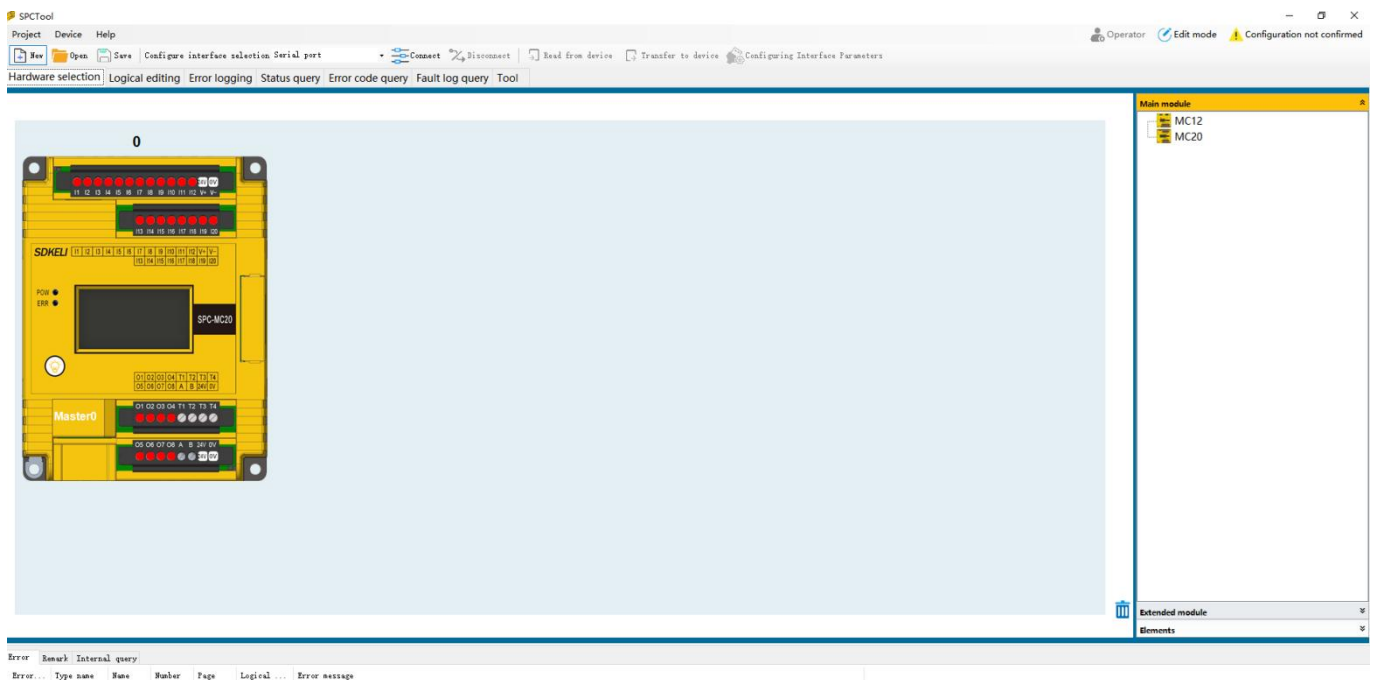


Figure 8.2 Display the master number

If the Multi-Master Function is configured, in Logical editing, the MPU logic unit will appear the input of the Master Result type of other masters and the output of Master Result type of the current master

module, as shown in the figure below.

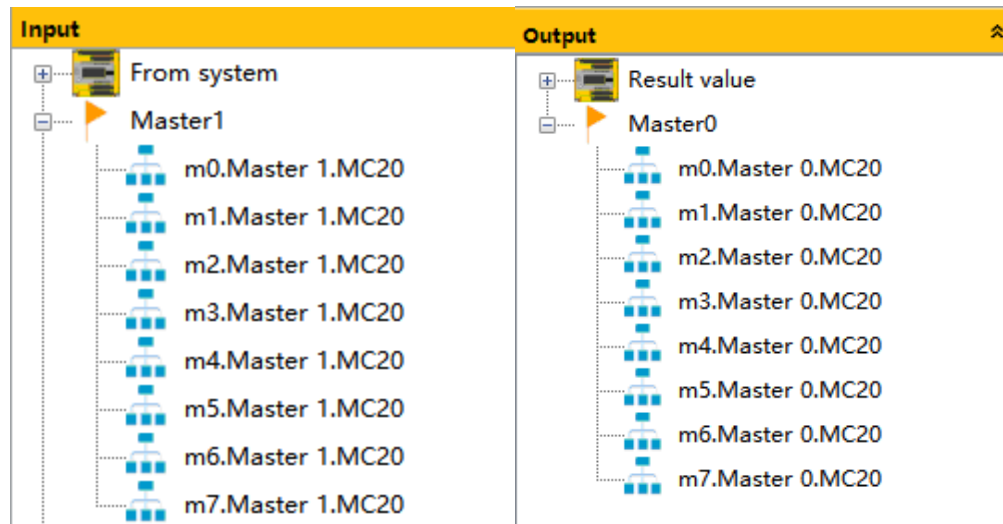


Figure 8.3 Input and output of Master Result type

Drag Master result to be used into the Logical editing area and edit the logical program.

9 Interface Parameter Settings

The SPC configuration software provides different interface parameter configuration functions based on the configured main module. The MC12 main module offers USB, TCP, and CAN interface parameter configuration capabilities, while the MC20 main module supports USB, TCP, and RS485 interface parameters. When clicking the "Configuration Interface Parameters" button in the toolbar, the system will display an interface parameter configuration window.

Interface parameter configuration

USB

Baudrate: 230400

Read Edit Write

Ethernet

Modbus TCP

☐ Enable heartbeat

Heartbeat(ms): 50

Write

CAN

Baudrate: 125K

Address: 1

Read Edit Write

A number between 1 and 247

Figure 9.1 Interface parameter configuration interface-MC12

Interface parameter configuration

USB

Baudrate: 230400

Read Edit Write

Ethernet

Modbus TCP

☐ Enable heartbeat

Heartbeat(ms): 50

Write

RS485

SPC Line/Modbus RTU

Baudrate: 230400

Address: 1

Read Edit Write

A number between 1 and 247

Modbus RTU

☐ Enable heartbeat

Heartbeat(ms): 50

Figure 9.2 Interface parameter configuration interface-MC20

The parameter configuration can be carried out through Figures 9.1 and 9.2.

Clicking on "Write", users can send the interface parameters.

If you do not want to issue the interface parameters separately here, you can also click "OK", and then during the configuration download process (refer to Section 10.1 for details), the parameters will be transmitted.

The communication protocol of the interface can be found in the hardware manual of the SPC product.



Tips

1. Mismatch between the network interface IP address, gateway parameters and connected device will trigger a prompt to modify interface parameters during network connection.

10 Configure Downloads And Reads

10.1 Configure Download

The users configuration of the safety controller through this software can be downloaded to the safety controller.

10.1.1 Configure Download Method

Users can download the configuration in two ways:

- (1) Click the button in the toolbar  Transfer to device , the configuration download will occur.
- (2) Click [Device]-[Transfer to Device] in the menu bar, and you can also configure and download it.

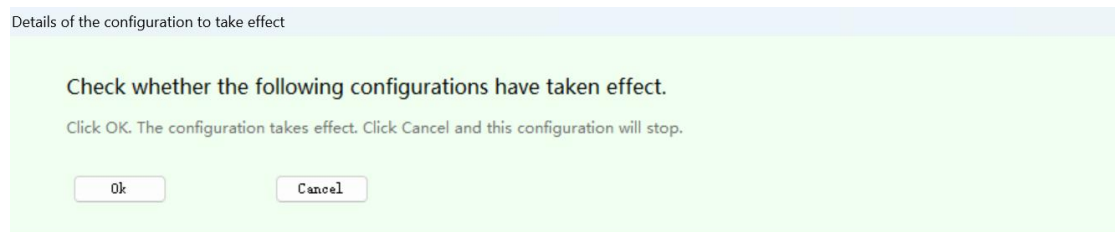
10.1.2 Fitness Check

Adaptability checks are performed before the configuration is transferred. Adaptability check will first check whether the main module matches, and if the main module matches, it will then check whether each expansion module matches the current configuration data. If each module is adapted to the configuration data, the transmission of the configuration data is started.

If all modules are adapted to the configuration data, the configuration can be transmitted to the security controller, otherwise the configuration download is cancelled.

10.1.3 Configuration Confirmation

After the configuration is transferred to the security controller, the transferred configuration is re-read from it and compared with the transferred data. If the data is consistent, a [Configuration Confirmation] window will pop up. The network parameters illustrated in this section are examples based on Ethernet connection, while the serial port parameters correspond to the serial port settings.



1. Network parameters

IP address	192.168.0.6
Subnet mask	255.255.255.0
Gateway	192.168.0.1
DNS	114.114.114.114
MAC	A00264320026
Port number	7680

2. System attributes

Parameter	Value
Model number	SPC-MC1284ALEC
Product version	1.0.0.0
System check sum	0x25 29 6B 22
Software check sum	0x9F 01 8D 4A
Configuration state	Unconfirmed

3. Component overview

Module	Model number	Oder Number
Main Module	SPC-MC1284ALEC	0
Expansion module1	SPC-EN0000S000	1

4. Module information

4.1 Module Connection Relationships

Figure 10.1 Configuration confirmation window

In **Configuration confirmation window**, all issued configuration data will be presented in chapters in the form of tables, pictures, text, etc., as shown in the figure below.

Details of the configuration to take effect

Check whether the following configurations have taken effect.

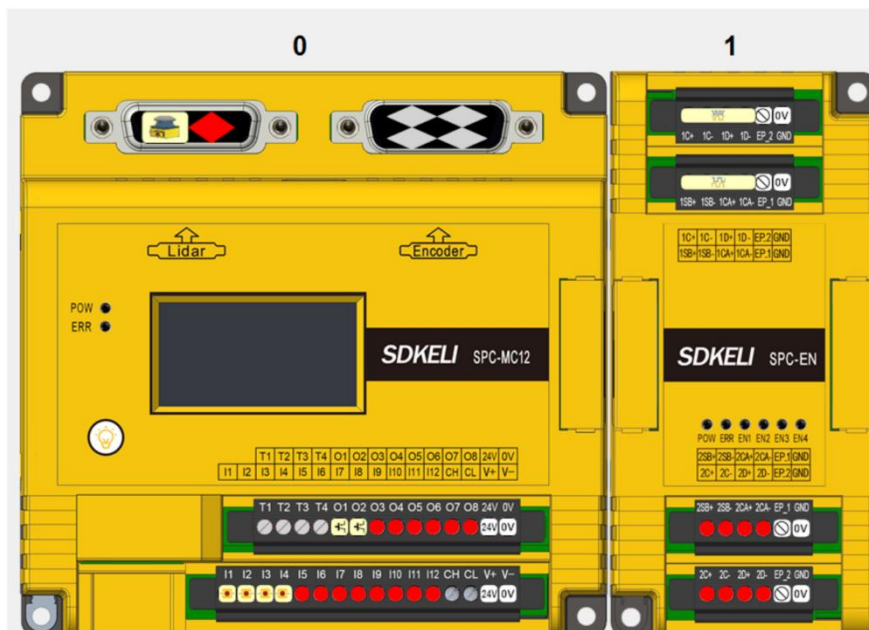
Click OK. The configuration takes effect. Click Cancel and this configuration will stop.

Ok

Cancel

4. Module information

4.1 Module Connection Relationships



Details of the configuration to take effect

Check whether the following configurations have taken effect.

Click OK. The configuration takes effect. Click Cancel and this configuration will stop.

Ok

Cancel

4.2 Main Module

4.2.1 Main Module Information

Oder Number	Device description	SN	Equipment type	Product version	Other attributes
0		--	SPC-MC1284ALEC	1.0.0.0	--

4.2.2 Component Information

Oder Number	Element type	Lead	Attributes
2	E-Stop single channel	I1	ON-OFF: Enables the function OFF-ON: Enables the function Test output:No Safety component or not: Yes
3	E-Stop single channel	I2	ON-OFF: Enables the function OFF-ON: Enables the function Test output:No Safety component or not: Yes
4	E-Stop single channel	I3	ON-OFF: Enables the function OFF-ON: Enables the function Test output:No Safety component or not: Yes
5	E-Stop single channel	I4	ON-OFF: Enables the function OFF-ON: Enables the function Test output:No Safety component or not: Yes
0	PNP single channel	O1	Safety component or not: Yes Static detection: Yes Dynamic detection: Yes Dynamic detection of pulse time:0us
1	PNP single channel	O2	Safety component or not: Yes Static detection: Yes Dynamic detection: Yes Dynamic detection of pulse time:0us
0	Safety KLM	RD1	Defense area switching configuration mode:IO1-IO4 are all output

4.3Expansion module1

4.3.1 Module information

4.3 Expansion module

4.3.1 Module information

Oder Number	Device description	SN	Equipment type	Product version
1	Expansion module	--	SPC-EN0000S000	1.0.0.0

4.3.2 Component list

Oder Number	Element type	Lead	Attributes
0	Safety SSI enc	EN1	Power supply voltage: Disable Total number of digits:8 Initial digit:0 Location data bit:8 Baud rate:100K Encoding mode: binary
1	Safety AB enc	EN2	Power supply voltage: Disable Enable resolution extension or not:Disabled

5. Program segment information

5. Program segment information

5.1 MPU

5.1.1 Program diagram

Page1

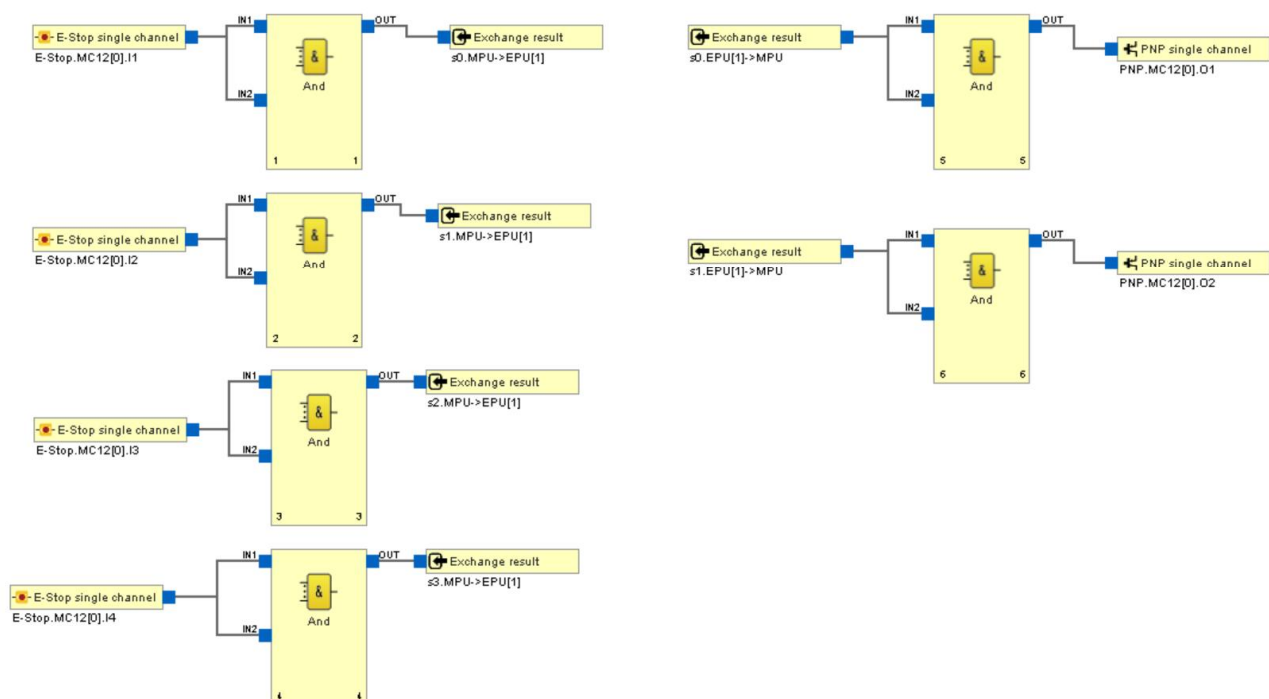


Figure 10.2 Configuration data displayed in the confirmation window

Here, the user can check and confirm the configuration. If the user confirms that the data is correct, click OK, which will be regarded as the users confirmation of the configuration, and the configuration will take effect. Click the [Cancel] button, If the user cancels the configuration download, the transmitted configuration will not take effect.

10.2 Configuration Read

10.2.1 Configure Read Method

The user can read the configuration in two ways:

- (1) Click the button in the toolbar  Read from device, will read its current configuration from the security controller.

(2) Click [Device]-[Read from Device] in the menu bar, and you can also read the configuration.

After reading the configuration of the controller, if the application of the main module is running, it will enter the APP operation mode; if not running, it will further check whether it can be started. If the application of the main module cannot be started, it will enter the online state.

Regarding the operation of the APP, please refer to Chapter 11: Application Startup and Shutdown.

10.2.2 Online State

After entering the online state, as shown in the following figure, no configuration changes are allowed.

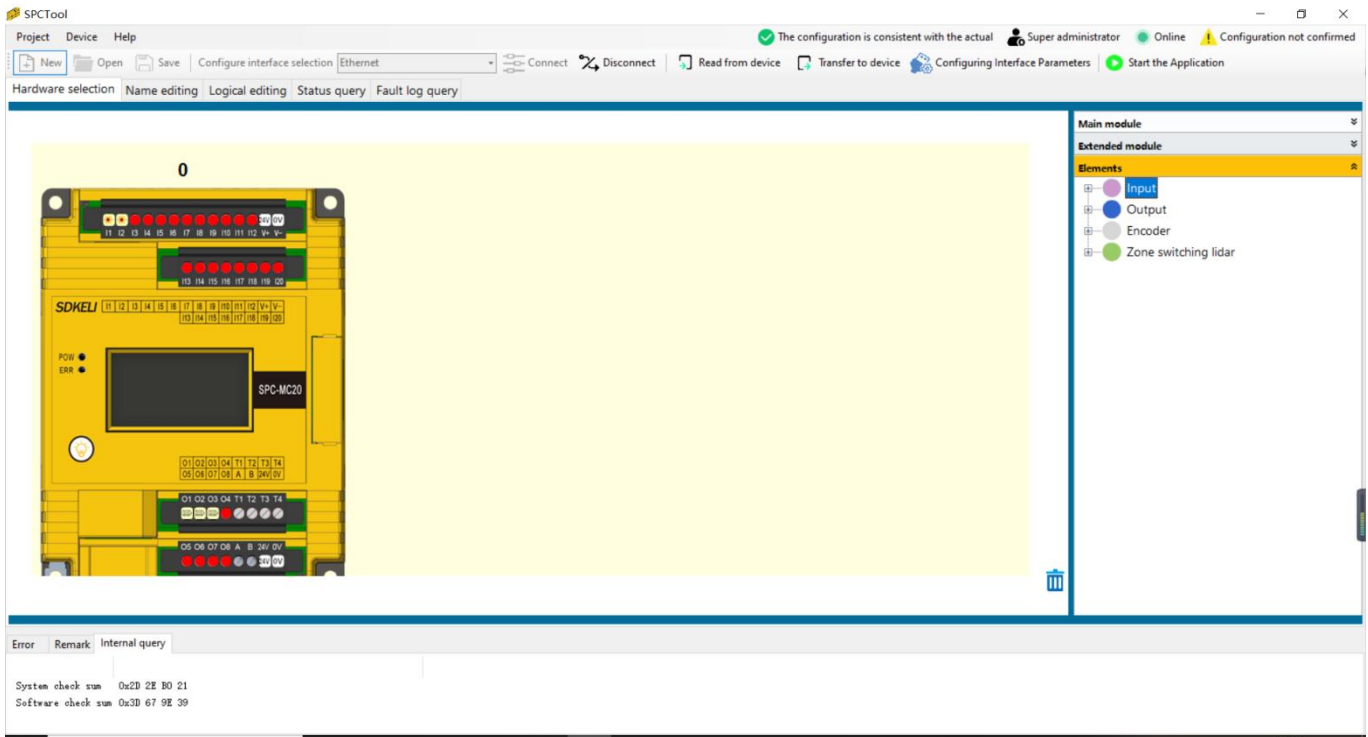


Figure 10.3 Online state

10.2.3 Check The Checksum

As shown in Figure 10.3, the current system checksum and software checksum are displayed in the lower internal query page.

10.2.4 Information View

In the hardware configuration interface, you can double-click the module to view the module information, as shown in the figure below.

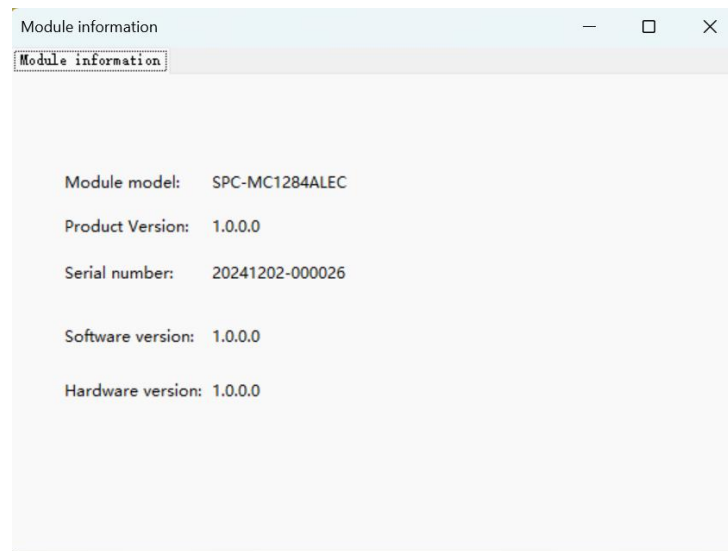


Figure 10.4Module Information

You can also double-click the component to view the component properties, as shown in the figure below.

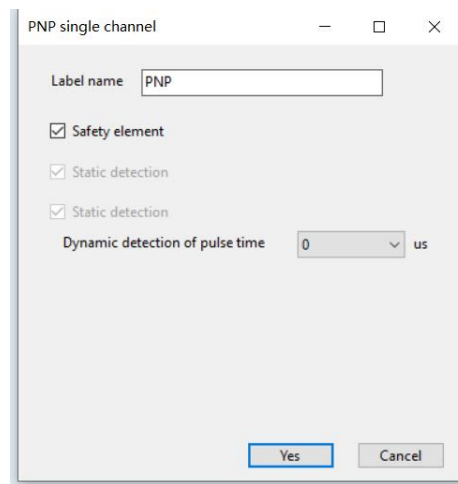


Figure 10.5 Component Information

In the logic editing interface, you can view each page of each logical unit, as shown in the figure below.

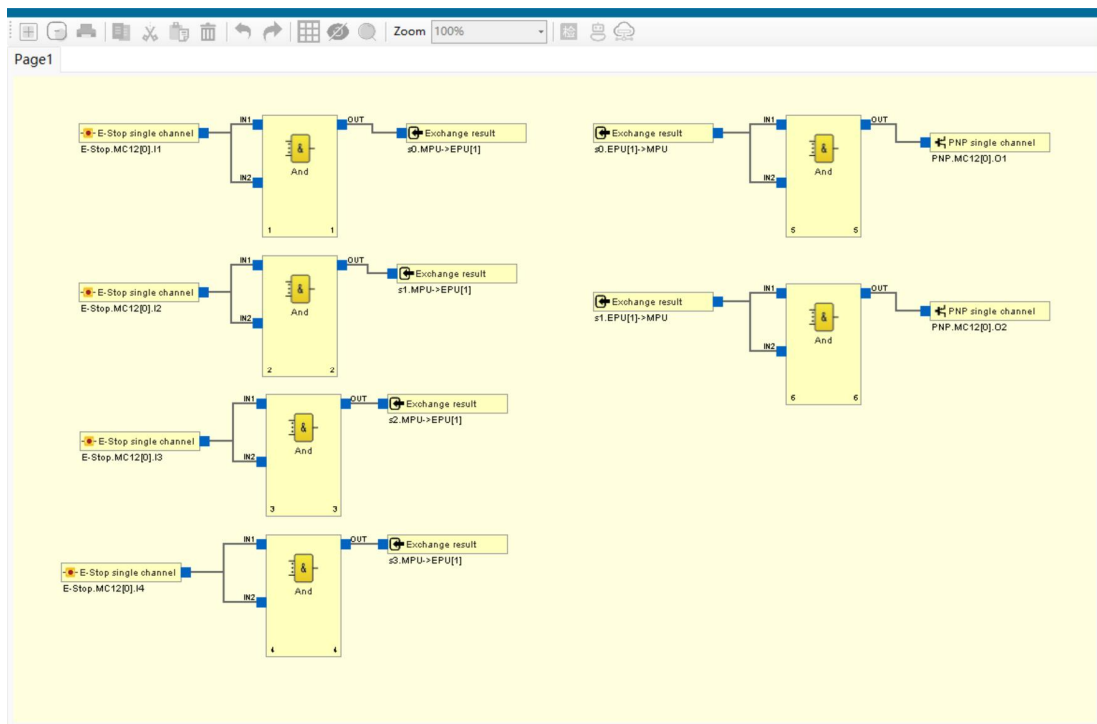


Figure 10.6 Logic program page

You can also view the function block properties through the context menu, as shown in the figure below.

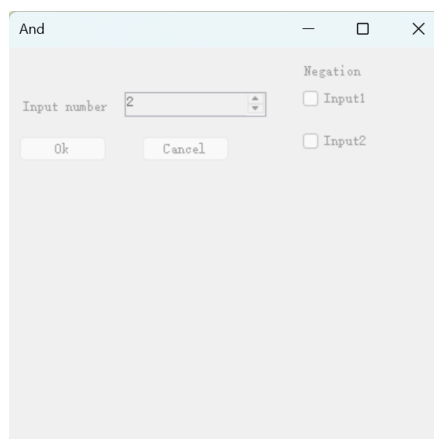


Figure 10.7 Function Block Properties

10.2.5 End Online State

If the user wants to modify the configuration, they need to end the online state first.

There are two ways to end the online state:

- (1) Click the button in the toolbar  Disconnect, disconnect from the device, and you will enter the editing state.
- (2) Click [Device]-[Disconnect] in the menu bar, and you will also enter the editing state..

11 Application Startup And Shutdown

An application refers to the application program of a programmable safety controller. The application can be started or stopped by using the button  on the toolbar. Starting or stopping the application requires certain user permissions. Please refer to Section 3.3 for details.

After the configuration is downloaded or read, if the application is running, the upper computer will enter the APP operation mode. The APP operation mode is shown in Figure 11.1.

If the APP is not running, the user can start it. Once the application is successfully launched, it will enter the running mode of the APP.

In the APP operation mode, the actual input and output values will be displayed synchronously on the program diagram.

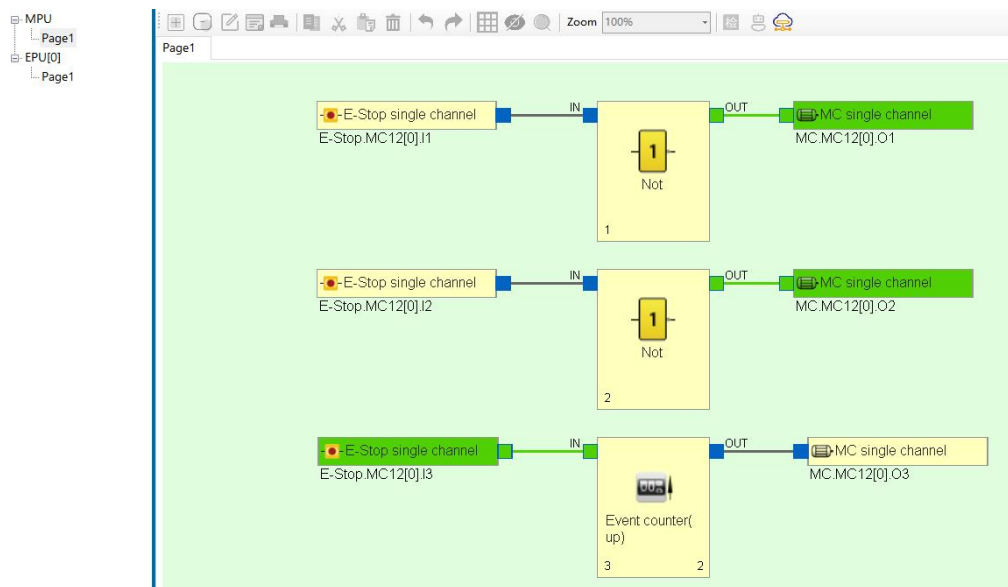


Figure 11.1 APP running mode



Tips

- 1.The startup and shutdown of the application, as well as the running mode of the APP, only support the network interface connection method.
- 2.Switching to the EPU logic unit is prohibited while the APP is running.
- 3.During APP operation, the following function blocks can display additional information at the bottom right of their graphic symbols: Delayer, Parallel Muting, Sequential Muting, Cross Muting, L-Type Muting, Position Detection Muting, Event counter (up), Event counter (down), and Event counter (up&down). No additional information is displayed for other function blocks.

12 Forced Mode

Forced mode refers to the situation where, the user can intervene in the logical program of the SPC system while its application program is running.

Regardless of the actual physical input values, this mode allows forcing SPC system inputs to 0 or 1. At the same time, the performance of the logical program of the SPC system is exactly the same as when the physical input has a corresponding value.

This function can be used to test the system wiring and check the logical program functionality during the debugging or maintenance period when the application is running.

Forced mode can only be available on MPU logic unit and not supported by EPU.



Attention

Restricted security in Forced mode

If not careful, the dangerous situation may not come to an end or may not end in a timely manner.

1. Before enabling Forced mode, make sure no one is in the dangerous area and eliminate all possible dangers to people or objects.
2. During the operation of Forced mode, ensure that no one can enter the dangerous areas of the machine or the facility.
3. If necessary, additional security measures will be taken.



Attention

1. In Forced mode, users can only directly influence the input within the system logic, but cannot affect the output and logical results (such as function blocks or jump addresses).
2. The output and logical results of the SPC system may change due to the forced input values. As a result, the protective function of the safety device may be deactivated.
3. Forced mode only affects the input of the function block and cannot influence the signals that are not determined by the output of the function block. For example, the input values that are directly routed to the PLC through the gateway.

12.1 Start Forced Mode

To enable Forced mode, the following conditions must be met:

- Connect the computer to the SPC system via the network interface.
- The user logs in as a super administrator.
- The configuration cannot be confirmed.

Steps to start Forced mode:

- Establish a connection with the SPC system.
- Enter online mode
- Switch to the logical editing interface and click the button  on the toolbar (start Forced).

- If the configuration is in the confirmed state, a dialog box will appear, allowing you to change the configuration status to unconfirmed.
- If the application is not launched, a dialog box will appear, and you can launch the application from here.
- In the pop-up dialog box for setting the forced parameters, select the duration of Forced mode. The duration is measured in minutes.
- Click "OK". Forced mode is activated, the background color of the logical editing area changes to a light red. At the same time, the countdown begins.
- If no other actions (such as forced input) are triggered within the set forced duration, Forced mode will automatically be deactivated when the time is up.

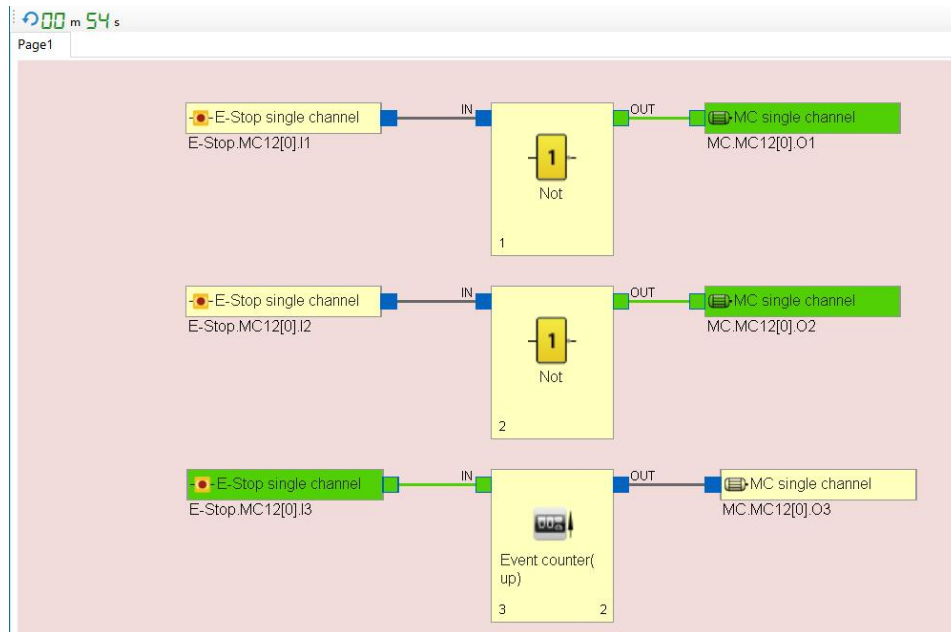


Figure 12.1 The logical editing page in Forced mode

12.2 Input Switching

To switch the input in Forced mode, follow these steps:

Left-click on the input element on the program diagram. Then, from the pop-up menu, select:

Forced Low: Regardless of the actual physical value of the input in the SPC system, it will be represented as 0 in the logical program.

Forced High: Regardless of the actual physical value of the input in the SPC system, it will be represented as 1 in the logical program.

Remove Forced: The value of this input will represent its actual physical value in the SPC system.

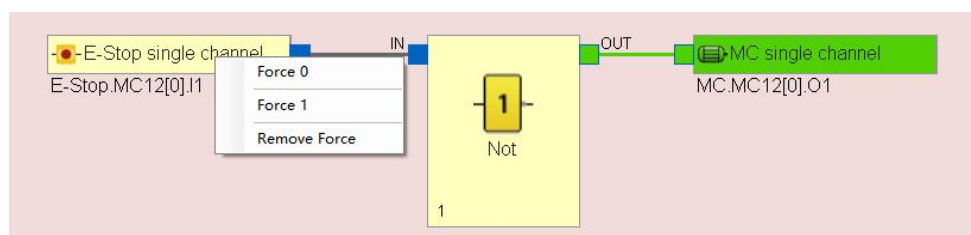


Figure 12.2 Set force menu

Due to the forced input, the edges of the graphic elements will be displayed in pink-purple. Input high (1) will be

shown in green, while input low (0) will remain in its original color.

Each time the input is switched, the countdown will start anew.

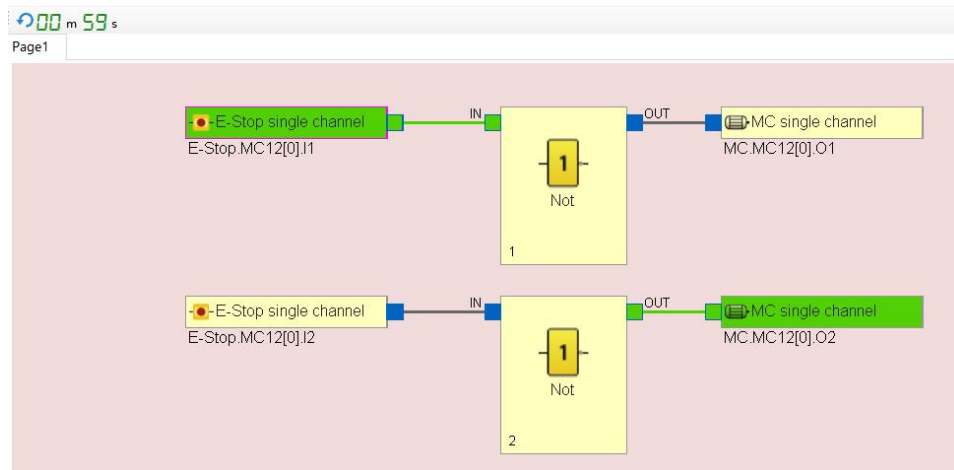


Figure 12.3 Input that is forced and input that is not forced



Tips

1. During the period when the input is forcibly controlled in the logic, the actual value of the physical input will not be displayed in the logic editor.
2. Forced mode is always applicable to the entire project. For logic programs with multiple pages in the logic editor, this means that the input that is forcibly controlled is set to the same value not only on the current page displayed in the logic editor, but also in all the places where it is used.
3. Due to communication rate issues, if the input changes rapidly, it will cause a lag in the process result. When the input stabilizes, the result will also stabilize.
4. Different from the offline simulation mode, the EDM (External Device Monitoring) function block is now available and effective at this time.

12.3 Exit Forced Mode

Forced mode can be ended in the following ways:

- Ended manually by the user. Click the button to end Forced mode.
- The time defined at startup will automatically end after it expires.

If the SPC system detects an error (such as a disconnection from the computer), it will automatically terminate within 30 seconds.

When Forced mode is terminated, all outputs of the SPC system will be set to 0, and the system will enter an unconfirmed state. The system needs to be reconfigured for confirmation.



Attention

When exiting Forced mode, it automatically enters the unconfirmed state, and all outputs remain at 0. At this point, if the regulations are not followed, the dangerous state of the machine may not be able to be terminated or may not be terminated in time.

1. Make sure that exiting Forced mode will not lead to any dangerous situations.

- 2.Ensure that the machine or equipment is in a safe state and will not be damaged when exiting Forced mode.
- 3.Before restarting the machine or equipment, make sure it won't cause any danger.

13 Status Query

After the configuration is read from the device, the status query function can be used. According to the reading situation, the items that can be queried are displayed. Figure 13.1 shows the status query interface of MC12 and one IO0842.

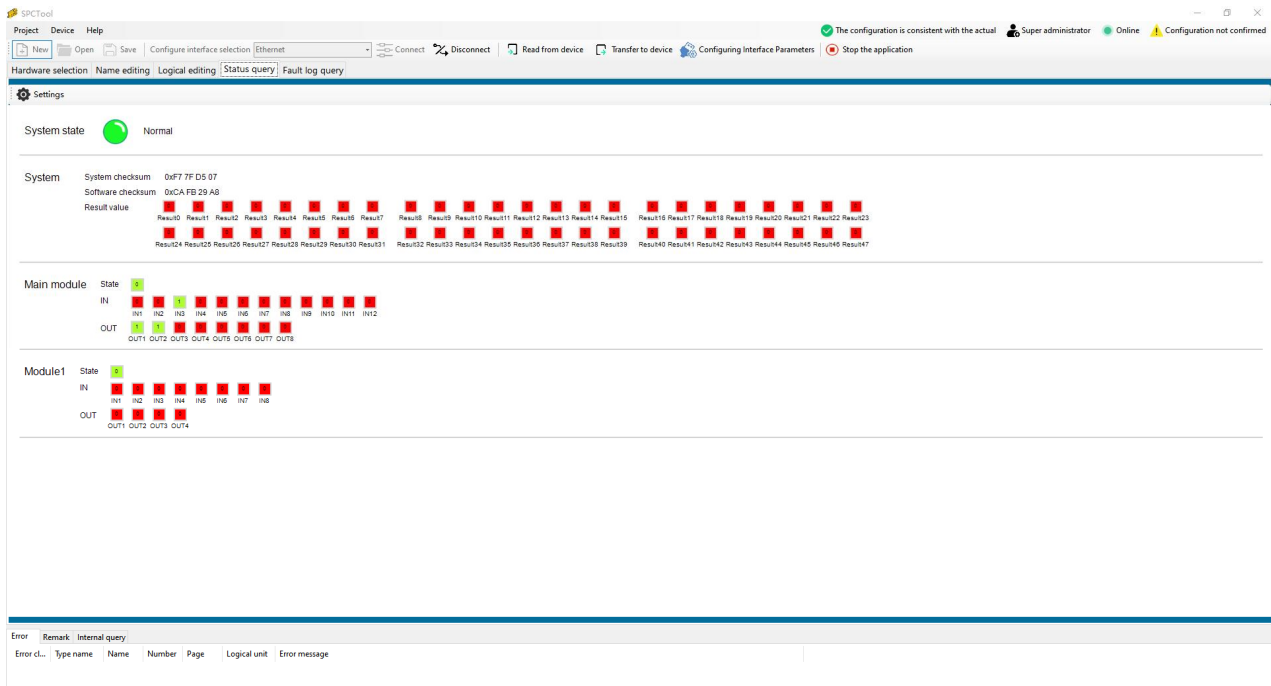


Figure 13.1 The status query function is available

Click the toolbar button  to set the refresh interval for status query. The default value is 500 ms, with a maximum setting of 20000 ms. System status and module status indicators are displayed in green for normal operation and in red for faults.

14 Fault Log Query

After successful connection with SPC, you can query the fault log. For the specific meaning of the fault code, please refer to the hardware specification of SPC products.

The fault log is divided into current fault log and historical fault log.

Current fault log, records faults since the last power on.

History fault log, that is, all the fault logs recorded.

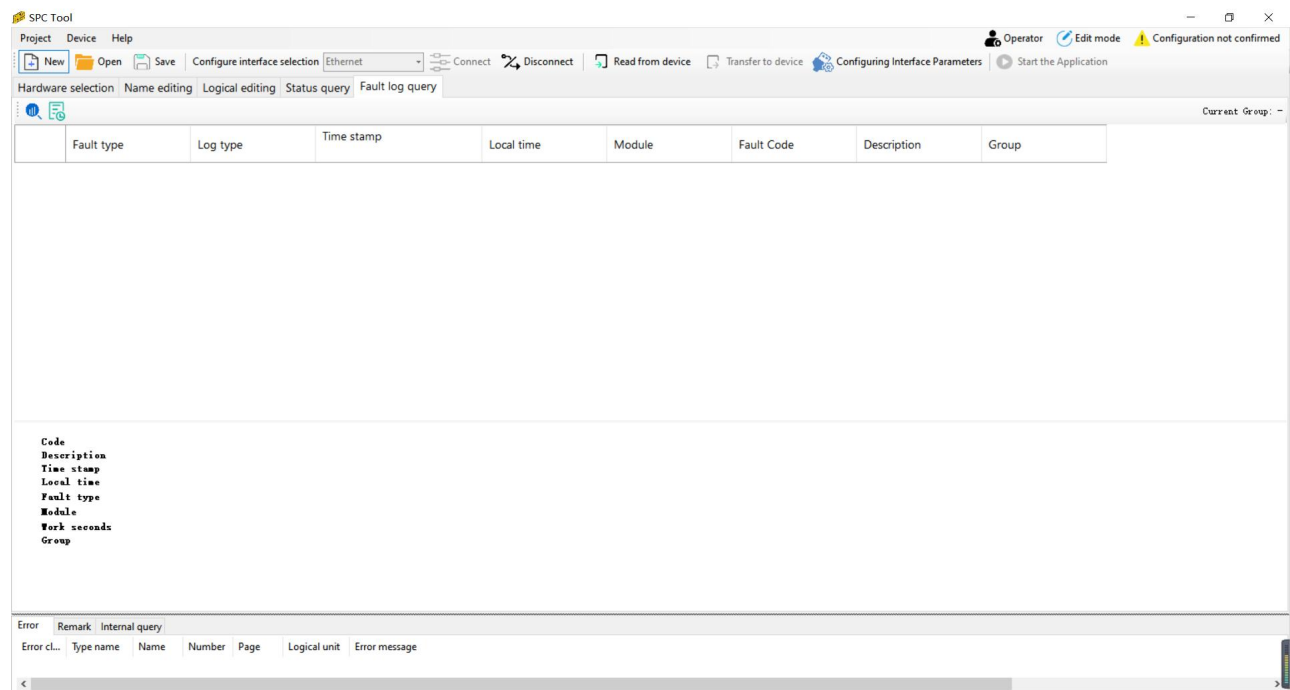


Figure 14.1 Fault log query interface

Click the button  to query the current fault log.

Click the button  to query the historical fault log.

The query results are displayed in the table below. Click a row in the table, and the detailed fault information of that row will be displayed at the bottom of the table.

SPC Tool

Project Device Help

New Open Save Configure interface selection Ethernet Connect Disconnect Read from device Transfer to device Configuring Interface Parameters Start the Application

Hardware selection Name editing Logical editing Status query Fault log query

Current Group: -

	Fault type	Log type	Time stamp	Local time	Module	Fault Code	Description	Group
			-	2026/1/26 15:07:37	0	02 000	Function block infor...	-

Code	27
Description	Function block information error
Time stamp	-
Local time	2026/1/26 15:07:37
Fault type	Unrecoverable
Module	0
Work seconds	-
Group	-

Error Remark Internal query

Error cl...	Type name	Name	Number	Page	Logical unit	Error message

Figure 14.2 Queries the current fault log results

15 File Saving And Reading

The configuration of SPC system can be saved in the form of files for convenient use.

During configuration, you can save it at any time; configurations read from the device can also be saved as files.

The configuration file opened by SPCTool can be downloaded to SPC.

Save

The configuration of SPC system can be saved as a file for easy use.

Users can save in the following two ways:

(1) Click the button  in the toolbar to save the current configuration. If it is the first time to save, a

save dialog box will pop up. Select the save path, name the file, and then save it to the specified path after confirmation.

(2) Click [Item] - [Save] in the menu bar to save the configuration.

Save As

You can save an open configuration to another file. You can also save a new configuration to another file.

Users can save it as follows:

Click [Project] - [Save as] in the menu bar in turn, and a save dialog box will pop up. Select the save path, name the file, and then confirm to complete.

Open

The configuration file has the extension.bin. To open the configuration file with SPCTool, you can do the following:

(1) Click the button  in the toolbar and select the file path.

(2) Click [Item] - [Open] in the menu bar, and select the file path.

(3) In the [Start] interface, click the open button and select the file path.

16 Frequently Asked Questions And Solutions

If an abnormality occurs during the use of the software, you can generally close the configuration software, replug and unplug the configuration cable, Safety controller Re-power and reopen the configuration software to solve the problem. If the customer has other abnormal operations in the process of using the software, please contact our technical staff, and we will provide comprehensive technical support services to meet the customers needs. The following is a list of typical possible problems and solutions for reference.

16.1 Software Fails To Start

Problem Description:

Double-click the software shortcut icon and the software cannot start.

Workaround:

(1) Move the cursor to the software shortcut icon, right-click the mouse button, and select Properties in the pop-up menu bar to open the image16.1.

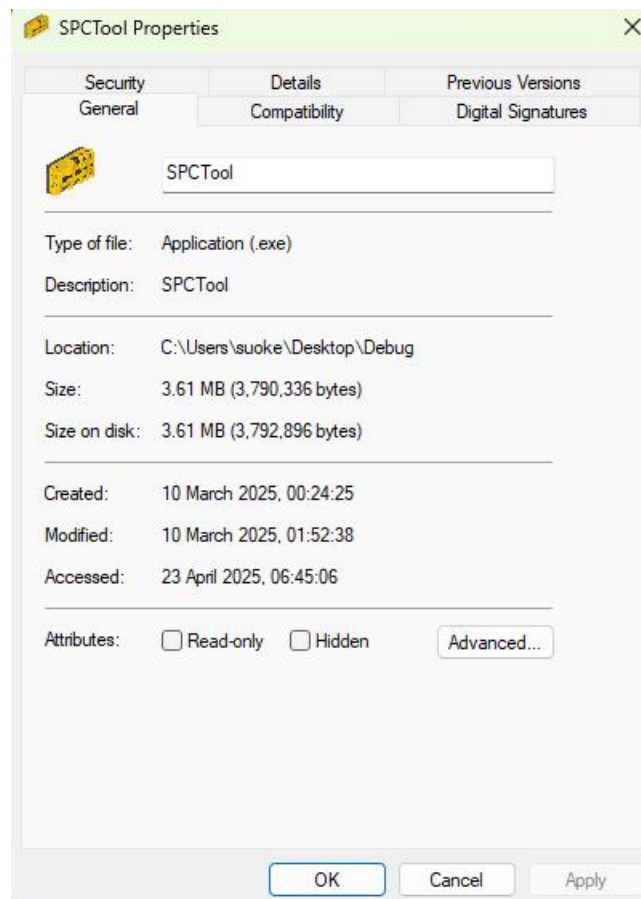


Figure 16.1 Properties window

(2) Select [Compatibility]. On this option page, check the option of 'Run this program as an administrator' under privilege level, and click [OK] to complete the modification. See diagram below16.2。

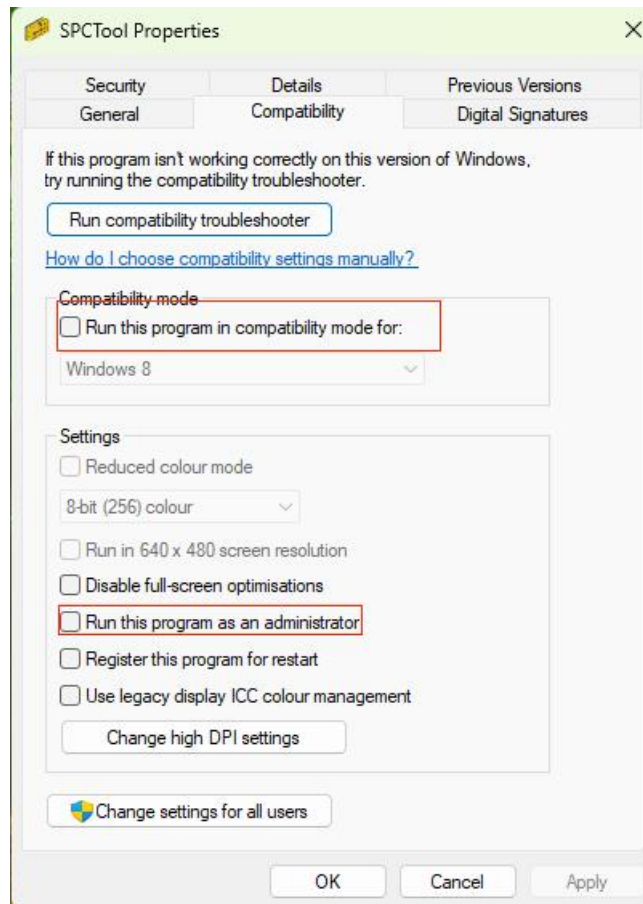


Figure 16.2 Set up to run the program as an administrator