

Hikrobot Co., Ltd.

Smart Camera Industrial Protocol

Operation Manual

HIKROBOT

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Symbol Conventions

The symbols that may be found in this document are defined as follows.

Symbol	Description
 Danger	Indicates a hazardous situation which, if not avoided, will or could result in death or serious injury.
 Caution	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance degradation, or unexpected results.
 Note	Provides additional information to emphasize or supplement important points of the main text.

Available Model

This manual is applicable to the vision sensors including SC2000Pro, SC2000E Series, and SC3000 Series, and smart cameras including SC5000 Series, SC6000, and SC7000Pro Series.

This manual is mainly intended for operation of industrial protocols supported by the Smart Cameras, including Ethernet/IP, ModBus, and Profinet.

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Chapter 1 EtherNet/IP

1.1 Introduction

EtherNet/IP is a network suitable for industrial environment and time-critical applications. EtherNet/IP uses standard Ethernet, TCP/IP technology and CIP's open application layer protocol, and it can share the network with normal Ethernet communication.

Note

This chapter takes Omron NX series PLC as an example to explain how to communicate with the smart camera via the EtherNet/IP communication protocol. For other devices, refer to the user manual provided by the manufacturer and make related settings by reading contents of this chapter.

1.2 Hardware Wiring

The wiring of Omron NX series PLC and the smart camera is shown below.

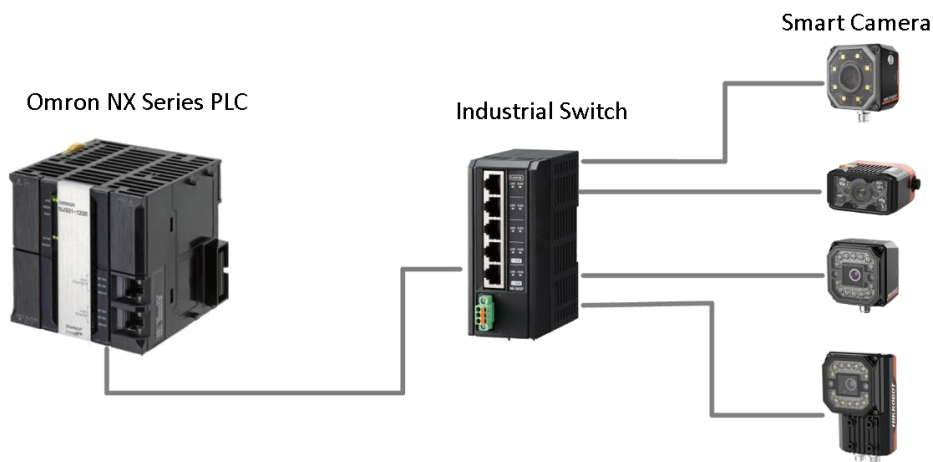


Figure 1-1 Hardware Wiring

1.3 Smart Camera Settings

Before using the smart camera's EtherNet/IP function to communicate with PLC devices, you need to set the smart camera first via the SCMVS client software.

Before you start:



- Make sure that the PC has installed the SCMVS client software.

- Check the device's firmware version. Please refer to the relevant instructions in the industrial protocol for specific requirements.

Note

Regarding SC2000Pro series smart camera, you need to operate it via the web, and operations are similar to those via the SCMVS client software.

Steps

1. Log in the device via the SCMVS client software.
 2. Click **Communication** on the menu bar.
 3. Click  to add Ethernet/IP communication.
 4. Switch on  to enable Ethernet/IP communication.
 5. Set **Input Size** and **Output Size** according to actual demands.
-

Note

The default value of **Input Size** and **Output Size** is 200.

6. (Optional) Enable **Result Byte Swap** according to actual demands.

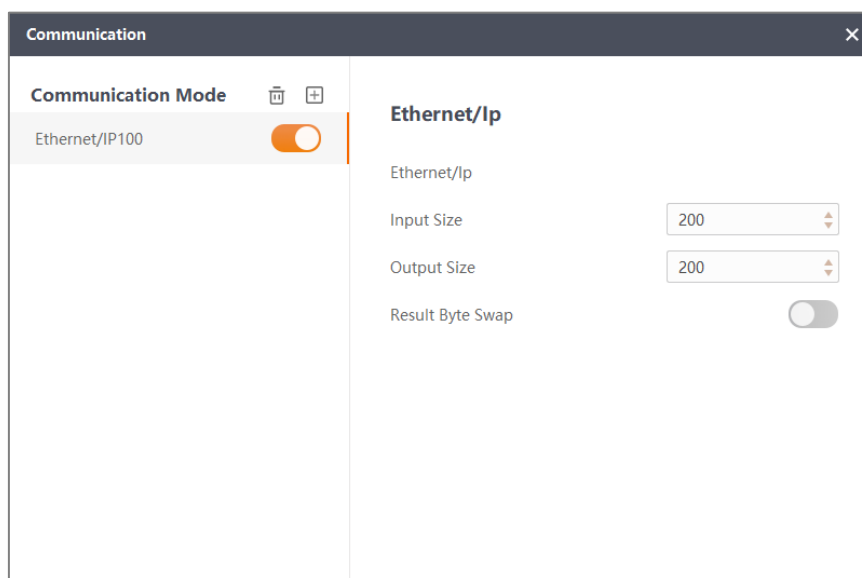


Figure 1-2 Set Communication Parameters

7. Click **Scheme Settings** in the scheme management pane of the main window, then select trigger source in the project editing dialog box according to the actual situation.
 - When using industrial protocol to trigger the device, select **Software** as the trigger source and click the **Loop Run** in the upper right area of the image live view pane.
 - When using IO to trigger the device, select **IO** as the trigger source.
8. Create a project and set parameters for cameras, base images, and vision tools according to actual demands.

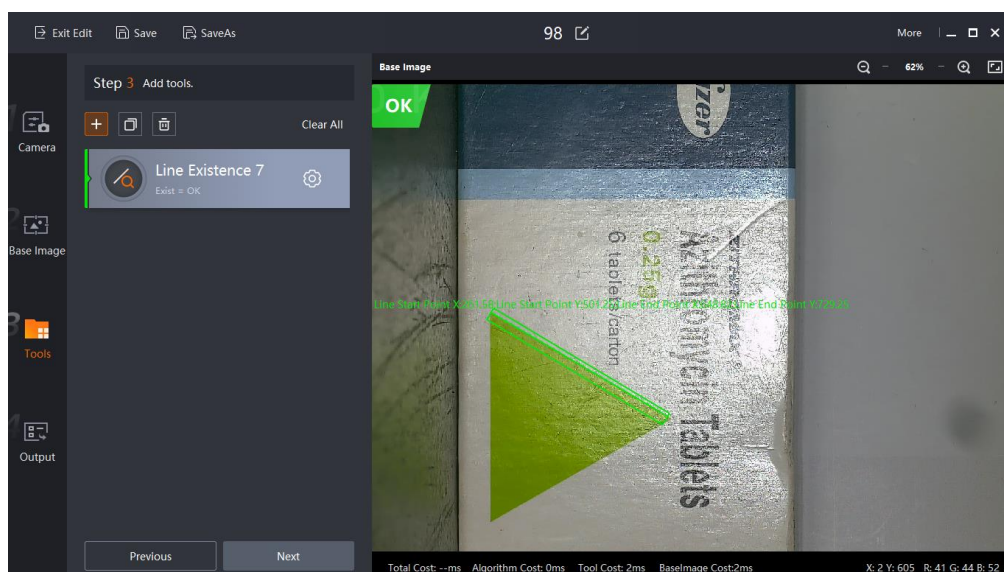


Figure 1-3 Line Existence

Note

Here we take the tool of line existence as an example.

9. Go to **Output** → **Tool Results** → **Add** to set the outputted content.

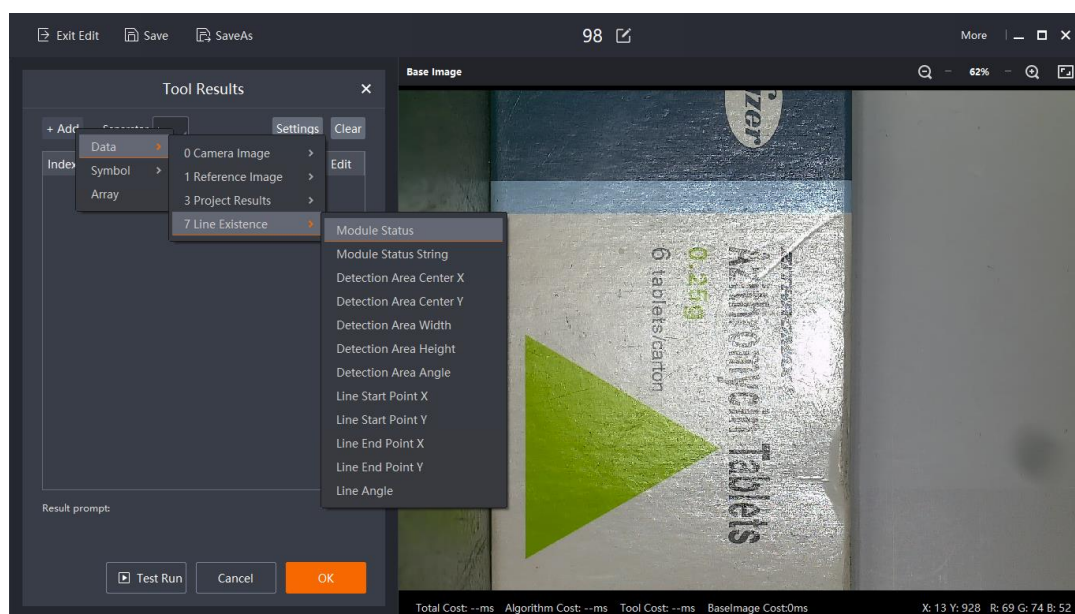


Figure 1-4 Set Tool Results

Note

Here we take the module status and module status string of line existence as an example to introduce tool results.

10. Save the project.
11. If you want to switch projects via communications, go to project management, select **Trigger Communication** as **Mode**, enter **Communication String**, and **Switch Return String** according to actual demands.

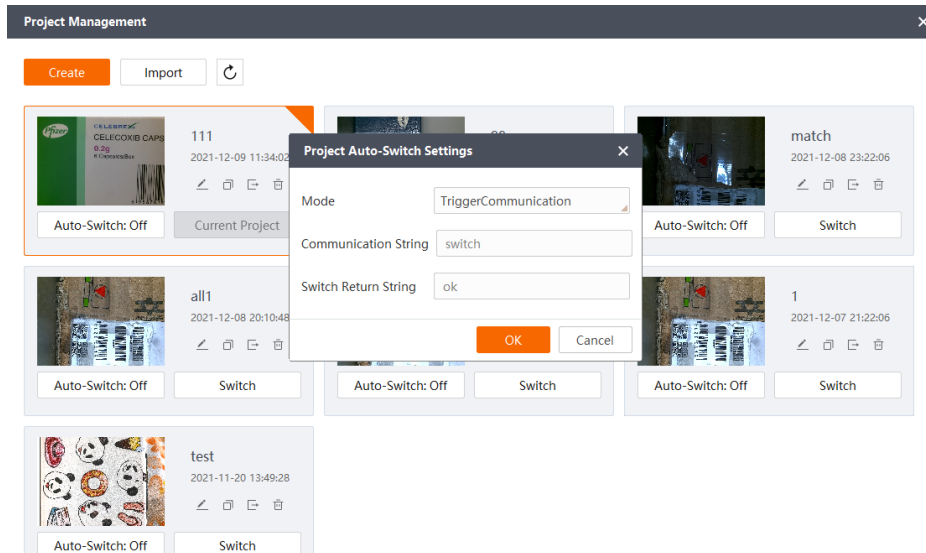


Figure 1-5 Project Switch Settings

1.4 PLC Settings

This section takes Omron NX series PLC as an example to explain how to set PLC. For the PLC from other manufacturers or different models, refer to this section and its user manual to configure.

1.4.1 Create Sysmac Studio Project

You need to create Sysmac Studio project first when using Omron NX series PLC.

Steps

1. Run Sysmac Studio, click **New Project**, enter parameters, and click **Create**.

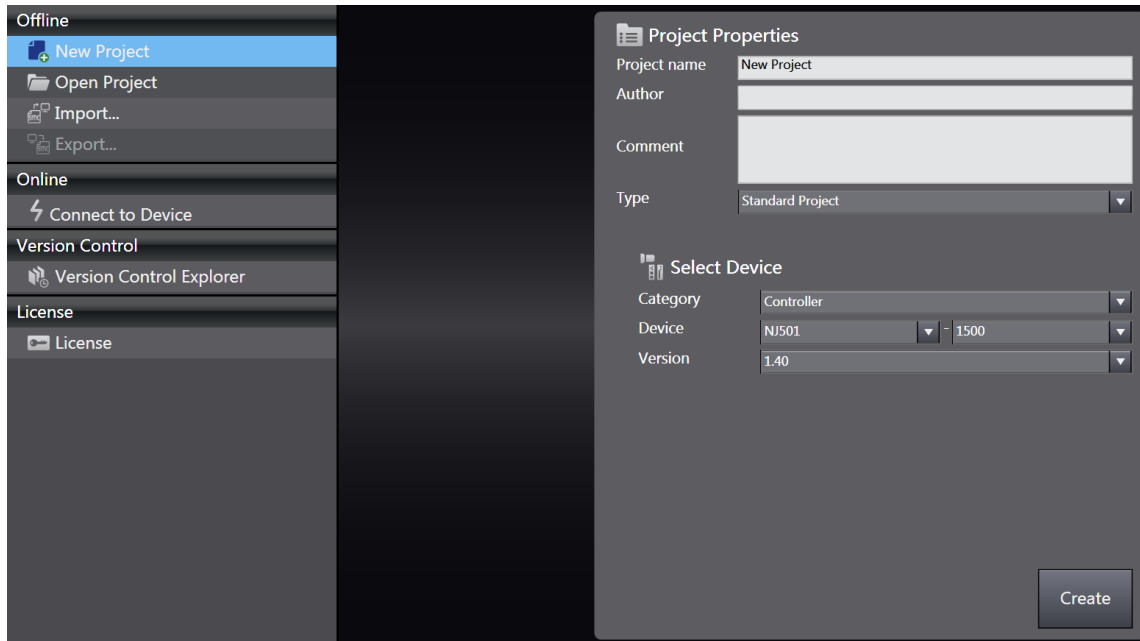


Figure 1-6 Create New Project

2. Create a new **Global Variables** whose size should be the same with that of the smart camera configured in the SCMVS.

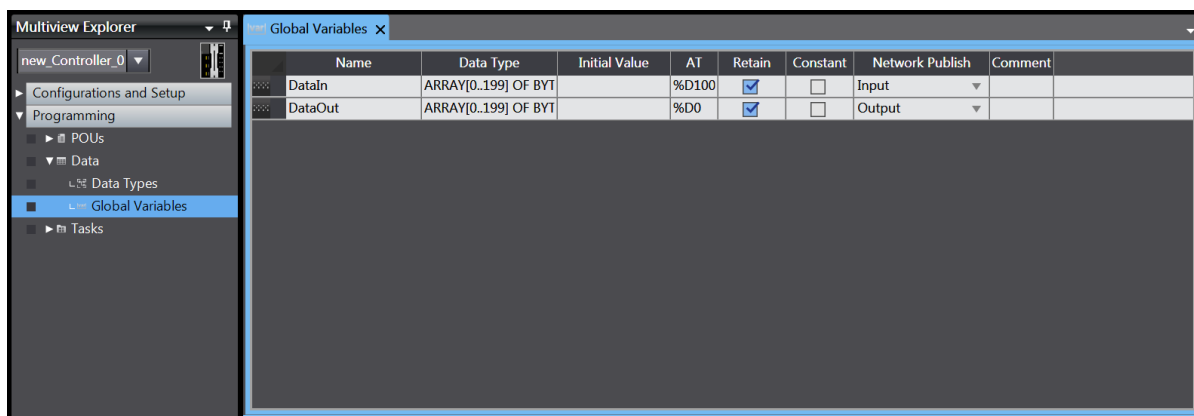


Figure 1-7 Create Global Variables

Note

When connecting multiple smart cameras, you should create several global variables with different names.

3. Go to **Controller Setup** → **Memory Settings**, check **Enable** of DM, and allocate the global variables created in step 2 to DM memory.

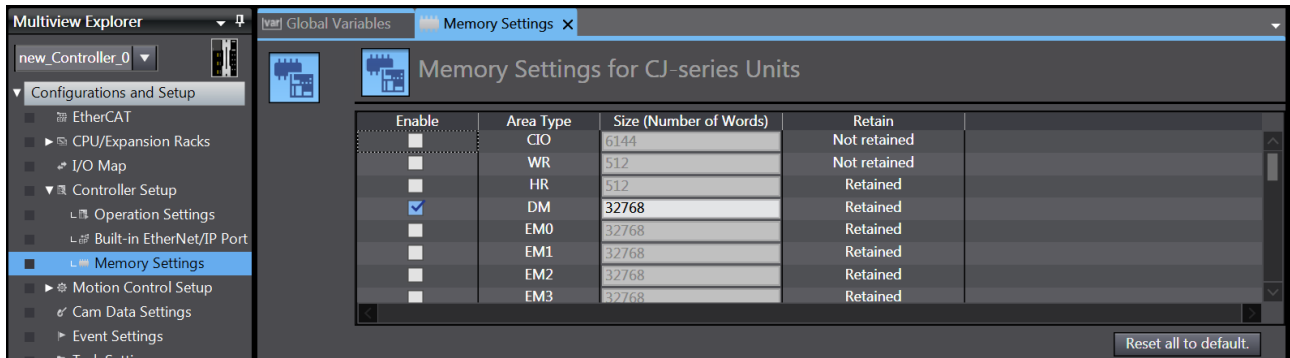


Figure 1-8 Enable DM Area Type

4. Go to **Controller Setup** → **Built-in EtherNet/IP Port Settings**, and set the IP address of PLC port 1.

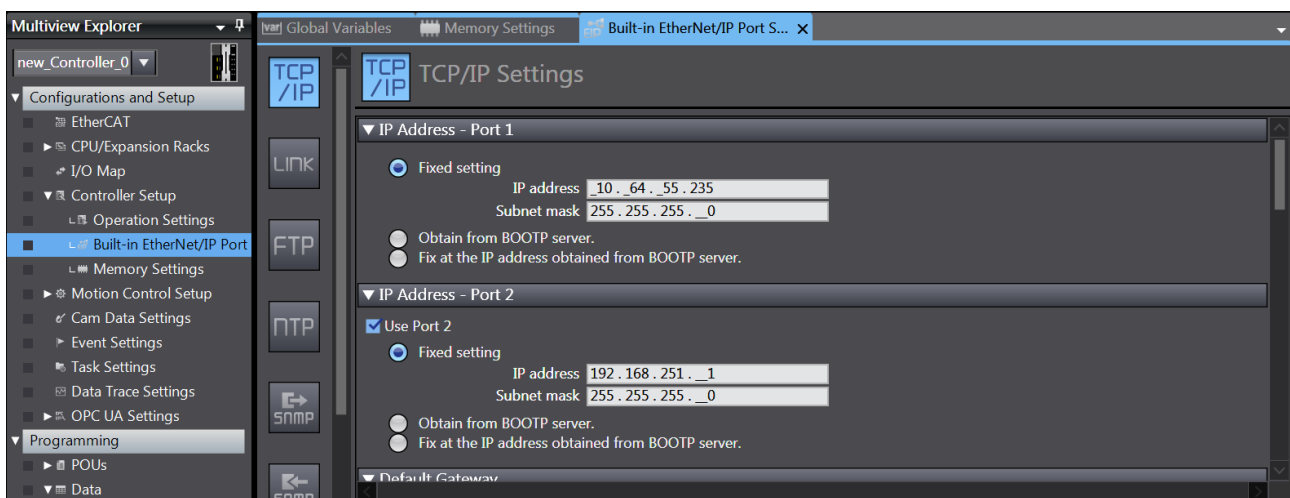


Figure 1-9 Set IP Address

Note

Make sure that the PLC and the smart camera's IP address are in the same network segment.

5. Click **Tools** in the menu, and select **EtherNet/IP Connection Settings**.

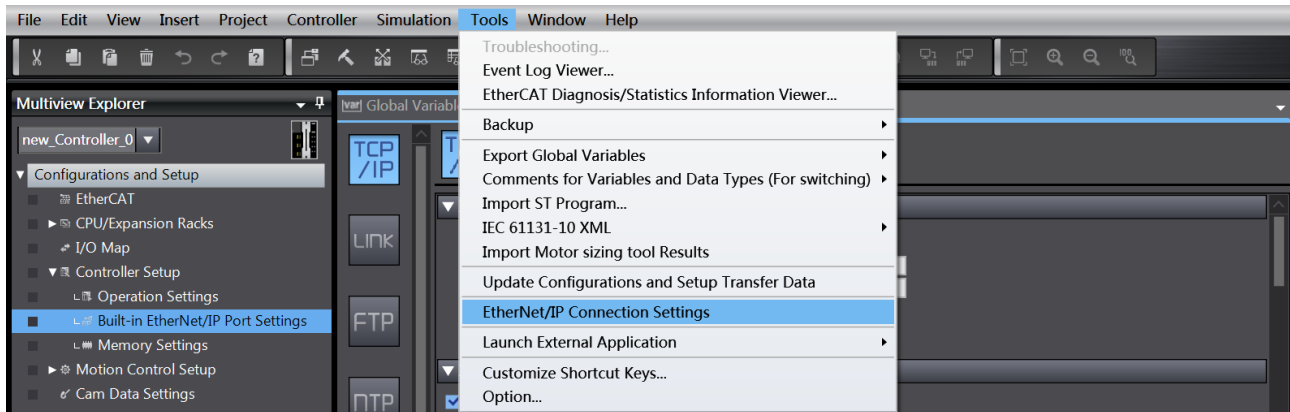


Figure 1-10 Open EtherNet/IP Connection Settings

6. Double-click port 1 in **EtherNet/IP Device List**, and click **Registration All** in tag sets to register global variables.

A screenshot of the 'EtherNet/IP Device List' window. It contains a table with the following data:

	Node Address	Device	Description
	10.64.55.235	Built-in EtherNet/IP Port Settings - Port 1	NX102-9000
	192.168.251.1	Built-in EtherNet/IP Port Settings - Port 2	NX102-9000

Figure 1-11 EtherNet/IP Device List

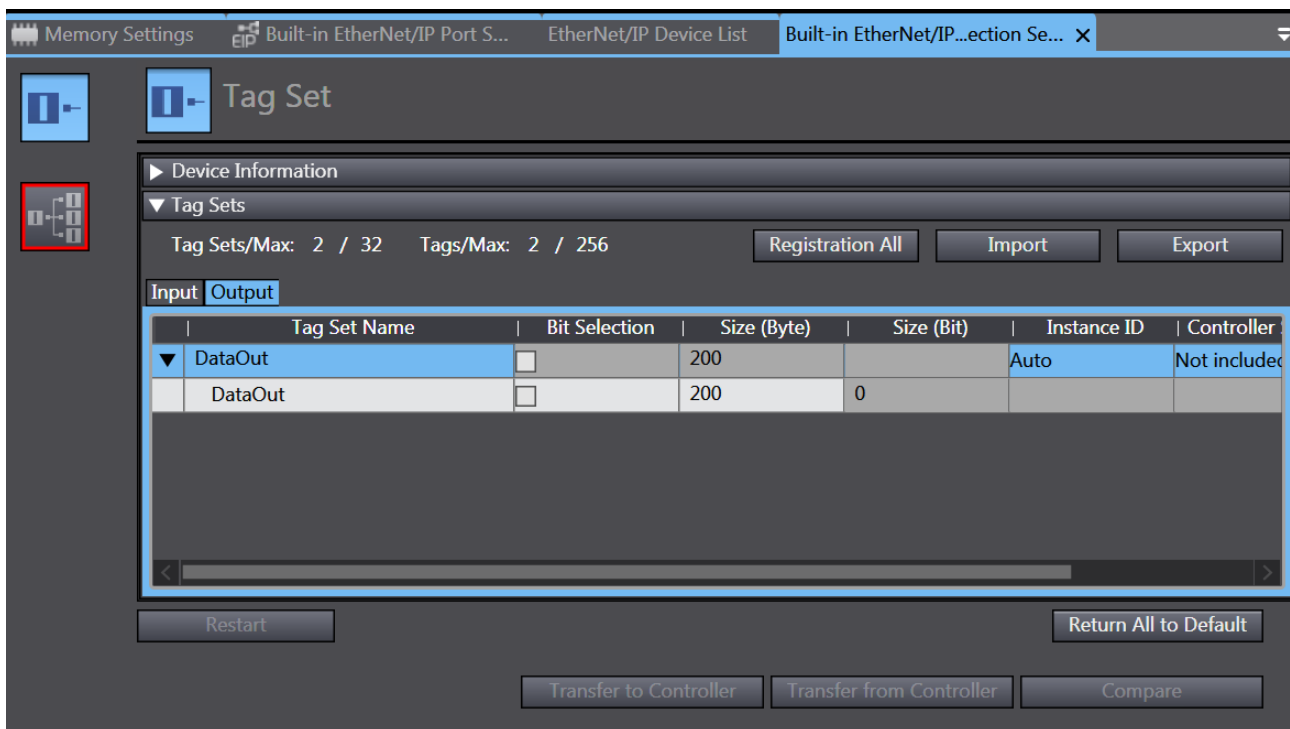


Figure 1-12 Register Global Variables

7. Right-click in the **Target Device** area, click **Display EDS Library**, select the corresponding EDS file in the EDS library, and click **Install**.

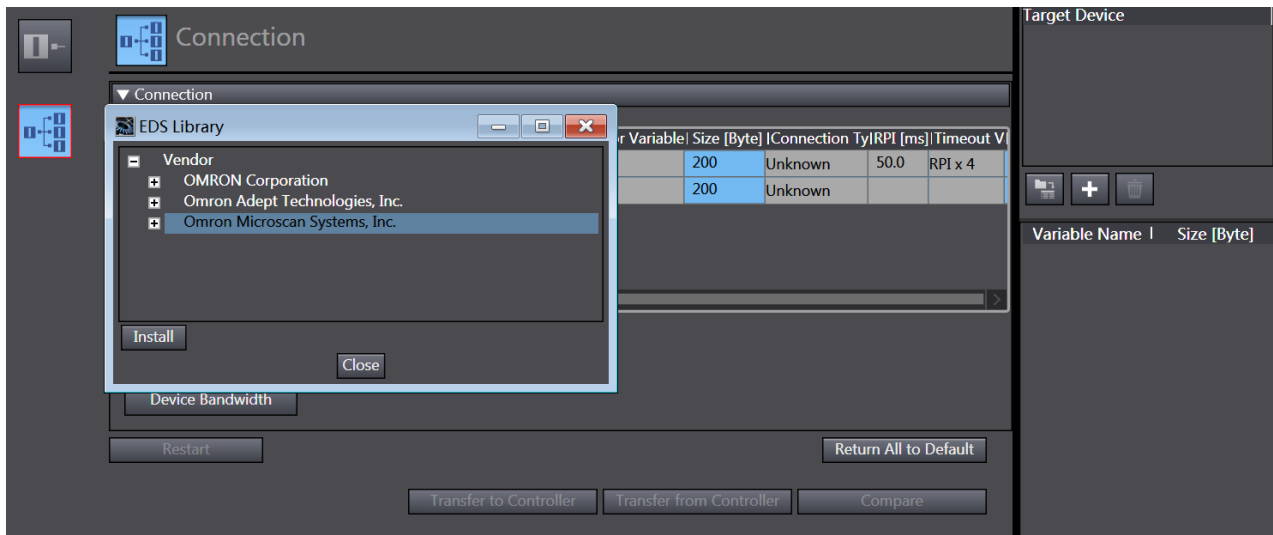


Figure 1-13 Install EDS File

8. Click **+** in the **Target Device** area to add devices, enter **Node address**, **Model name**, and **Revision** according to actual demands, and click **Add**.
9. Click **+** in **Built-in EtherNet/IP Port Settings**, add created target devices, select **Consume Data From/Produce Data To** as **Connection I/O Type**, and set size and originator variable that are global variable created before.

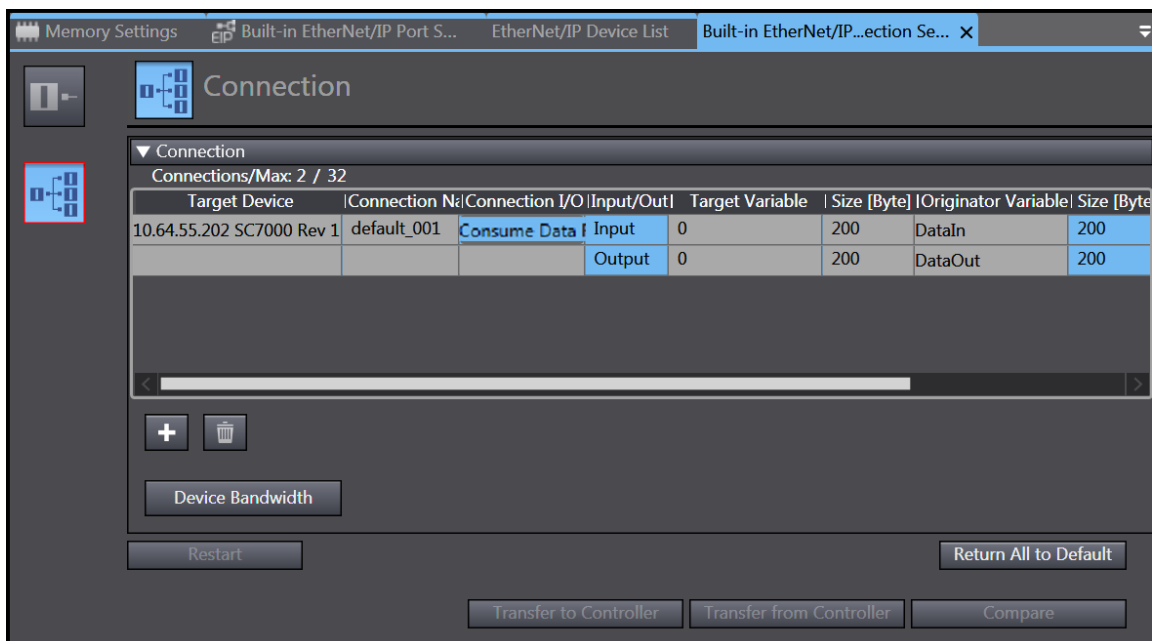


Figure 1-14 Create Target Device

10. Go to **Tools** → **Export Global Variables** → **Network Configurator...**, and export the global variables.

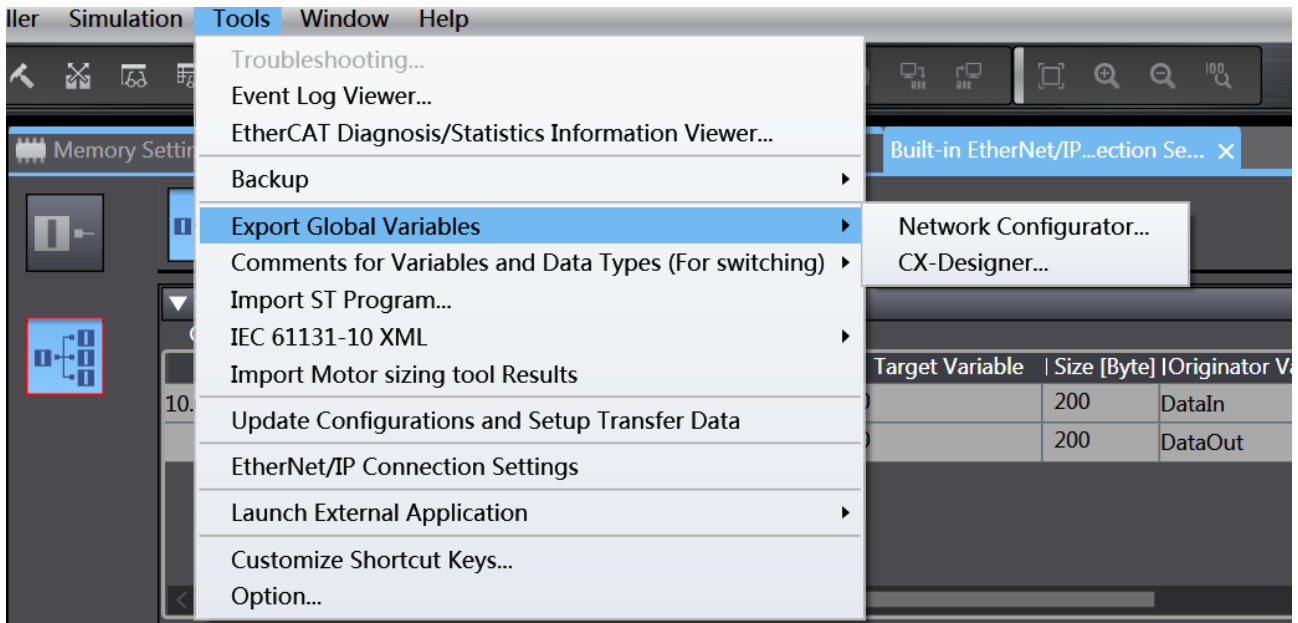


Figure 1-15 Export Global Variable File

11. Save and compile the project, and synchronize it to the PLC controller.

1.4.2 Network Configurator Settings

After the project is created, you need to set it via the network configurator.

Steps

1. Run Network Configurator, click **EDS File** and select **Install...** to import the device's EDS file.

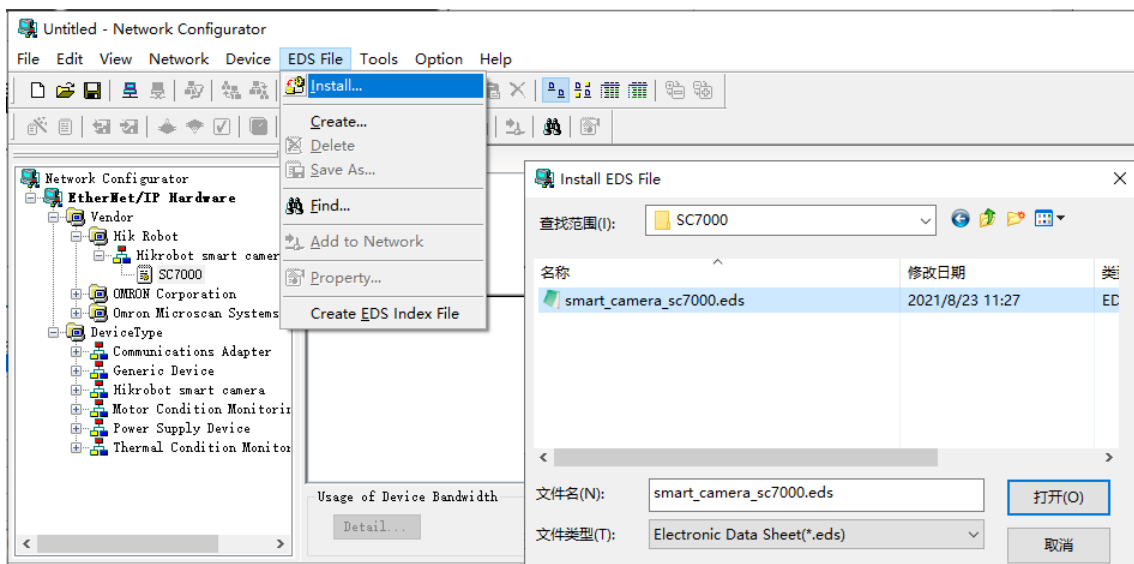


Figure 1-16 Import EDS File

2. Drag in the corresponding PLC controller and the smart camera.

3. Right-click the smart camera to modify its IP address.

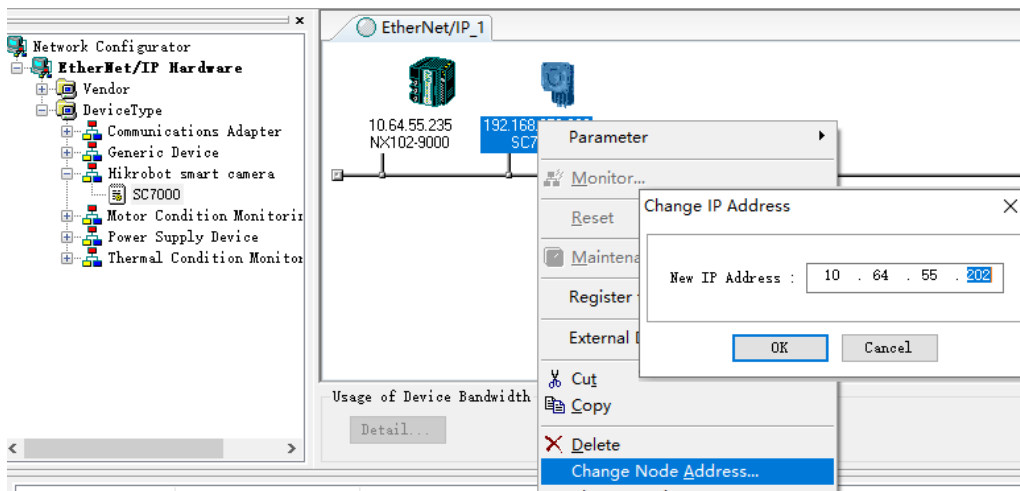


Figure 1-17 Modify IP Address

4. Double-click the PLC, go to **Tag Sets** → **To/From File** → **Import from File**, and import the global variables created in the Sysmac Studio.

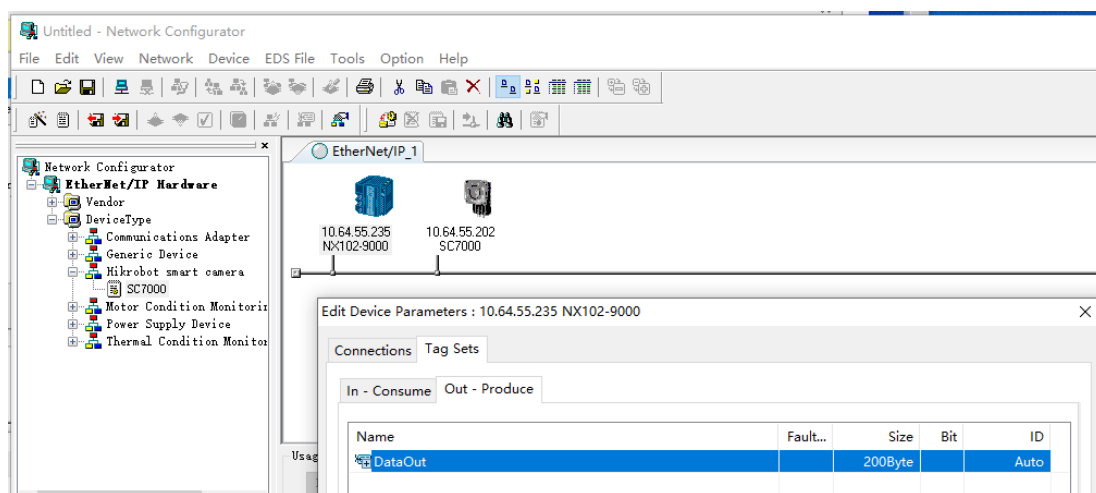


Figure 1-18 Import Global Variables

5. Establish the connection between the smart camera's input/output and the global variables of PLC controller. **Data In** connects to **Input_13**, and **Data Out** connects to **Output_22**, and set **Packet Interval** as 50 ms.

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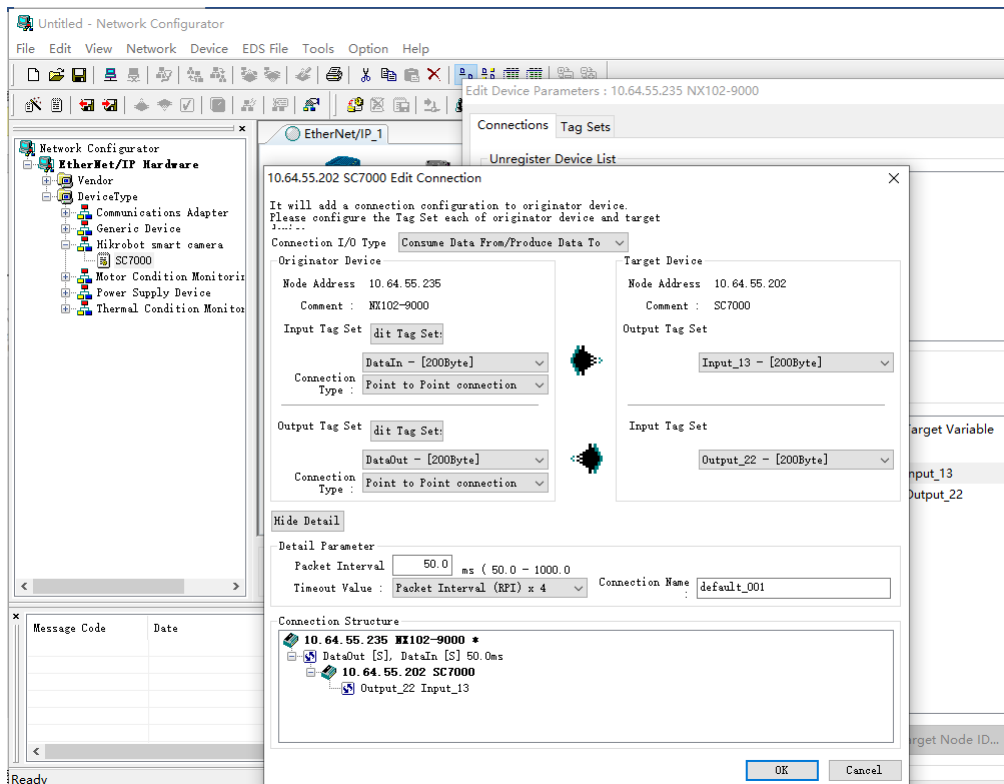


Figure 1-19 Establish Connection

6. Select interface for PLC controller and download configuration to the PLC.

Note

After the PLC and the smart camera is successfully connected, the PLC's red NET ERR indicator will go off.

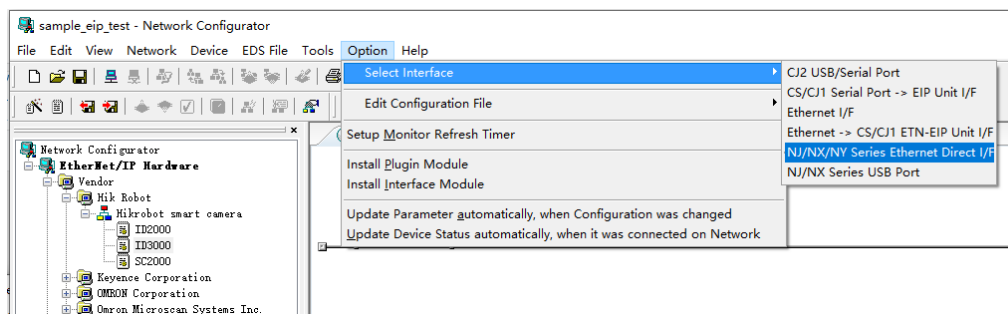


Figure 1-20 Select PLC's Communication Interface Type

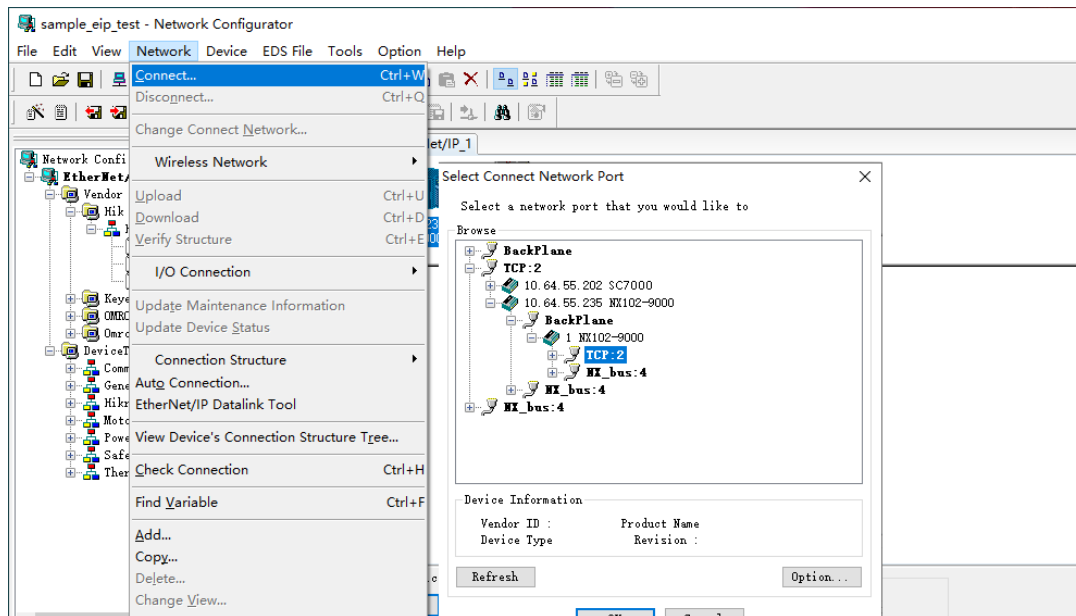


Figure 1-21 Connect to the PLC

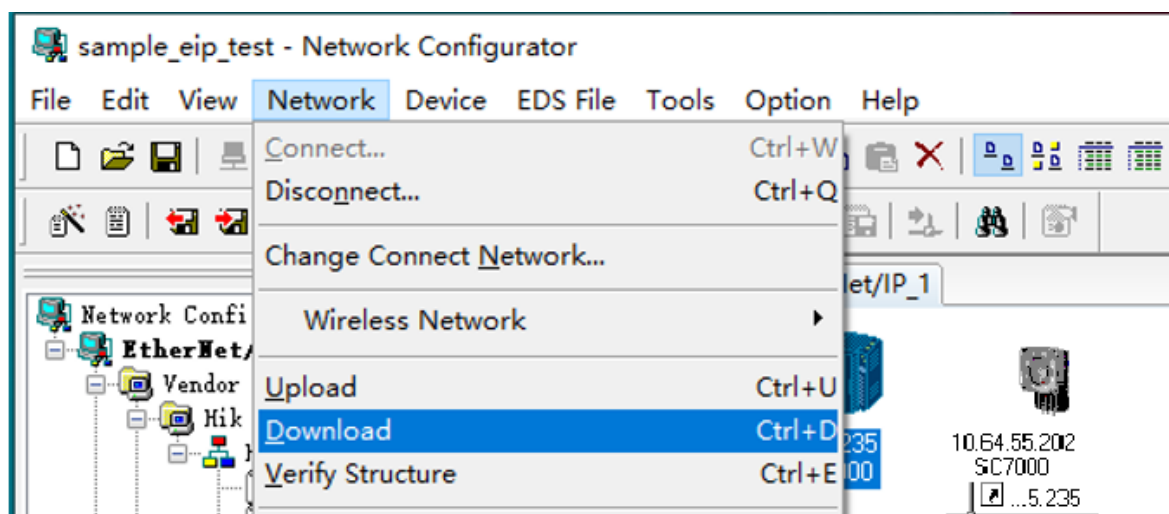


Figure 1-22 Download Configuration to the PLC

1.5 Input and Output Mapping

1.5.1 Input Mapping

The definition of input mapping (i.e. smart camera > PLC controller) is shown below.

Table 1-1 Input Mapping Table

Byte	BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
0-1	useful data length							
2					Decoding	Acquiring	Trigger Ack	Trigger Ready
3	General Fault						Results Timeout	Results Available
4-17	Reserved							
18-19	Result Length							
20	Result Data 0							
...	...							
199	Result Data 179							
...	Result Data ...							

Table 1-2 Input Mapping Table Description

Name	Description
Trigger Ready	The device is ready to receive new trigger signals. When the Trigger Enable is set and the device is ready to receive the next trigger signal, the Trigger Ready will be set.
Trigger Ack	The device has already received the trigger signal.
Acquiring	The device is acquiring images.
Decoding	The device is recognizing decodes on images.
Reserved	Reserved.
Results Available	The device outputs new results. When the PLC is set to Result Ack, the Results Available will be cleared.

Results Timeout	Results are not gotten when the time is out, and internal timeout is 6 sec. When the PLC is set to Result Ack, the Results Timeout will be cleared.
General Fault	A device's internal fault occurred, and you can clear this signal via Clear Error.
Result Length	It refers to the length of valid data contained in the result area.
Result Data	<p>It refers to the reading result of the device in ASCII code format of continuous storage.</p> <ul style="list-style-type: none"> • When the result data length is less than the configured result module, the remaining data is filled with 0. • When the result data length is greater than the configured result module, the extra data is cut off.

1.5.2 Output Mapping

The definition of output mapping (i.e. PLC controller > smart camera) is shown below.

Table 1-3 Output Mapping Table

Byte	BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
0						Results Ack	Trigger	Trigger Enable
1	Clear Error							Execute Command
2-17	Reserved							
18-19	User Data Length							
20	User Data 0							
...	...							
199	User Data 179							
...	User Data ...							

Table 1-4 Output Mapping Table Description

Name	Description
Trigger Enable	The PLC controls the device's trigger enable function via this bit.
Trigger	When following conditions are met, the PLC sets this bit to trigger the device to acquire an image and run the algorithm once. <ul style="list-style-type: none">• Trigger Enable is set.• The device is not currently acquiring images and running algorithms.• Trigger Ready is set.
Results Ack	After the PLC reads the trigger result, it sets this bit to notify the device, and the device clears Results Available and Results Timeout after confirmation.
Execute Command	Execute the command specified in the User Data area once on the rising edge.
Clear Error	Clear error status.
Reserved	Reserved.
User Data Length	It refers to the length of valid data contained in the User Data area.
User Data	It refers to the data or commands sent to the device.

1.6 Trigger Test

Communication Sequence Diagram

The communication sequence diagram of PLC and the device is shown below.

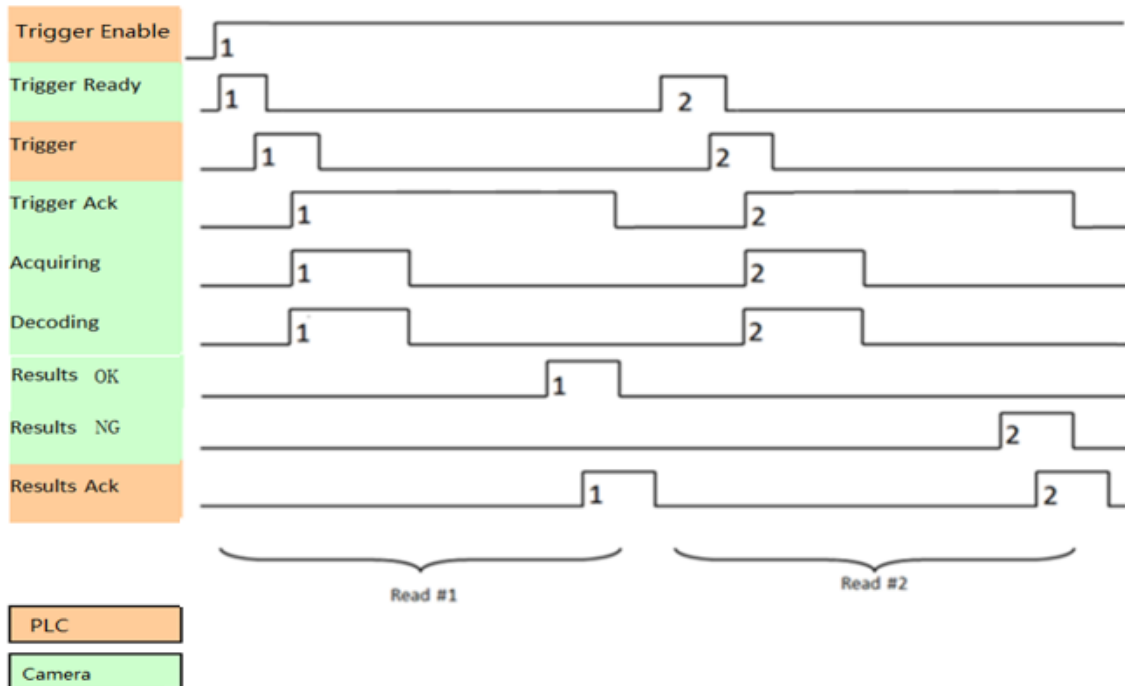


Figure 1-23 Communication Sequence Diagram

The logic of the above sequence diagram is shown below:

1. PLC sets Trigger Enable signal DataOut[0].0. After the device is ready, set Trigger Ready signal DataIn[2].0.
2. After detecting the device's Trigger Ready signal, the PLC sends Trigger signal DataOut[0].1 and controls the device to operate once.
3. The device starts to acquire images and runs the algorithm after receiving Trigger signal.
 - If the result of the algorithm tool is outputted correctly, set the Results Available signal DataIn[3].0 and put contents of the configuration result into the address starting from DataIn [20].
 - If the result output times out, set the Results Timeout signal DataIn[3].1 and clear the start address of DataIn [20].

Note

For tools like character recognition, the result will be outputted only after the character is recognized. Otherwise, the result output will time out at this time. If you need to return results quickly, you can use the exception output function.

4. After detecting Results Available, the PLC starts to read results from DataIn [20].

5. After reading results is finished, set Results Ack signal DataOut[0].2, and notify the device.
6. After triggering is finished, reset the PLC first (set Results Ack) and then repeat the steps from 1 to 5 above for a new round of triggering.

Create Variables

Create variables in accordance with the device's input/output mapping area.

Ladder Diagram

When the PLC triggers the device to run the project, related ladder diagrams are shown below.

- Enable Trigger

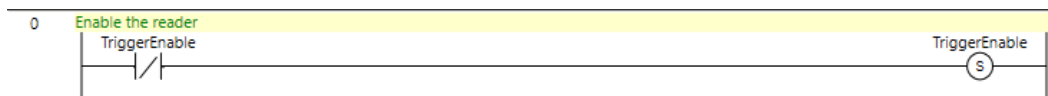


Figure 1-24 Enable Trigger

- Send Trigger Signal

The trigger signal can be generated by adding an edge signal before Trigger Ready according to actual demands. For example, when the PLC detects the photoelectric input signal, it sends a trigger signal once.

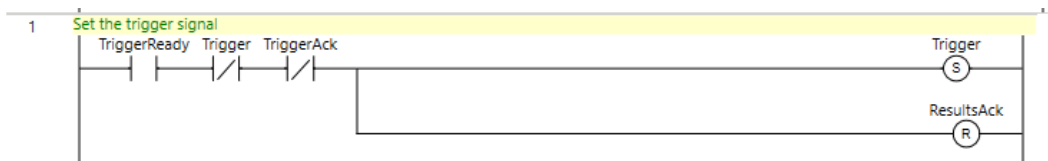


Figure 1-25 Send Trigger Signal

- Clear Trigger Signal

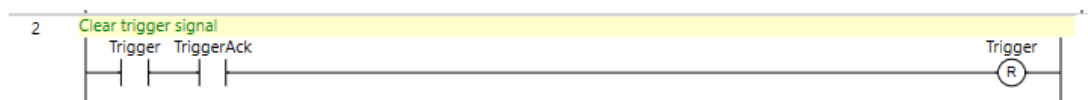


Figure 1-26 Clear Trigger Signal

- Get Device Results

When the device feeds back the Results Available signal, it means that result data has been updated, and the PLC can read result data to the user's storage area. After the reading is complete, set the Results Ack signal to acknowledge that the device has completed reading



Open the variable monitoring window of the Sysmac Studio, and add the created DataIn input variable and DataOut output variable. The online value of the variable is the internal input/output value of the device.



The related ladder diagram of project switching test is shown below.

- Send Switching Command

Write command character to User Data area, and write command character length to User

Data Length.

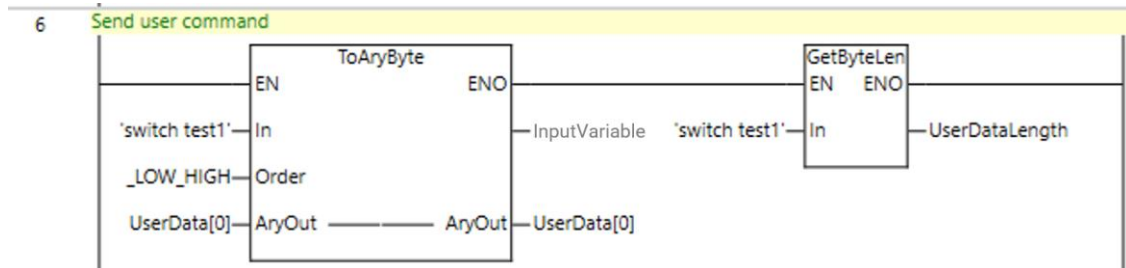


Figure 1-29 Send Switching Command

- Execute Switching Command

Write a rising edge to the Executive Command bit in the control area to execute a switching command once for the project.

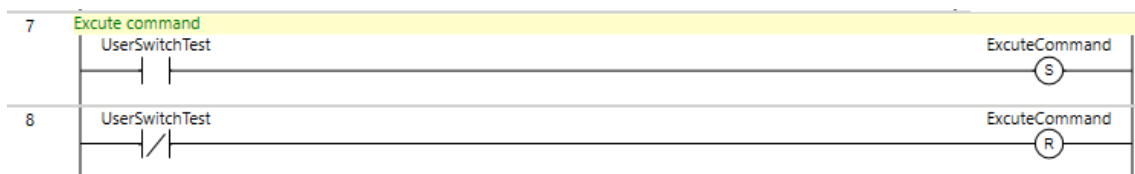


Figure 1-30 Execute Switching Command

Chapter 2 Profinet

2.1 Introduction

Profinet is an open industrial EtherNet standard launched by PI for automation. Profinet uses TCP/IP and IT standards. It is a real-time EtherNet that not only supports standard TCP/IP, but also provides time precision that standard EtherNet cannot achieve.

Note

This chapter takes Siemens S7 series PLC as an example to explain how to communicate with smart cameras via Profinet communication protocol. For other devices, refer to the user manual provided by the manufacturer and make related settings by reading contents of this chapter.

2.2 Hardware Wiring

The wiring of Siemens S7 series PLC and the smart camera is shown below.

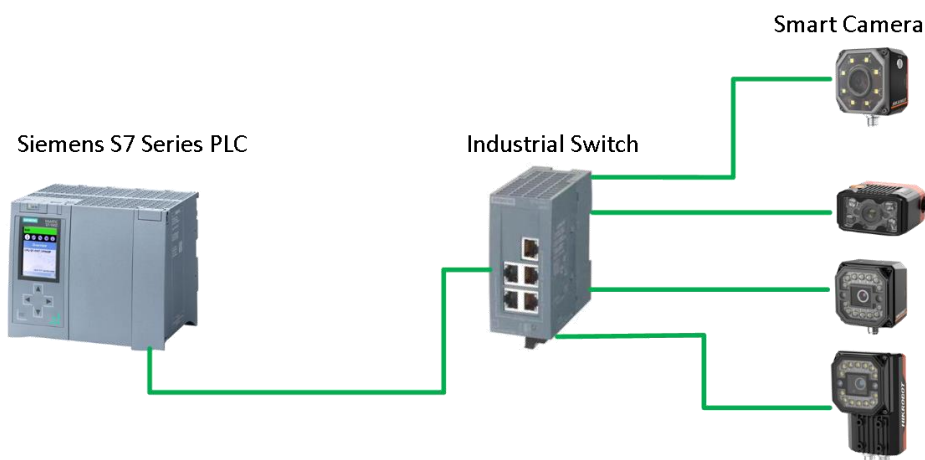


Figure 2-1 Hardware Wiring

Note

The device IP address configured in the PLC must be in the same network segment as the camera IP address in the SCMVS client but not identical, otherwise it may result in communication errors.

2.3 Smart Camera Settings

Before using the smart camera's Profinet function to communicate with other devices, you need to set the smart camera first via the SCMVS client software.



Before you start:

- Make sure that the PC has installed the SCMVS client software.
- Check the device's firmware version. Please refer to the relevant instructions in the industrial protocol for specific requirements.

Note

Regarding SC2000Pro series smart camera, you need to operate it via the web, and operations are similar to those via the SCMVS client software.

Steps

1. Log in the device via the SCMVS client software.
2. Click **Communication** on the menu bar.
3. Click  to add Profinet communication.
4. Switch on  to enable Profinet communication.
5. Enter **Device Name** according to actual demands.

Note

Make sure that the device name is unique.

6. Set **Result Module** according to actual demands. The default value is 64 bytes.

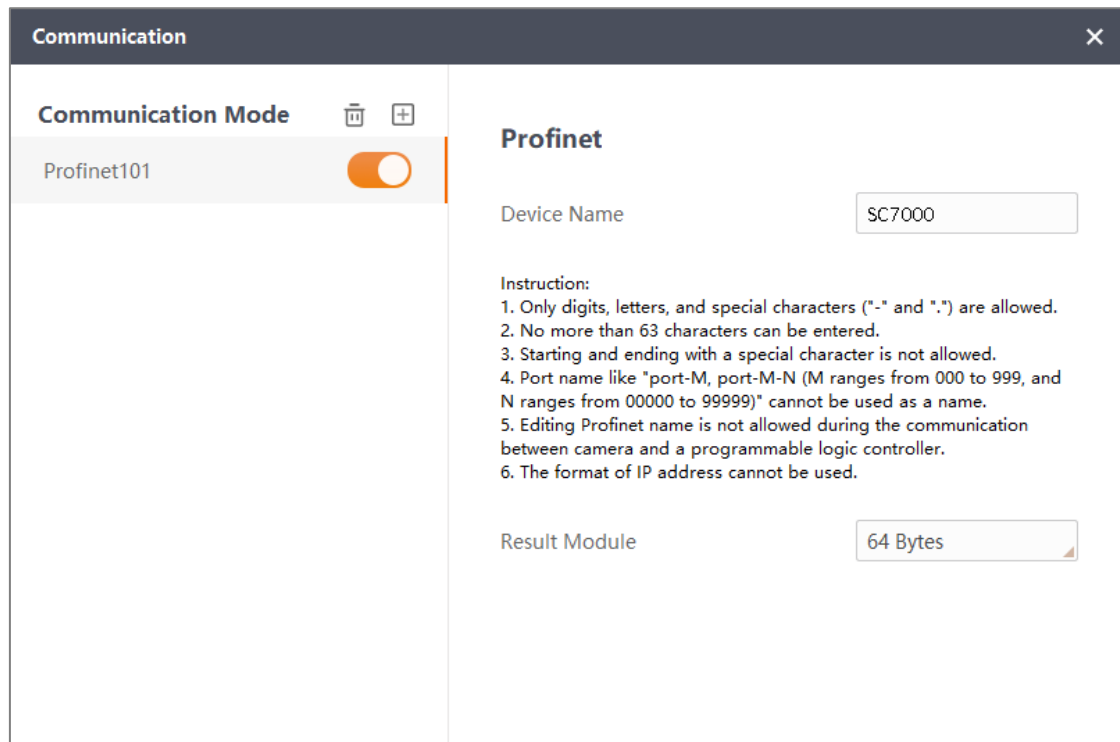


Figure 2-2 Set Communication Parameters

7. Click **Scheme Settings** in the scheme management pane of the main window, then select trigger source in the project editing dialog box according to the actual situation.
 - When using industrial protocol to trigger the device, select **Software** as the trigger source and click the **Loop Run** in the upper right area of the image live view pane.
 - When using IO to trigger the device, select **IO** as the trigger source.
8. Create a project and set parameters for cameras, base images, and vision tools according to actual demands.

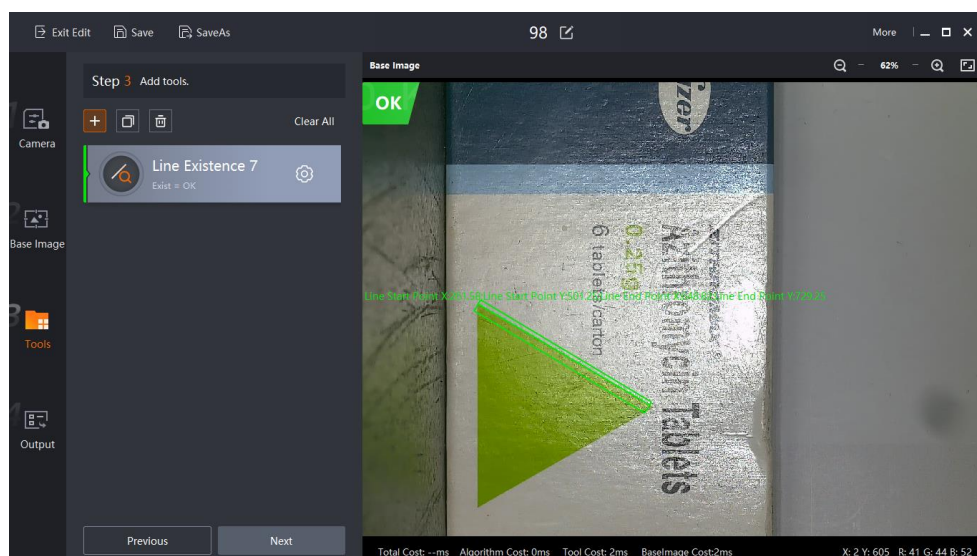


Figure 2-3 Line Existence

Note

Here we take the tool of line existence as an example.

9. Go to **Output** → **Tool Results** → **Add** to set the outputted content.

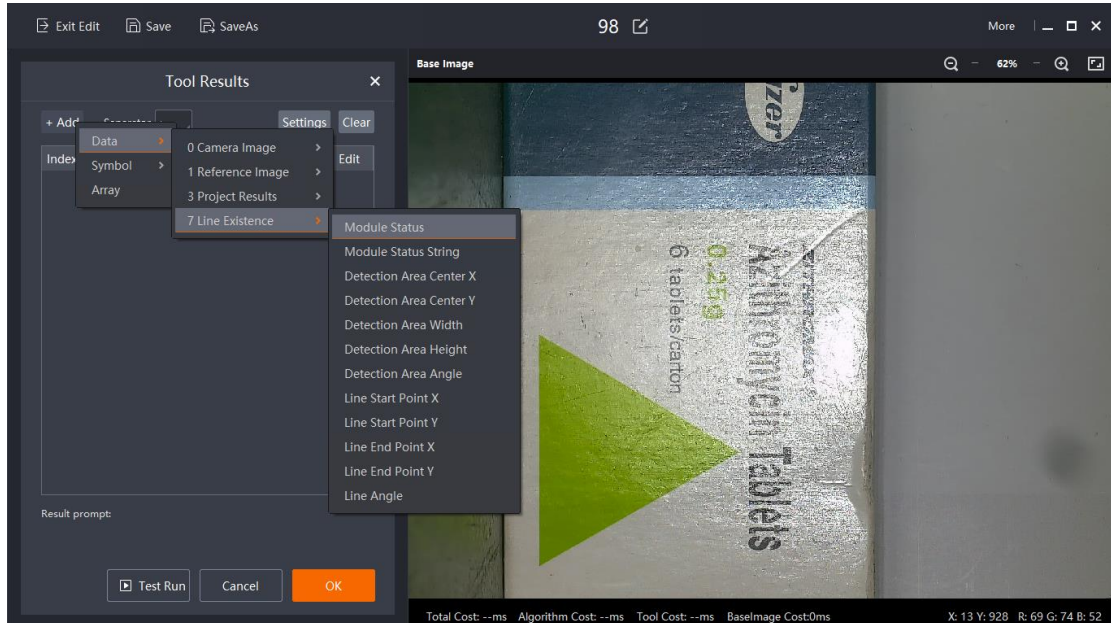


Figure 2-4 Set Tool Results

Note

Here we take the module status and module status string of line existence as an example to introduce tool results.

10. Save the project.

11. If you want to switch projects via communications, go to project management, select **Trigger Communication** as **Mode**, enter **Communication String**, and **Switch Return String** according to actual demands.

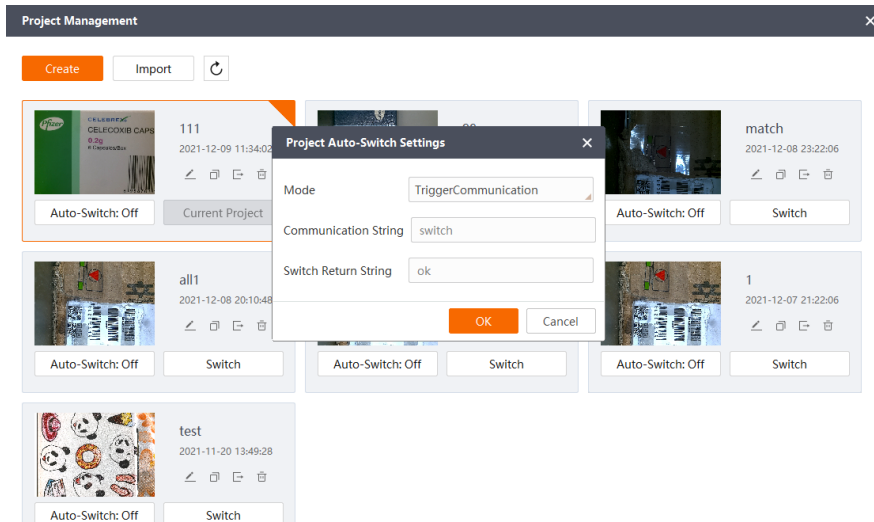


Figure 2-5 Project Switch Settings

2.4 PLC Settings

This section takes Siemens S7 series PLC as an example to explain how to set PLC. For the PLC from other manufacturers or different models, refer to this section and its user manual to configure.

Steps

1. Run TIA Portal, click **Create new project**, enter parameters, and click **Create**.

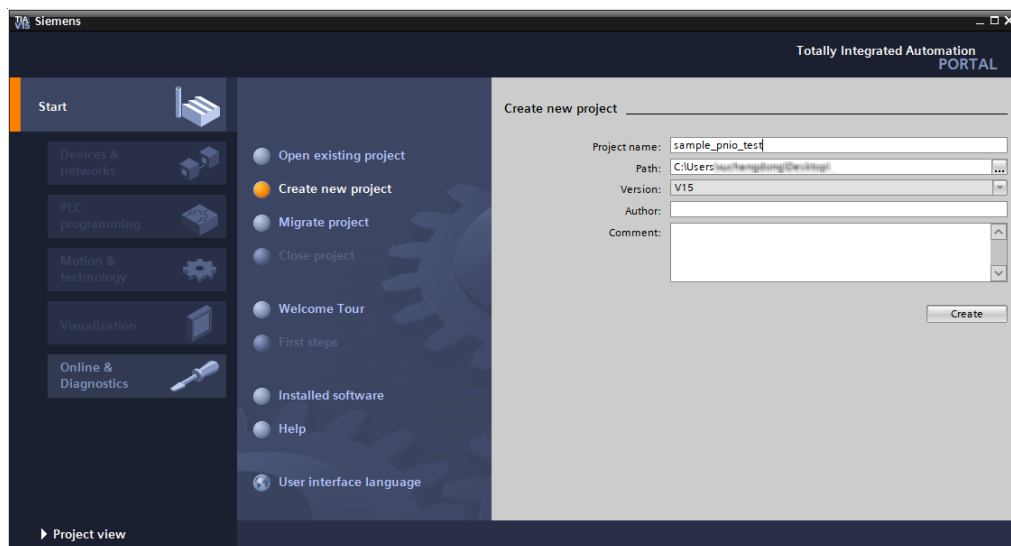


Figure 2-6 Create New Project

2. Go to **Options** → **Manage general station description files (GSD)**, import the GSDML files to TIA Portal, and click **Install**.

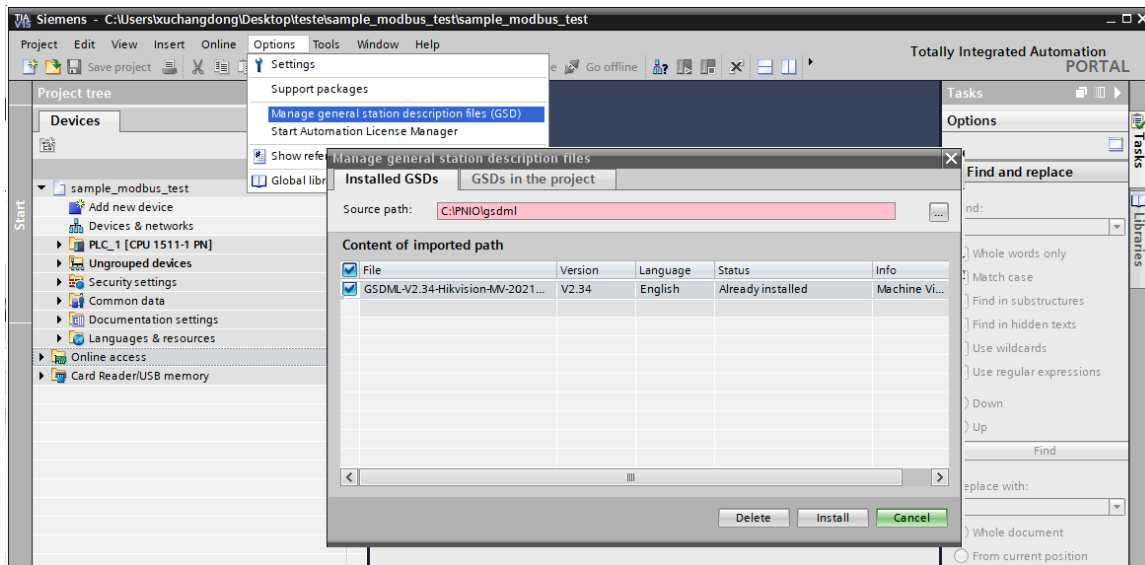


Figure 2-7 Install GSDs

- Go to **Devices & networks** → **Hardware category** → **Other field devices** → **PROFINET IO** → **Sensors** → **Hikvision** → **Machine Vision Systems**, find the corresponding device, drag or double-click the device to move it onto the network view.
- Add the PLC controller and distribute the device to it.

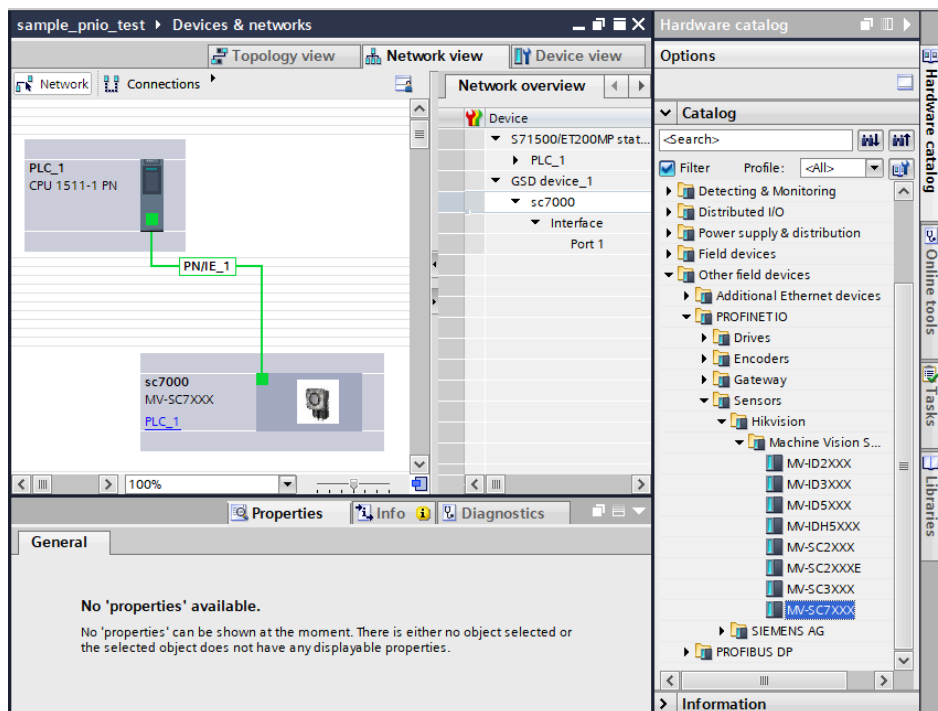


Figure 2-8 Select Device

- Double-click the device to set its name.

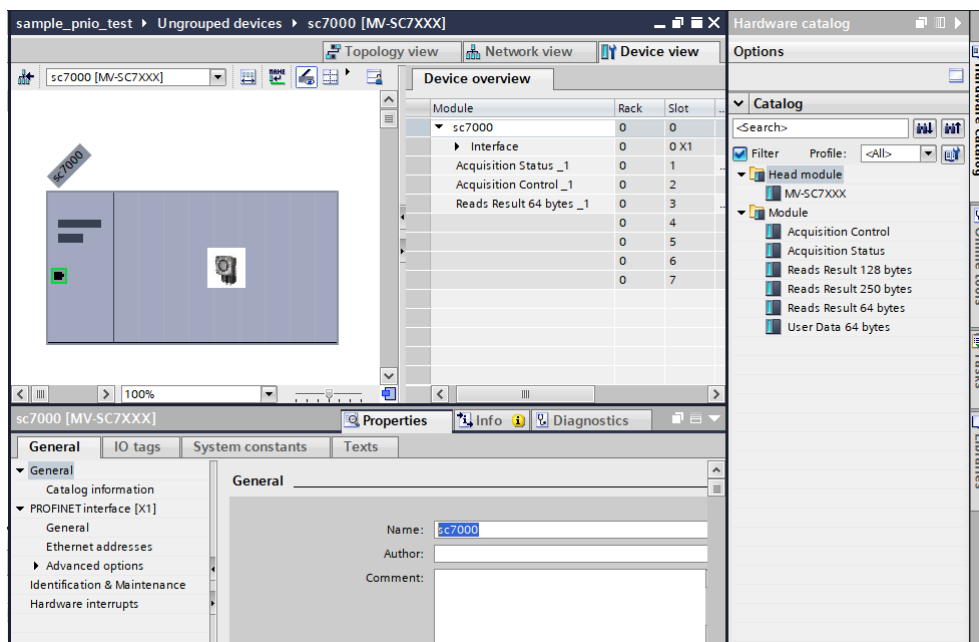


Figure 2-9 Set Device Name

Note

The name configured here should be the same with that in the SCMVS. Otherwise, communication error may occur.

6. Set the subnet that the interface is networked with, and the IP address.

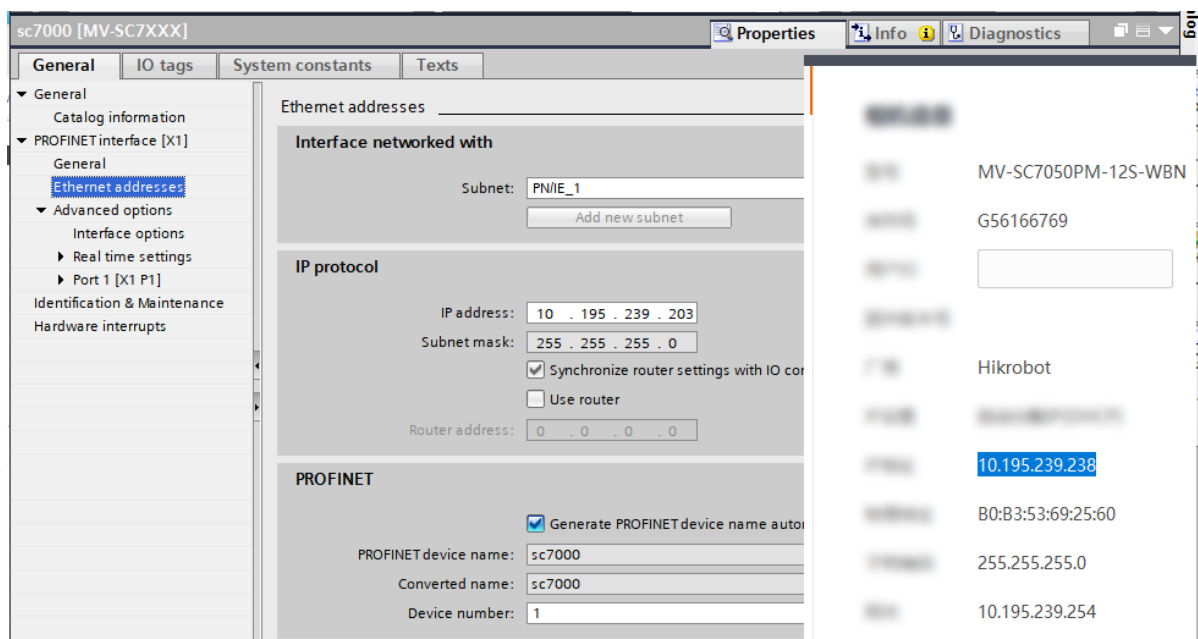


Figure 2-10 Set IP Address

Note

The device IP address must be in the same network segment as the camera IP address in the SCMVS client but not identical, otherwise it may result in communication errors.

7. Set the device's IO cycle and other parameters.

Note

Increase the value of **Accepted update cycles without IO data** in Watchdog time if the device goes offline.

8. Recompile and load the PLC program. When the PLC is connected to the device, the indicators of the PLC and device will be solid green.

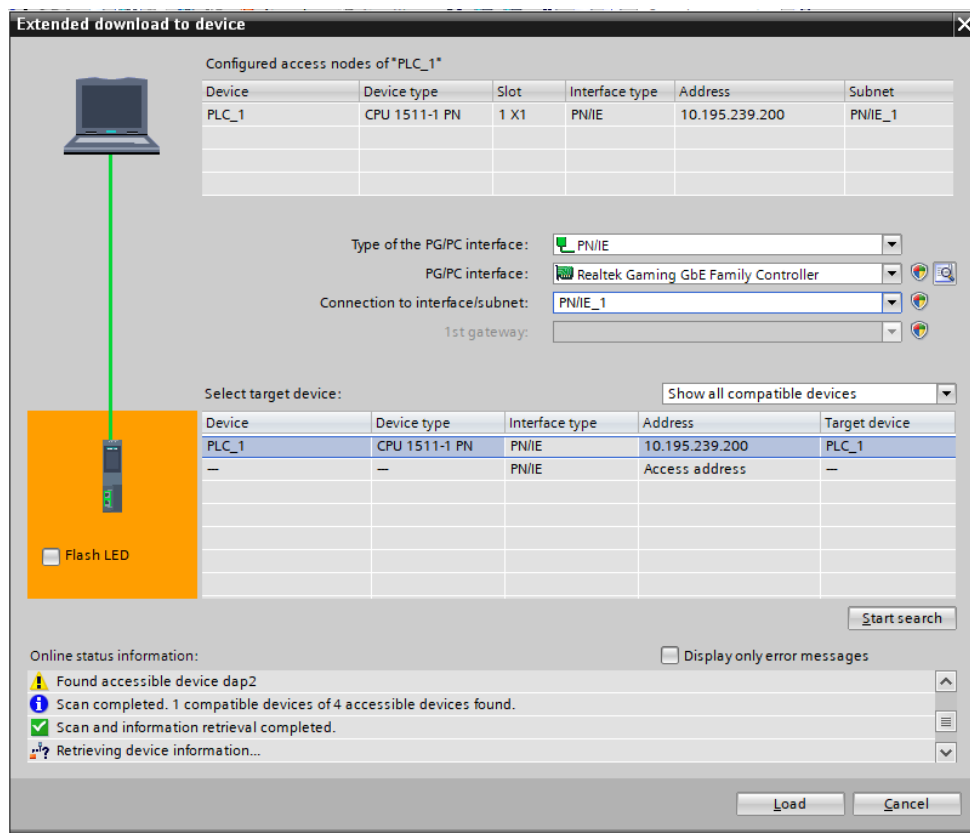


Figure 2-11 Load PLC Program

2.5 Device Module Definition

The device has six configurable modules as shown below:

- Acquisition Status Module
- Acquisition Control Module
- Reads Result 64 Bytes Module
- User Data 64 Bytes Module

- Reads Result 128 Bytes Module
- Reads Result 250 Bytes Module

Acquisition Status Module

The acquisition status module sends the information about the current status of the device from the device to the PLC.

- Slot No.: 1
- Size: 1 byte

Table 2-1 Acquisition Status Module Description

Bit	Name	Description
0	Trigger Ready	The device is ready to receive new trigger signal. When the Trigger Enable is set and the device is ready to receive next trigger signal, the Trigger Ready will be set.
1	Trigger Ack	The device has already received the trigger signal.
2	Acquiring	The device is acquiring images.
3	Decoding	The device is recognizing decodes on images.
4	Results Available	The device outputs new results. When the PLC is set to Result Ack, the Results Available will be cleared.
5	Results Timeout	Results are not gotten when the time is out, and internal timeout is 6 sec. When the PLC is set to Result Ack, the Results Timeout will be cleared.
6	Reserved	Reserved.
7	General Fault	An internal error occurred.

Acquisition Control Module

The acquisition control module sends images from the PLC to the device.

- Slot No.: 2
- Size: 1 byte

Table 2-2 Acquisition Control Module Description

Bit	Name	Description
0	Trigger Enable	The PLC controls the device's trigger enable function via this bit.
1	Trigger	When following conditions are met, the PLC sets this bit to trigger the device to acquire an image and run the algorithm once. <ul style="list-style-type: none"> • Trigger Enable is set. • The device is not currently acquiring images and running algorithms. • Trigger Ready is set.
2	Results Ack	After the PLC reads the trigger result, it sets this bit to notify the device, and the device clears Results Available and Results Timeout after confirmation.
3	Execute Command	Execute the command specified in the User Data area once on the rising edge.
4-6	Reserved	Reserved.
7	Clear Error	Clear error status.

Reads Result 64 Bytes Module

The reads result 64 bytes module reads and sends the device's processing result from the device to the PLC.

- Slot No.: 3, configurable
- Size: 65 bytes

Table 2-3 Reads Result 64 Bytes Module Description

Bit	Name	Description
0	Result Length	It refers to the length of valid data contained in the Result Data area.
1...64	Result Data	It refers to the result output by the device, and its length is 64 bytes. <ul style="list-style-type: none"> • When the actual result is smaller than 64 bytes, the spare bytes will be filled with 0. • When the actual result is greater than 64 bytes, the extra bytes will be cut off.

User Data 64 Bytes Module

The user data 64 bytes module sends user data from the PLC to the device.

- Slot No.: 4, configurable
- Size: 65 bytes

Table 2-4 User Data 64 Bytes Module Description

Bit	Name	Description
0	User Data Length	It refers to the actual length of data contained in the User Data area.
1...64	User Data	It refers to the data or commands sent to the device.

Reads Result 128 Bytes Module

The reads result 128 bytes module is the result data and is sent to the PLC by the device.

- Slot No.: 3, configurable
- Size: 129 bytes

Table 2-5 Reads Result 128 Bytes Module

Bit	Name	Description
0	Result Length	It refers to the length of valid data contained in the Result Data area.
1...128	Result Data	It refers to the result output by the device, and its length is 128 bytes. <ul style="list-style-type: none">• When the actual result is smaller than 128 bytes, the spare bytes will be filled with 0.• When the actual result is greater than 128 bytes, the extra bytes will be cut off.

Reads Result 250 Bytes Module

The reads result 250 bytes module is the result data and is sent to the PLC by the device.

- Slot No.: 3, 5, 6, 7, configurable
- Size: 251 bytes

Table 2-6 Reads Result 250 Bytes Module

Bit	Name	Description
0	Result Length	It refers to the length of valid data contained in the Result Data area.
1...250	Result Data	It refers to the result output by the device, and its length is 250 bytes. <ul style="list-style-type: none"> • When the actual result is smaller than 250 bytes, the spare bytes will be filled with 0. • When the actual result is greater than 250 bytes, the extra bytes will be cut off.

2.6 Trigger Test

Communication Sequence Diagram

The communication sequence diagram of PLC and the device is shown below.

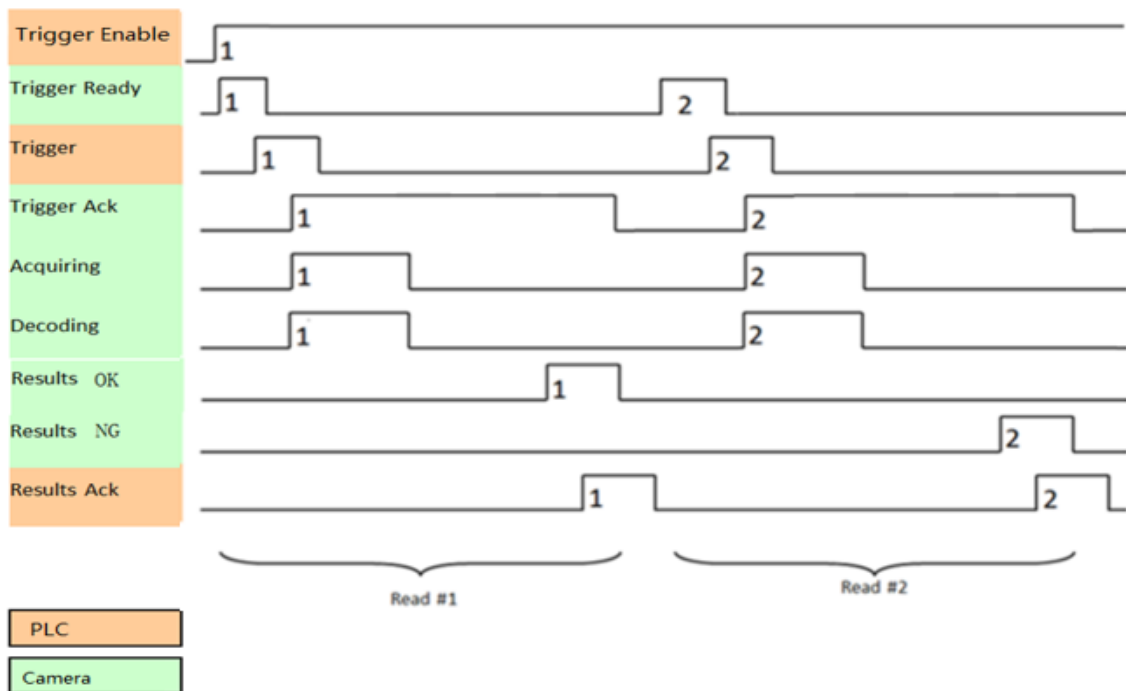


Figure 2-12 Communication Sequence Diagram

The logic of the above sequence diagram is shown below:

1. PLC sets Trigger Enable signal Q0.0. After the device is ready, set Trigger Ready signal I0.0.
2. After detecting the device's Trigger Ready signal, the PLC sends Trigger signal Q0.1 and controls the device to operate once.

3. The device starts to acquire images and runs the algorithm after receiving Trigger signal.
- If the result of the algorithm tool is outputted correctly, set the Results Available signal I0.4 and put contents of the configuration result into the address starting from QB2.
 - If the result output times out, set the Results Timeout signal I0.5 and clear the start address of QB2.
-

Note

For tools like character recognition, the result will be outputted only after the character is recognized. Otherwise, the result output will time out at this time. If you need to return results quickly, you can use the exception output function.

4. After detecting Results Available, the PLC starts to read results from QB2.
5. After reading results is finished, set Results Ack signal Q0.2, and notify the device.
6. After triggering is finished, reset the PLC first (set Results Ack) and then repeat the steps from 1 to 5 above for a new round of triggering.

Create Variables

Create a new PLC variable according to the address assigned to the device in the device configuration, and you can view the current value of each module of the device online.

Overview of addresses								
Filter: <input checked="" type="checkbox"/> Inputs <input checked="" type="checkbox"/> Outputs <input type="checkbox"/> Address gaps <input checked="" type="checkbox"/> Slot								
	Type	Addr. fr...	Addr. to	Size	Module	Rack	Slot	Device name
	I	0	0	1 Bytes	Acquisition Status _1	0	1	sc7000 [MV-SC7XXX]
	O	0	0	1 Bytes	Acquisition Control _1	0	2	sc7000 [MV-SC7XXX]
	I	1	65	65 By...	Reads Result 64 bytes _1	0	3	sc7000 [MV-SC7XXX]

Figure 2-13 Overview of Address

Project tree

Devices

sample_pnio_test

Add new device

Devices & networks

PLC_1 [CPU 1511-1 PN]

Device configuration

Online & diagnostics

Program blocks

Technology objects

External source files

PLC tags

Show all tags

Add new tag table

MV_SC_Tags [43]

PLC data types

Watch and force tables

Online backups

Traces

Device proxy data

Program info

PLC supervisions & alarms

PLC alarm text lists

sample_pnio_test > PLC_1 [CPU 1511-1 PN] > PLC tags > MV_SC_Tags [43]

MV_SC_Tags

	Name	Data type	Address	Retain	Access...	Write...	Visible...
1	Trigger Ready	Bool	%I0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2	Trigger Ack	Bool	%I0.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	Acquiring	Bool	%I0.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	Decoding	Bool	%I0.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	Results Available	Bool	%I0.4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6	Results Timeout	Bool	%I0.5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
7	General Fault	Bool	%I0.7	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
8	Trigger Enable	Bool	%Q0.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
9	Trigger	Bool	%Q0.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
10	Results Ack	Bool	%Q0.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
11	Excute Command	Bool	%Q0.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
12	Clear Error	Bool	%Q0.7	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
13	Result Length	Byte	%IB1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
14	Result Data0	Char	%IB2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
15	Result Data1	Char	%IB3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
16	Result Data2	Char	%IB4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
17	Result Data3	Char	%IB5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
18	Result Data4	Char	%IB6	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
19	Result Data5	Char	%IB7	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
20	Result Data6	Char	%IB8	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
21	Result Data7	Char	%IB9	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Figure 2-14 Create PLC Variable

Ladder Diagram

When the PLC triggers the device to run the project, related ladder diagrams are shown below.

- Enable Trigger

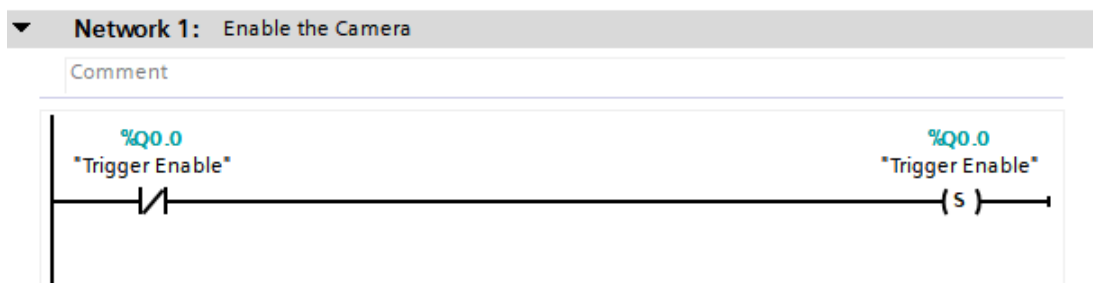


Figure 2-15 Enable Camera

- Send Trigger Signal

The trigger signal can be generated by adding an edge signal before Trigger Ready according to actual demands. For example, when the PLC detects the photoelectric input signal, it sends a trigger signal once. The figure below describes that a trigger signal is

outputted every second via the internal system clock.

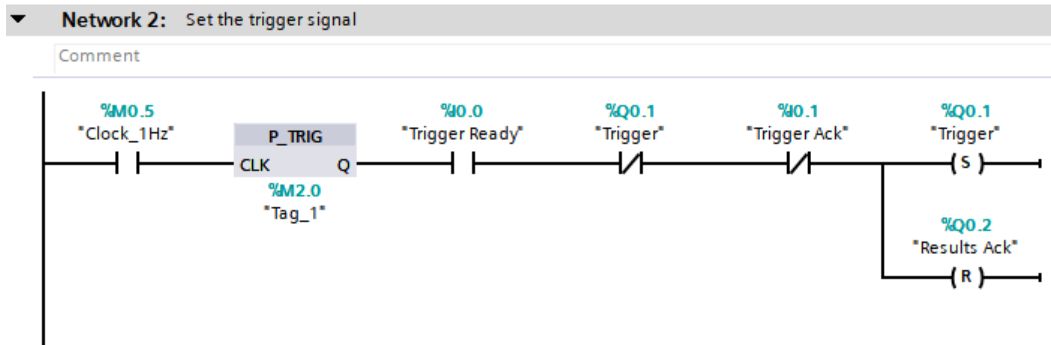


Figure 2-16 Send Trigger Signal

- Clear Trigger Signal

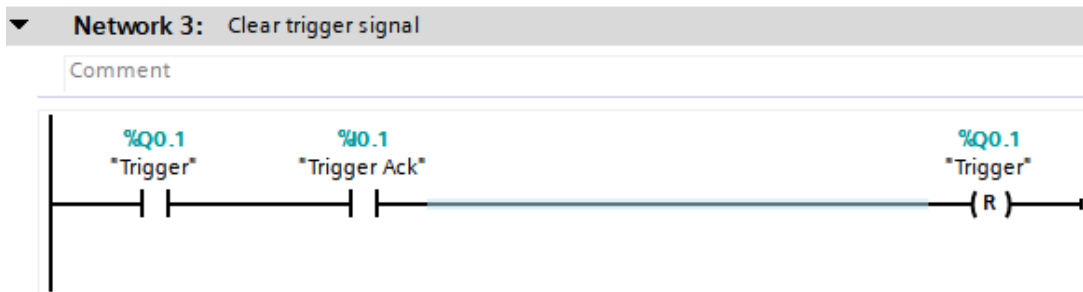


Figure 2-17 Clear Trigger Signal

- Get Device Results

Create a DB data block to store the reading result, add the result variable as shown below. The first byte is the result length, and the result data is stored starting from the second byte.

		MV_SC_Result								
		Name	Data type	Offset	Start value	Retain	Accessible f...	Writa...	Visible in ...	Setpoint
1	Static									
2		Result Length	Byte	0.0	16#0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3		Result Data0	Char	1.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4		Result Data1	Char	2.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5		Result Data2	Char	3.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6		Result Data3	Char	4.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7		Result Data4	Char	5.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8		Result Data5	Char	6.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9		Result Data6	Char	7.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10		Result Data7	Char	8.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
11		Result Data8	Char	9.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
12		Result Data9	Char	10.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
13		Result Data10	Char	11.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
14		Result Data11	Char	12.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
15		Result Data12	Char	13.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
16		Result Data13	Char	14.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
17		Result Data14	Char	15.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
18		Result Data15	Char	16.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
19		Result Data16	Char	17.0	**	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Figure 2-18 Add Result Data Block

When the device feeds back the Results Available or Timeout signal, it means that the result

data has been updated, and the PLC reads the result data to the DB data block. After the reading is finished, set the Results Ack signal to acknowledge that the device has finished reading the result data.

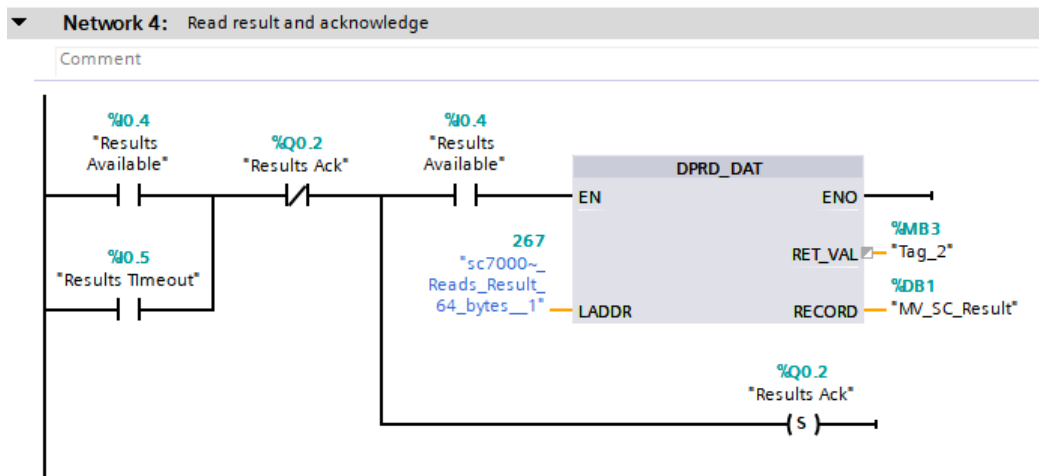


Figure 2-19 Get Results

View Results

Through the monitoring and option tab, you can monitor the status of the variables of each module of the device and view the result output. You can also add trace records of the variables via the Trace tab to view the control sequence.

MV_SC_Result								
	Name	Data type	Offset	Start value	Monitor value	Retain	Accessible f...	Writa...
1	Static							
2	Result Length	Byte	0.0	16#0	16#05	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	Result Data0	Char	1.0	' '	'1'	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	Result Data1	Char	2.0	' '	' '	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	Result Data2	Char	3.0	' '	'O'	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6	Result Data3	Char	4.0	' '	'K'	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
7	Result Data4	Char	5.0	' '	' '	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
8	Result Data5	Char	6.0	' '	'\$00'	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
9	Result Data6	Char	7.0	' '	'\$00'	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
10	Result Data7	Char	8.0	' '	'\$00'	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
11	Result Data8	Char	9.0	' '	'\$00'	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
12	Result Data9	Char	10.0	' '	'\$00'	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
13	Result Data10	Char	11.0	' '	'\$00'	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
14	Result Data11	Char	12.0	' '	'\$00'	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
15	Result Data12	Char	13.0	' '	'\$00'	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
16	Result Data13	Char	14.0	' '	'\$00'	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Figure 2-20 View Results

2.7 Project Switching Test

Hardware Configuration

Add User Data 64 bytes module to the device, and recompile the hardware configuration and download it to the PLC.

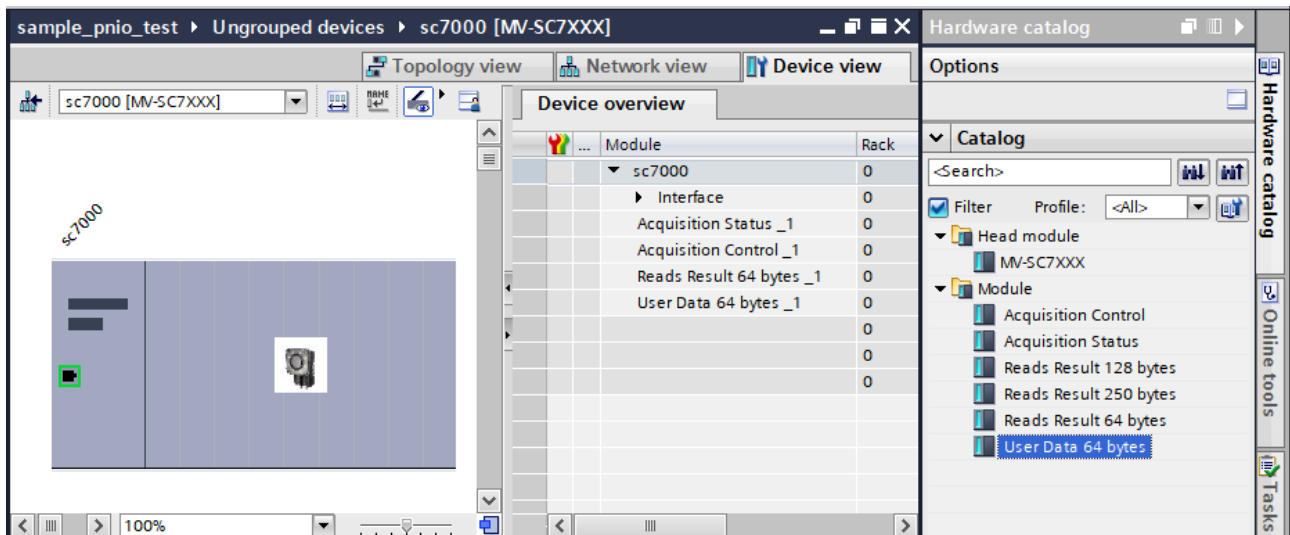


Figure 2-21 Add User Data Module

Ladder Diagram

Create a DB data block to store the reading result, add the command variable as shown below. The first byte is the command length, and command character is stored starting from the second byte.

Project tree		sample_pnio_test ▶ PLC_1 [CPU 1511-1 PN] ▶ Program blocks ▶ MV_SC_Command [DB2]							
PLC programming	Devices	Keep actual values Snapshot Copy snapshots to start values							
	sample_pnio_test	MV_SC_Command							
	PLC_1 [CPU 1511-1 PN]								
	Program blocks								
	MV_SC_Command [DB2]								
	MV_SC_Result [DB1]								
	System blocks								
	Technology objects								
	External source files								
	PLC tags								
	Show all tags								
	Add new tag table								
		Name	Data type	Offset	Start value	Retain	Accessible f...	Writa...	Visible in ...
		1 Static							
		2 Command Length	Byte	0.0	12				
		3 Command Data0	Char	1.0	's'				
		4 Command Data1	Char	2.0	'w'				
		5 Command Data2	Char	3.0	'i'				
		6 Command Data3	Char	4.0	't'				
		7 Command Data4	Char	5.0	'c'				
		8 Command Data5	Char	6.0	'h'				
		9 Command Data6	Byte	7.0	' '				
		10 Command Data7	Char	8.0	't'				
		11 Command Data8	Char	9.0	'e'				
		12 Command Data9	Char	10.0	's'				
		13 Command Data10	Char	11.0	't'				
		14 Command Data11	Char	12.0	'i'				
		15 Command Data12	Char	13.0	' '				
		16 Command Data13	Char	14.0	' '				

Figure 2-22 Add Command Data Block

The related ladder diagram of project switching test is shown below.

- Send Switching Command

Write "command length + command character" to User Data 64 bytes module.

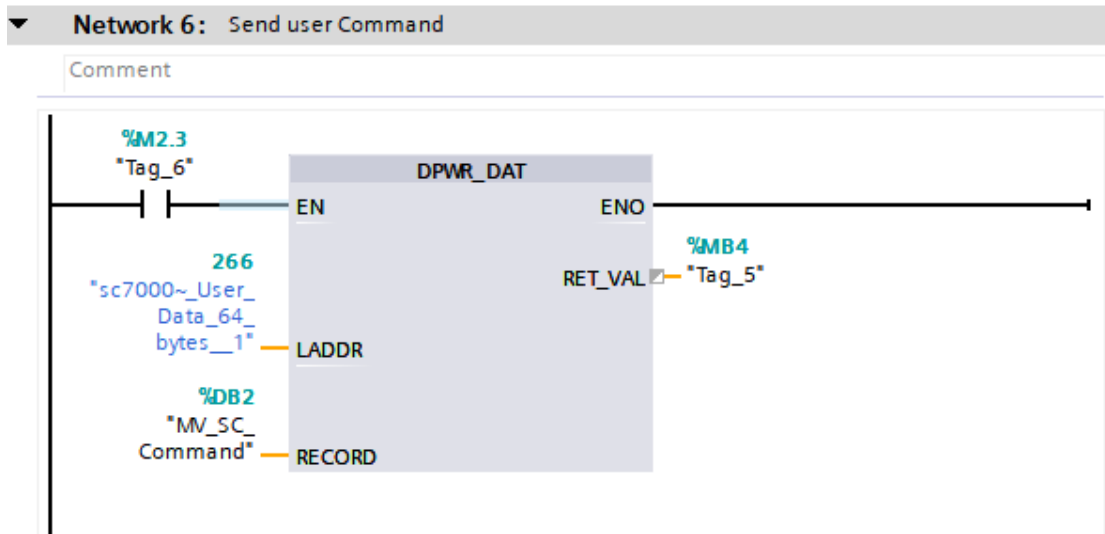


Figure 2-23 Send Switching Command

- Execute Switching Command

Write a rising edge to the Executive Command of the Acquisition Control Module to trigger the execution of the command.

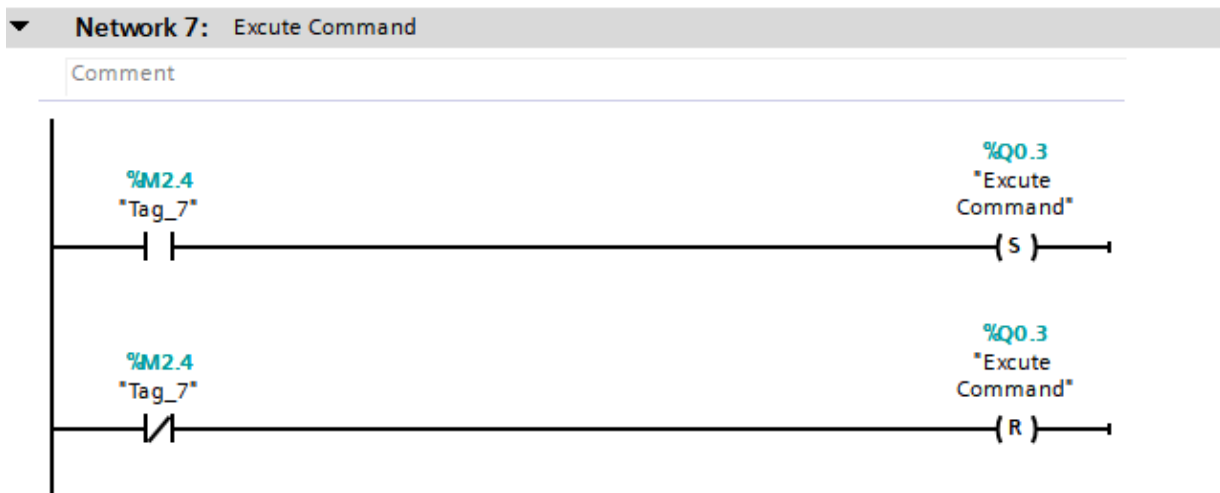


Figure 2-24 Execute Switching Command

Chapter 3 ModBus

3.1 Introduction

Modbus is a request/response protocol whose services are specified by function codes. Port 502 is reserved for ModBus communication. It uses standard Ethernet hardware and software to exchange I/O data and diagnostic information.

Note

This chapter takes Siemens S7 series PLC as an example to explain how to communicate with smart cameras via ModBus communication protocol. For other devices, refer to the user manual provided by the manufacturer and make related settings by reading contents of this chapter.

3.2 Hardware Wiring

The wiring of PLC controller, ModBus TCP test tool, and the smart camera is shown below.

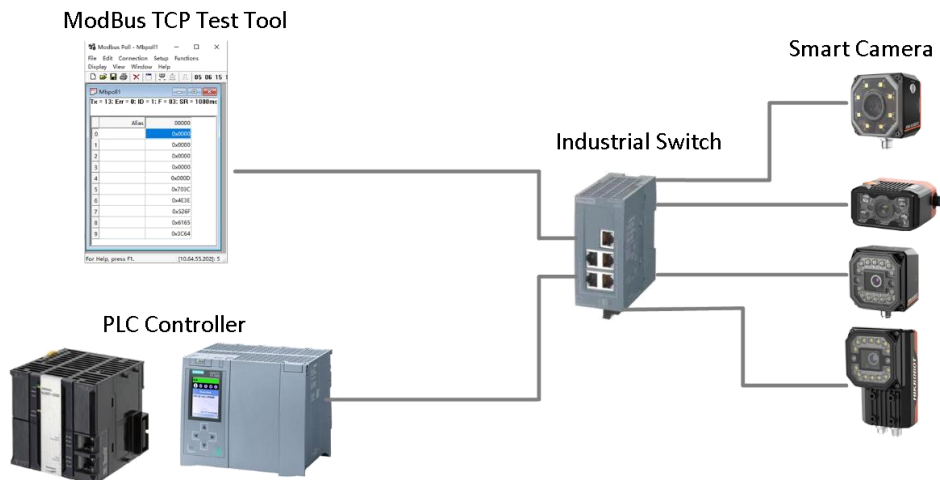


Figure 3-1 Hardware Wiring

3.3 Smart Camera Settings

Before using the smart camera's ModBus function to communicate with other devices, you need to set the smart camera first via the SCMVS client software.

Before you start:



- Make sure that the PC has installed the SCMVS client software.

- Check the device's firmware version. Please refer to the relevant instructions in the industrial protocol for specific requirements.

Note

Regarding SC2000Pro series smart camera, you need to operate it via the web, and operations are similar to those via the SCMVS client software.

Steps

1. Log in the device via the SCMVS client software.
2. Click **Communication** on the menu bar.
3. Click  to add ModBus communication.
4. Switch on  to enable ModBus communication.
5. Keep the default parameter settings.

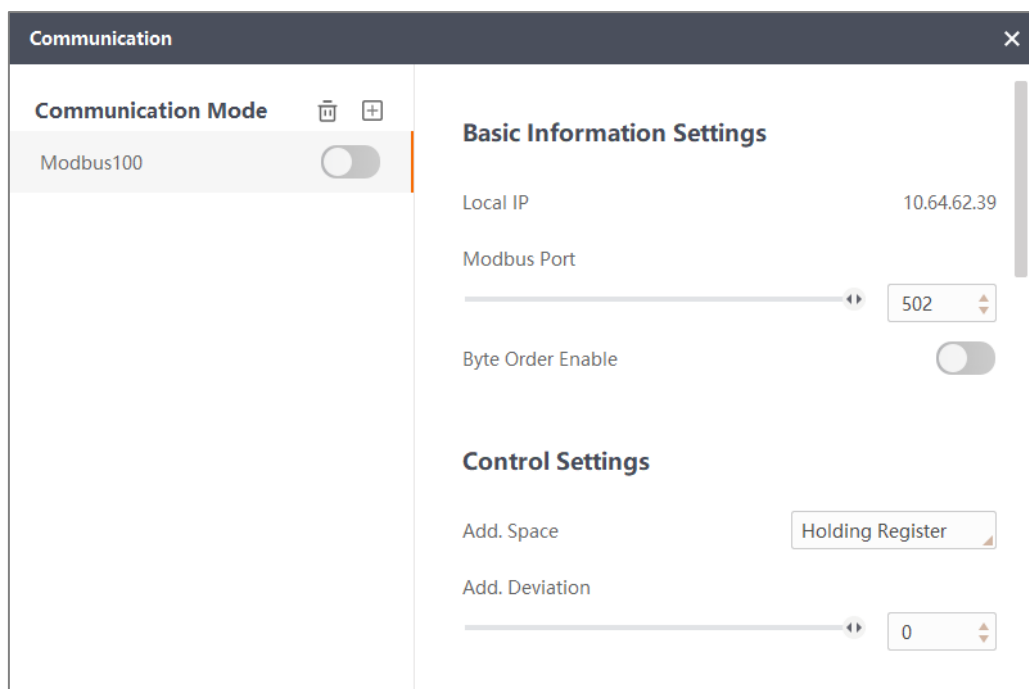


Figure 3-2 Set Communication Parameters

Note

Result byte swap is only valid for float type results.

6. Click **Scheme Settings** in the scheme management pane of the main window, then select trigger source in the project editing dialog box according to the actual situation.
 - When using industrial protocol to trigger the device, select **Software** as the trigger source and click the **Loop Run** in the upper right area of the image live view pane.
 - When using IO to trigger the device, select **IO** as the trigger source.
7. Create a project and set parameters for cameras, base images, and vision tools according to actual demands.

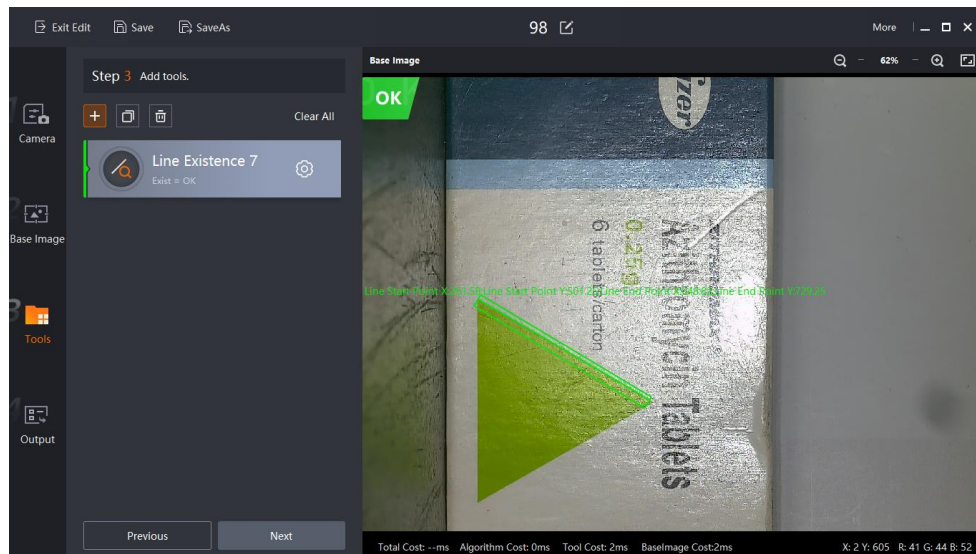


Figure 3-3 Line Existence

Note

Here we take the tool of line existence as an example.

8. Go to **Output** → **Tool Results** → **Add** to set the outputted content.

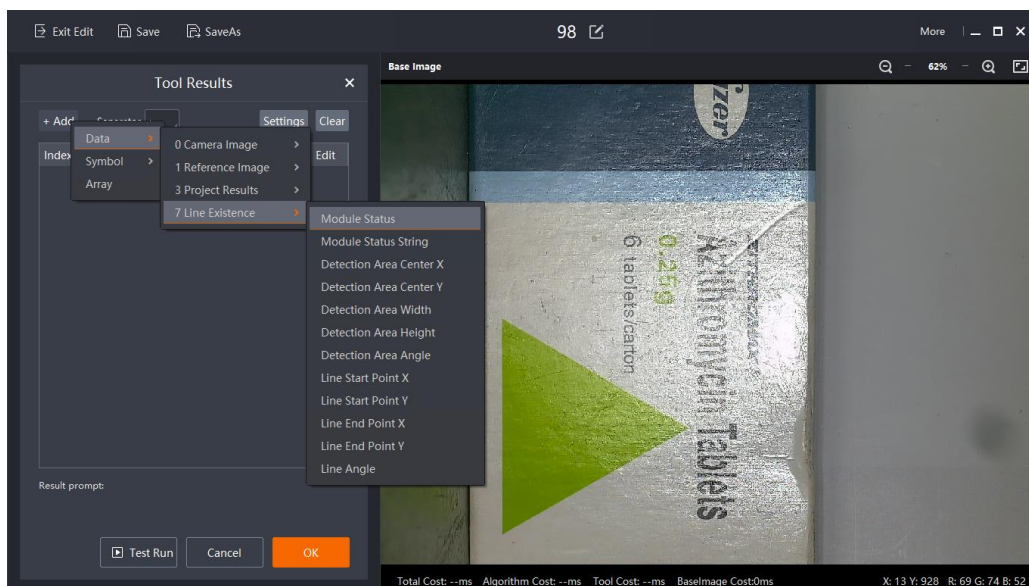


Figure 3-4 Set Tool Results

Note

Here we take the module status and module status string of line existence as an example to introduce tool results.

9. Save the project.

10. If you want to switch projects via communications, go to project management, select **Trigger Communication** as **Mode**, enter **Communication String**, and **Switch Return String** according to actual demands.

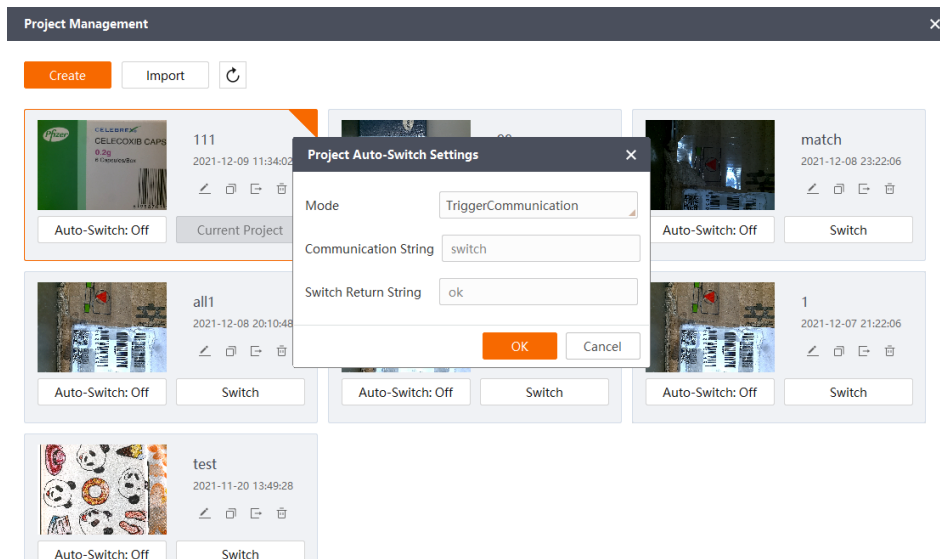


Figure 3-5 Project Switch Settings

3.4 ModBus TCP Test Tool

The ModBus TCP test tool can be used to test whether the ModBus communication between devices is normal. When the device is working in server mode, ModBus Poll test software can be used. When the ModBus Poll software works in client mode, it will automatically connect to the device.

Steps

1. Enter connection setup parameters according to actual demands.

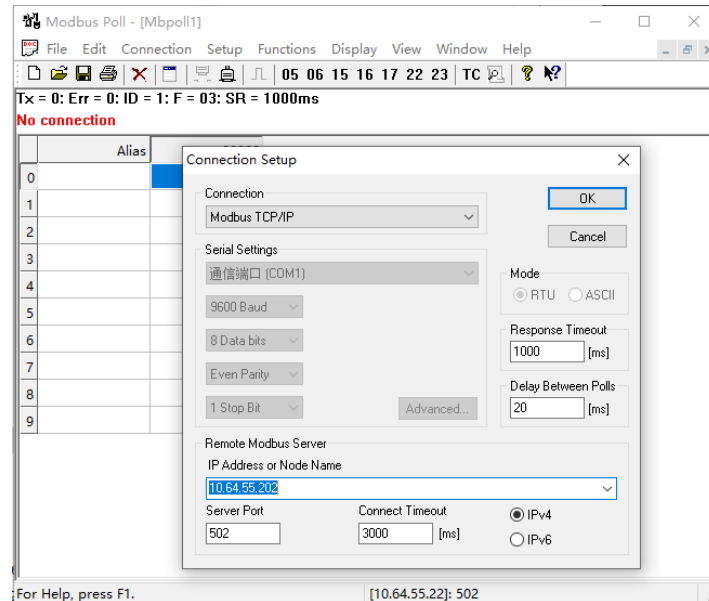


Figure 3-6 Set IP Address and Port

Note

The server port is set as 502.

2. Poll and read the holding registers of the device via the 03 command, start reading from address offset 0, and set an appropriate number of read registers and polling read interval time.

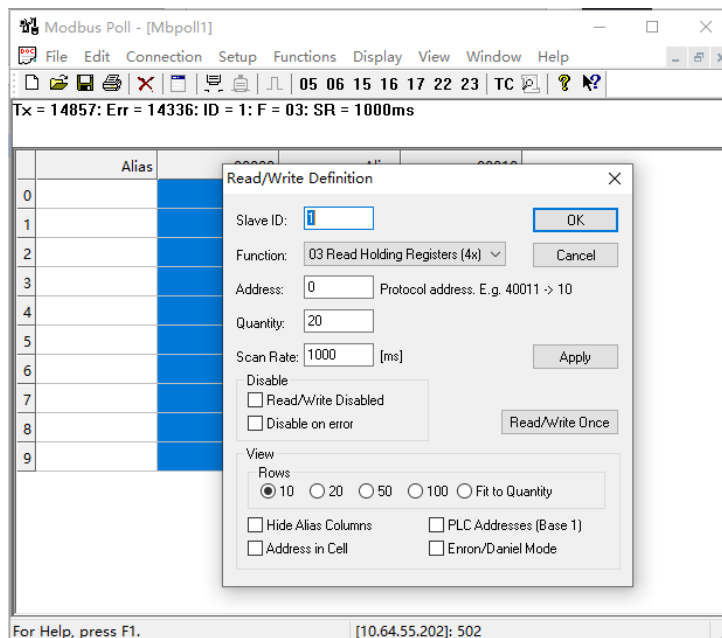


Figure 3-7 Set Polling and Reading Holding Register

3. Alternately write 3 and 5 to the register of offset address 0 in the control area to trigger the device to run the project once, and return the project result in the result area.

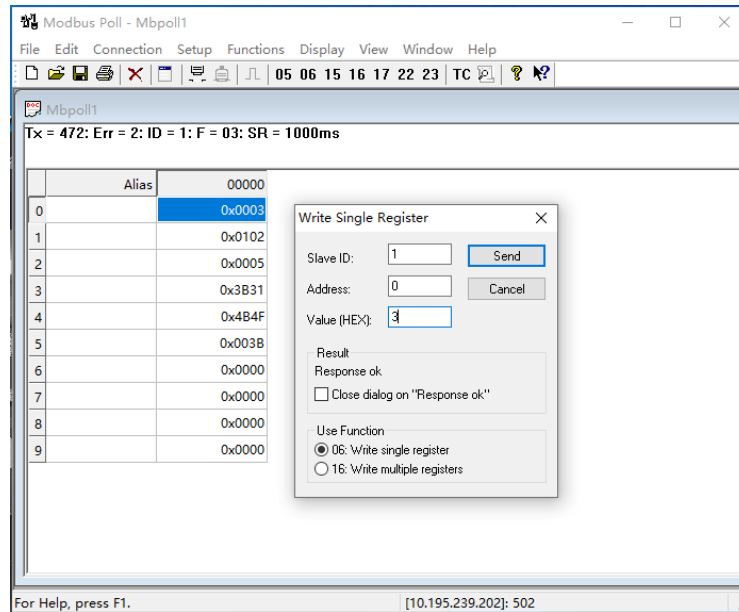


Figure 3-8 Write Single Register

3.5 PLC Settings

This section takes the ModBus TCP settings of Siemens S7 series PLC as an example to explain how to set PLC's ModBus communication. For ModBus devices from other manufacturers or different models, refer to this section and its user manual to configure.

Steps

1. Run TIA Portal, click **Create new project**, enter parameters, and click **Create**.

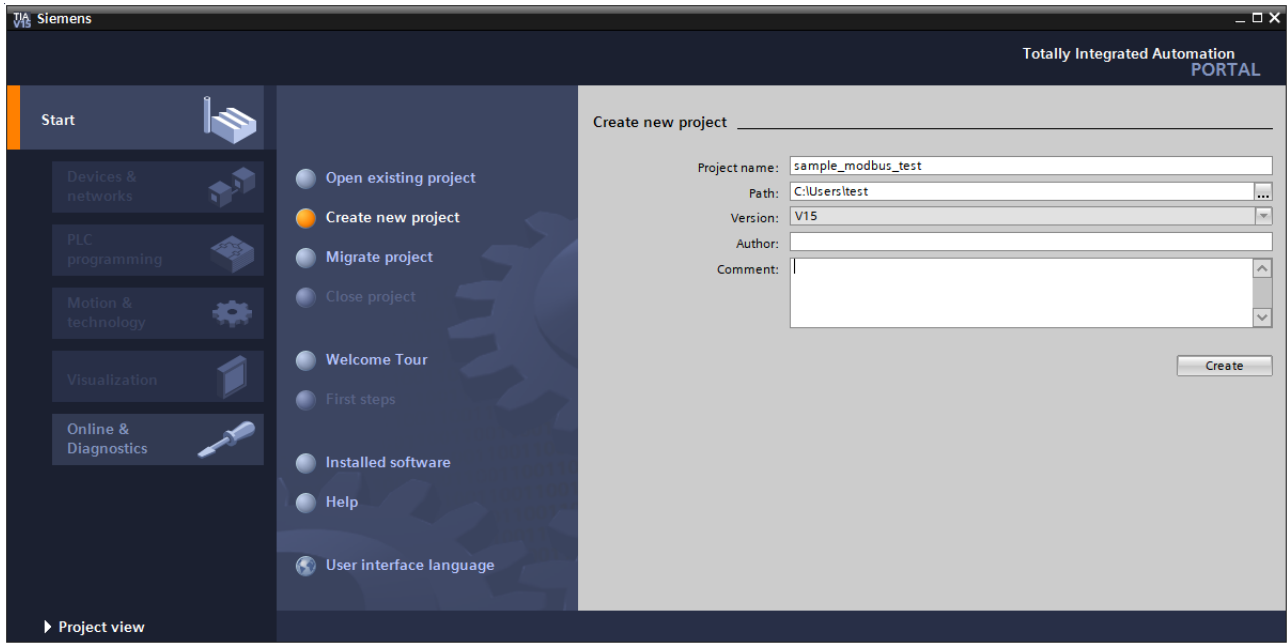


Figure 3-9 Create New Project

2. Add the corresponding PLC controller.

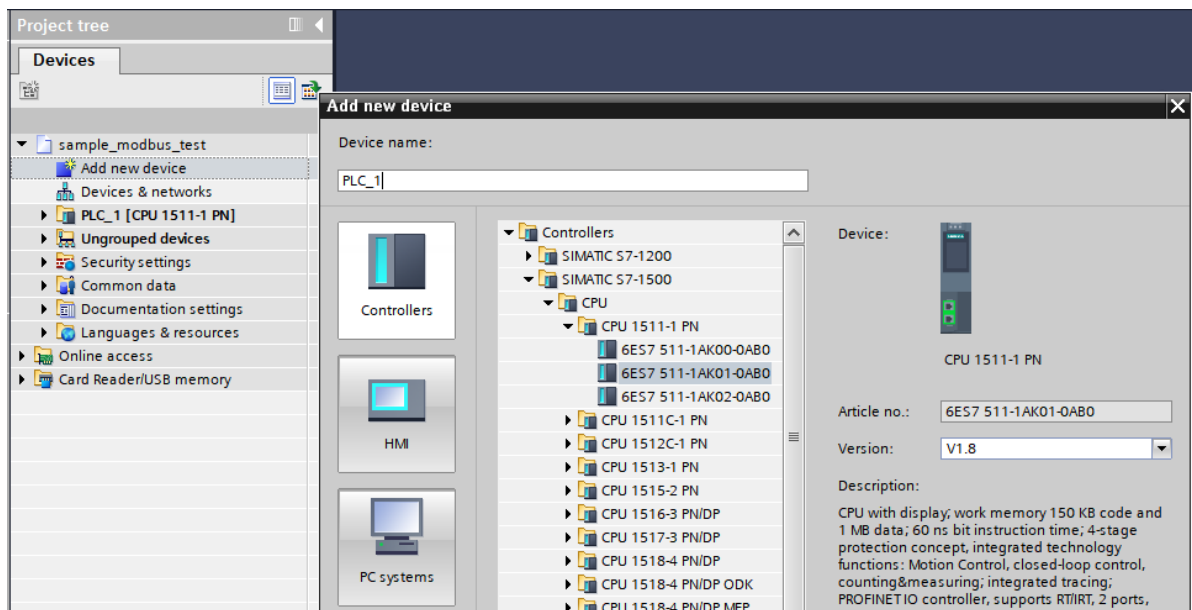


Figure 3-10 Add PLC

3. Set the IP address of the PLC controller.

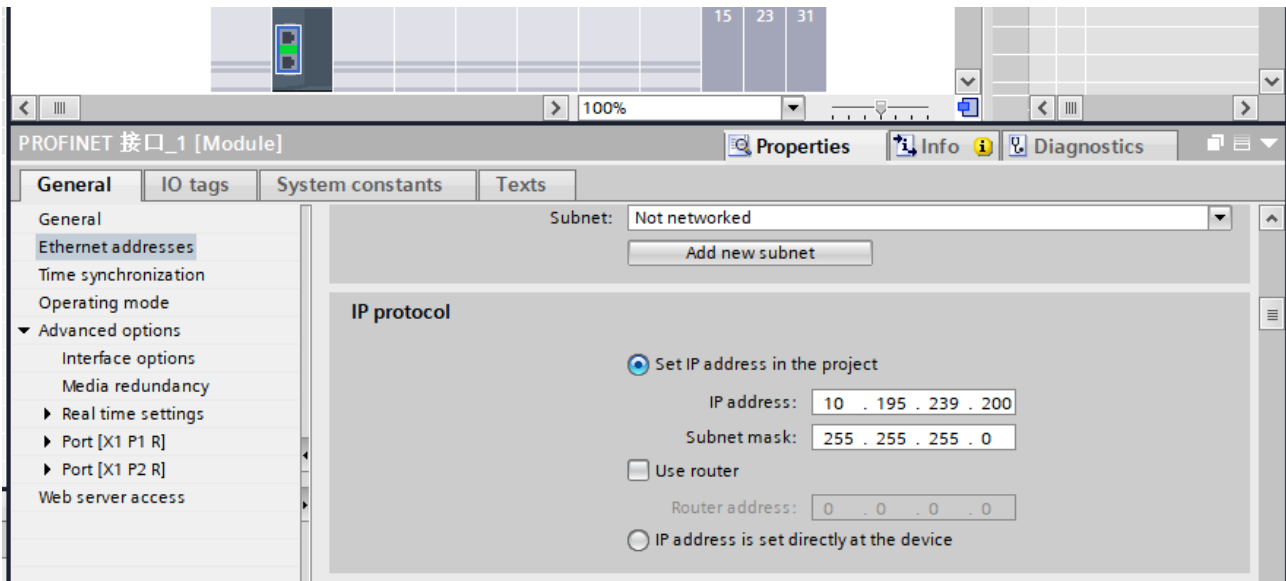


Figure 3-11 Set IP Address

- Go to **Communication** → **Others** → **MODBUS TCP**, and add two MB_CLIENT commands.

Note

Two MB_CLIENT commands: One is used to write to register, and the other one is used to read register.

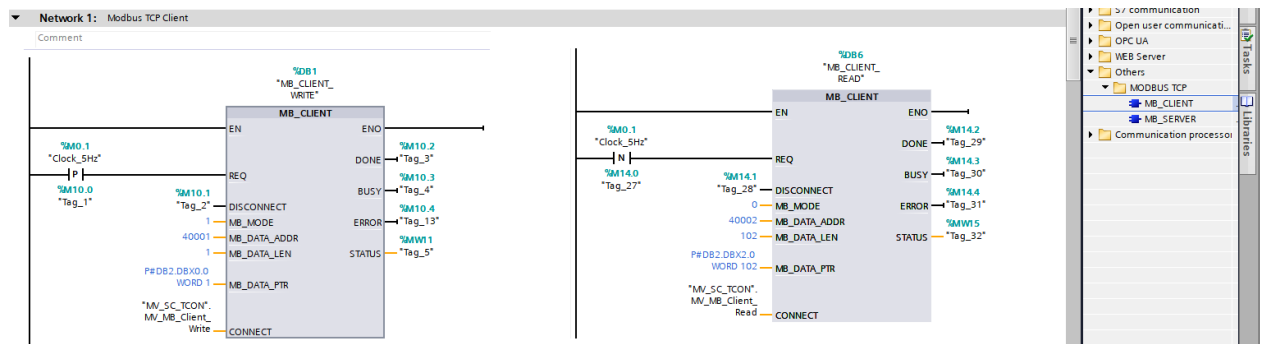


Figure 3-12 Add MB_CLIENT Commands

- MB_DATA_PTR points to the pointer of the data register, create a new MV_SC_REG data block to store the communication data of the device's register, and add variables to the data block.

MV_SC_REG										
	Name	Data type	Offset	Start value	Retain	Accessible f...	Writa...	Visible in ...	Setpoint	Supervis...
1	Static									
2	Control	Word	0.0	16#0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
3	Status	Word	2.0	16#0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
4	Result	Struct	4.0			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
5	Result Length	Word	4.0	16#0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
6	Result Data	Array[0..199] of Char	6.0			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Figure 3-13 MV_SC_REG Data Block

6. Create a new MV_SC_TCON data block at the CONNECT pin, and create two TCON_IP_v4 type variables (MV_MB_Client_Write, MV_MB_Client_Read), and expand variables to assign values to them.

MV_SC_TCON										
	Name	Data type	Start value	Retain	Accessible f...	Writa...	Visible in ...	Setpoint	Supervis...	Comment
1	Static									
2	MV_MB_Client_Write	TCON_IP_v4			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			
3	Interfaceld	HW_ANY	64		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			HW-identifier of IE-interface submodule
4	ID	CONN_OUC	16#1		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			connection reference / identifier
5	ConnectionType	Byte	16#0B		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			type of connection: 11=TCP/IP, 19=UDP (17=TCP)
6	ActiveEstablished	Bool	1		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			active/passive connection establishment
7	RemoteAddress	IP_V4			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			remote IP address (IPv4)
8	ADDR	Array[1..4] of Byte			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			IPv4 address
9	ADDR[1]	Byte	16#0a		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			IPv4 address
10	ADDR[2]	Byte	16#c3		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			IPv4 address
11	ADDR[3]	Byte	16#ef		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			IPv4 address
12	ADDR[4]	Byte	16#c6		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			IPv4 address
13	RemotePort	UInt	502		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			remote UDP/TCP port number
14	LocalPort	UInt	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			local UDP/TCP port number
15	MV_MB_Client_Read	TCON_IP_v4			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			
16	Interfaceld	HW_ANY	64		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			HW-identifier of IE-interface submodule
17	ID	CONN_OUC	16#2		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			connection reference / identifier
18	ConnectionType	Byte	16#0B		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			type of connection: 11=TCP/IP, 19=UDP (17=TCP)
19	ActiveEstablished	Bool	1		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			active/passive connection establishment
20	RemoteAddress	IP_V4			<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			remote IP address (IPv4)
21	RemotePort	UInt	502		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			remote UDP/TCP port number
22	LocalPort	UInt	0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			local UDP/TCP port number

Figure 3-14 MV_SC_TCON Data Block

Note

The ID value should be different.

7. Repeat steps above to configure other pins.
8. Compile project and download it to the PLC controller.

3.6 Device Register Definition

The device only uses holding registers and is divided into four areas: control, status, result, and command.

Control

The PLC sends commands via control area and controls the device to acquire image, and

run projects.

The control area controls the device to get images from PLC to the device.

- Control area location: holding registers (the offset value is fixed as 0).
- Control area size: 1 register (2 bytes)

Table 3-1 Control Area Definition

REG/bit	Name	Description
REG0.0	Trigger Enable	The PLC controls the device's trigger enable function via this bit.
REG0.1	Trigger	When following conditions are met, the PLC sets this bit to trigger the device to acquire an image and run the algorithm once. <ul style="list-style-type: none">• Trigger Enable is set.• The device is not currently acquiring images and running algorithms.• Trigger Ready is set.
REG0.2	Results Ack	After the PLC reads the trigger result, it sets this bit to notify the device, and the device clears Results Available and Results Timeout after confirmation.
REG0.3-7	Reserved	Reserved.
REG0.8	Execute Command	Execute the command specified in the commands area once on the rising edge.
REG0.9-14	Reserved	Reserved.
REG0.15	Clear Error	Clear error status.

Status

The status area feeds back the device's current status from the device to PLC.

- Status area location: holding registers (the offset value is fixed as 1).
- Status area size: 1 register (2 bytes)

Table 3-2 Status Area Definition

REG1/bit	Name	Description
REG1.0	Trigger Ready	The device is ready to receive new trigger signals. When the Trigger Enable is set and the device is ready to receive next trigger signal, the Trigger Ready will be set.
REG 1.1	Trigger Ack	The device has already received the trigger signal.
REG 1.2	Acquiring	The device is acquiring images.
REG 1.3	Decoding	The device is recognizing decodes on images.
REG 1.4-7	Reserved	Reserved.
REG 1.8	Results Available	The device outputs new results. When the PLC is set to Result Ack, the Results Available will be cleared.
REG 1.9	Results Timeout	Results are not gotten when the time is out, and internal timeout is 6 sec. When the PLC is set to Result Ack, the Results Timeout will be cleared.
REG 1.10-14	Reserved	Reserved.
REG 1.15	General Fault	A device's internal fault occurred, and you can clear this signal via Clear Error.

Result

The result area stores result data from the device to PLC.

- Result area location: holding registers (the offset value is fixed as 2).
- Result size: 4 to 500 registers (100 by default).

Table 3-3 Result Area Definition

REG/word	Name	Description
REG2	Result Length	It refers to the length of valid data contained in the result area.
REG3...	Result Data	It refers to the result output by the device. <ul style="list-style-type: none"> • When result data length is smaller than configured result module, the spare bytes will be filled with 0. • When result data length is greater than configured result module, the extra bytes will be cut off.

Command

The command area stores commands that users send to the device from the PLC.

- Command area location: holding registers (the offset value is fixed as 500).
- Command area size: 4 to 500 registers to configure (100 by default).

Table 3-4 Command Area Definition

REG/word	Name	Description
REG500	User Data Length	It refers to the length of valid data contained in the command area.
REG501...	User Data	It refer command character.

3.7 Trigger Test

Communication Sequence Diagram

The communication sequence diagram of PLC and the device is shown below.

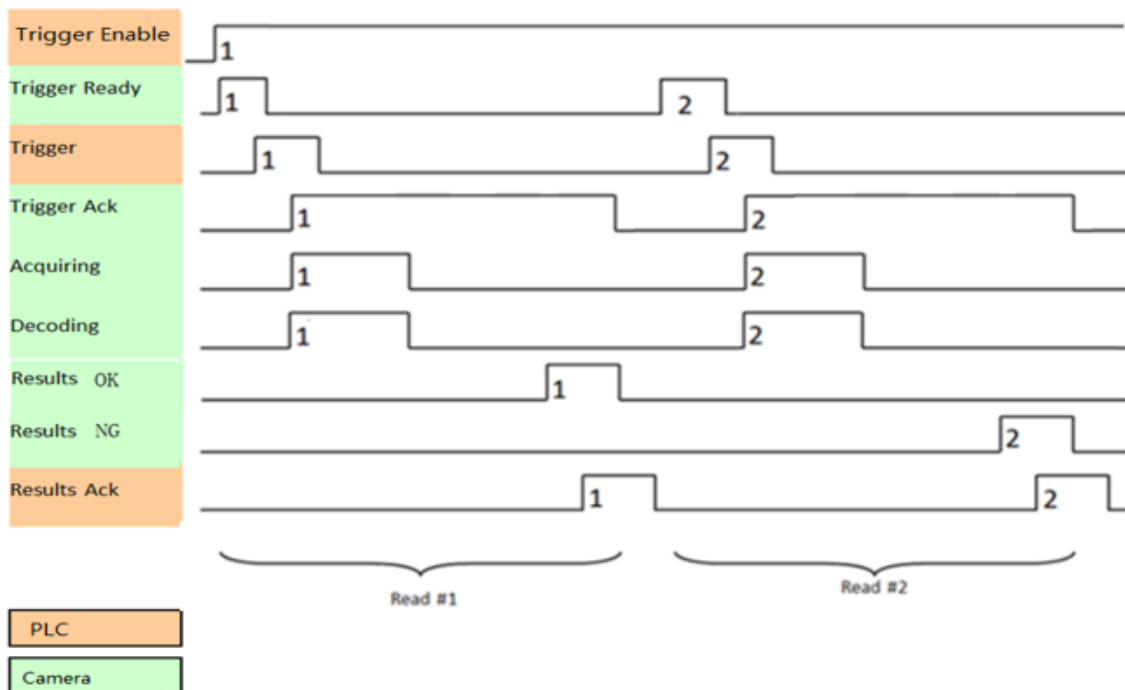


Figure 3-15 Communication Sequence Diagram

The logic of the above sequence diagram is shown below:

1. PLC sets Trigger Enable signal REG0.0. After the device is ready, set Trigger Ready signal REG1.0.
2. After detecting the device's Trigger Ready signal, the PLC sends Trigger signal REG0.1 and controls the device to operate once.
3. The device starts to acquire images and runs the algorithm after receiving Trigger signal.
 - If the result of the algorithm tool is outputted correctly, set the Results Available signal REG1.8 and put contents of the configuration result into the address starting from REG2.
 - If the result output times out, set the Results Timeout signal REG1.9 and clear the start address of REG2.

Note

For tools like character recognition, the result will be outputted only after the character is recognized. Otherwise, the result output will time out at this time. If you need to return results quickly, you can use the exception output function.

4. After detecting Results Available, the PLC starts to read results from REG2.
5. After reading results is finished, set Results Ack signal REG0.2, and notify the device.
6. After triggering is finished, reset the PLC first (set Results Ack) and then repeat the steps from 1 to 5 above for anew round of triggering.

Create Variables

Create variables in accordance with the device's register.

MV_SC_TAGS								
	Name	Data type	Address	Retain	Acces...	Writa...	Visibl...	Supervis...
1	Trigger Enable	Bool	%M100.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
2	Trigger	Bool	%M100.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
3	Results Ack	Bool	%M100.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
4	Excute Command	Bool	%M101.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
5	Clear Error	Bool	%M101.7	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
6	Trigger Ready	Bool	%M102.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
7	Trigger Ack	Bool	%M102.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
8	Acquiring	Bool	%M102.2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
9	Decoding	Bool	%M102.3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
10	Results Available	Bool	%M103.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
11	Results Timeout	Bool	%M103.1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
12	General Fault	Bool	%M103.7	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

Figure 3-16 Create Variables

Ladder Diagram

When the PLC triggers the device to run the project, related ladder diagrams are shown

below.

- Send Control and Reading Status

Write MW100 to the control area of the device, read the status area of the device to MW102, and create variables for each bit of control and status.

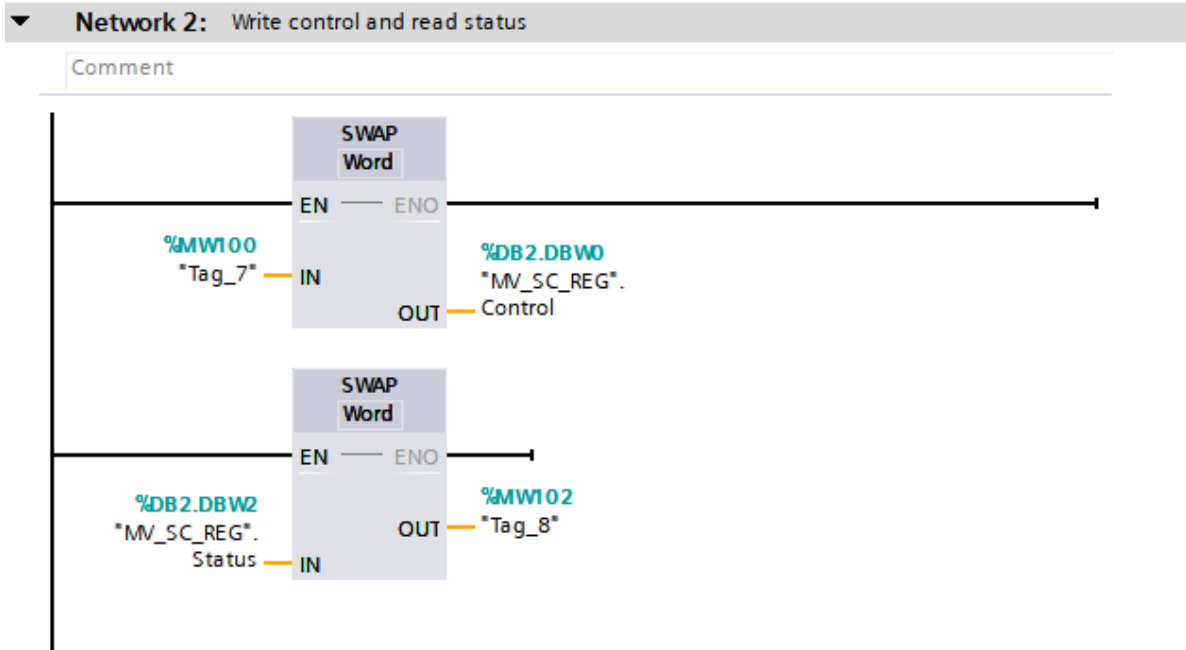


Figure 3-17 Send Control and Reading Status

- Enable Trigger

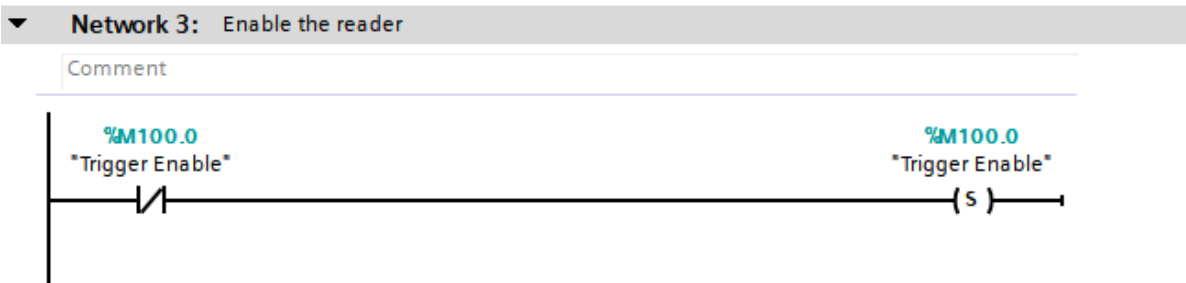


Figure 3-18 Enable Trigger

- Send Trigger Signal

The trigger signal can be generated by adding an edge signal before Trigger Ready according to actual demands. For example, when the PLC detects the photoelectric input signal, it sends a trigger signal once. The figure below describes that a trigger signal is

outputted every second via the internal system clock.

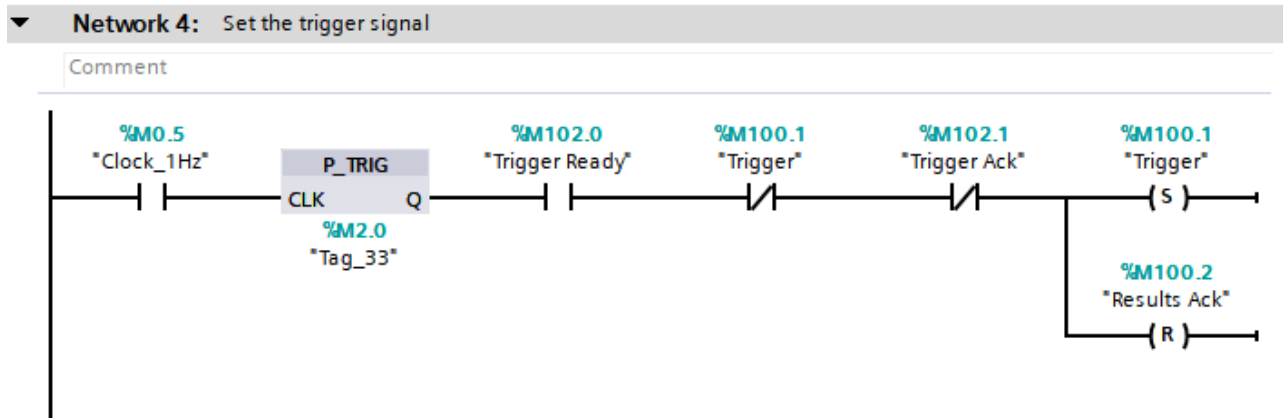


Figure 3-19 Send Trigger Signal

- Clear Trigger Signal

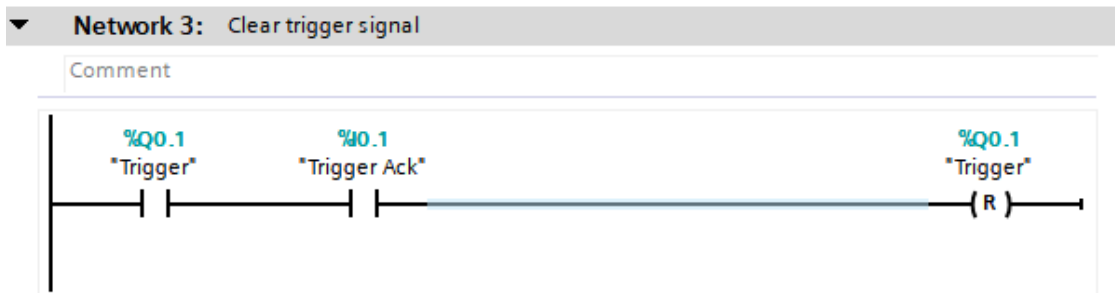


Figure 3-20 Clear Trigger Signal

- Get Device Results

Create a DB data block to store the reading result, add the result array variable as shown below.

MV_SC_RESULT									
	Name	Data type	Offset	Start value	Retain	Accessible f...	Writa...	Visible in ...	Setpoint
1	Static				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	result	Array[0..199] of Char	0.0		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Figure 3-21 Add Result Array Variable

When the device feeds back the Results Available or Timeout signal, it means that the result data has been updated, and the PLC reads the result data to the DB data block.

After the reading is finished, set the Results Ack signal to acknowledge that the device has

finished reading the result data.

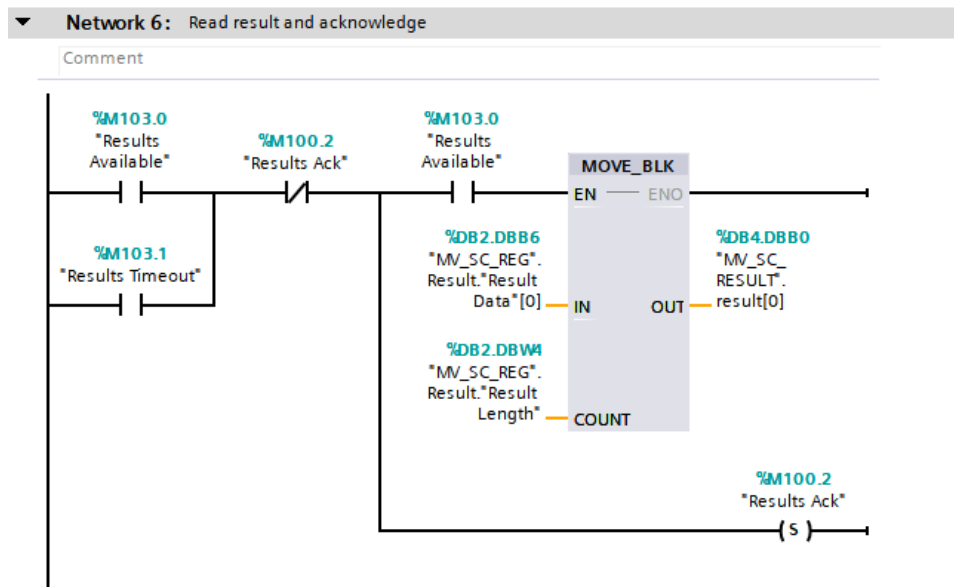


Figure 3-22 Get Device Results

- Clear Error

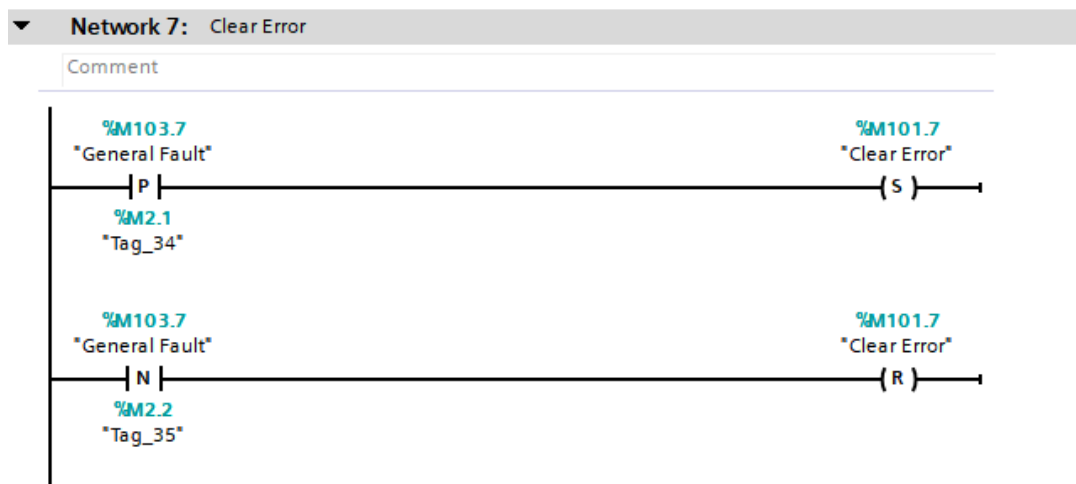


Figure 3-23 Clear Error

View Results

Through the monitoring and option tab, you can monitor the status of the variables of each module of the device and view the result output. You can also add trace records of the

variables via the Trace tab to view the control sequence.

	Name	Data type	Offset	Start value	Monitor value	Retain	Accessible f...	Writa...	Visible in ...
1	Static								
2	Control	Word	0.0	16#0	16#0005	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	Status	Word	2.0	16#0	16#0000	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	Result	Struct	4.0			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	Result Length	Word	4.0	16#0	16#0005	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6	Result Data	Array[0..199] of Char	6.0			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
7	Result Data[0]	Char	6.0	' '	' '	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
8	Result Data[1]	Char	7.0	' '	'i'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
9	Result Data[2]	Char	8.0	' '	'k'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
10	Result Data[3]	Char	9.0	' '	'o'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
11	Result Data[4]	Char	10.0	' '	'\$00'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
12	Result Data[5]	Char	11.0	' '	' '	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Figure 3-24 View Results

3.8 Project Switching Test

Create a DB data block to store command data, add the command variable as shown below. The first byte is the command length, and command character is stored starting from the second byte.

	Name	Data type	Offset	Start value	Retain	Accessible f...	Writa...	Visible in ...	Setpoint
1	Static				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	Command Length	Word	0.0	12	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	Command Data0	Char	2.0	'w'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	Command Data1	Char	3.0	's'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5	Command Data2	Char	4.0	't'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6	Command Data3	Char	5.0	'i'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7	Command Data4	Char	6.0	'h'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8	Command Data5	Char	7.0	'c'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9	Command Data6	Char	8.0	't'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10	Command Data7	Char	9.0	' '	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
11	Command Data8	Char	10.0	's'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
12	Command Data9	Char	11.0	'e'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
13	Command Data10	Char	12.0	'i'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
14	Command Data11	Char	13.0	't'	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
15	Command Data12	Char	14.0	' '	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Figure 3-25 Add Command Data Block

Note

The byte order of command character should be set according to the figure above.

The related ladder diagram of project switching test is shown below.

- Send Switching Command

Write "command length + command character" to the command area.

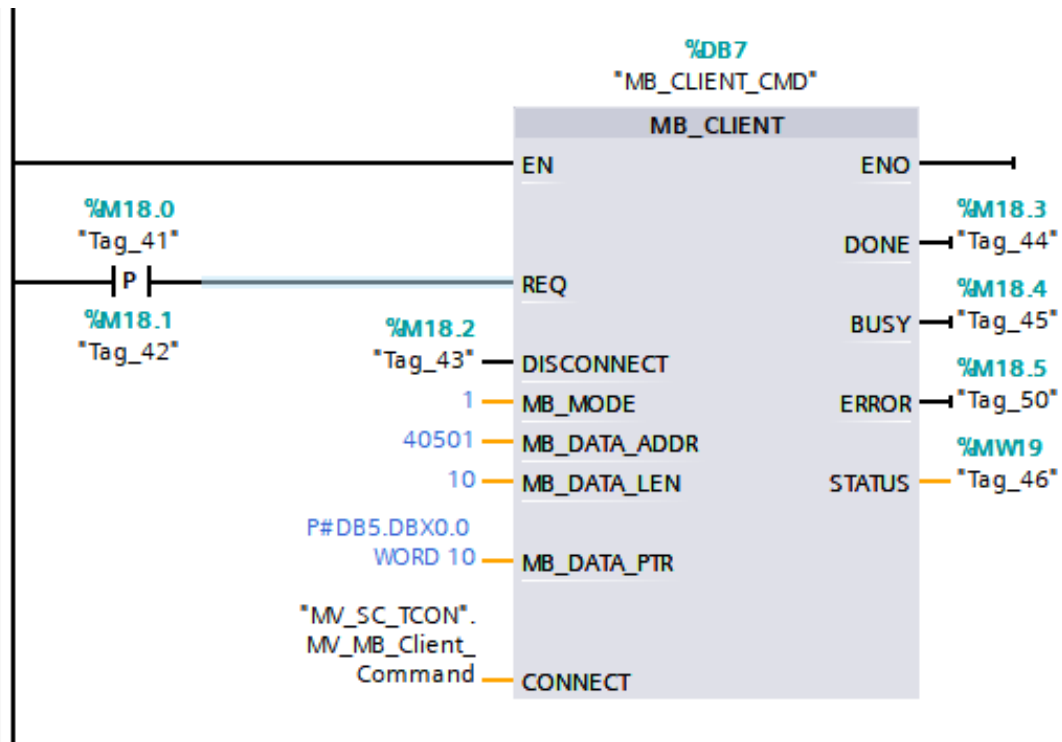


Figure 3-26 Send Switching Command

- Execute Switching Command

Write a rising edge to the Executive Command bit in the control area to execute a switching command once for the project.

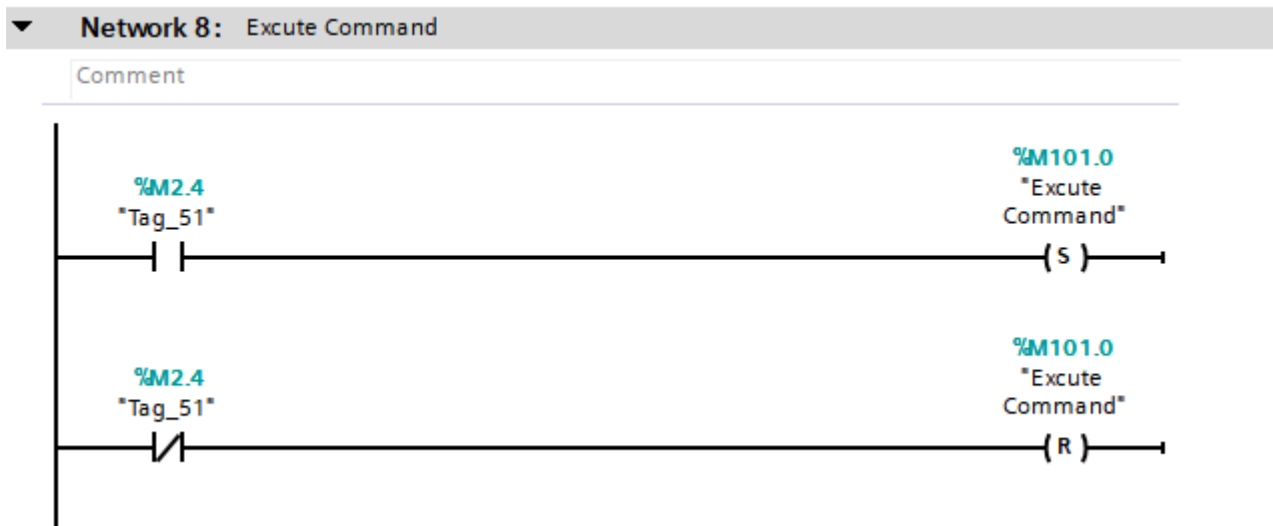


Figure 3-27 Execute Switching Command

Chapter 4 Revision History

Table 4-1 Revision History

Version	Document No.	Revision Date	Revision Details
V1.0.2	UD43601B	Jun. 27, 2025	Fix some errors.
V1.0.1	UD42936B	May 15, 2025	Fix some errors.
V1.0.0	UD26475B	Sept. 9, 2022	Original version.



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