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 SC1000 Series, SC2000 Series, and SC3000 Series, and smart cameras including SC5000X Series and SC6000 Series.
This manual is mainly intended for operation of industrial protocols supported by the Smart Cameras, including Ethernet/IP, Modbus, PROFINET, KV, MELSEC/SLMP and FINS.

Contact Information

Hangzhou Hikrobot Co., Ltd.
E-mail: global.support@hikrobotics.com
Website: ***https://en.hikrobotics.com/***

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Chapter 1 EtherNet/IP

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

- Here we take 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.
- For SC5000X series and SC6000 series smart cameras, you can scan the QR code below to view details about data communication with PLC via EtherNet/IP.

Figure 1-1 Communication Protocol for Vision Master 4.4.30

1.1 Hardware Wiring

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

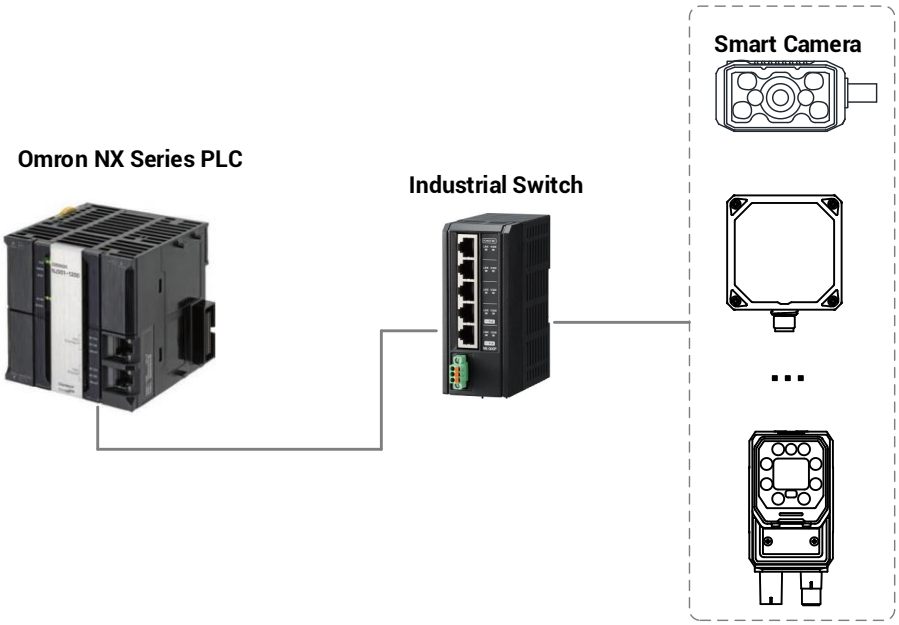


Figure 1-2 Hardware Wiring

1.2 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 SC5000X series and SC6000 series smart cameras, you need to operate it via the embedded VM software, 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.

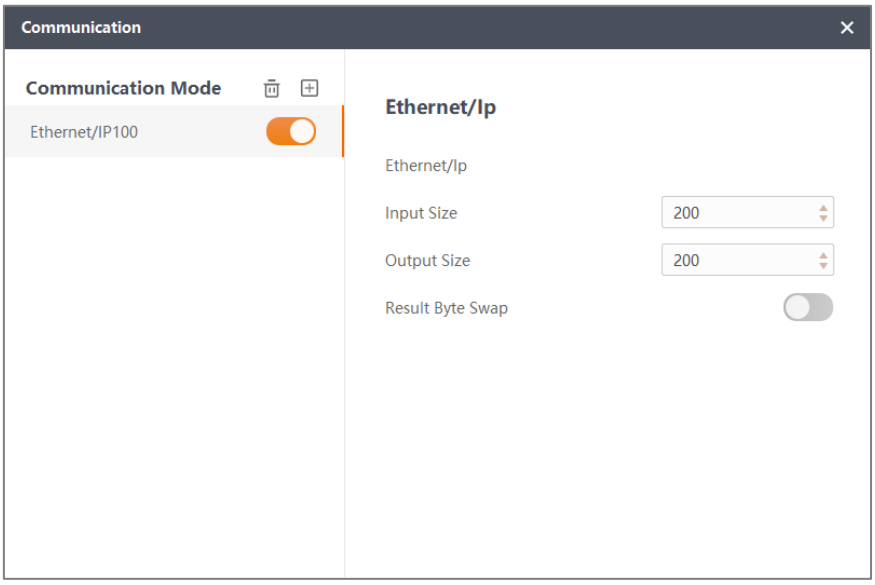


Figure 1-3 Set Communication Parameters

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.

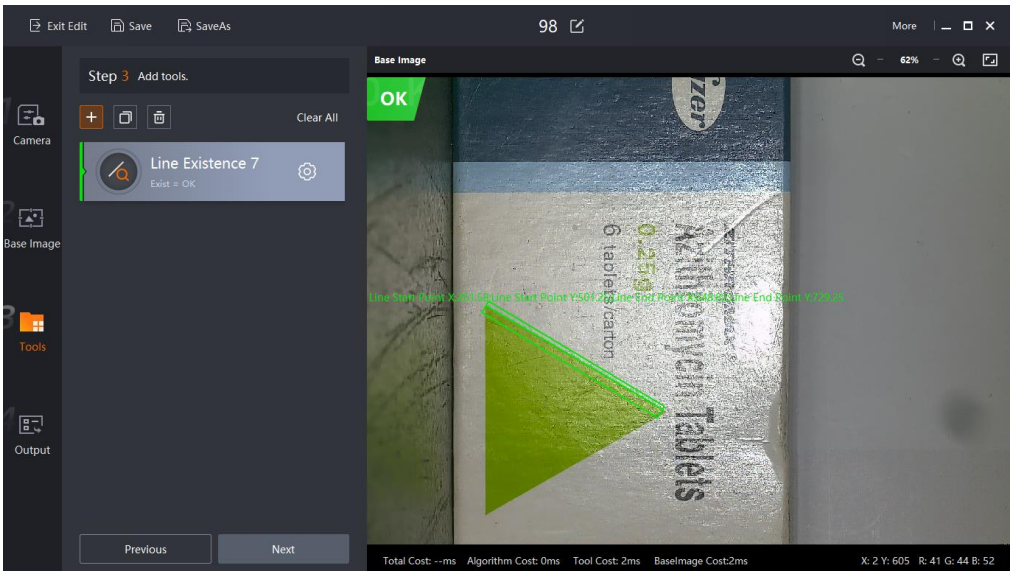


Figure 1-4 Line Existence

Note

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

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

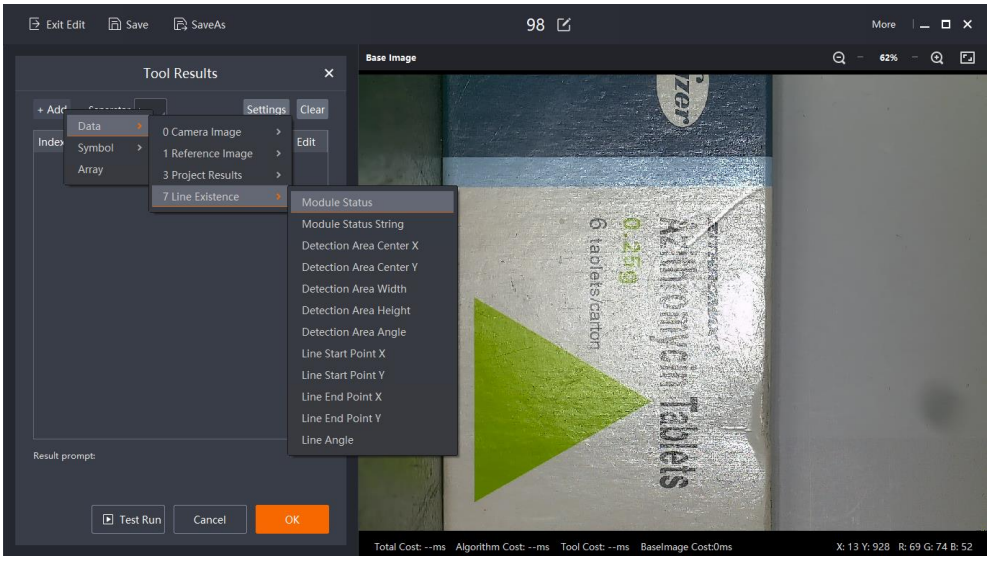


Figure 1-5 Set Tool Results

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.

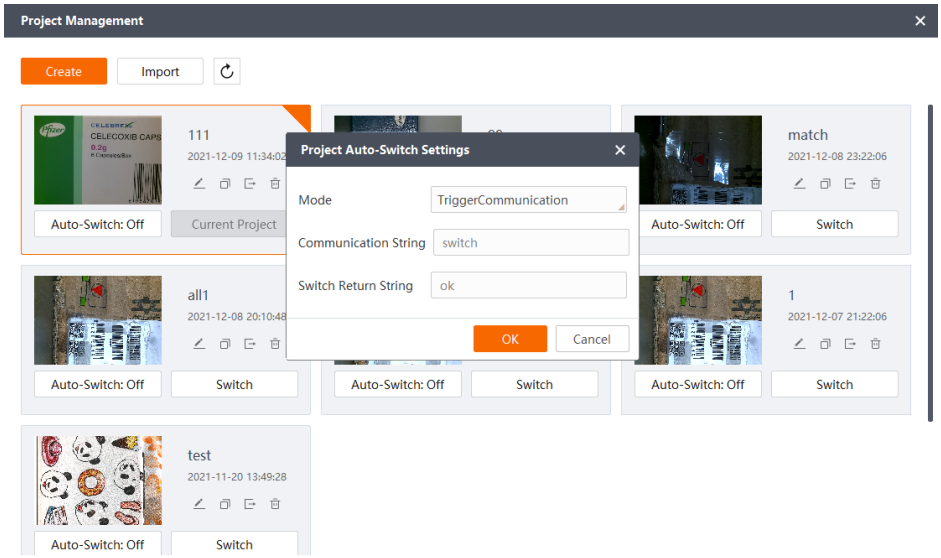


Figure 1-6 Project Switch Settings

1.3 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.

1.3.1 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**.

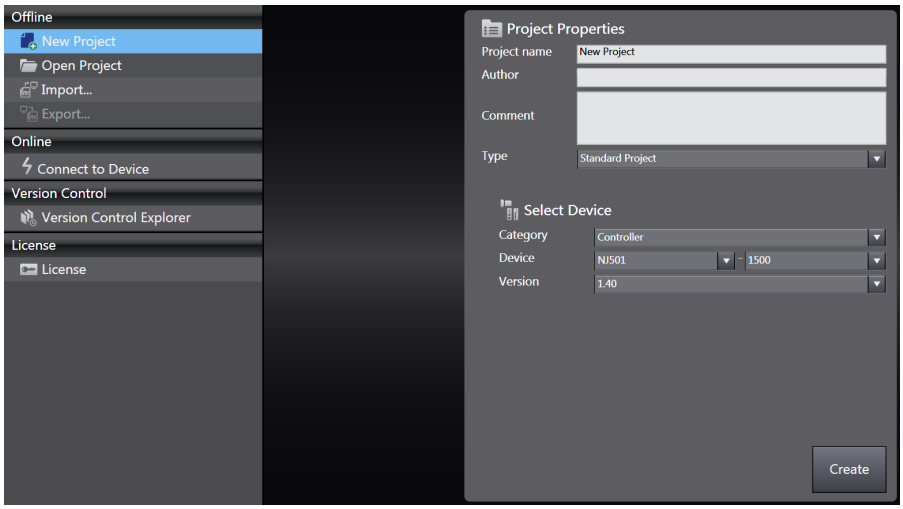


Figure 1-7 Create New Project

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

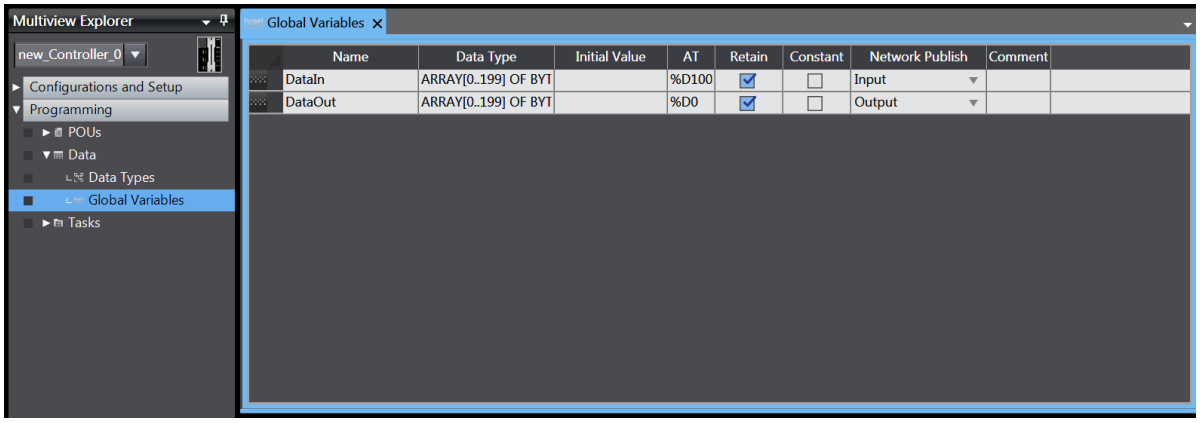


Figure 1-8 Create Global Variables

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.

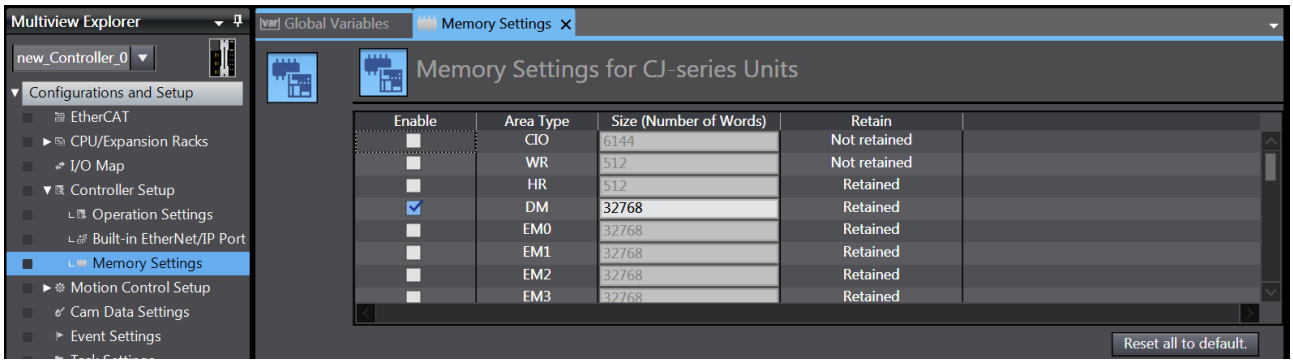


Figure 1-9 Enable DM Area Type

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

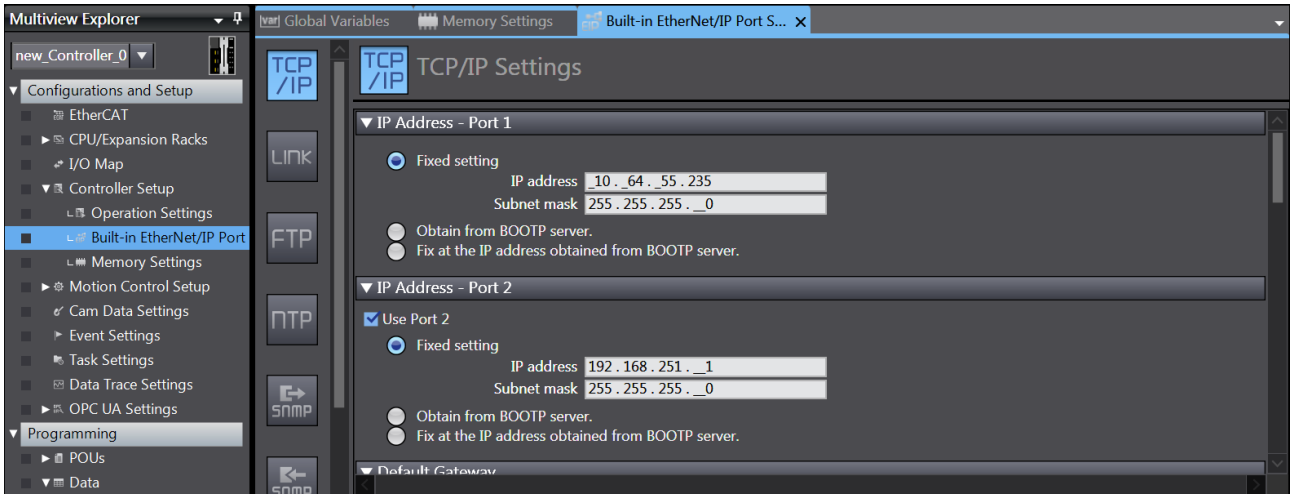


Figure 1-10 Set IP Address

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**.

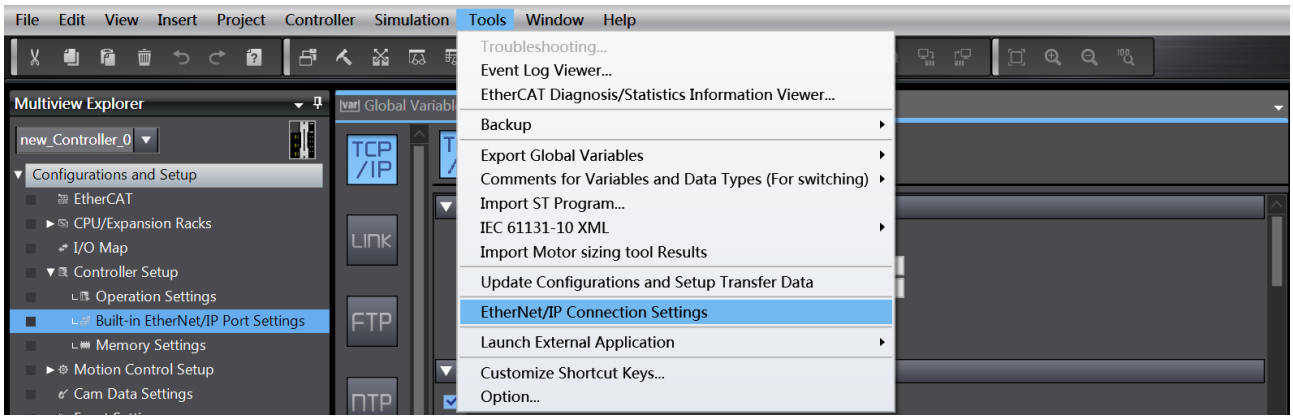


Figure 1-11 Open EtherNet/IP Connection Settings

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

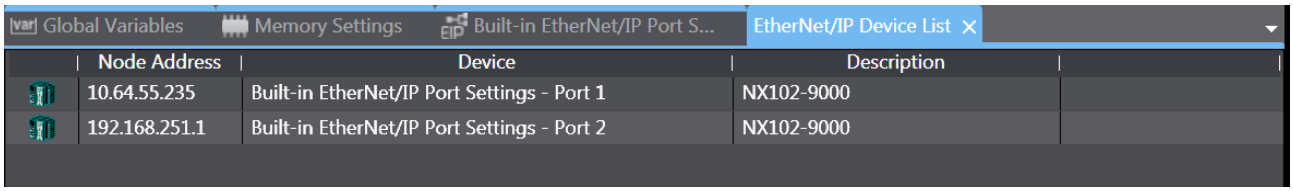


Figure 1-12 EtherNet/IP Device List

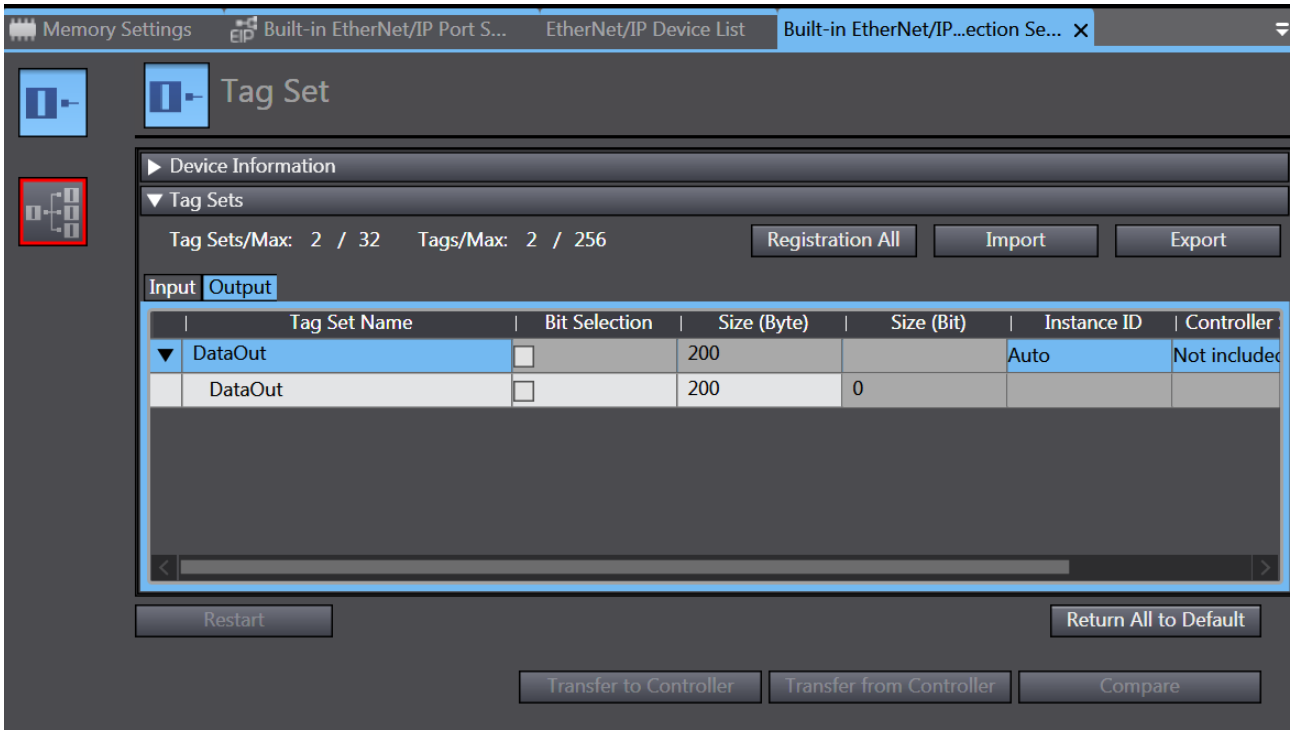


Figure 1-13 Register Global Variables

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

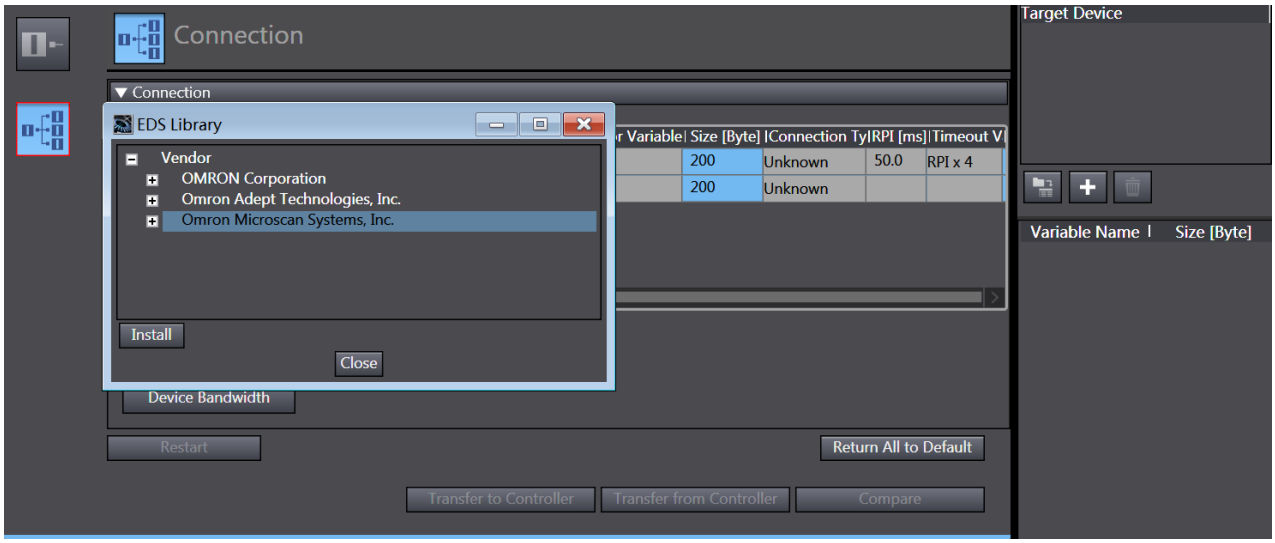


Figure 1-14 Install EDS File

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.

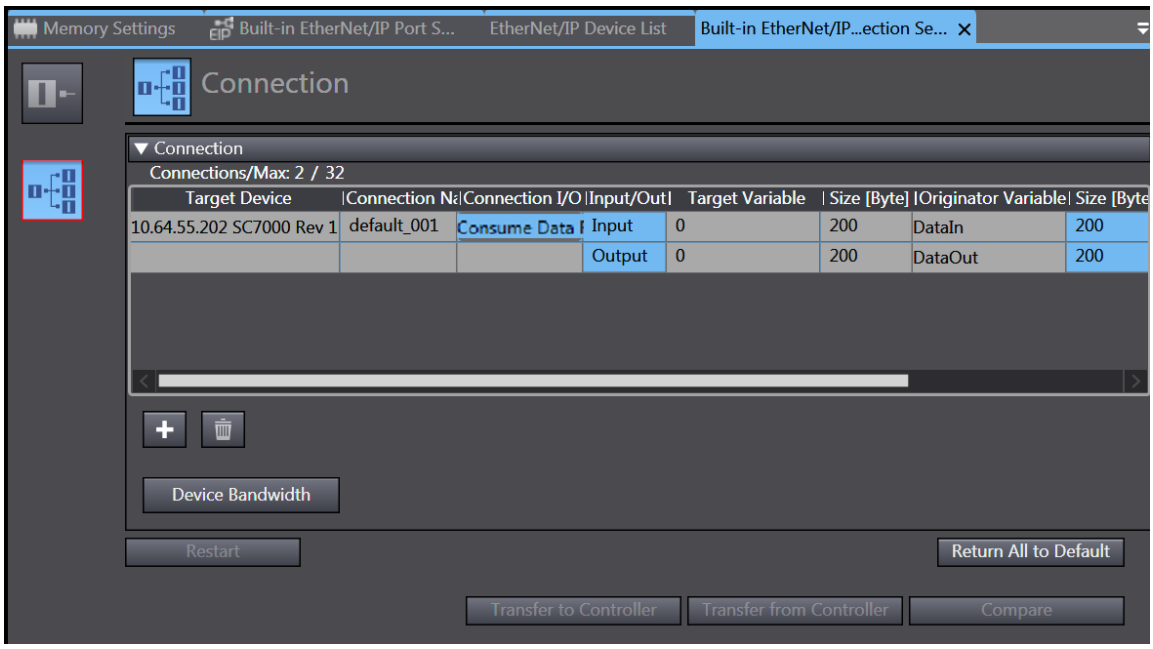


Figure 1-15 Create Target Device

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

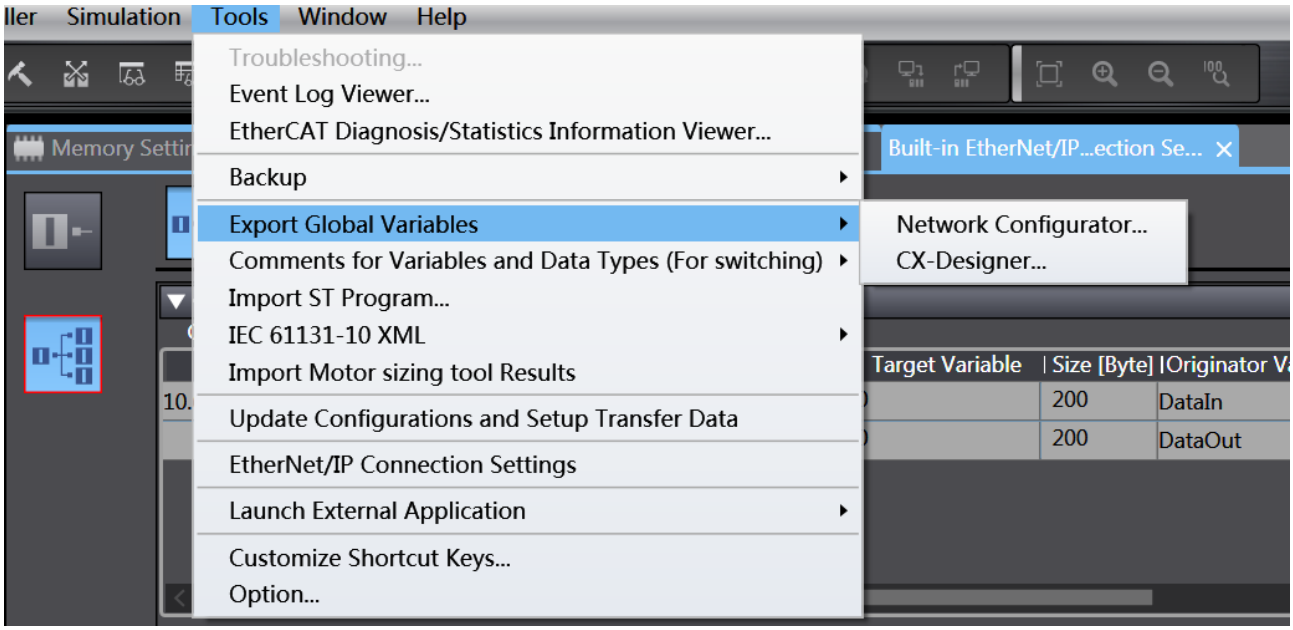


Figure 1-16 Export Global Variable File

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

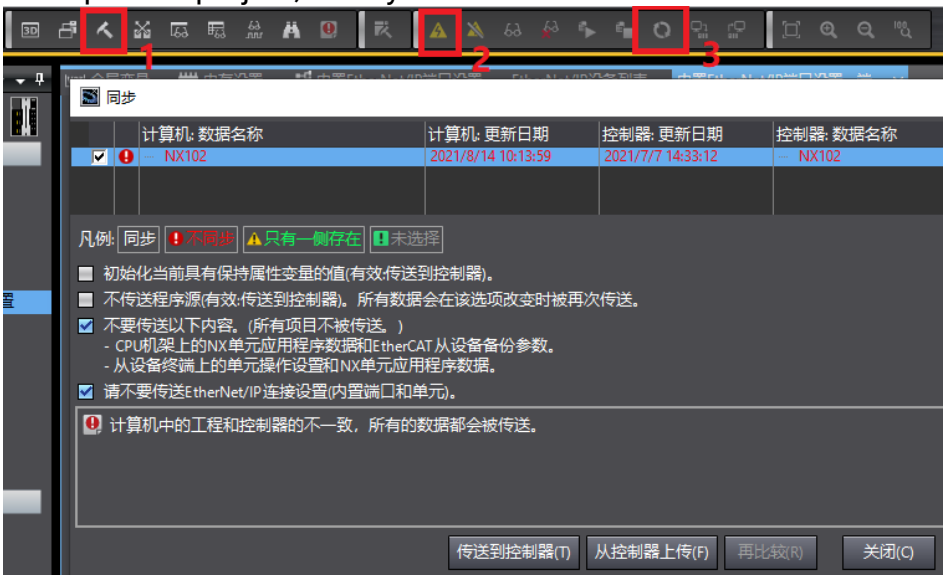


Figure 1-17 Synchronize to the PLC Controller

1.3.2 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.

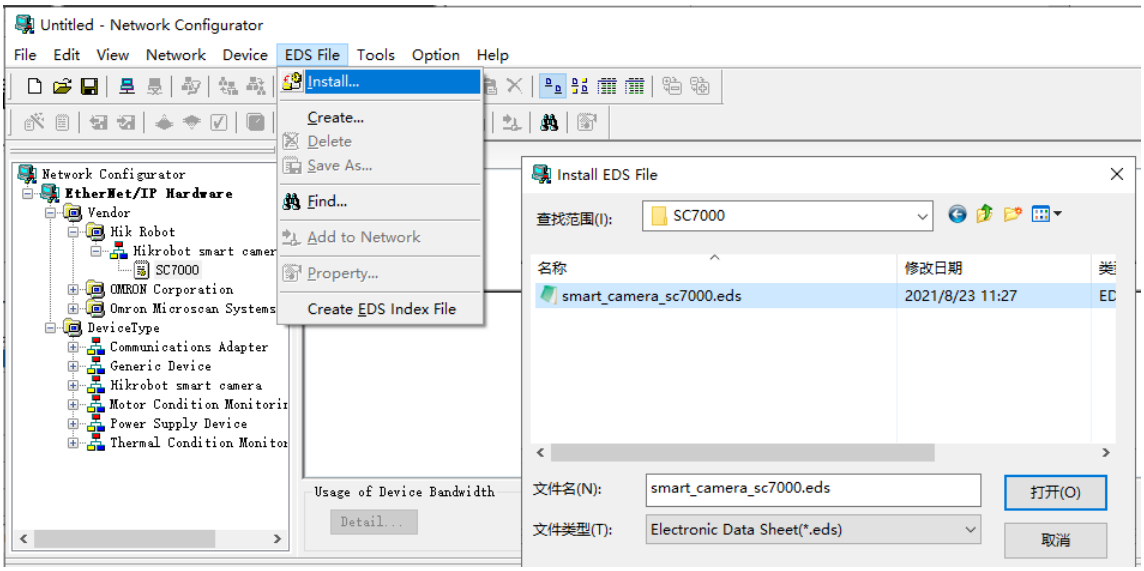


Figure 1-18 Import EDS File

2. Drag in the corresponding PLC controller and the smart camera.
3. Right-click the smart camera to modify its IP address.

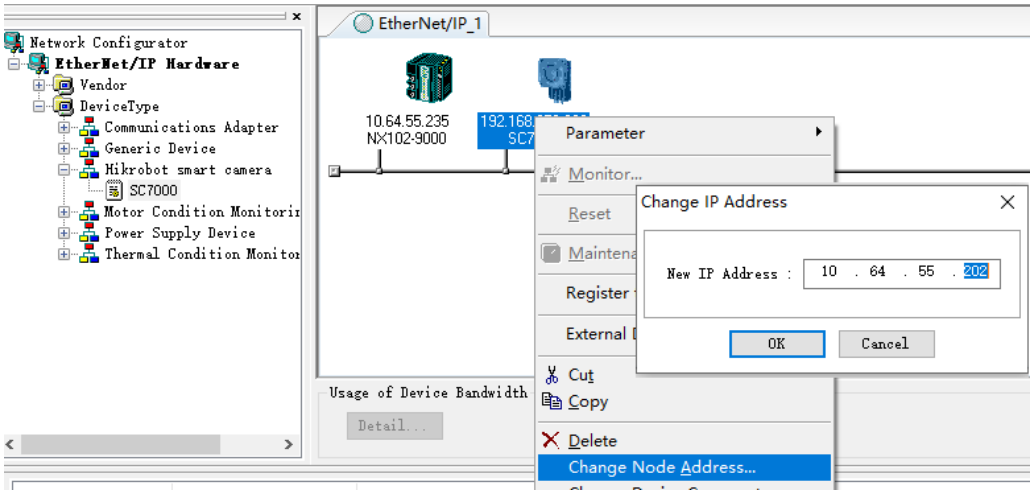


Figure 1-19 Modify IP Address

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.

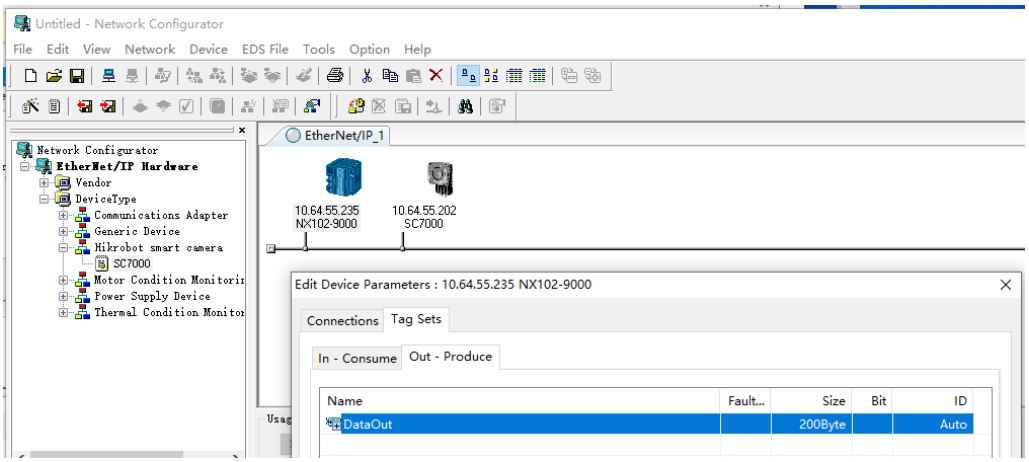


Figure 1-20 Import Global Variables

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**.

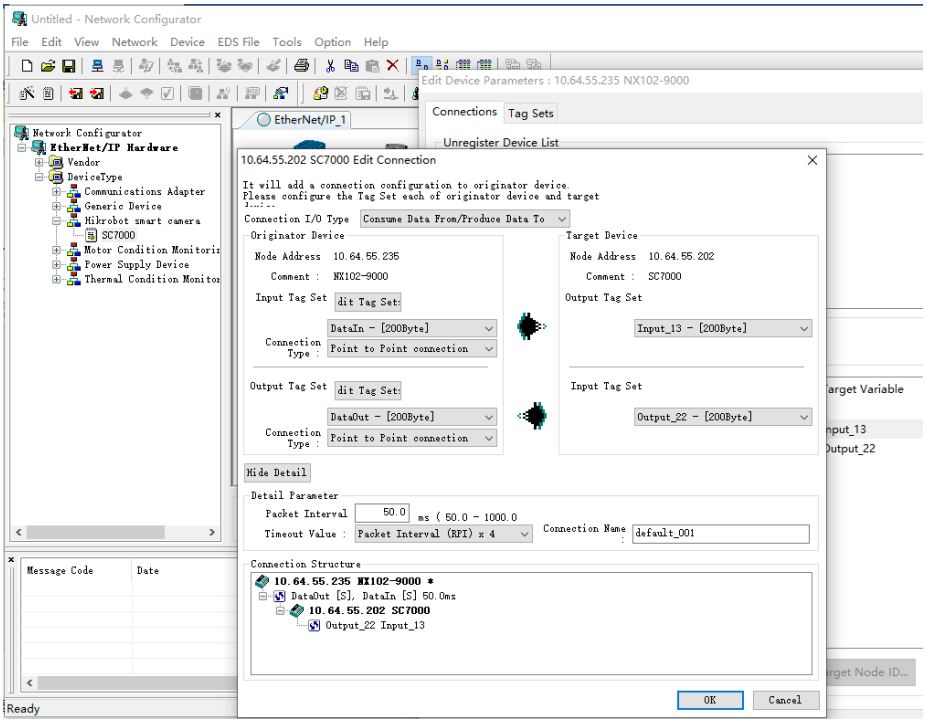


Figure 1-21 Establish Connection

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.

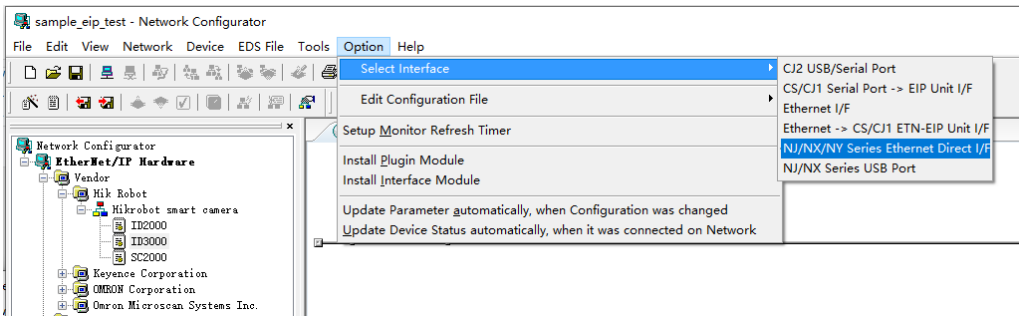


Figure 1-22 Select PLC's Communication Interface Type

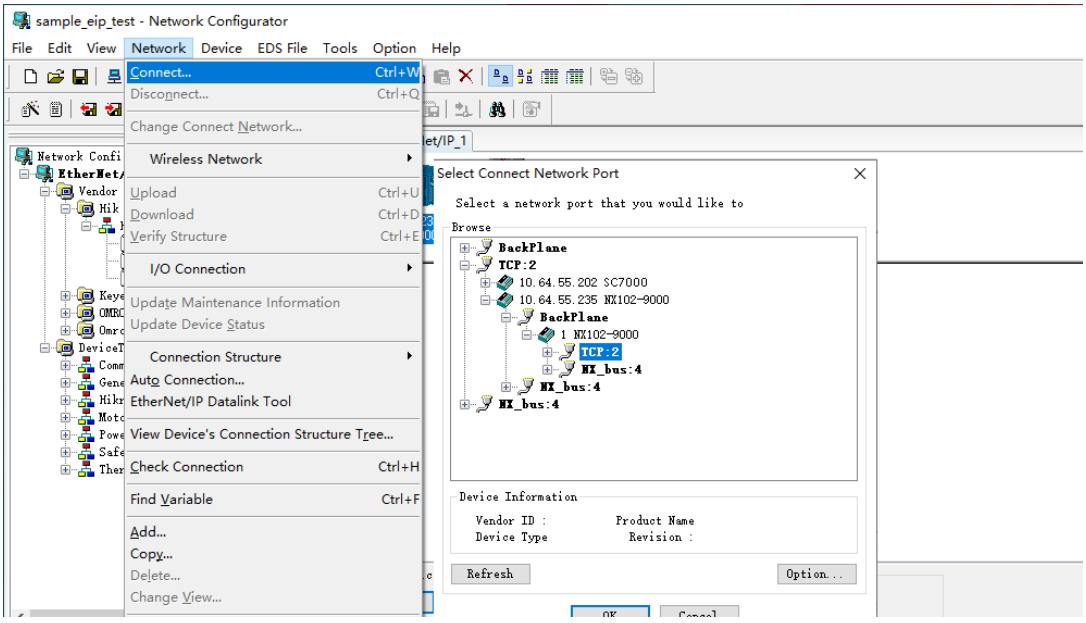


Figure 1-23 Connect to the PLC

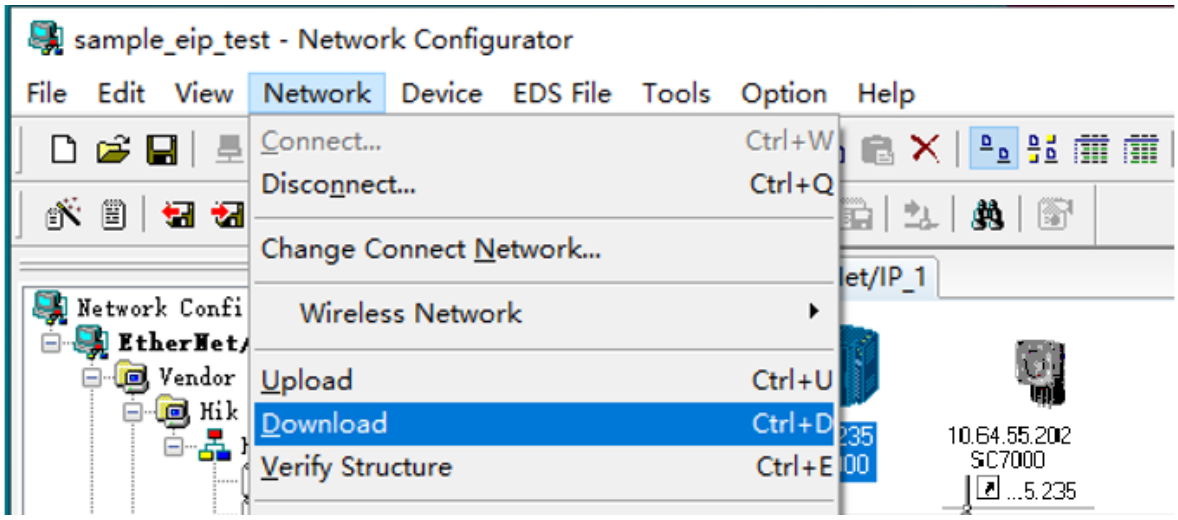


Figure 1-24 Download Configuration to the PLC

1.4 Input and Output Mapping

1.4.1 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					Command failed	Command success	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.
Command Success	Executing communication command succeeded.
Command Failed	Executing communication command failed. This signal can be cleared through Clear Error command.
Result Length	It refers to the length of valid data contained in the result area.
Result Data	It refers to the reading result of the device in ASCII code format of continuous storage. ● 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.

1.4.2 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. ● 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.

1.5 Trigger Test

Communication Sequence Diagram

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

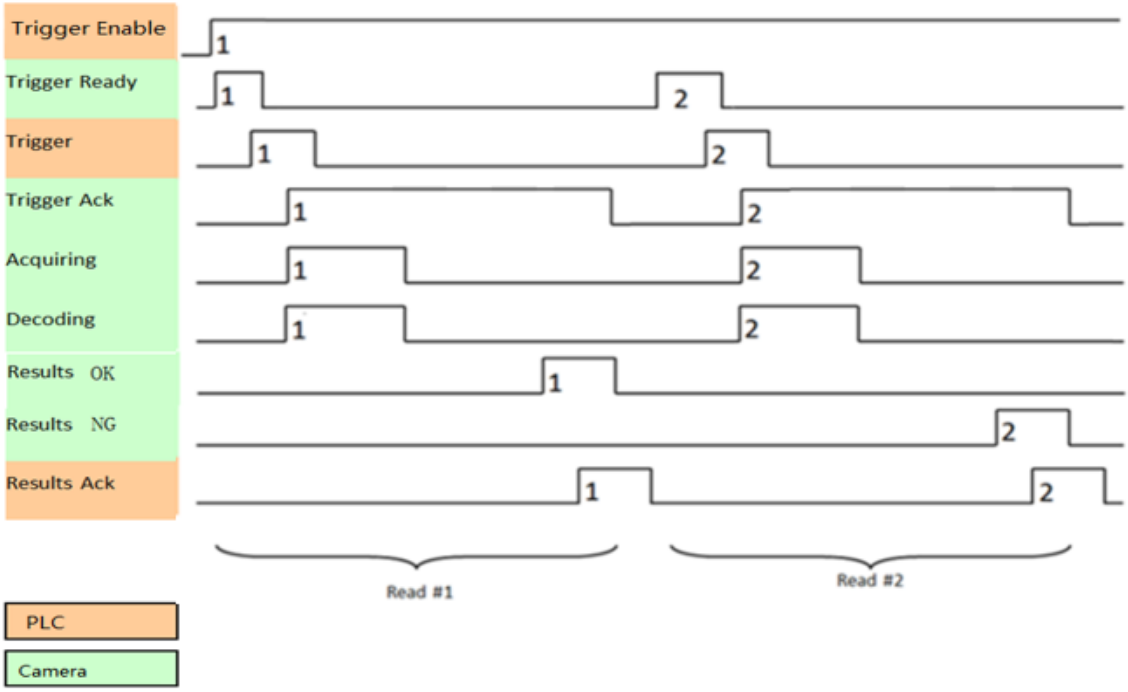


Figure 1-25 Communication Sequence Diagram

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, as shown below.

TriggerEnable	BOOL		%D0.0	☑	☐
Trigger	BOOL		%D0.1	☑	☐
ResultAck	BOOL		%D0.2	☑	☐
ExcuteCommand	BOOL		%D0.8	☑	☐
ClearError	BOOL		%D0.15	☑	☐
UserDataLength	UINT		%D9	☑	☐
UserData	ARRAY[0..179] OF BYTE		%D10	☑	☐
TriggerReady	BOOL		%D101.0	☑	☐
TriggerAck	BOOL		%D101.1	☑	☐
Acquiring	BOOL		%D101.2	☑	☐
Decoding	BOOL		%D101.3	☑	☐
ResultsAvailable	BOOL		%D101.8	☑	☐
ResultsTimeout	BOOL		%D101.9	☑	☐
GeneralFault	BOOL		%D101.15	☑	☐
ResultLength	UINT		%D109	☑	☐
ResultData	ARRAY[0..179] OF BYTE		%D110	☑	☐
UserResultData	ARRAY[0..179] OF BYTE		%D500	☑	☐
UserSwitchTest	BOOL		%D600.0	☑	☐
UserSwitchCommand	STRING[13]	'switch test1'		☑	☑

Figure 1-26 Create Variables

Ladder Diagram

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

- Enable Trigger

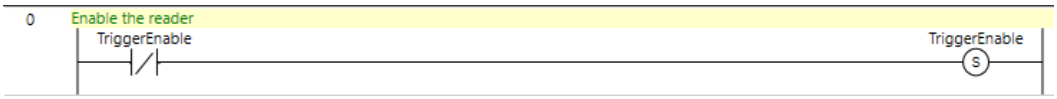


Figure 1-27 Enable Trigger

- 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.

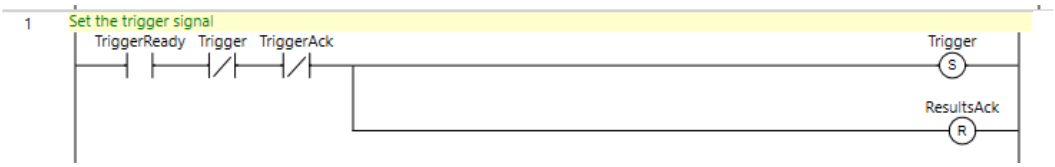


Figure 1-28 Send Trigger Signal

- Clear Trigger Signal

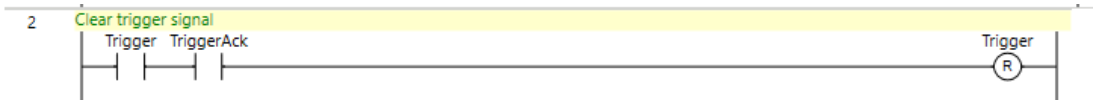


Figure 1-29 Clear Trigger Signal

- 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 result data.

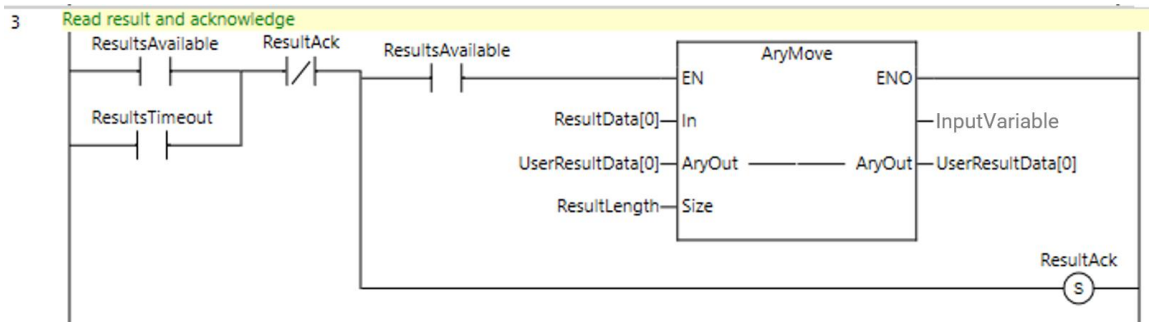


Figure 1-30 Get Device Results

View Results

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.

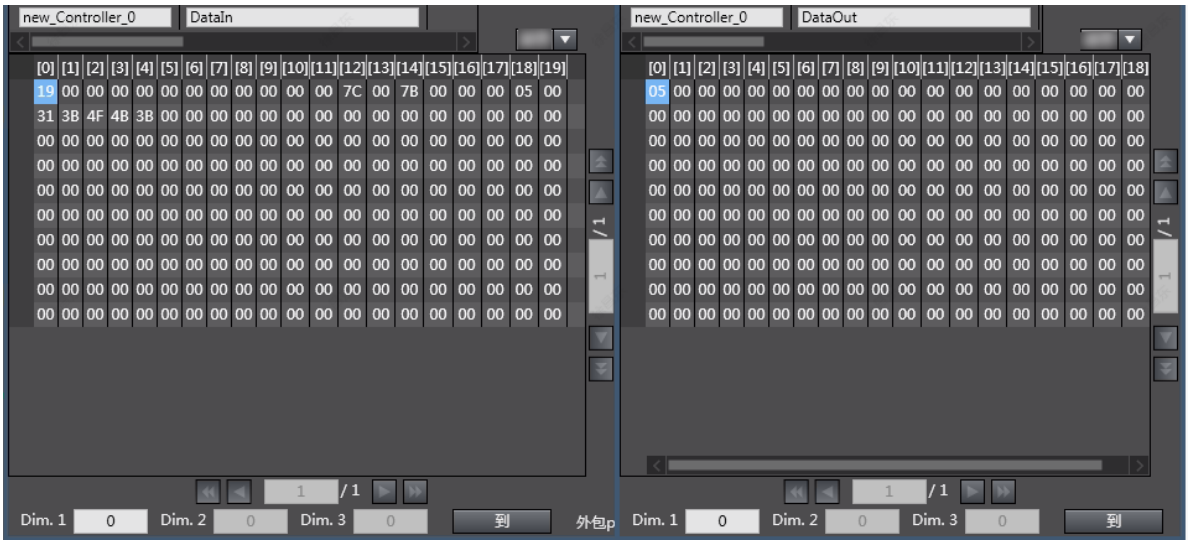


Figure 1-31 View Results

1.6 Project Switching Test

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.

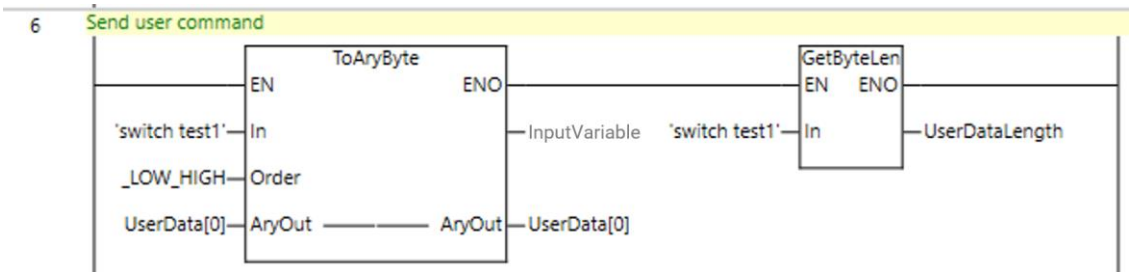


Figure 1-32 Send Switching Command

- 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.

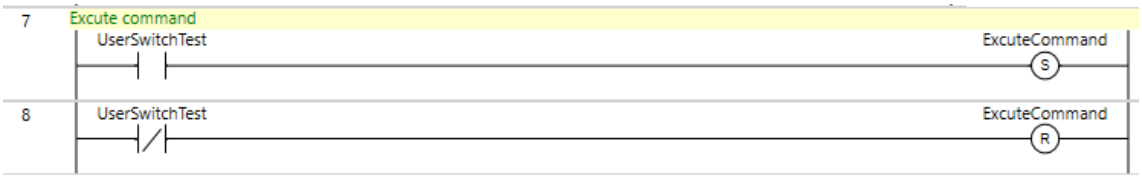


Figure 1-33 Execute Switching Command

1.7 FTP Image Saving Naming Test

The smart camera can receive strings from the PLC via industrial protocols and supports using the strings for FTP image saving names or triggering branches. This section introduces how to use the communication input string to name FTP image saving files.

Steps

1. After settings of the smart camera and PLC, set the camera's **Trigger Source** as **Communication Trigger**, and configure the **Communication String**, for example, **"trig"**.
2. On the SCMVS client software **Communication Settings** page, add **FTP Communication** and set the **FileName Strategy** to **"Subscribe"**, with the **FileName Subscription** set to the communication input string.



Figure 1-34 FTP Communication

3. Click the **Continuous Run** in the upper right area of the image live view pane.
4. Write the string to the user data area. For example, to name the image saving file as "12345678", you need to enter the complete string as "trig 12345678", i.e., write the string length at output mapping area 18, and sequentially write the complete string starting from address 20.
5. At output mapping area 0.0, first write 1 to enable the smart camera's trigger function; then write 1 at address 1.0 to execute the user data area command. This will trigger the camera once and save the image with the filename "12345678 + timestamp".

Chapter 2 PROFINET

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

- Here we take 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.
- For SC5000X series and SC6000 series smart cameras, you can scan the QR code below to view details about data communication with PLC via PROFINET.

Figure 2-1 Communication Protocol for Vision Master 4.4.30

2.1 Hardware Wiring

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

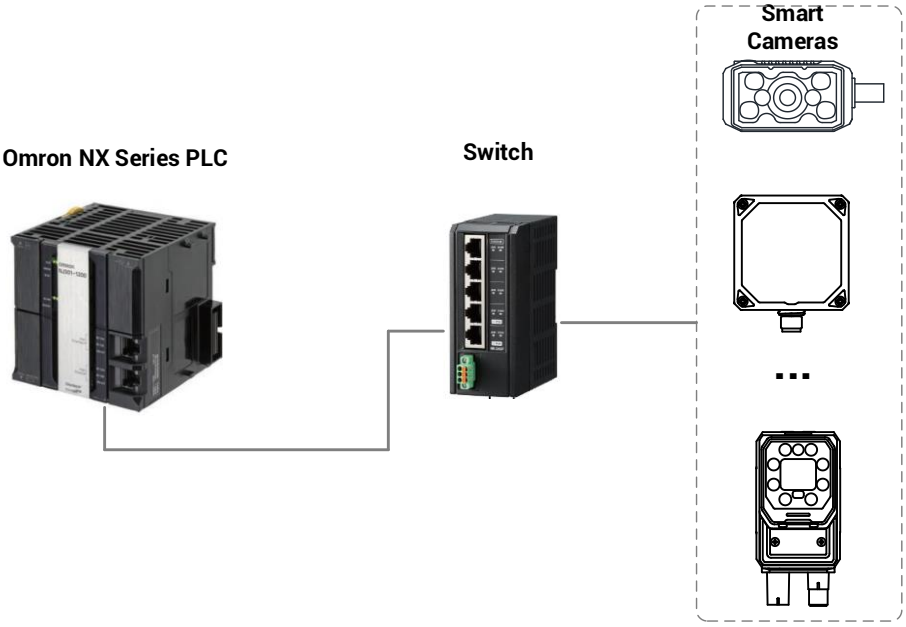


Figure 2-2 Hardware Wiring

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.

2.2 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 SC5000X series and SC6000 series smart camera, you need to operate it via the embedded VM, 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.

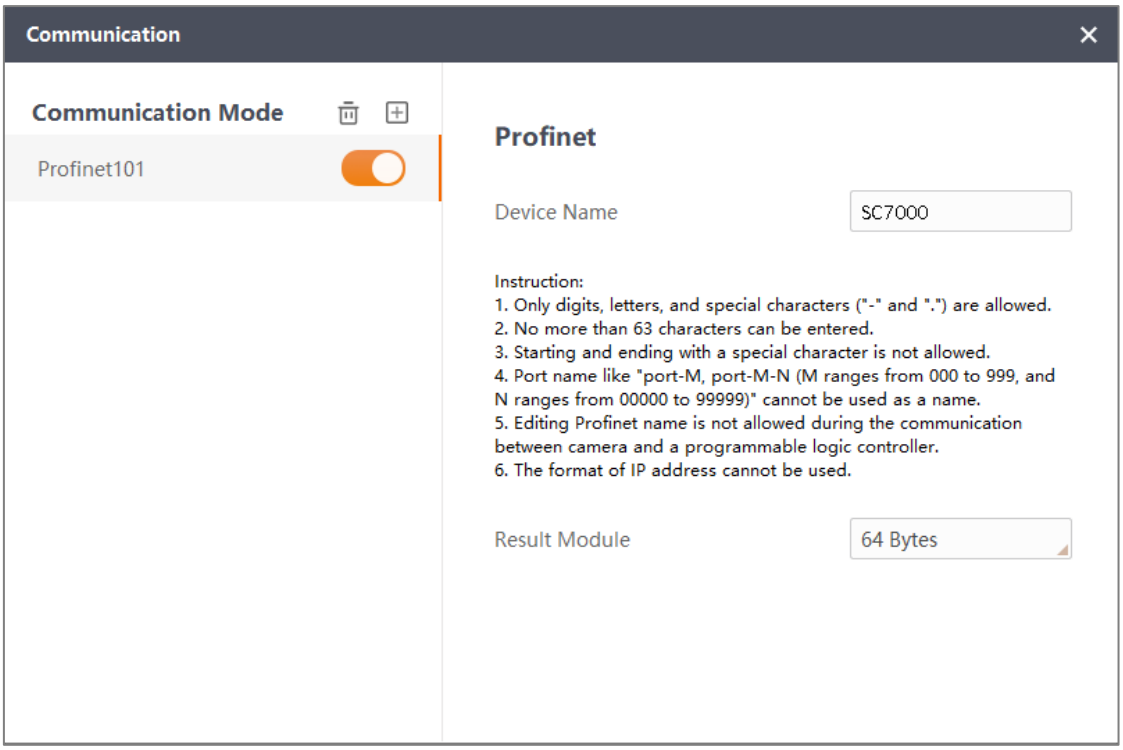


Figure 2-3 Set Communication Parameters

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.

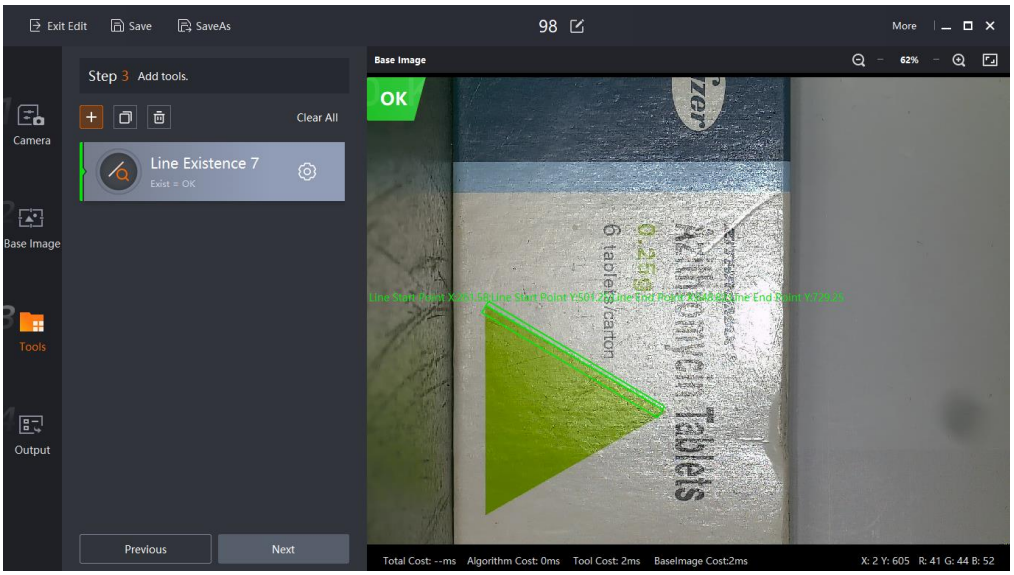


Figure 2-4 Line Existence

Note

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

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

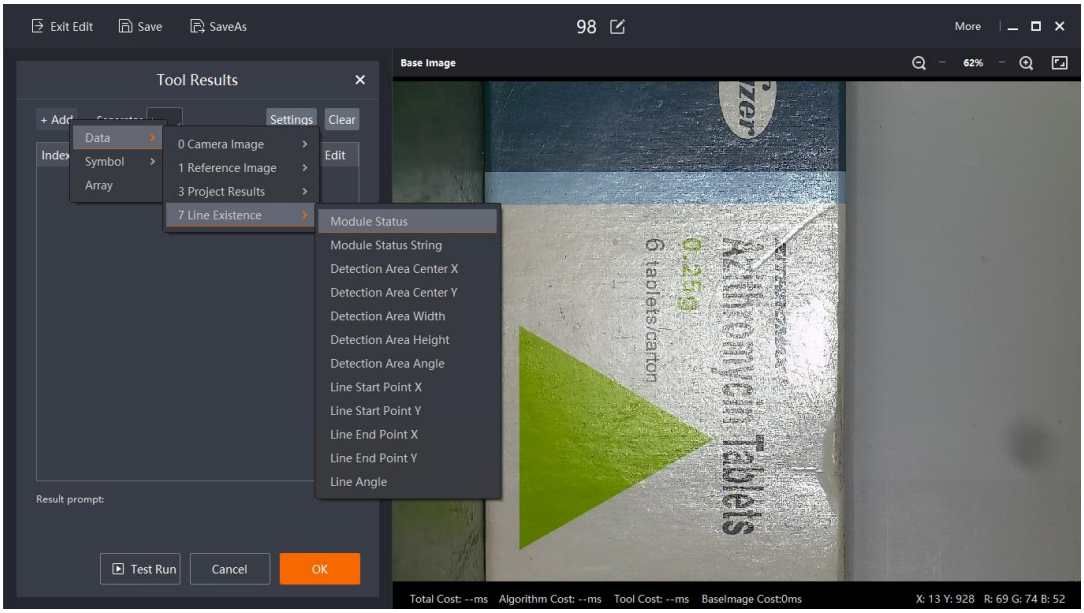


Figure 2-5 Set Tool Results

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.

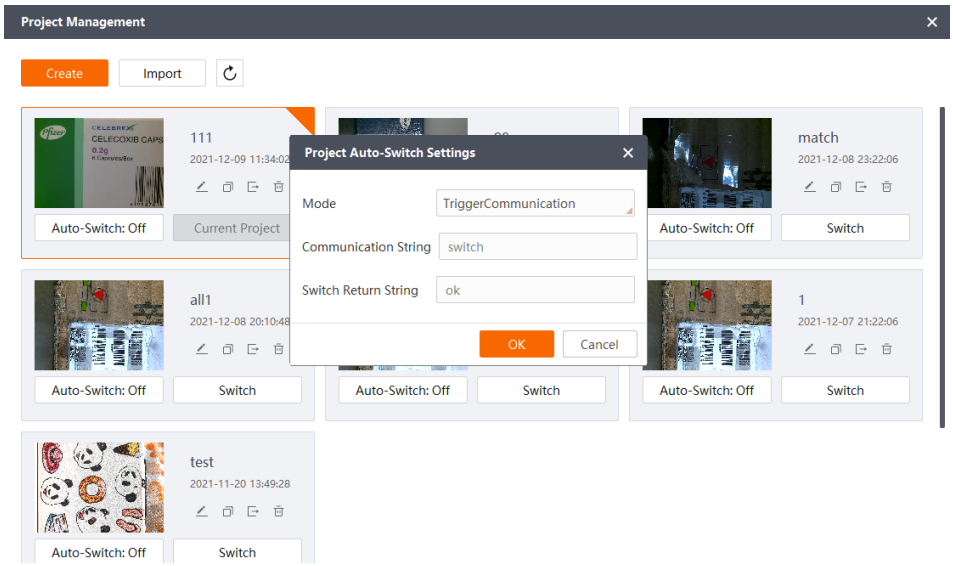


Figure 2-6 Project Switch Settings

2.3 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**.

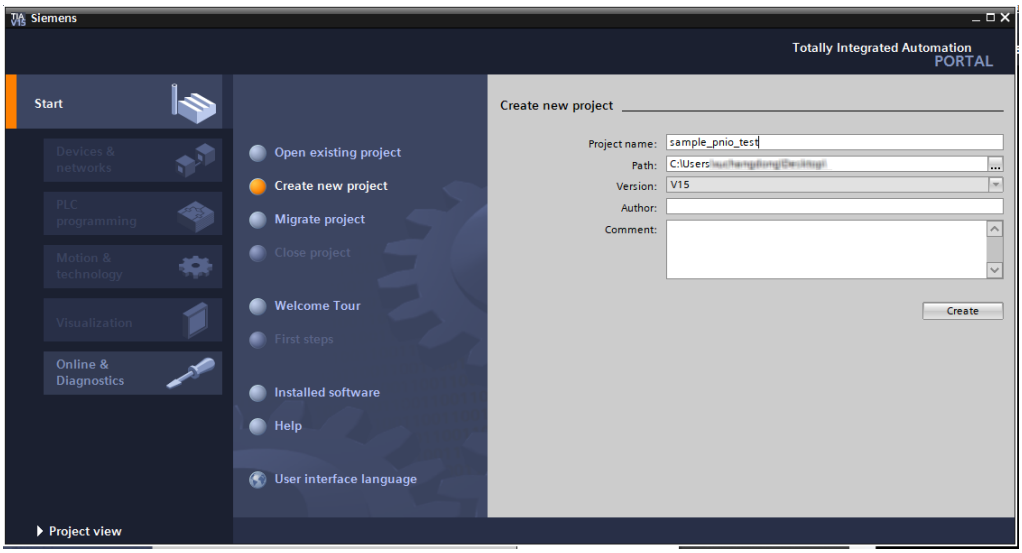


Figure 2-7 Create New Project

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

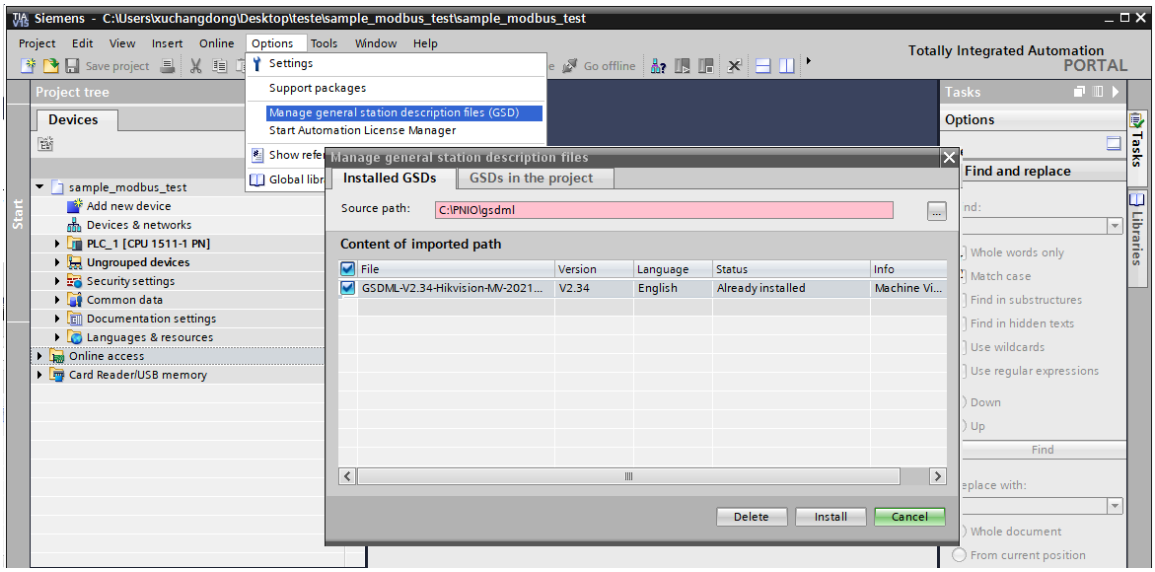


Figure 2-8 Install GSDs

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

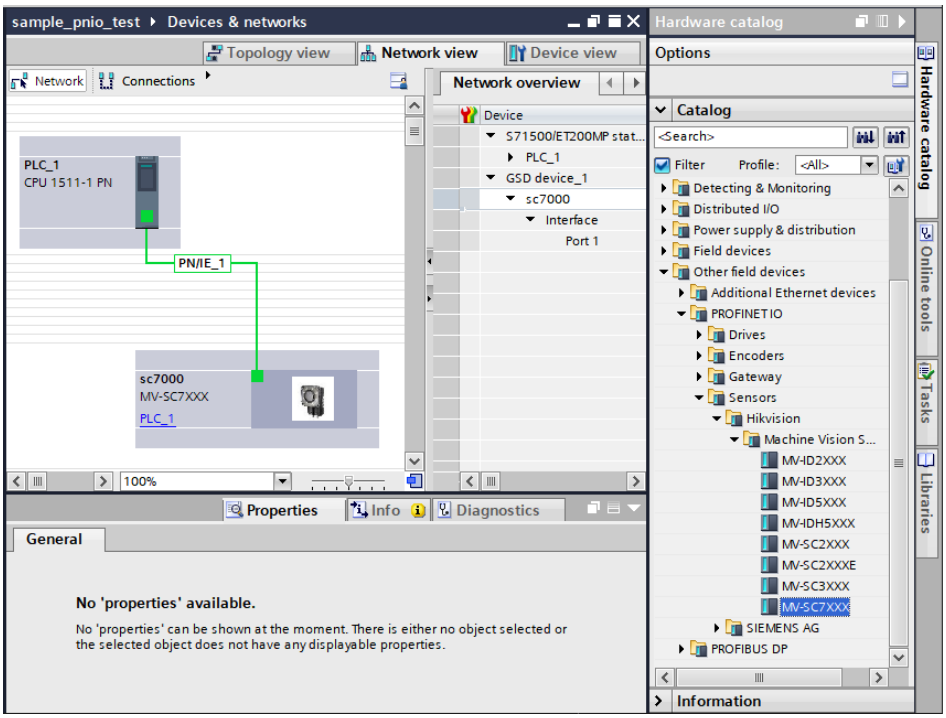


Figure 2-9 Select Device

5. Double-click the device to set its name.

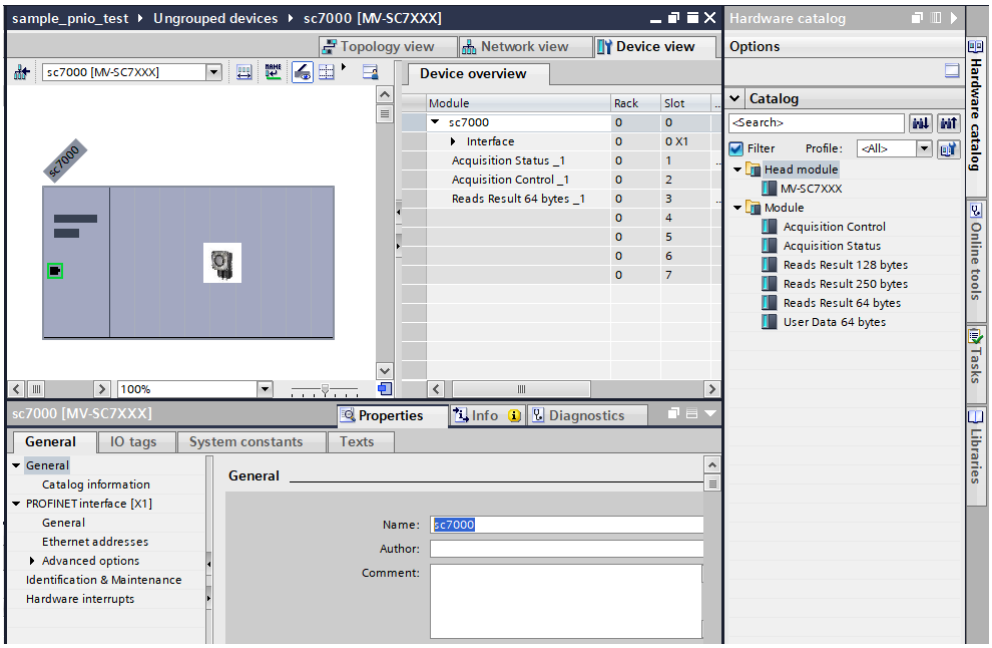


Figure 2-10 Set Device Name

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.

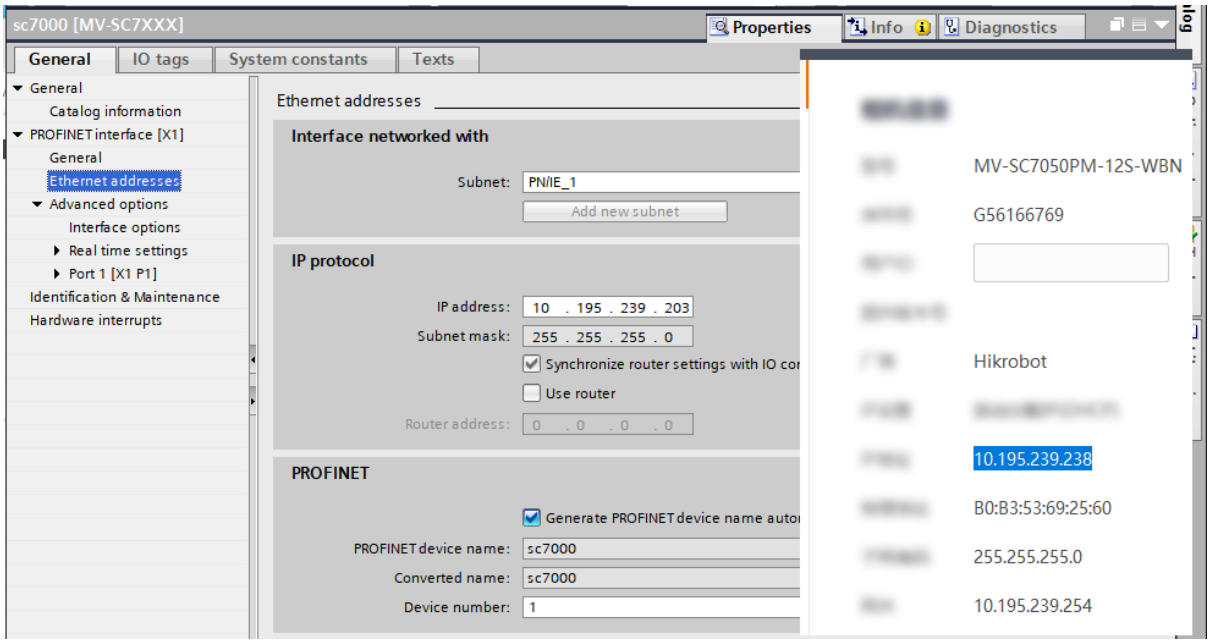


Figure 2-11 Set IP Address

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.

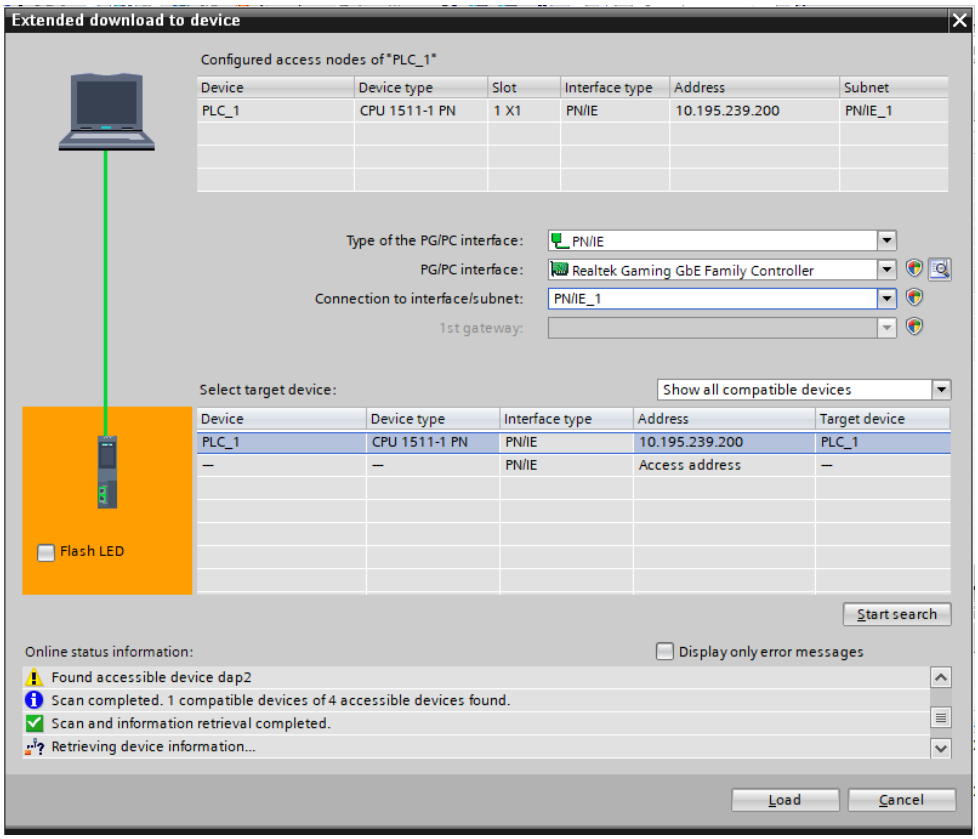


Figure 2-12 Load PLC Program

2.4 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	Command Success	Executing communication command succeeded.
7	General Fault	An internal error occurred, such as a command execution error or the PLC sending an incorrect command, and this position is set to 1.

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. ● 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. ● 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. ● 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. ● 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.

2.5 Trigger Test

Communication Sequence Diagram

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

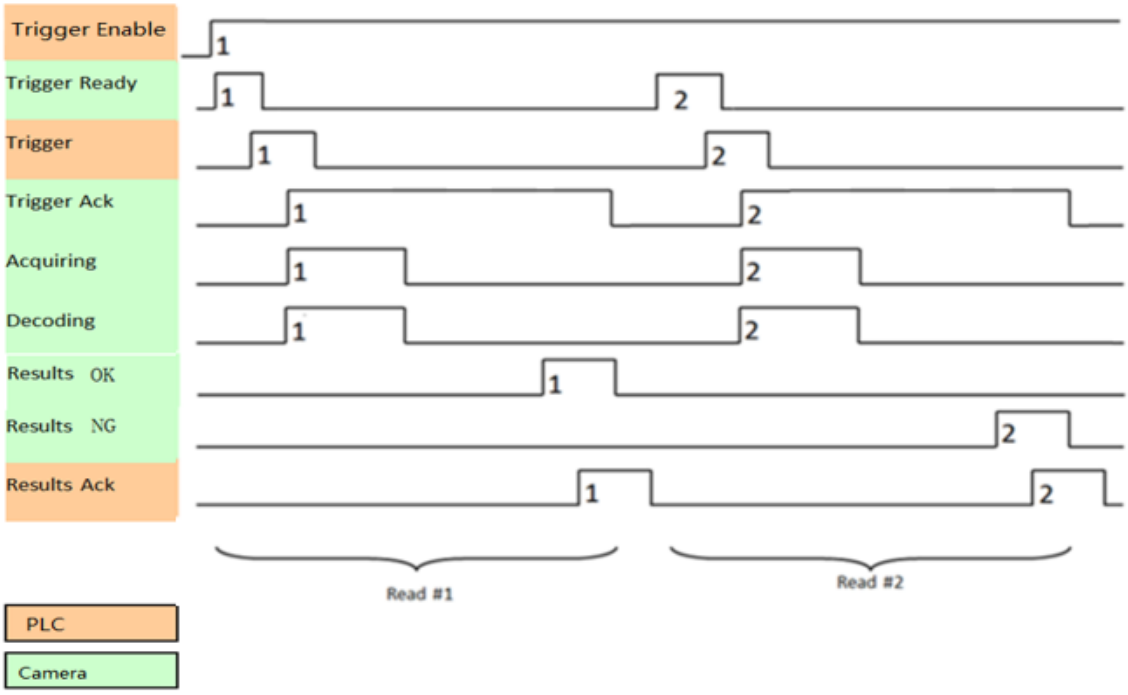


Figure 2-13 Communication Sequence Diagram

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.

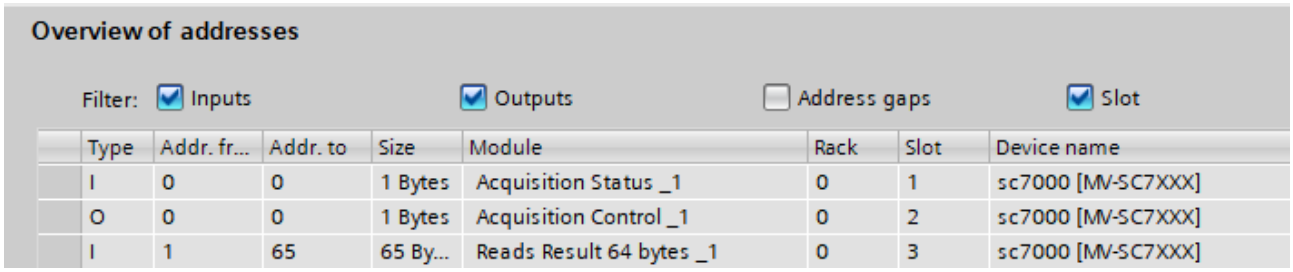


Figure 2-14 Overview of Address

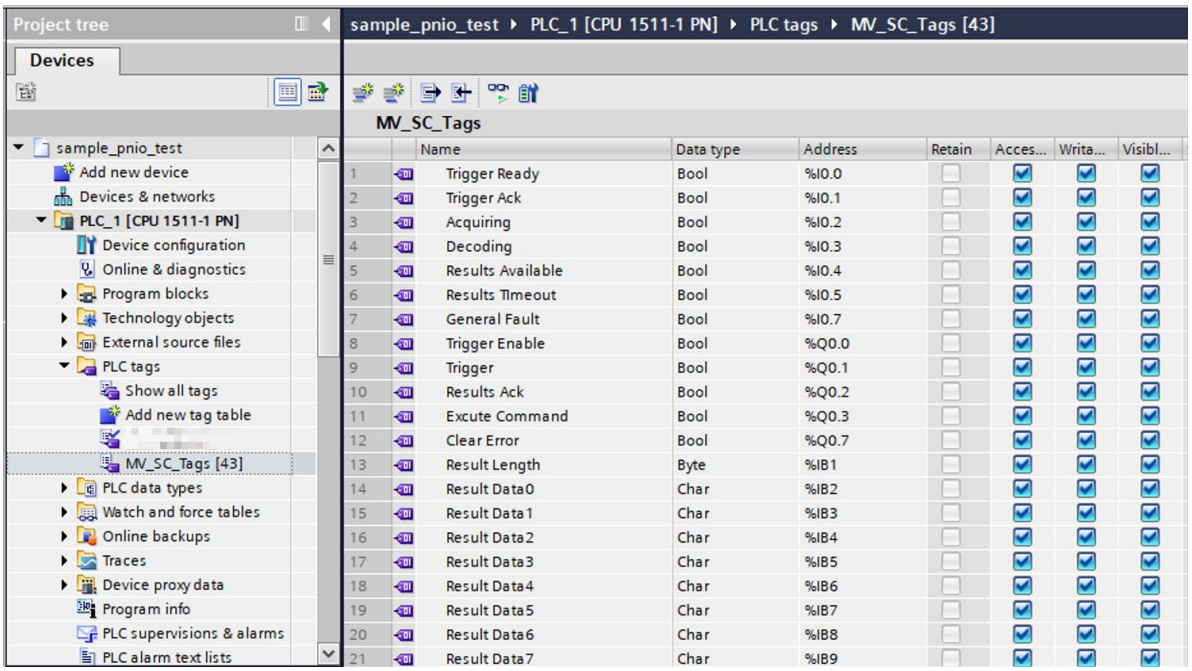


Figure 2-15 Create PLC Variable

Ladder Diagram

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

- Enable Trigger

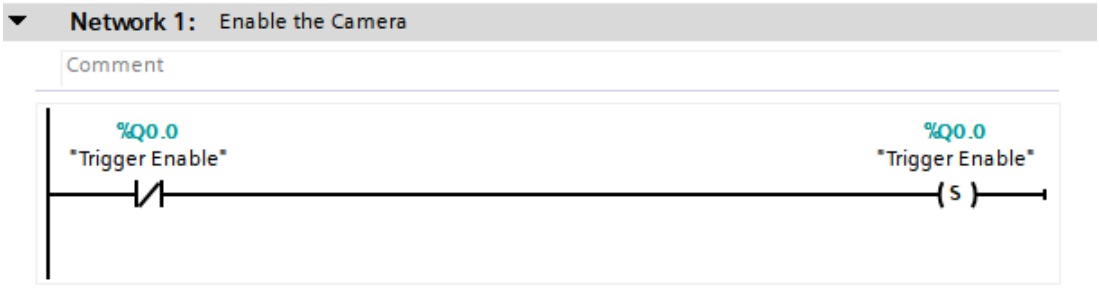


Figure 2-16 Enable Camera

- 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.

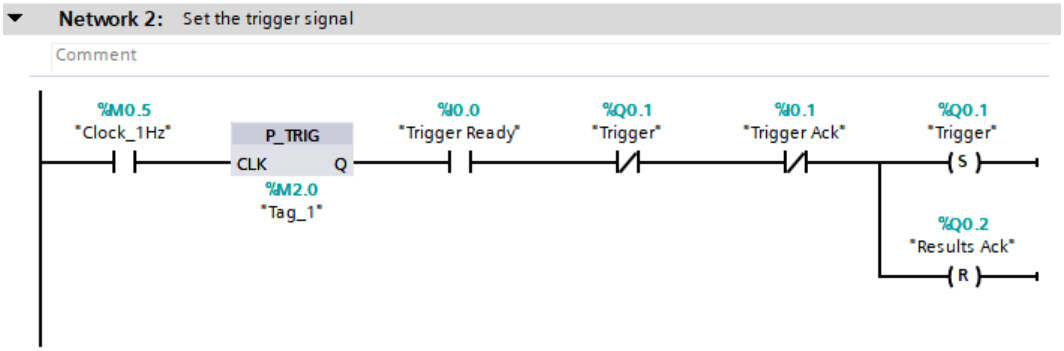


Figure 2-17 Send Trigger Signal

- Clear Trigger Signal

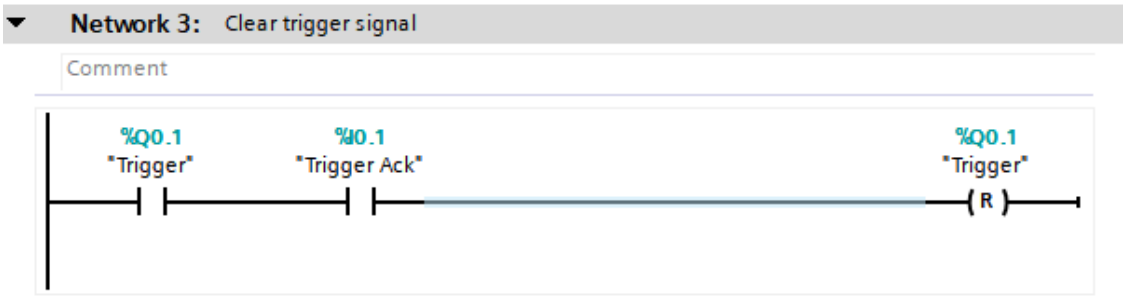


Figure 2-18 Clear Trigger Signal

- 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.

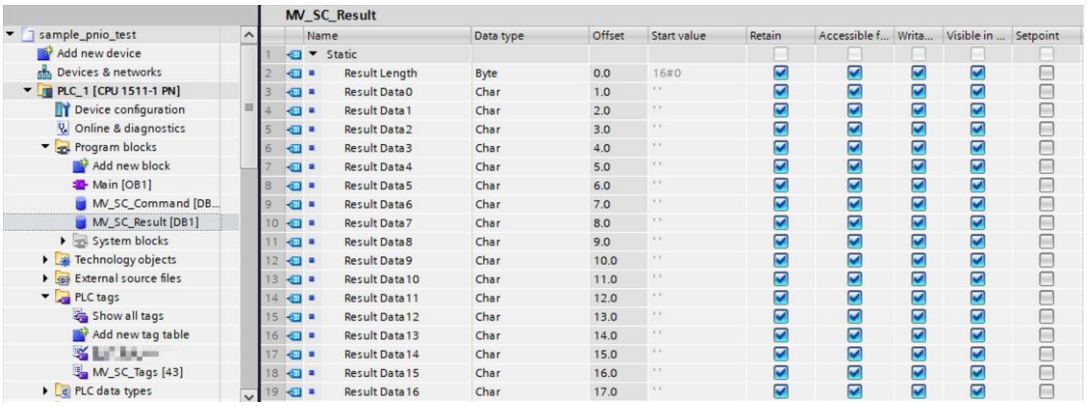


Figure 2-19 Add Result Data Block

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.

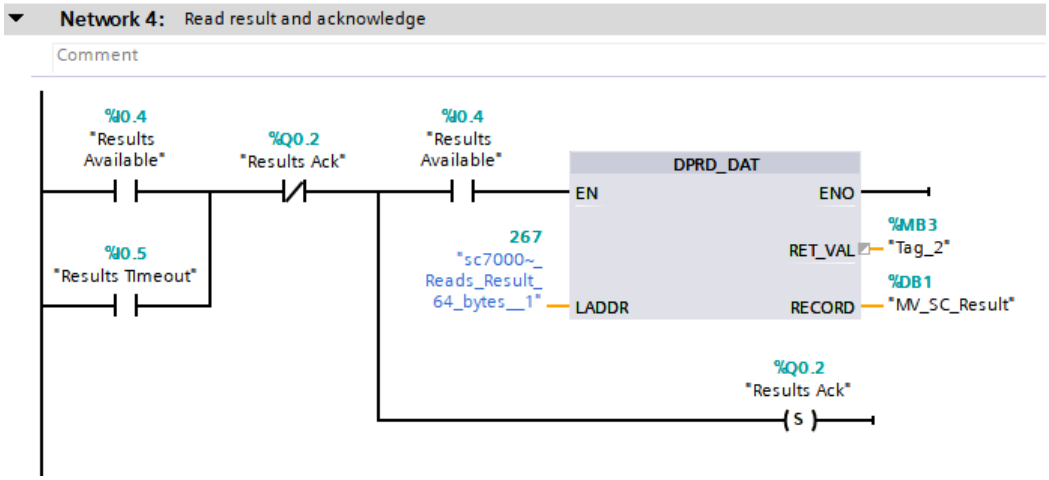
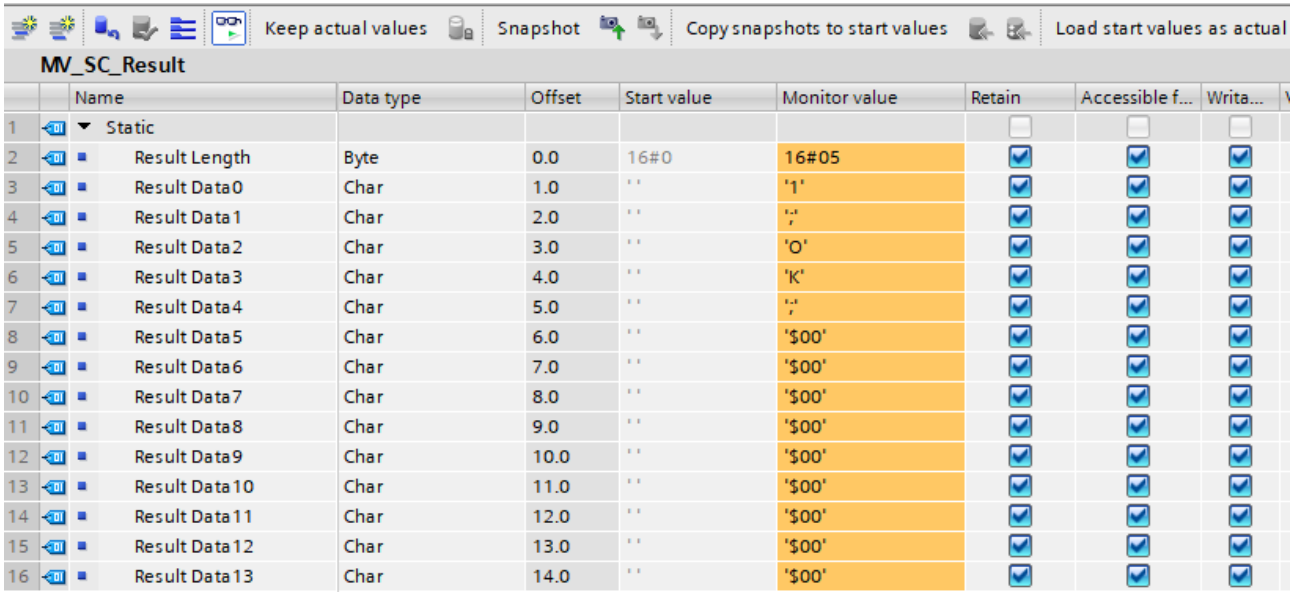


Figure 2-20 Get Results

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.



Keep actual values | Snapshot | Copy snapshots to start values | Load start values as actual

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			
3	Result Data0	Char	1.0	' '	'1'			
4	Result Data1	Char	2.0	' '	';'			
5	Result Data2	Char	3.0	' '	'O'			
6	Result Data3	Char	4.0	' '	'K'			
7	Result Data4	Char	5.0	' '	';'			
8	Result Data5	Char	6.0	' '	'$00'			
9	Result Data6	Char	7.0	' '	'$00'			
10	Result Data7	Char	8.0	' '	'$00'			
11	Result Data8	Char	9.0	' '	'$00'			
12	Result Data9	Char	10.0	' '	'$00'			
13	Result Data10	Char	11.0	' '	'$00'			
14	Result Data11	Char	12.0	' '	'$00'			
15	Result Data12	Char	13.0	' '	'$00'			
16	Result Data13	Char	14.0	' '	'$00'			

Figure 2-21 View Results

2.6 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.

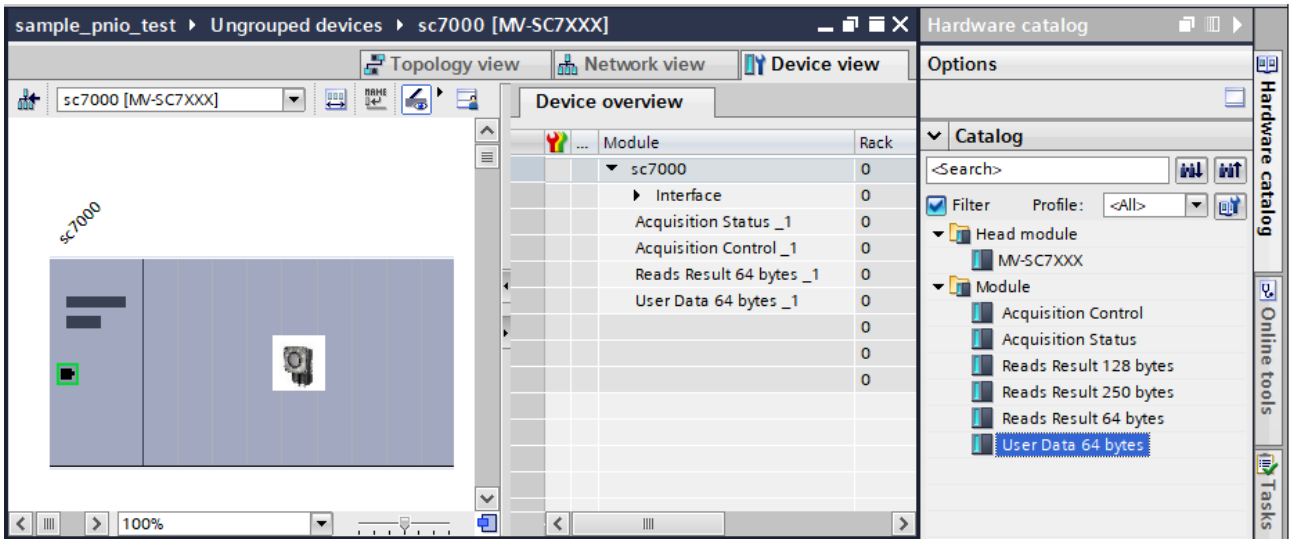


Figure 2-22 Add User Data Module

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.

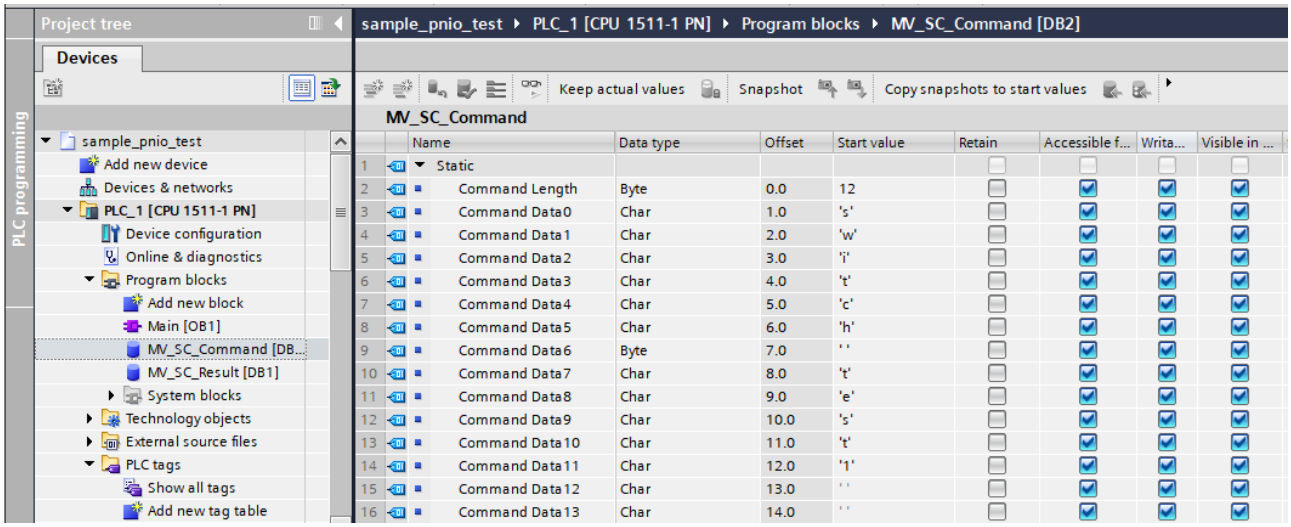


Figure 2-23 Add Command Data Block

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.

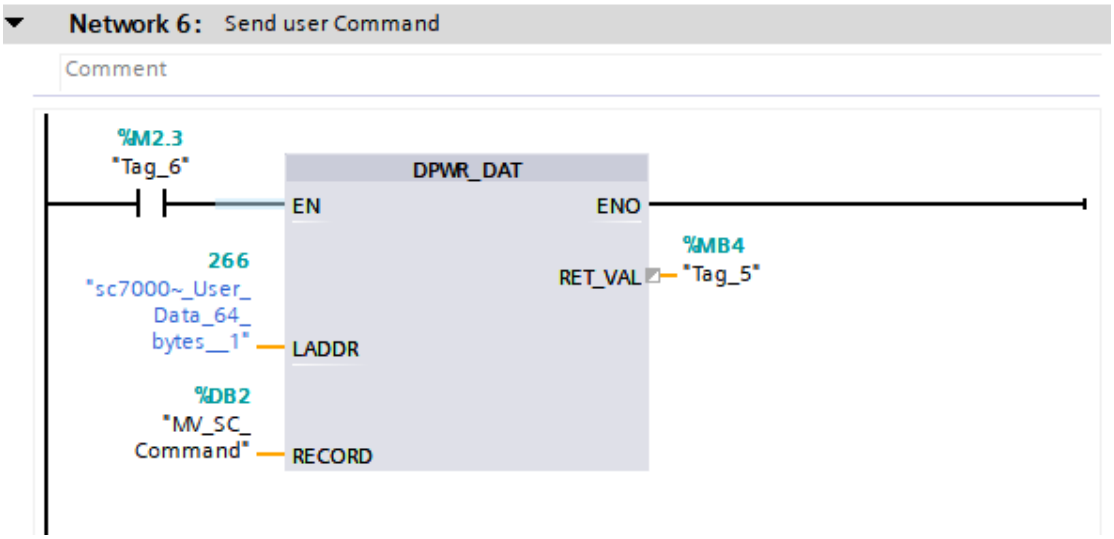


Figure 2-24 Send Switching Command

- Execute Switching Command

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

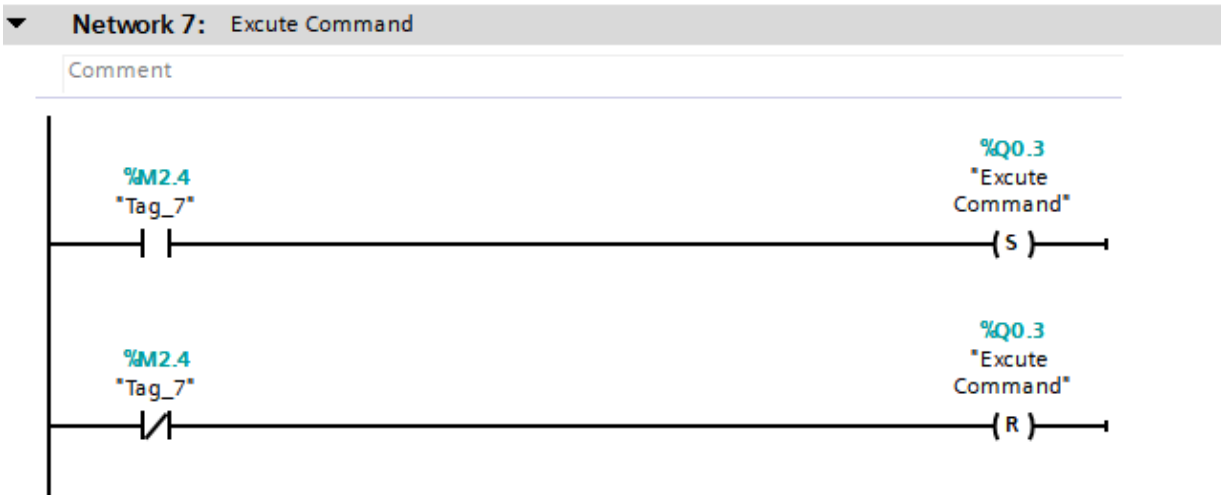


Figure 2-25 Execute Switching Command

2.7 FTP Image Saving Naming Test

The smart camera can receive strings from the PLC via industrial protocols and supports using the strings for FTP image saving names or triggering branches. This section

introduces how to use the communication input string to name FTP image saving files.

Steps

1. After settings of the smart camera and PLC, set the camera's **Trigger Source** as **Communication Trigger**, and configure the **Communication String**, for example, **"trig"**.
2. On the SCMVS client software **Communication Settings** page, add **FTP Communication** and set the **FileName Strategy** to **"Subscribe"**, with the **FileName Subscription** set to the communication input string.



Figure 2-26 FTP Communication

3. Click the **Continuous Run** in the upper right area of the image live view pane.
4. Write the string in the command area. For example, to name the image saving file as "12345678", you need to enter the complete string as "trig 12345678", i.e., write the string length at output mapping area 0, and sequentially write the complete string starting from address 1.
5. At control module 0, first write 1 to enable the smart camera's trigger function; then write 1 at address 3 to execute the command area. This will trigger the camera once and save the image with the filename "12345678 + timestamp".

Chapter 3 Modbus

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.
Modbus protocol has two different implementation methods. Differences between the two are shown below.

Table 3-1 Comparison of Modbus Protocol Implementation Methods

Implementation Methods	Modbus TCP	Modbus RTU
Protocol Stack	TCP/IP-based (Ethernet)	Serial Communication-based (RS-232/485)
Standard	Modbus Messaging on TCP/IP	Modbus over Serial Line
Port	Default Port 502	None (Physical Serial Port)
Transmission Speed	Fast (100 Mbit/s or 1000 Mbit/s)	Slow (Typ. ≤ 115.2 kbps)

Modbus protocol adopts the Modbus TCP implementation method. Because the device only has one RS-232 communication serial port, which supports point-to-point connections with the PC, and cannot support multiple serial communications, while Modbus TCP offers faster transmission speeds.

Note

Here we take 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.

3.1 Hardware Wiring

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

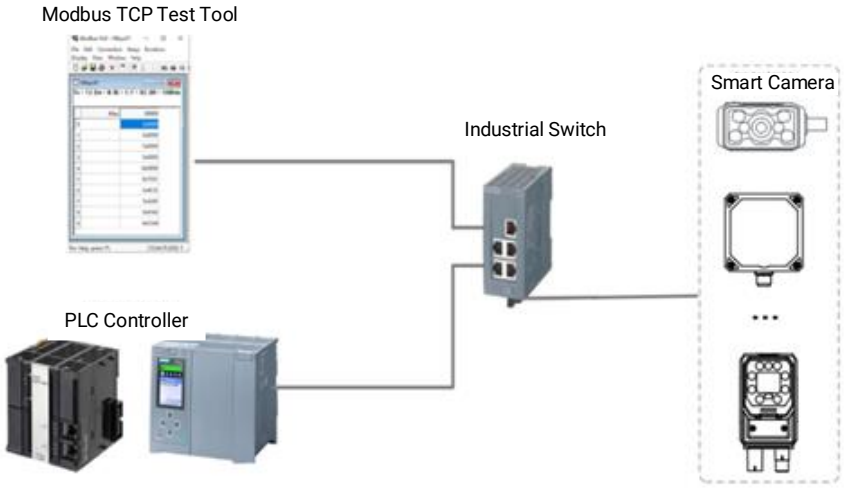


Figure 3-1 Hardware Wiring

3.2 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 SC5000X series and SC6000 series smart camera, you need to operate it via the embedded VM, 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.

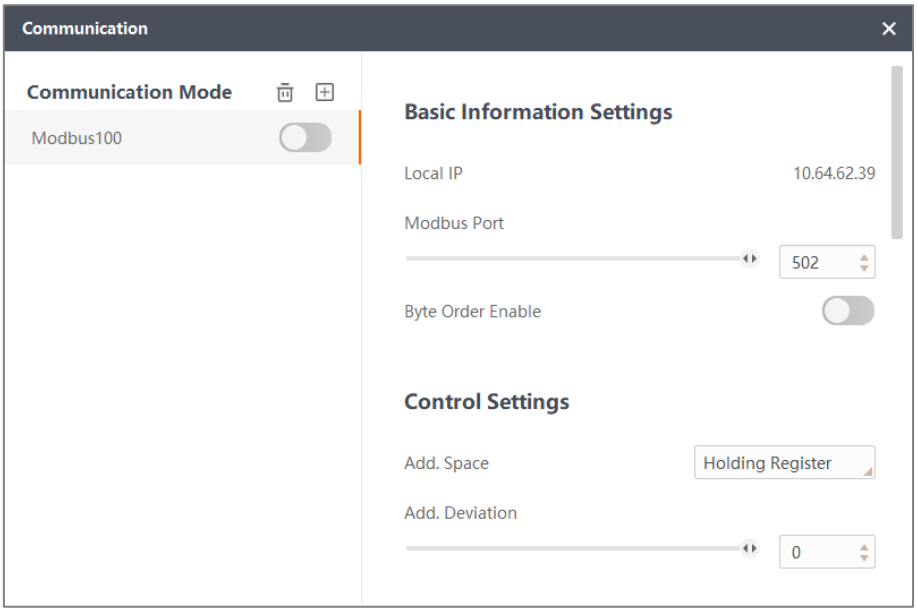


Figure 3-2 Modbus Communication Settings

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.

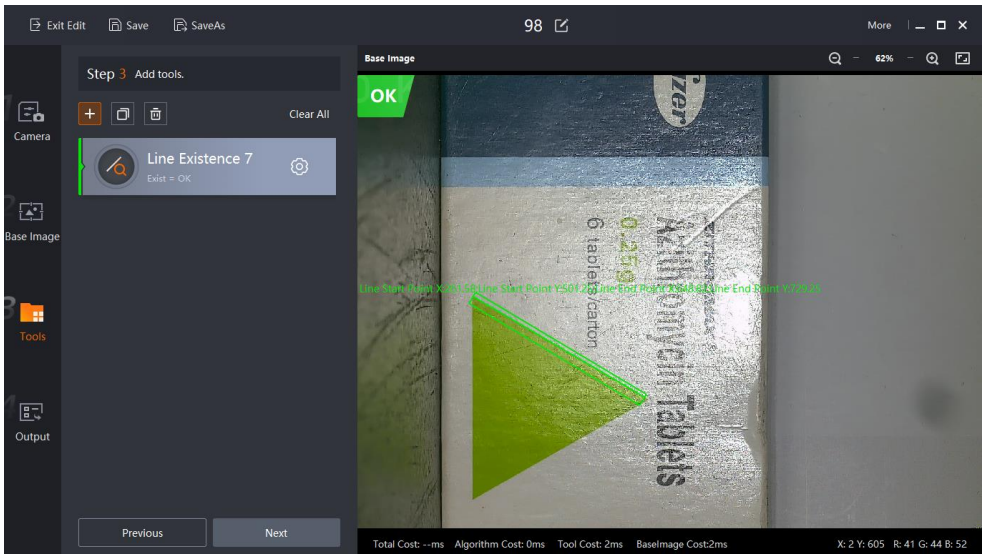


Figure 3-3 Line Existence

Note

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

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

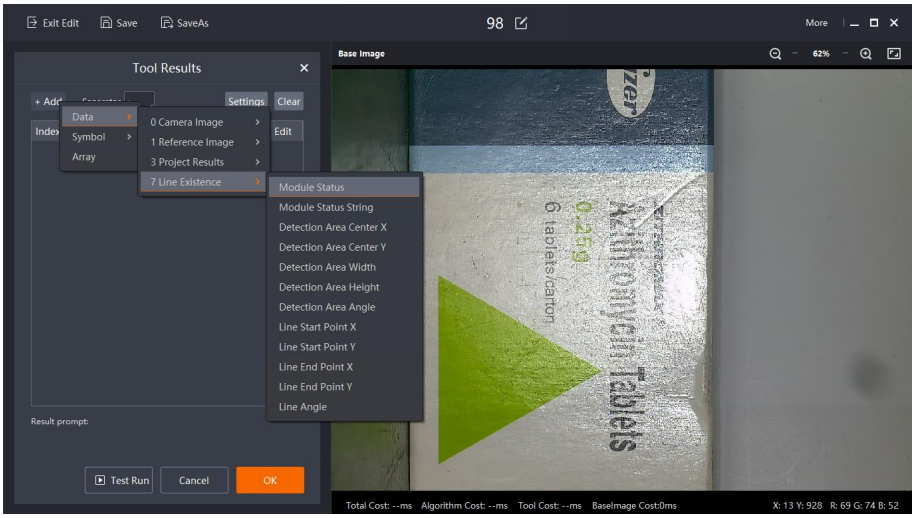


Figure 3-4 Set Tool Results

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.

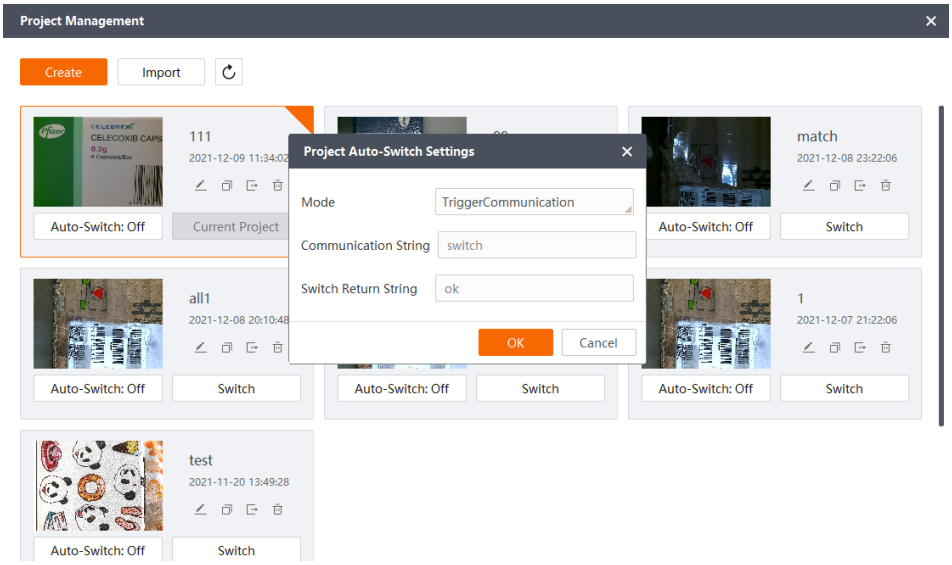


Figure 3-5 Project Switch Settings

3.3 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.

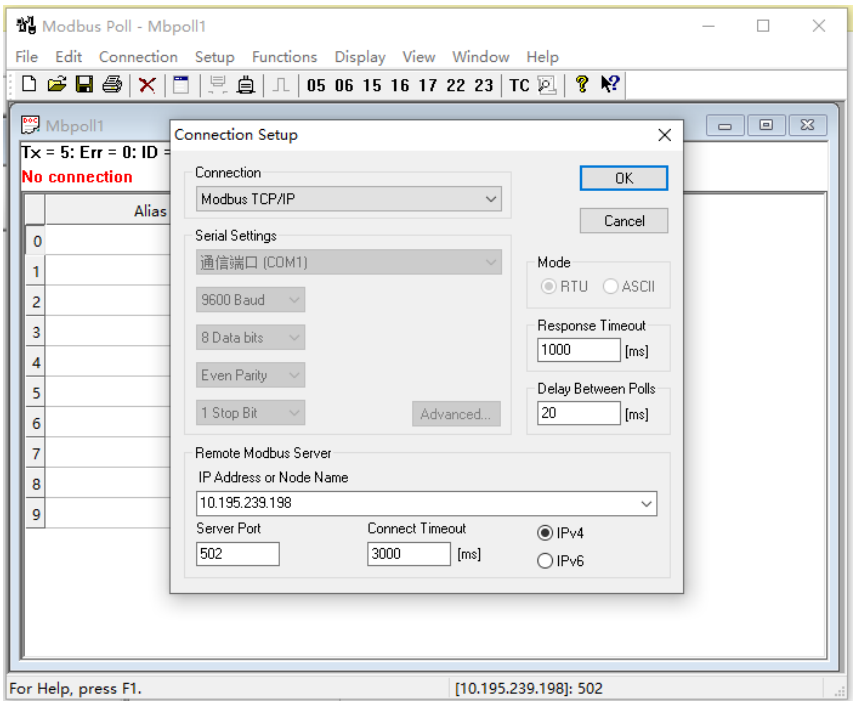


Figure 3-6 Set IP Address and Port

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.

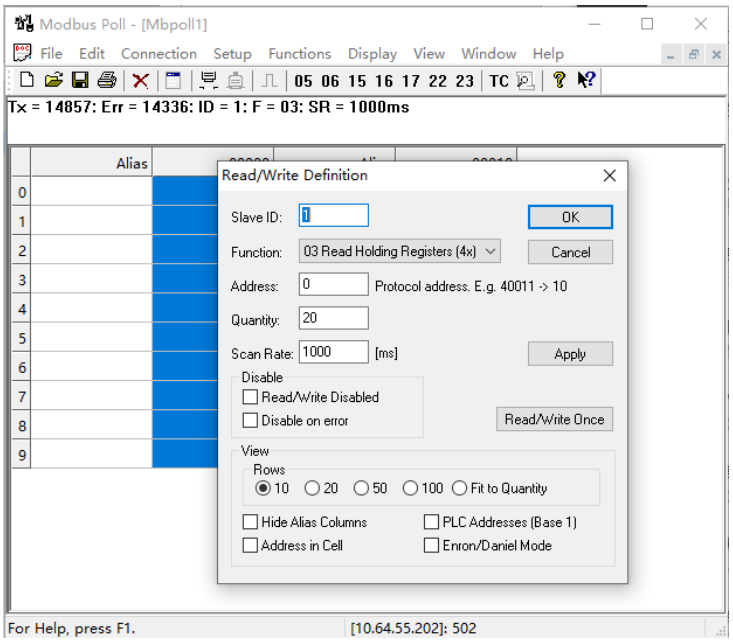


Figure 3-7 Set Polling and Reading Holding Register

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.

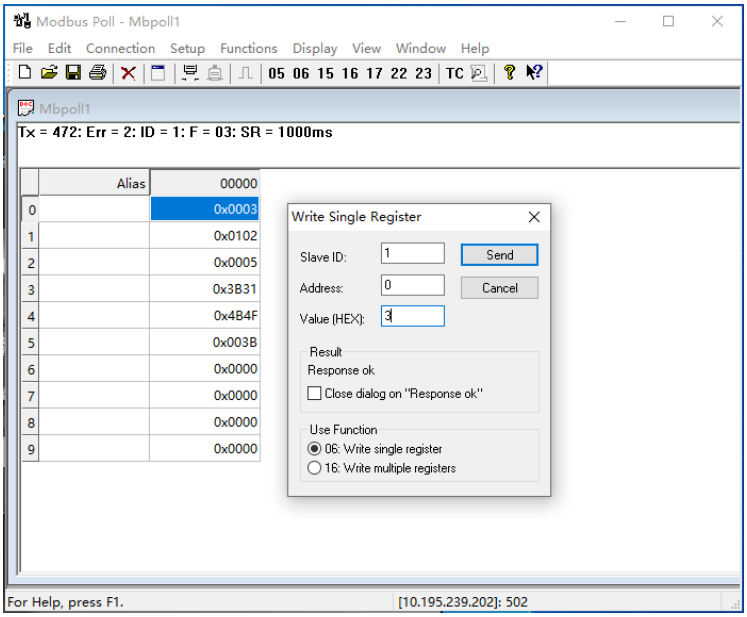


Figure 3-8 Single-trigger Photo Capture

3.4 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**.

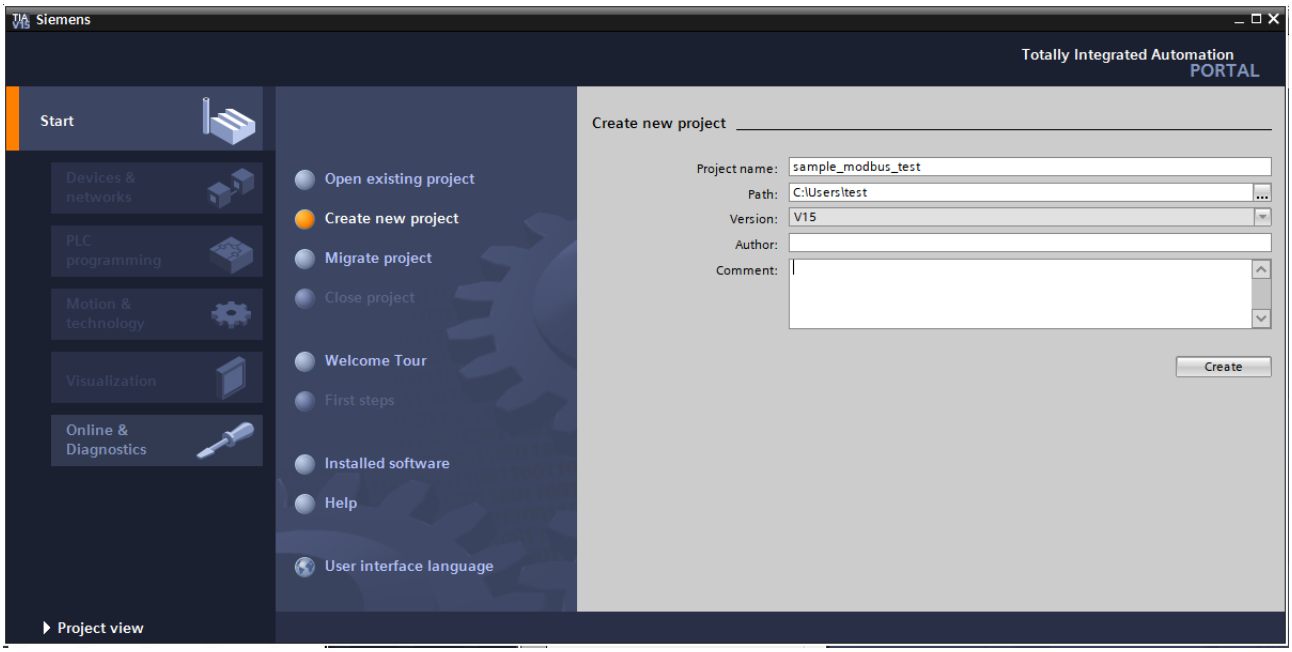


Figure 3-9 Create New Project

2. Add the corresponding PLC controller.

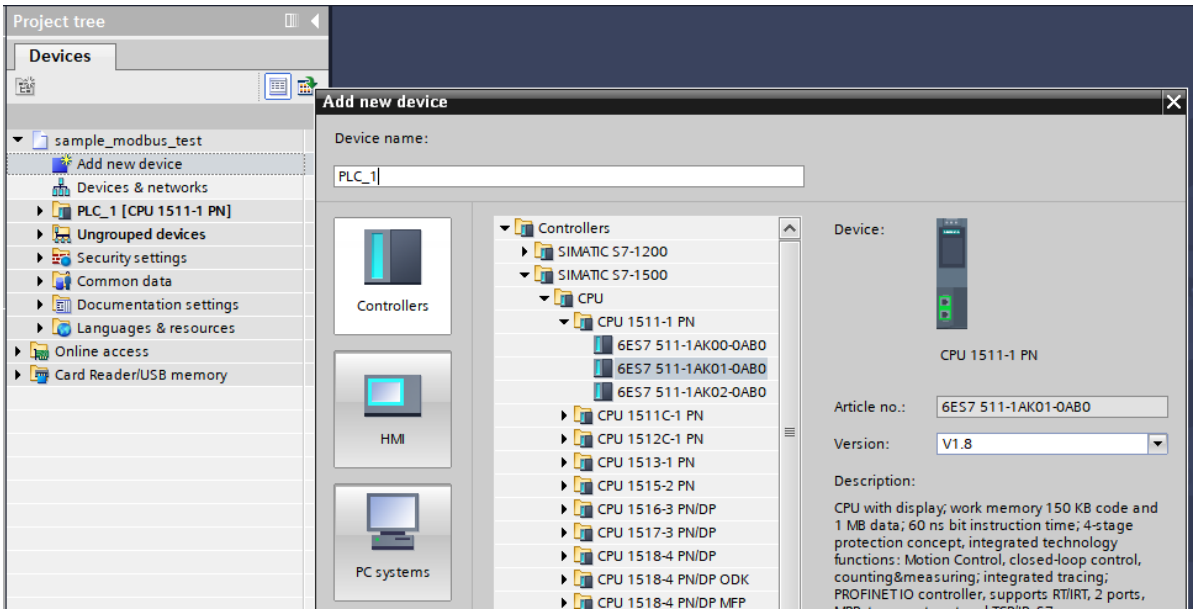


Figure 3-10 Add PLC

3. Set the IP address of the PLC controller.

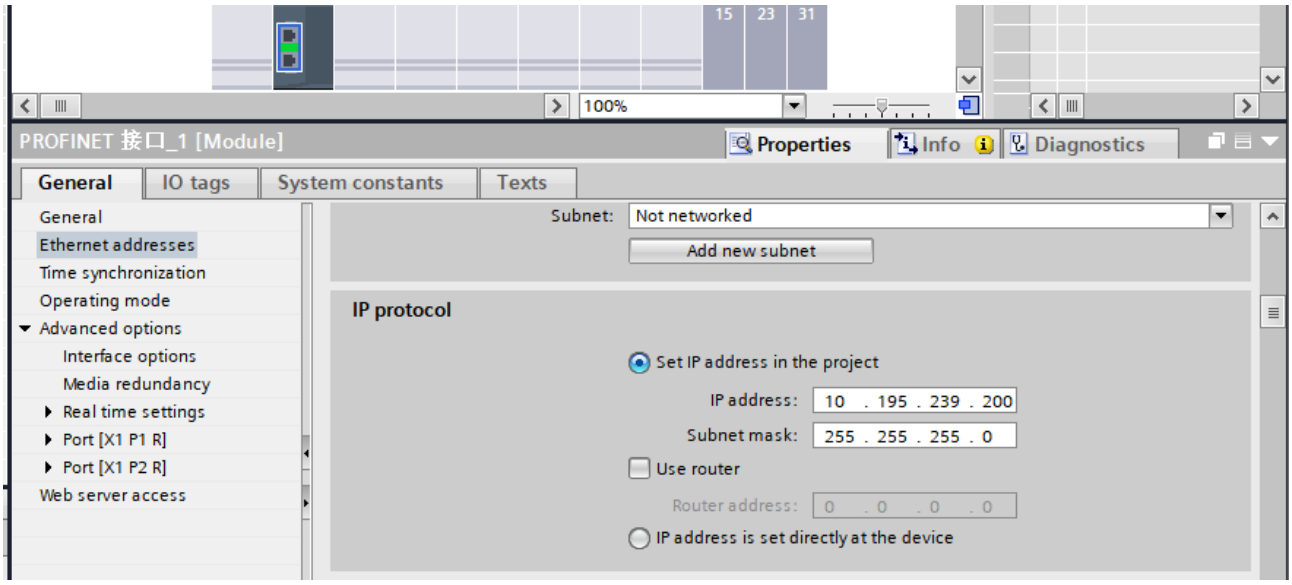


Figure 3-11 Set IP Address

4. 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.

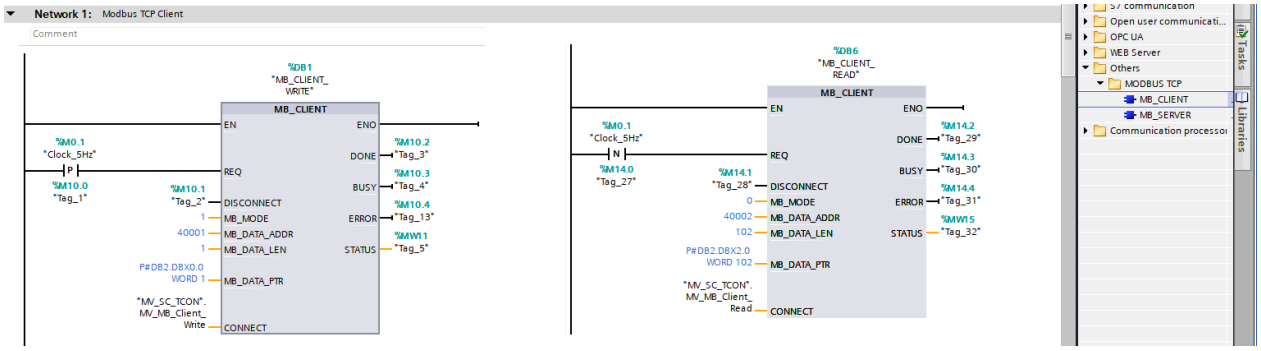


Figure 3-12 Add MB_CLIENT Commands

5. 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.

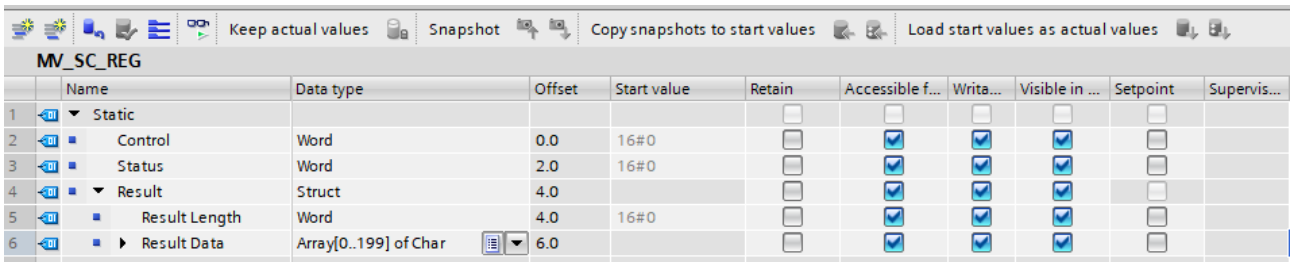


Figure 3-13 MV_SC_REG Data Block

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.

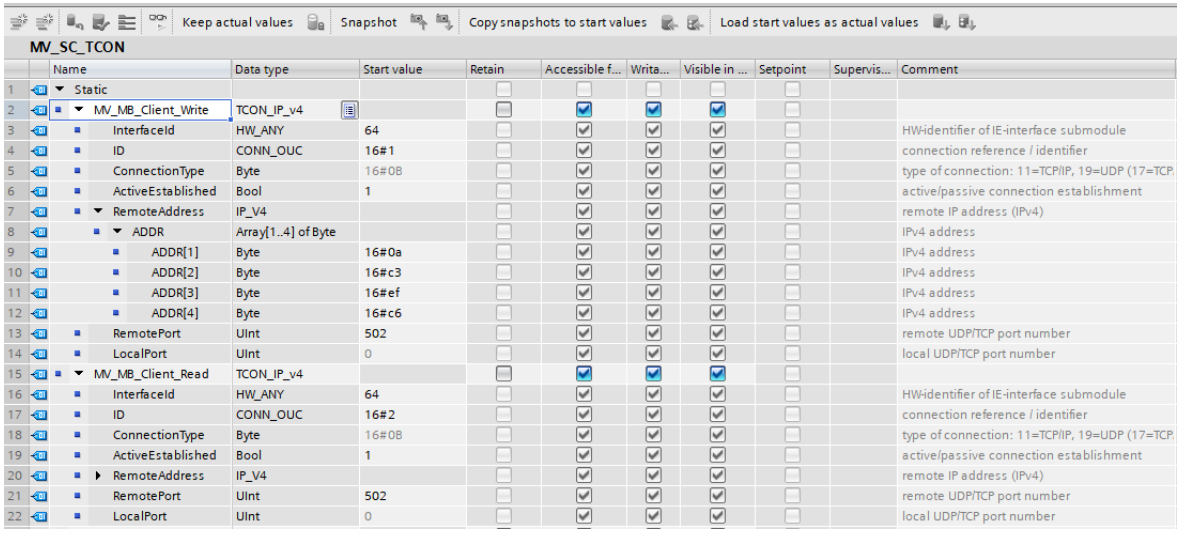


Figure 3-14 MV_SC_TCON Data Block

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.

3.5 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 default offset value is 0, supporting customization.
- Control area size: 1 register (2 bytes)

Table 3-2 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. ● 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 default offset value is 1, supporting customization.
- Status area size: 1 register (2 bytes)

Table 3-3 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	Command Success	Executing communication command succeeded.
REG 1.11	Command Failed	Executing communication command failed.
REG 1.12-14	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 default offset value is 2, supporting customization.
- Result size: 4 to 500 registers (100 by default).

Table 3-4 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. ● 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 default offset value is 500, supporting customization.
- Command area size: 4 to 500 registers to configure (100 by default).

Table 3-5 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 refers to command character.

3.6 Trigger Test

Communication Sequence Diagram

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

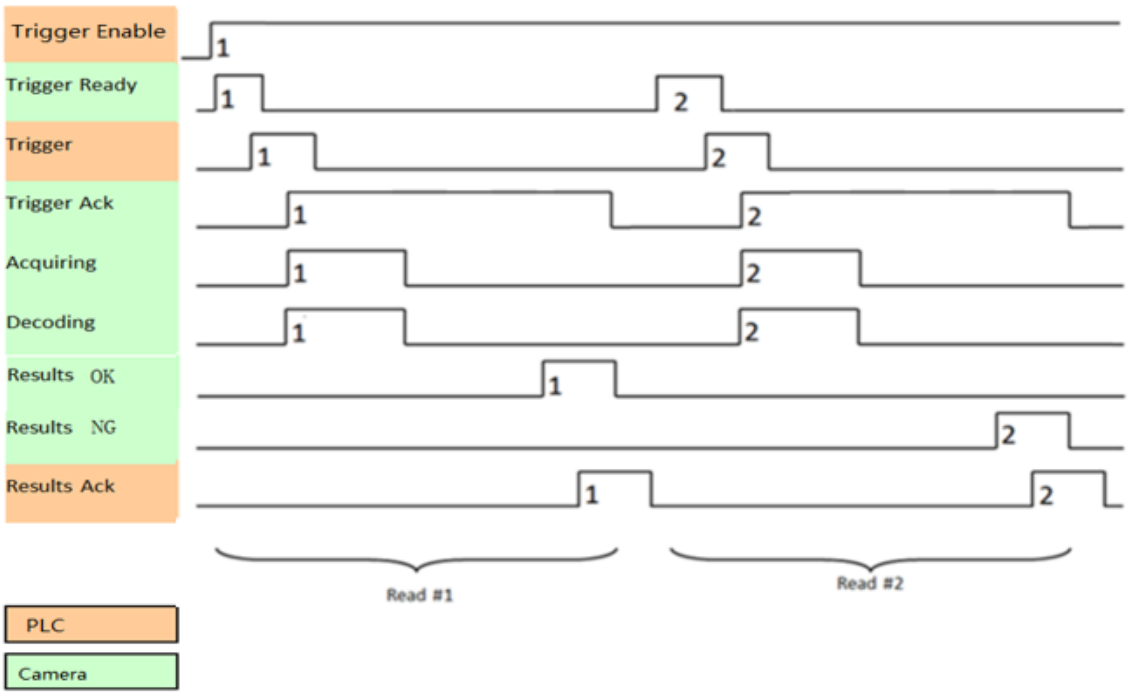


Figure 3-15 Communication Sequence Diagram

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

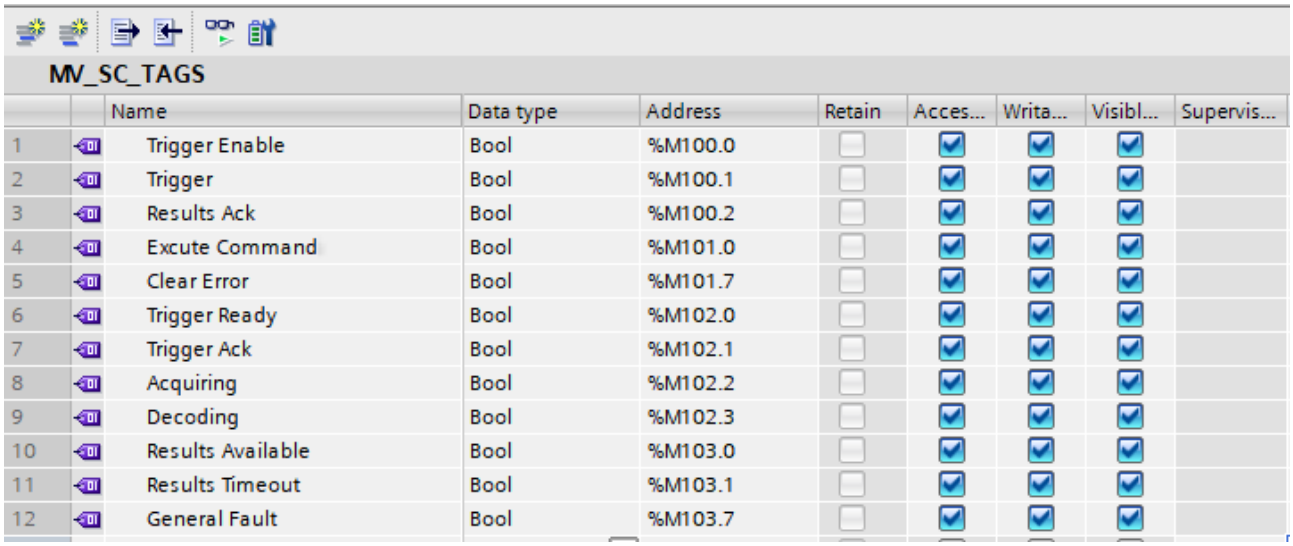
For tools like character recognition, the result will be outputted only after the character is recognized. Otherwise, the result output will time out at this time. If you need to return results quickly, you can use the exception output function.

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 a new 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	☐	☑	☑	☑	
2	Trigger	Bool	%M100.1	☐	☑	☑	☑	
3	Results Ack	Bool	%M100.2	☐	☑	☑	☑	
4	Excute Command	Bool	%M101.0	☐	☑	☑	☑	
5	Clear Error	Bool	%M101.7	☐	☑	☑	☑	
6	Trigger Ready	Bool	%M102.0	☐	☑	☑	☑	
7	Trigger Ack	Bool	%M102.1	☐	☑	☑	☑	
8	Acquiring	Bool	%M102.2	☐	☑	☑	☑	
9	Decoding	Bool	%M102.3	☐	☑	☑	☑	
10	Results Available	Bool	%M103.0	☐	☑	☑	☑	
11	Results Timeout	Bool	%M103.1	☐	☑	☑	☑	
12	General Fault	Bool	%M103.7	☐	☑	☑	☑	

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.

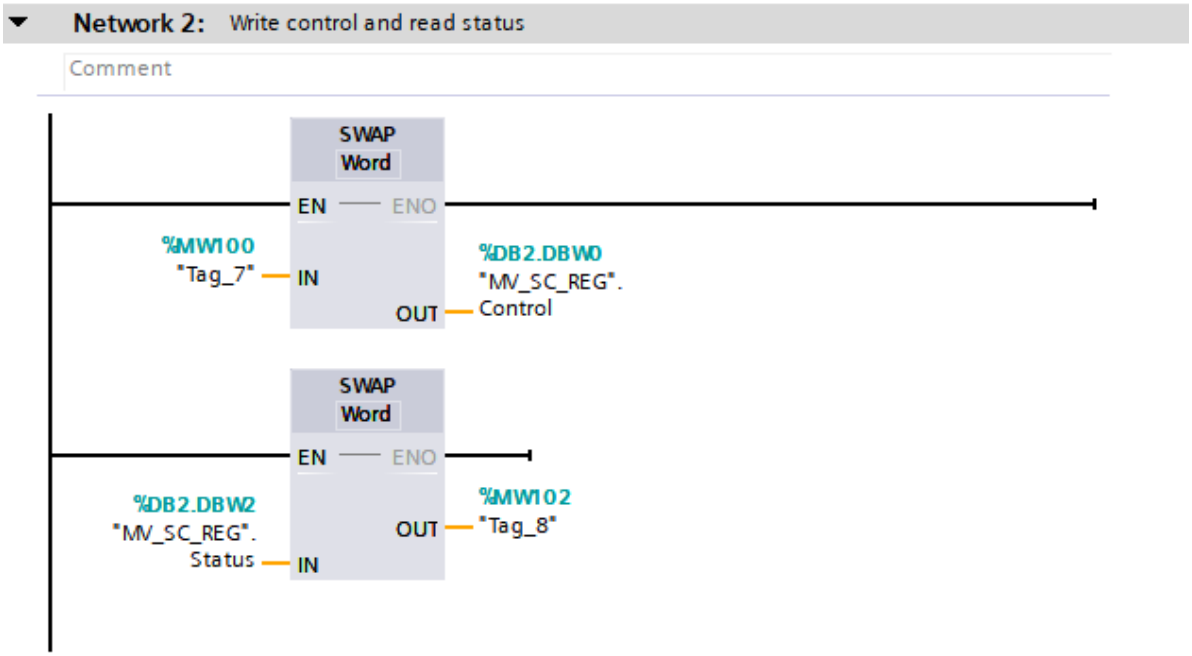


Figure 3-17 Send Control and Reading Status

- Enable Trigger

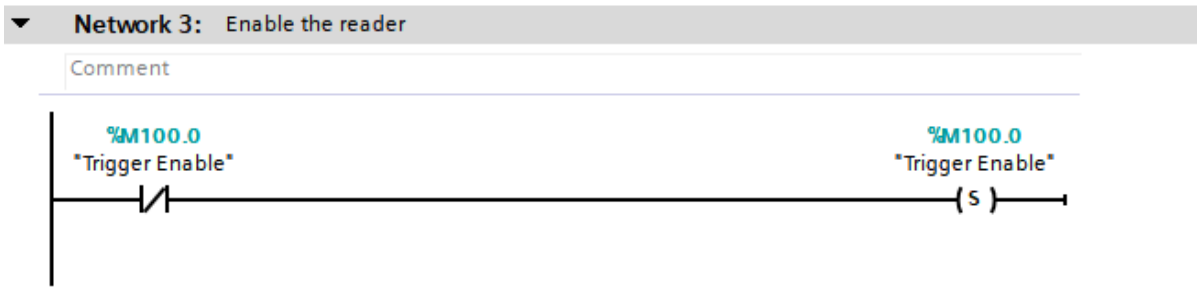


Figure 3-18 Enable Trigger

- 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.

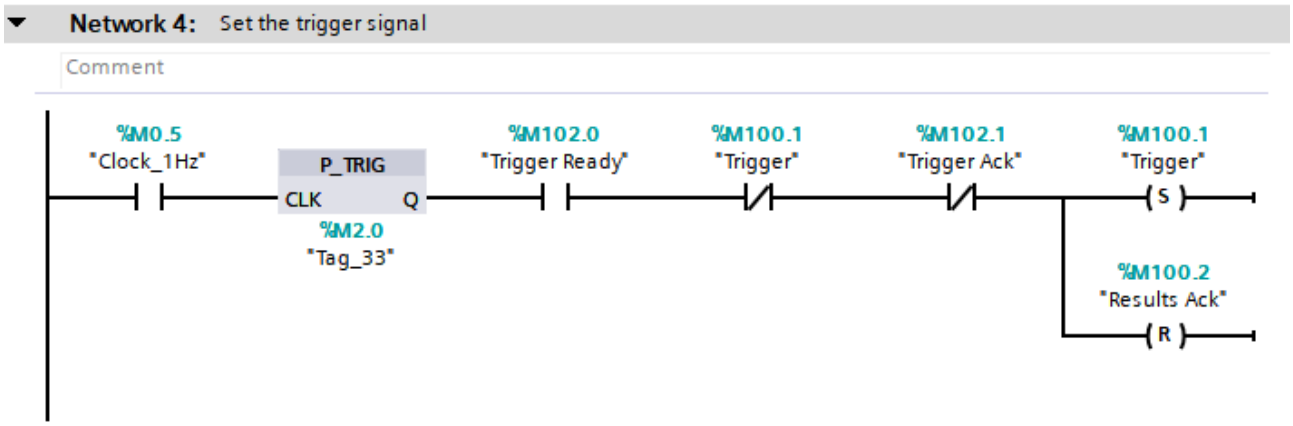


Figure 3-19 Send Trigger Signal

- Clear Trigger Signal

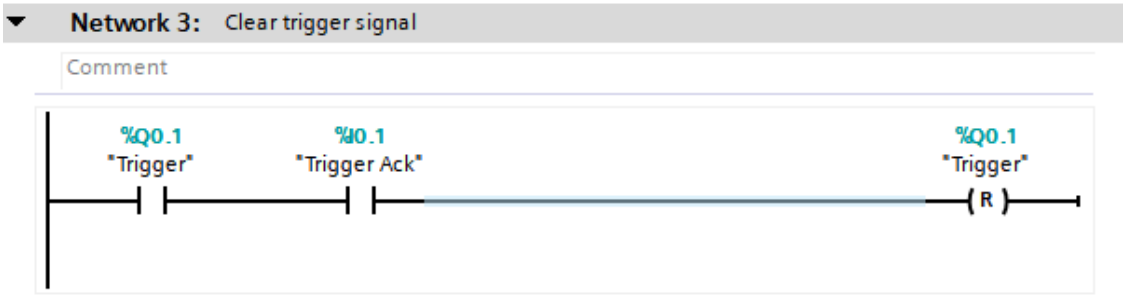


Figure 3-20 Clear Trigger Signal

- Get Device Results

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

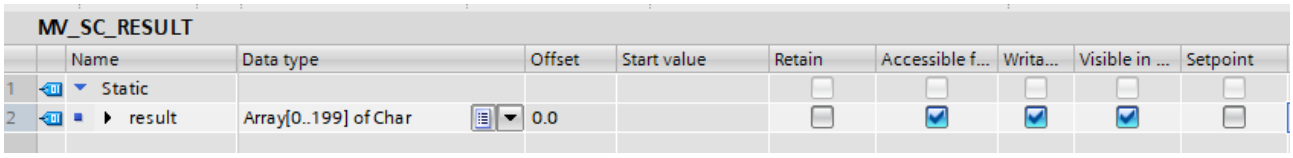


Figure 3-21 Add Result Array Variable

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.

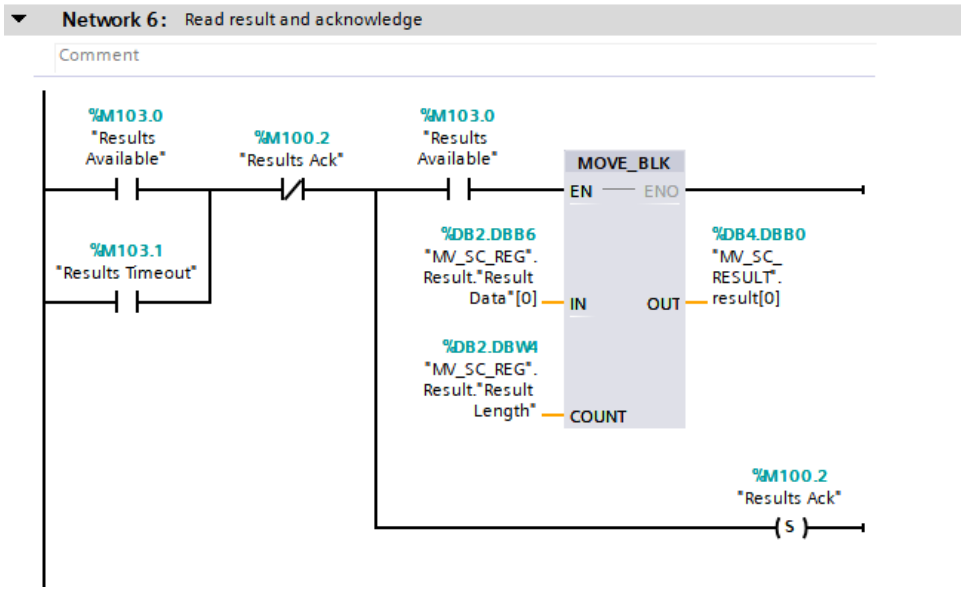
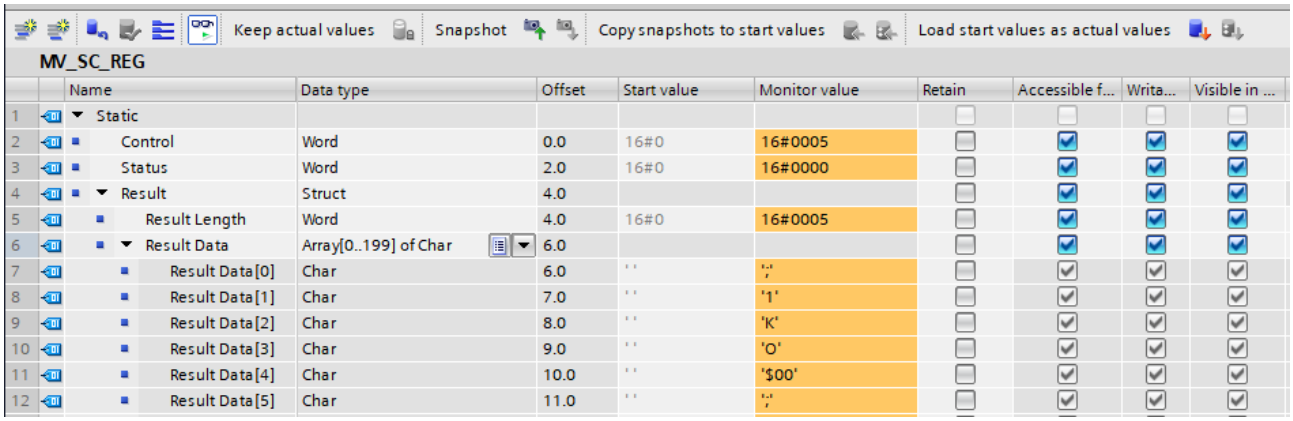


Figure 3-22 Get Device Results

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.



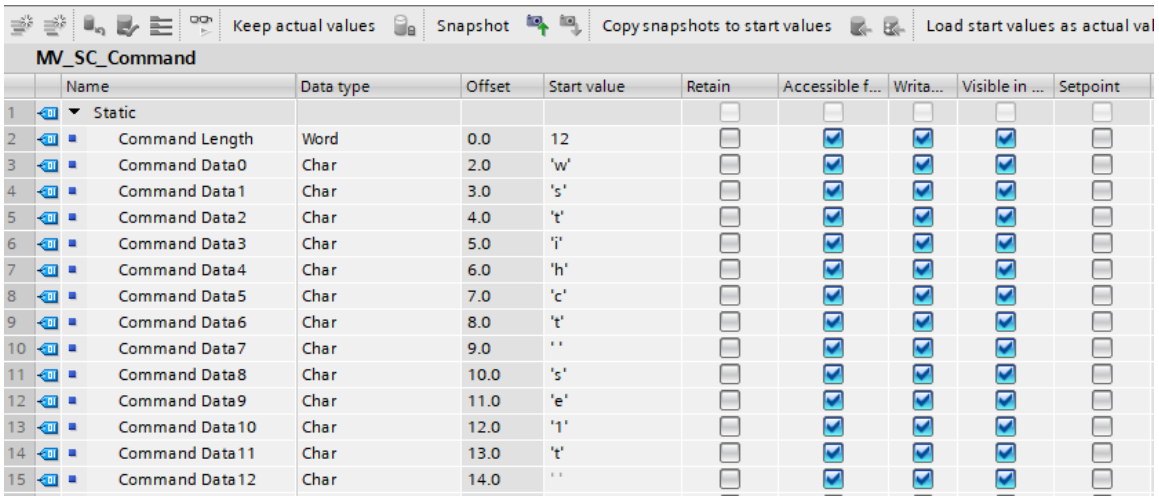
	Name	Data type	Offset	Start value	Monitor value	Retain	Accessible f...	Writa...	Visible in ...
1	Static								
2	Control	Word	0.0	16#0	16#0005				
3	Status	Word	2.0	16#0	16#0000				
4	Result	Struct	4.0						
5	Result Length	Word	4.0	16#0	16#0005				
6	Result Data	Array[0..199] of Char	6.0						
7	Result Data[0]	Char	6.0	' '	';'				
8	Result Data[1]	Char	7.0	' '	'1'				
9	Result Data[2]	Char	8.0	' '	'K'				
10	Result Data[3]	Char	9.0	' '	'O'				
11	Result Data[4]	Char	10.0	' '	'$00'				
12	Result Data[5]	Char	11.0	' '	';'				

Figure 3-23 View Results

3.7 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.



Keep actual values | Snapshot | Copy snapshots to start values | Load start values as actual val

MV_SC_Command

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

Figure 3-24 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.

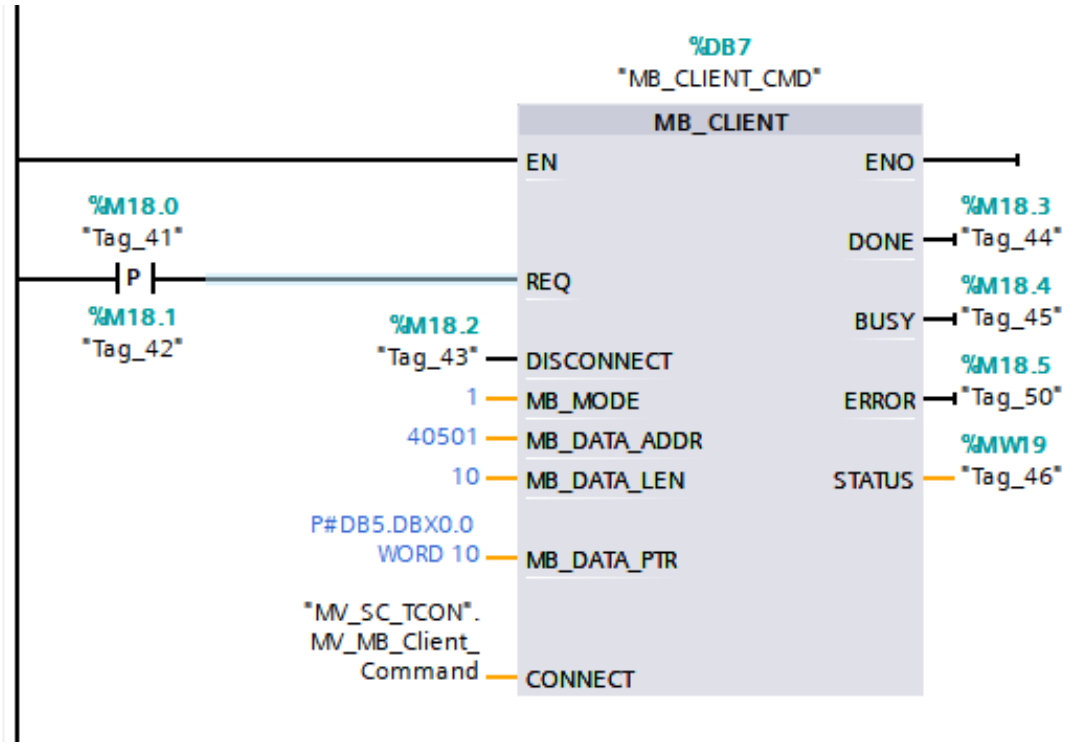


Figure 3-25 Send Switching Command

- 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.

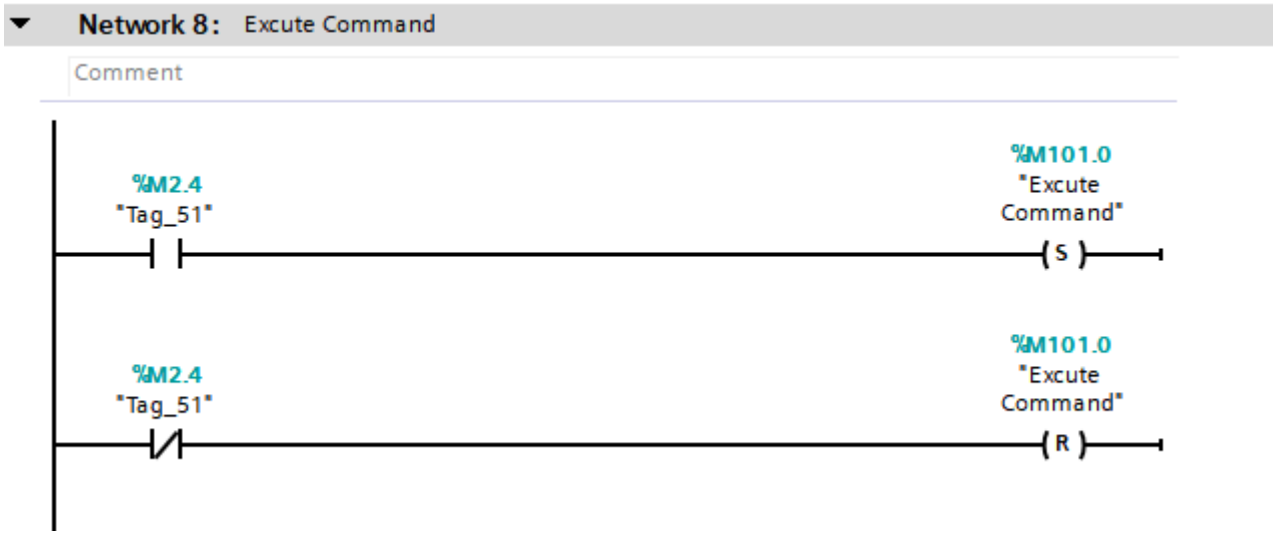


Figure 3-26 Execute Switching Command

3.7 FTP Image Saving Naming Test

The smart camera can receive strings from the PLC via industrial protocols and supports using the strings for FTP image saving names or triggering branches. This section introduces how to use the communication input string to name FTP image saving files.

Steps

1. After settings of the smart camera and PLC, set the camera's **Trigger Source** as **Communication Trigger**, and configure the **Communication String**, for example, **"trig"**.
2. On the SCMVS client software **Communication Settings** page, add **FTP Communication** and set the **FileName Strategy** to **"Subscribe"**, with the **FileName Subscription** set to the communication input string.



Figure 3-27 FTP Communication

3. Click the **Continuous Run** in the upper right area of the image live view pane.

4. Write the string in the command area. For example, to name the image saving file as “12345678”, you need to enter the complete string as “trig 12345678”, i.e., write the string length at REG500, and sequentially write the complete string starting from REG501.
5. At REG0.0, first write 1 to enable the smart camera’s trigger function; then write 1 at REG0.8 to execute the command area. This will trigger the camera once and save the image with the filename “12345678 + timestamp”.

Chapter 4 KV

KV (Keyence Visual) communication protocol is a command/response system for industrial automation control networks developed by Keyence, and it helps achieve seamless communication between various networks.

Note

Here we take Keyence KV series PLC as an example to explain how to communicate with the smart camera via the KV communication protocol. For other devices, refer to the user manual provided by the manufacturer and make related settings by reading contents of this chapter.

4.1 Hardware Wiring

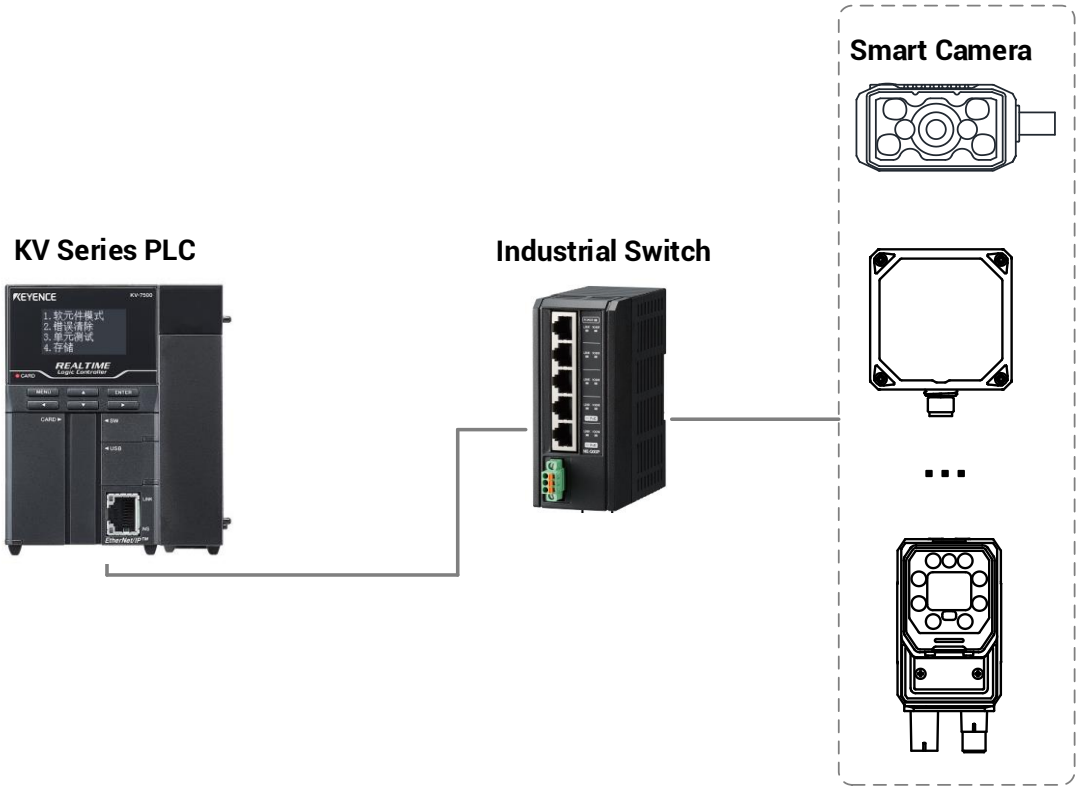


Figure 4-1 Hardware Wiring

4.2 Smart Camera Settings

Before using the smart camera's KV 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 SC5000X series and SC6000 series smart camera, you need to operate it via the embedded VM, and operations are similar to those via the SCMVS client software.

Steps

1. Log in the device via the SCMVS client software. Click **Communication** on the menu bar.
2. Click ⊞ to add KV communication.
3. Switch on ◯ to enable KV communication.
4. Set the following parameters in the **Basic Information Configuration area**.
   - **Communication Mode**: Default is Client. The smart camera serves as the client to initiate access.
   - **Server IP**: Input the PLC' IP address.
   - **Server Port**: Use the default value. It must match the port number in the PLC settings in the subsequent section.
   - **Polling Interval (ms)**: Set the waiting time after a control command is issued. For example, after modifying a control command and triggering a snapshot, the smart camera will capture the image only after the polling interval has elapsed.

Note

Currently, other modes are not supported.

5. When the device operates in KV Client mode, it is divided into four areas: Control, Status, Result, and Command. All areas are located in the data register. The device address and number of points can be configured.

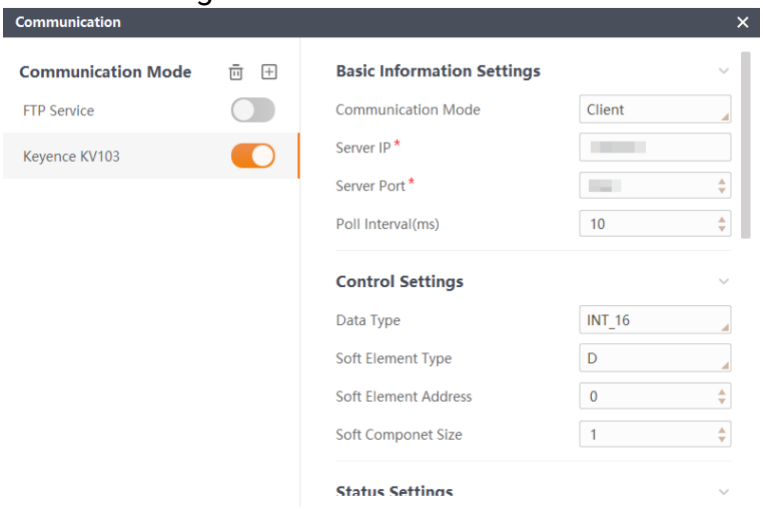


Figure 4-2 KV Communication Settings

- **Data Type**: Default is 16-bit decimal. Currently, other types are not supported.

–**Soft Element Type**: Default is D. Currently, other types are not supported.
–**Soft Element Address**: It must be consistent with the configuration in the PLC control software. The address here determines the starting address and size in the PLC control software.
– **Soft Element Size**: Indicates the minimum space required for this section. The example above shows that at least 1 byte is required.
In the example above, the device address is 0, indicating that the control area must start from the 0th register.

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.

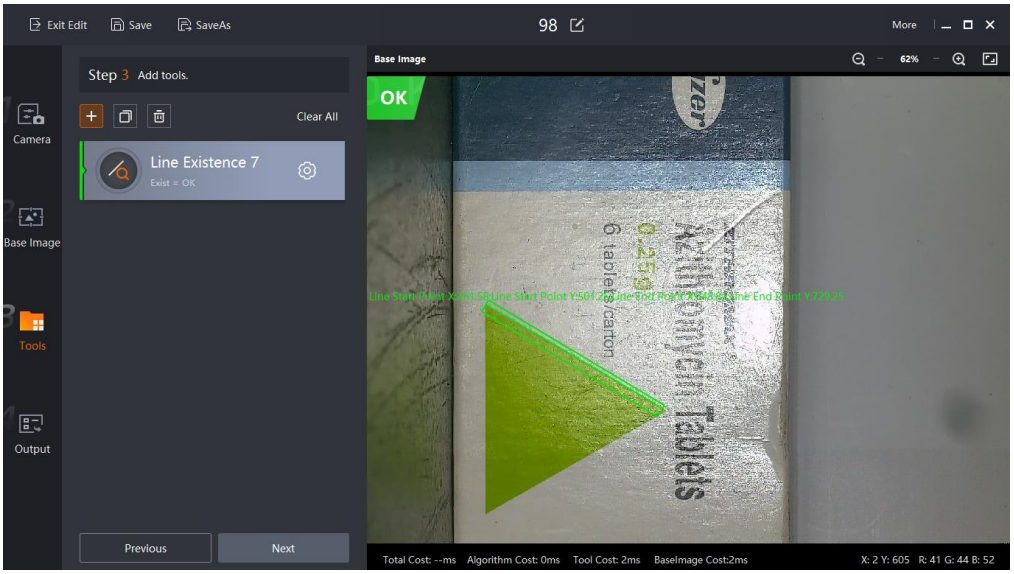


Figure 4-3 Line Existence

Note

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

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

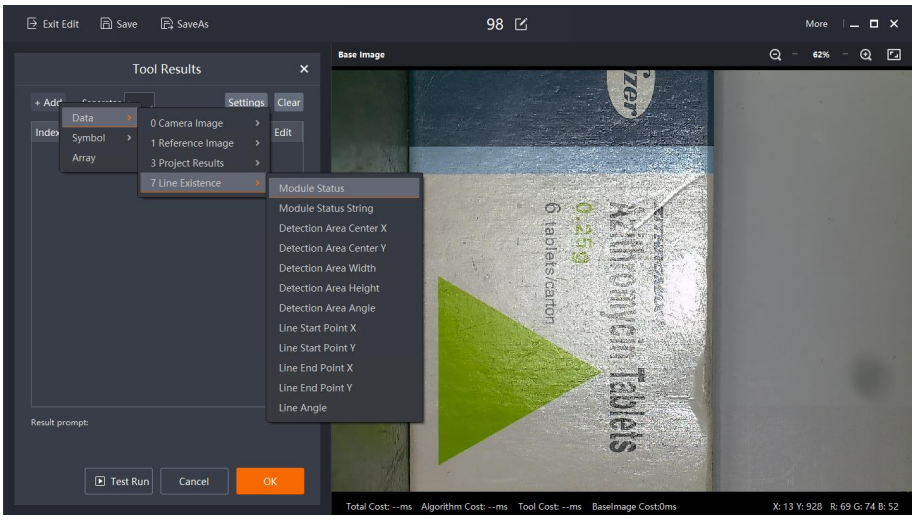


Figure 4-4 Set Tool Results

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.

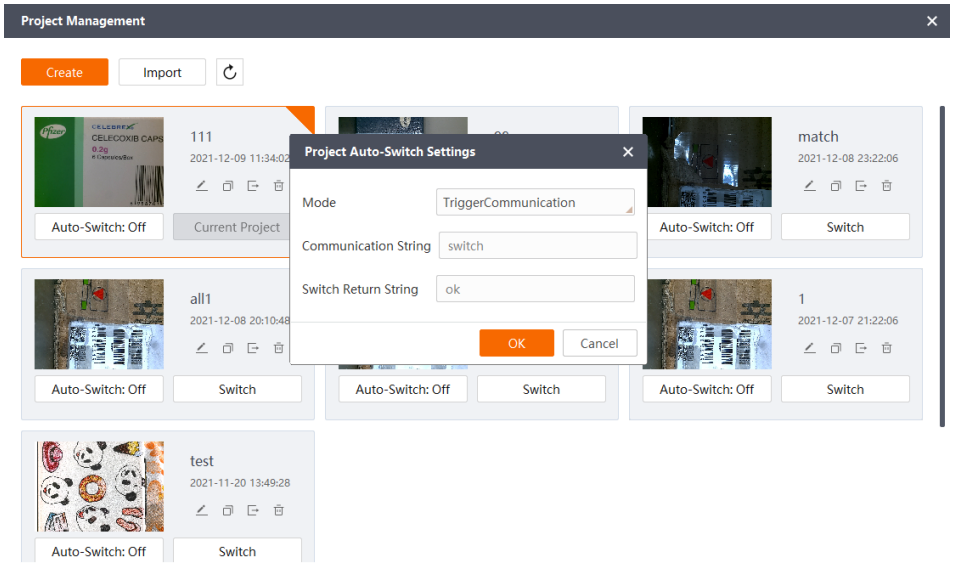


Figure 4-5 Project Switch Settings

4.3 PLC Settings

This section takes the Keyence KV-7500 PLC as an example to explain how to set PLC's KV

communication. For PLC devices from different models, refer to this section and its user manual to configure.

Steps

1. Run the PLC control software (KV STUDIO Ver.11G_Trial), and select **File** > **New Project** from the navigation bar.
2. In the **New Project** dialog box, enter the **Project Name** and **Location** (local storage path of the project), select the default supported model KV-7500, and click **OK**.
3. In the **Confirm Unit Configuration Settings** dialog box, click **Yes**.
4. On the **Settings Unit** tab of the **Unit Editor page**, enter the PLC's IP address in the **IP Address** parameter field, and use the default value for the **Port Number (Upper Link)** parameter.

Note

The **IP Address** should not duplicate the IP address of the smart camera.
The parameter value of the **Port Number (Upper Link)** should match the setting on the device side.

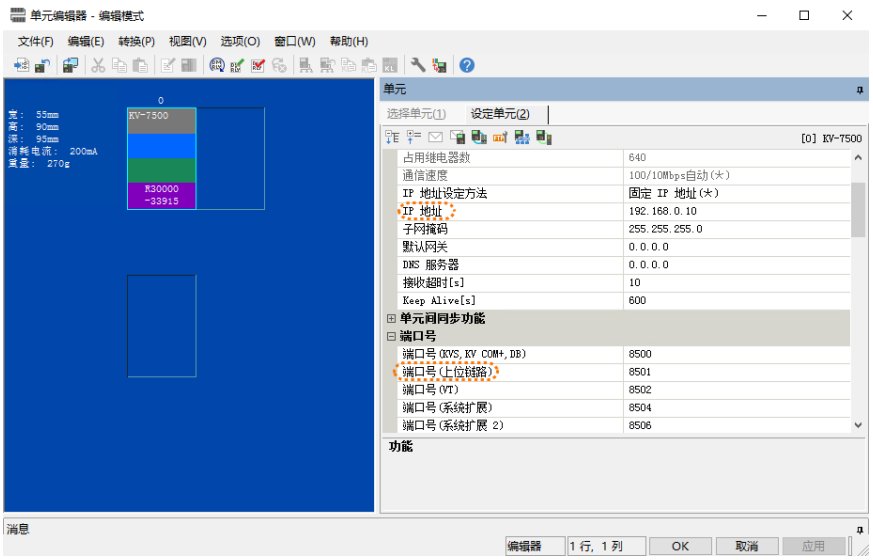


Figure 4-6 Unit Editor

5. Click **Apply** first, then click **OK**.
6. In the top navigation bar, click **(PLC Transfer** > **Monitor Mode)** to transfer the configuration to the PLC.
   In the top toolbar, the connection method must be set to **USB**, as shown below.



Figure 4-7 Connection Method

7. In the **Transfer Program** dialog box, click **Execute** and wait for the writing to complete.
8. Configure the registers.
   1) In the software navigation bar, click to enter the **Batch Change/Read Device Values window**.

2) Select **Add Device** > **Batch Insert** to run the Batch Insert dialog box and configure the following parameters.

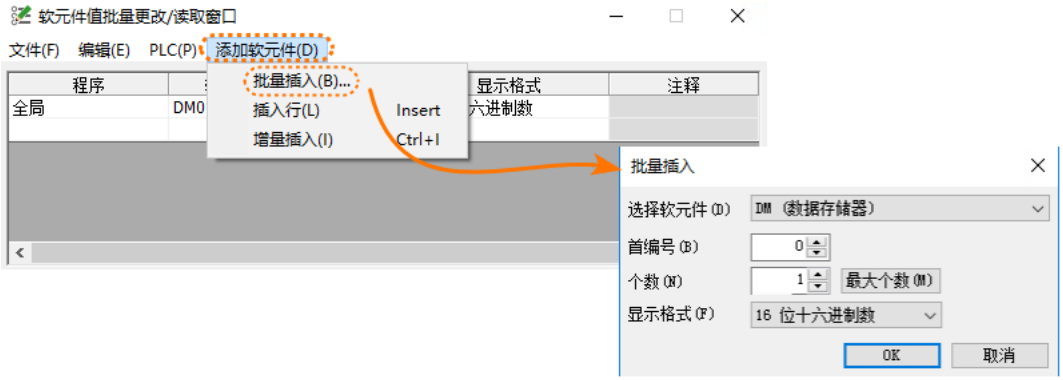


Figure 4-8 Add Device

- Select Device: Choose DM (Data Memory).
- Starting Number: Must be consistent with the device address configured for each area on the smart camera side. For example, if adding register locations for the control area (starting from the 1st) as shown in the figure above, then the corresponding device address configured on the camera side would be 0.
- Number of Points: Set the number of registers for each area according to the actual required bit length. For example, setting it to 1 means storing 1 unit starting from the first address.
- Display Format: 16-bit hexadecimal is sufficient. You can choose other formats if you have specific requirements.

3) Modify the data in the registers by changing the device values to achieve communication with the camera.

Result

After the configuration is complete, the **Batch Change/Read Device Values Window** is shown below.

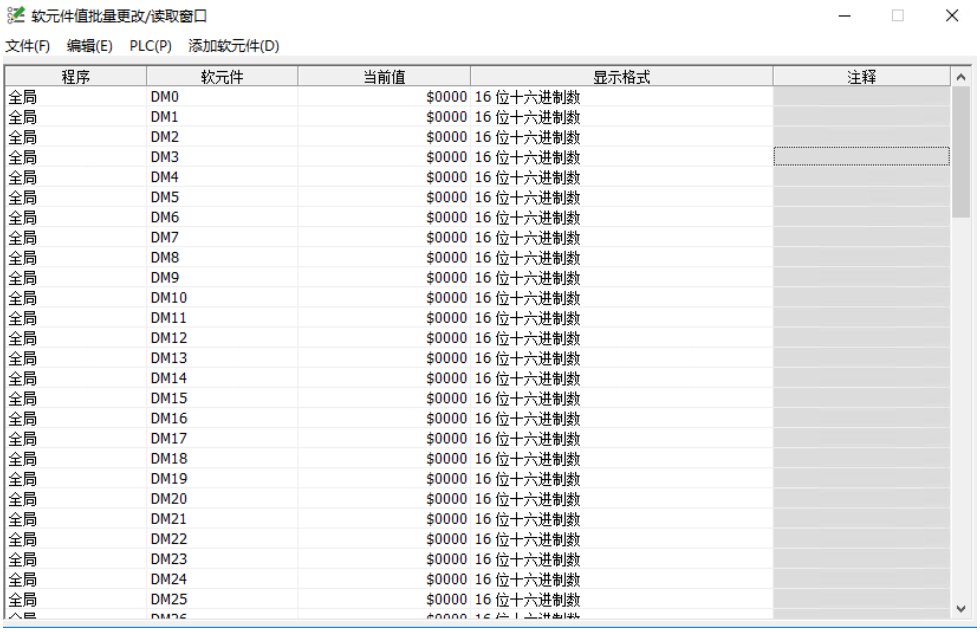


Figure 4-9 Batch Change/Read Device Values Window

4.4 Device Register Definition

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

Control

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

- Control area location: holding registers, the default offset value is 0, supporting customization.
- Control area size: 1 register (2 bytes)

Table 4-1 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. ● 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 default offset value is 1, supporting

customization.

- Status area size: 1 register (2 bytes)

Table 4-2 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	Command Success	Executing communication command succeeded.
REG 1.11	Command Failed	Executing communication command failed.
REG 1.12-14	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 default offset value is 2, supporting customization.
- Result size: 4 to 500 registers (100 by default).

Table 4-3 Result Area Definition

REG/word	Name	Description
REG 2	Result Length	It refers to the length of valid data contained in the result area.
REG 3…	Result Data	It refers to the result output by the device. ● 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 default offset value is 500, supporting customization.
- Command area size: 4 to 500 registers to configure (64 by default).

Table 4-4 Command Area Definition

REG/word	Name	Description
REG 500	User Data Length	It refers to the length of valid data contained in the command area.
REG 501…	User Data	It refers to command character.

4.5 Trigger Test

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

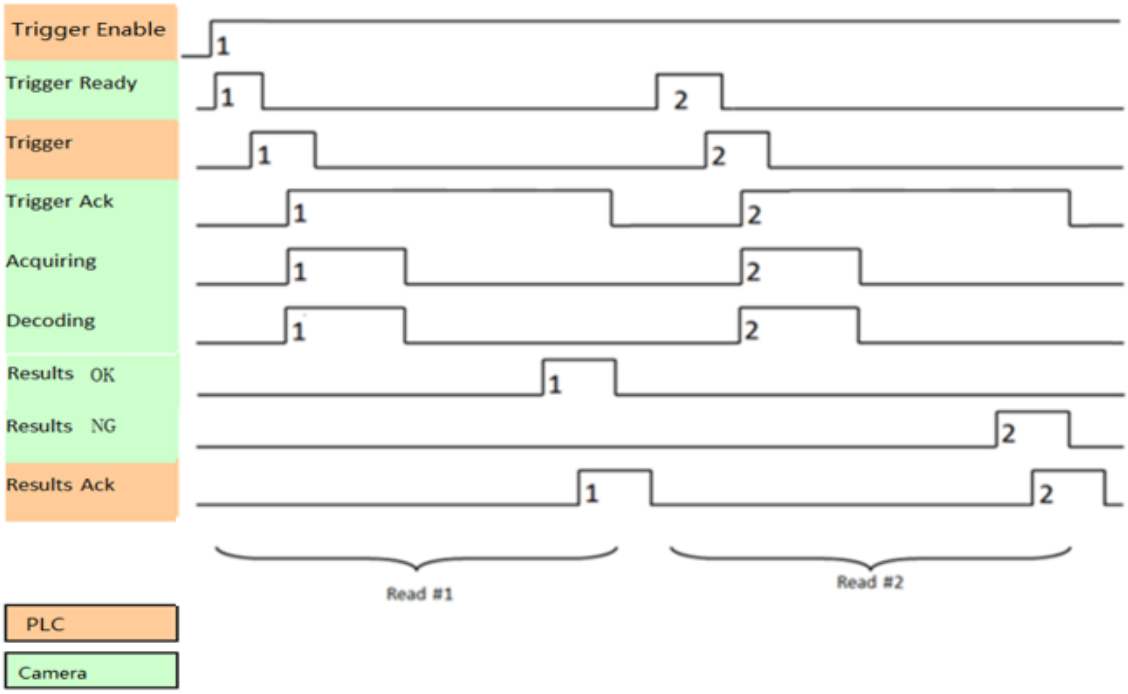


Figure 4-10 Communication Sequence Diagram

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 a new round of triggering.

4.6 Project Switching Test

Steps

1. Complete the smart camera and PLC settings, set the switching mode to communication switching, and configure the communication string as “switch”.
2. In the batch change/read window for soft component values, write the switching scheme command in the instruction area. Assuming the scheme name is “11111”, the scheme switching command is “switch 11111”, which converts to hexadecimal as “73 77 69 74 63 68 20 31 31 31 31 31”. The instruction is shown in the diagram below.

Note

The order of every two characters is from right to left, meaning the low-order byte is on the right and the high-order byte is on the left. For characters of “sw”, “7773” should be entered in the DM501 soft component.

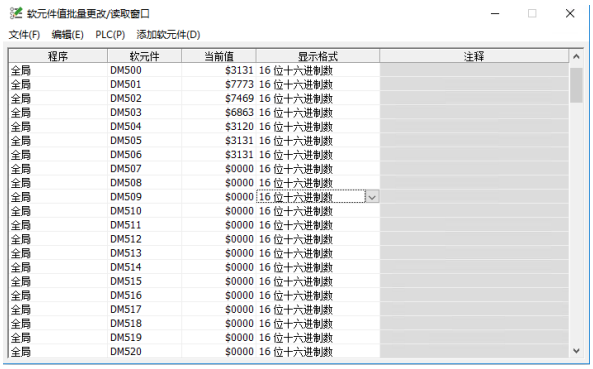


Figure 4-11 Switching Scheme Command Configuration

3. In the top menu bar, select **PLC > Write All Items to PLC (W)**.
4. After writing is completed, click the (Batch Monitor Window) in the top toolbar to verify the write operation.
5. In the control area, enter “0004”, then select **PLC > Write All Items to PLC (W)** to clear the previous operation.



Figure 4-12 Clear Command

6. Enter “0100” again, select PLC > Write All Items to PLC (W), and the scheme switching will be triggered.

4.7 FTP Image Saving Naming Test

The smart camera can receive strings from the PLC via industrial protocols and supports using the strings for FTP image saving names or triggering branches. This section introduces how to use the communication input string to name FTP image saving files.

Steps

1. After settings of the smart camera and PLC, set the camera's **Trigger Source** as **Communication Trigger**, and configure the **Communication String**, for example, **"trig"**.
2. On the SCMVS client software **Communication Settings** page, add **FTP Communication** and set the **FileName Strategy** to **"Subscribe"**, with the **FileName Subscription** set to the communication input string.



Figure 4-13 FTP Communication

3. Click the **Continuous Run** in the upper right area of the image live view pane.
4. Write the string in the command area. For example, to name the image saving file as "12345678", you need to enter the complete string as "trig 12345678", i.e., write the string length at REG500, and sequentially write the complete string starting from REG501.
5. At REG0.0, first write 1 to enable the smart camera's trigger function; then write 1 at REG0.8 to execute the command area. This will trigger the camera once and save the image with the filename "12345678 + timestamp".

Chapter 5 MELSEC/SLMP

MELSEC/SLMP refers to communication protocols such as reading or writing of the device data of the Q/L series programmable controller CPU by external devices via the C24 or E71 module.

Note

- MELSEC/SLMP supports TCP protocol only and does not support UDP protocol.
- Here we take Mitsubishi Q series and FX3U series PLCs as an example to explain how to communicate with smart cameras via MELSEC/SLMP communication protocol, For other devices, refer to the user manual provided by the manufacturer and make related settings by reading contents of chapter.

5.1 Hardware Wiring

The wiring of Mitsubishi series PLC and the smart code reader is shown below.

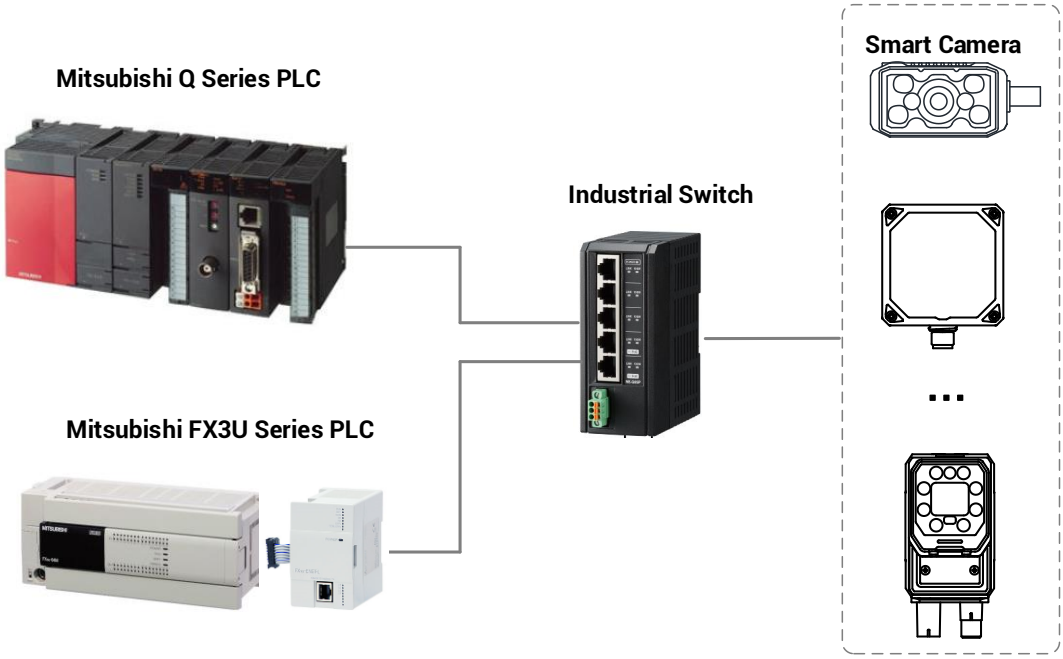


Figure 5-1 Hardware Wiring

5.2 Smart Camera Settings

Before using the smart camera's MELSEC/SLMP 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 SC5000X series and SC6000 series smart camera, you need to operate it via the embedded VM, and operations are similar to those via the SCMVS client software.

Steps

1. Log in the device via the SCMVS client software, click **Communication** on the menu bar.
2. Click ⊞ to add MELSEC/SLMP communication.
3. Switch on ◯ to enable MELSEC/SLMP communication.
4. Set the following parameters in the basic information configuration area.

- **Server IP**: Input PLC's IP address. (Required parameter)
- **Server Port**: Use the default value. It must match the port number in the PLC settings in the subsequent section. (Required parameter)
- **Data Frame Type:** Select the data frame type. The default selection is BIN_3E. (Required parameter).
- **Network Number:** Set the network layer number where the PLC is located. It is used to distinguish different network layers. It must match the PLC settings.
- **Node Number:** Use the default value. Set the physical address of the PLC in the network (similar to MAC address or station number).
- **Processor Number:** Use the default value. Set the target CPU module number in the PLC (used in multi-CPU systems).
- **Byte Order Enable:** Default is disabled. If enabled, byte swapping is applied, and the output results will follow the byte order. If disabled, results are output in normal order.
- **Polling Interval (ms):** Set the time interval for the smart camera to read PLC register data. A smaller value updates data faster with higher real-time performance but increases communication load on the network and PLC CPU. A larger value reduces real-time performance but lightens the load on the network and PLC.
- **Timeout (ms):** Use the default value. Set the maximum waiting time for connecting to the PLC.

5. When the device operates in MELSEC/SLMP mode, it is divided into four areas: control, status, result, and command, all located in holding registers. The soft component address and soft component points are configurable.



Figure 5-2 Melsec/SLMP Communication Settings

- **Address Space**: Default is D (other types are currently not supported).
- **Address Offset:** Set the offset of each area's register relative to the starting address. For example, 0 means no offset. If set to 1, the command input needs to be offset by 1 register from the starting position. This must match the configuration in the PLC control software, as the starting address in the PLC software is determined by this setting.
- **Data Quantity:** Indicates the minimum space required for this section. The diagram above shows that at least 1 byte is required.

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.

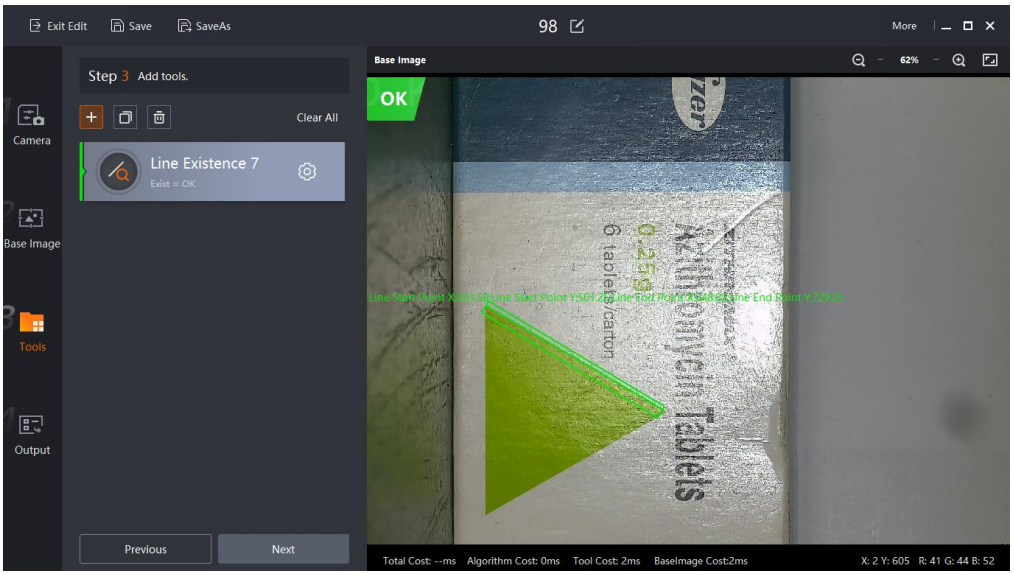


Figure 5-3 Line Existence

Note

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

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

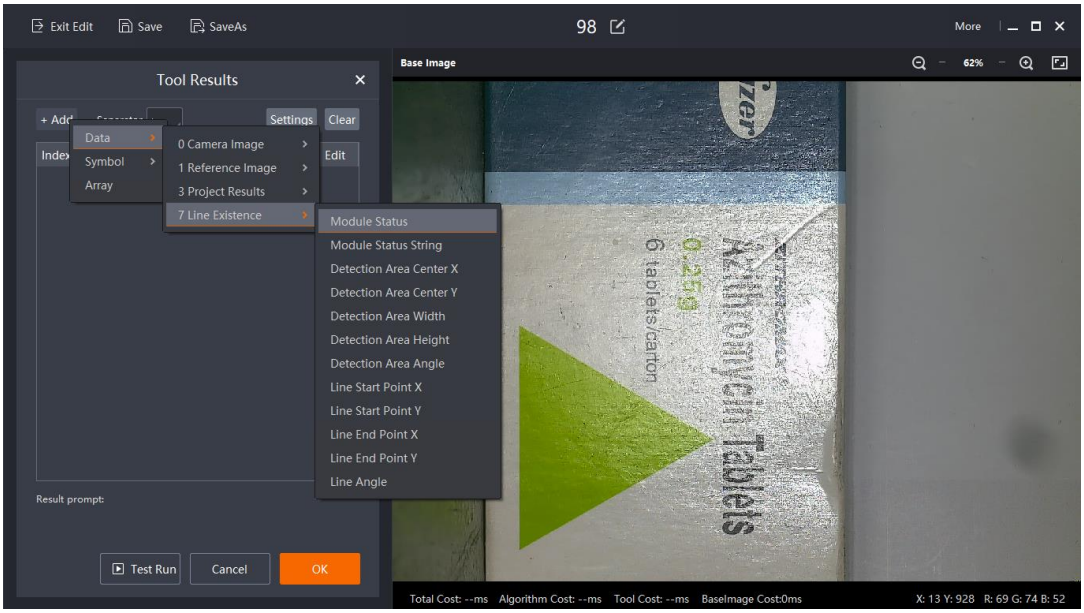


Figure 5-4 Set Tool Results

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.

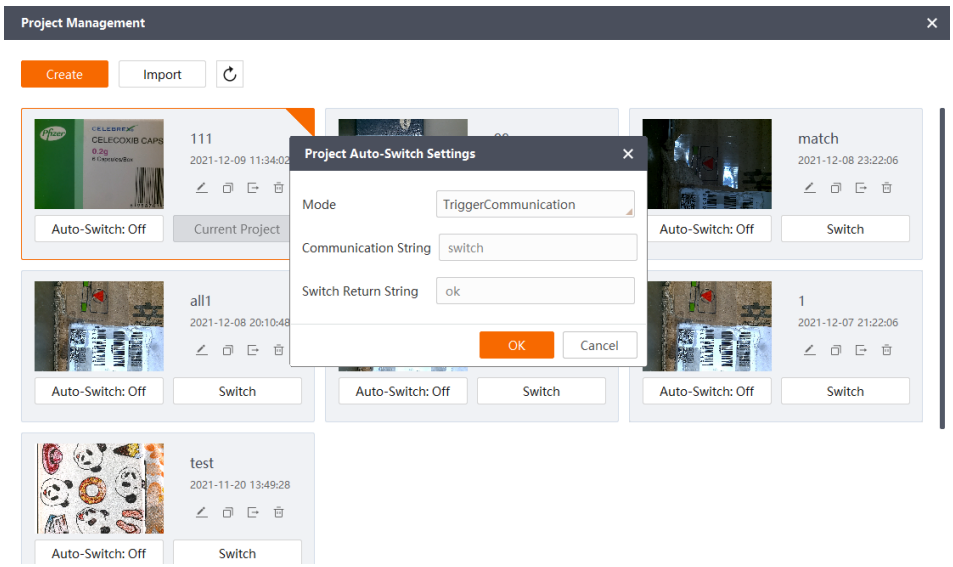


Figure 5-5 Project Switch Settings

5.3 PLC Settings

This section takes Mitsubishi FX3U series and Q series PLCs 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.

5.3.1 Mitsubishi FX3U Series PLC

Mitsubishi FX3U series PLC uses an external Ethernet module to realize MELSEC/SLMP communication function, and the hardware configuration should be done before use. Use FX3U-ENET-L configuration tool to set IP address of Ethernet module and enable MC communication function.

Ethernet Module Configuration

When using the Mitsubishi FX3U series PLC, the Ethernet module configuration must be completed first.

Steps

1. Run FX3U-ENET-L configurator, select **Module 0**, and click **Operational settings**.

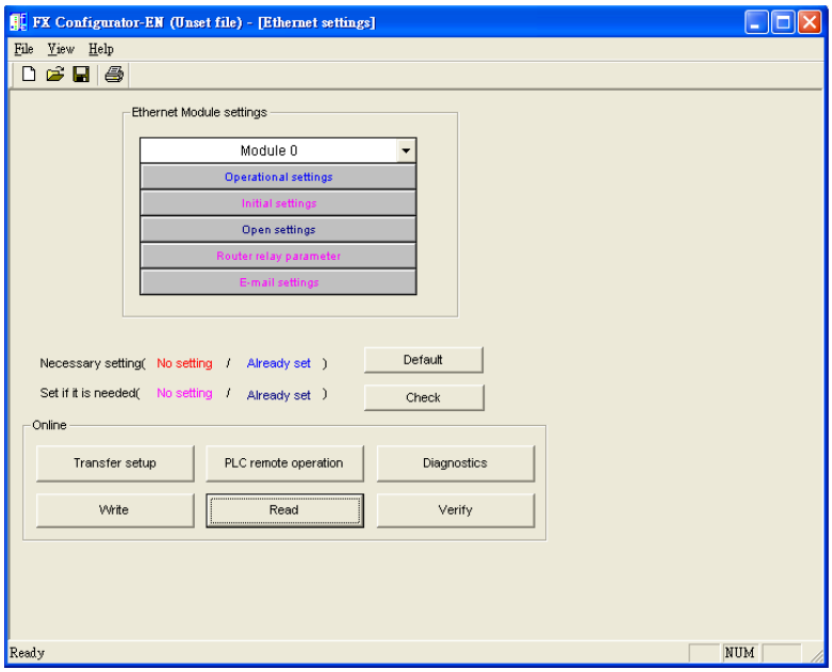


Figure 5-6 Ethernet Module Settings

2. Configure operational settings.

- **Communication Data Code**: The device should be set as BIN_1 frame if **Binary code** is selected, and the device should be set as ASCII_1E frame if **ASCII code** is selected.
- **Initial Time**: Select **Always wait for OPEN**.
- **IP Address**: It should be the same with the device's Server IP address.

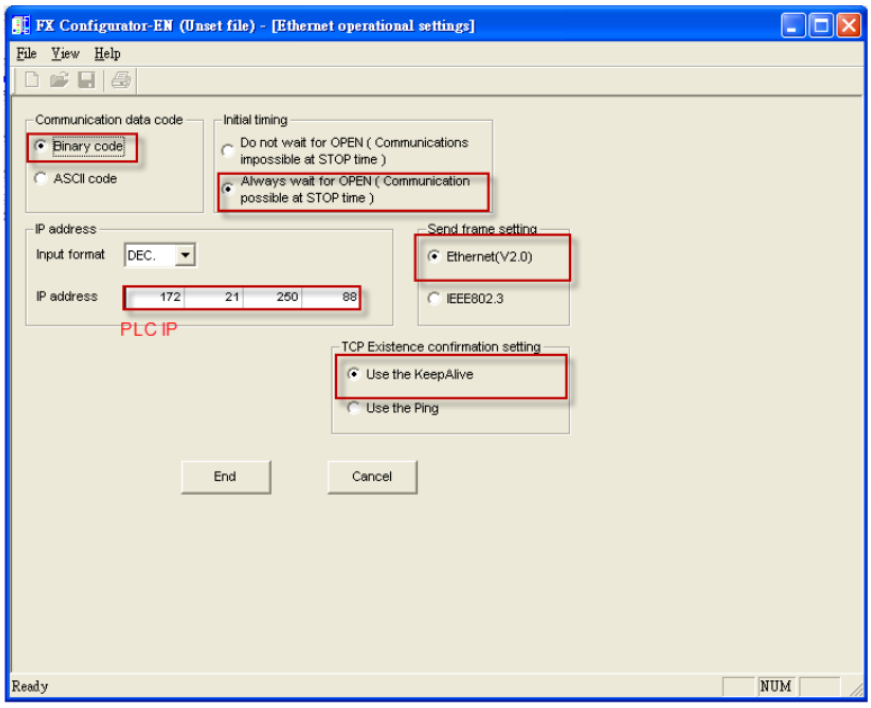


Figure 5-7 Ethernet Running Settings

3. Click **Open settings**, select **TCP** as **Protocol**, **Passive (MC)** as **Open system**, and set **5000** as **Host station Port No. (DEC.)**.

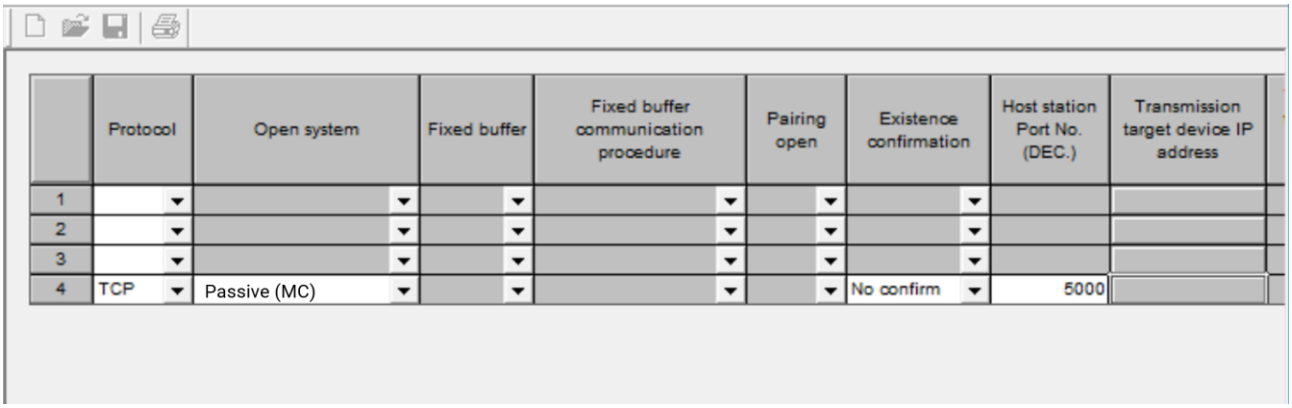


Figure 5-8 Configure MC Communication Parameters

4. Write to PLC after configuration.

Create GX-Works2 Project

When using Mitsubishi FX3U series PLC, you should also create GX-Works2 project.

Steps

1. Create a new GX-Works2 project, set **Series** and **Type** in according with FX3U series PLC
2. Go to **Navigation → Connection Destination → PC Side I/F Serial Setting → Serial USB**, and set COM Port and Transmission Speed. Make sure that PLC can be visited via the cable of USB to serial port.

5.3.2 Mitsubishi Q Series PLC

Regarding the Mitsubishi Q series PLC, you can configure it via GX-Works2.

Steps

1. Create a new GX-Works2 project, set **Series** and **Type** in according with Q series PLC.
2. Click **PLC Parameters** in the left navigation bar to enter the **Parameter Settings** dialog. Configure the PLC **IP Address** and **Port Number**.
3. Click **End Settings** > **Check** > **End Setting** sequentially to complete the process.
4. Click **Ethernet CC IE/MELSECNET** in the navigation bar to configure network-related parameters, as shown in the figure below.

Note

Configure the IP address as the current network segment of the PLC.

5. Click **End Setting** > **Check** > **End Setting** sequentially to complete the process.

6. In the navigation bar, click **Connection Target**, then click Connection1 to enter the connection target settings dialog.

1) Click **Programmable Controller Direct Connection Settings,** select **Ethernet**, choose the **network adapter** of the current PC as the adapter, and enter the current PC's IP address. Click **Yes** after configuration.

2) In the **Computer Side I/F** row, click **Ethernet Board**, select the **network adapter** of the current PC as the adapter, enter the current PC's IP address, and click **OK** after configuration.

3) In the **Programmable Controller Side I/F** row, click **PLC Module**, configure as shown in the figure below, and click **OK** after configuration.

4) In the **Other Station Specification** row, click **No Specification**, configure as shown in the figure below, and click **OK** after configuration.

5) In the Connection Target Settings dialog, click Communication Test. If the PLC is successfully connected, a pop-up will indicate a successful connection.

6) Click **OK** to save the configuration.

7. Register Configuration

7) In the left navigation bar, go to **Project** > **Soft Element Memory**, double-click **MAIN** to open the **register configuration page**, and configure as follows.

8) Click  to write all device data to the PLC.

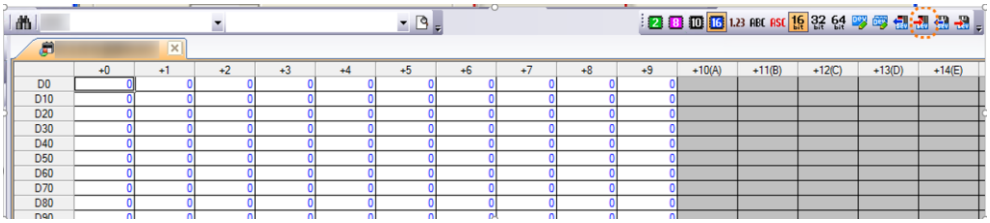


Figure 5-9 Writing Soft Elements to PLC

8. Communication Data Code Setting: When selecting binary code, the device end must be configured as BIN_3E frame; when selecting ASCII code, the device end must be configured as ASCII_3E frame.

9. Check Allow Writing During RUN (FTP and MC Protocol).

10. Open the settings, enable the MC protocol, configure the TCP protocol and port number. The port number should match the Server Port configured on the device.

5.4 Device Register Definition

The device is divided into four modules: control, status, result, and command.

Control

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

- Control module location: software component D area (the offset is configurable and the default value is 0).
- Module size: 1 word (2 bytes)

Table 5-1 Control Module Definition

D0/bit	Name	Description
D0.0	Trigger Enable	The PLC controls the device's trigger enable function via this bit.
D0.1	Trigger	When following conditions are met, the PLC sets this bit to trigger the device to acquire an image and run the algorithm once. ● Trigger Enable is set. ● The device is not currently acquiring images and running algorithms. ● Trigger Ready is set.
D0.2	Results Ack	After the PLC reads the latest result, this bit will be set and the Results OK and Results NG will be cleared.
D0.3	Execute Command	Execute the command specified in the commands area.
D0.4-14	Reserved	Reserved.
D0.15	Clear Error	Clear error status.

Status

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

- Status module location: software component D area (the offset is configurable and the default value is 1).
- Module size: 1 word (2 bytes)

Table 5-2 Status Module Definition

D1/bit	Name	Description
D1.0	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.
D1.1	Trigger Ack	The device has already received the trigger signal.
D1.2	Acquiring	The device is acquiring images.
D1.3	Decoding	The device is recognizing decodes on images.
D1.4-7	Reserved	Reserved.
D1.8	Results OK	The device outputs new results. When the PLC is set to Result Ack, the Results Available will be cleared.
D1.9	Results NG	When the device fails to read a code or obtain an output result, this bit will be cleared after the PLC sets the Results Ack bit. Note: When using the NG signal, the NoRead function must be disabled.
D1.10	Command Success	Executing communication command succeeded.
D1.11	Command Failed	Executing communication command failed.
D1.12-14	Reserved	Reserved.
D1.15	General Fault	A device's internal fault occurred, and you can clear this signal via Clear Error.

Result

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

- Result module location: software component D area (the offset is configurable and the default value is 2).
- Result size: 2 to 500 words (100 by default).

Table 5-3 Result Area Definition

Word	Name	Description
D2	Result Length	It refers to the length of valid data contained in the result area.
D3…	Result Data	It refers to the result output by the device, 128 bytes in total. ● 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 default offset value is 500, supporting customization.
- Command area size: 4 to 500 registers to configure (64 by default).

Table 5-4 Command Area Definition

REG/word	Name	Description
D500	User Data Length	It refers to the length of valid data contained in the command area.
D501…	User Data	It refers to command character.

5.5 Trigger Test

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

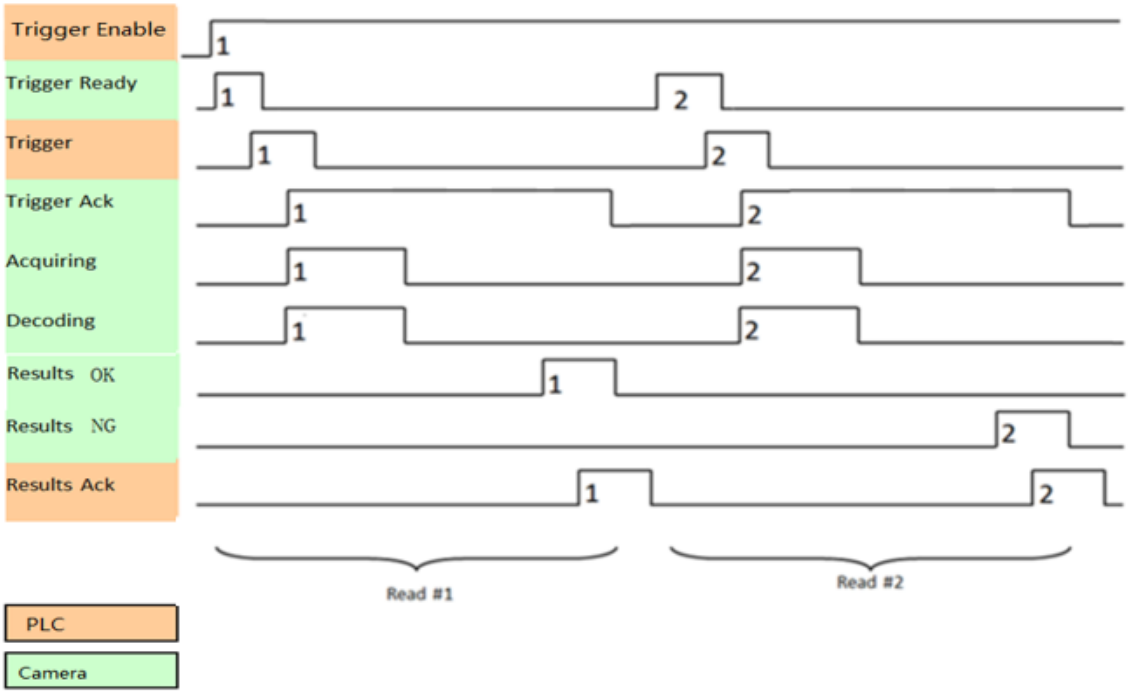


Figure 5-10 Communication Sequence Diagram

The logic of the above sequence diagram is shown below:

1. PLC sets Trigger Enable signal D0.0. After the device is ready, set Trigger Ready signal D1.0.
2. After detecting the device's Trigger Ready signal, the PLC sends Trigger signal D0.1 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 D1.8 and put contents of the configuration result into the address starting from D2.
- If the result output times out, set the Results Timeout signal D1.9 and clear the start address of D2.

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 D2.
5. After reading results is finished, set Results Ack signal D2, 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.

5.6 Project Switching Test

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.

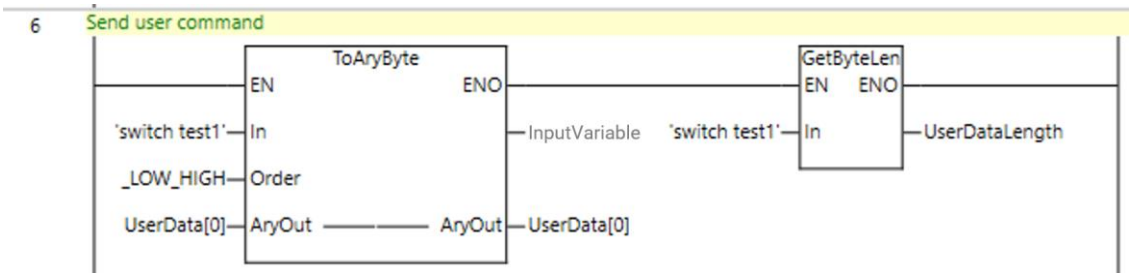


Figure 5-11 Send Switching Command

● 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.

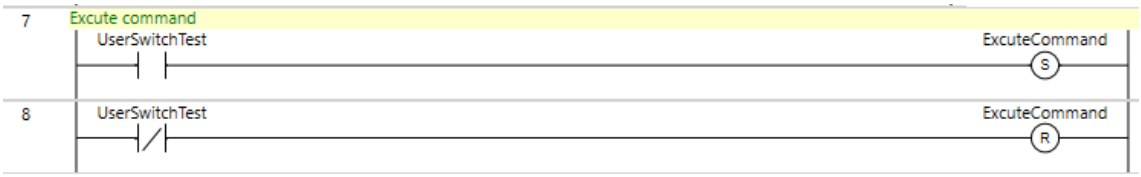


Figure 5-12 Execute Switching Command

Steps

1. Complete the smart camera and PLC settings, set the **Switching Mode** to **Communication Switching**, and configure the **Communication String** as “switch”.
2. In the batch change/read window for soft element values, write the switching scheme command in the instruction area. Assuming the scheme name is “11111”, the scheme switching command is “switch 11111”, which converts to hexadecimal as “73 77 69 74 63 68 20 31 31 31 31 31”. The instruction is shown in the diagram below.

5.7 FTP Image Saving Naming Test

The smart camera can receive strings from the PLC via industrial protocols and supports using the strings for FTP image saving names or triggering branches. This section introduces how to use the communication input string to name FTP image saving files.

Steps

1. Complete the smart camera and PLC settings, set the camera’s **Trigger Source** as **Communication Trigger**, and configure the **Communication String**, for example, **“trig”**.

2. On the SCMVS client software **Communication Settings** page, add **FTP Communication** and set the File naming policy to **"Subscribe"**, with the **File Naming Subscription** set to the communication input string.



Figure 4-14 FTP Communication

3. Click the **Continuous Run** in the upper right area of the image live view pane.
4. Write the string in the command area. For example, to name the image saving file as "12345678", you need to enter the complete string as "trig 12345678", i.e., write the string length at D500, and sequentially write the complete string starting from D501.
5. At D0.0, first write 1 to enable the smart camera's trigger function; then write 1 atD0.3 to execute the command area. This will trigger the camera once and save the image with the filename "12345678 + timestamp".

Chapter 6 FINS

FINS (Factory Interface Network Service) communication protocol is a command/response system for industrial automation control networks developed by Omron, and it helps achieve seamless communication between various networks.

Note

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

6.1 Hardware Wiring

The wiring of Mitsubishi series PLC and the smart code reader is shown below.

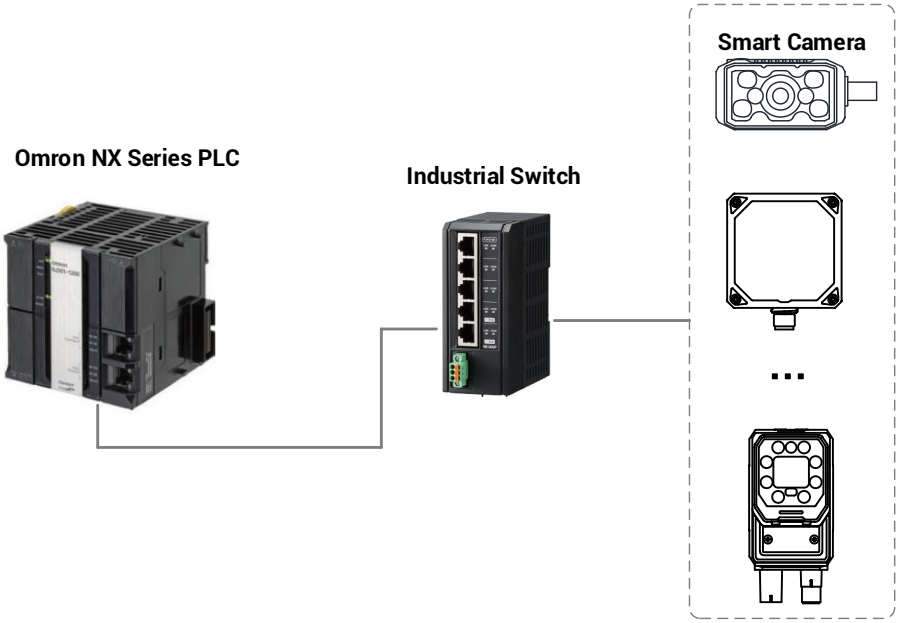


Figure 6-1 Networking Method

6.2 Smart Camera Settings

Before using the smart camera's FINS 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 SC5000X series and SC6000 series smart camera, you need to operate it via the embedded VM, 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 open the Communication Settings dialog.
3. Click ⊞ to add FINS communication.
4. Switch on ◯ to enable FINS communication and configure relevant parameters.
   −Configure Basic Information
   - **Server IP:** Enter PLC's IP address (required).
   - **Server Port**: Enter PLC's port No. (required).
   - **Byte Swap**: When enabled, results are output by byte order. When disabled, results are output by normal sequence.
   - **Timeout (s)**: Set the timeout duration for connecting to the PLC.
   - **Polling Interval (ms)**: Set the interval for the device to periodically request basic information from the PLC.

   −Control, Status, Result, Command configuration

   The parameters in these four areas are similar. Configure them based on the actual interface display as follows:
   - **Address Space**: Set the storage space for instructions. Currently, only DM is supported.
   - **Address Offset**: Set the address offset for the control area. The default value is 0 (no offset). If set to 4, instructions will be offset by 4 registers from the starting position.
   - **Data Quantity** (Word): Set the number of valid data bits for input. For example, if set to 1, only 1 bit of data is valid. Inputs exceeding this limit will not take effect.
   - **Polling Interval (ms)**: Set the interval for the device to periodically request control instruction data from the PLC.
   - **Byte Swap**: If enabled, byte swapping is applied, and the output results will follow the byte order.
   - Timeout (s): Set the maximum waiting time for receiving results.
5. Click **Scheme Settings** in the **Scheme Editing** pane of the main window, then select **External Trigger** as the trigger mode, and select trigger source 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.
6. Create a project and set parameters for cameras, base images, and vision tools according to actual demands.

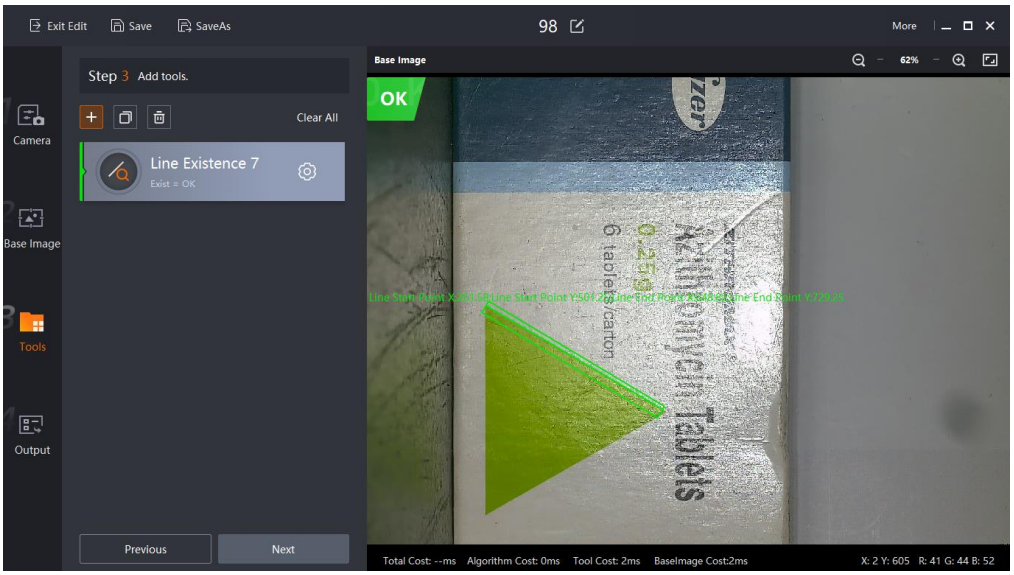


Figure 6-2 Line Existence

Note

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

7. Go to **Output** > **Tool Results** > **Add** to set the outputted content.

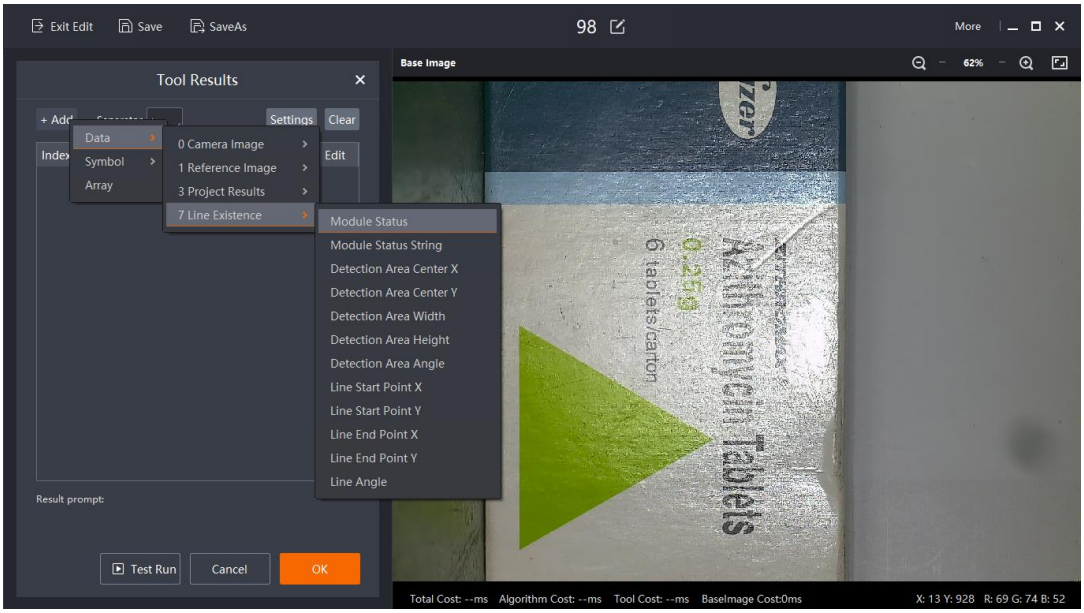


Figure 6-3 Set Tool Results

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.

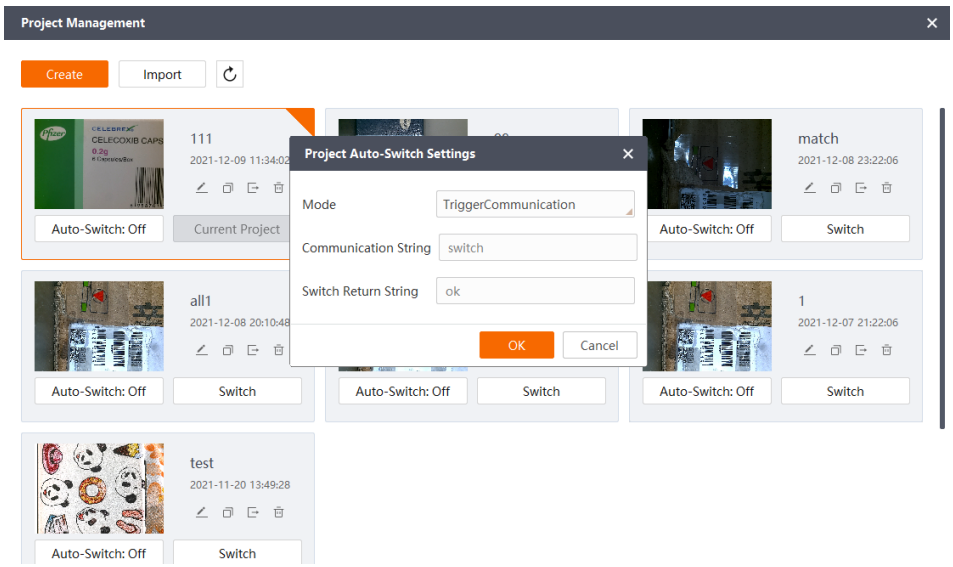


Figure 6-4 Project Switch Settings

6.3 PLC Settings

This section takes Omron NJ102-9000 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 Sysmac Studio, click **New Project**, define the **project name**, and choose the corresponding **type, device, and version** from the **Device Selection** based on the actual hardware used. Click **Create**.

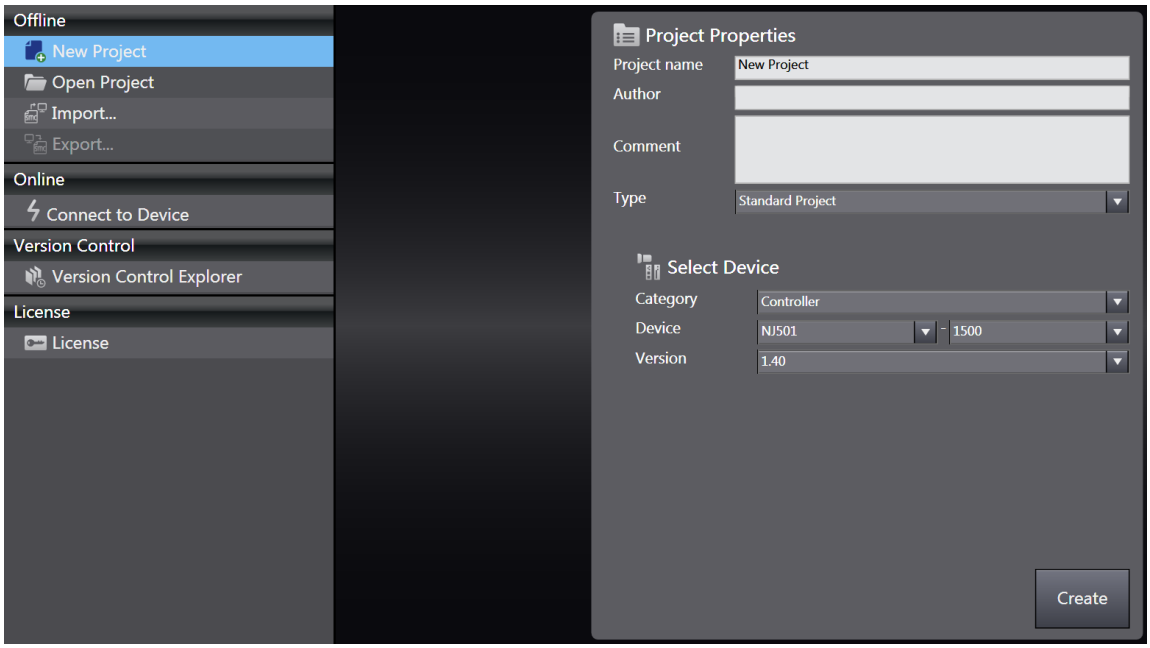


Figure 6-5 Create New Project

2. In the left navigation pane, go to **Configuration and Settings** > **Controller Settings**, click **Built-in EtherNet/IP Port Settings**, and configure Port 2 to be on the same subnet as the device. Configure Port 1 as shown in the figure below.

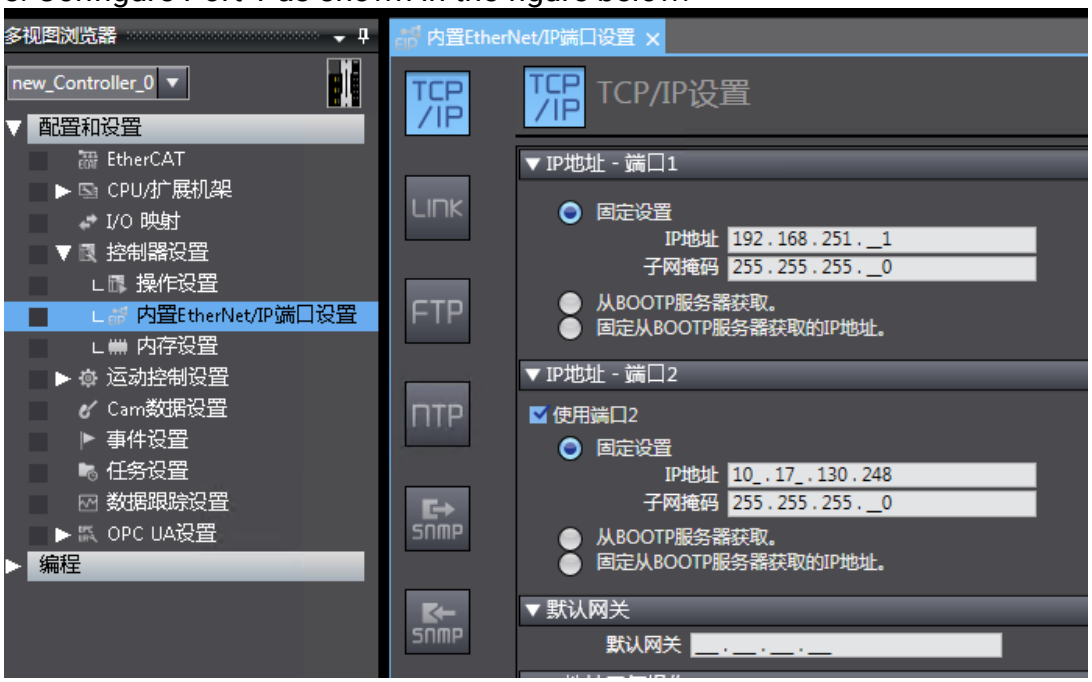


Figure 6-6 Built-In EtherNet/IP Port Settings

3. Click **Memory Settings**, check **DM** to enable the DM area type in memory settings.

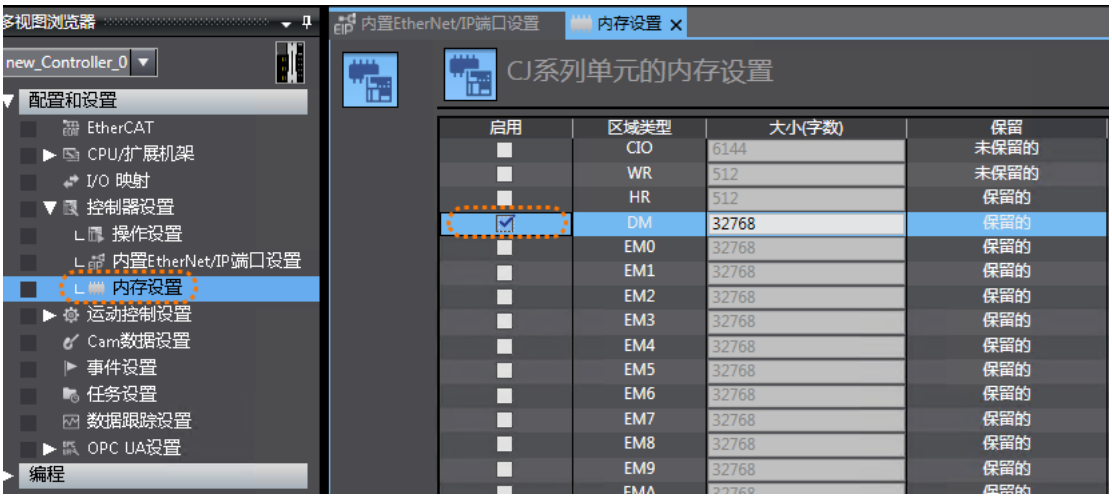


Figure 6-7 Memory Settings

4. In the left navigation pane, go to **Programming** > **Data**, click **Global Variables**, and create the global variables required for communication. The size should match the values set in the SCMVS client.

Note

Variable names should start with a capital letter.
When connecting multiple devices, create multiple input and output global variables with different names.

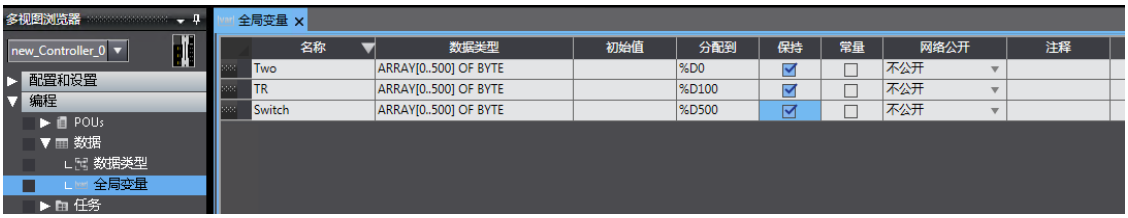


Figure 6-8 Create Global Variables

For other variable types, refer to the figure below.

TriggerEnable	BOOL		%D0.0	☑	☐
Trigger	BOOL		%D0.1	☑	☐
ResultAck	BOOL		%D0.2	☑	☐
ExcuteCommand	BOOL		%D0.8	☑	☐
ClearError	BOOL		%D0.15	☑	☐
UserDataLength	UINT		%D9	☑	☐
UserData	ARRAY[0..179] OF BYTE		%D10	☑	☐
TriggerReady	BOOL		%D101.0	☑	☐
TriggerAck	BOOL		%D101.1	☑	☐
Acquiring	BOOL		%D101.2	☑	☐
Decoding	BOOL		%D101.3	☑	☐
ResultsAvailable	BOOL		%D101.8	☑	☐
ResultsTimeout	BOOL		%D101.9	☑	☐
GeneralFault	BOOL		%D101.15	☑	☐
ResultLength	UINT		%D109	☑	☐
ResultData	ARRAY[0..179] OF BYTE		%D110	☑	☐
UserResultData	ARRAY[0..179] OF BYTE		%D500	☑	☐
UserSwitchTest	BOOL		%D600.0	☑	☐
UserSwitchCommand	STRING[13]	'switch test1'		☑	☑

Figure 6-9 Other Variables

5. After adding global variables, click the **Monitor tab** in the top toolbar. On the Monitor Table page, enter the variable name in the **Name** field to add a monitor table for viewing or modifying data stored in different bits of the registers, as shown below.

Note

Click **Monitor (Table)*** at the bottom of the monitor table and select **Add Tab** to create multiple tabs for viewing data from multiple variables.

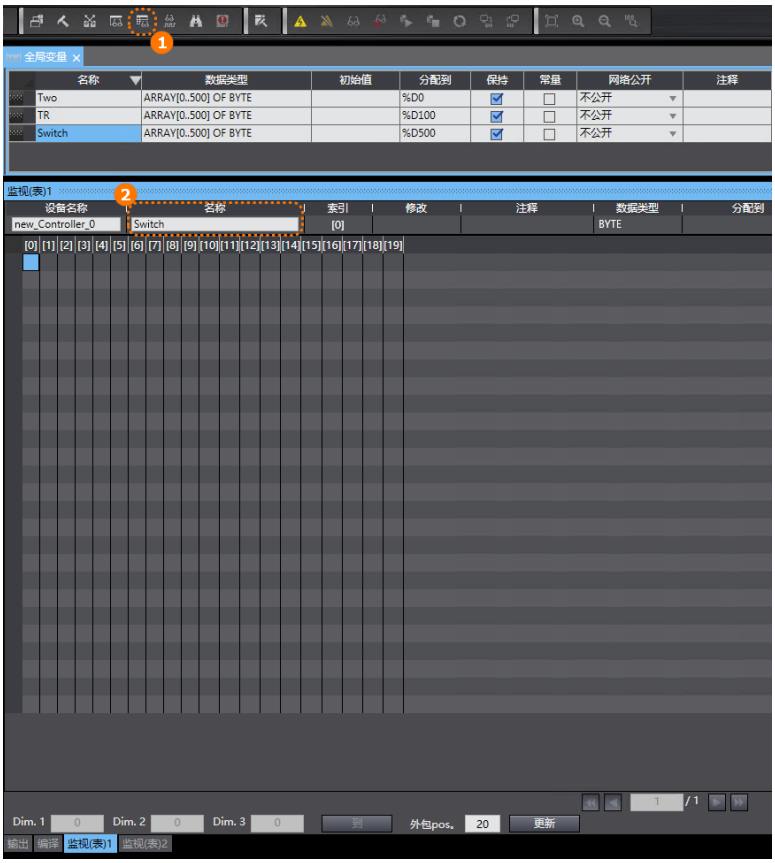


Figure 6-10 Add Monitor Table

6. After completing the above configurations, click **Online** > **Sync** in the top toolbar, and then click **Transfer to Controller** to download the project to the PLC controller.



Figure 6-11 Sync to PLC

Wait for the synchronization to complete. The PLC configuration is finished.

6.4 Device Register Definition

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

Control

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

- Control area location: holding registers, the default offset value is 0, supporting customization.
- Control area size: 1 register (2 bytes)

Table 6-1 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. ● 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 default offset value is 1, supporting

customization.

- Status area size: 1 register (2 bytes)

Table 6-2 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	Command Success	Executing communication command succeeded.
REG 1.11	Command Failed	Executing communication command failed.
REG 1.12-14	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 default offset value is 2, supporting customization.
- Result size: 4 to 500 registers (100 by default).

Table 6-3 Result Area Definition

REG/word	Name	Description
REG 2	Result Length	It refers to the length of valid data contained in the result area.
REG 3…	Result Data	It refers to the result output by the device. ● 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 default offset value is 500, supporting customization.
- Command area size: 4 to 500 registers to configure (100 by default).

Table 6-4 Command Area Definition

REG/word	Name	Description
REG 500	User Data Length	It refers to the length of valid data contained in the command area.
REG 501…	User Data	It refers to command character.

6.5 Trigger Test

Communication Sequence Diagram

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

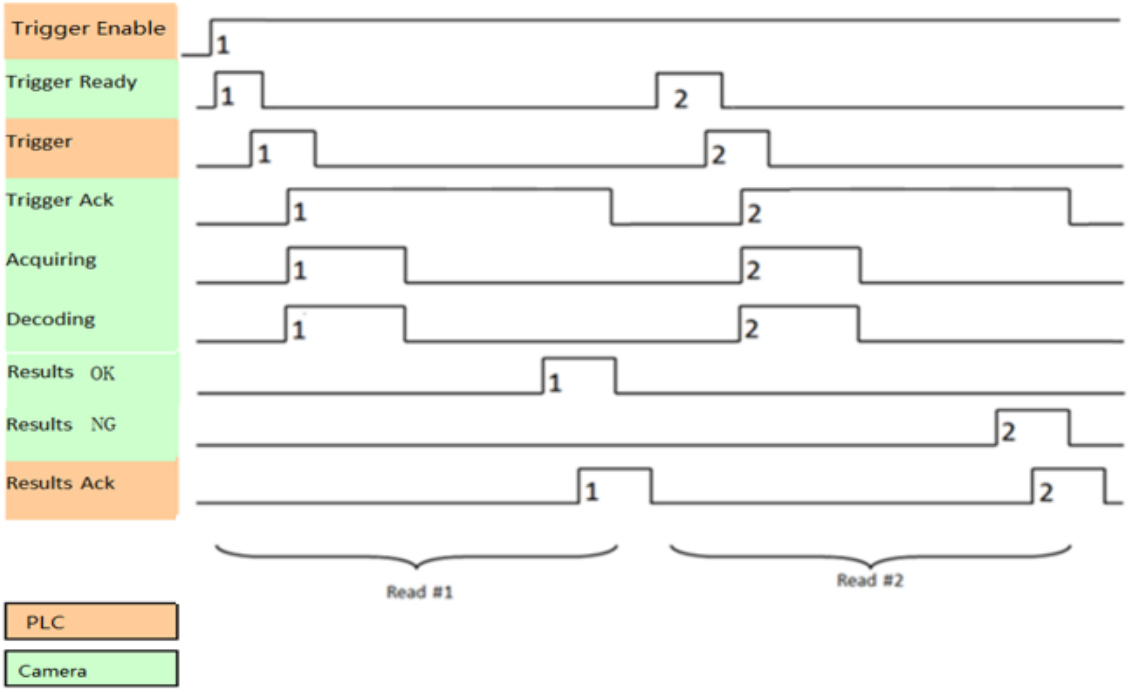


Figure 6-12 Communication Sequence Diagram

The logic of the above sequence diagram is shown below:

1. PLC sets Trigger Enable signal D0.0. After the device is ready, set Trigger Ready signal D1.0.
2. After detecting the device's Trigger Ready signal, the PLC sends Trigger signal REG0.1 and controls the device to initiate barcode reading.
3. The device starts to acquire images and decodes after receiving Trigger signal.

- If the barcode is recognized correctly, set the Results OK signal D1.8 and put the barcode length and content into the address starting from D2.
- If no barcode is recognized, set the Results NG signal D1.9 and clear the start address of D2.

Note

- With NoRead enabled: If no code is read, reports Results OK + "NoRead" characters.
- With NoRead disabled: If no code is read, reports Results NG.

4. After detecting Results OK/NG, the PLC starts to read results from D2.
5. After reading results is finished, set Results Ack signal D0.2, 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.

Note

If the device cannot output results due to internal errors (e.g., IDMVS connected but image acquisition not started), it sets the General Fault signal (D1.15). The PLC should then set the Clear Error signal (D0.15) after confirming the error cause. Once cleared, triggering can resume.

Create Variables

Based on the device memory area definitions, create variables as shown below.

	TriggerEnable	BOOL		%D0.0	☑	☐
	Trigger	BOOL		%D0.1	☑	☐
	ResultsAck	BOOL		%D0.2	☑	☐
	ClearError	BOOL		%D0.15	☑	☐
	TriggerReady	BOOL		%D1.0	☑	☐
	TriggerAck	BOOL		%D1.1	☑	☐
	Acquiring	BOOL		%D1.2	☑	☐
	Decoding	BOOL		%D1.3	☑	☐
	ResultsOK	BOOL		%D1.8	☑	☐
	ResultsNG	BOOL		%D1.9	☑	☐
	GeneralFault	BOOL		%D1.15	☑	☐
	ResultLength	UINT		%D2	☑	☐
	ResultData	ARRAY[0..199] OF BYTE		%D3	☑	☐
	ResultDataUser	ARRAY[0..199] OF BYTE		%D500	☑	☐

Figure 6-13 Create Variables

Ladder Diagram

When the PLC continuously triggers barcode reading, relevant ladder diagrams can be seen as follows:

- Enable Device Trigger

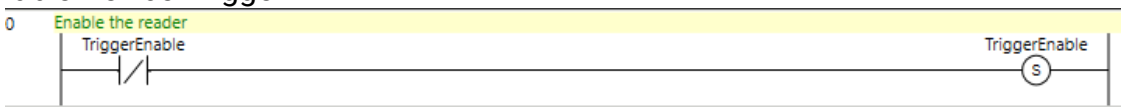


Figure 6-14 Enable Device Trigger

- Trigger Barcode Reading
  Add edge signals before Trigger Ready to generate triggers based on application needs (e.g., triggered by a photoelectric sensor input).

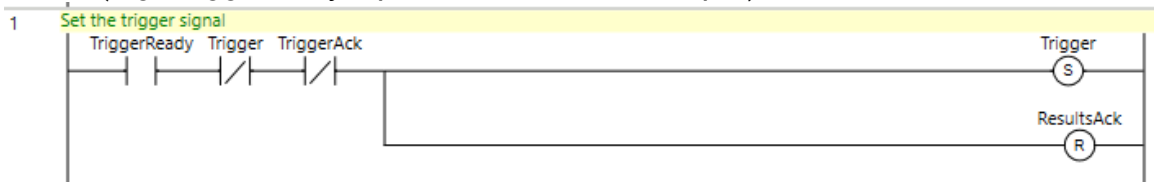


Figure 6-15 Trigger Barcode Reading

- Clear Trigger Signal

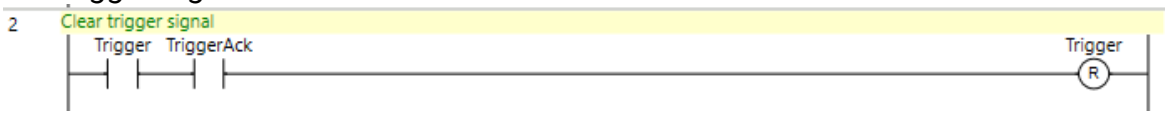


Figure 6-16 Clear Trigger Signal

- Retrieve Device Results
  When Results OK or NG is received, the PLC reads result data into the user's memory area.
  After reading, set Results Ack to confirm.
  If the barcode byte order is incorrect, enable byte-swapping for result data in the device configuration.

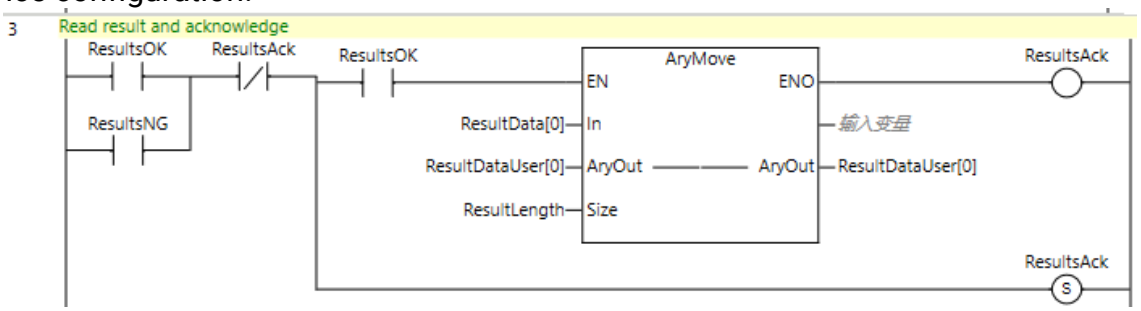


Figure 6-17 Retrieve Device Results

- Clear Errors

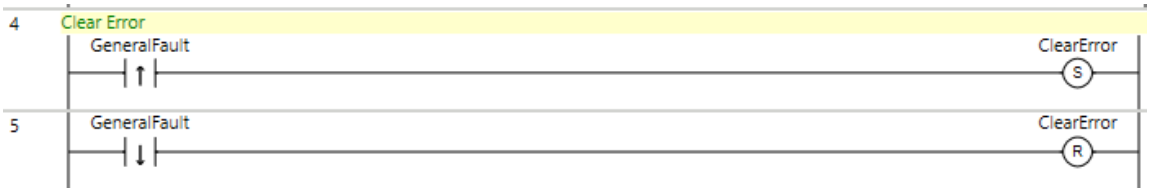


Figure 6-18 Clear Errors

View Results

Use the monitoring window to check the status of device module variables and view output results.

6.6 Project Switching Test

Steps

1. Complete the smart camera and PLC settings, set the switching mode to communication switching, and configure the communication string as "switch".
2. In the instruction area registers, write the switching scheme command in the instruction area. Assuming the scheme name is "null", the scheme switching command is "switch null", which converts to hexadecimal as "73 77 69 74 63 68 20 6e 75 6c 6c". The instruction is shown in the diagram below.



Figure 6-14 Switching Scheme Command Configuration

3. Write "0x0004" into the Control Area Registers to clear the previous content, then enter the trigger command "0x0100". Press Enter after inputting to trigger the scheme switch.



Figure 6-15 Trigger Scheme Switch

6.7 FTP Image Saving Naming Test

The smart camera can receive strings from the PLC via industrial protocols and supports using the strings for FTP image saving names or triggering branches. This section introduces how to use the communication input string to name FTP image saving files.

Steps

1. After settings of the smart camera and PLC, set the camera's **Trigger Source** as **Communication Trigger**, and configure the **Communication String**, for example, **"trig"**.
2. On the SCMVS client software **Communication Settings** page, add **FTP Communication** and set the **FileName Strategy** to **"Subscribe"**, with the **FileName Subscription** set to the communication input string.



Figure 6-16 FTP Communication

3. Click the **Continuous Run** in the upper right area of the image live view pane.
4. Write the string in the command area. For example, to name the image saving file as "12345678", you need to enter the complete string as "trig 12345678", i.e., write the string length at REG500, and sequentially write the complete string starting from REG501.

5. At REG0.0, first write 1 to enable the smart camera’s trigger function; then write 1 at REG0.8 to execute the command area. This will trigger the camera once and save the image with the filename “12345678 + timestamp”.

Chapter 7 Revision History

Table 4-1 Revision History

Version	Document No.	Revision Date	Revision Details
V1.1.0	UD45347B	Dec. 26, 2025	● Add descriptions related to KV protocol, MELSEC/SLMP, and FINS protocol. ● Add explanation of Modbus protocol implementation methods. ● Add QR code of communication protocol Vision Master 4.4.30 (SC5000X and SC6000 smart cameras) for details about data communication with PLC via EtherNet/IP and PROFINET.
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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Hikrobot Co., Ltd.

Tel: 400-989-7998

Website: https://en.hikrobotics.com/

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