How to Use the TIA Portal to Set a Siemens PLC and the MGate 5103

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Contents

About Moxa

Moxa is a leading manufacturer of industrial networking, computing, and automation solutions. With over 25 years of industry experience, Moxa has connected more than 30 million devices worldwide and has a distribution and service network that reaches customers in more than 70 countries. Moxa delivers lasting business value by empowering industry with reliable networks and sincere service for automation systems. Information about Moxa's solutions is available at www.moxa.com. You may also contact Moxa by email at info@moxa.com.

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1 Application Description

The **TIA Portal** is **Siemens**'s new software platform to configure and program **S7-300**/**400**/**1200**/**1500** PLCs. This technical note demonstrates how to configure the **Siemens S7-300** to connect with the **MGate 5103** in **TIA Portal** V14.

The **MGate 5103** supports a variety of maintenance functions, such as **Protocol Diagnostics**, **Traffic Monitoring**, **Status Monitoring**, and **Fault Protection**. The **Status Monitoring** function notifies a PLC/DCS/SCADA system when a Modbus device gets disconnected or does not respond. If a command has run successfully, the status bit's value will be 1. If a command has failed, the status bit's value will then be 0. In this case, the master device will be aware of the failure status of the slave device. When a PROFINET connection is disconnected, the **Fault Protection** function executes actions on end devices identified by a pre-defined value set by the user.

This technical note also demonstrates how the PROFINET IO controller (**Siemens** PLC) receive these Modbus command statuses by sending **PROFINET Acyclic Read** commands, as well as how the **Fault Protection** function works. We also demonstrated how to use the **Protocol Diagnostics** and **Traffic Monitoring** functions for troubleshooting.

2 System Topology

This technical note demonstrates how to exchange data between a PROFINET IO controller and six Modbus RTU slaves. The Modbus RTU slave IDs 1-3 use Modbus Read command, and shows the **Status Monitoring** function. The Modbus RTU slave IDs 4-6 use Modbus Write command, and shows the **Fault Protection** function.

We use **Siemens S7-300** as the **PROFINET IO controller** to connect the **MGate 5103**. On a PC, we run **Modbus Slave** tools to simulate Modbus RTU slaves and connect to the **MGate 5103**'s serial port.
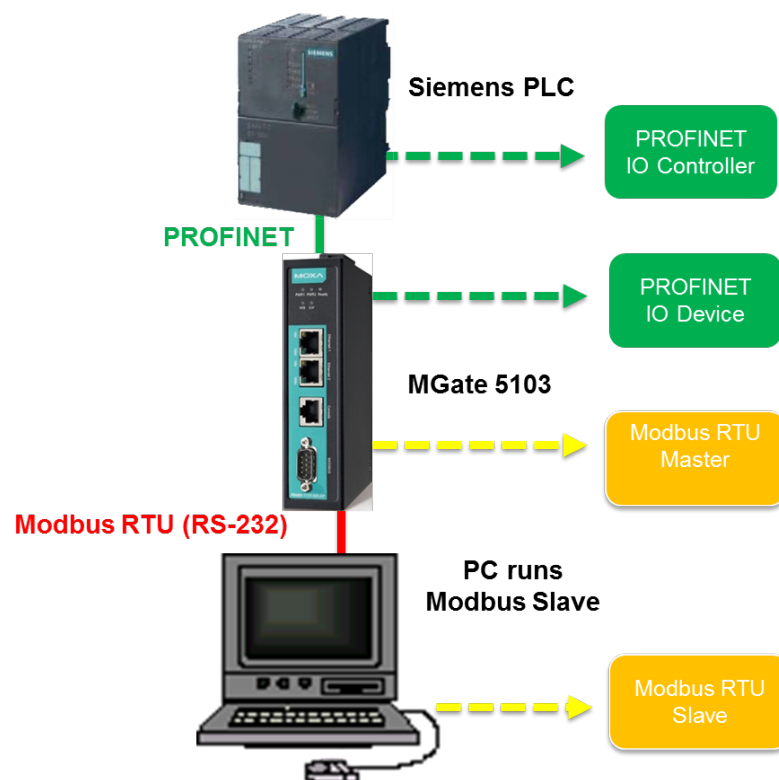
3 Required Equipment and Components

A. TIA Portal V14

As a registered **Siemens**'s customer, you can download the trial software for the **TIA Portal** V14 and test it for 21 days.

Version: V14

Download Website:

https://support.industry.siemens.com/cs/document/109740158/simatic-step-7-(tia-portal)-v14-trial-download?dti=0&lc=en-WW

B. Modbus Slave

Modbus Slave is a very popular Modbus slave simulator to test and debug of your Modbus devices. It supports Modbus RTU/ASCII and Modbus TCP/IP.

Version: V6+

Download Website: http://www.modbustools.com/download.html

C. MGate 5103 Firmware

Version: V.1.0 or higher

Download Website: http://www.moxa.com

D. MGate 5103's GSDML File

The **GSDML** (General Station Description Mark-Up Language) file is an electronic device datasheet or device database file that identifies the PROFINET IO device. This file can be installed into the PROFINET Engineering Tool, e.g., the TIA Portal, so that this PROFINET Engineering Tool can configure the PROFINET IO Device.

Version:

GSDML-V2.2-Moxa-Device0202-20170502.xml/GSDML-V2.3-Moxa-Device0202-20170502.xml

Download Website: http://www.moxa.com

Note: For wiring, please refer to the MGate 5103's User's Manual.

4 MGate 5103 Settings

For details, please refer to the MGate 5103 user's manual. You can download it from www.moxa.com

A. Protocol Conversion

Log in to the **MGate 5103**'s Web Console. Set **Protocol Conversion**: Role 1 as **PROFINET IO Device**, Role 2 as **Modbus RTU/ASCII Master**.
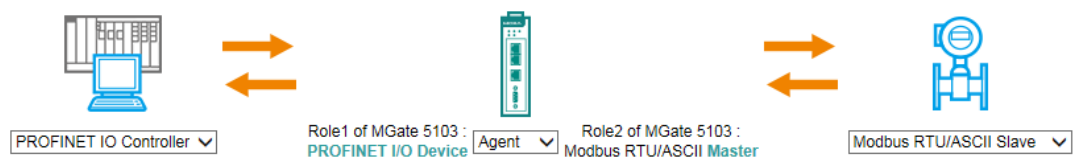
B. Configure Modbus Commands

Under **Modbus RTU/ASCII setting**, set Modbus as **RTU**, **Max. retry** as 0. The default of this value is 3. Change this value to 0 in order to quickly detect when a Modbus command failed.

Then add the commands below to poll Slave ID1-ID3's register 0, and add Function Code 06 commands to write Slave ID4-ID6's register 0.

Role	Master
Mode	RTU

Master Settings

Initial delay	0	(0 - 30000 ms)
Max. retry	0	(0 - 5)
Response timeout	1000	(10 - 120000 ms)
Inter-frame delay	0	(10 - 500 ms, 0: default)
Inter-character timeout	0	(10 - 500 ms, 0: default)

Modbus Commands

➕ Add　🖉 Edit　🗐 Clone　🗑 Delete　↕ Move

Index	Name	Slave ID	Function	Address / Quantity	Trigger	Poll Interval	Endian Swap
1	ID1	1	3	Read address 0, Quantity 1	Cyclic	1000	None
2	ID2	2	3	Read address 0, Quantity 1	Cyclic	1000	None
3	ID3	3	3	Read address 0, Quantity 1	Cyclic	1000	None
4	ID4	4	6	Write address 0, Quantity 1	Data Change	N/A	None
5	ID5	5	6	Write address 0, Quantity 1	Data Change	N/A	None
6	ID6	6	6	Write address 0, Quantity 1	Data Change	N/A	None

For ID4 command's **Fault Protection**, keep it as **Keep latest data**.

Name	ID4
Slave ID	4
Function	06 - Write Single Register
Trigger	Data Change
Endian swap	None
Write starting address	0 (0 - 65535)
Write quantity	1
Fault protection	Keep latest data
Fault timeout	60000 (100 - 65535 ms)

For ID5 command's **Fault Protection**, choose **Clear all data bit to 0** and set **Fault timeout** as 10000 ms.

Name	ID5
Slave ID	5
Function	06 - Write Single Register
Trigger	Data Change
Endian swap	None
Write starting address	0 (0 - 65535)
Write quantity	1
Fault protection	Clear all data bit to 0
Fault timeout	10000 (100 - 65535 ms)

For ID6 command's **Fault Protection**, choose **Set to user defined value** and set **Fault value** as 0xFF 0xFF . **Fault timeout** is set as 10000 ms.

Name	ID6
Slave ID	6
Function	06 - Write Single Register
Trigger	Data Change
Endian swap	None
Write starting address	0 (0 - 65535)
Write quantity	1
Fault protection	Set to user defined value
Fault timeout	10000 (100 - 65535 ms)

Fault value(Hex)

	0	1	2	3	4	5	6	7	8	9
0	FF	FF								

C. Configure PROFINET Setting

Only the Device Name needs to be set. Set it as mgate-dev.

D. I/O Data Mapping

Allow the MGate to automap the data on both sides of the MGate's IO Internal Memory. Check **I/O Data Mapping** with Data flow direction: **PROFINET IO Controller →**
Modbus RTU/ASCII Slave or **PROFINET IO Controller ← Modbus RTU/ASCII Slave**.
Make sure the **PROFINET Output or Input Slot Size** is fully and correctly mapped to
Modbus Internal Address.

5 Siemens PLC Setting

(1) Create a new project.
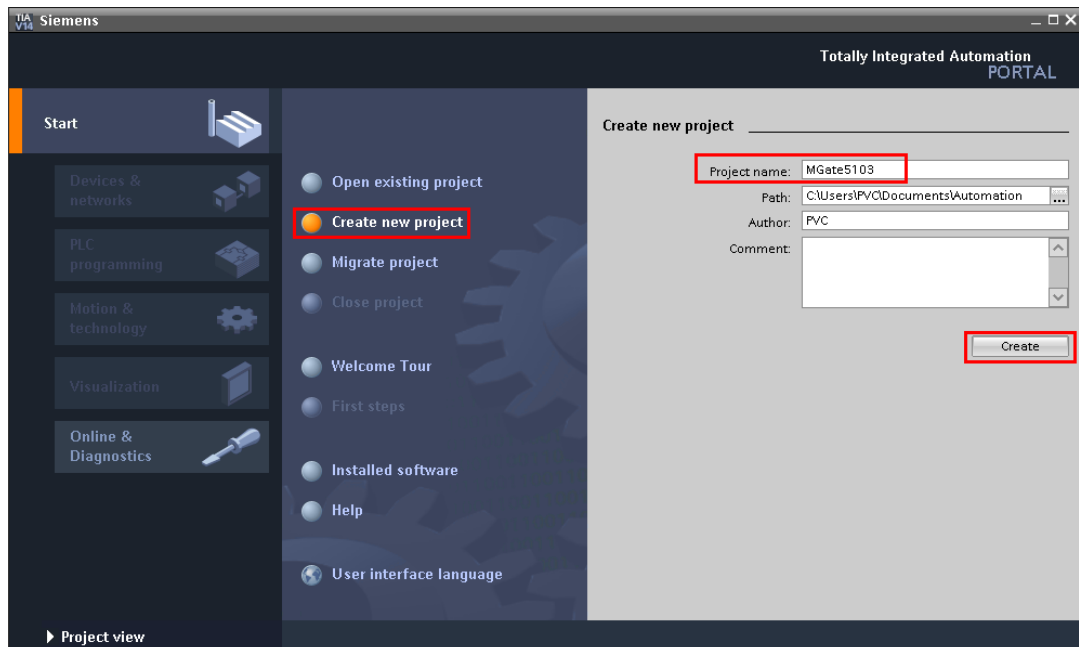
(2) After the project is successfully created, click **Configure a device** to add the PLC.
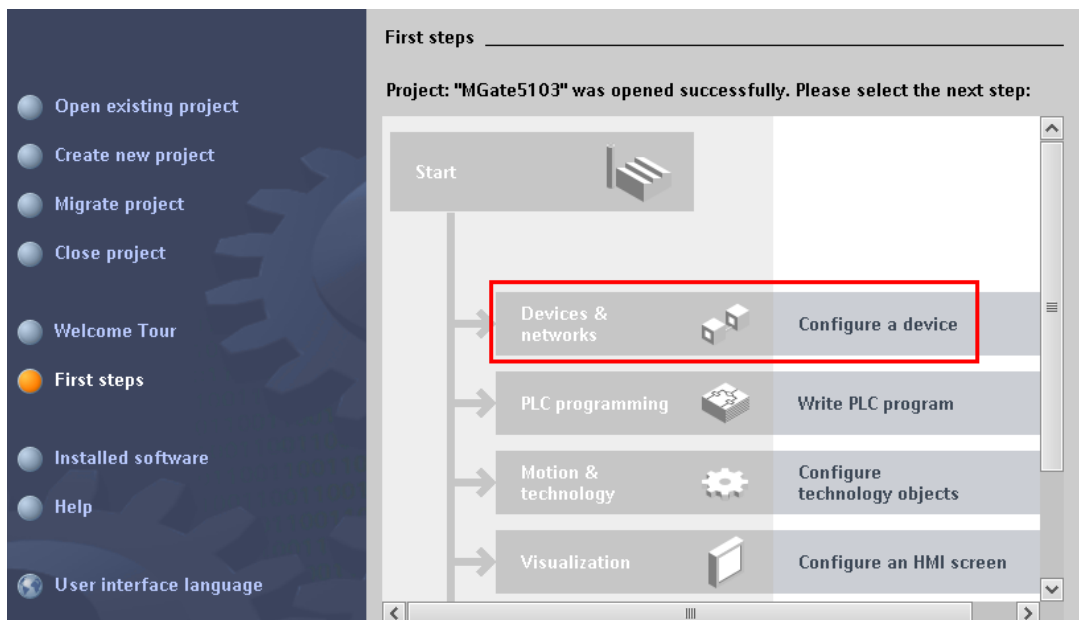
According to the actual PLC's CPU model, select it from "**Controllers → S7-300 → CPU**"
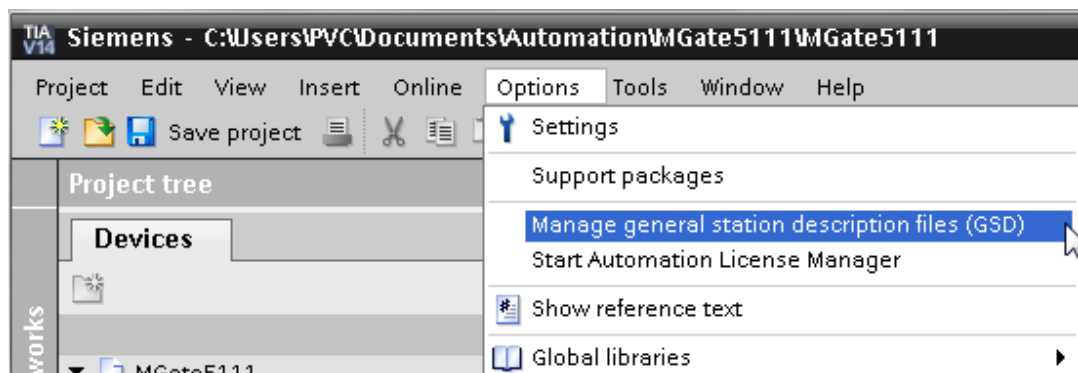as below:
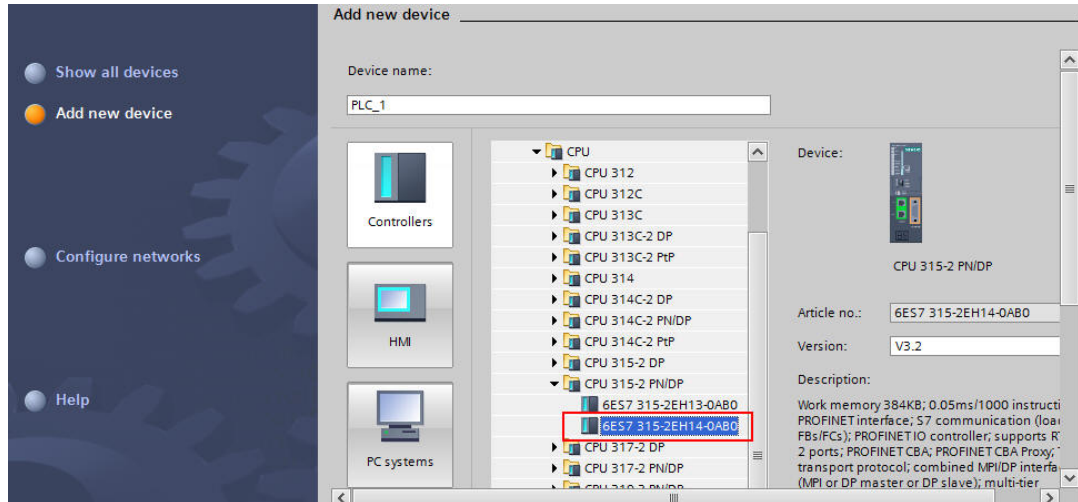
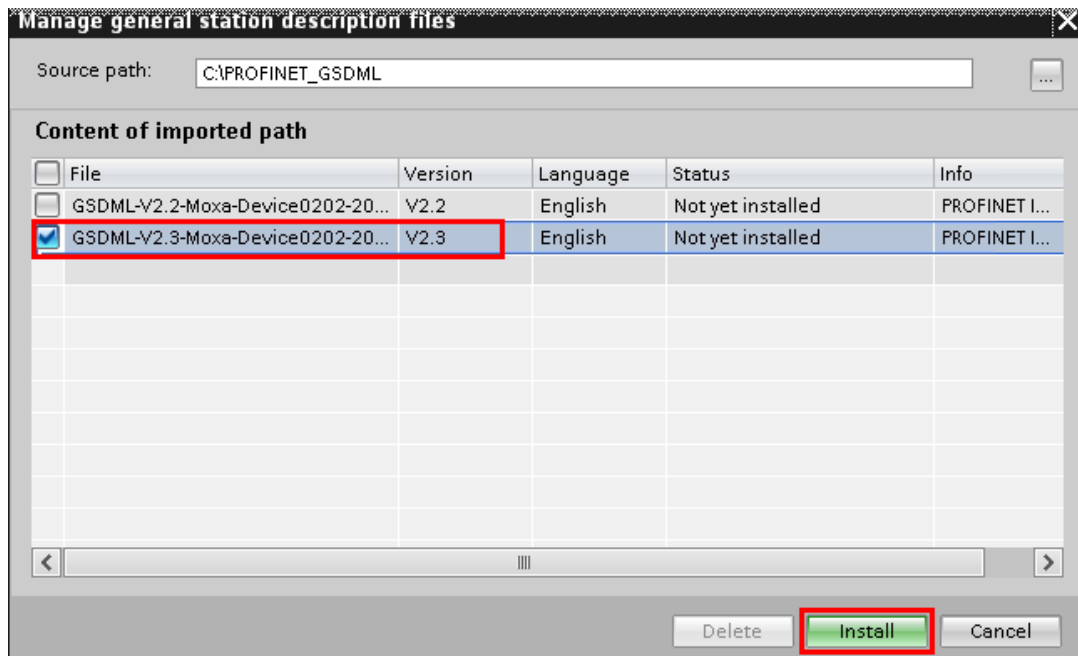**(3)** Click PLC's **PROFINET interface_1** to set its **IP Address**.
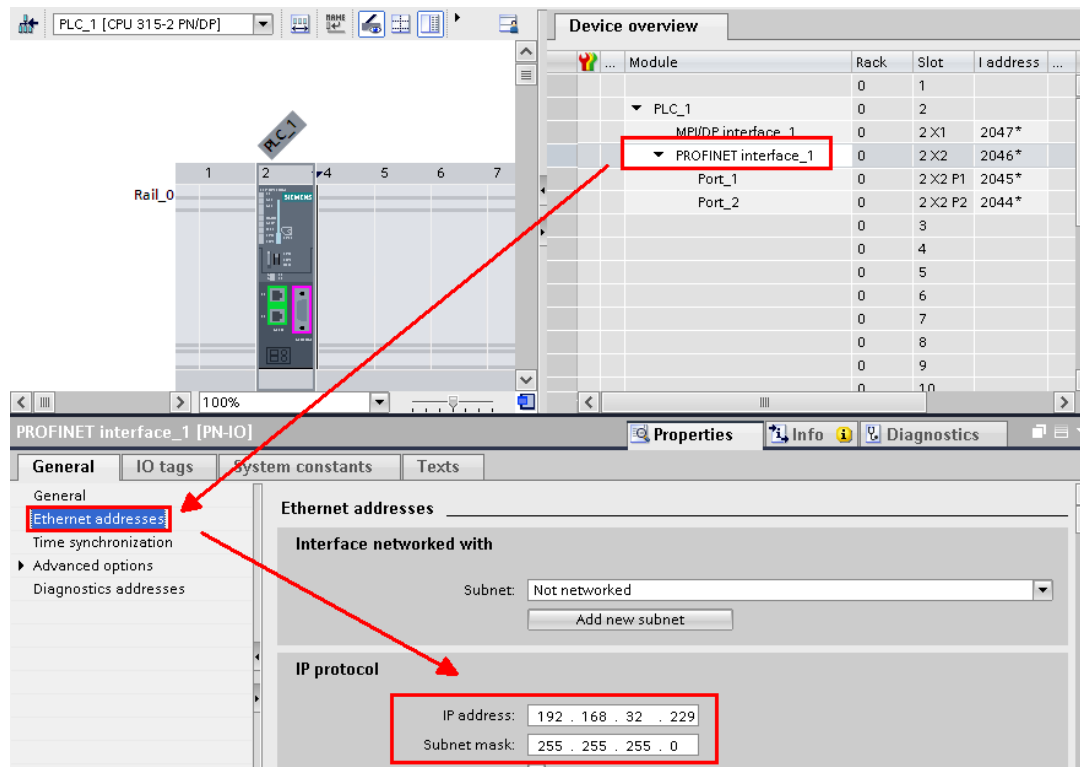
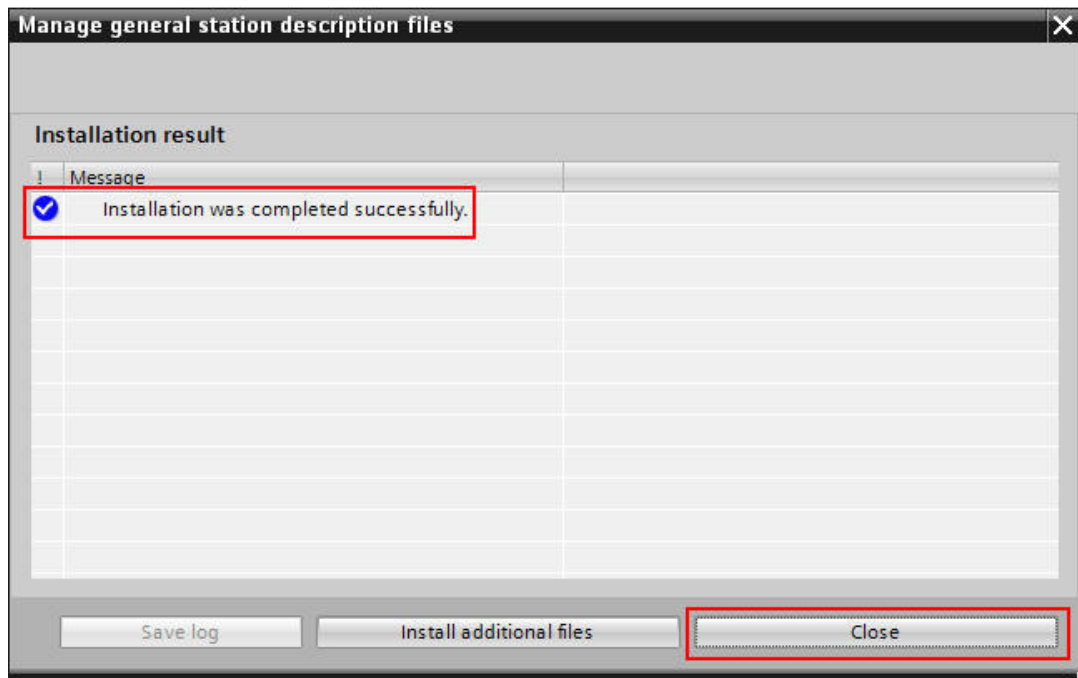**(4)** Click **Add new subnet** to create subnet as **PN/IE_1**.
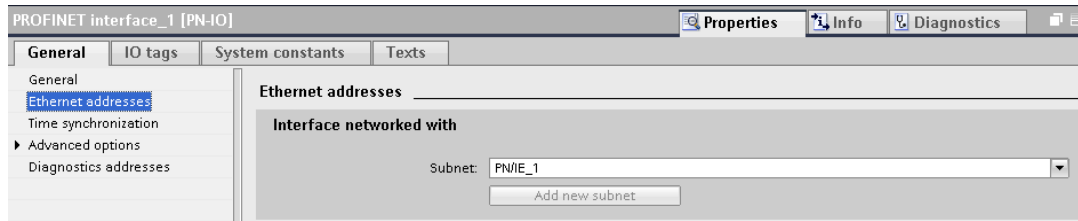
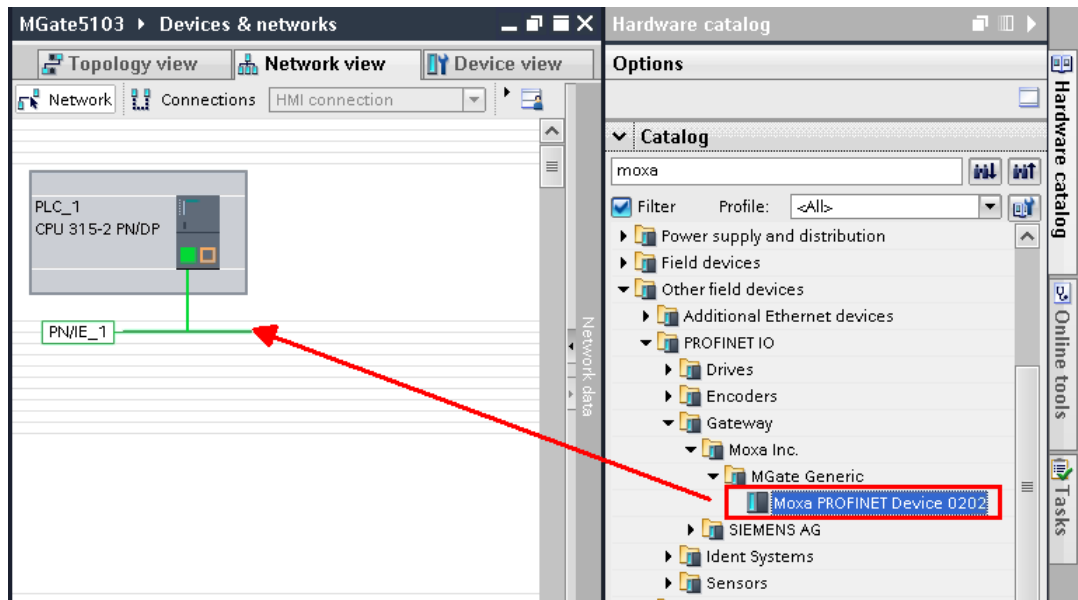**(5)** Click **Options → Manage general station description** to install the **MGate 5103**'s GSD file.

Select the latest version of the **MGate 5103**, V2.3, and then click **Install**.

Make sure the installation is successful.

(6) In the **Hardware catalog** window, filter "moxa" to search **the MGate 5103**. Choose the **Moxa PROFINET Device 0202** device icon, and drag and drop to **PN/IE_1** subnet.
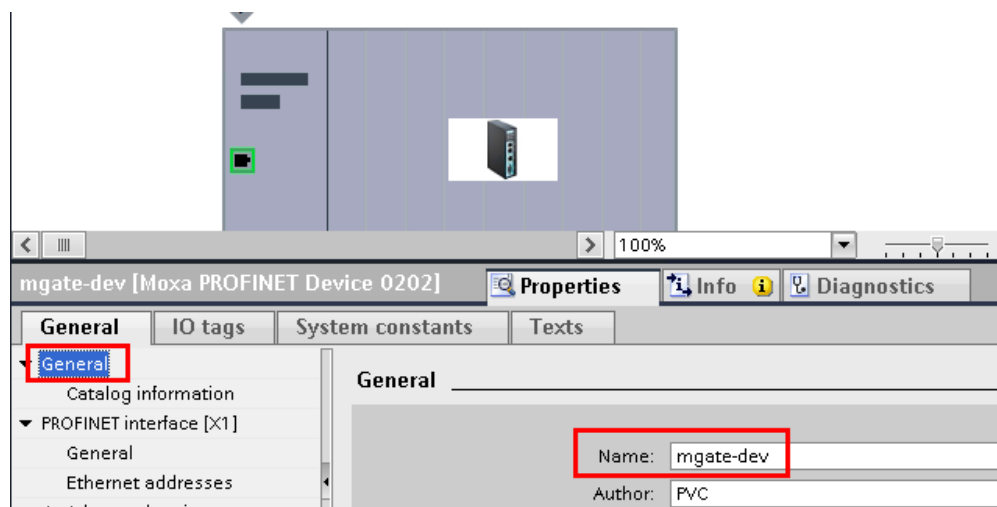
(7)   Under **Network view**, it shows that the **MGate 5103** is in the **PN/IE_1** subnet. Click **Not assigned** to assign the **MGate 5103** to **PN/IE_1**.
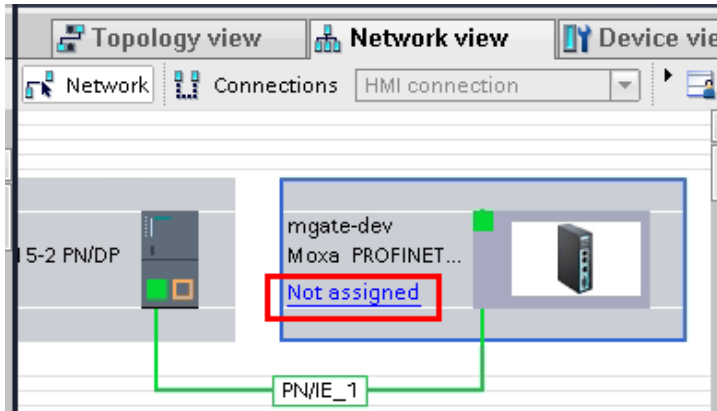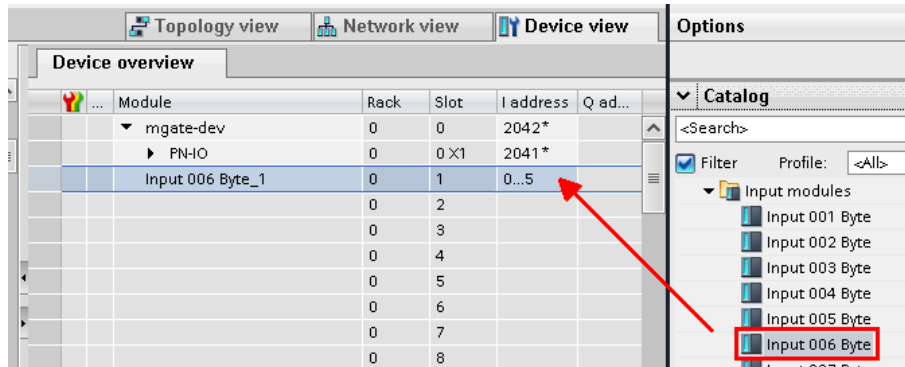

Then **MGate 5103** is set into the **PLC_1**'s PROFINET IO System.
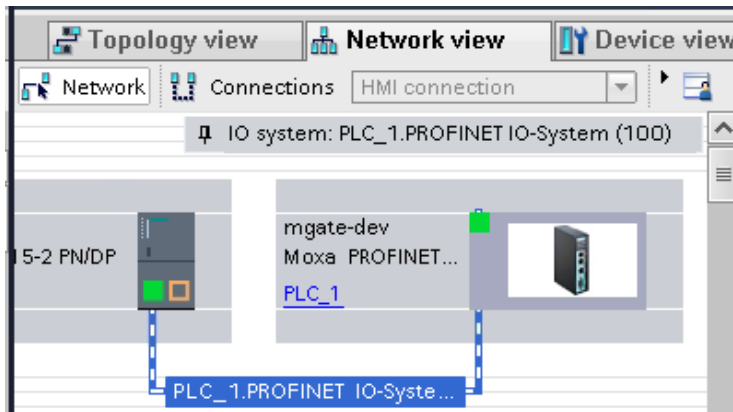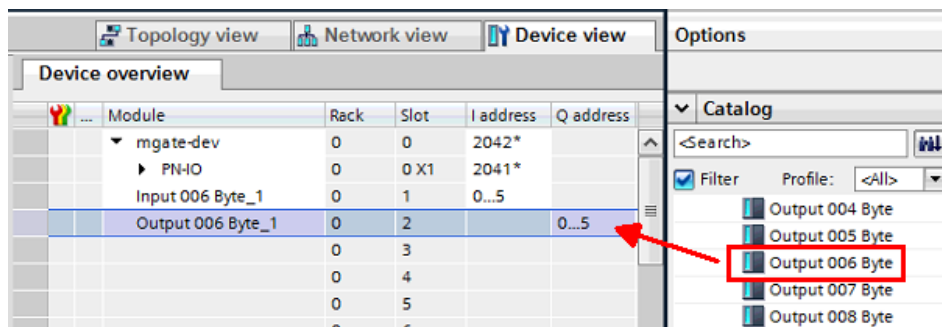

If your **MGate 5103** Device Name is not **mgate-dev**, you can modify it via **Properties → General → Name**".

(8) Under the **MGate 5103**'s Device view, drag and drop **Input 006 Byte** to Slot 1. Assign the **I address** to 0-5.

Drag and drop **Output 006 Byte** to Slot 2. Assign the **Q address** to 0-5.

(9) We want to get the register values of Modbus ID1- ID3 and make sure these Modbus commands' responses are valid. If a Modbus command's response is invalid or times out, the register value will show 0xFFFF. We will show the details later. We created these tags below:

		Name	Data type	Address ▲	Comment
1		Input1	Word	%IW0	PIW0
2		Input2	Word	%IW2	PIW2
3		Input3	Word	%IW4	PIW4
4		Output4	Word	%QW0	Write ID4
5		Output5	Word	%QW2	Write ID5
6		Output6	Word	%QW4	Write ID6
7		ID1Value	Word	%MW0	Show ID1 running value
8		ID2Value	Word	%MW2	Show ID1 running value
9		ID3Value	Word	%MW4	Show ID1 running value
10		RecordByte	Byte	%MB10	Modbus Command Status
11		ID1Status	Bool	%M10.0	ID1 command status
12		ID2Status	Bool	%M10.1	ID2 command status
13		ID3Status	Bool	%M10.2	ID3 command status
14		ReqBit	Bool	%M11.0	REQ = 1: Send request
15		ValidBit	Bool	%M11.1	New data record was received and is valid
16		BusyBit	Bool	%M11.2	BUSY = 1: The reading process is not yet complete.
17		ErrorBit	Bool	%M11.3	ERROR = 1: An error occurred during the reading process.
18		StatusCode	DWord	%MD12	Block status or error information

Click **Main [OB1]** to edit program.

Drag and Drop the **RDREC** function block to Network 1. DB setting pops up to add **RDREC Instance**. Click **OK** to apply it.
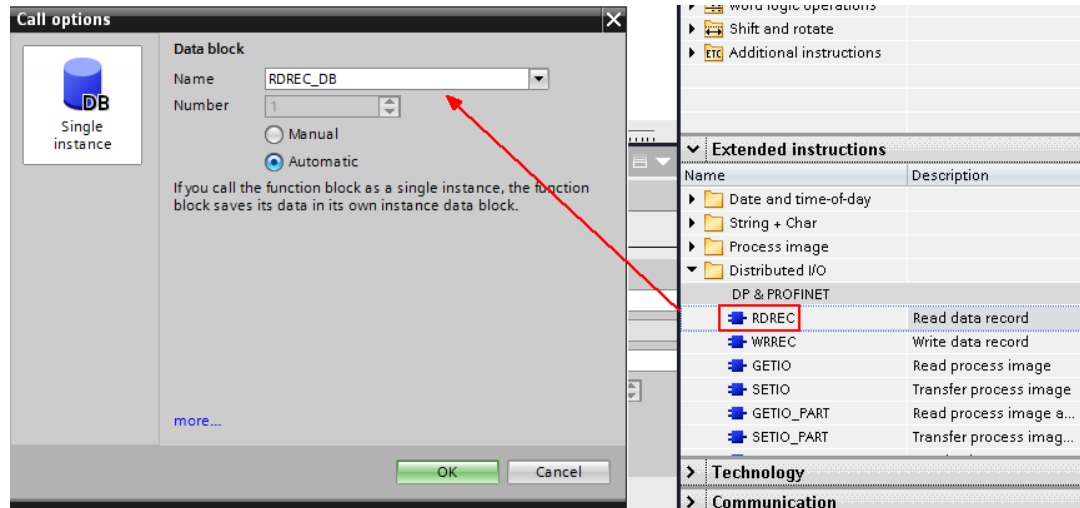

Fill in the input/output parameters as below:
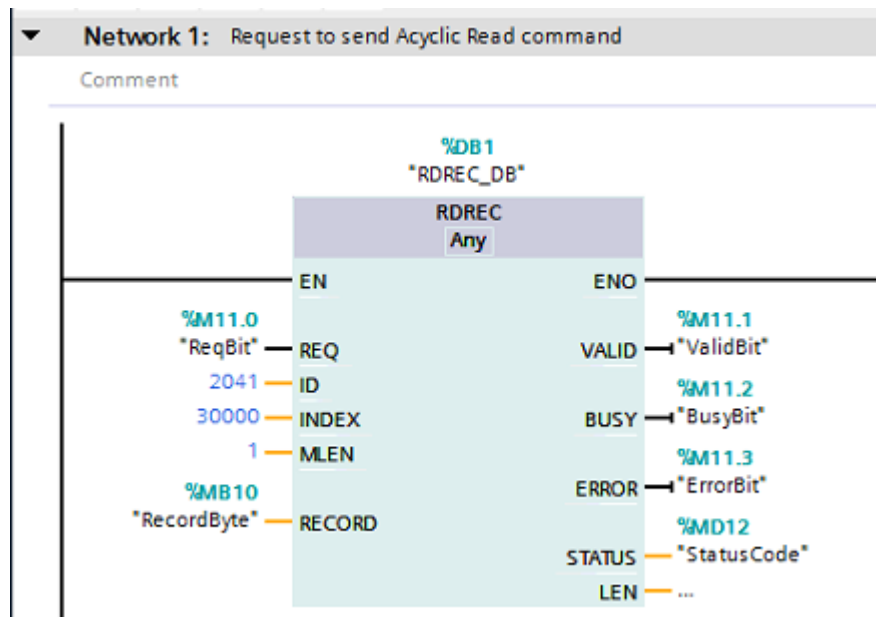
Parameter descriptions:

①. REQ: If this bit is true, the request will be sent to the **MGate 5103**.

②. VALID: Bit memory M11.1 indicates whether a new data record was received and valid.

③. BUSY: Bit memory M11.2 indicates whether the read process has been terminated.

④. ERROR: Bit memory M11.3 indicates whether an error occurred while processing the function.

⑤. STATUS: The bit memory - double word MD12 contains block status or error information.

⑥. ID: It is the PN-IO diagnostic address, which is **2041**, as below. This address is used for PROFINET acyclic read/write for the **MGate 5103** to do some pre-define diagnoses.
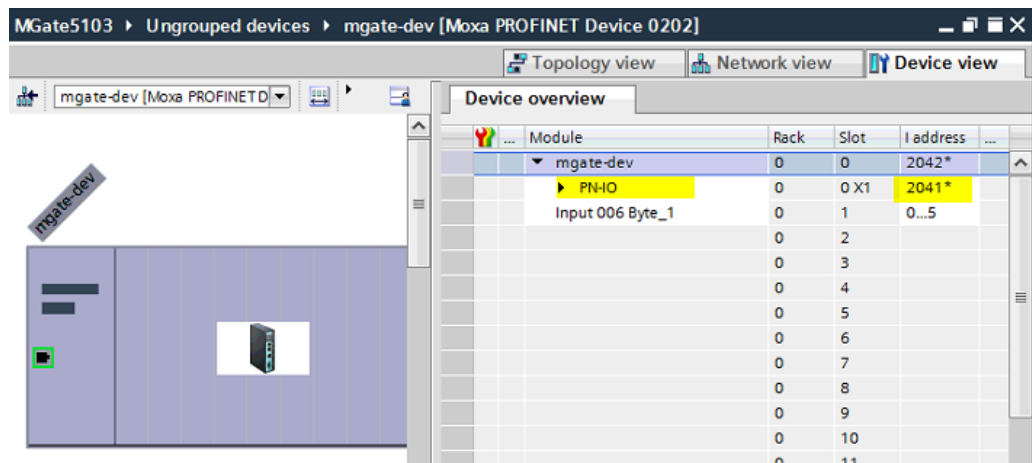
⑦. INDEX: Data record number. For the **MGate 5103,** the command status starting address is **30000**.

⑧. MLEN: The maximum length of bytes of the data record information to be fetched. In this demo, we only need one byte to get command 1-3 status (Bit 0-2).

⑨. RECORD: The destination area for the read data record. We use MB10 to store it.
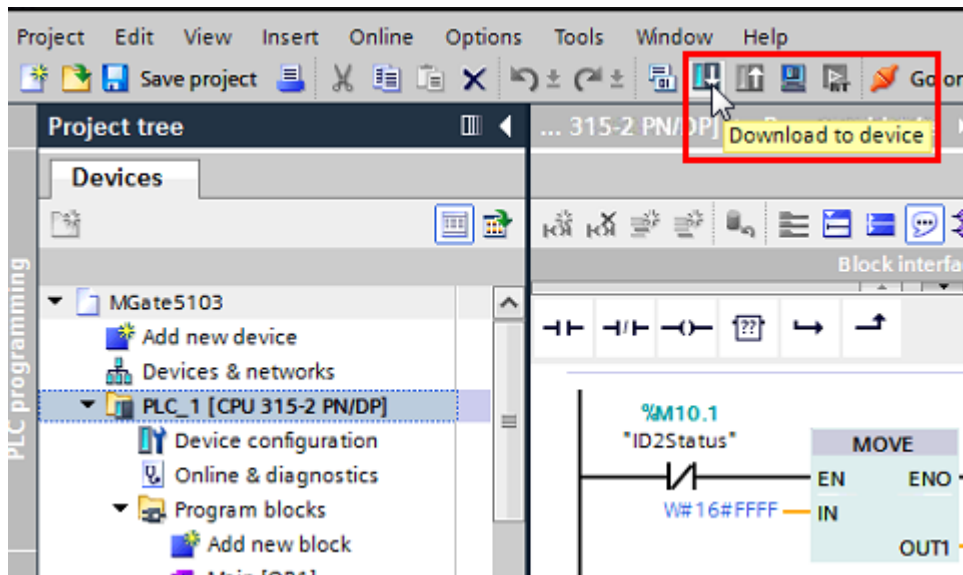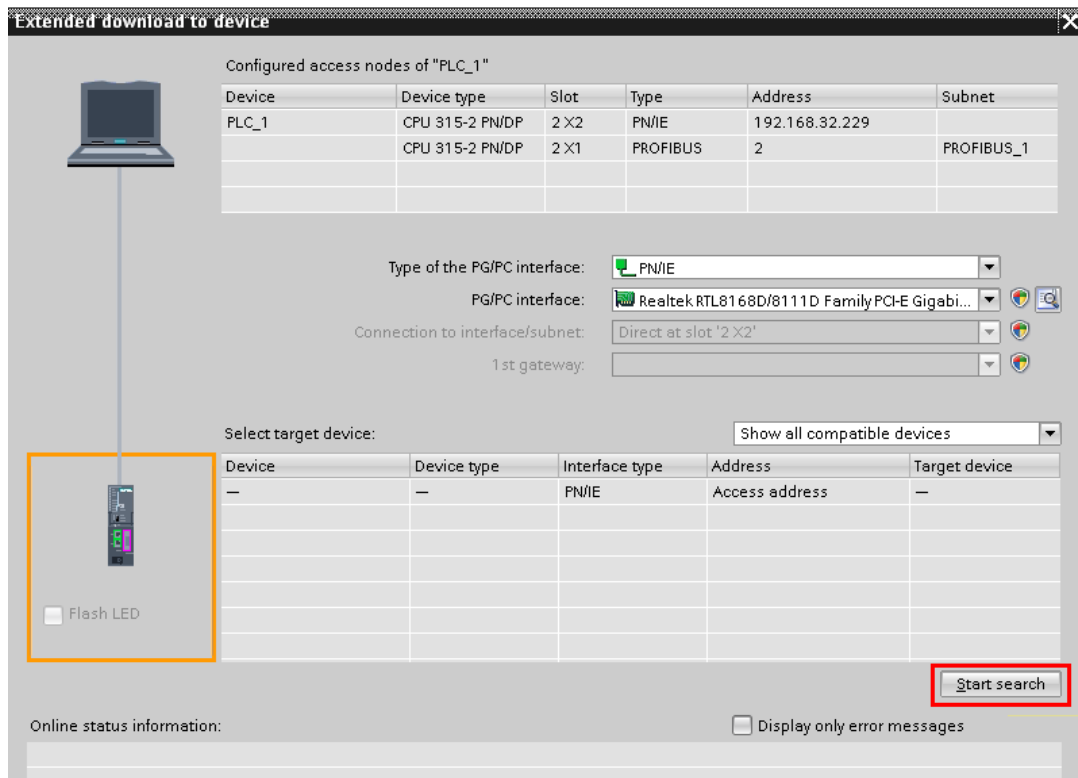
Other Networks' programs are illustrated as below:
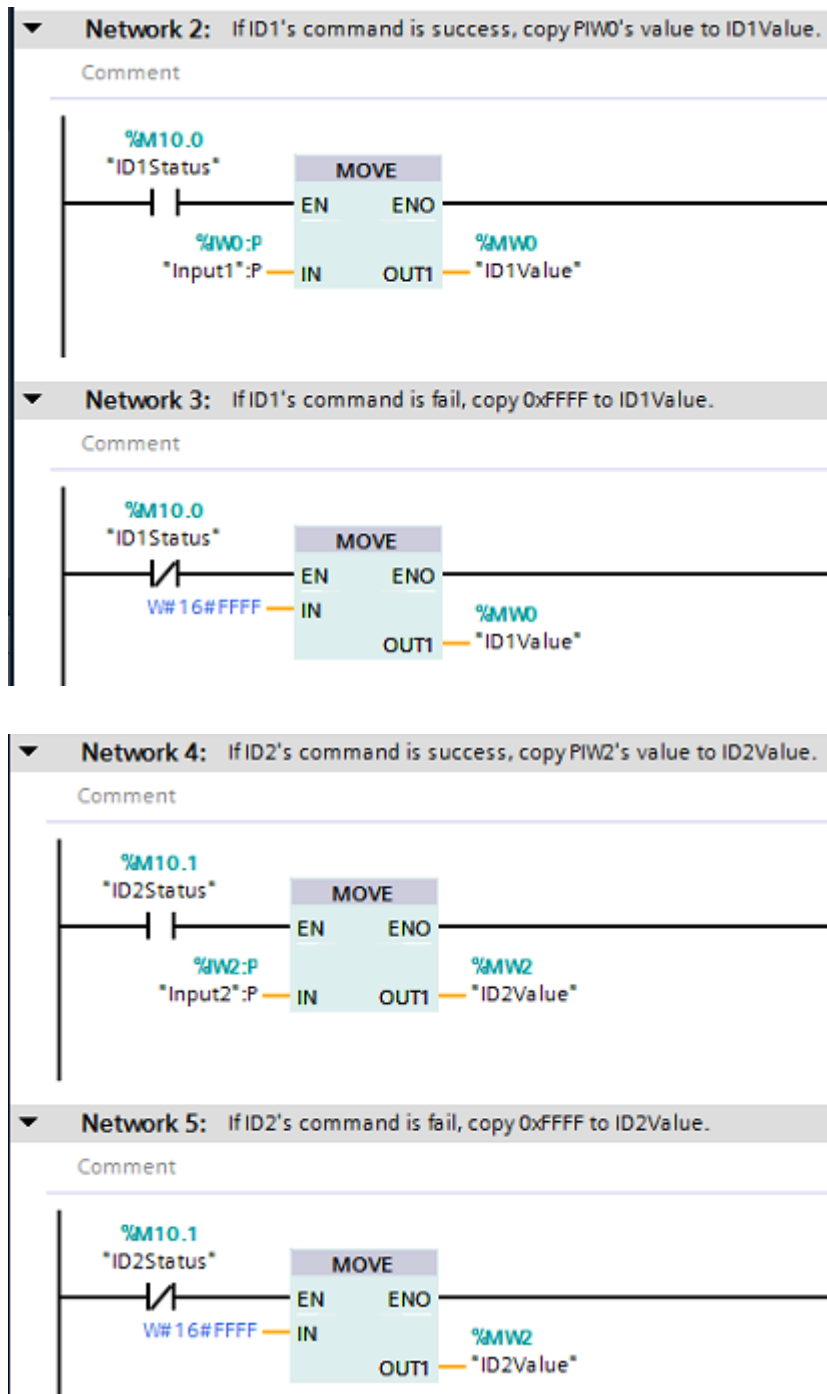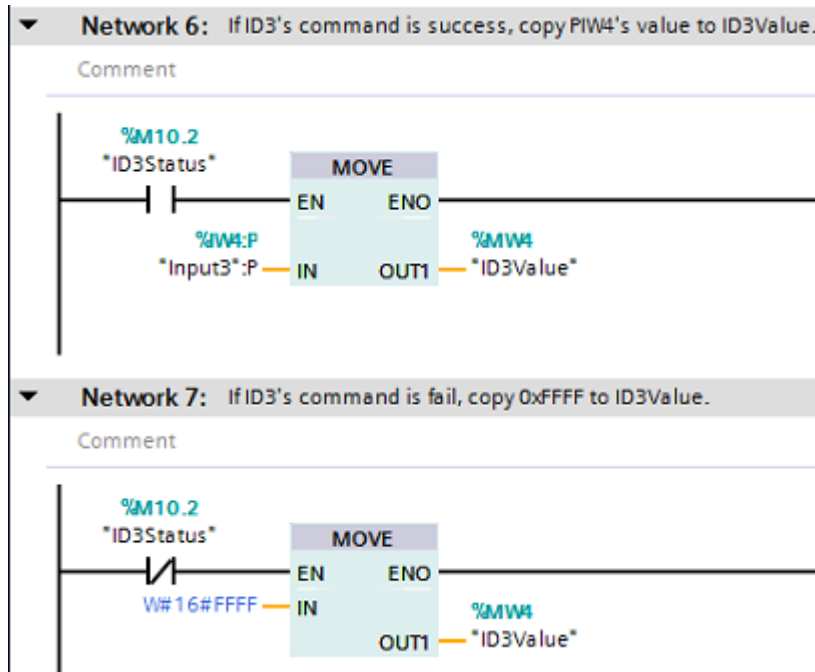
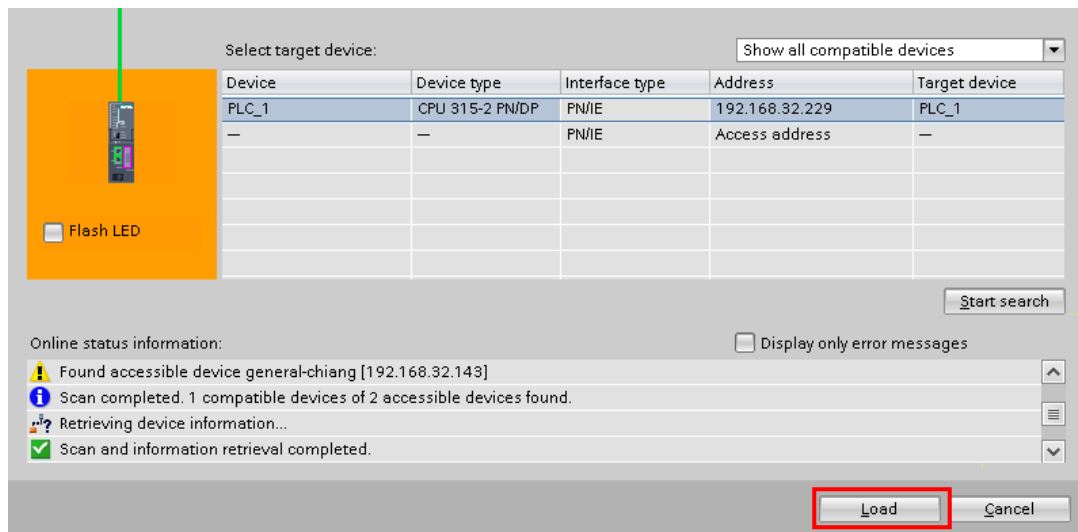(10) Execute **Compile** and make sure there is no error.
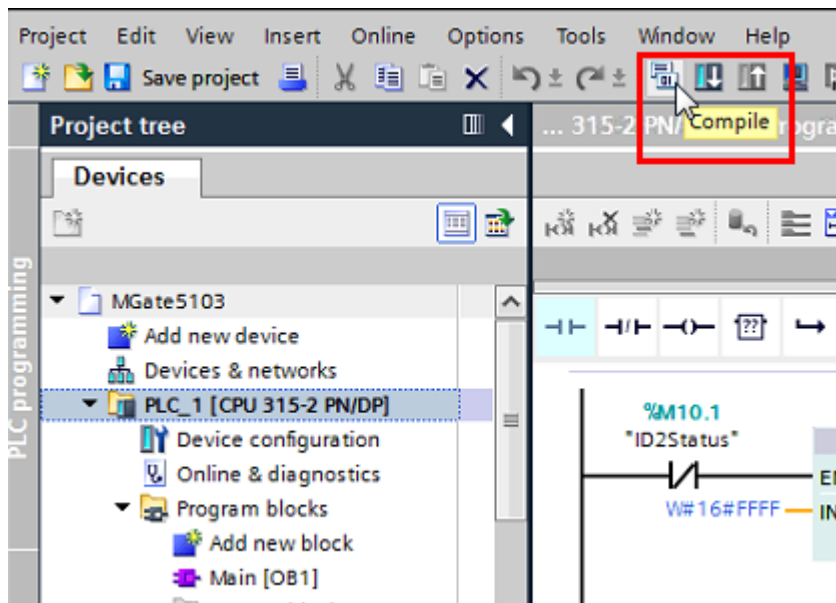
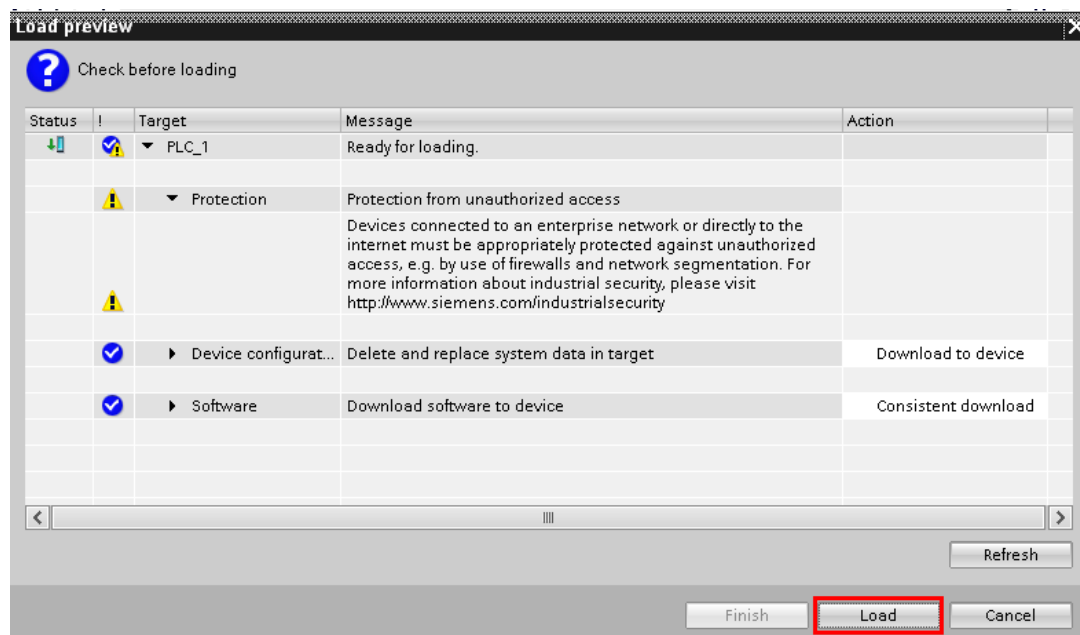(11) Execute **Download.**

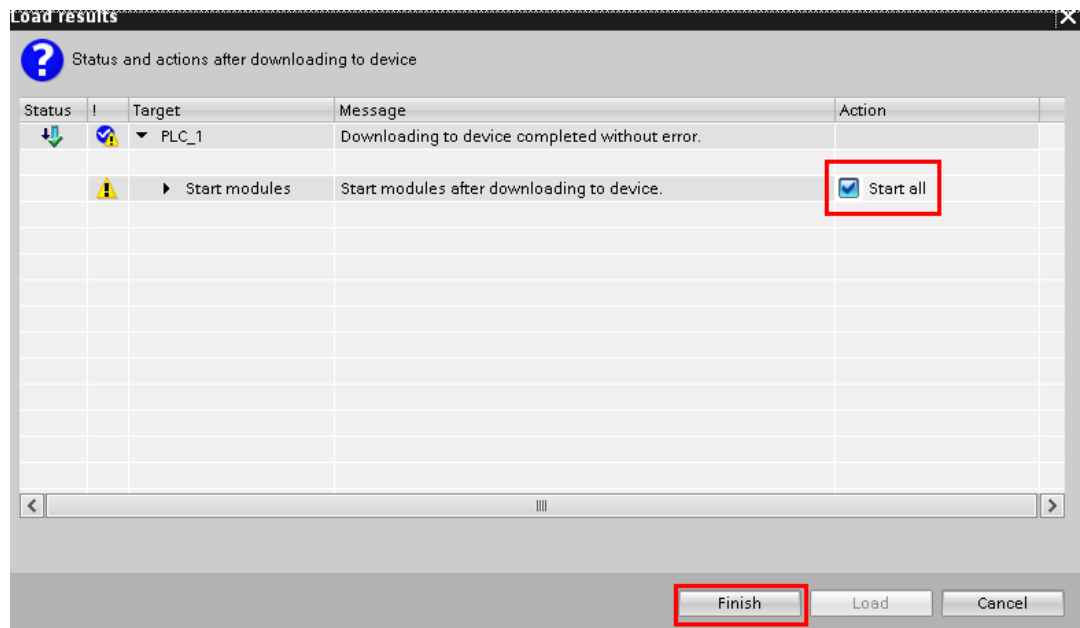Click **Start Search** to search an accessible PLC.

When an accessible PLC has been found, execute **Load**.

The **TIA Portal** will check hardware and software consistency. After checking for any errors, click **Load** to download.
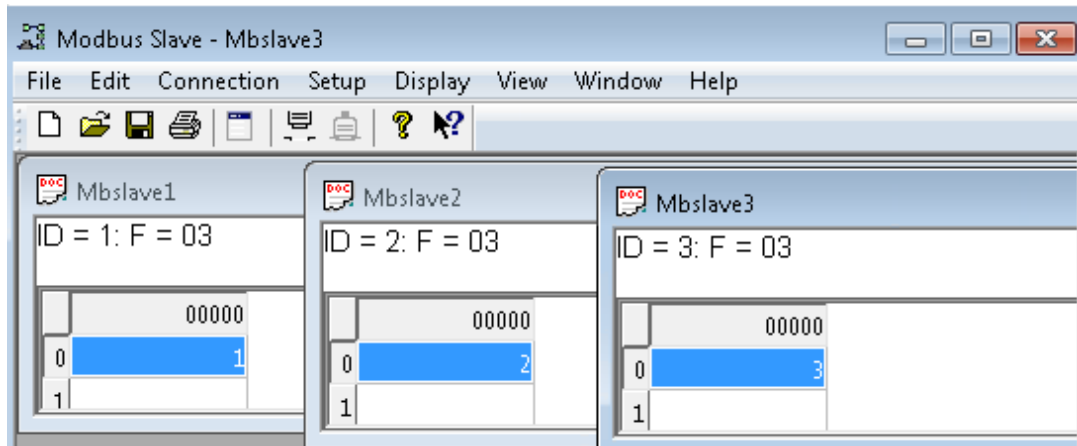
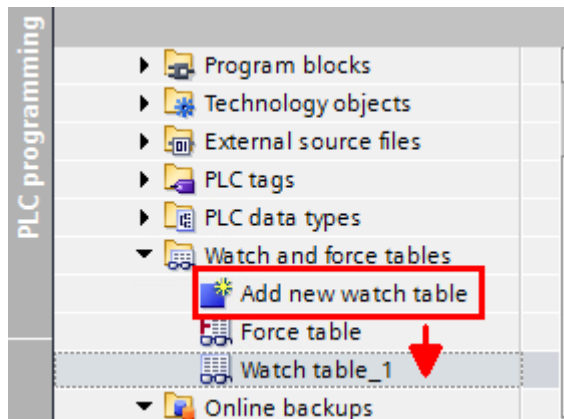After loading, enable **Start all** to start modules, then click **Finish**.

6 Communication Test

A. Status Monitoring

(1) PC runs the **Modbus Slave** tool to connect to the **MGate 5103**'s Serial port. Add slave ID1-ID3 and set each one's register 0's value as 1, 2, 3, respectively.

(2)   Click **Add new watch table** to create the **Watch table_1**.
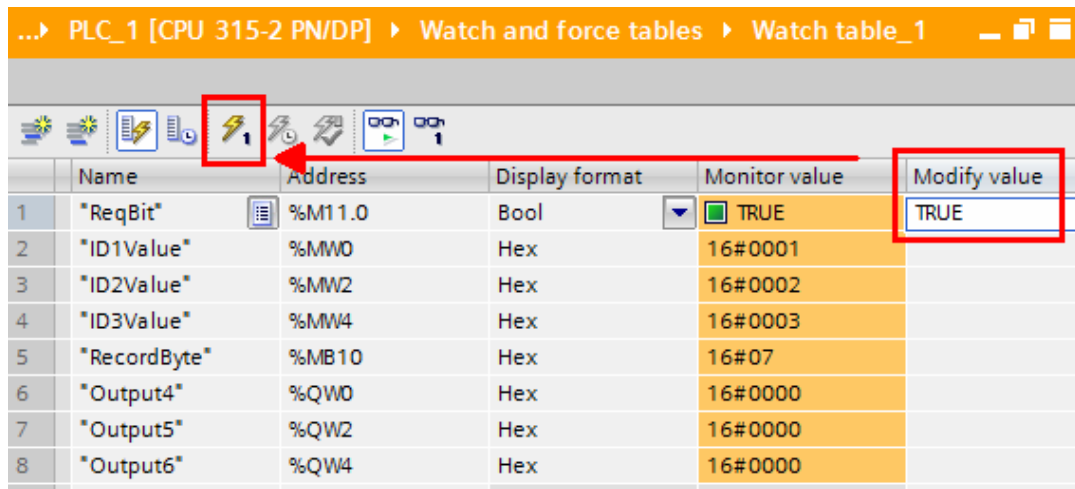

Add the tags below to be monitored:

(3) Click **Go online**,then click **Monitor all**.
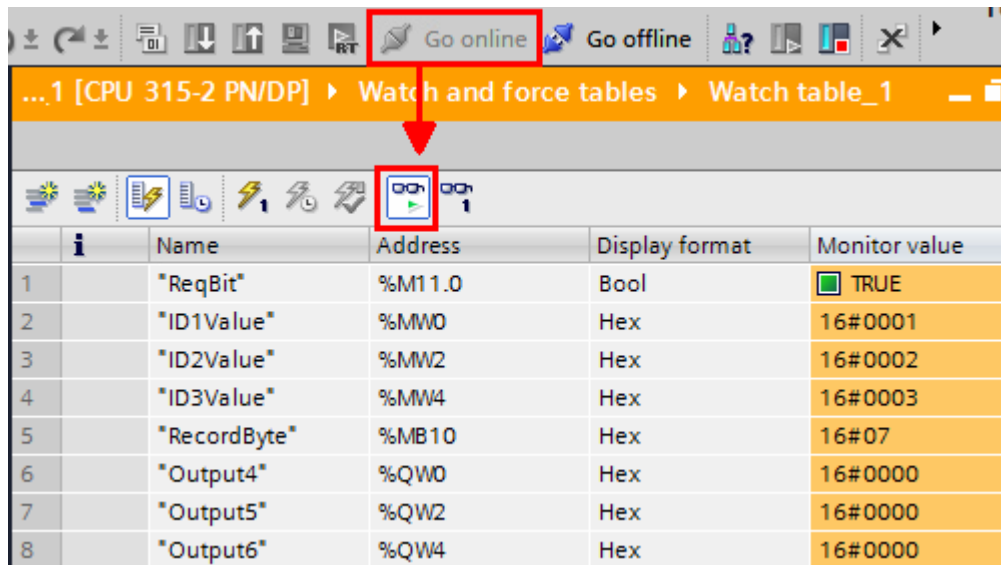
If **ReqBit** status is not **True**, you can input **True** under the **Modify value** column, click the **Modify** button to enable send request.

We can see **RecordByte** shows a value of 7, pointing out that the commands 1-3 are successful. The **ID1Value**-**ID3Value** are running as 1, 2, 3, respectively.

(4) We can use the MGate's Protocol Diagnostics tool on the Web Console to check Modbus and PROFINET communication status:

Via **System Monitoring → Protocol Status → Modbus RTU/ASCII Diagnose**, we can see its **Received Valid response** counter is equal to the **Sent request** counter.

Via **System Monitoring → Protocol Status → Modbus RTU/ASCII Traffic**, we can log Modbus RTU communication traffic:

Via **System Monitoring → Protocol Status → PROFINET Diagnose**, we can see its **Connected PLC MAC Address**:

Via **System Monitoring → Protocol Status → I/O Data View**, we can choose **PROFINET IO Controller ← Modbus RTU/ASCII Slave** data flow side to see the Modbus slave input data:

(5)   Disable Modbus Slave ID 2 on **Modbus Slave** tool, so Modbus Command 2 can't receive any responses. Check **Watch table**, **RecordByte** shows a value of 5 and **ID2value** is updated as 0xFFFF.

	Name	Address	Display format	Monitor value
1	"ReqBit"	%M11.0	Bool	■ TRUE
2	"ID1Value"	%MW0	Hex	16#0001
3	"ID2Value"	%MW2	Hex	16#FFFF
4	"ID3Value"	%MW4	Hex	16#0003
5	"RecordByte"	%MB10	Hex	16#05

Check **Modbus RTU/ASCII Diagnose**, the **Timeout** counter is increasing:

⁝⋅Modbus RTU/ASCII Diagn

Main Menu

Quick Setup
Overview
Basic Settings
Network Settings
Serial Settings
- Protocol Settings
- System Management
- System Monitoring
  - System Status
  - Protocol Status
    I/O Data View
    Modbus RTU/ASCII Diagnose
    PROFINET Diagnose
    Modbus RTU/ASCII Traffic
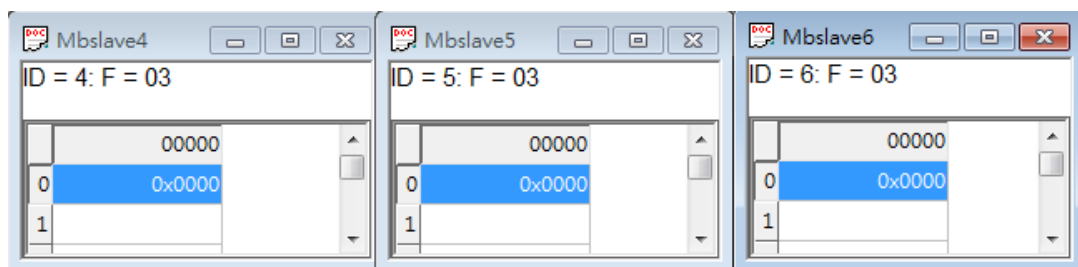
☑ Auto refresh

Category	Item	Value
Modbus		
	Mode	RTU Master
	Sent request	2929
	Received valid response	2875
	Received invalid response	0
	Received CRC/LRC Error	0
	Received exception	0
	Timeout	53
Serial Port		
	Port number	1
	Break	0
	Frame error	0
	Parity error	0
	Overrun error	0

B.   Fault Protection

(1) Add slave ID4-ID6 on the Modbus Slave tool as below:

Mbslave4 — ID = 4: F = 03 — 00000 / 0: 0x0000 / 1
Mbslave5 — ID = 5: F = 03 — 00000 / 0: 0x0000 / 1
Mbslave6 — ID = 6: F = 03 — 00000 / 0: 0x0000 / 1

(2) On Watch table, we set **Modify value** under QW0 as 0x0004, QW2 as 0x0005, QW4 as 0x0006. Then click the **Modify** button.
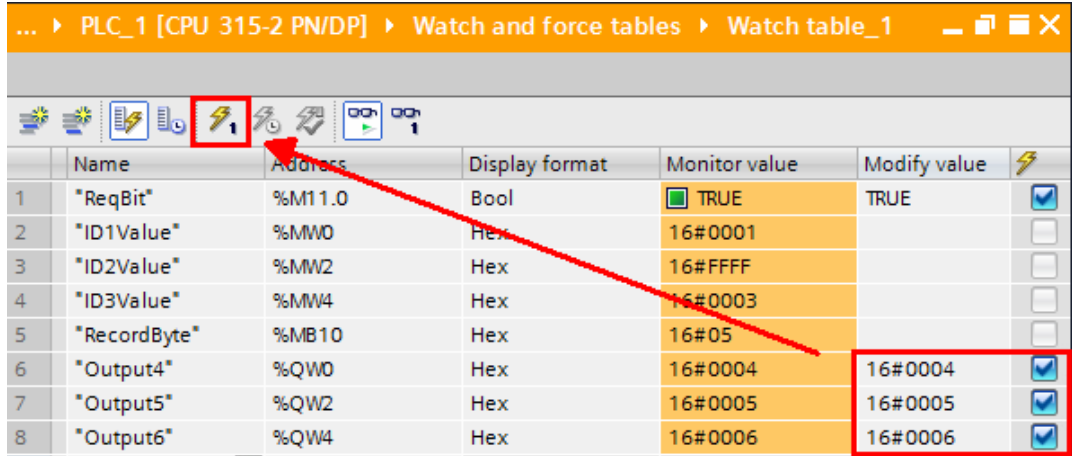
(3) Check Modbus Slave ID 4-ID6; they are updated as 0x0004, 0x0005, 0x0006.

Via **System Monitoring → Protocol Status → I/O Data View**, we can choose **PROFINET IO Controller → Modbus RTU/ASCII Slave** data flow side to see the PROFINET output data:

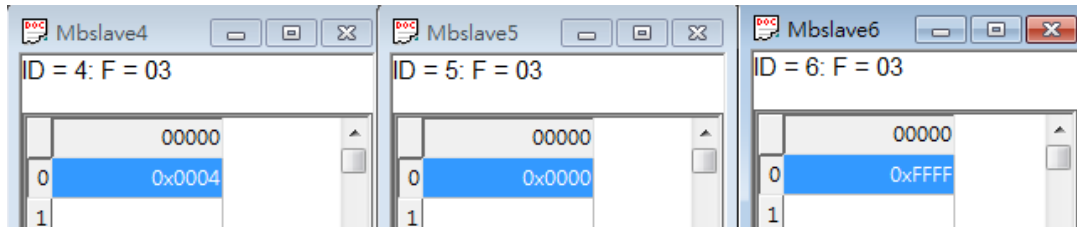(4) Shut down the PLC. After 10000 ms, the **Fault Timeout** is on. Check whether Modbus Slave ID 4's register 0 value still is 0x0004. Slave ID 5's register 0 value is updated as 0x0000, and Slave ID 6's register 0 value is updated as 0xFFFF.

Check **PROFINET IO Controller → Modbus RTU/ASCII Slave** data flow side; they all updated as its **Fault Value**:

Check **PROFINET Diagnose**. Its **Connected PLC MAC Address** shows **Not Connected**: