How to communicate with S7-1200 and LXM28A via MGate 5123

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Contents

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About Moxa

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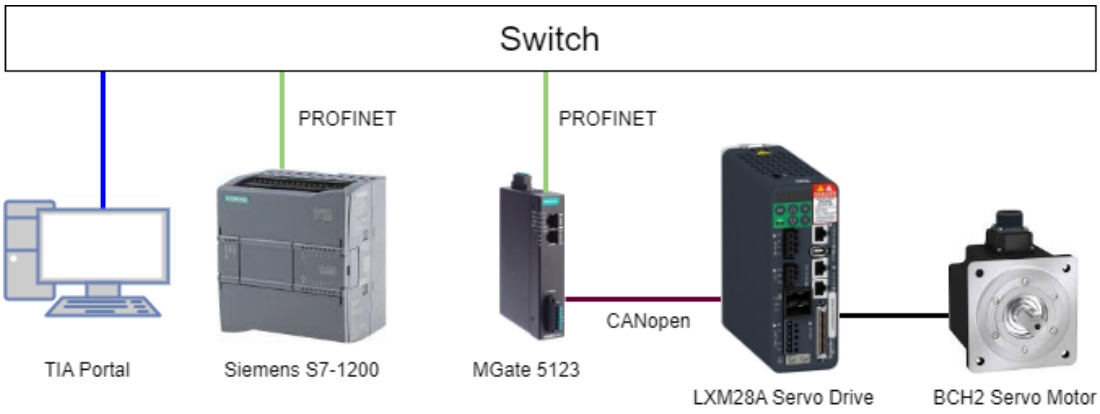
1 Introduction

The MGate 5123 is an industrial Ethernet gateway for converting CANopen, J1939, or CAN proprietary (CAN 2.0A/B) to PROFINET network communications. To integrate existing CAN-based devices into a PROFINET network, use the MGate 5123 as a CAN master to collect data and exchange data with the PROFINET controller.

This document shows how to use the MGate 5123 to do data exchange between the Siemens S7-1200 PLC and Schneider Electric Lexium 28 servo drive (LXM28A). Northbound, the MGate communicates with S7-1200 via PROFINET and acts as a PROFINET IO Device. Southbound, the MGate communicates with LXM28A via CANopen and acts as a CANopen master.

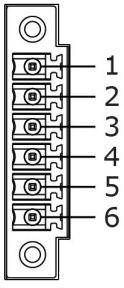
See Figure 1 for the system topology of this demonstration. For the MGate and LXM28A CAN port pin assignment, see Figure 2. Connect MGate pin 1 to LXM28A pin 2 and MGate pin 2 to LXM28A pin 1. The PC runs Siemens TIA Portal for S7-1200 PLC configuration, monitoring and controlling the PLC.

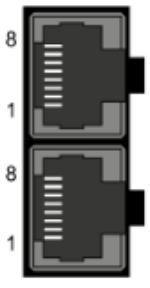


< Figure 1. System Topology >

CAN Port (6-pin Terminal Block)

Pin	CAN
1	CAN_L
2	CAN_H
3	CAN Signal GND
4	Ext-CAN_L*
5	Ext-CAN_H*
6	CAN_SHLD





Pin	Signal	Meaning
1	CAN_H	CAN interface
2	CAN_L	
3,7	CAN_0V	Reference potential CAN
6	SHLD	Ground/Shield
4,5,8	–	Reserved

MGate 5123 CAN Port **LXM28A CAN interface (CN4)**

< Figure 2. CAN Port Pin Assignment>

2 System Requirements

Hardware Equipment

1. **Siemens S7-1200 PLC:**
   a. Processor: CPU 1212C AC/DC/RLY
   b. Article number: 6ES7 212-1BE31-0XB0
   c. Version: 3.0
2. **MGate 5123:**
   a. Firmware version: 2.0 or later
   b. GSDML file: GSDML-V2.42-MOXA-Device0204-20230505.xml
3. **Schneider LXM28A Servo Drive:**
   a. Model: LXM28AUA5M3X
   b. EDS file: SELXM28_017500.eds
4. **Schneider BCH2 Servo Motor:**
   a. Model: BCH2MBA533CA5C

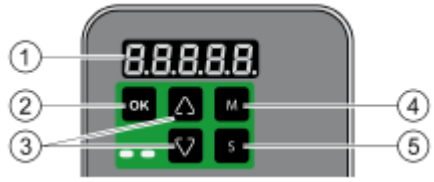
Software Equipment

1. **Siemens TIA Portal:**
   Siemens PLC Engineering Software published by Siemens AG.
   a. Version: 17

3 LXM28A Servo Drive Settings

3.1 Set Device Configuration via HMI

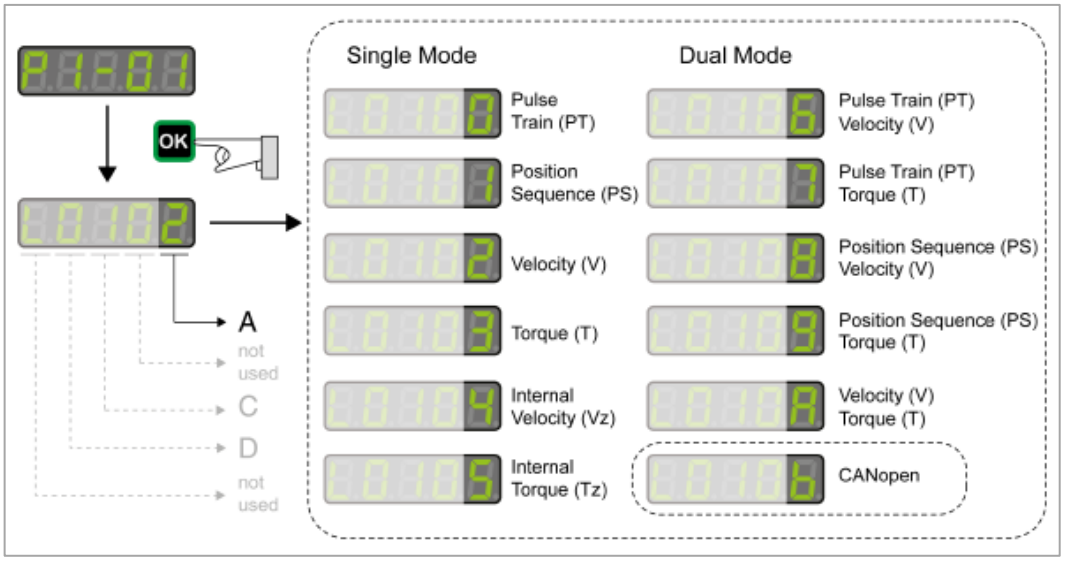
The integrated HMI allows you to edit parameters via the integrated Human-machine Interface (HMI).



Item	Description
1	5-digit 7-segment display
2	OK key
3	Arrow keys
4	M key
5	S key

3.1.1 Setting the Operating Mode

Use the parameter **P1-01** to set **Operating Mode** and **Direction of Movement**:



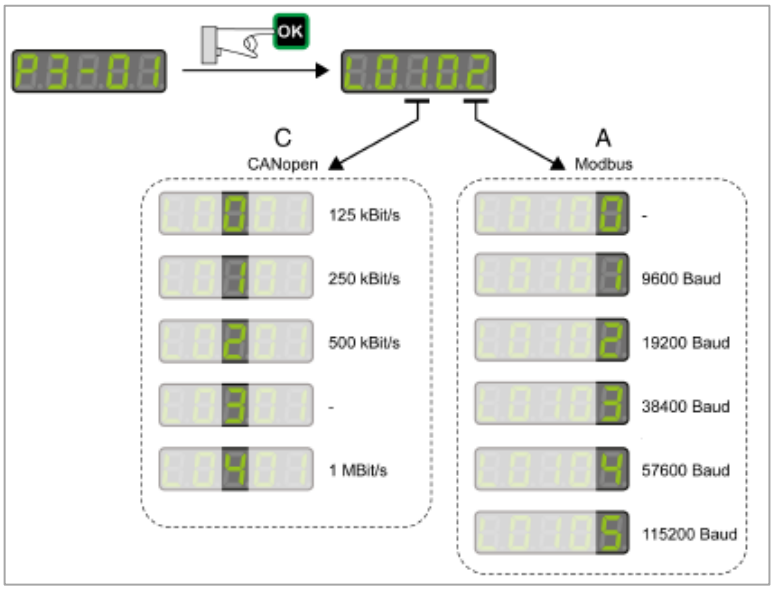
Set **A** as b: The drive operates in the operating mode CANopen.

Set **C** as 0: Movement is in a counterclockwise direction.

The product activates the changed settings the next time it is powered on.

3.1.2 Baudrate Setting

Use the parameter **P3-01** to set the baudrate:



Set as **L0002**: CANopen baudrate is **125 kBit/s**, Modbus baudrate is **19,200 Baud**.

When the product is powered on next, the modified settings will become active.

3.1.3 CANopen Device Address Setting

Use the parameter **P3-05** to set the CANopen device address:

Set as 2.

The changed settings will become active the next time the product is powered on.

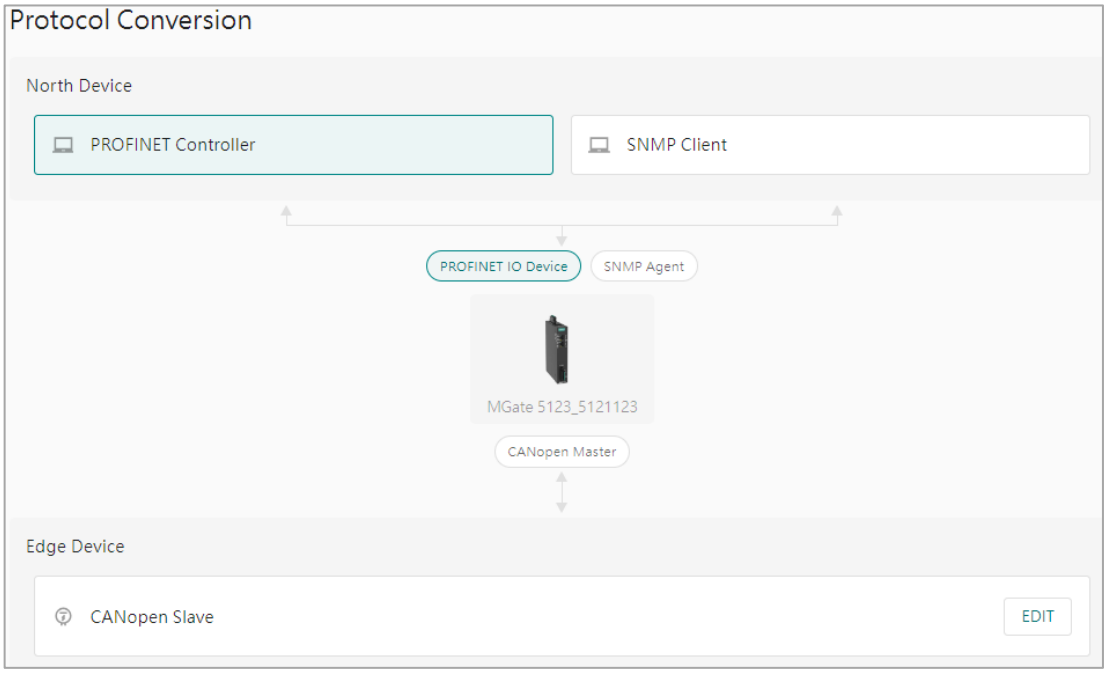
4 MGate 5123 Settings

Log in to the MGate 5123's web console and perform the following settings.

4.1 Protocol Conversion

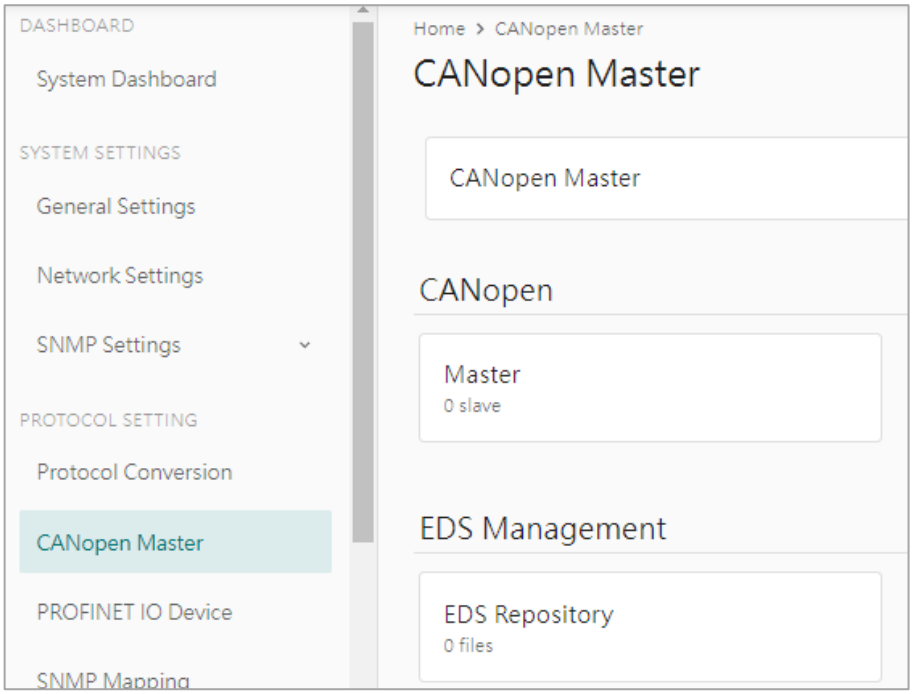
In the **Protocol Conversion** settings, the "North Device" site is fixed as "PROFINET Controller". On the "Edge Device" site, you have the choice of selecting either CANopen slave, J1939, or CAN Proprietary protocols. For this demonstration, we chose CANopen slave.

Set as below:



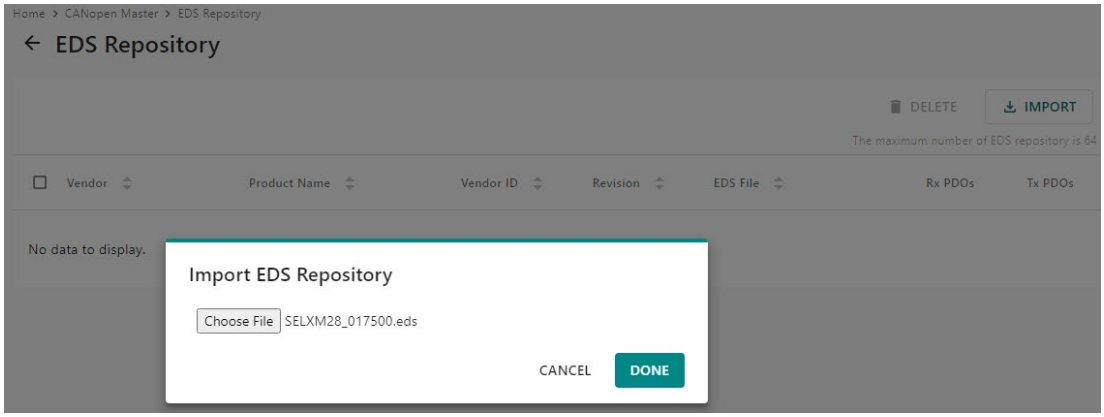
4.2 CANopen Master Settings

Manage CANopen devices on this page.



4.2.1 Import CANopen Slave Device EDS File

Before adding the CANopen slave device, import the EDS of the CANopen slave device. Click **EDS Repository** to import LXM28A's EDS file.

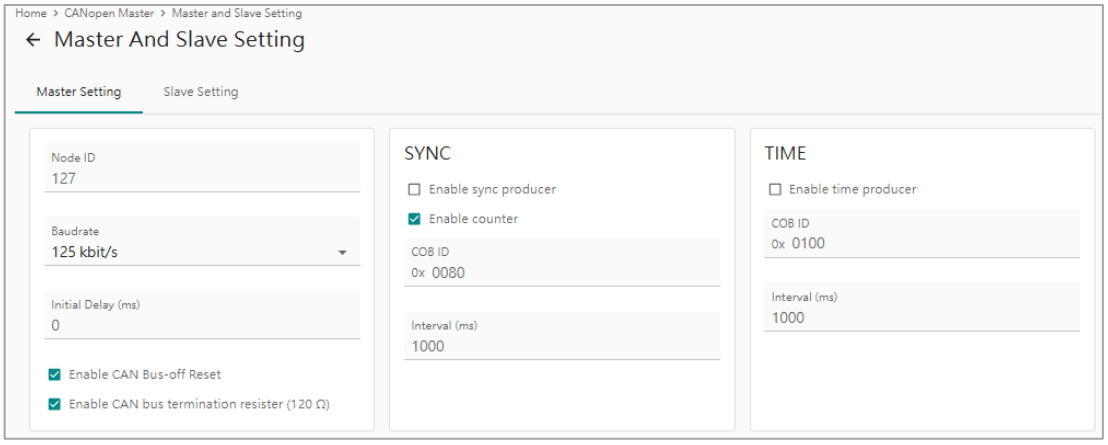


Click **DONE** for the LXM28A's EDS file to import successfully.

4.2.2 CANopen Master Settings

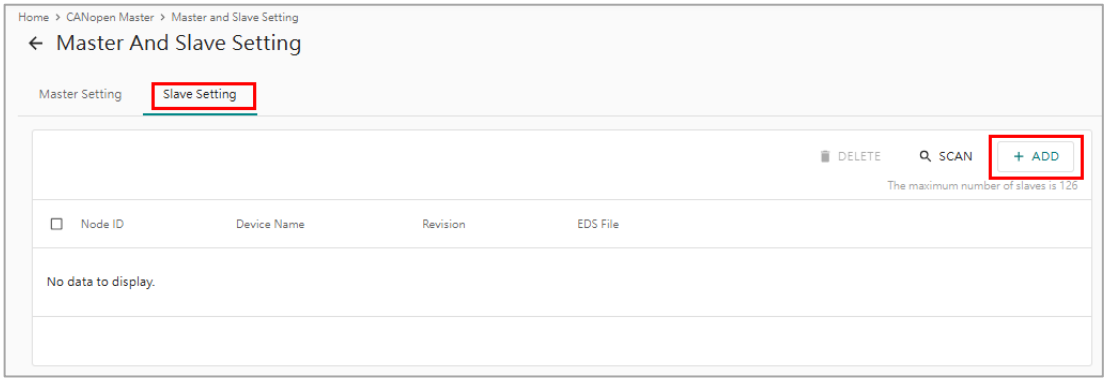
Click **CANopen Master** to configure the MGate's CANopen master settings:

- Set **Node ID** as **127** and baudrate as **125 kbits/s**.
- Enable **CAN Bus-OFF Reset** will auto reset the error count and restart the bus.
- Enable or disable **CANbus Termination Resistor 120 ohms**, depending on whether the bus needs the termination resistor.
- In this demo, we don't need to use Sync Producer or Time Producer. So, disable them.

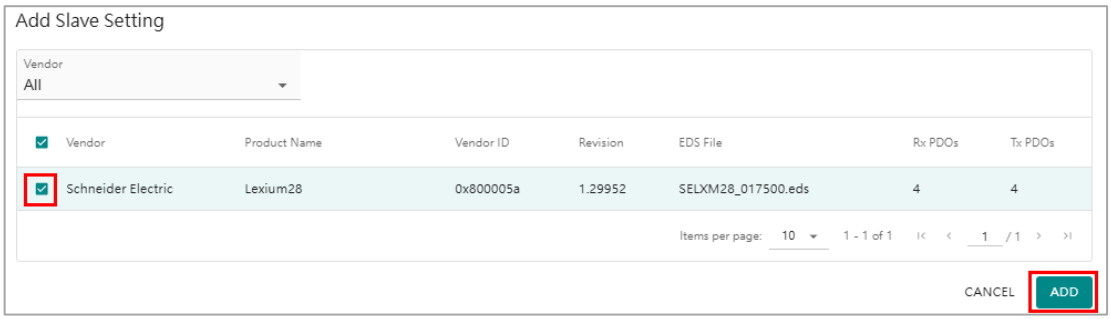


4.2.3 CANopen Slave Settings

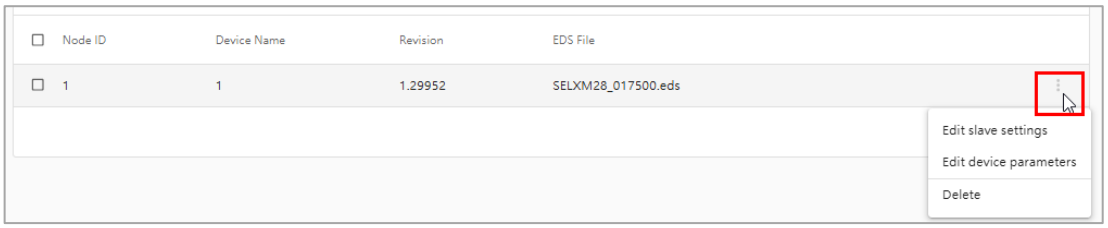
Select the Slave **Setting** tab and click the **ADD** button to add a CANopen slave.



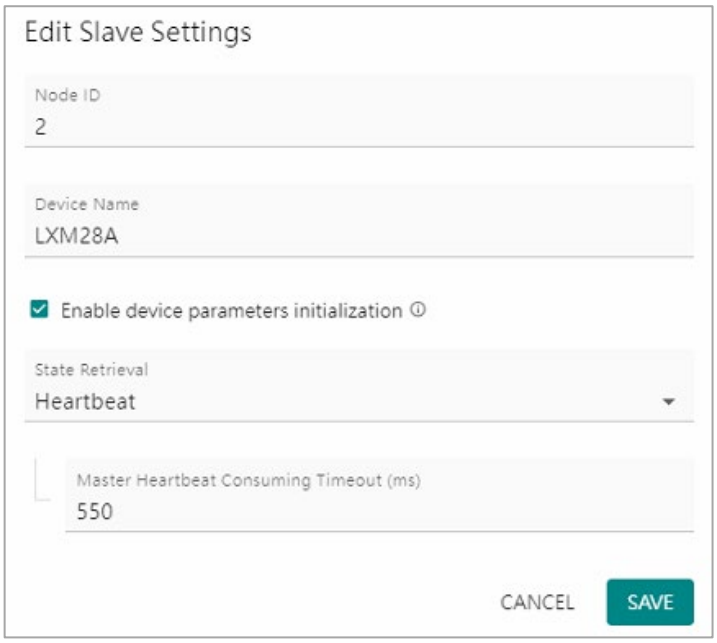
The **Add Slave Setting** window pops up. Choose Lexium28 and click the **ADD** button.



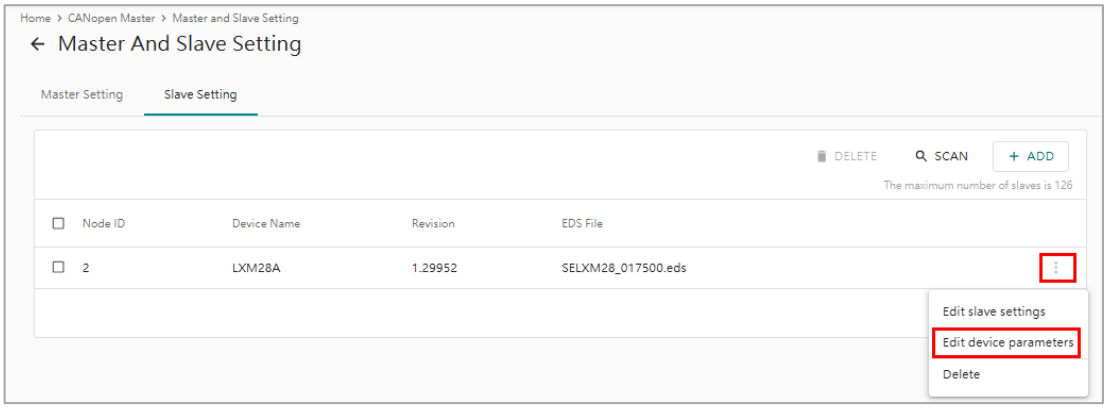
It creates the "Node ID 1" slave. Click the **Edit** button and choose **Edit slave settings** to change further settings.



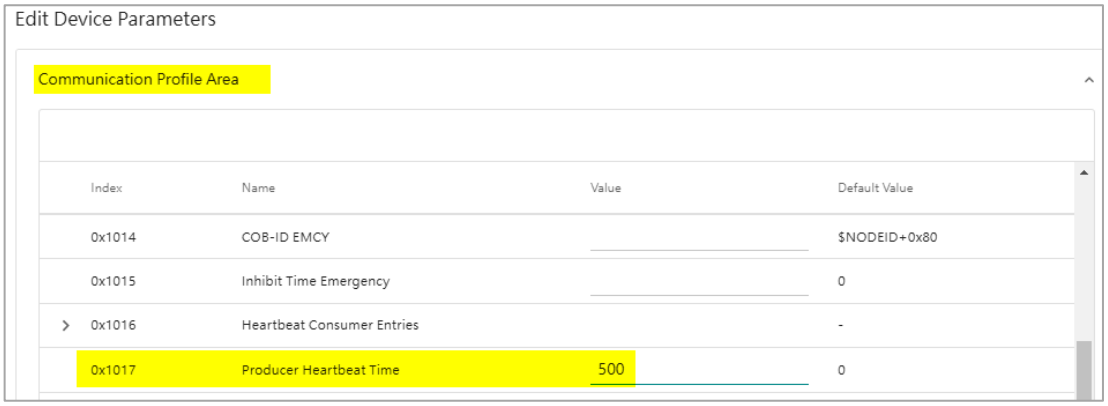
Change Node ID as 2 and change Device Name to **LXM28A**. Choose **Heartbeat** to retrieve the slave's status and set **Heartbeat Consuming Timeout** to 550 ms. If you want the MGate to dynamically configure the slave's device parameters and PDO mapping, enable the **Enable device parameters initialization** setting. This feature will let the MGate send SDO requests to set the slave's communication parameters and PDO mapping when the CANopen bus is ready to submit the MGate's CANopen settings.



If you enable the **Enable device parameters initialization** setting, click **Edit device parameters** to set the slave's communication parameters.

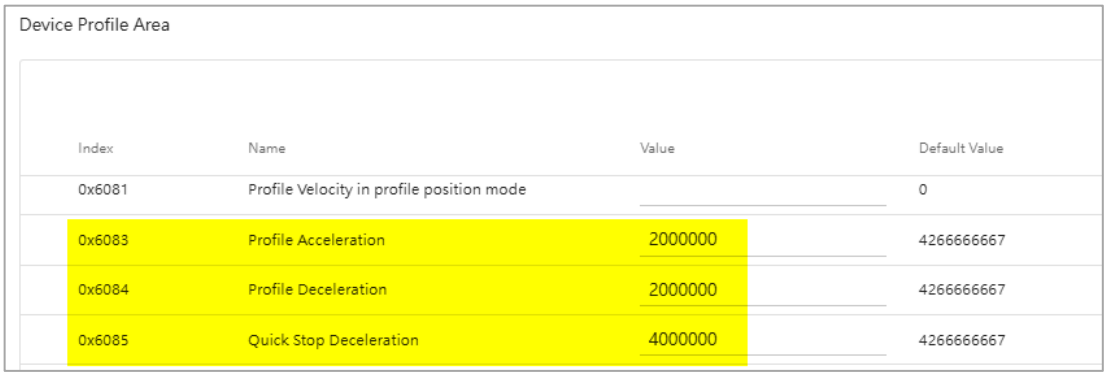


In **Communication Profile Area**, we set **0x1017 Producer Heartbeat Time** to 500 ms.



In **Device Profile Area**, we set the settings:

- 0x6083 (Profile Acceleration), value 2000000
- 0x6084 (Profile Deceleration), value 2000000
- 0x6085 (Quick Stop Deceleration), value 4000000



4.2.4 PDO Settings

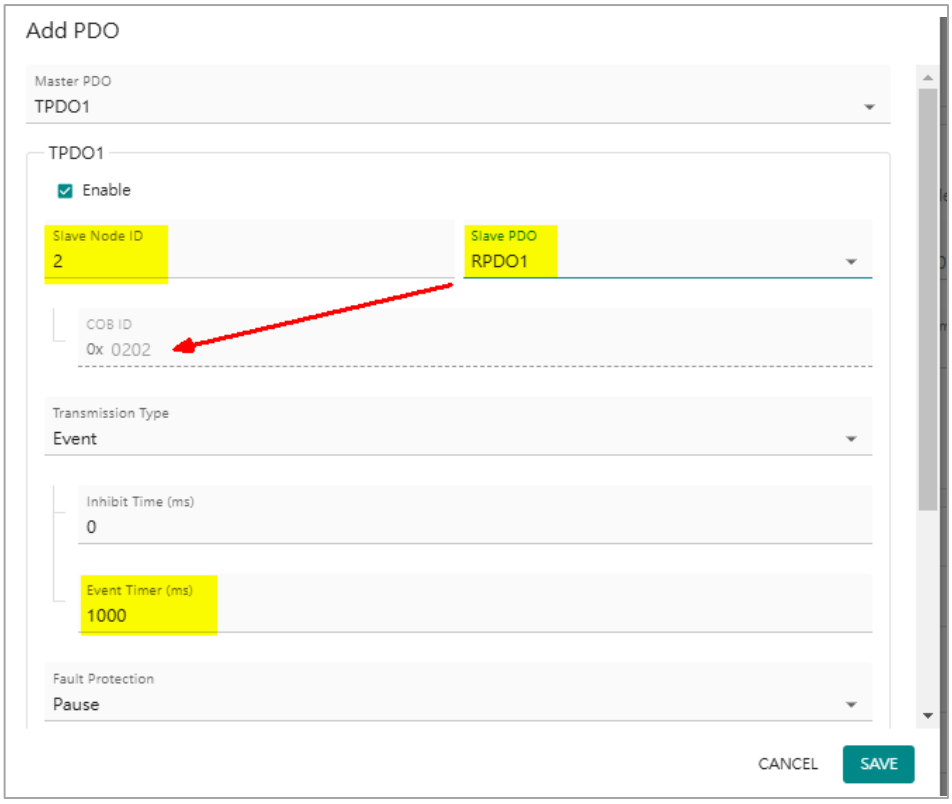
The MGate's PDO settings allow 256 TPDO entries for mapping the slave's RPDO and 256 RPDO entries for mapping the slave's TPDO.

In this demo, we enable the slave's RPDO1, RPDO2, TPDO1, and TPDO2, and mapping to MGate's TPDO1, TPDO2, RPDO1, and RPDO2. Each PDO adds steps as below:

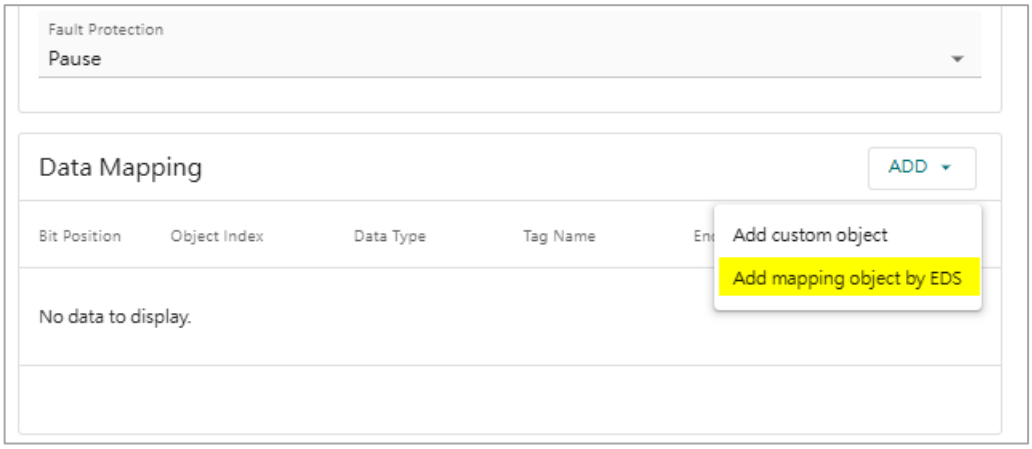
1. Slave's RPDO1:

Choose TPDO1 from the **Master PDO** drop-down list. Change Slave Node ID to 2 and choose RPDO1 from the Slave **PDO** drop-down list. The **COB ID** will be updated to 0x202.

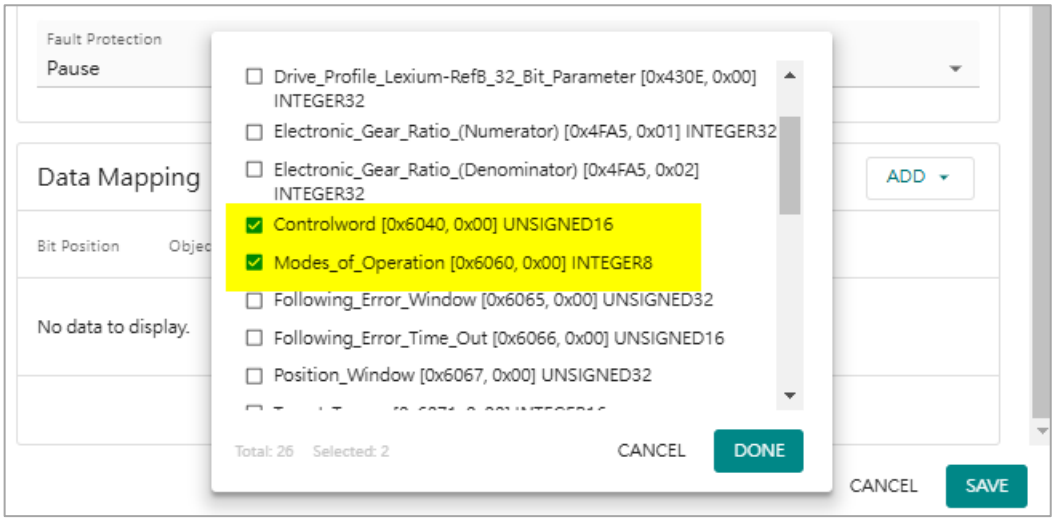
Choose **Event** from the **Transmission Type** drop-down list and set **Event Timer** to 1,000 ms.



In the **Data Mapping** section, click the **ADD** button and choose **Add mapping object by EDS**.

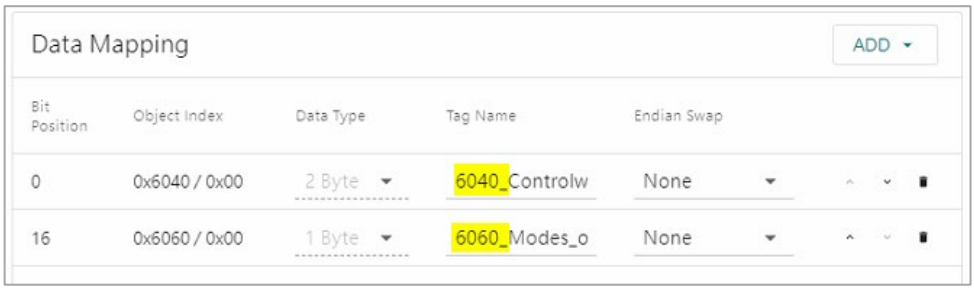


Choose **Controlword [0x6040, 0x00]** and **Modes_of_Operation [0x6060, 0x00]**. Click the **DONE** button.

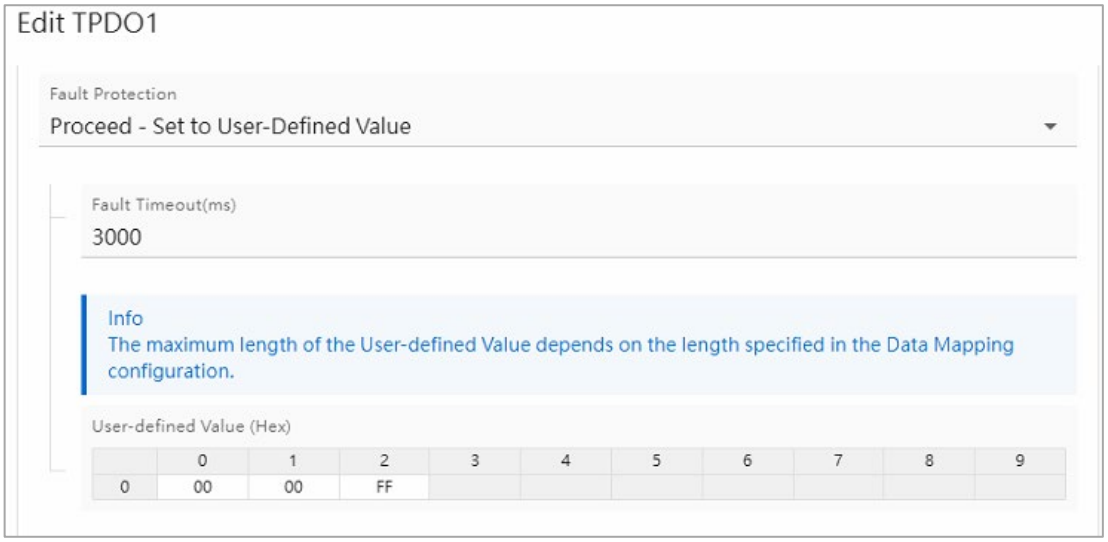


The slave's RPDO1 Data Mapping result is given below. Use the **Arrow** button to change object's **Bit Position**.

Tag Names should be prefixed with the Object Index for easy identification.

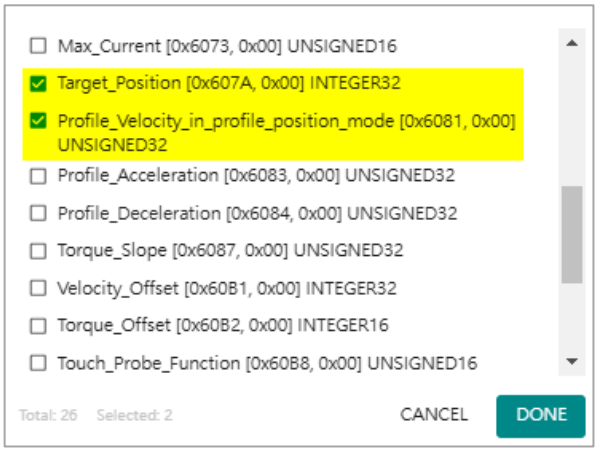


The **Fault Protection** function sends a predefined setting to field devices to prevent incorrect actions when upstream communication times out (**Fault Timeout**). Choose **Proceed – Set to User-Define Value** and set the **User-Define Value** to **00 00 FF**. The first two bytes mean the value of the **Control Word** object is 0x0000 (stop and servo off) and the value of the **Modes of Operation** object is 0xFF (JOG mode).

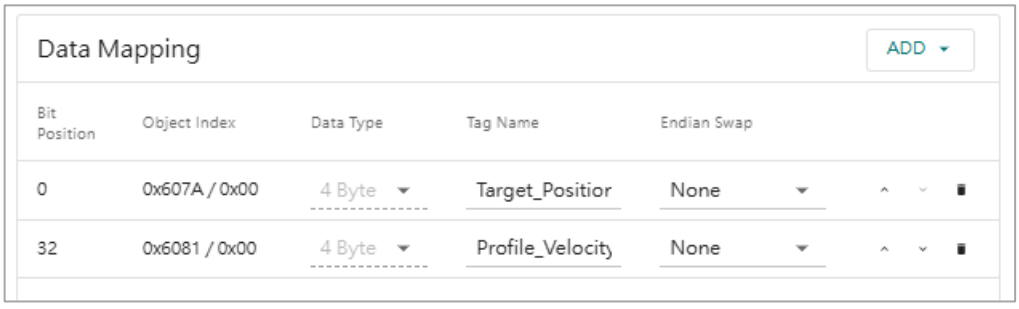


2. Slave's RPDO2:

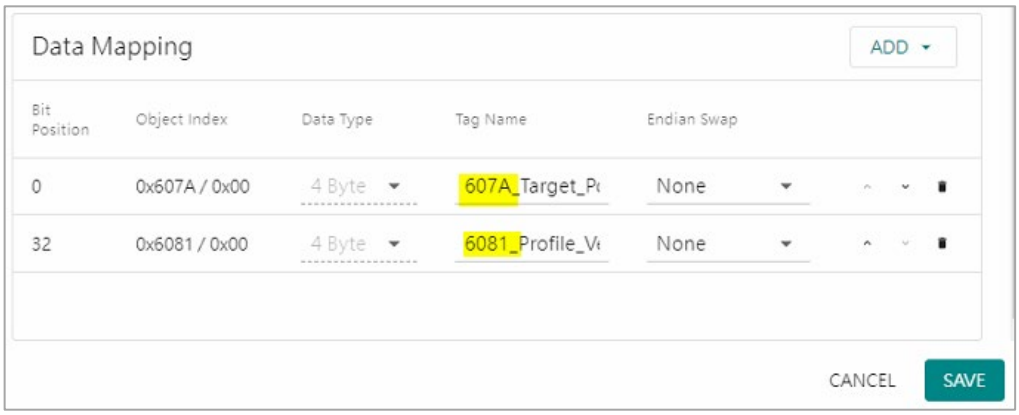
Choose TPDO2 from the **Master PDO** drop-down list. Change Slave Node ID to 2 and choose RPDO2 from the **Slave PDO** drop-down list. The system will update the COB ID to 0x302. Choose **Event** from the **Transmission Type** drop-down list and set **Event Timer** as 1,000 ms. In the **Data Mapping** section, click the **ADD** button and choose **Add mapping object by EDS**. Choose **Target_Position [0x607A, 0x00]** and **Profile_Velocity_in_profile_position_mode [0x6081, 0x00]**. Click the **DONE** button.



The slave's RPDO2 Data Mapping results are given below:



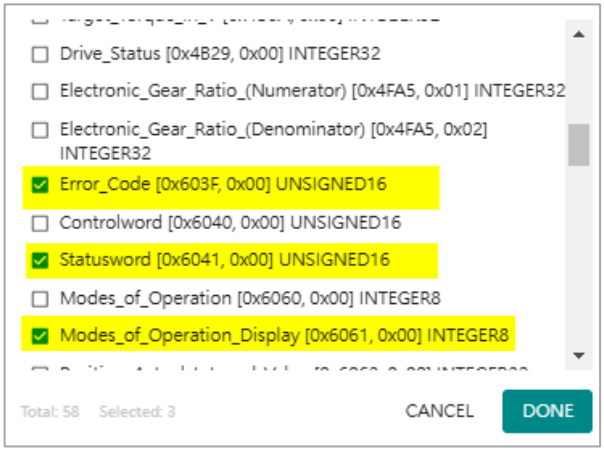
Change Tag Name with the Object Index prefix:



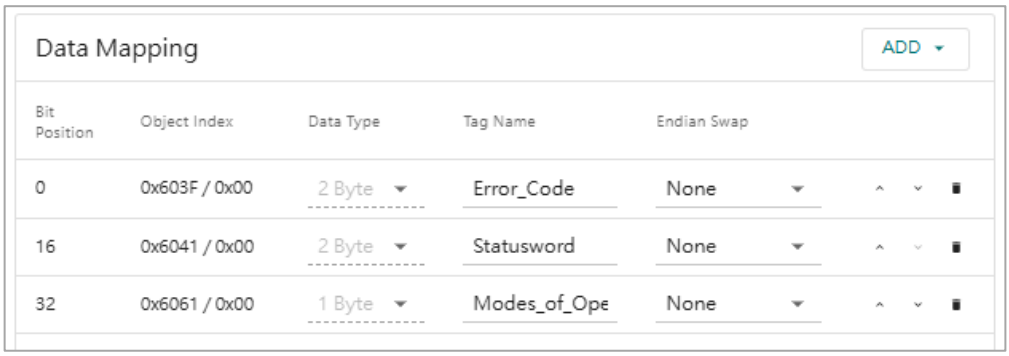
3. Slave's TPDO1:

Choose RPDO1 from the **Master PDO** drop-down list. Change Slave Node ID to 2 and choose TPDO1 from the **Slave PDO** drop-down list. The system will update the COB ID to 0x182. Choose **Event** from the **Transmission Type** drop-down list and set **Inhibit Time** to 500 ms and **Event Timer** to 1,000 ms.

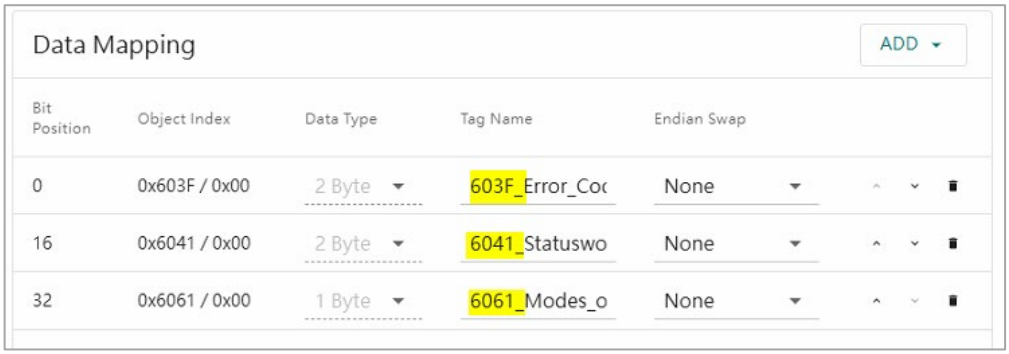
In the **Data Mapping** section, click the **ADD** button and choose **Add mapping object by EDS**. Choose **Error_Code [0x603F, 0x00]**, **Statusword [0x6041, 0x00]**, and **Modes_of_Operation_Display [0x6061, 0x00]**. Click the **DONE** button.



The slave's TPDO1 Data Mapping results are below:



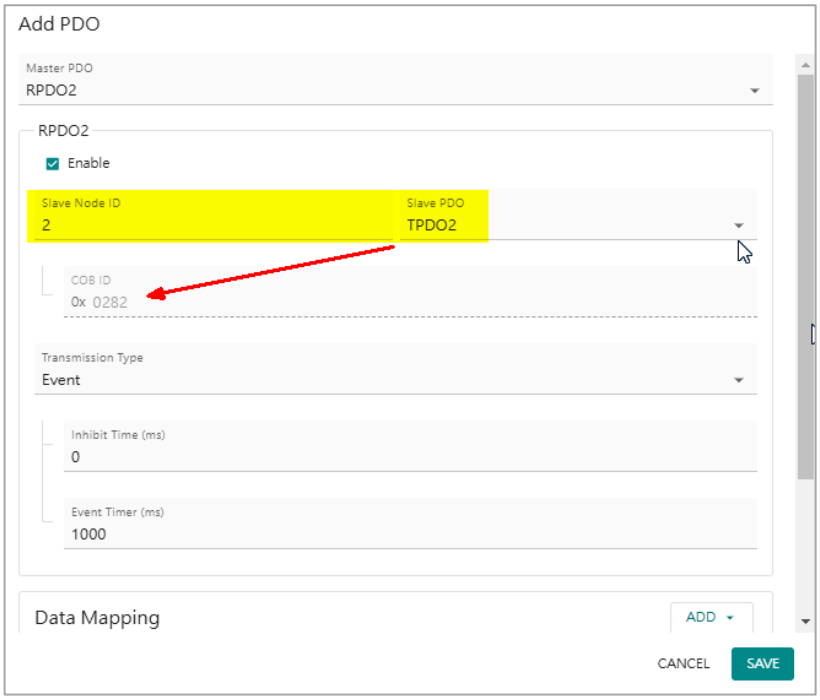
Change Tag Name with the Object Index prefix:



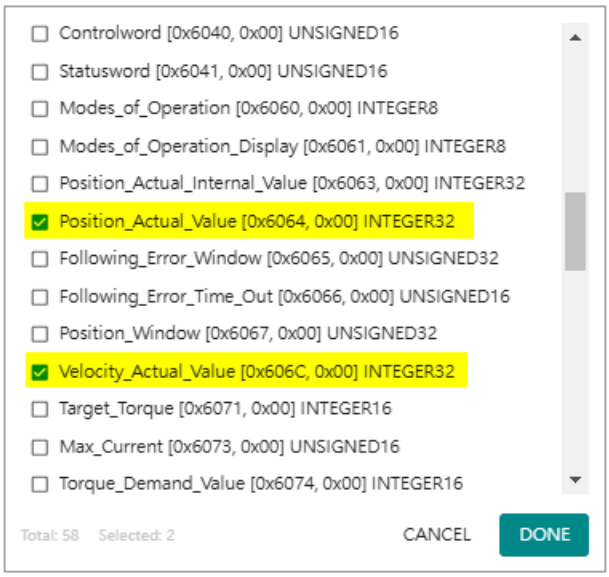
4. Slave's TPDO1:

Choose RPDO2 from the **Master PDO** drop-down list. Change Slave Node ID to 2 and choose TPDO2 from the **Slave PDO** drop-down list. The system will update the COB ID to 0x282. Choose **Event** from the **Transmission Type** drop-down list and set **Inhibit Time** to 500 ms and **Event Timer**" to 1,000 ms.

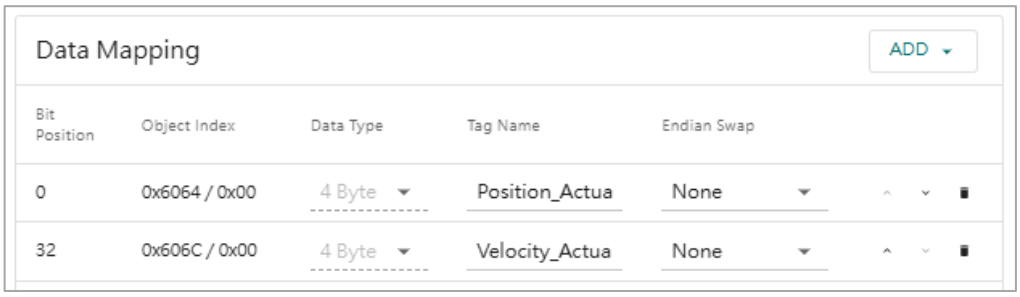
In the **Data Mapping** section, click the **ADD** button and choose **Add mapping object by EDS**. Choose **Error_Code [0x603F, 0x00]**, **Statusword [0x6041, 0x00]**, and **Modes_of_Operation_Display [0x6061, 0x00]**. Click the **DONE** button.



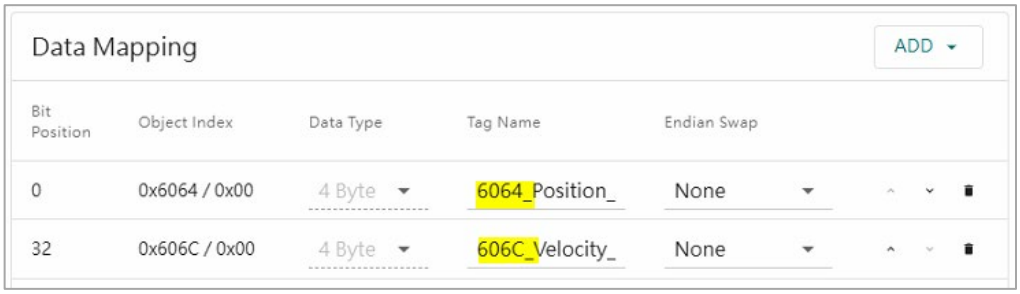
In the **Data Mapping** section, click the **ADD** button and choose **Add mapping object by EDS**. Choose **Position_Actual_Value [0x6064, 0x00]** and **Velocity_Actual_Value [0x606C, 0x00]**. Click the **DONE** button.



The slave's TPDO2 Data Mapping results are below:



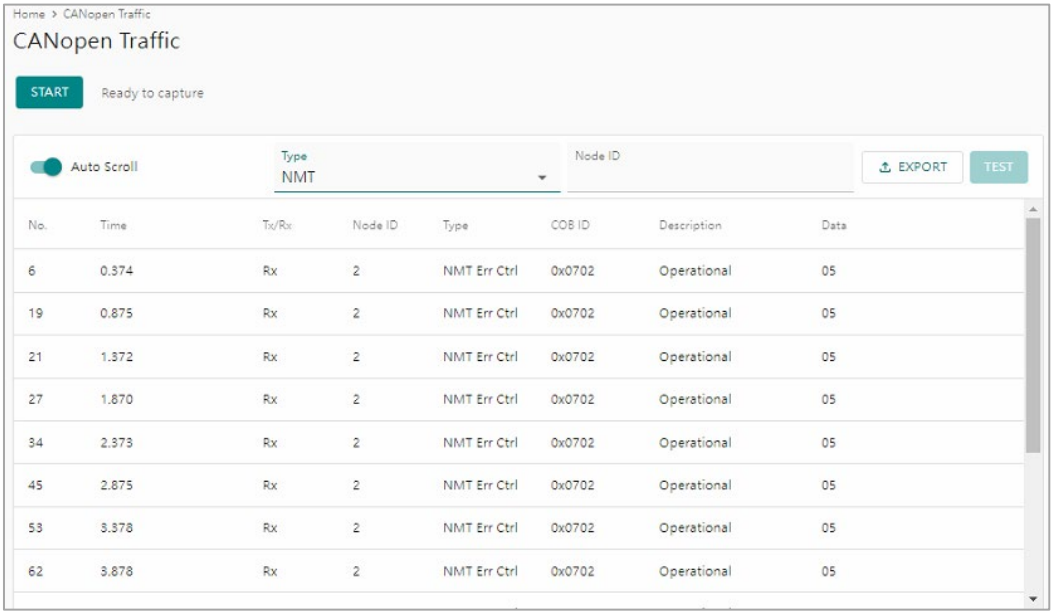
Change Tag Name with the Object Index prefix:



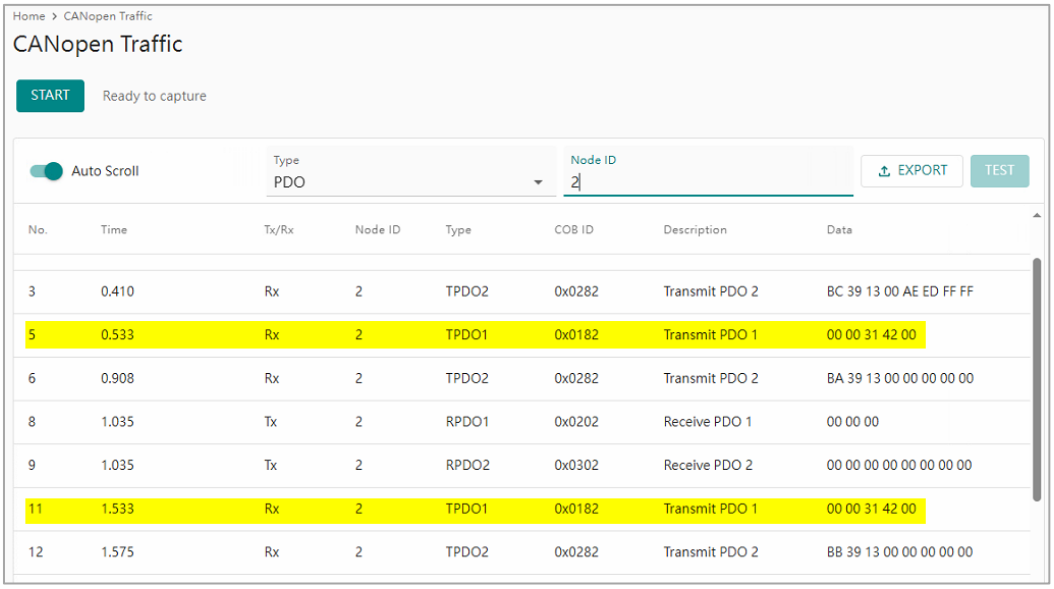
4.2.5 Verify Slave's CANopen Settings

After applying **CANopen Settings**, the MGate will send an SDO requests to set the slave's communication parameters and PDO mapping because the "Enable device parameters initialization" setting was enabled. Start capturing **CANopen Traffic** to log communications. Then, verify the slave's CANopen settings.

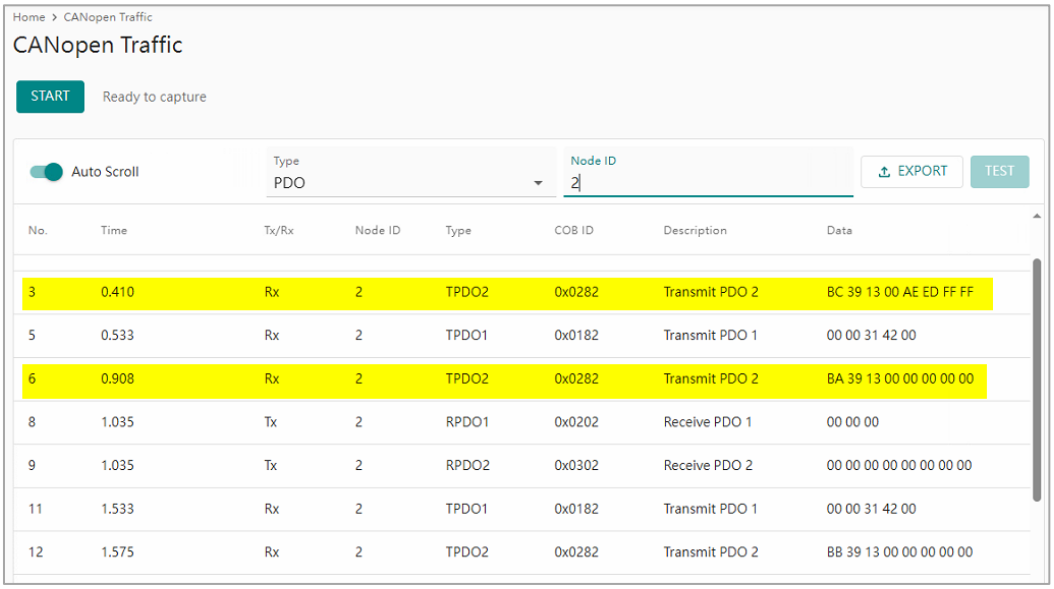
1. **Heatbeat producer time** is 500 ms: Select **NMT** from the **Type** filter. Verify that the interval is about 500 ms.



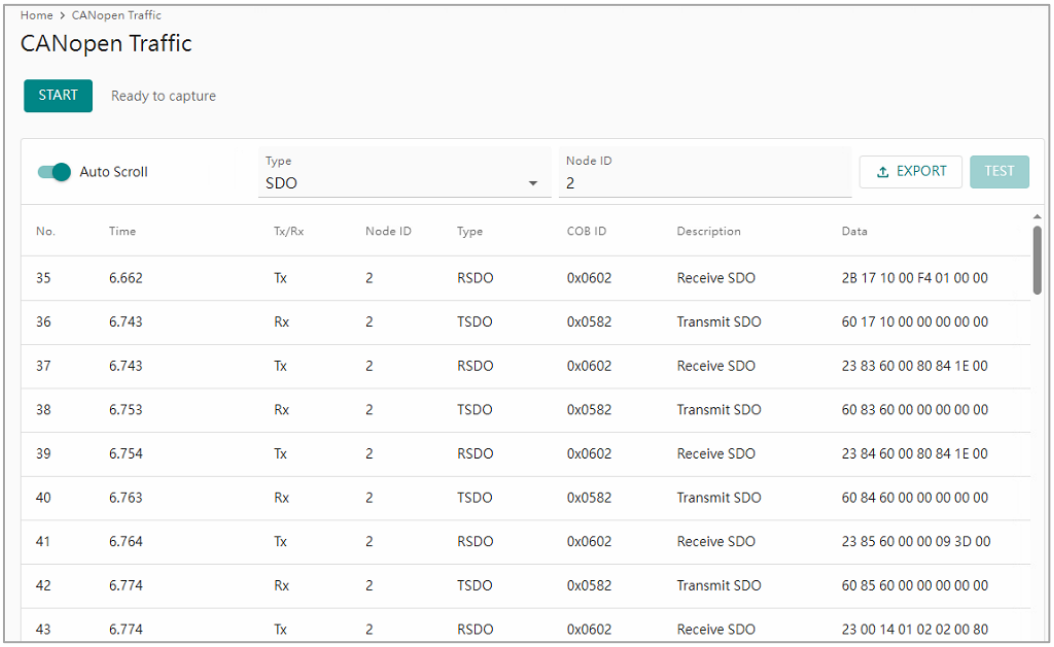
2. **Slave's TPDO1:** The data length of TPDO1 is 5 bytes. The Tx interval time is 1,000 ms to meet the **Event Timer** setting.



3. Slave's TPDO2: The data length of TPDO1 is 8 bytes. The Tx interval time is 500 ms, and the data changes to meet the **Inhibit Time** setting.



4. Verify the **device parameters initialization** process. Reboot the slave. After booting up the slave, the MGate will send an SDO request to write the config to the slave.

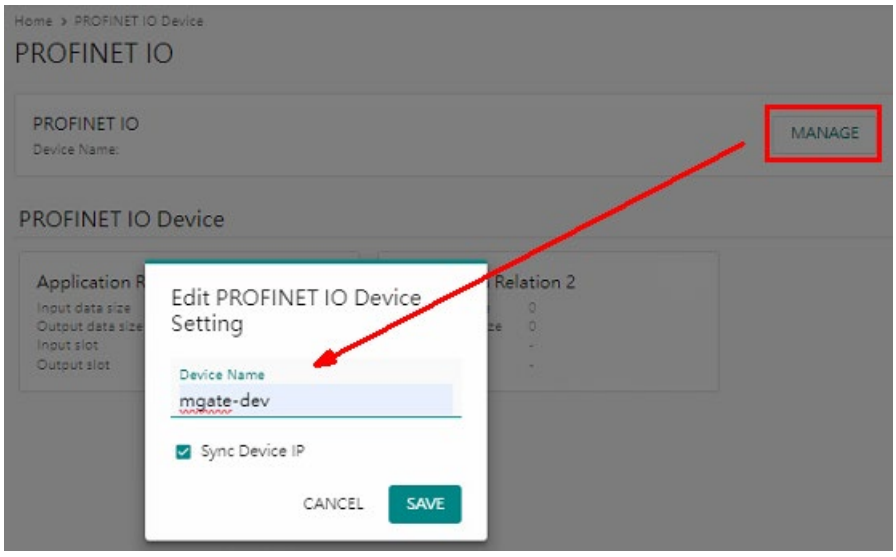


No.	Time	Tx/Rx	Node ID	Type	COB ID	Description	Data
35	6.662	Tx	2	RSDO	0x0602	Receive SDO	2B 17 10 00 F4 01 00 00
36	6.743	Rx	2	TSDO	0x0582	Transmit SDO	60 17 10 00 00 00 00 00
37	6.743	Tx	2	RSDO	0x0602	Receive SDO	23 83 60 00 80 84 1E 00
38	6.753	Rx	2	TSDO	0x0582	Transmit SDO	60 83 60 00 00 00 00 00
39	6.754	Tx	2	RSDO	0x0602	Receive SDO	23 84 60 00 80 84 1E 00
40	6.763	Rx	2	TSDO	0x0582	Transmit SDO	60 84 60 00 00 00 00 00
41	6.764	Tx	2	RSDO	0x0602	Receive SDO	23 85 60 00 00 09 3D 00
42	6.774	Rx	2	TSDO	0x0582	Transmit SDO	60 85 60 00 00 00 00 00
43	6.774	Tx	2	RSDO	0x0602	Receive SDO	23 00 14 01 02 02 00 80

4.3 PROFINET IO Settings

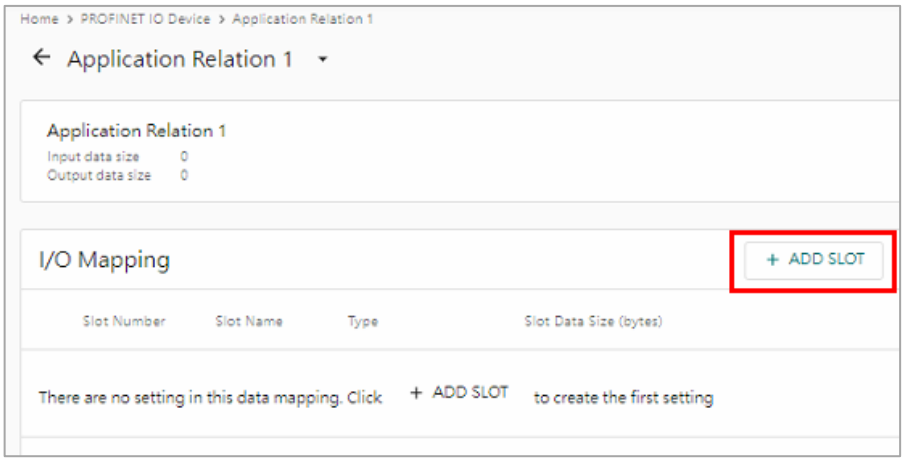
4.3.1 Device Name Settings

In the **PROFINET IO Device** setting, click the **MANAGE** button to set **Device Name** as mgate-dev. Click the **SAVE** button.

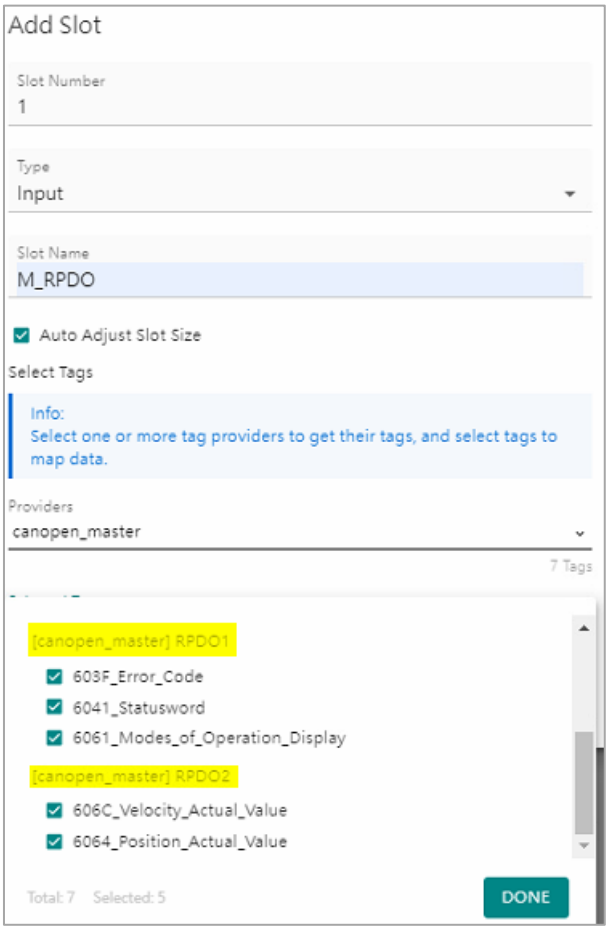


4.3.2 PROFINET IO Settings

Choose **Application Relation 1** to map CANopen IO data. In the **I/O Mapping** tab, click **ADD SLOT** to add IO modules.

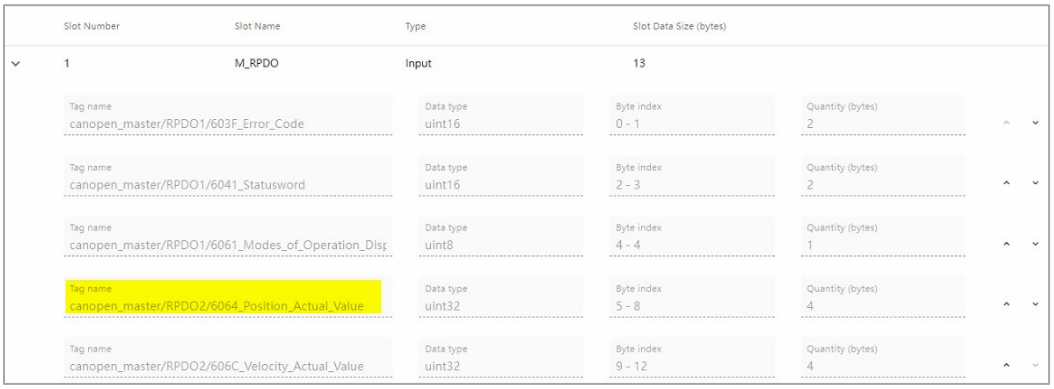


- Add Slot Number 1 module as an **Input** type module. Choose all RPDO1 tags and RPDO2 tags. Enable **Auto Adjust Slot Size** to auto calculate the data size.

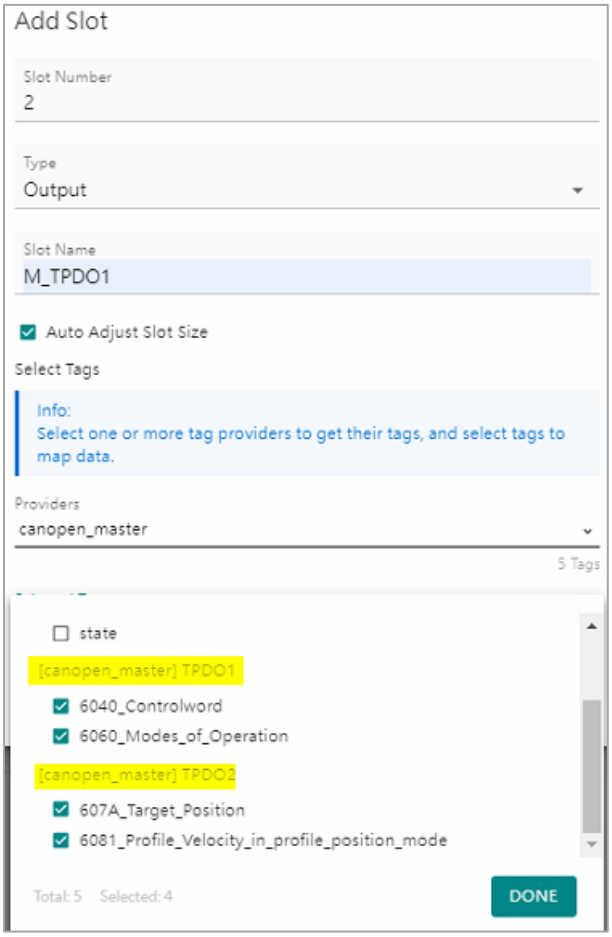


- After adding, use the **Arrow** button to change the tag's **Byte Index position**.

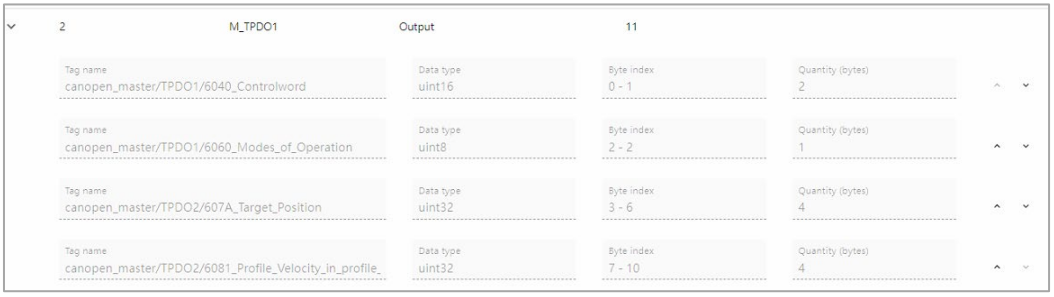
The final mapping of Slot 1 is below:



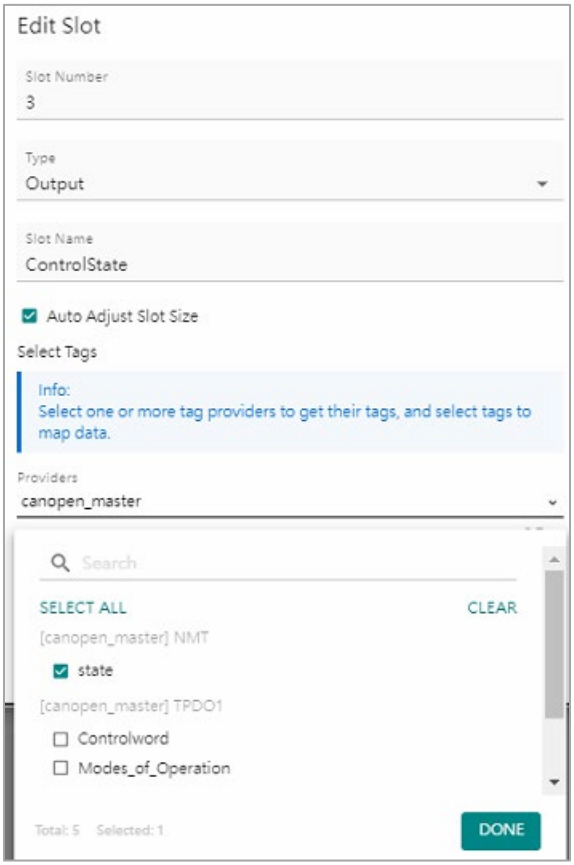
- Add Slot Number 2 module as an **Output** type module. Choose all TPDO1 and TPDO2 tags. Enable **Auto Adjust Slot Size** to auto calculate the data size.



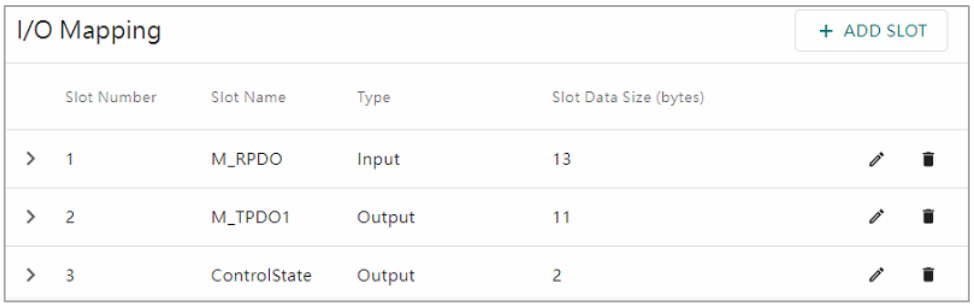
- The final mapping of Slot 2 is below:



- Add Slot Number 3 module as an **Output** type module. Choose **[canopen_master] NMT > State** tags. Enable **Auto Adjust Slot Size** to auto calculate the data size.



After adding, each slot data size shows as below:

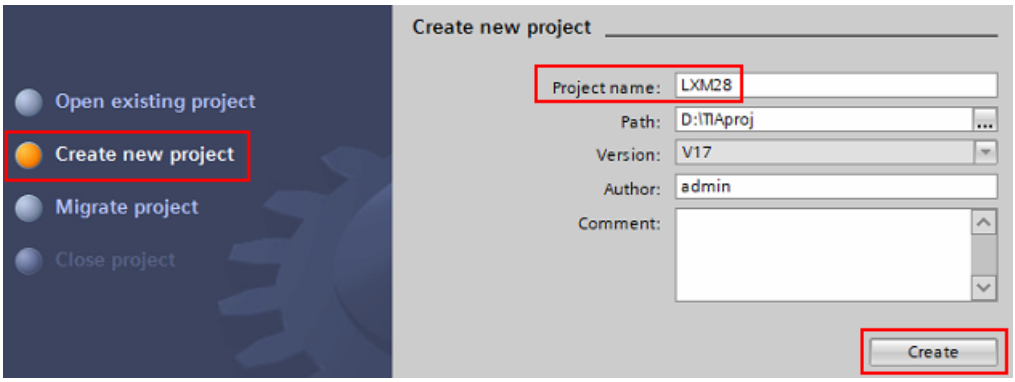


5 Siemens S7-1200 Setting

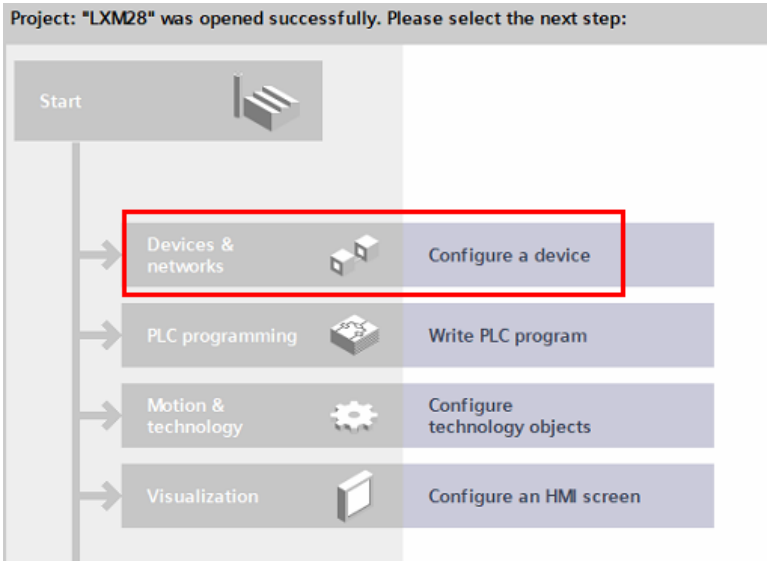
We use TIA Portal to configure the Siemens S7-1200.

5.1 Hardware Configuration

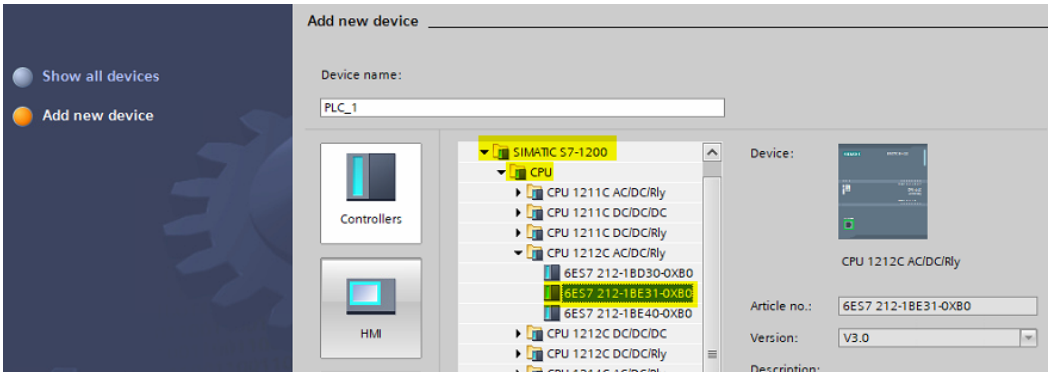
1. Create a new project.



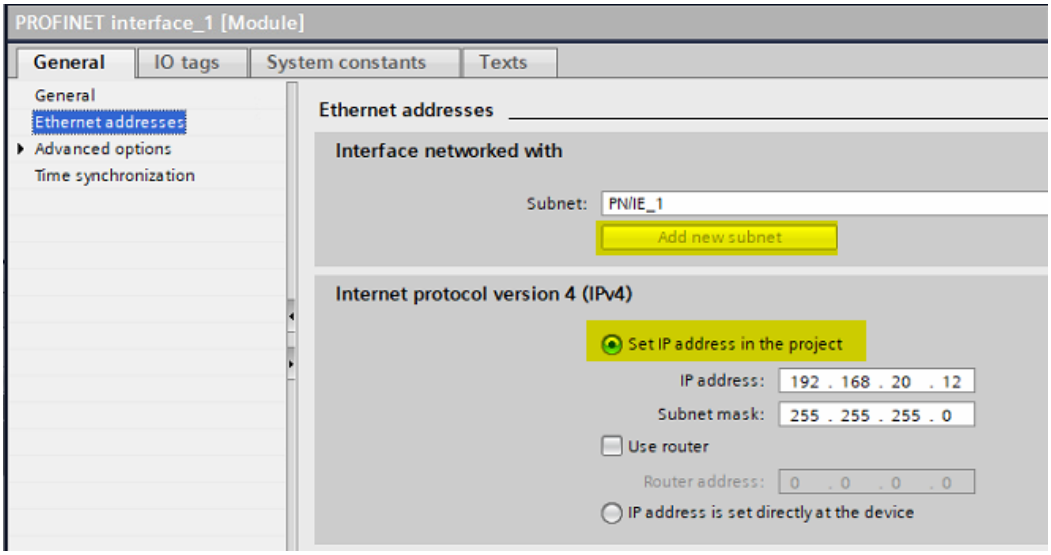
2. On successful creation of the project, click **Configure a device** to add the PLC.



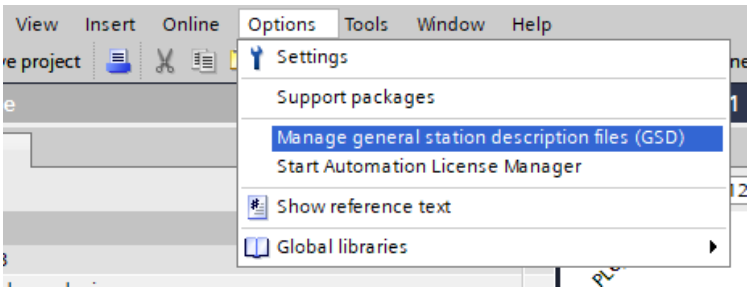
3. Under the actual PLC's CPU model, select it from **Controllers > Simatic S7-1200 > CPU** as below:



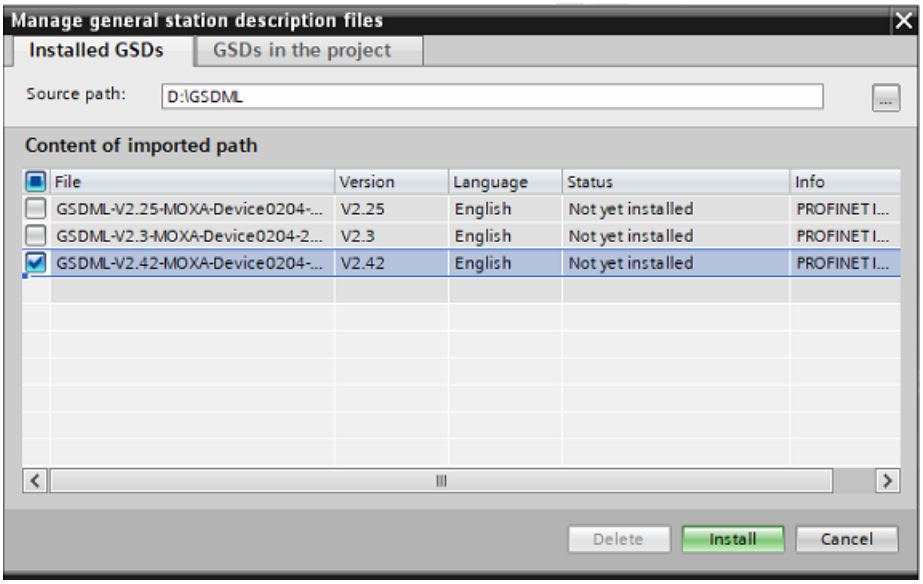
4. Click **PLC's PROFINET interface** to set its IP Address. Click **Add new subnet** to create a subnet to **PN/IE_1**.



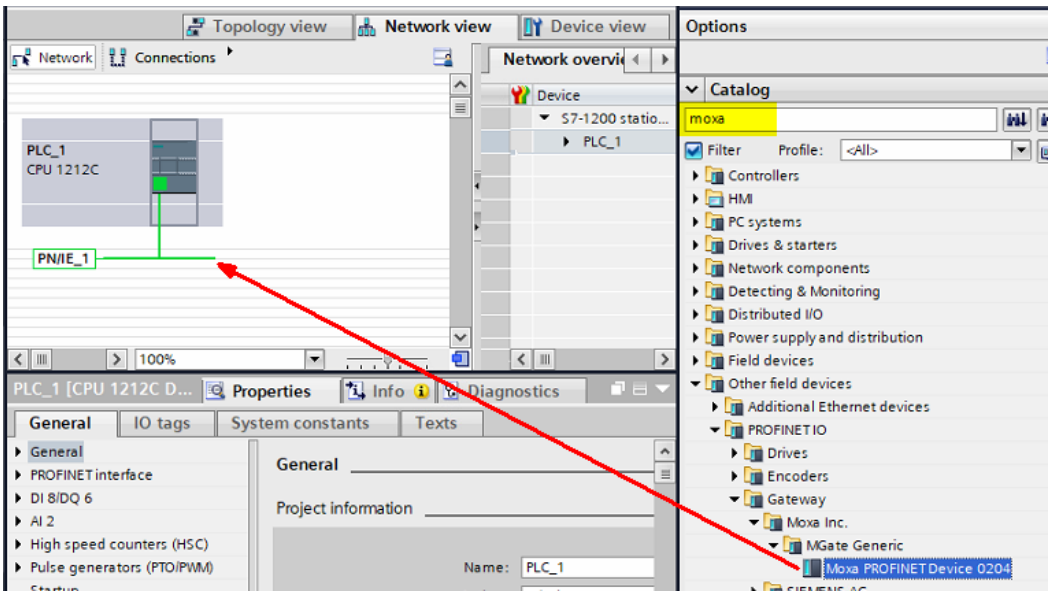
5. Click **Options > Manage general station description** to install the MGate 5123's GSD file.



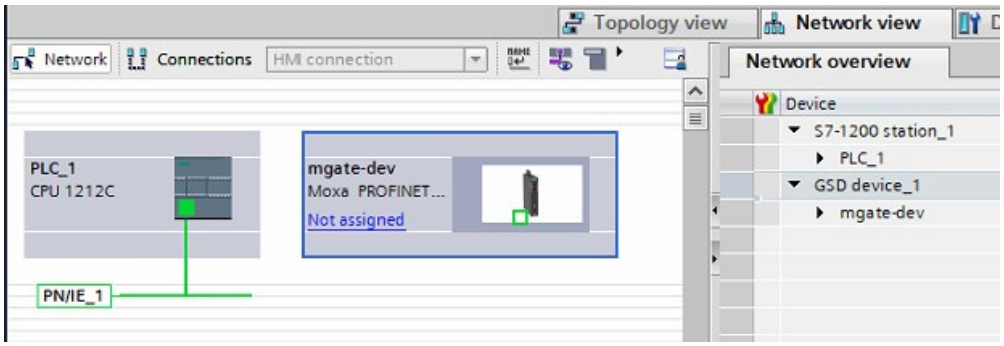
Select the latest version of the MGate 5123, V2.42 and click **Install**.



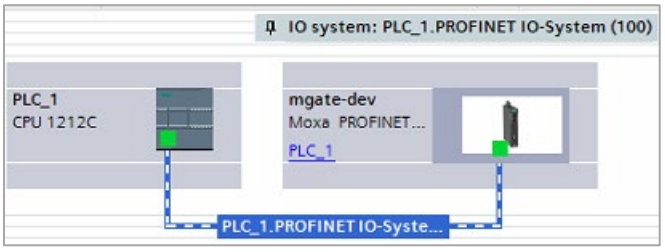
6. In the **Hardware catalog** window, filter "moxa" to search the MGate 5123. Choose the **Moxa PROFINET Device 0202** device icon and drag and drop to the "PN/IE_1" subnet.



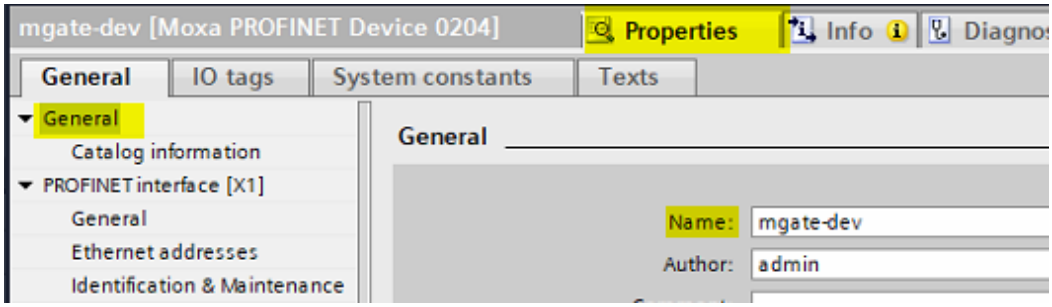
7. In **Network view**, you will see the MGate 5123 is in the **PN/IE_1** subnet. Click **Not assigned** to assign the MGate 5123 to **PN/IE_1**.



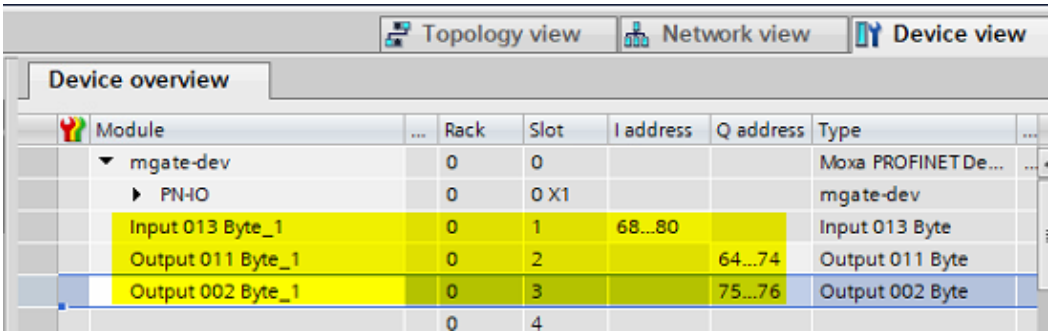
The MGate 5123 is then set into the **PLC_1**'s PROFINET IO System.



If your MGate 5123 device name is not "mgate-dev", change it via **Properties > General > Name**.



8. In the MGate 5123's **Device overview**, drag and drop **Input 013 Byte** to Slot 1, **Output 011 Byte** to Slot 2, and **Output 002 Byte** to Slot 3.



5.2 Software Configuration

5.2.1 Modify Tag table

1. In **Default tag table**, create the **Input** and **Output** tags as below:

Default tag table

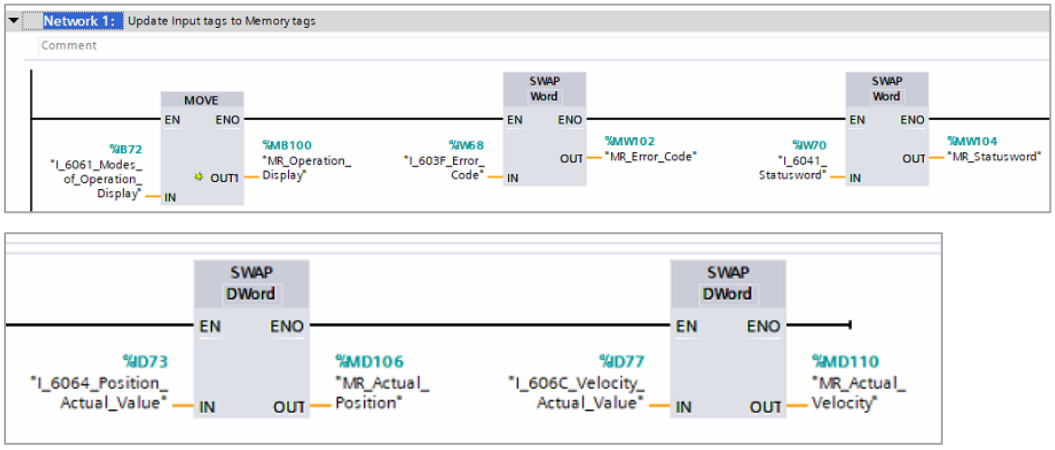
	Name	Data type	Address
1	I_6041_Statusword	Word	%IW70
2	I_603F_Error_Code	Word	%IW68
3	I_6064_Position_Actual_Value	DWord	%ID73
4	I_606C_Velocity_Actual_Value	DWord	%ID77
5	I_6061_Modes_of_Operation_...	Byte	%IB72
6	Q_ControlNMTState	Word	%QW75
7	Q_6040_Controlword	Word	%QW64
8	Q_6060_Modes_of_Operation	Byte	%QB66
9	Q_607A_Target_Position	DWord	%QD67
10	Q_6081_Profile_Velocity_in_pr...	DWord	%QD70

2. Create **Memory** tags for program configuration or tag monitoring:

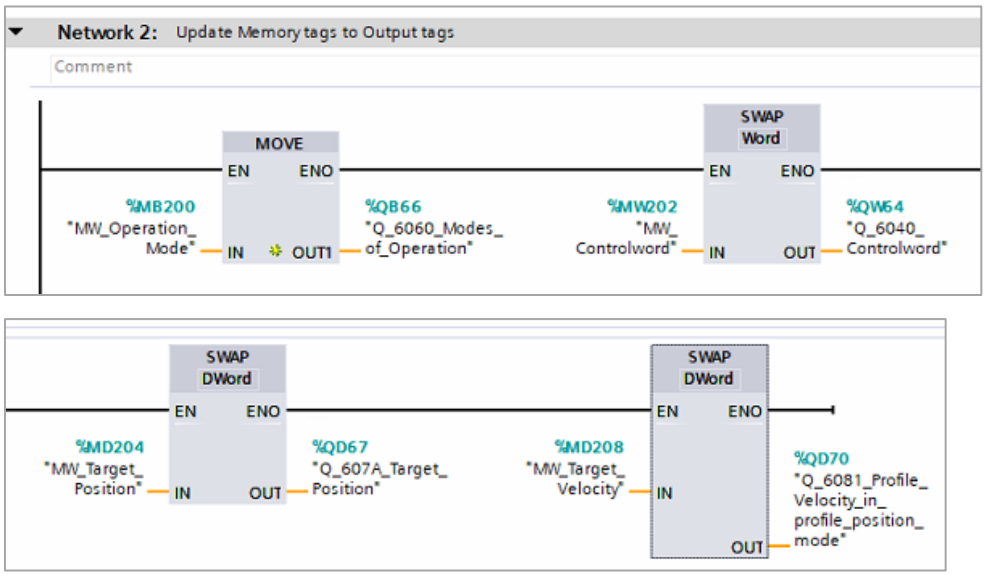
11	MR_Operation_Display	Byte	%MB100
12	MR_Error_Code	Word	%MW102
13	MR_Statusword	Word	%MW104
14	MR_Actual_Position	DWord	%MD106
15	MR_Actual_Velocity	DWord	%MD110
16	MW_Operation_Mode	Byte	%MB200
17	MW_Controlword	Word	%MW202
18	MW_Target_Position	DWord	%MD204
19	MW_Target_Velocity	DWord	%MD208
20	MW_ControlNMTState	Word	%MW212

5.2.2 Modify OB1

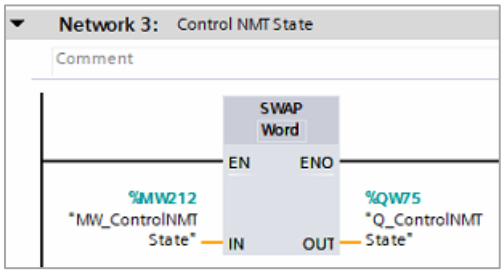
1. The PROFINET data format is different from CANopen. If the tag is multi-byte, reverse the byte order. In this demonstration, we keep the CANopen data without swapping. So, in Network **1**, the program uses **SWAP** instructions to copy the value of the **Input** tag to the **Memory** tag. If you swapped the tag value in the **4.2.4 PDO Settings**, use **MOVE** instructions.



2. Add **Network 2**: Update Memory tags to **Output** tags

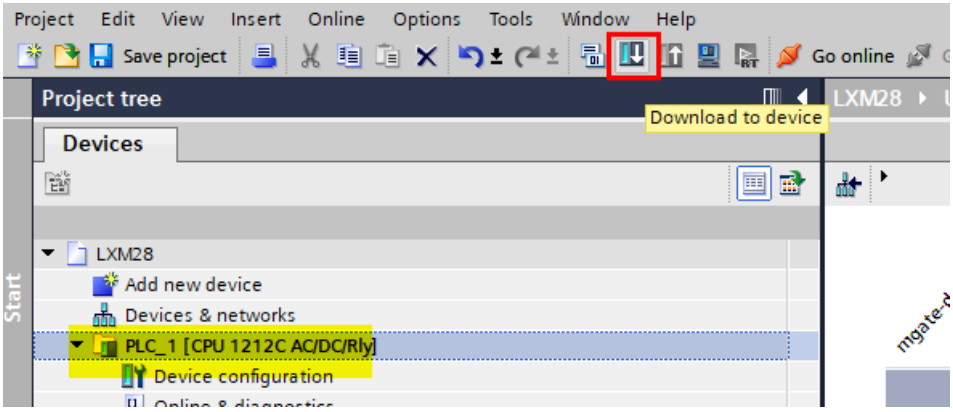


3. Add **Network 3**: Control NMT State

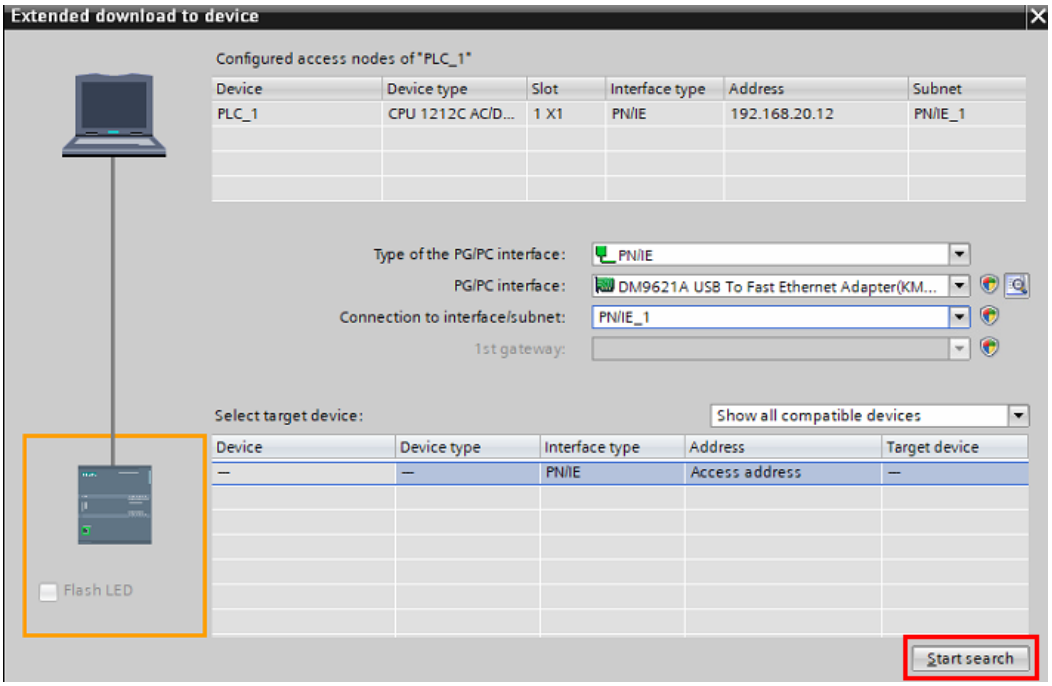


5.3 Download to PLC

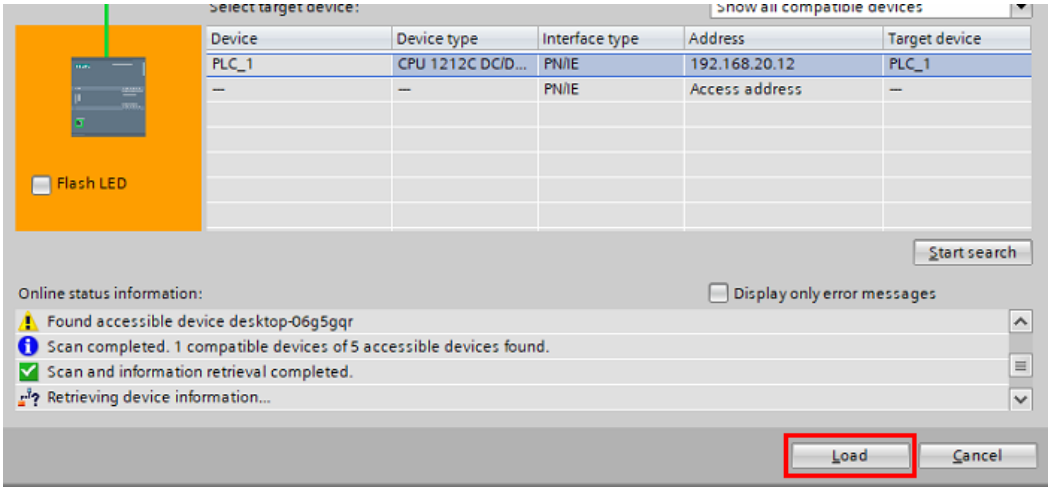
1. Execute **Download**.



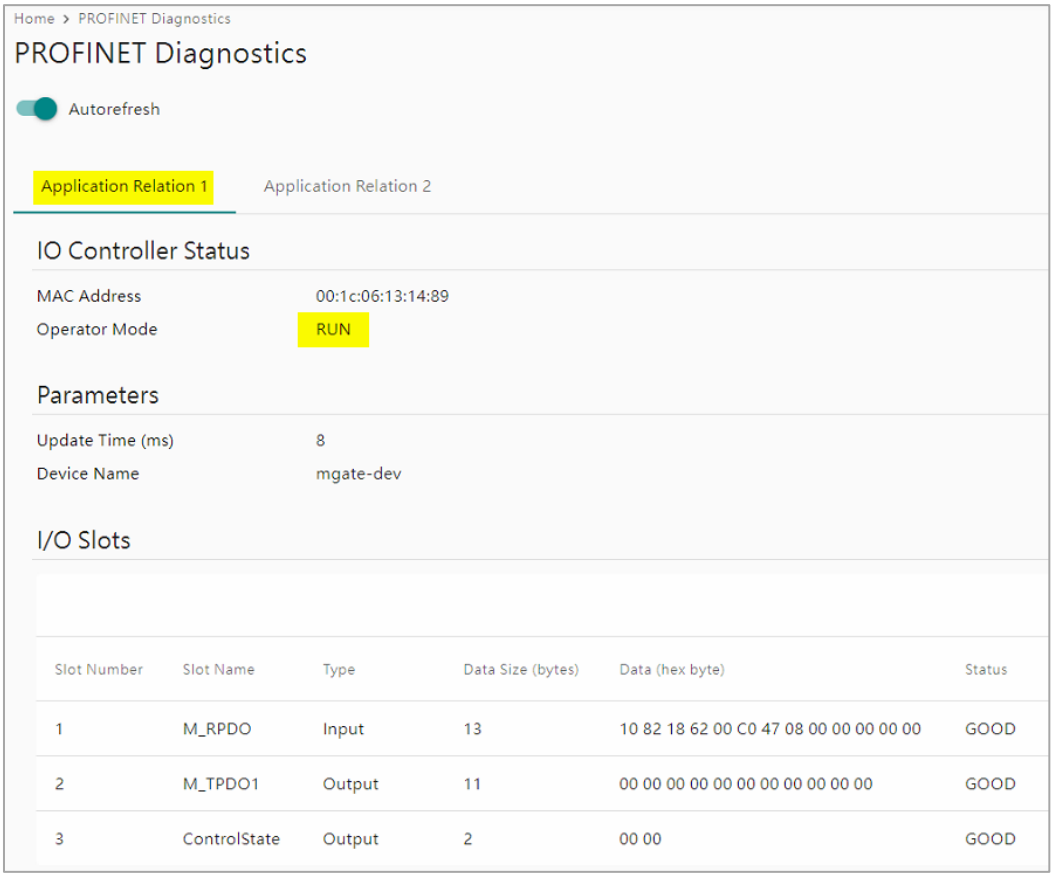
2. Click **Start Search** to search for an accessible PLC.



3. When found, execute **Load**.



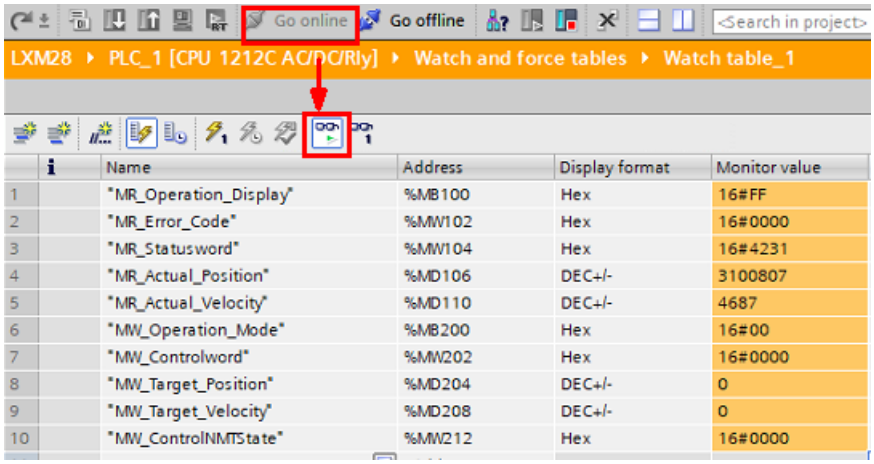
4. After loading, enable **Start all** to start modules and click **Finish**.
5. Check the MGate's **PROFINET Diagnostics** on the web console. Make sure **IO Controller Status-> Operator Mode** is **RUN** and all IO Module Status are **GOOD**.



6 Communication Test

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

Add the tags below to be observed and click **Go online**. Then, click **Monitor all**.



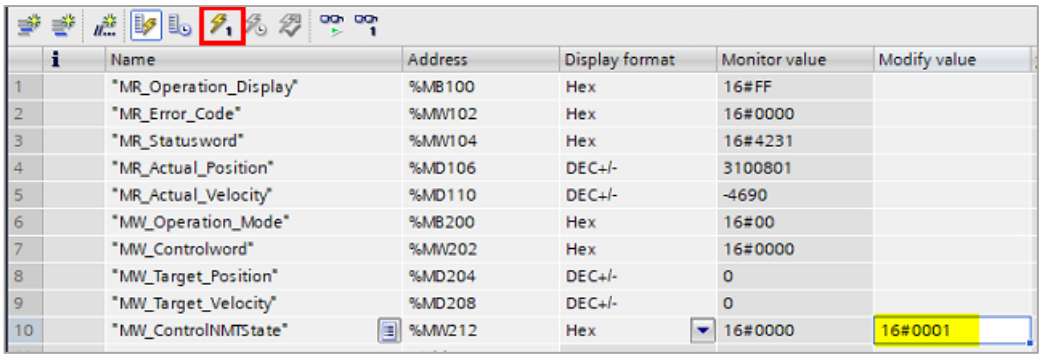
	Name	Address	Display format	Monitor value
1	"MR_Operation_Display"	%MB100	Hex	16#FF
2	"MR_Error_Code"	%MW102	Hex	16#0000
3	"MR_Statusword"	%MW104	Hex	16#4231
4	"MR_Actual_Position"	%MD106	DEC+/-	3100807
5	"MR_Actual_Velocity"	%MD110	DEC+/-	4687
6	"MW_Operation_Mode"	%MB200	Hex	16#00
7	"MW_Controlword"	%MW202	Hex	16#0000
8	"MW_Target_Position"	%MD204	DEC+/-	0
9	"MW_Target_Velocity"	%MD208	DEC+/-	0
10	"MW_ControlNMTState"	%MW212	Hex	16#0000

6.1 NMT State Test

Write canopen_master/NMT/state to update the NMT state. The valid values are:

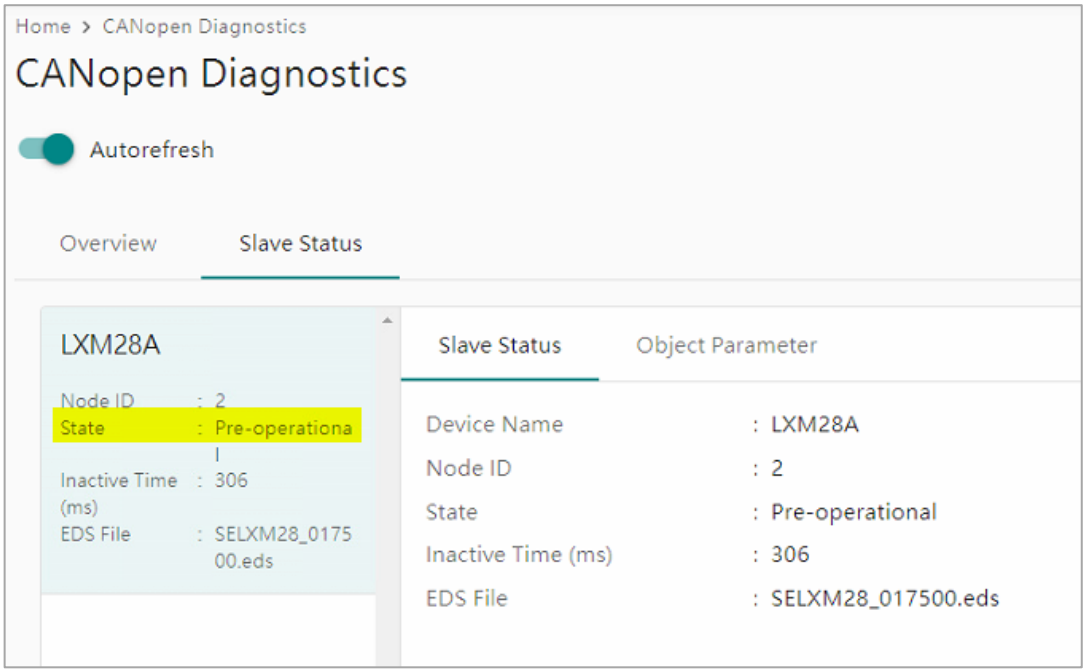
- 0 => Enter to **Operational Mode**
- 1 => Enter to **Pre-Operational Mode**
- 2 => Enter to **Stop Mode**

Change the **MW_ControlNMTState** value to 0x0001:

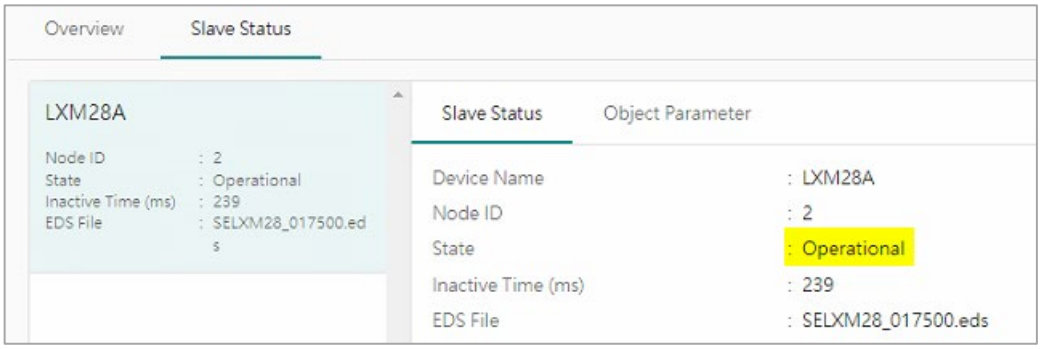


	Name	Address	Display format	Monitor value	Modify value
1	"MR_Operation_Display"	%MB100	Hex	16#FF	
2	"MR_Error_Code"	%MW102	Hex	16#0000	
3	"MR_Statusword"	%MW104	Hex	16#4231	
4	"MR_Actual_Position"	%MD106	DEC+/-	3100801	
5	"MR_Actual_Velocity"	%MD110	DEC+/-	-4690	
6	"MW_Operation_Mode"	%MB200	Hex	16#00	
7	"MW_Controlword"	%MW202	Hex	16#0000	
8	"MW_Target_Position"	%MD204	DEC+/-	0	
9	"MW_Target_Velocity"	%MD208	DEC+/-	0	
10	"MW_ControlNMTState"	%MW212	Hex	16#0000	16#0001

Check **CANopen Diagnostics** on the MGate's web console. The status of LXM28A shows **Pre-Operational**.

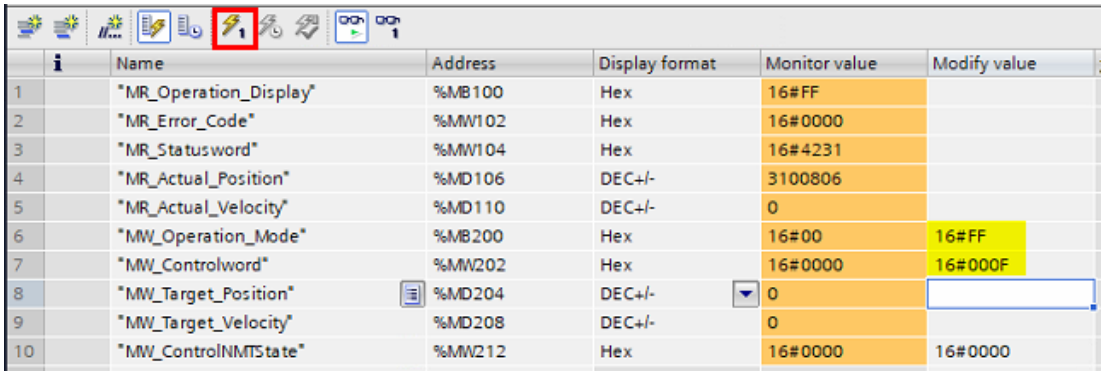


Change the **MW_ControlNMTState** value to 0x0000. Check **CANopen Diagnostics** on the MGate's web console. The status of LXM28A shows "Operational".



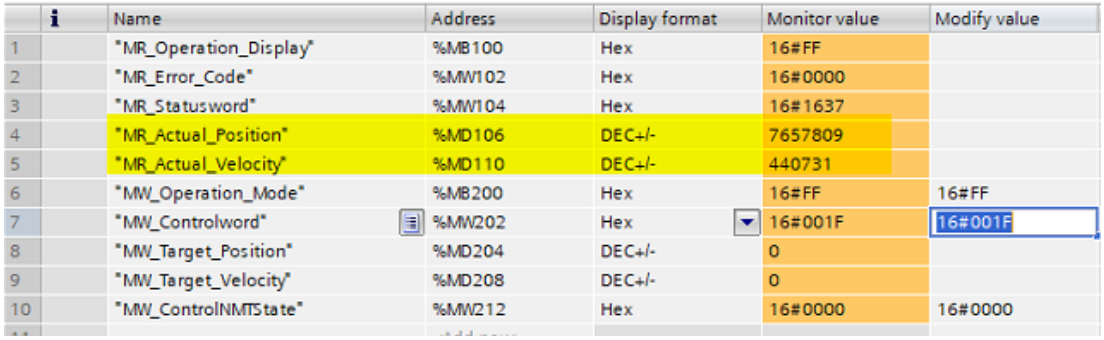
6.2 JOG Mode Test

In this test, we set the **Operation Mode** to **JOG** mode by setting **MW_Operation_Mode** to **0xFF**. Set **Controlword** to **Enable Operation** by setting **MW_Controlword** to **0x000F**. Click **Modify**.



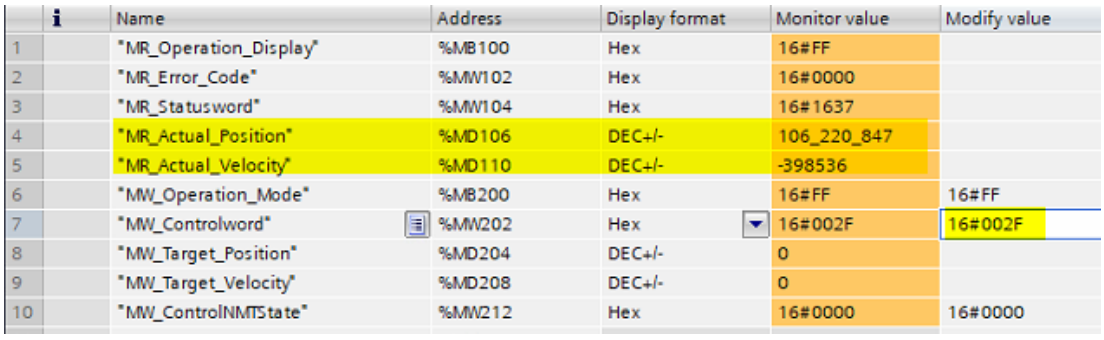
	Name	Address	Display format	Monitor value	Modify value
1	"MR_Operation_Display"	%MB100	Hex	16#FF	
2	"MR_Error_Code"	%MW102	Hex	16#0000	
3	"MR_Statusword"	%MW104	Hex	16#4231	
4	"MR_Actual_Position"	%MD106	DEC+/-	3100806	
5	"MR_Actual_Velocity"	%MD110	DEC+/-	0	
6	"MW_Operation_Mode"	%MB200	Hex	16#00	16#FF
7	"MW_Controlword"	%MW202	Hex	16#0000	16#000F
8	"MW_Target_Position"	%MD204	DEC+/-	0	
9	"MW_Target_Velocity"	%MD208	DEC+/-	0	
10	"MW_ControlNMTState"	%MW212	Hex	16#0000	16#0000

Next, modify **MW_Controlword** to **0x001F**. It triggers LXM28A to start JOG in a **positive** direction. We see the value of MR_Actual_Position steadily increasing, and the value of **MR_Actual_Velocity** is positive.



	Name	Address	Display format	Monitor value	Modify value
1	"MR_Operation_Display"	%MB100	Hex	16#FF	
2	"MR_Error_Code"	%MW102	Hex	16#0000	
3	"MR_Statusword"	%MW104	Hex	16#1637	
4	"MR_Actual_Position"	%MD106	DEC+/-	7657809	
5	"MR_Actual_Velocity"	%MD110	DEC+/-	440731	
6	"MW_Operation_Mode"	%MB200	Hex	16#FF	16#FF
7	"MW_Controlword"	%MW202	Hex	16#001F	16#001F
8	"MW_Target_Position"	%MD204	DEC+/-	0	
9	"MW_Target_Velocity"	%MD208	DEC+/-	0	
10	"MW_ControlNMTState"	%MW212	Hex	16#0000	16#0000

Next, change **MW_Controlword** to **0x002F**. It triggers LXM28A to start JOG in a **negative** direction. We see the value of **MR_Actual_Position** steadily decreasing, and the value of **MR_Actual_Velocity** is negative.



	Name	Address	Display format	Monitor value	Modify value
1	"MR_Operation_Display"	%MB100	Hex	16#FF	
2	"MR_Error_Code"	%MW102	Hex	16#0000	
3	"MR_Statusword"	%MW104	Hex	16#1637	
4	"MR_Actual_Position"	%MD106	DEC+/-	106_220_847	
5	"MR_Actual_Velocity"	%MD110	DEC+/-	-398536	
6	"MW_Operation_Mode"	%MB200	Hex	16#FF	16#FF
7	"MW_Controlword"	%MW202	Hex	16#002F	16#002F
8	"MW_Target_Position"	%MD204	DEC+/-	0	
9	"MW_Target_Velocity"	%MD208	DEC+/-	0	
10	"MW_ControlNMTState"	%MW212	Hex	16#0000	16#0000

6.3 Fault Protection Test

Now, we see the BCH2 servo motor is in reverse movement. If we unplug the Ethernet cable of S7-1200 to disconnect PROFINET connection, it triggers the fault protection function, which we set in “4.2.4 PDO settings”. The operation mode will be 0x00, and the BCH2 servo motor stops the movement and stays in servo off mode.