User Manual

Version 2.0.0 Oct 2024

IEC850-211-S

Modbus TCP to IEC-61850 Gateway

Warranty

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Document Revision

Version	Author	Date	Description
1.0.0	Evan	2021/01/06	First Released Revision
1.0.1	Evan	2021/08/09	
1.0.2	Alina	2024/05/08	Modify object & Utility picture
2.0.0	Alina	2024/10/01	Modify objects & Utility usage changes & add connection descriptions

Contents

1. Introduction

1.1. IEC-61850 Introduction

IEC 61850 is an international standard defining communication protocols for intelligent electronic devices at electrical substations. It is developed by the International Electrotechnical Commission's (IEC) Technical Committee 57 reference architecture for electric power systems. The objective of the standard is to specify requirements and to provide a framework to achieve interoperability between the IEDs supplied from different suppliers. This protocol can run over TCP/IP networks or substation LANs using high speed switched Ethernet to obtain the necessary response times below four milliseconds for protective relaying.

1.2. Modbus TCP Introduction

MODBUS/TCP is a variant of the MODBUS family of simple, vendor-neutral communication protocols intended for supervision and control of automation equipment. Specifically, it covers the use of MODBUS messaging in an “Intranet” or “Internet” environment using the TCP/IP protocols. The most common use of the protocols at this time are for Ethernet attachment of PLC’s, I/O modules, and gateways to other simple field buses or I/O networks.

1.3. About IEC850-211-S

IEC850-211-S is a network gateway allowing IEC-61850 MMS client to access Modbus TCP network as a Modbus TCP client. IEC-61850 protocol is used in substation automation. The IEDs exchange information with other IEDs or SCADA via IEC-61850 protocol for protection and control devices.
IEC850-211-S support Logical Node and Data Object as below table. It also support data set and unbuffered report function to exchange data with a client. The data mapping rule can be configured via ICPDAS Utility.

Logical Node	Data Object
GGIO	Ind . IntIn . AnIn . AnOut . SPCSO
MMXU	TotW . TotVAr . TotPF . PhV . A .Hz
MMTR	SupWh . DmdWh
GAPC	SPCSO

1.4. Features

- Read/Write Modbus register via IEC-61850
- Configurable IEC-61850 server
- Configurable Modbus TCP client
- Support Logical Node GGIO. MMXU.MMTR.GAPC
- Support common Data Object Ind, SPCSO, AnIn, AnOut. IntIn.TotW.TotVAr.TotPF.PhV.A.Hz
- Support Modbus DI, DO,AI,AO types
- Support Modbus function code 1, 2, 3, 4, 5, 6,16
- Maximum support 32 Modbus TCP servers

1.5. Specifications

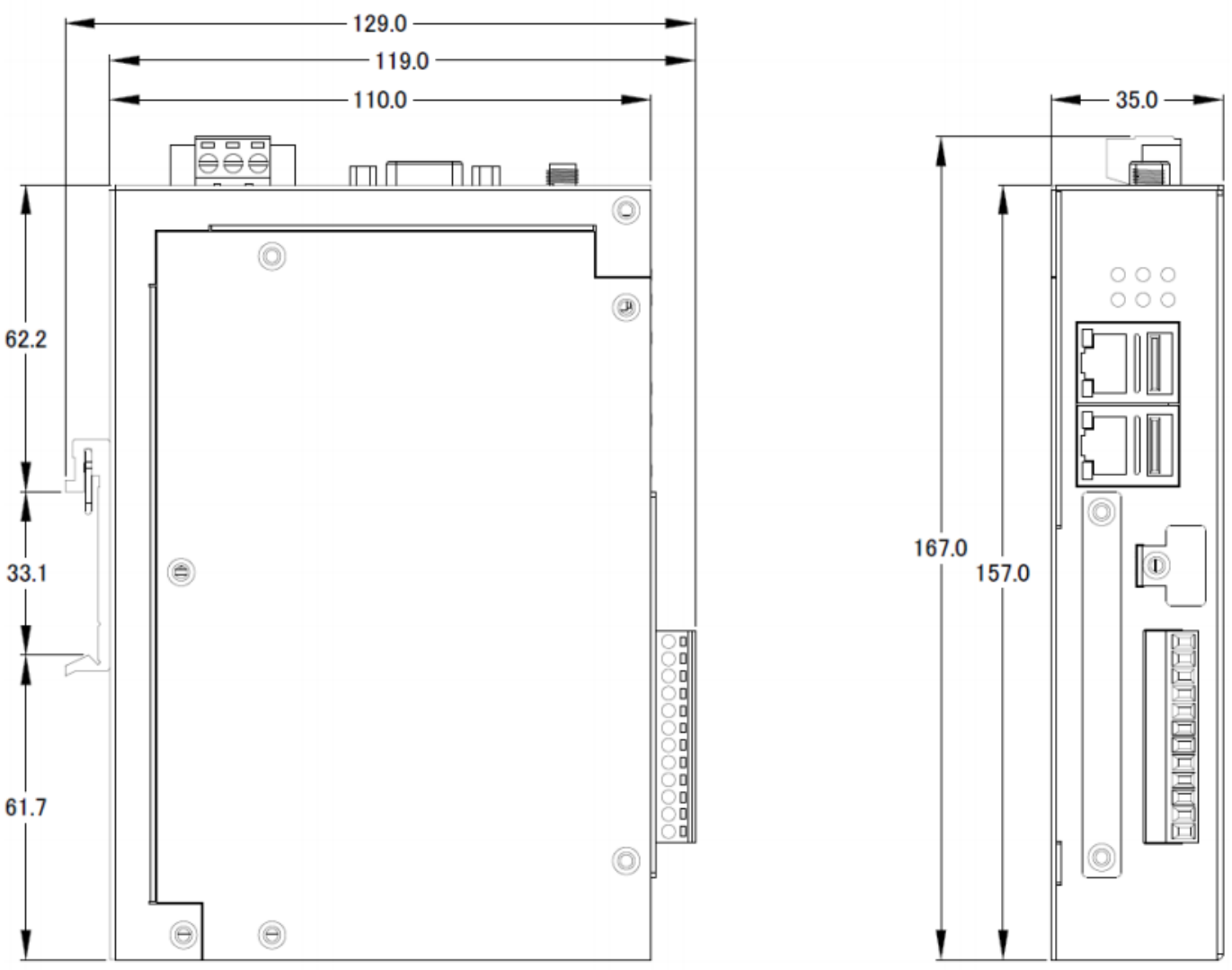
System	
CPU	Cortex-A8, 1 GHz
SDRAM	512 MB
Flash	512 MB
FRAM	64 KB
LED Indicators	PWR(Power), RUN(Running), L1, L2, L3
Communication Ports	
VGA	1 (reserved)
Ethernet	RJ-45 x 2, 10/100/1000 Based-TX (Auto-negotiating, Auto MDI/MDI-X, LED indicators)
USB 2.0	2 (reserved)
Console Port	RS-232 (RxD, TxD and GND); Non-isolated
ttyO2	RS-485 (reserved) (Data+, Data-); Non-isolated
ttyO4	RS-232 (reserved) (RxD, TxD and GND);

	Non-isolated	
ttyO5	RS-485 (reserved) (Data+, Data-); 2500 VDC isolated	
Protocol		
Modbus	identity	Modbus TCP client
	Function	1, 2, 3, 4, 5, 6,16
	connection	Max. 32 Modbus TCP servers
IEC-61850	identity	IEC-61850 MMS server
	connection	Max. 5 MMS clients
	Logical Node	LLN0、LPHD、GGIO.MMXU.MMTR.GAPC
	Data Object	Ind, SPCSO, AnIn, AnOut. IntIn.TotW.TotVAr.TotPF.PhV.A.Hz
	control	status-only direct-with-normal-security direct-with-enhanced-security sbo-with-normal-security sbo-with-enhanced-security
Power		
Supply Voltage	+12 to +48 VDC	
Consumption	4.8 W	
Connector	3-pin Removable Terminal Block	
Mechanism		
Dimensions	35 mm x 167 mm x 119 mm	
Casing	Metal	
Installation	DIN-Rail	
Environment		
Operating Temp.	-25°C ~ +75°C	
Storage Temp	-30°C ~ +85°C	
Humidity	10 ~ 90% RH, non-condensing	

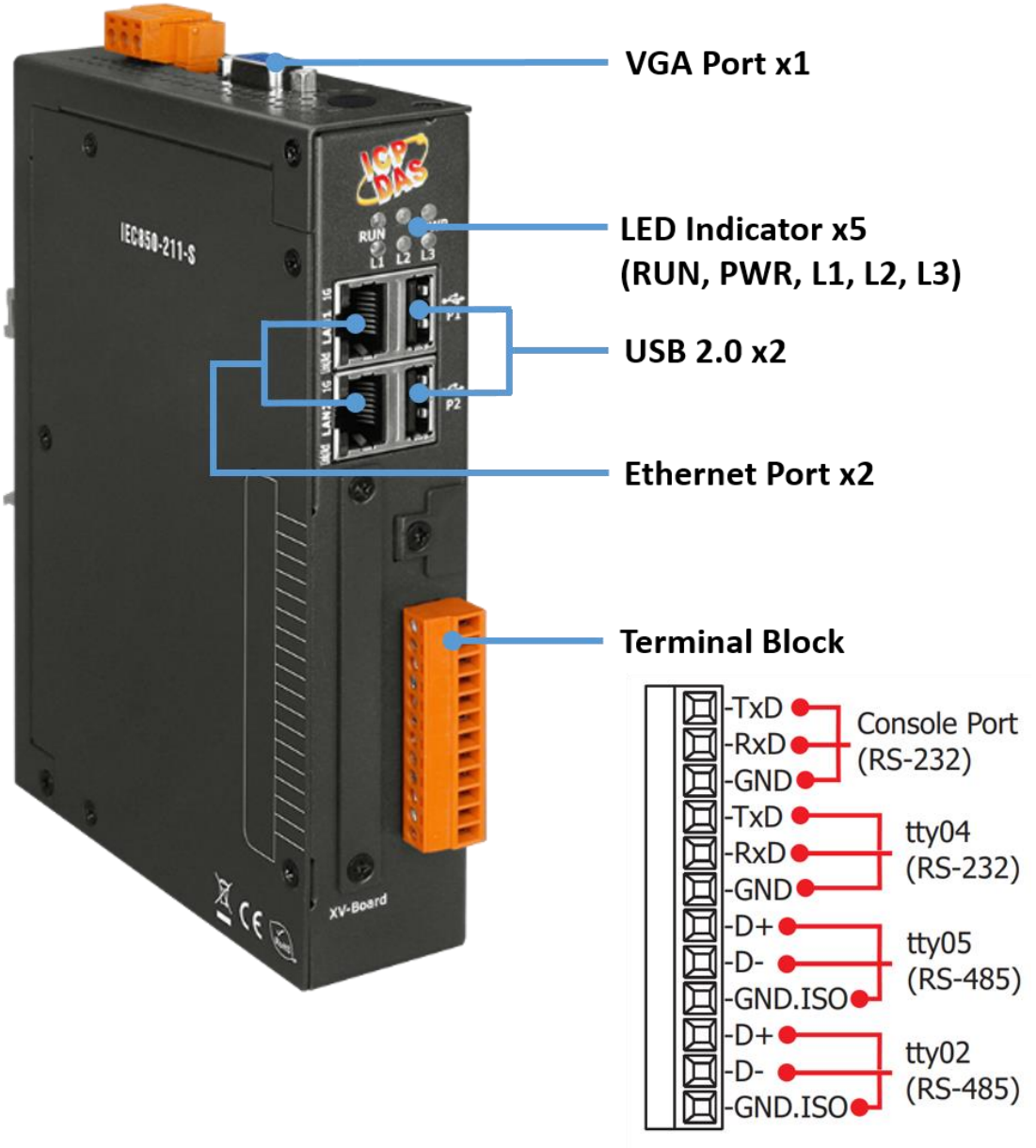
2.Hardware

2.1. Dimensions

Unit: mm

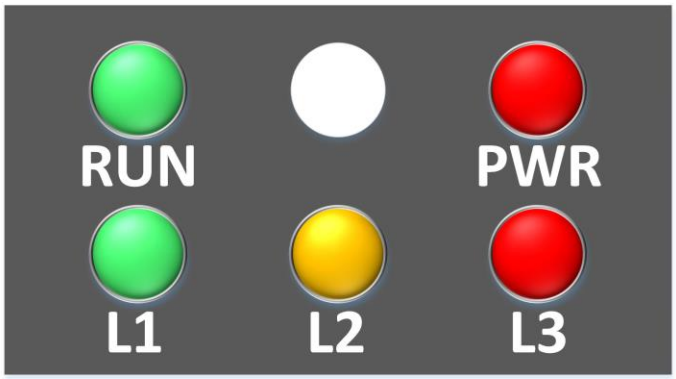


2.2. Appearance



2.3. LED Indicator

There are five LEDs to indicate the various states of the IEC850-211-S. The following is the illustration of these five LEDs.



LED Name	LED Status	Description
PWR	**ON**	Power on
	OFF	Power failure
RUN	**Blink**	OS is running
	OFF	OS stops running
L1	**Flash every second**	Firmware is running
	Other	Firmware stops running
L2	**Flash every second**	Some Modbus servers are disconnected
	OFF	No Warning
L3	**ON**	The Configuration is incorrect
	OFF	No Error

3. Getting Started With IEC850-211-S

3.1. Preparations for Devices

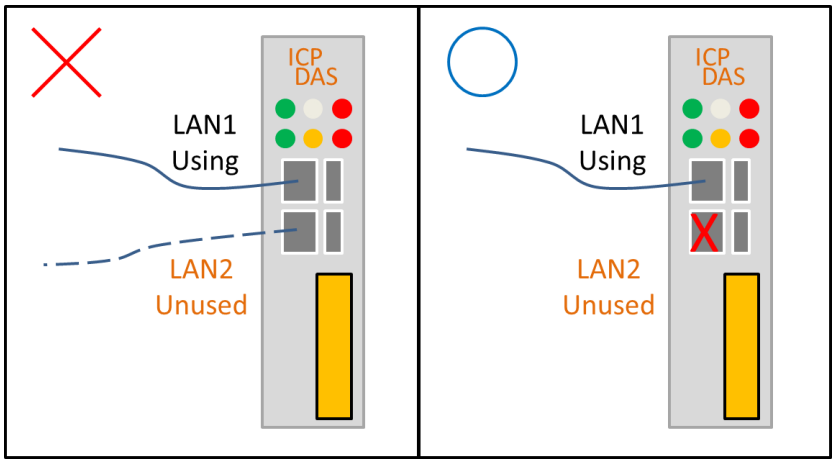
In addition to the IEC850-211-S, please prepare the following:

1. **Power Supply: +12 ~ +48 VDC** (Ex: DP-665)
2. **Ethernet Hub or Switch** (Ex: NS-205)
3. **PC/NB:** Can connect to the network and set the network

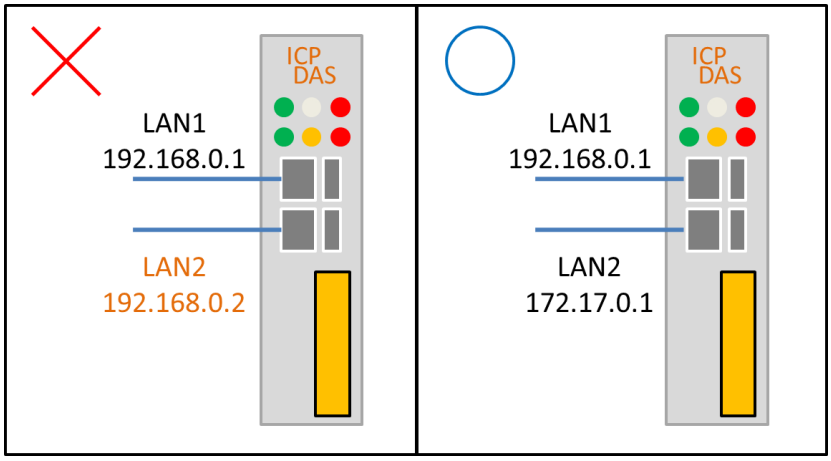
3.2. Hardware Wiring

In order to avoid abnormalities when using Ethernet and RS-485, please follow the following usage rules:

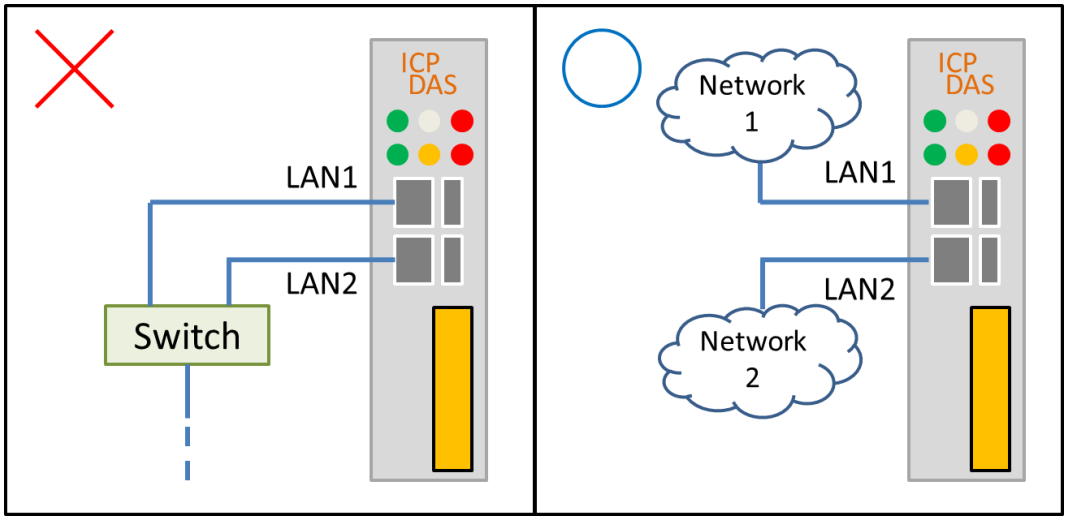
1. **Do not** plug in the network cable if the LAN (LAN1 or LAN2) is not used on IEC850-211-S.



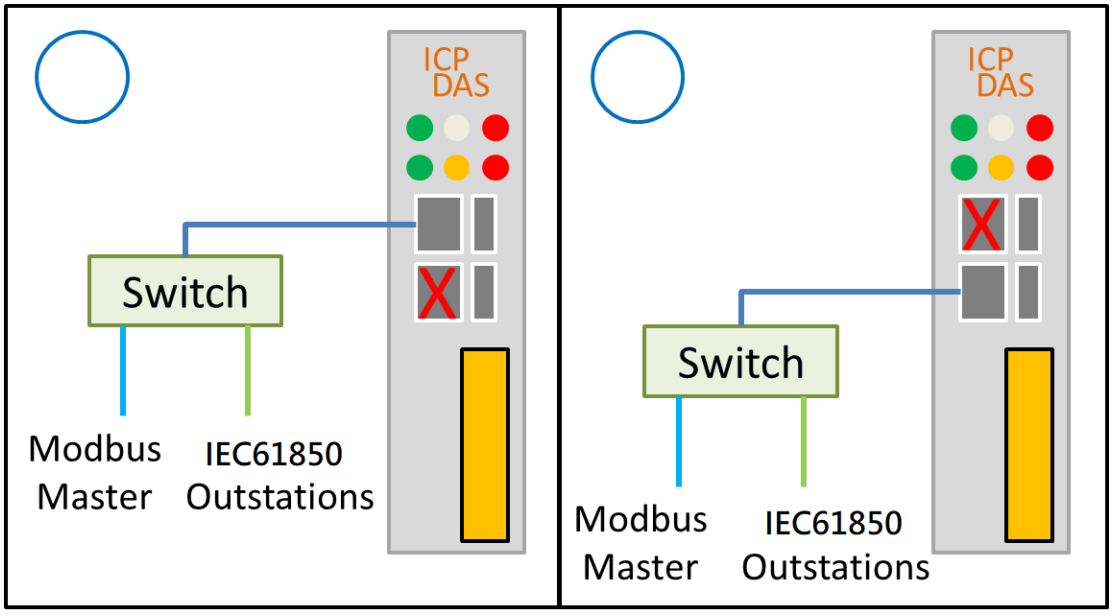
2. When both LAN1 and LAN2 are enabled, they **cannot** be set to the same network segment.

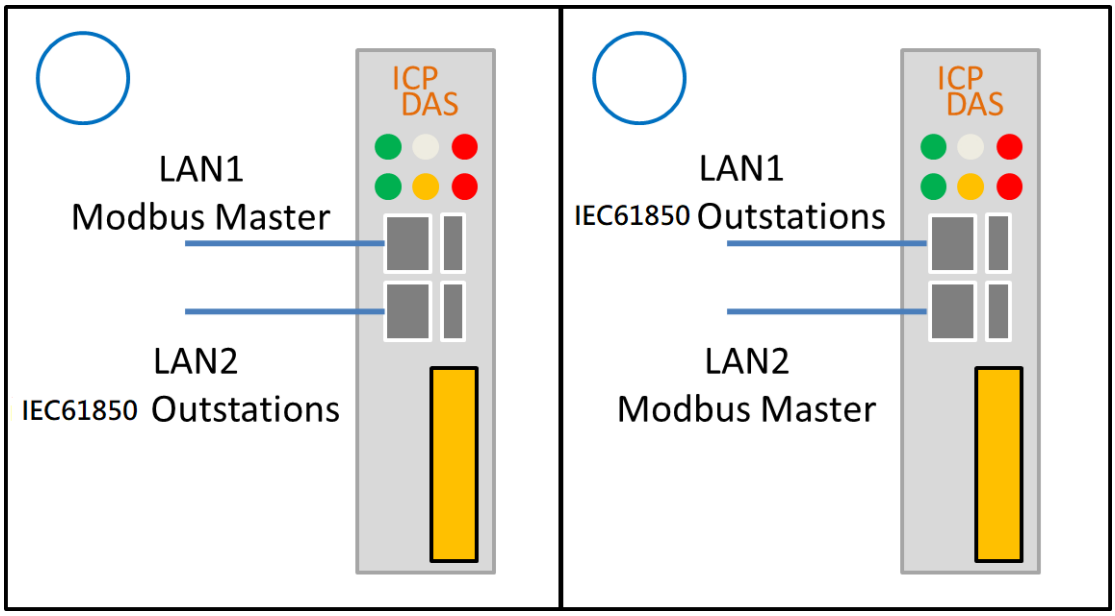


3. When both LAN1 and LAN2 are enabled, they must be connected to two separate networks.



4. Modbus TCP and IEC61850 devices have no fixed LAN settings.





After power is connected, please **wait 1 minute** for IEC850-211-S start-up procedure. When the **"RUN"** indicator starts **flashing** and **"PWR"** indicator is **constantly lit**, it represents the boot is complete. After the module boots successfully, if the **"L1"** indicator flashes every second, it means the firmware is running.

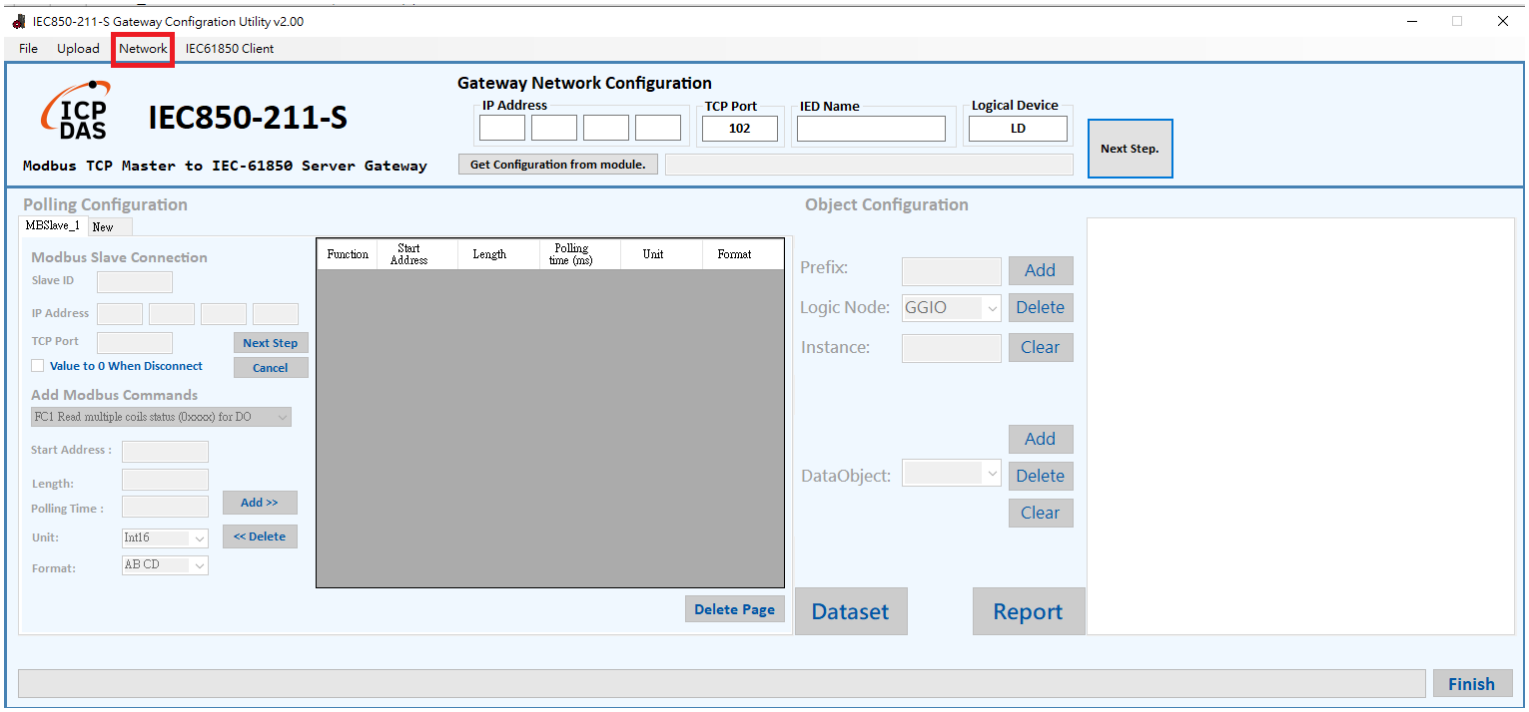
3.3. IEC850-211-S Utility

Step 0:

Download and install IEC850_211_S_Utility

Step 1:

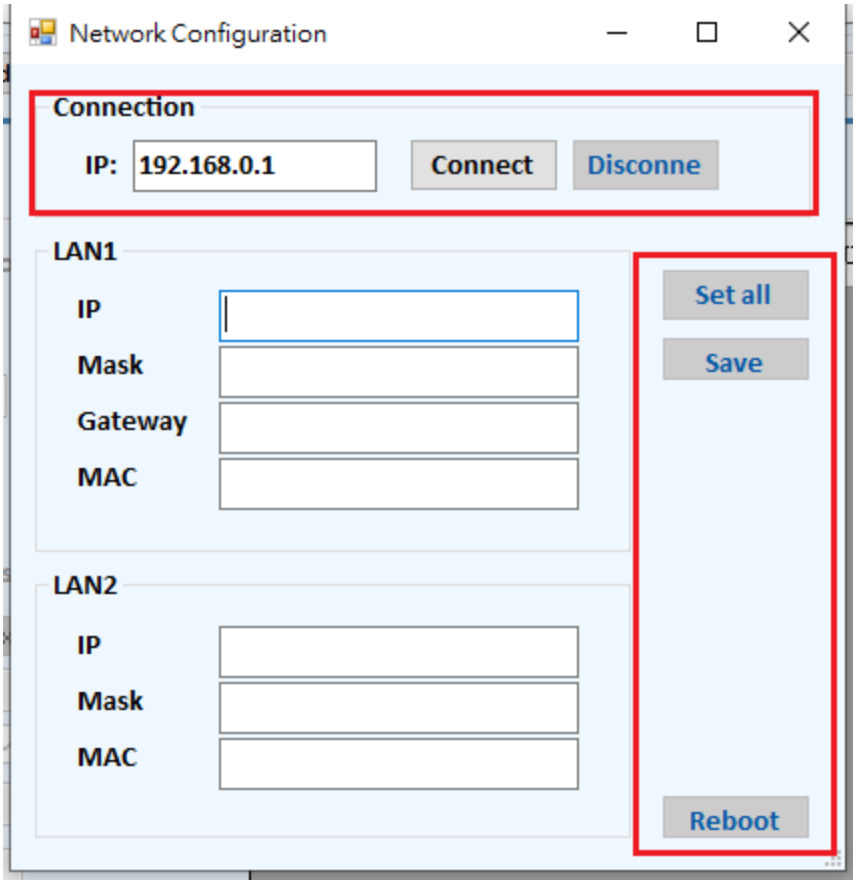
Open IEC850_211_S_Utility and press "Network" option in the top toolbar.



Step 2:

Connect to the module and set network parameter.

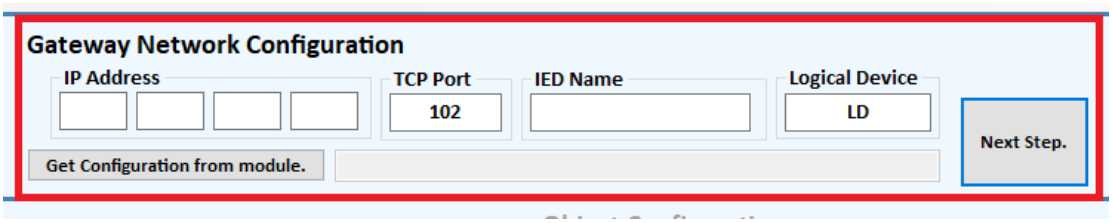
- "Set all" is to write the configuration to the module.
- "Save" is to save the configuration.
  - "Reboot" is to reboot the module.



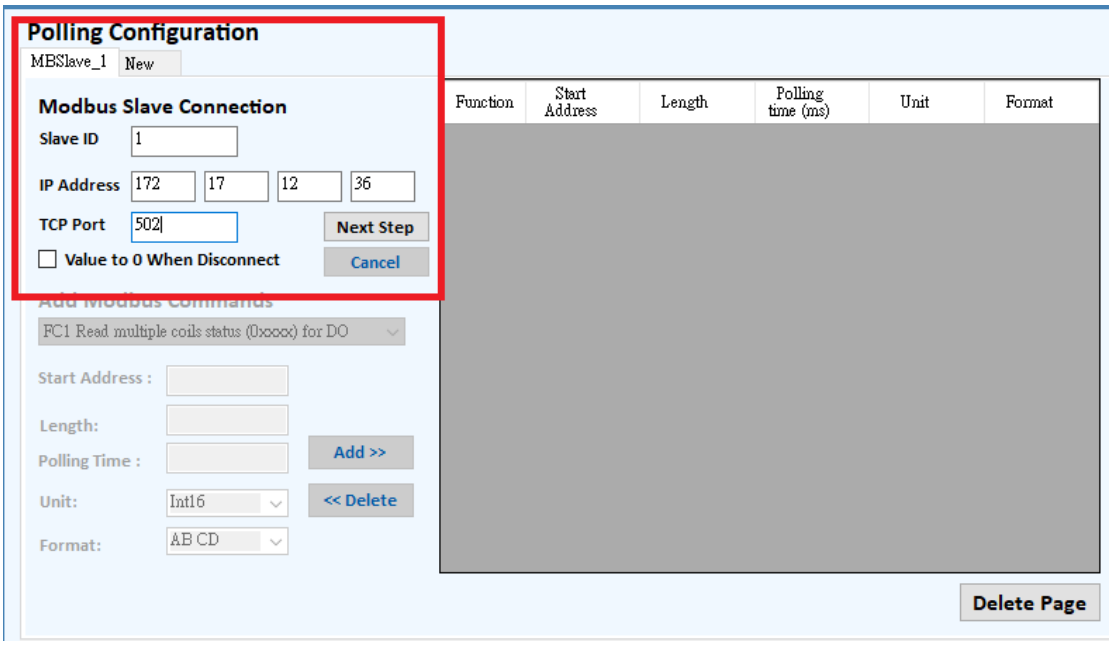
Step 3:

Start to set gateway data mapping.

1. Input the IP address that you want to listen for IEC-61850 and input IED name and LD name.

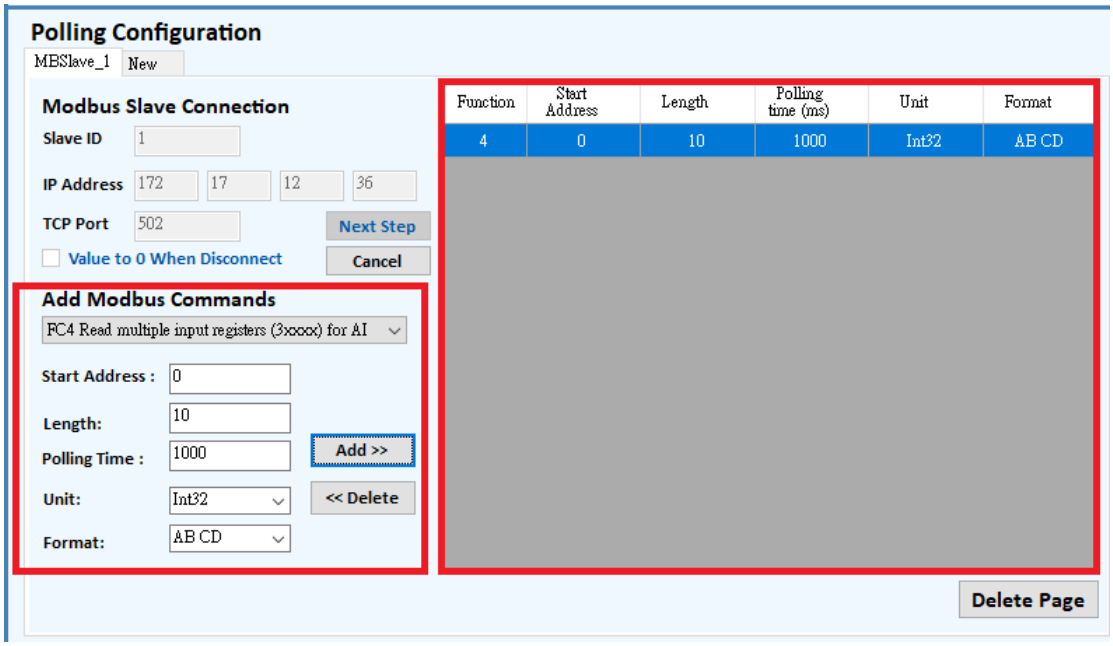


2. Enter the station number, IP address, communication port, Modbus device of the Modbus TCP server you want to poll, and whether you want to clear the object value to 0 if it is disconnected from IEC850-211-S.

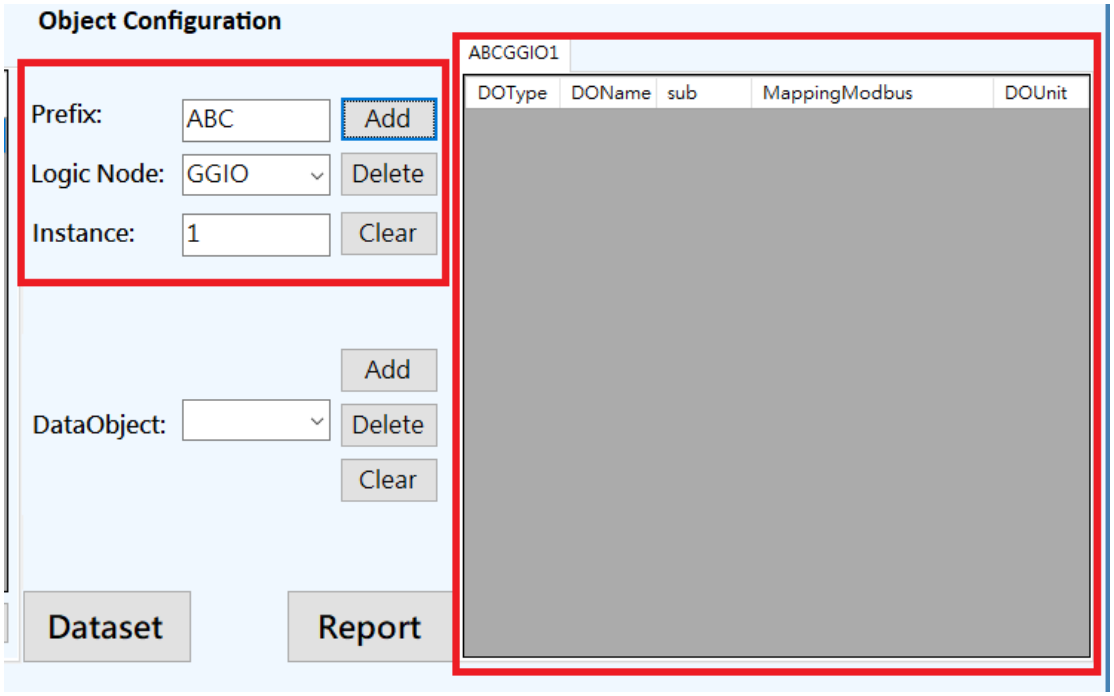


3. Enter the Modbus register address, data length, unit and data format.

- "Add" is to add command to the right side table.
- "Delete" is to delete the command you choose from the right side table.

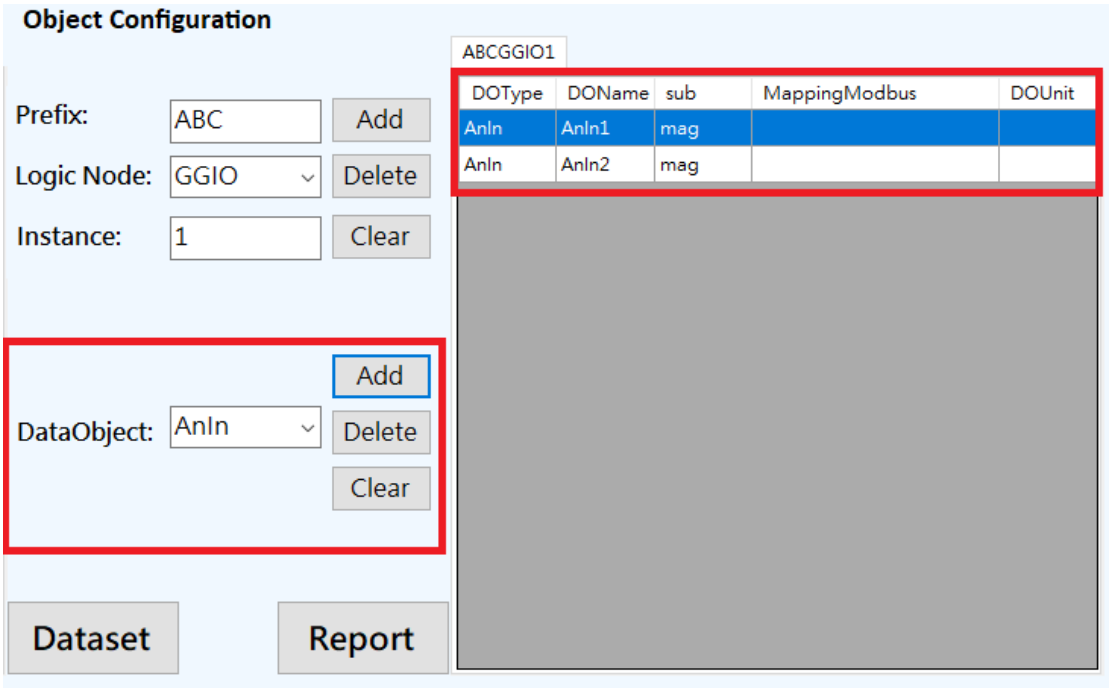


4. Add a new logical node: Enter Prefix (can be filled in or not). Select the logical node to be created. Fill in Instance (required)
   - ➢ "Add" adds a logical node to the list on the right
   - ➢ "Delete" deletes the currently selected list from the list on the right
   - ➢ "Clear" deletes all lists on the right

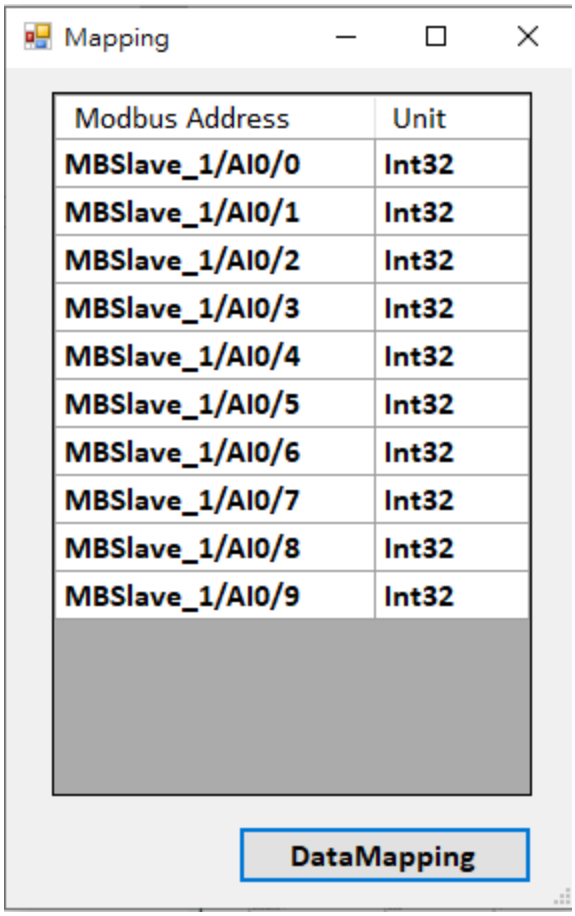


5. Add a new data object: Select the data object to be added and click the "DOName" field to modify the object name.
   - ➢ "Add" adds a Data Object to the list on the right

- “Delete” deletes the currently selected Data Object from the list on the right
- “Clear” deletes all Data Object on the right



6. Mapping Modbus Address
   - Double-click the "MappingModbus" field and the following window will pop up showing all the Modbus Addresses that can be mapped.



The meaning of **MBSlave_1/AI0/0** is:

MBSlave_1: Modbus device number (up to 32 devices can be connected)

AI0: This command is the AI type + Modbus command setting sequence on the left (users can ignore this sequence)

0:Address 0

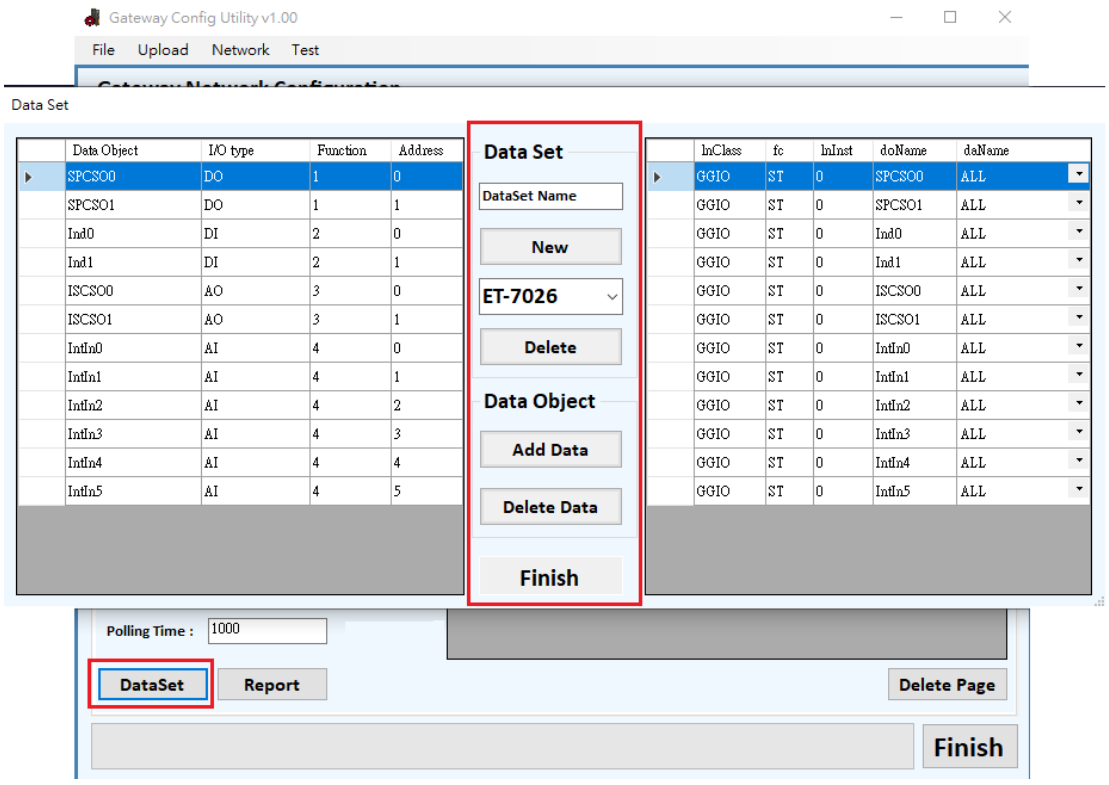
Remark:

1. If the selected unit is Int32/Int64, so the unit occupies 2/4 of the Modbus register, it will be automatically selected in sequence (ex: select MBSlave_1/AI0/0. Since the unit is Int32, the actual Mapping address of this object is MBSlave_1 /AI0/0 and MBSlave_1/AI0/1)
2. Following point 1, if the selected address does not have enough addresses, Mapping will not be possible.
3. Unable to cross commands Ex: If two Modbus commands are set, 0~9 and 10~20, the addresses of 9&10 cannot be mapped.

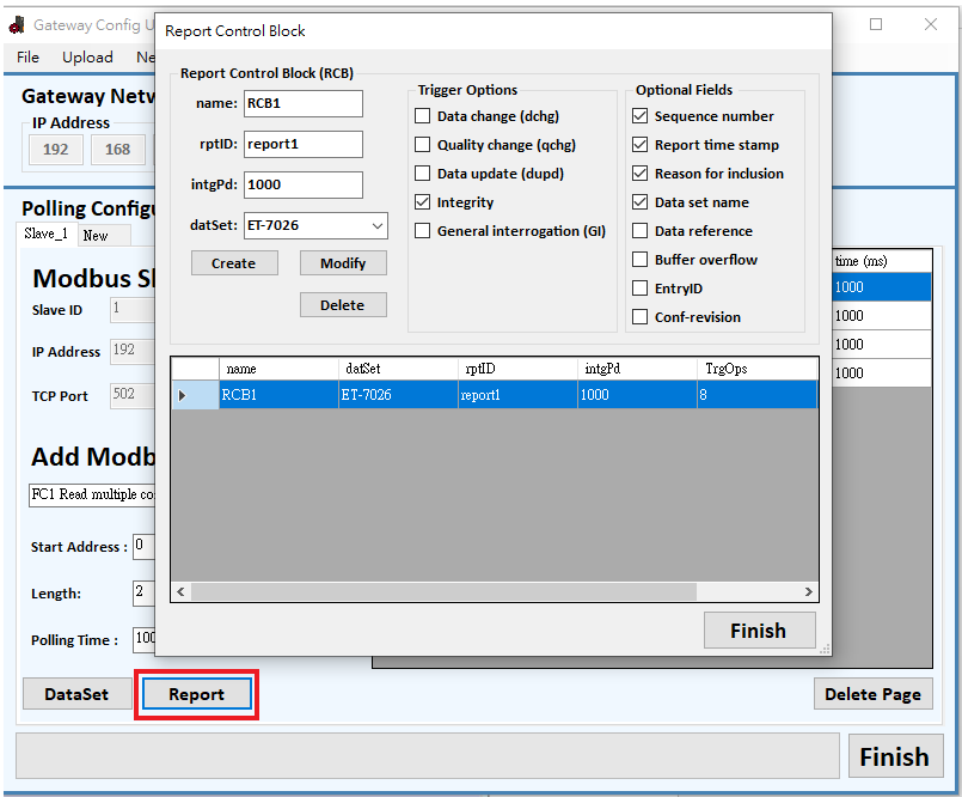
- Double-click the address field to be mapped and press the "DataMapping" button

7. Press “DataSet” button and start to configure data set function.
   - “New” is to create a data set named after the text in the top text box.

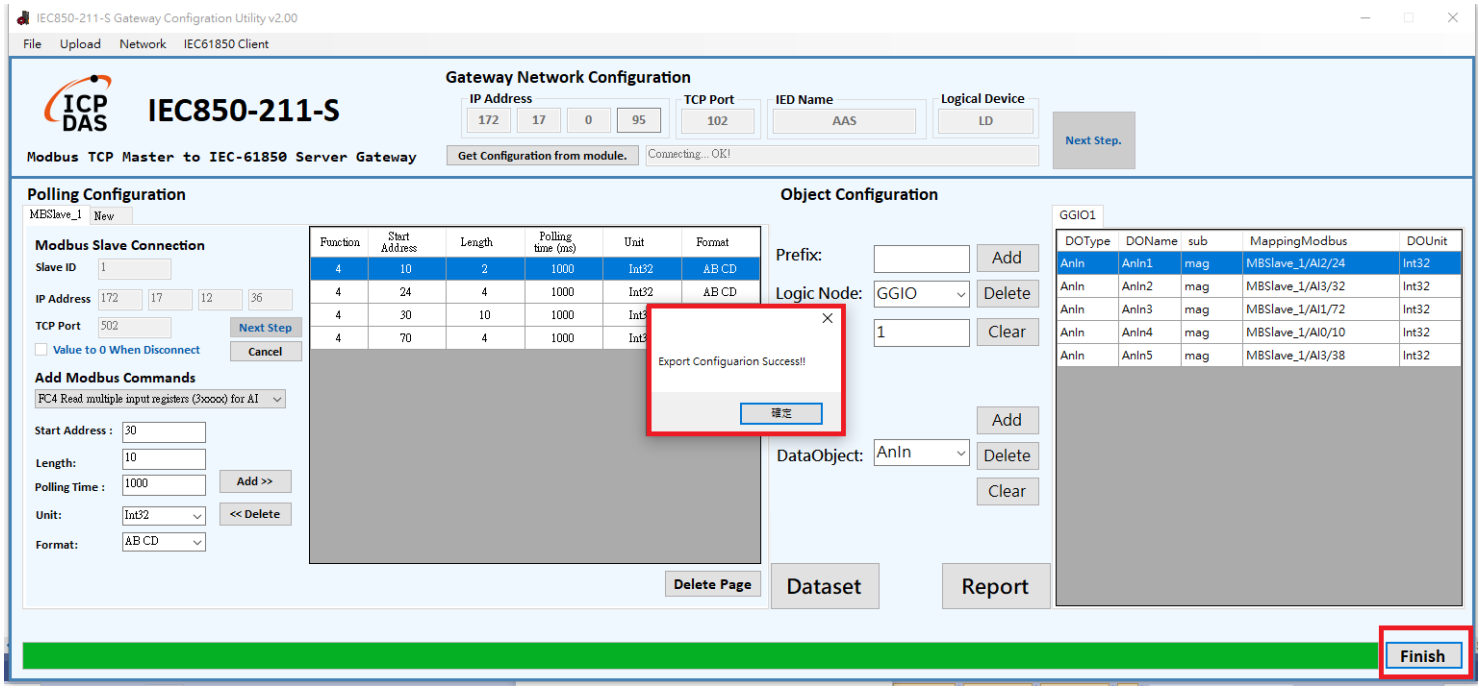
- The drop-down menu is to choose which data set can be configured now.
- “Delete” is to delete the data set chosen now.
- “Add Data” is to add the data object in the left side table to the data set chosen now.
- “Delete Data” is to delete the chosen data object in the right side table from the data set.
- “Finish” is to leave this window.



8. Press “Report” button and start to configure report function.
   - “Create” is to create a report control block with parameter in the text boxes, check boxes and drop-down menu.
   - “Modify” is to modify the report control block chosen now.
   - “Delete” is to delete the report control block chosen now.



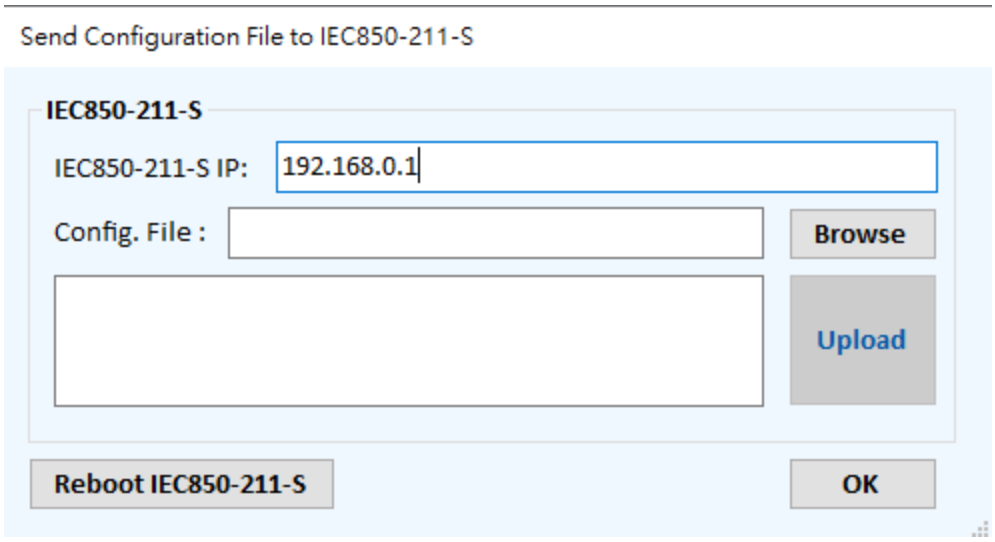
9. Press “Finish” button to convert the configuration to a file named “GatewayConfig.toml” and it is put in the folder “Gateway_Configuration” which is next to the utility.



Step 4:

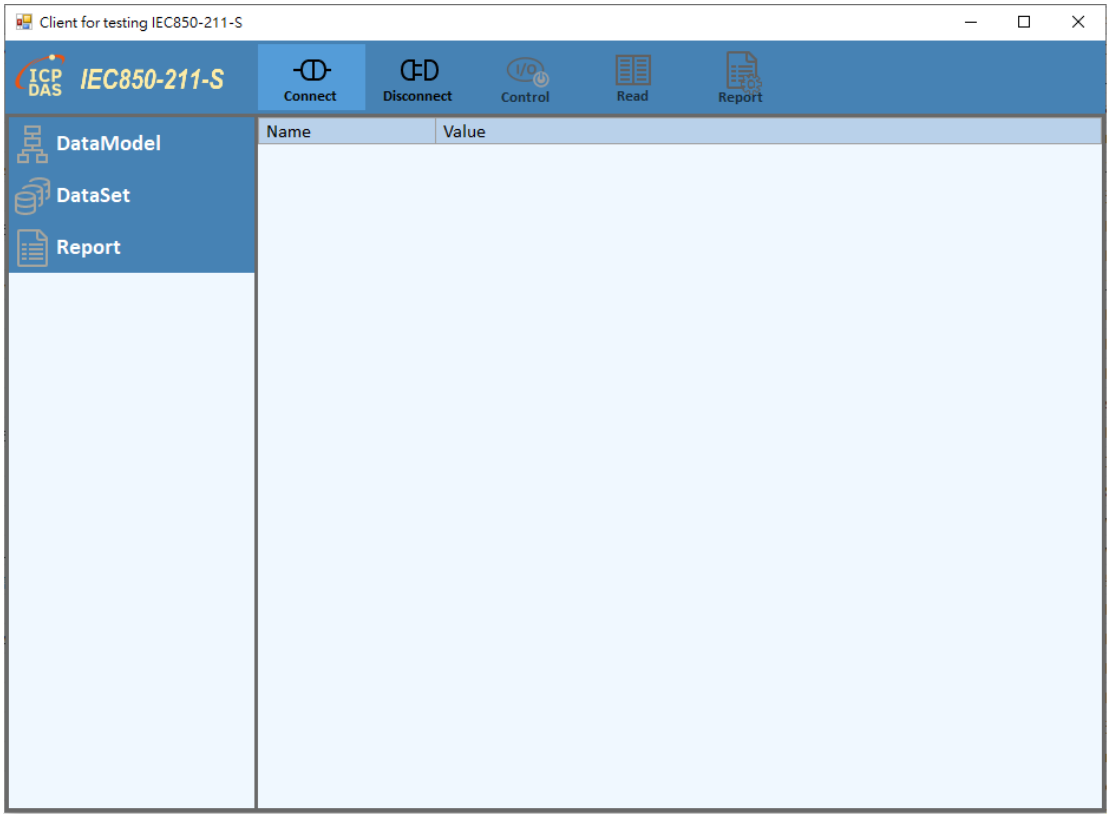
Press “Upload” option in the top toolbar to upload the setting file to IEC850-211-S.

- “Browse” is to choose the file that you want to upload to module.
- “Upload” is to upload the file to module.
  - “Reboot” is to reboot the module. **Note:** After uploading the file, you must press “Reboot” button to reboot module, or the file will be lost.



Step 5:

Press “Test” option in the top toolbar to test IEC850-211-S.



3.4 Update Firmware

Open IEC850_211_S_Utility and press “Upload” option in the top toolbar. Connect to the module and choose the new firmware(After clicking Browse, you must change the lower right corner to All file to see the firmware update file). Then upload the new firmware to IEC850-211-S and reboot. After reboot the module, it will automatically replace the old firmware with the new one and run it.