User Manual

Version 2.0.2 Dec 2025

IEC850-211-S

Modbus TCP to IEC-61850 Gateway

Warranty

All products manufactured by ICP DAS are under warranty regarding defective materials for a period of one year, beginning from the date of delivery to the original purchaser.

Warning

ICP DAS assumes no liability for any damage resulting from the use of this product. ICP DAS reserves the right to change this manual at any time without notice. The information furnished by ICP DAS is believed to be accurate and reliable. However, no responsibility is assumed by ICP DAS for its use, nor for any infringements of patents or other rights of third parties resulting from its use.

Copyright

Trademarks

Names are used for identification purposes only and may be registered trademarks of their respective companies.

Document Revision

Version	Author	Date	Description
1.0.0	Evan	2021/01/06	First Released Revision
1.0.1	Evan	2021/08/09	Update FW instructions
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
2.0.1	Alina	2025/08/04	Added instructions
2.0.2	Alina	2025/08/04	New Support Items

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.

Logic Node	Data Object
CSWI	Pos
GGIO	Ind . IntIn . AnIn . AnOut . SPCSO . DPCSO.ISCSO
MHAI	Hz.HKf.ThdA.ThdOddA.ThdEvnA.ThdPhV.ThdOddPhV.ThdPPV.ThdOddPPV.ThdEvnPPV.HCfA
MMXU	TotW . TotVAr . TotPF . PhV . A .Hz . TotVA . PPV . W . Var . VA . PF
MMTR	SupWh . DmdWh . TotVAh . TotWh . TotVArh . SupVArh . DmdVArh
GAPC	SPCSO
MSQI	SeqA . SeqV
XCBR	Loc . OpCnt . Pos . BlkOpn . BlkCls
XSWI	Loc . OpCnt . Pos . BlkOpn . BlkCls . SwTyp

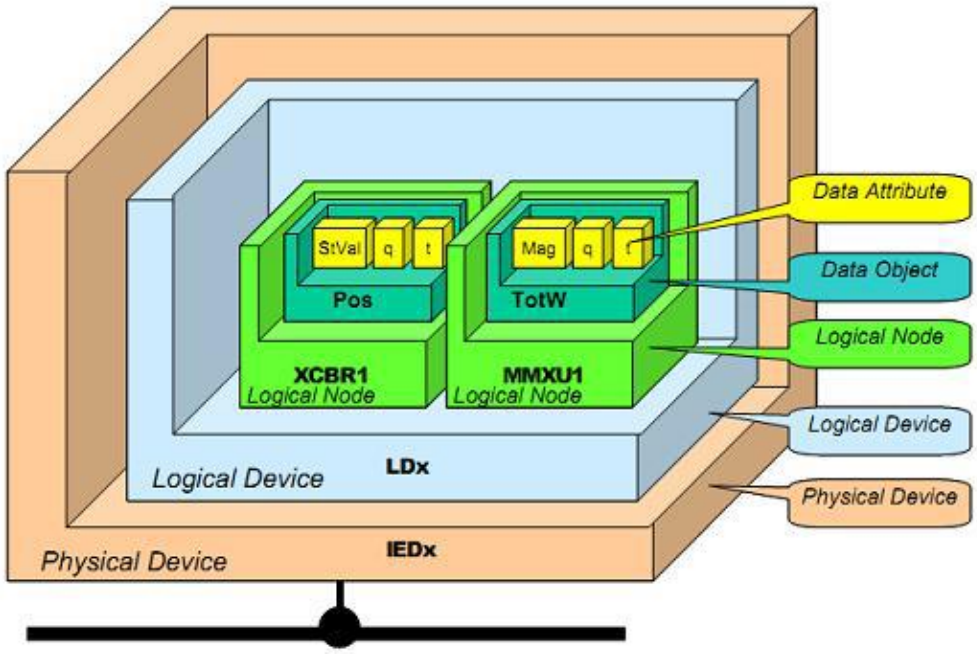
Modbus function codes corresponding to supported data objects

Modbus Function Code	Data Object
01 Coil Status(0x)	SPCSO. DPCSO .Pos . BlkOpn . BlkCls
02 Input Status(1x)	Ind . Loc
03 Holding register (4x)	AnOut
04 Input register(3x)	IntIn. AnIn. TotW . TotVAr . TotPF . PhV . A .Hz. SupWh . DmdWh . SupWh . DmdWh . TotVAh . TotWh . TotVArh . SupVArh . DmdVArh . TotVA . PPV . W . Var . VA . PF . Hz.HKf.ThdA.ThdOddA.ThdEvnA.ThdPhV.ThdOddPhV.ThdPPV.ThdOddPPV.ThdEvnPPV. HCfA . ISCSO . OpCnt

1.4. IEC61850 MMS Protocol

IEC 61850 (IEC 61850 – Communication Networks and Systems in Substations) standard defines MMS protocol (Manufacturing Message Specification) as a server/client type communication. This protocol is used for information exchange between IEDs (IED – Intelligent Electronic Device) and higher level devices (such as SCADAs) over the Ethernet. The MMS protocol is mapped on TCP/IP and enables the access to server based on its IP address where client can read/write data, read configuration and exchange files.

IEC 61850 is an object oriented standard. Each physical device consists of logical devices (LD), logical nodes (LN), data objects (DO) and data attributes (DA) as illustrated in blow Figure.



1.5. 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

1.6. Specifications

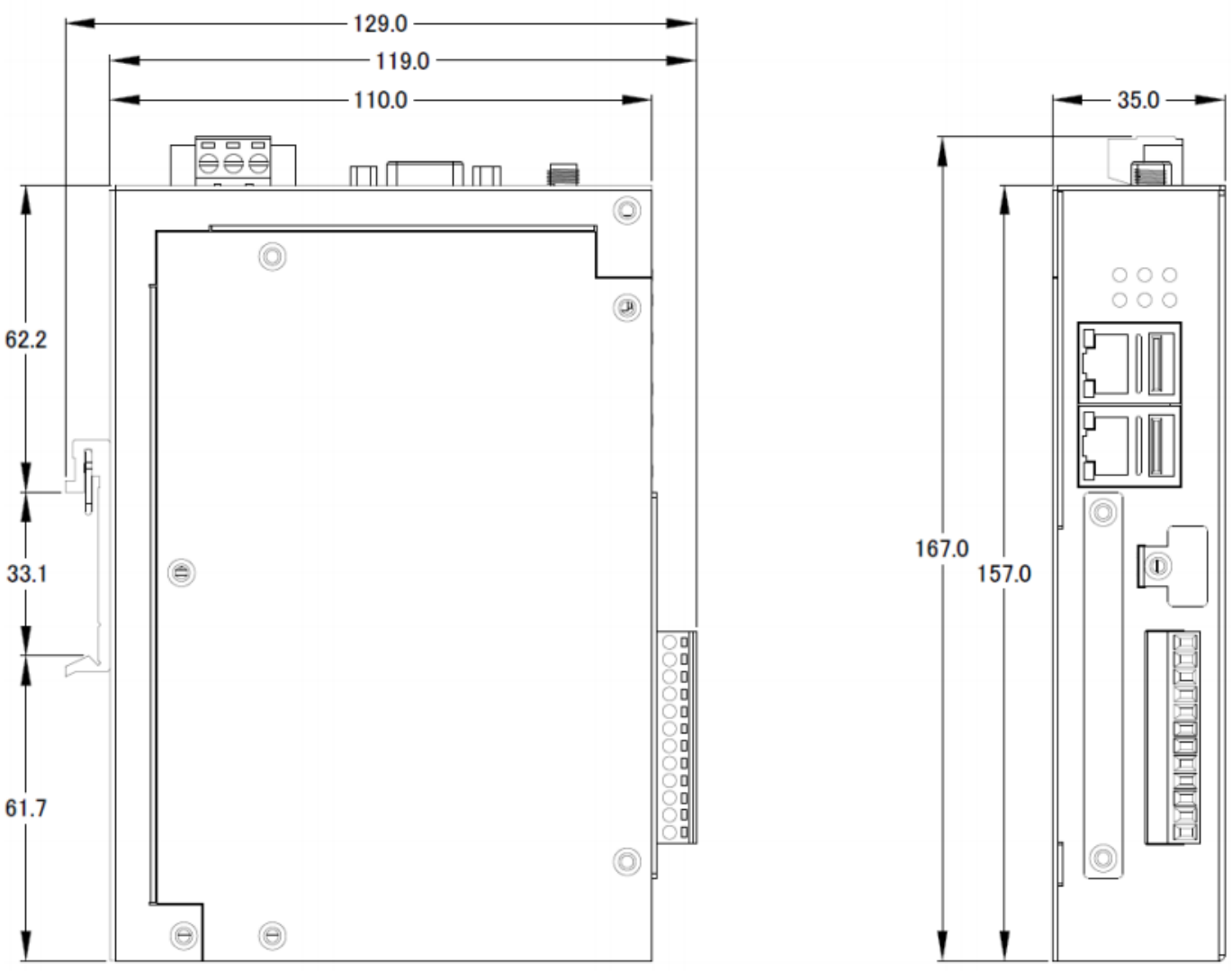
System		
CPU	Cortex-A8, 1 GHz	
SDRAM	512 MB	
Flash	512 MB	
FRAM	64 KB	
LED Indicators	PWR(Power), RUN(Running), L1, L2, L3	
Communication Ports		
VGA	1 (reserved)	
Ethernet	RJ-45 x 2, 10/100/1000 Based-TX (Auto-negotiating, Auto MDI/MDI-X, LED indicators)	
USB 2.0	2 (reserved)	
Console Port	RS-232 (RxD,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

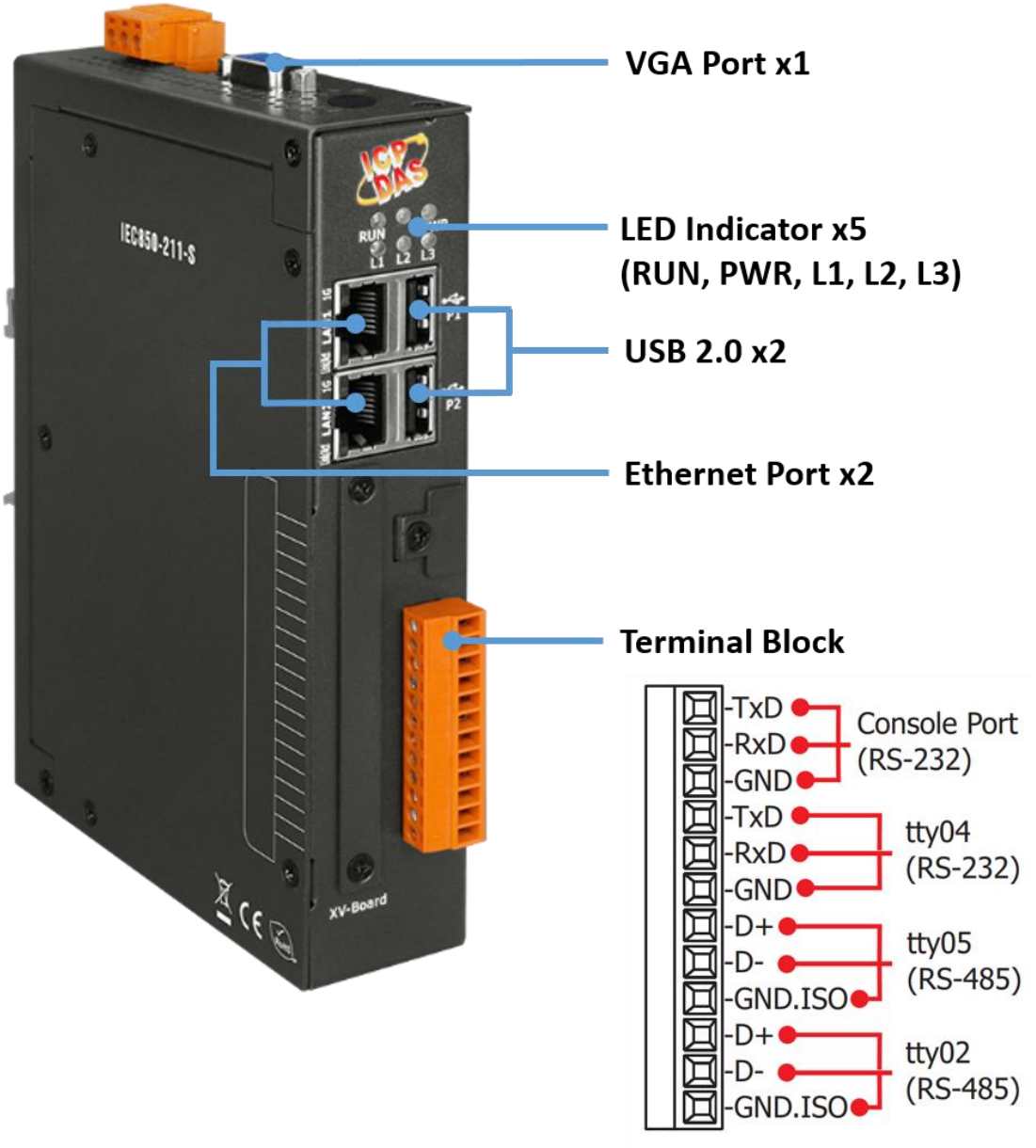
2.Hardware

2.1. Dimensions

Unit: mm

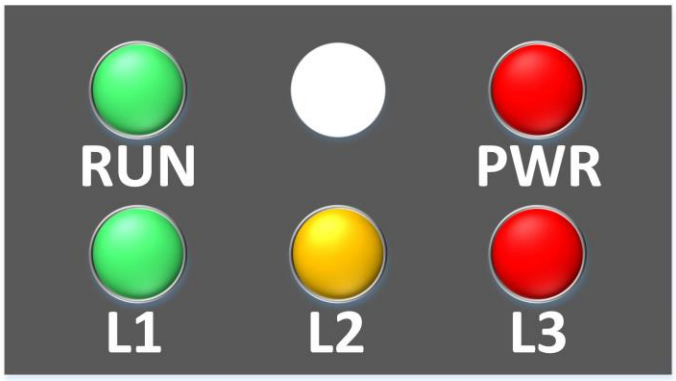


2.2. Appearance



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

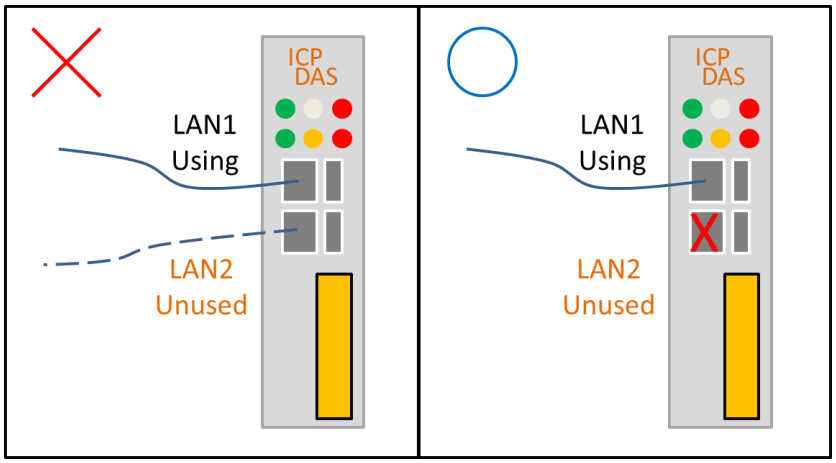
In addition to the IEC850-211-S, please prepare the following:

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

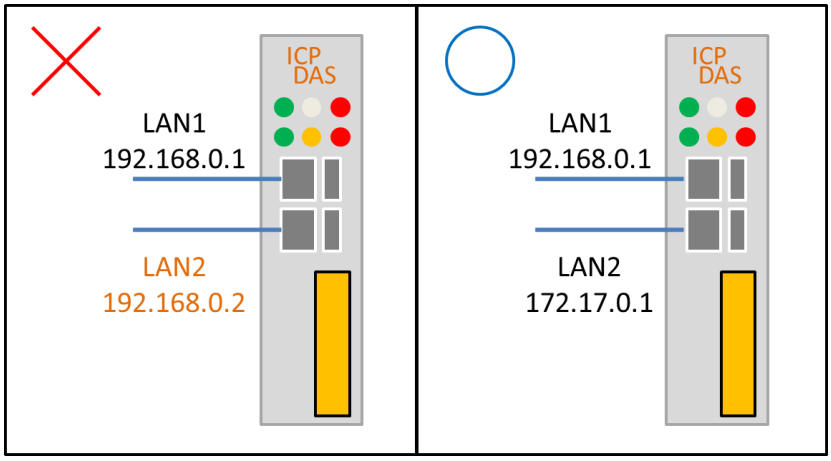
3.2. Hardware Wiring

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

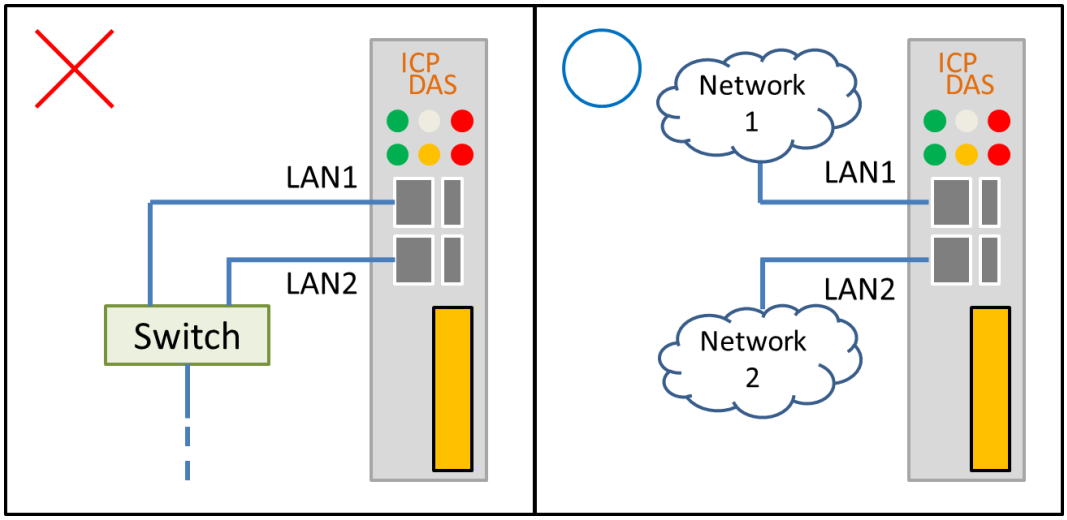
1. **Do not** plug in the network cable if the LAN (LAN1 or LAN2) is not used on IEC850-211-S.



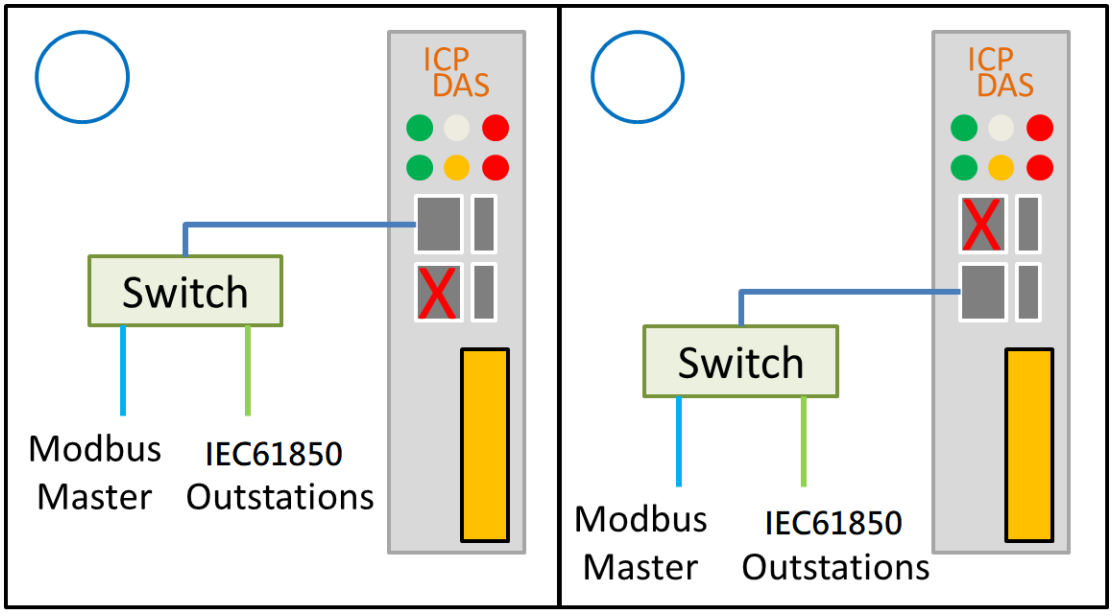
2. When both LAN1 and LAN2 are enabled, they **cannot** be set to the same network segment.

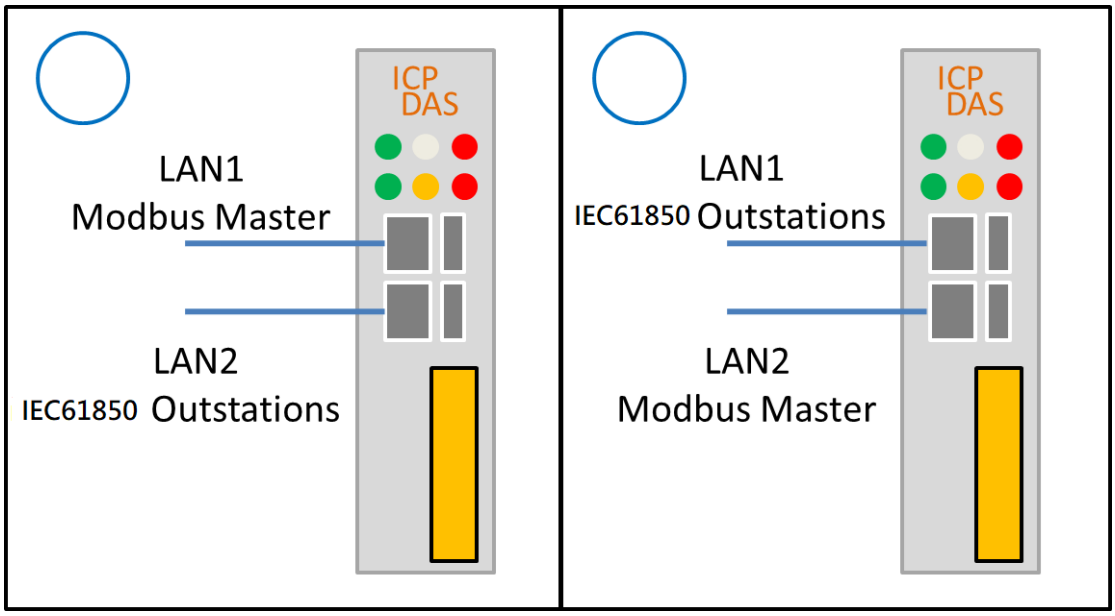


3. When both LAN1 and LAN2 are enabled, they must be connected to two separate networks.



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.

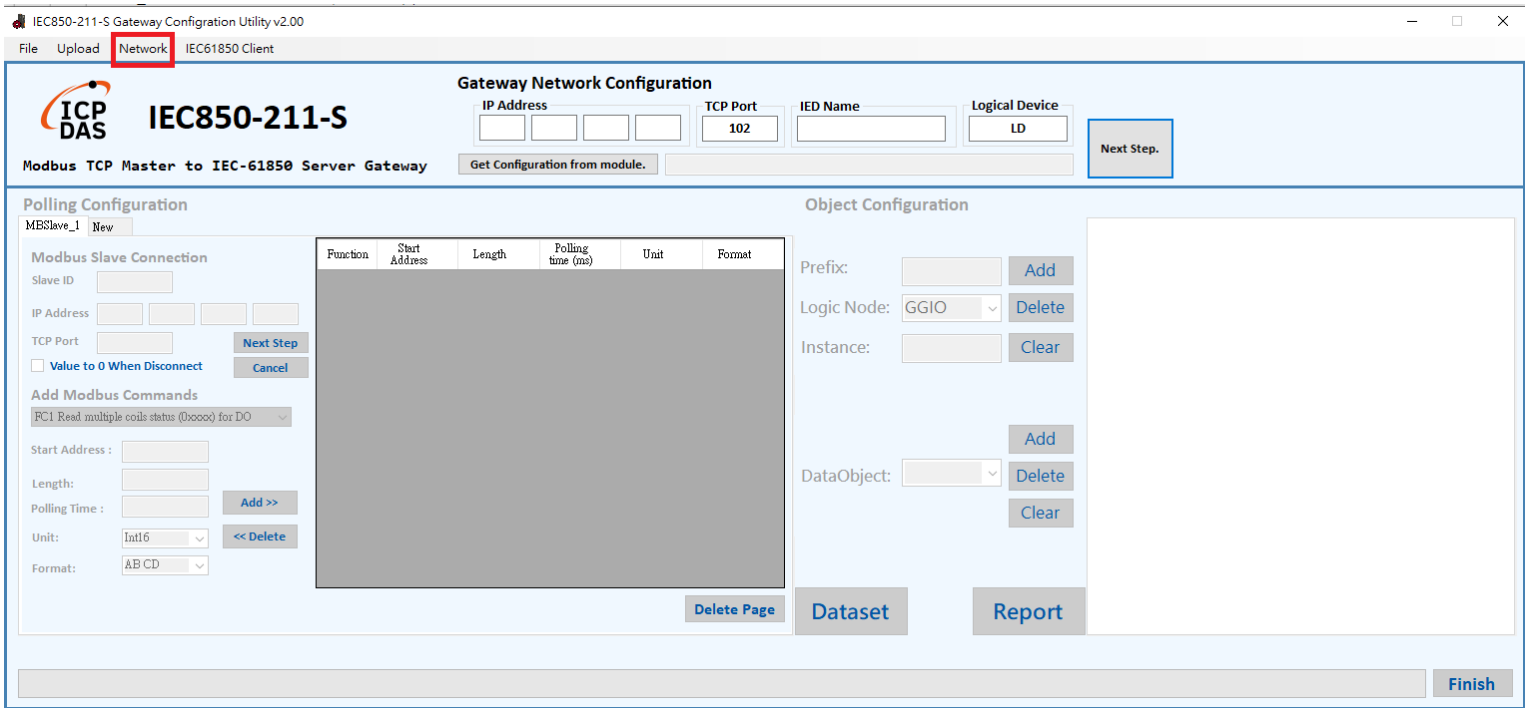
3.3. IEC850-211-S Utility

Step 0:

Download and install IEC850_211_S_Utility

Step 1:

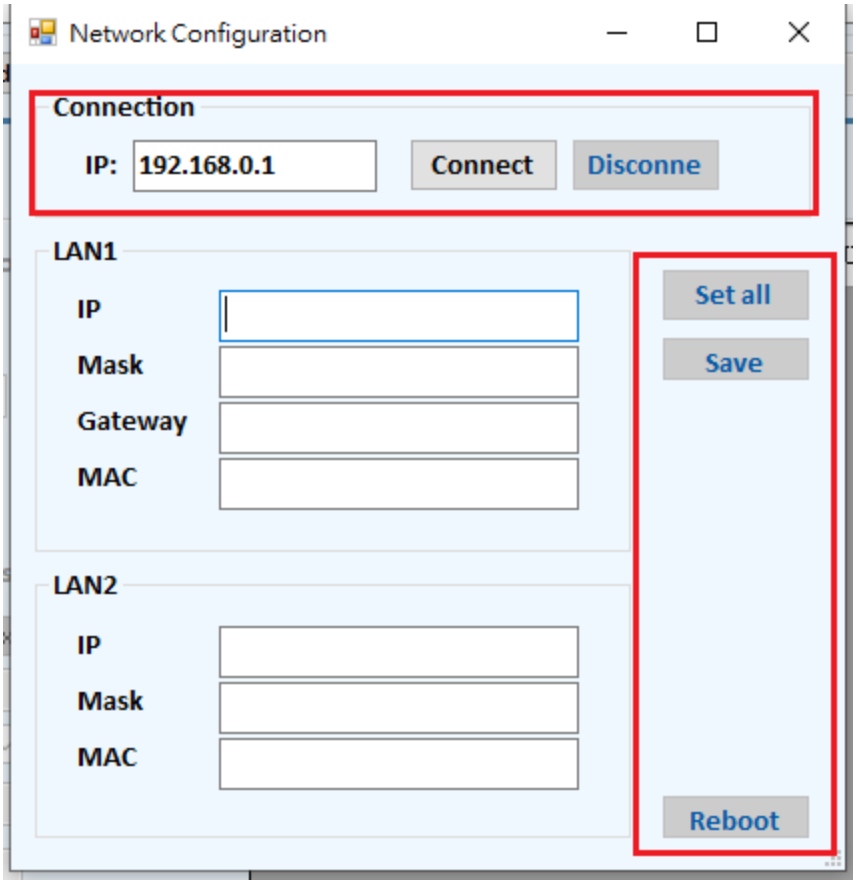
Open IEC850_211_S_Utility and press "Network" option in the top toolbar.



Step 2:

Connect to the module and set network parameter.

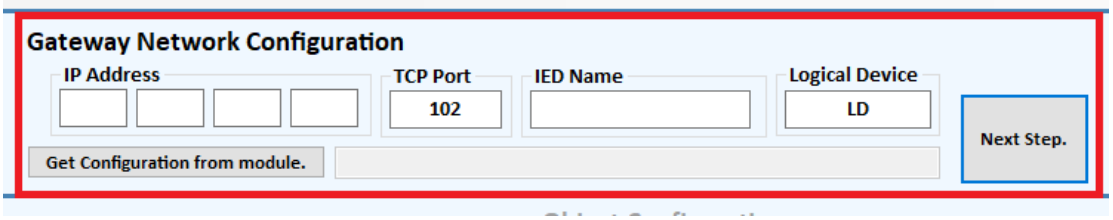
- "Set all" is to write the configuration to the module.
- "Save" is to save the configuration.
  - "Reboot" is to reboot the module.



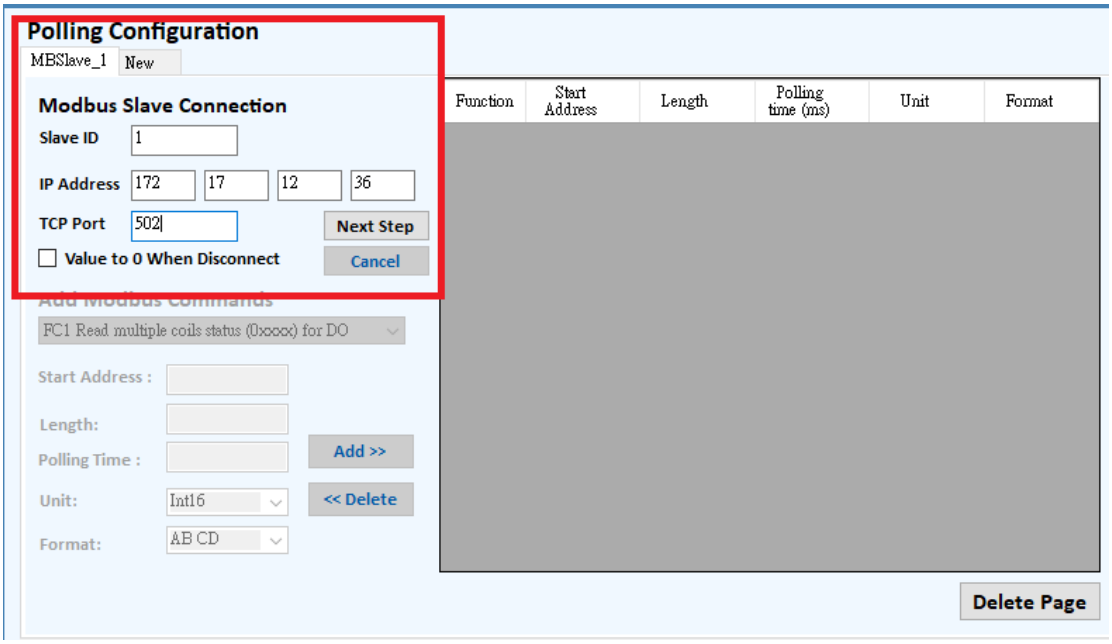
Step 3:

Start to set gateway data mapping.

1. Input the IP address of IEC-850-211-S and input IED name and LD name.

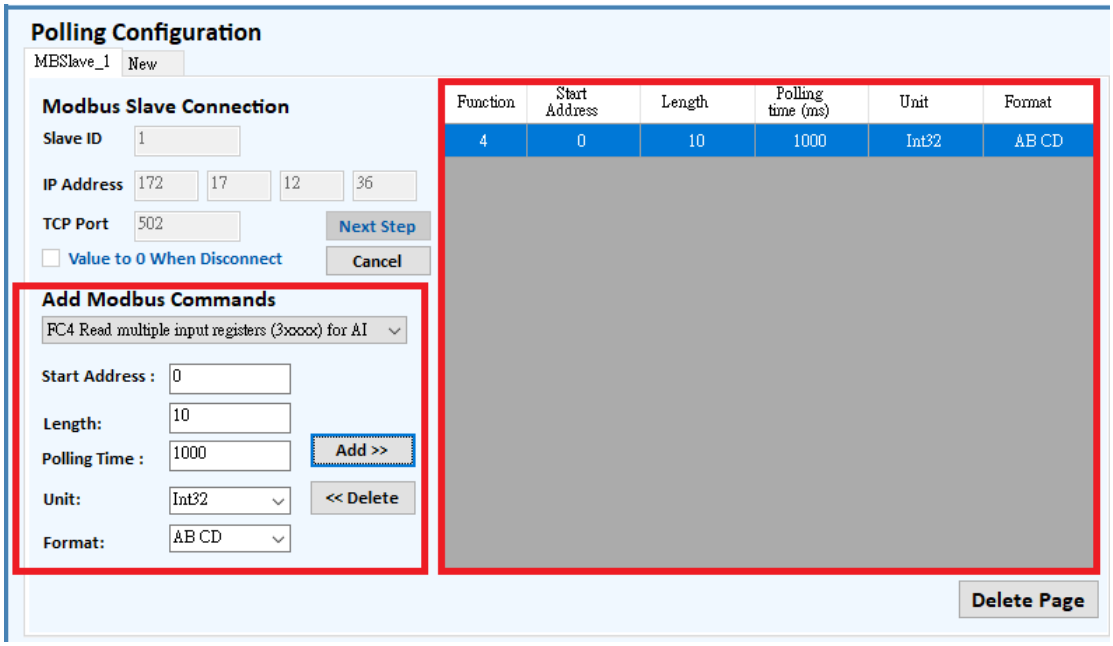


2. Enter the station number, IP address, communication port, Modbus device of the Modbus TCP server you want to poll, and whether you want to clear the object value to 0 if it is disconnected from IEC850-211-S.



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

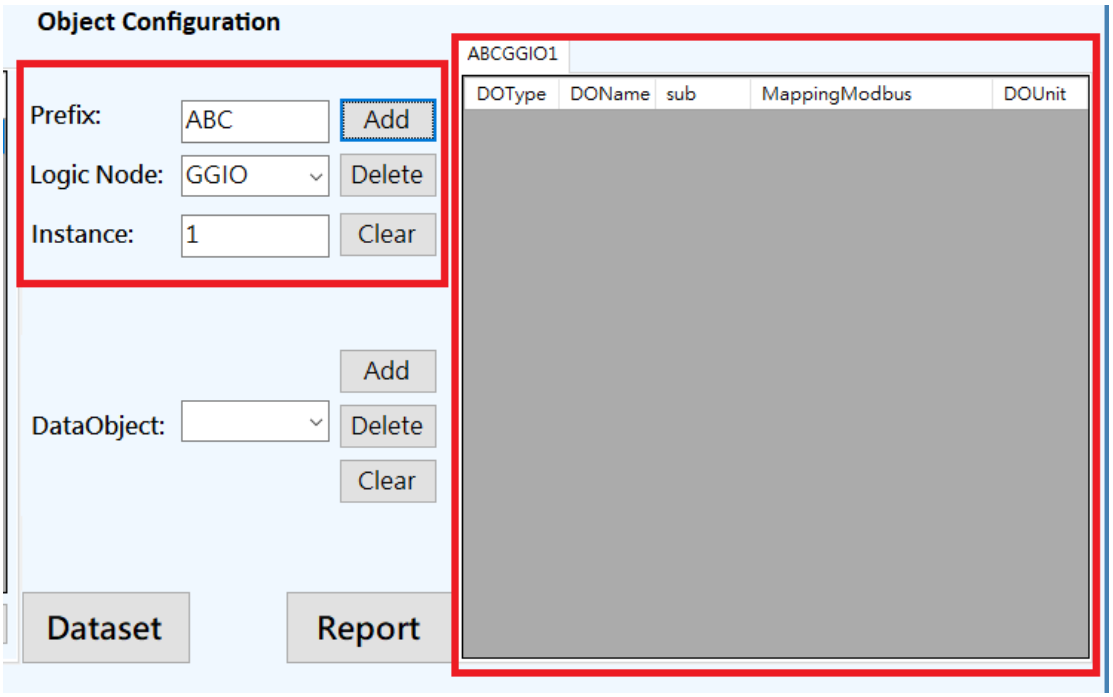
- "Add" is to add command to the right side table.
- "Delete" is to delete the command you choose from the right side table.



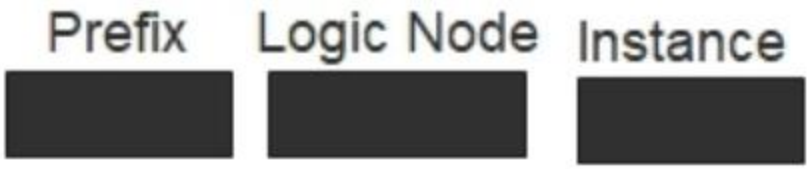
Steps 2~3 are mainly used to set the Modbus command of IEC850-211-S. Taking the setting diagram of step 3 as an example, IEC850-211-S will read the following address

FUNCTION CODE 4
Address 0
Address 1
Address 2
Address 3
Address 4
Address 5
Address 6
Address 7
Address 8
Address 9

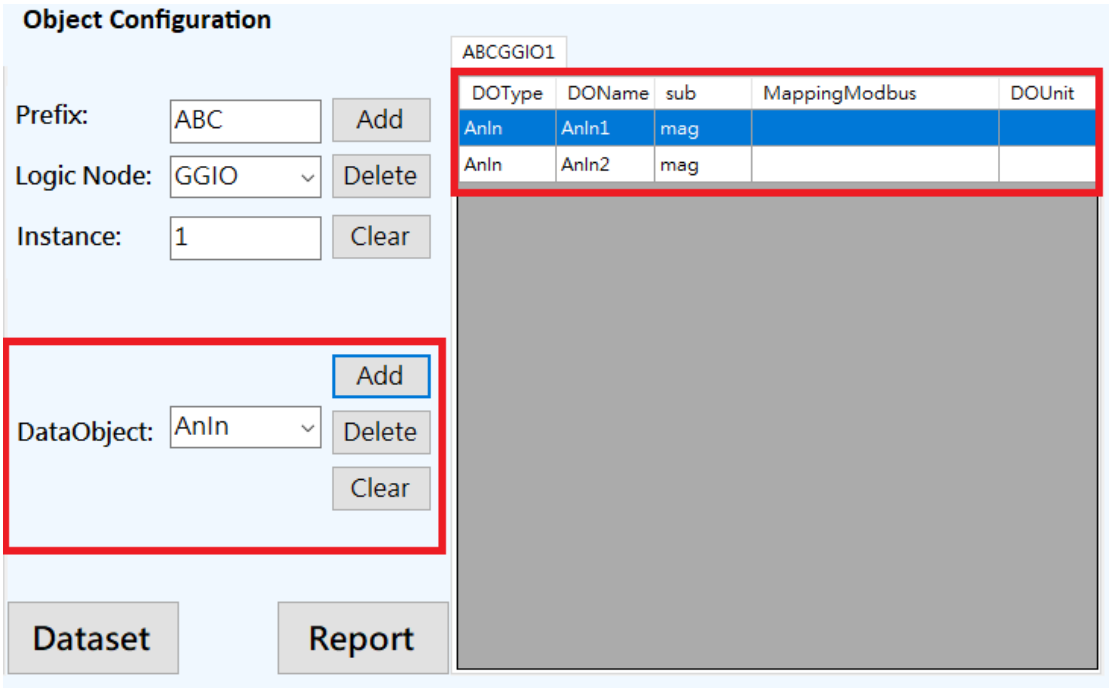
4. Add a new logical node: Enter Prefix (can be filled in or not). Select the logical node to be created. Fill in Instance (required)
   - "Add" adds a logical node to the list on the right
   - "Delete" deletes the currently selected list from the list on the right
   - "Clear" deletes all lists on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



The name of the logical node will be equal to Prefix + Logic Node + Instance

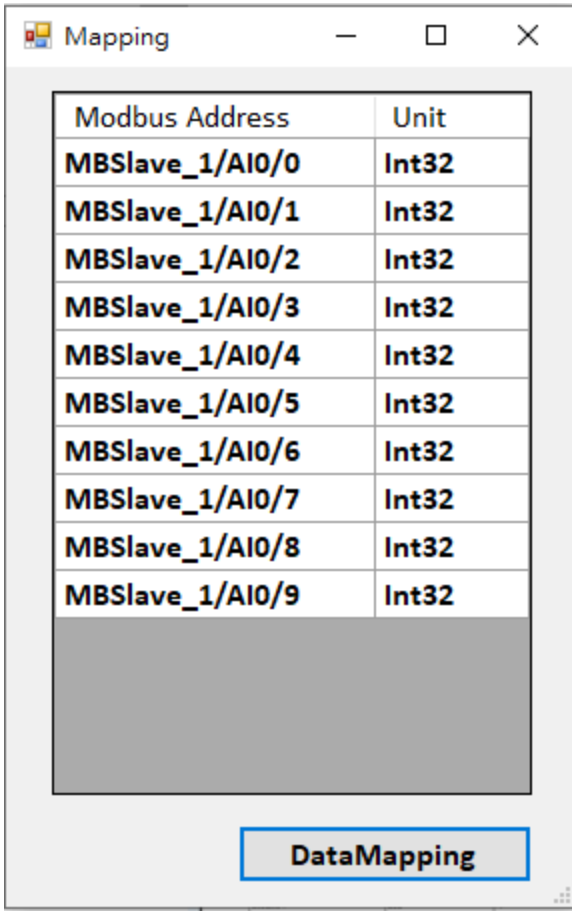


5. Add a new data object: Select the data object to be added and click the "DOName" field to modify the object name.
   - "Add" adds a Data Object to the list on the right
   - "Delete" deletes the currently selected Data Object from the list on the right
   - "Clear" deletes all Data Object on the right



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.
4. Some objects will automatically generate child objects. If this is not necessary, you can leave the Mapping Address blank.

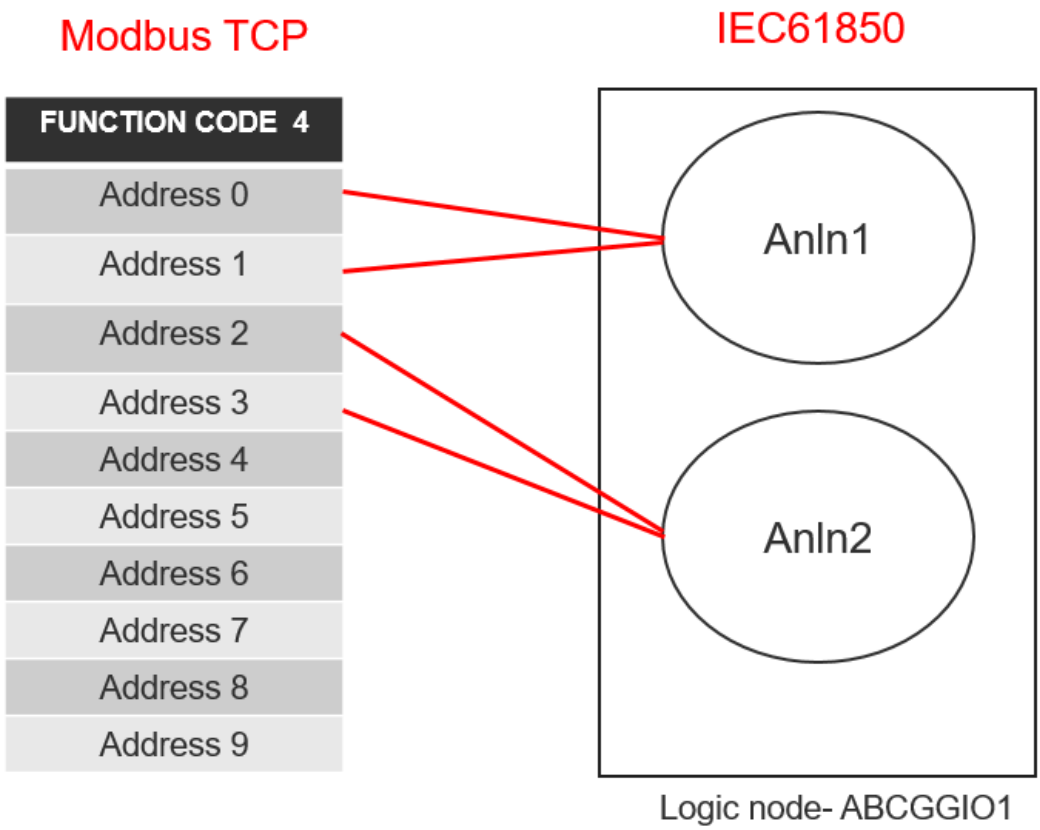
- Double-click the address field to be mapped and press the "DataMapping" button

Steps 4 and 5 are mainly used to set the logical nodes and objects of the IEC61850 protocol in IEC850-211-S.
Step 6 is used to set the value of the Modbus address corresponding to the object.
The following is an example (one Modbus register = 16 bits, when Unit = 32 bits, it will correspond to 2 registers.):
Setting:

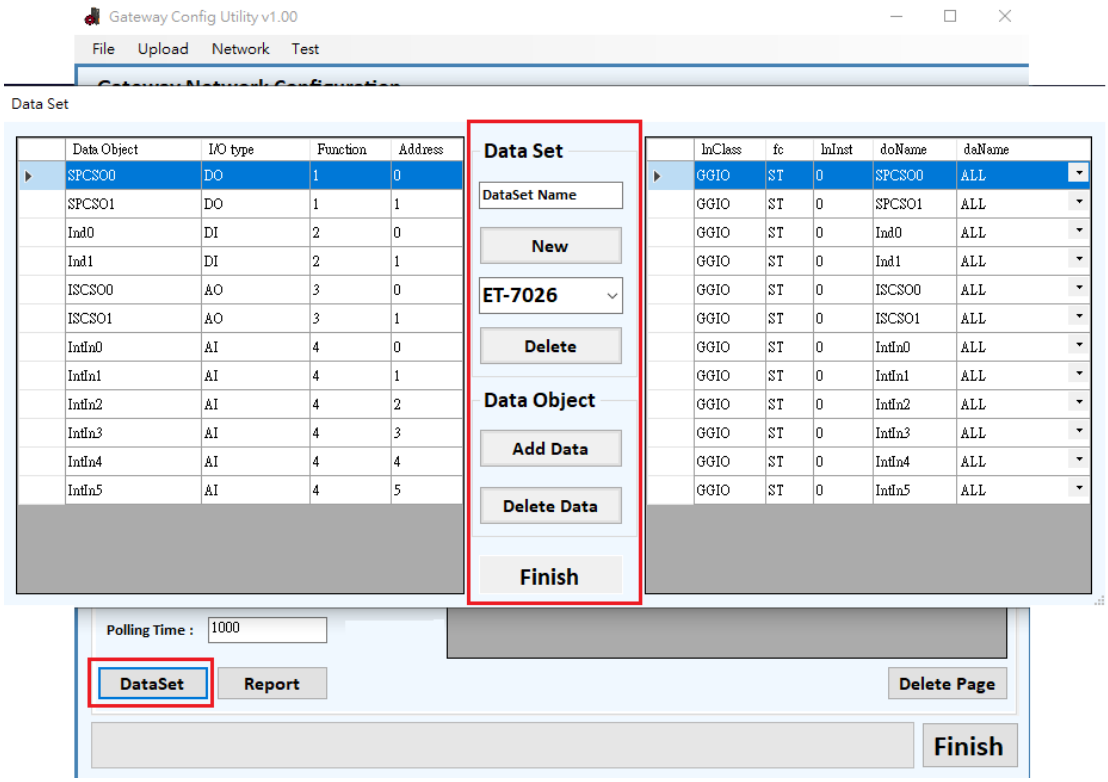
ABCGGIO1

DOType	DOName	sub	MappingModbus	DOUnit
AnIn	AnIn1	mag	MBSlave_1/AI0/0	Int32
AnIn	AnIn2	mag	MBSlave_1/AI0/2	Int32

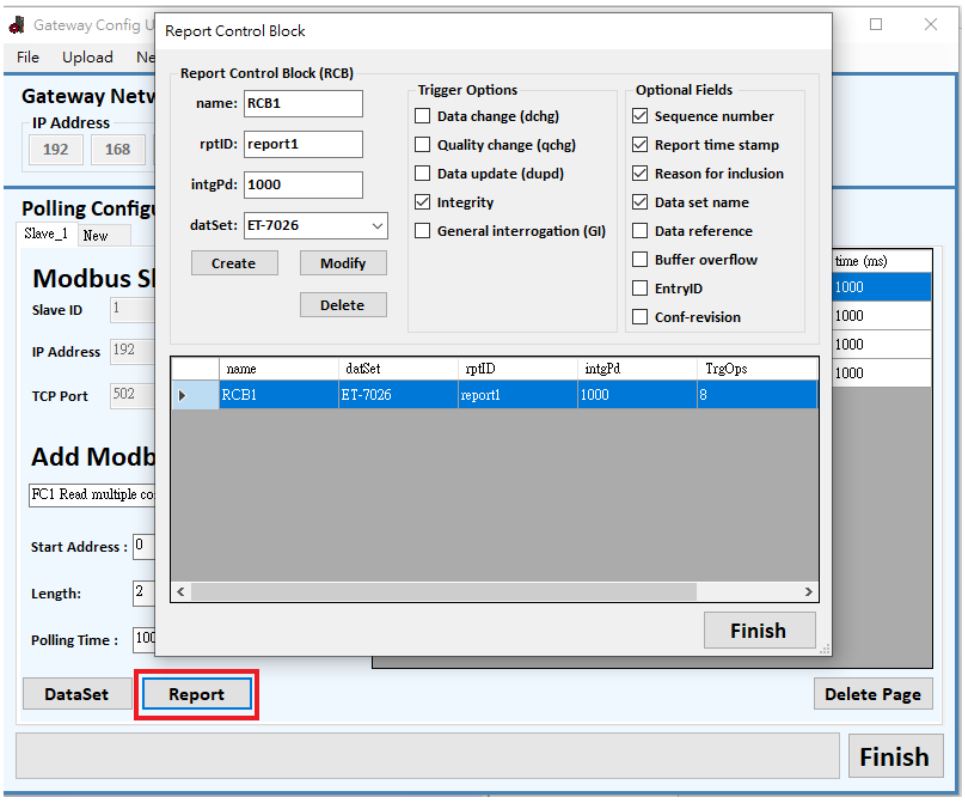
Result



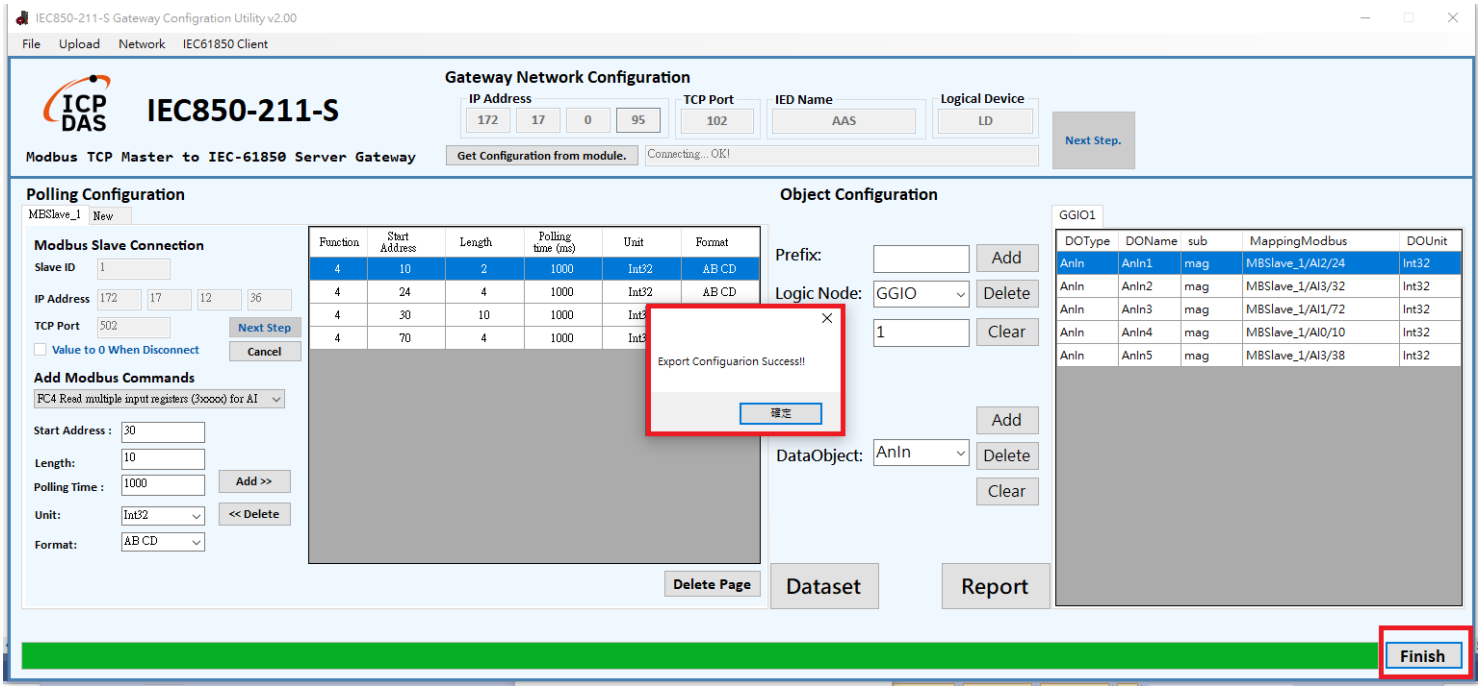
7. Press “DataSet” button and start to configure data set function.
   - “New” is to create a data set named after the text in the top text box.
   - The drop-down menu is to choose which data set can be configured now.
   - “Delete” is to delete the data set chosen now.
   - “Add Data” is to add the 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.



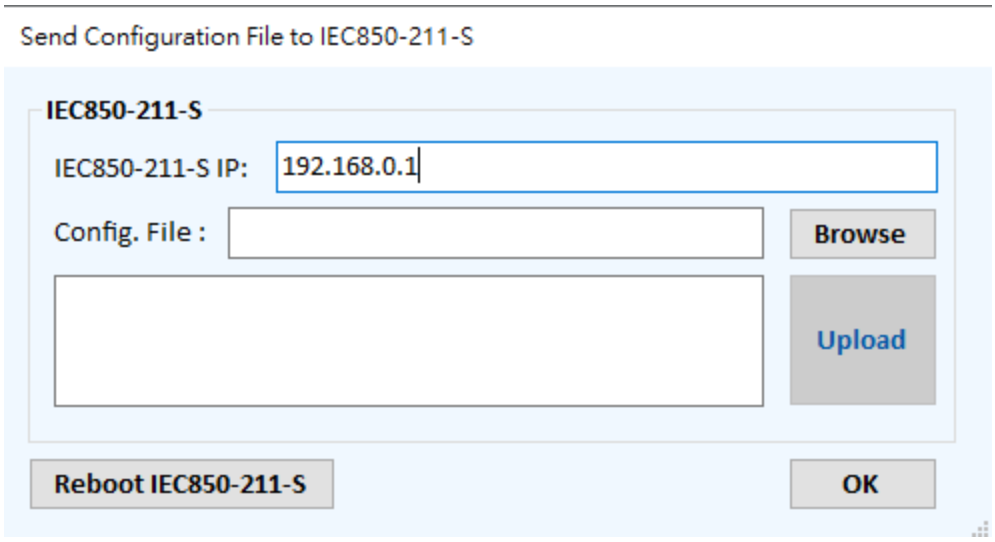
9. Press “Finish” button to convert the configuration to a file named “GatewayConfig.toml” and it is put in the folder “Gateway_Configuration” which is next to the utility.



Step 4:

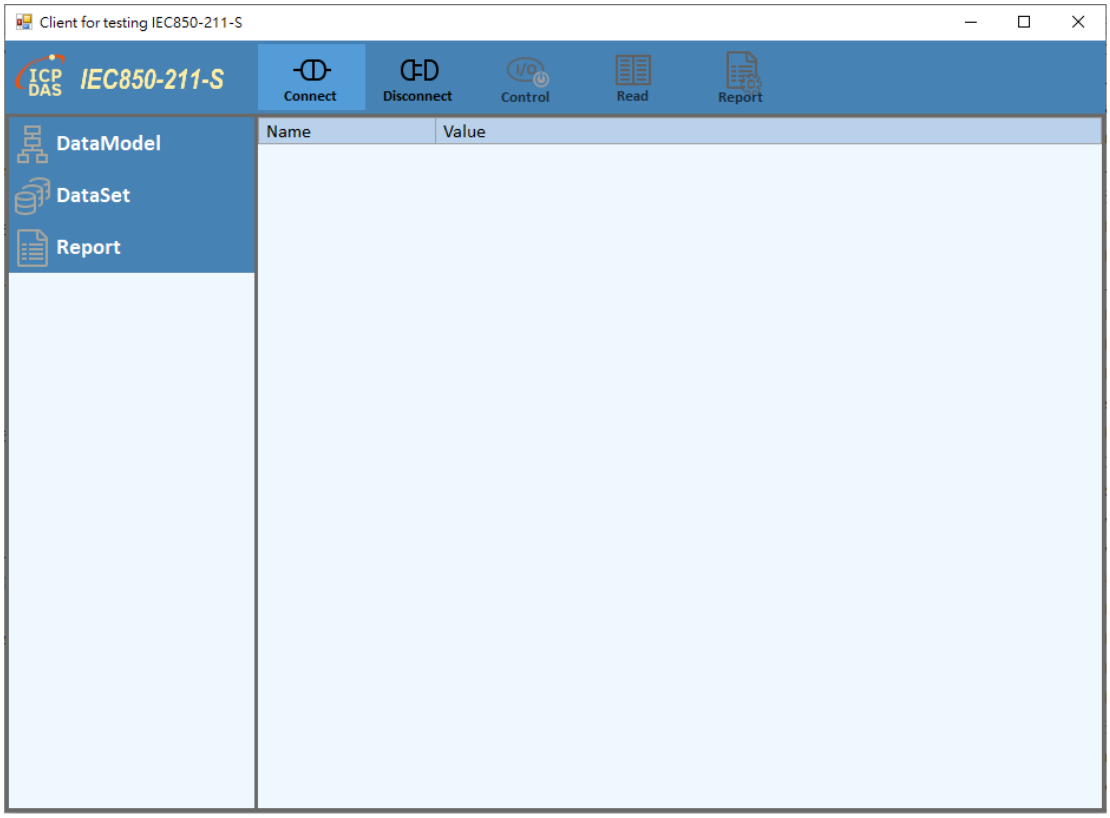
Press “Upload” option in the top toolbar to upload the setting file to IEC850-211-S.

- “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.