User Manual

May 2024 v1.00

DNP-211-S

DNP3 Slave to Modbus TCP Client 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.

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Document Revision

Version	Author	Date	Description
1.00	Ming	2024/05/06	First Released Revision

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1. Introduction

1.1. DNP3 Introduction

DNP3 (Distributed Network Protocol 3) is a communication protocol used between automation components. The protocol is formulated with reference to IEC 870-5. The purpose is to unify the communication method of SCADA so that SCADA can use the DNP3 protocol to communicate with master stations, remote terminal units (RTUs), intelligent electronic devices (IEDs), etc., and are mainly used in utilities such as electric and water companies.

The DNP3 protocol has certain of reliability and allows reliable communications in the adverse environments that electric utility automation systems are subjected to being specifically designed to overcome distortion induced by electromagnetic interference (EMI), aging components, and poor transmission media. A large number of CRC check codes are used in the protocol to ensure the accuracy of data. It is suitable for high security, Data communication field of medium speed and medium amount of data.

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 is for Ethernet attachment of PLC' s, I/O modules, and gateways to other simple field buses or I/O networks.

1.3. About DNP-211-S

The DNP-211-S is a gateway that supports DNP3 slave to Modbus TCP master protocol conversion. Its main function is to integrate existing Modbus slave devices into DNP3 slave devices for control by a DNP3 master station. In the DNP3 network, the DNP-211-S acts as a DNP3 slave device supporting several common data groups and variations to facilitate communication with the master station. In the Modbus TCP network, the DNP-211-S serves as a Modbus TCP concentrator, polling each Modbus TCP device individually and aggregating this data for the DNP3 master station to read and control.

The DNP-211-S utility offers configuration capabilities for all DNP3 I/O data and Modbus address mapping, allowing users to easily adjust setting. With this software, you can easily manage and set up the DNP-211-S to ensure smooth communication and effective data control.

1.4. Features

- Integrate Modbus TCP slaves and convert to a DNP3 slave.
- DNP3 supports connections via RS-485, TCP/IP, and UDP.
- Configurable mapping data points
- DNP3 supports Binary, Binary Output, Analog, and Analog Output data.
- Analog and Analog Output data support word, int32, float, and double formats.
- Modbus TCP supports function code 1, 2, 3, 4, 5, 6, 15, 16.
- DNP3 data provides the Modbus TCP connection status.
- Supports up to 32 Modbus TCP slaves.

1.5. Specifications

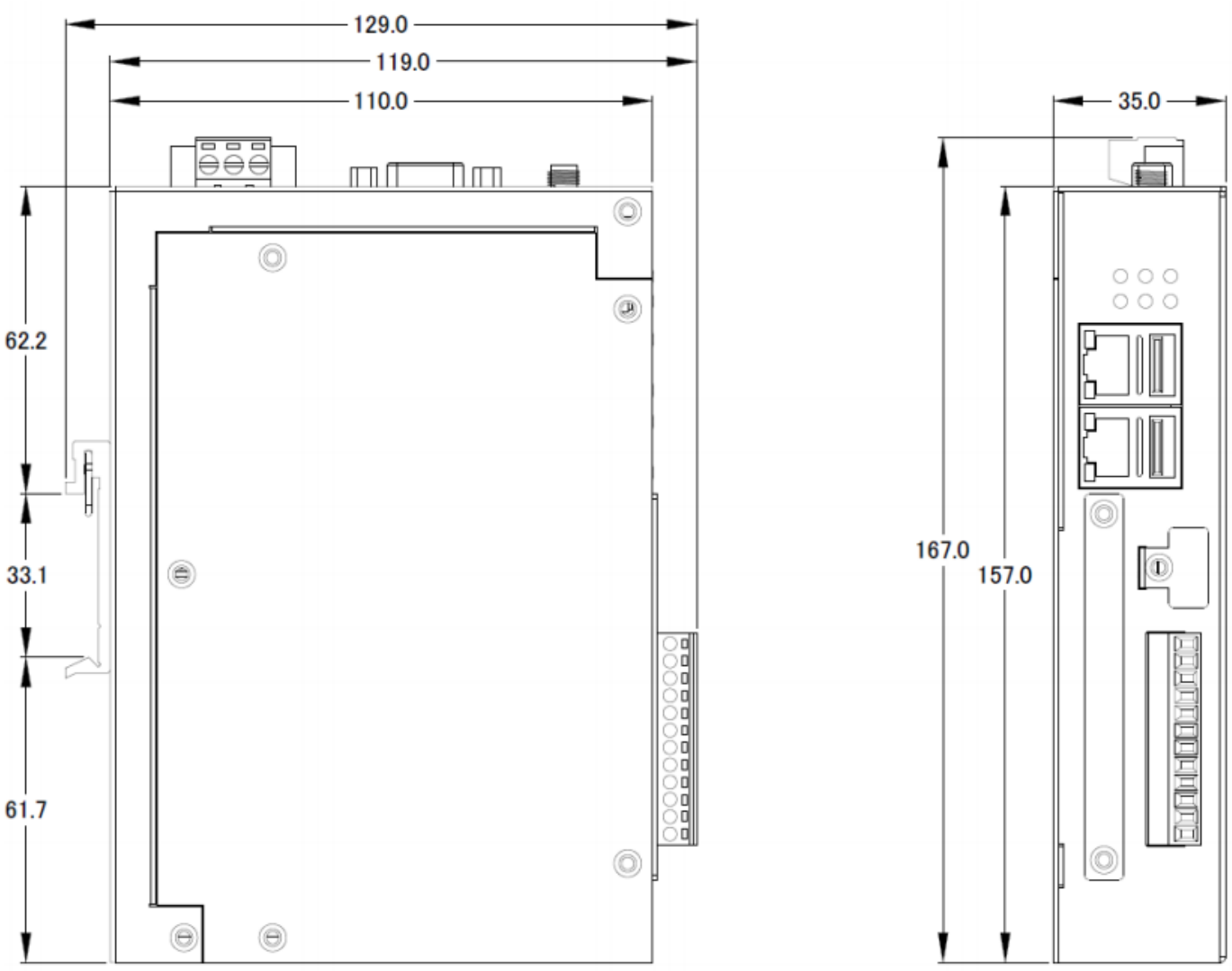
System		
CPU		Cortex-A8, 1 GHz
SDRAM		512 MB
Flash		512 MB
FRAM		64 KB
LED Indicators		PWR (Power) · RUN (System Run) · L1 (Firmware Run) L2 (Modbus TCP connection) · L3 (DNP3 connection)
Communication Ports		
VGA		1 (reserved)
Ethernet		RJ-45 x 2, 10/100/1000 Based-TX (auto-negotiating, Auto MDI/MDI-X, LED indicators)
USB 2.0		2 (reserved)
Console Port		RS-232 (RxD, TxD and GND); Non-isolated
ttyO2		RS-485 (Data+, Data-); Non-isolated
ttyO4		RS-232 (RxD, TxD and GND); Non-isolated
ttyO5		RS-485 (Data+, Data-); 2500 VDC isolated
Protocol		
Modbus	Identity	Modbus TCP client
	Function	1, 2, 3, 4, 5, 6, 15, 16
	Connection	Max. 32 Modbus TCP slaves
DNP3	Identity	DNP3 slave
	Connection	Support RS-485 / Ethernet
	Group	1, 10, 11, 30, 40, 41
	Data Point	DI: 8192 DO: 8192 AI: 2048 AO: 2048
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

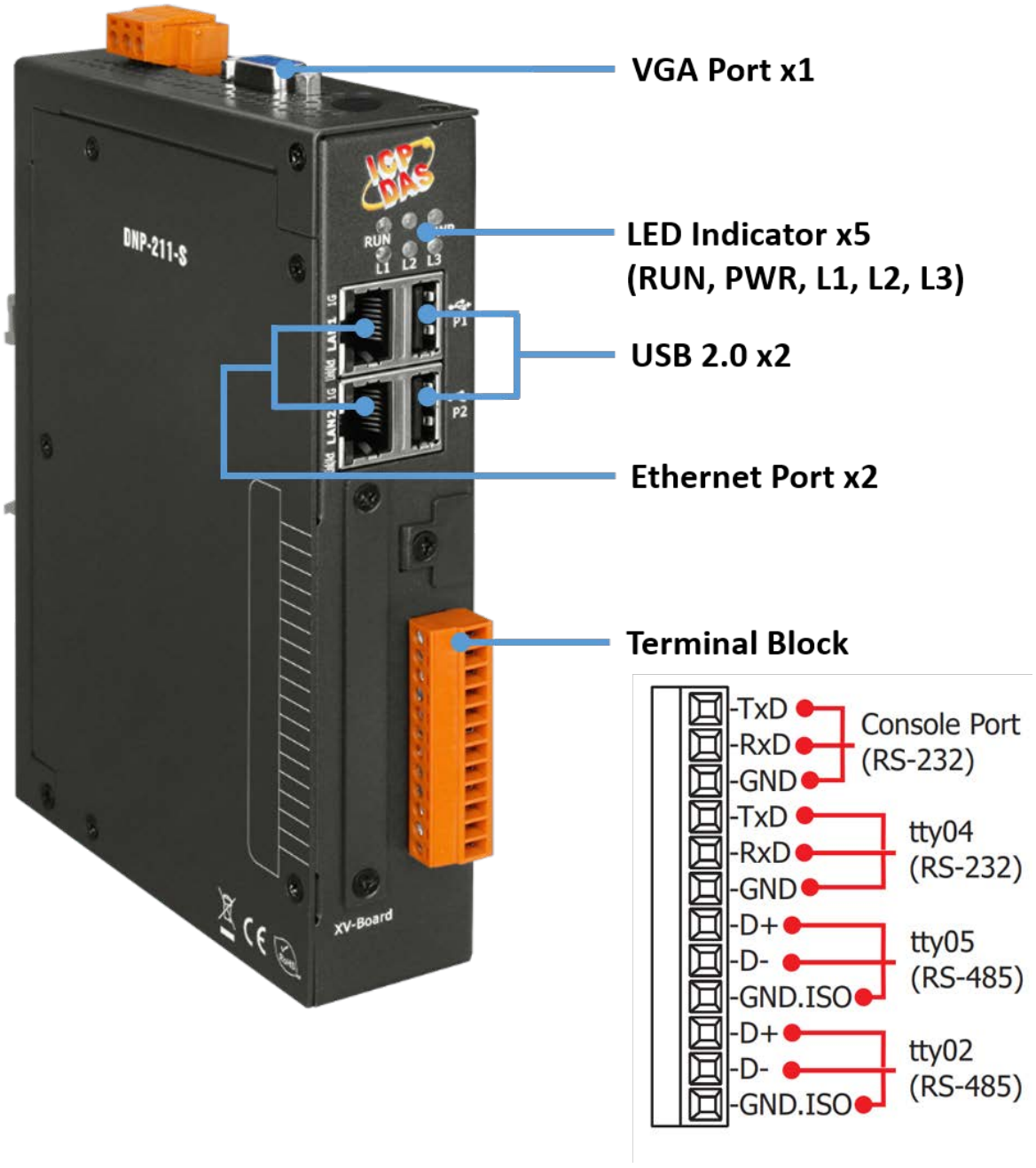
2. Hardware

2.1. Dimensions

Unit: mm

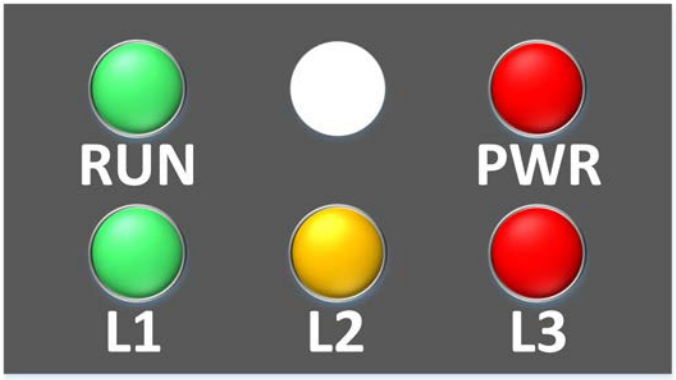


2.2. Appearance



2.3. LED Indicator

There are five LEDs to indicate the various states of the DNP-211-S. Since the power-on time of DNP-211-S is about 1 minute, if you need to observe the status of these LEDs, please wait 1 minute after powering on. 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 500 ms	At least one Modbus slave disconnected
	OFF	No Warning
L3	Flash every 500 ms	DNP3 disconnected
	OFF	No Warning
L1, L2, L3	All constant light	DNP211S_Config.toml file error

*After connecting the DNP-211 to the power supply, please wait for 1 minute to complete the startup process. When the "RUN" LED starts flashing and the "PWR" LED remains on, it means that the startup has been completed. If The "L1" LED blinks once per second, indicating that the firmware is running.

3. Getting Started With DNP-211-S

3.1. Preparations for Devices

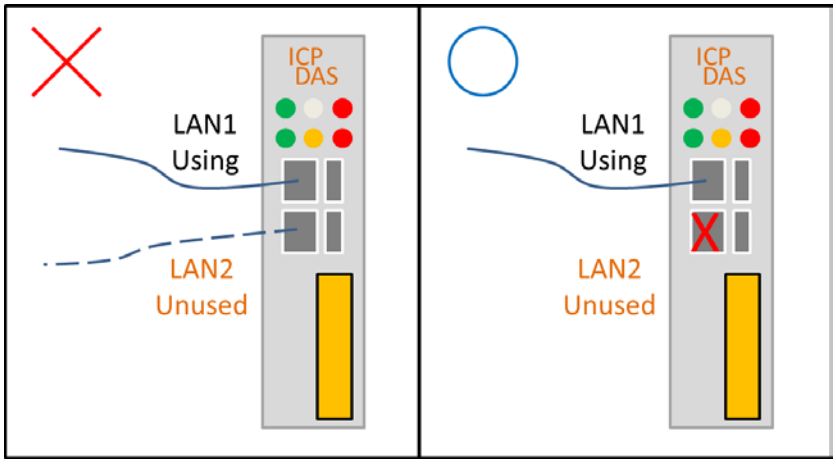
In addition to the DNP-211-S, please prepare the following:

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

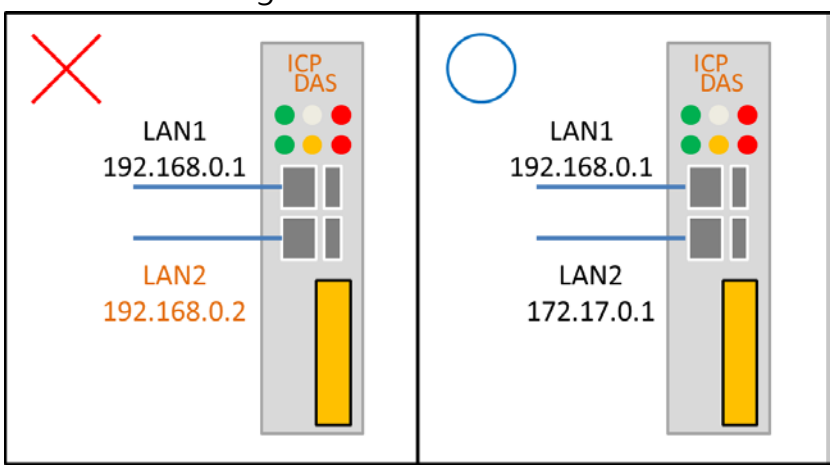
3.2. Hardware Wiring and setting rules

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

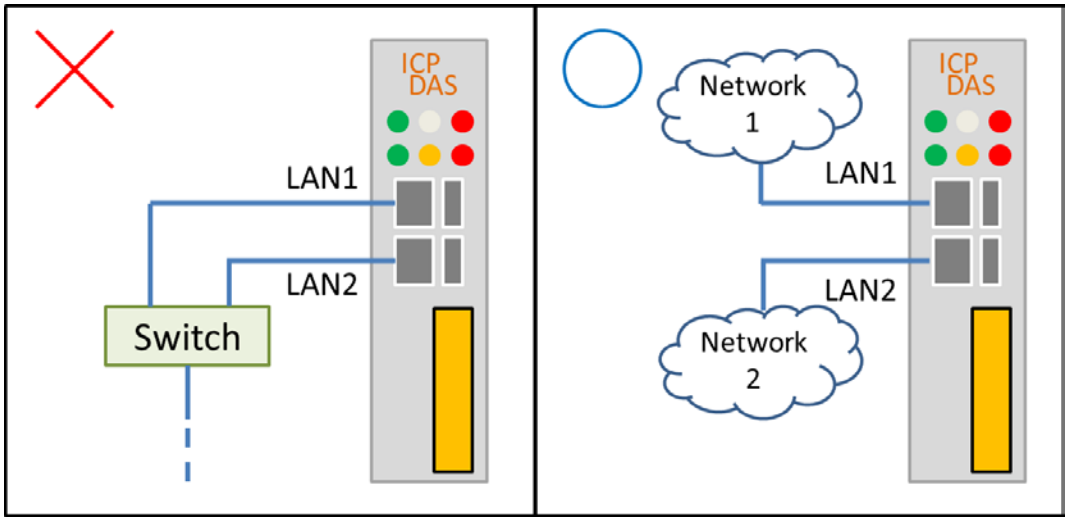
1. **Do not** plug in the network cable if the LAN (LAN1 or LAN2) is not used on DNP-211-S.



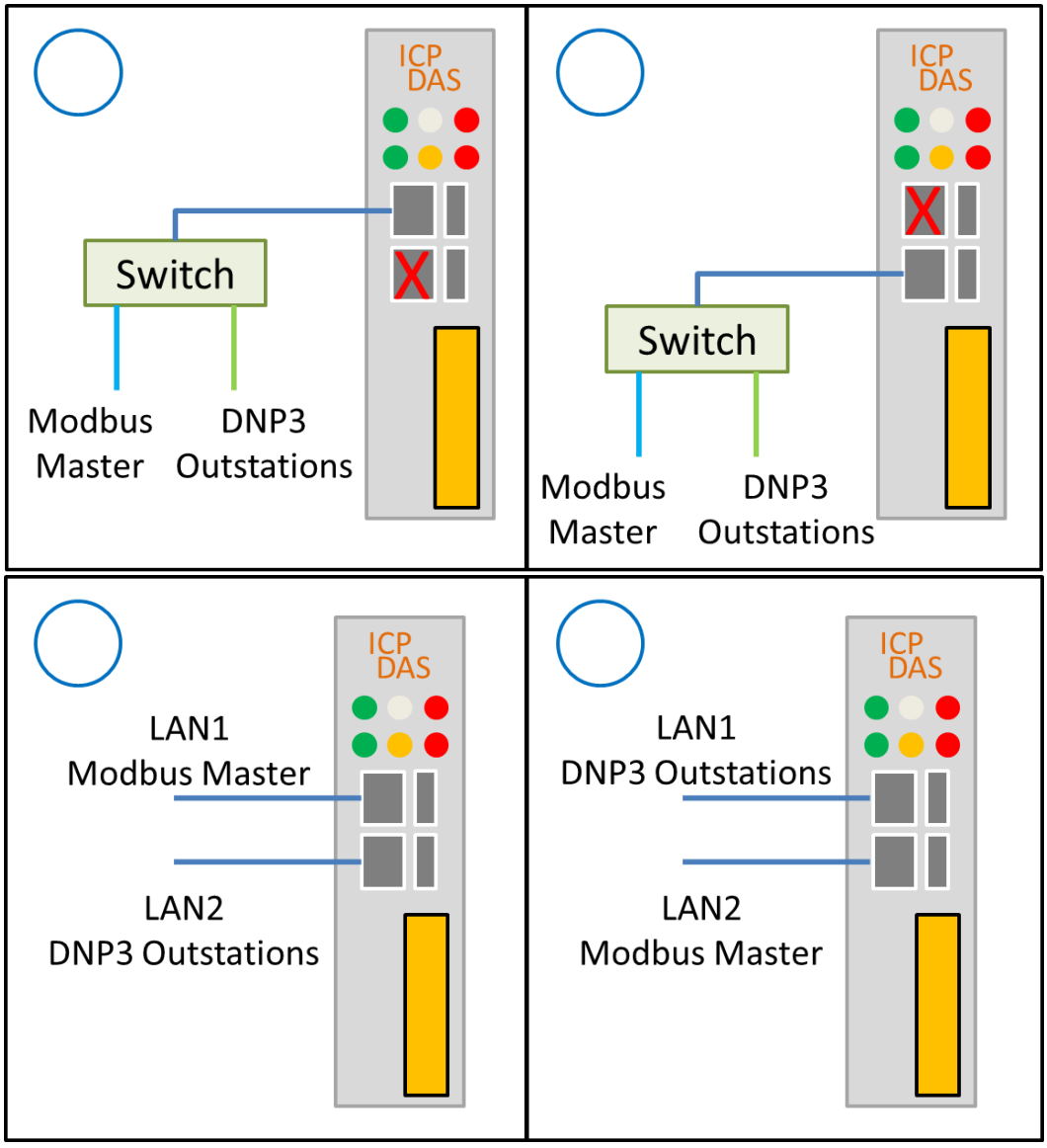
2. When both LAN1 and LAN2 are enabled, they **cannot** be set to the same network segment.



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



4. Modbus TCP and DNP3 devices have no fixed LAN settings.



3.3. DNP-211-S Utility

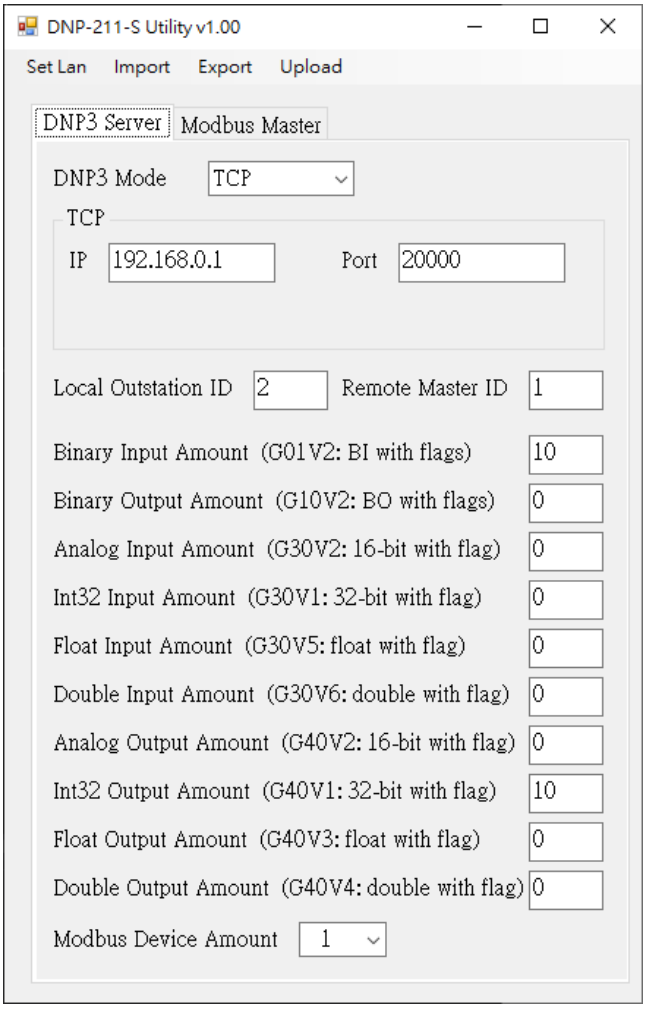
3.3.1 Download DNP-211-S Utility

https://www.icpdas.com/tw/download/index.php?model=DNP-211

Download DNP_211_S_Utility_vxxx.zip file and extract it.

3.3.2 DNP-211-S Utility Introduction

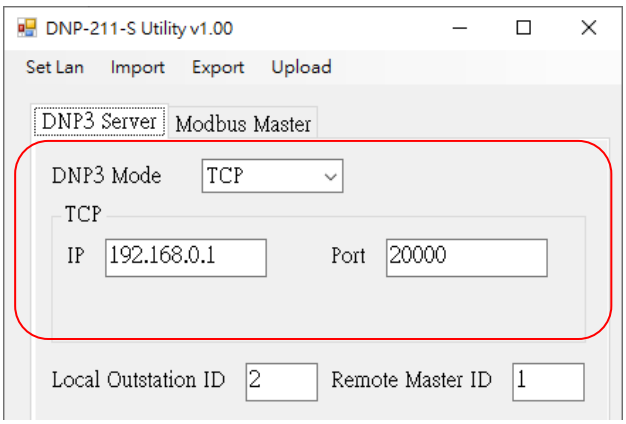
DNP-211-S Utility is a utility for DNP-211-S to generate dedicated connection settings and I/O mapping table, and it can also be used to modify the IP address and to update the firmware of the DNP-211-S. After opening DNP_211_S_Utility, the screen will be as below:



3.3.3 DNP-211-S Communication Configure

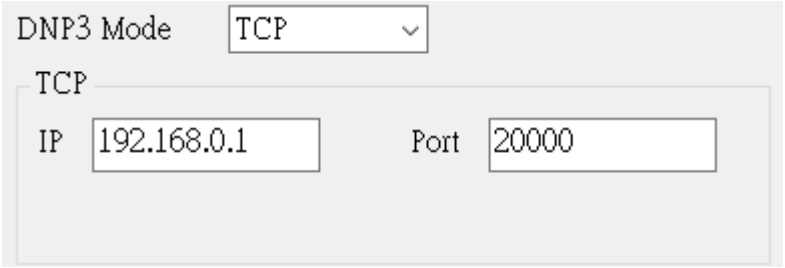
The DNP-211-S Utility main function is to assist the user in generating configuration file used by DNP-211-S. The following is a step-by-step description of how to generate the configuration file:

1. Set the connection mode between DNP-211-S and the DNP3 master station:

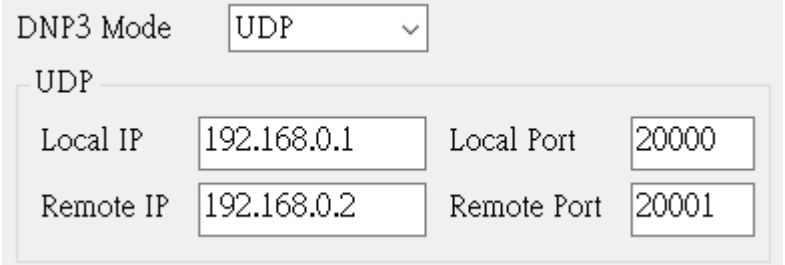


DNP3 Mode: The methods of connecting with the DNP3 master station include TCP, UDP, and Serial:

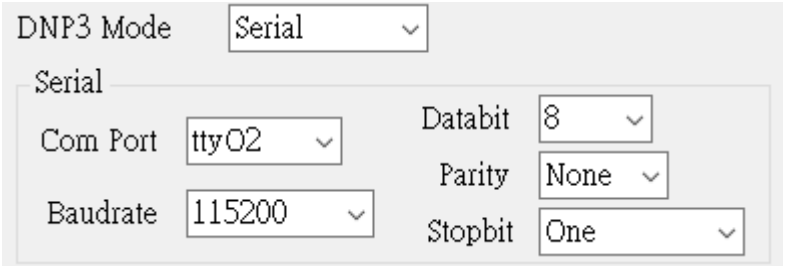
TCP: Set the IP and the Port to be used for the DNP-211-S module.



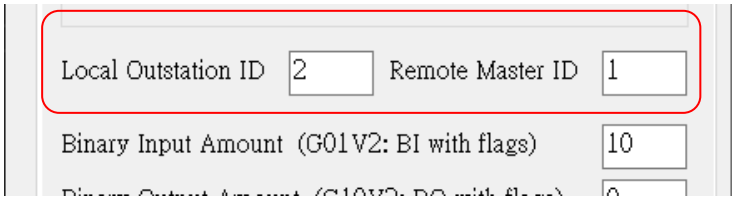
UDP: Set the DNP-211-S's Local IP/Port and the master station's Remote IP/Port.



Serial: Set the DNP-211-S's Com Port, Baudrate, and Data Format.

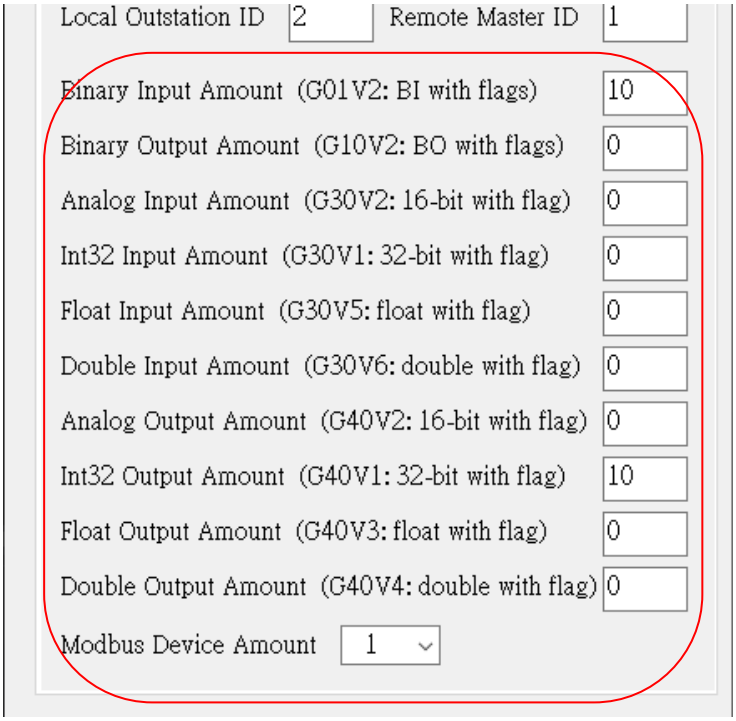


2. Set the DNP-211-S and DNP3 master's DNP3 station number, ensuring that the station numbers are not duplicated.



Local Outstation ID: Slave ID of the DNP-211-S (0 ~ 65519).
Remote Master ID: DNP3 master ID (0 ~ 65519).

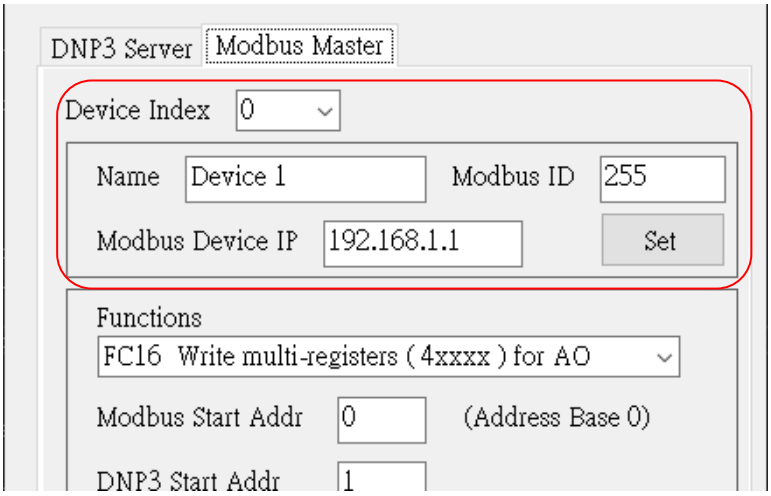
3. Set the total number of I/O points on the DNP-211-S and the number of Modbus slave devices to be controlled.



Binary Input Amount: Set DI points for DNP-211-S.
Binary Output Amount: Set DO points for DNP-211-S.

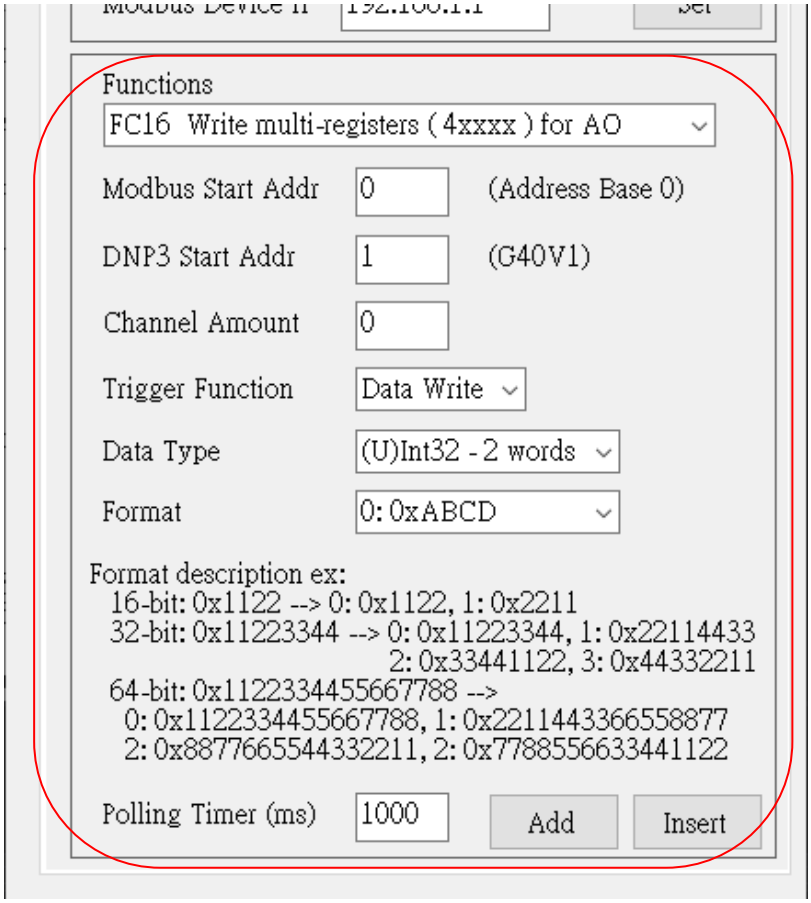
Analog Input Amount: Set Word AI channels for DNP-211-S.
Int32 Input Amount: Set Int32 AI channels for DNP-211-S.
Float Input Amount: Set Float AI channels for DNP-211-S.
Double Input Amount: Set Double AI channels for DNP-211-S.
Analog Output Amount: Set Word AO channels for DNP-211-S.
Int32 Output Amount: Set Int32 AO channels for DNP-211-S.
Float Output Amount: Set Float AO channels for DNP-211-S.
Double Output Amount: Set Double AO channels for DNP-211-S.
Modbus Device Amount: Number of Modbus TCP devices.

4. Switch to Modbus Master page and Setting connection information of Modbus TCP Slaves.



Device Index: Select the Modbus TCP slave to configure.
Name: Setting device name of the Modbus TCP slave.
Modbus ID: Setting the Modbus ID of the Modbus TCP slave.
Modbus Device IP: Setting IP address of the Modbus TCP slave.
Set button: After completed the above setting, click the "Set" button to modify the configuration file.

5. Set the Modbus function code, start address, and data length for reading and writing.



Functions: Select Modbus function code of the command.

Modbus Start Addr: Start address of the Modbus command (address base 0).

DNP3 Start Addr: Map to the start address of the specific I/O in DNP3.

Channel Amount: Mapped channel amount (**not byte number**).

Trigger Function: For the output modes of Function 5, 6, 15, and 16, there are two options available: Cycle and Data Write. Cycle performs periodic cyclic output, while Data Write performs output only when the DNP3 master sends the output command.

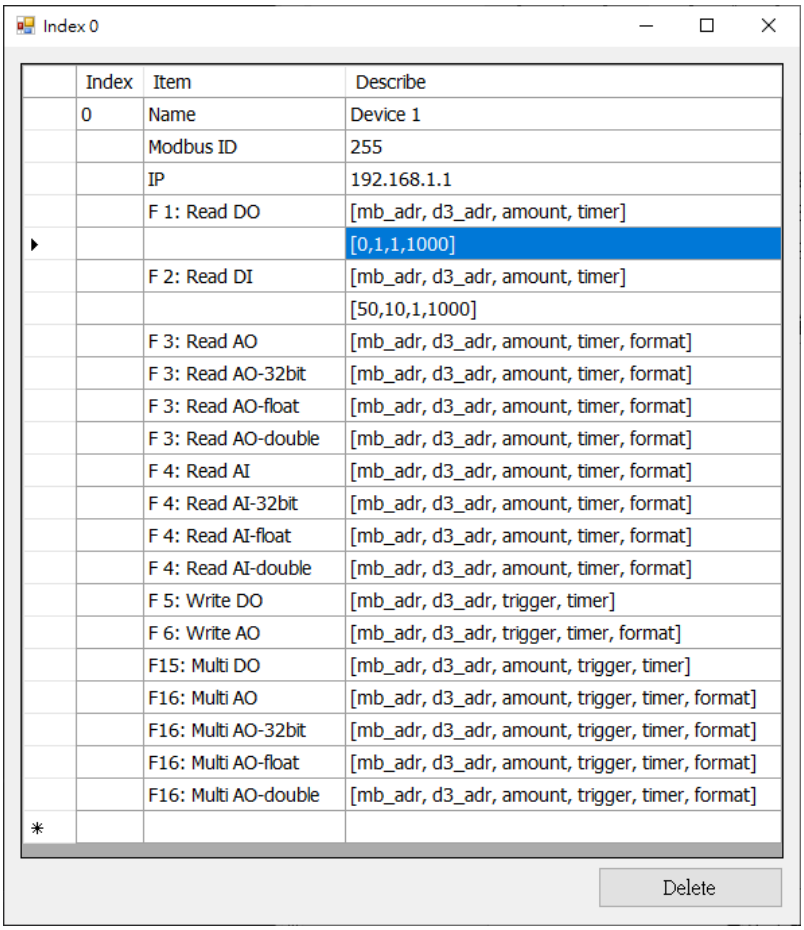
Format: Select the Big Endian or Little Endian data formats.

Polling Timer (ms): Cycle time of Modbus commands.

Add button: Press the "Add" button to add the aboved setting to the configuration file.

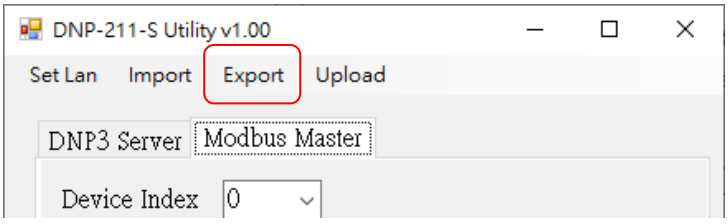
Insert button: Press "Insert" to insert the setting above the selected item.

6. Verify if the configuration information is correct.



Delete button: Pressing "Delete" will remove the selected item.

7. Repeat steps 4 to 6 for all Modbus TCP slaves settings.
8. Click "Export" to output the DNP211S_Config.toml file.

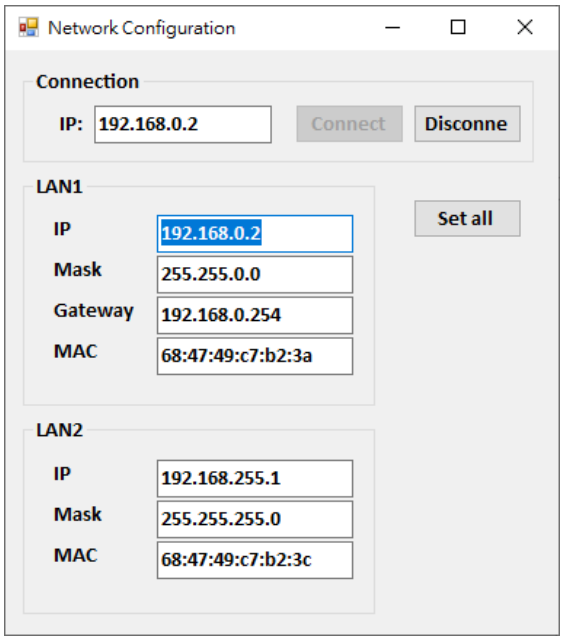


9. Click "Upload," enter the DNP-211-S's IP, and press "Upload" to load the file. After loading, wait for the DNP-211-S to reboot automatically to complete the configuration.

Note: "Upload" function not only uploads the DNP211S_Config.toml file but also uploads the d2s_xxxx.tar.gz firmware file. After updating the configuration file or firmware, the DNP-211-S will automatically reboot. The reboot process takes about 1 minute. Please do not turn off the power during this time, as it may result in a failed update.

3.3.4 Change the IP Address of the DNP-211-S

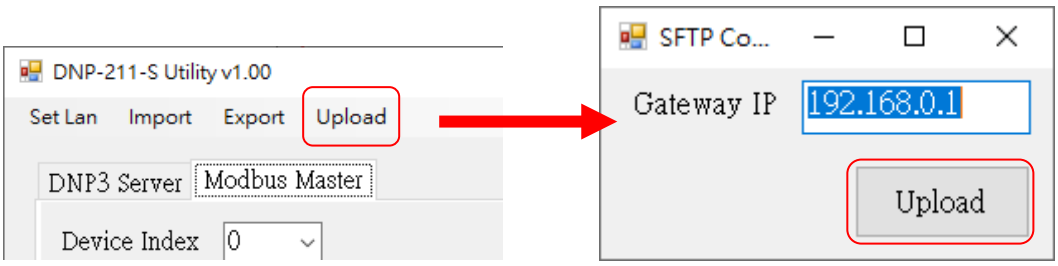
The DNP-211-S has two LAN ports. To change the IP address, first press "Set Lan" to open the Network Configuration screen. Enter the current IP address of the DNP-211-S for connection. Once connected successfully, the current IP settings for the two LAN ports of the DNP-211-S will be displayed. After modification, press "Set all" to change the IP settings.



Note: After updating the settings, the DNP-211-S will automatically reboot. The reboot time is approximately 1 minute. Please do not turn off the power during this time, otherwise the update will fail.

3.3.5 Update the Firmware of the DNP-211-S

Link to the firmware download web page for the DNP-211-S, download the latest firmware d2s_xxxx.tar.gz file, and use the "Upload" function of the DNP-211-S Utility to upload the firmware.



Note: After updating the firmware, the DNP-211-S will automatically reboot. The reboot process takes about 1 minute. Please do not turn off the power during this time, as it may result in a failed update.

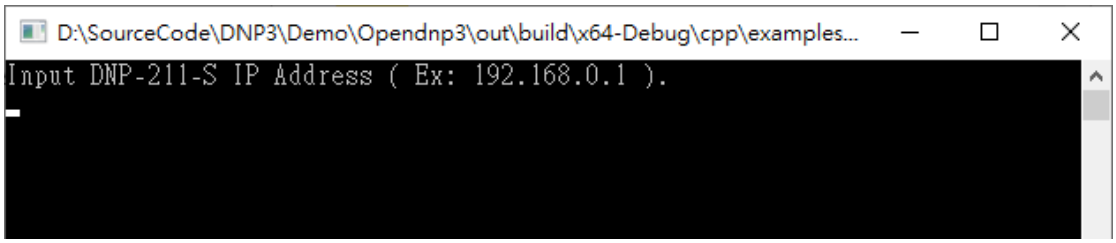
3.4. DNP-211-S Tester

3.4.1. Download DNP-211-S Tester：

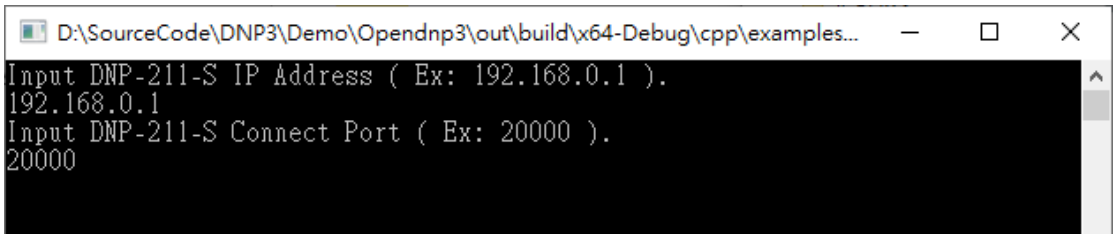
https://www.icpdas.com/tw/download/index.php?model=DNP-211

3.4.2. DNP-211-S Tester Introduction

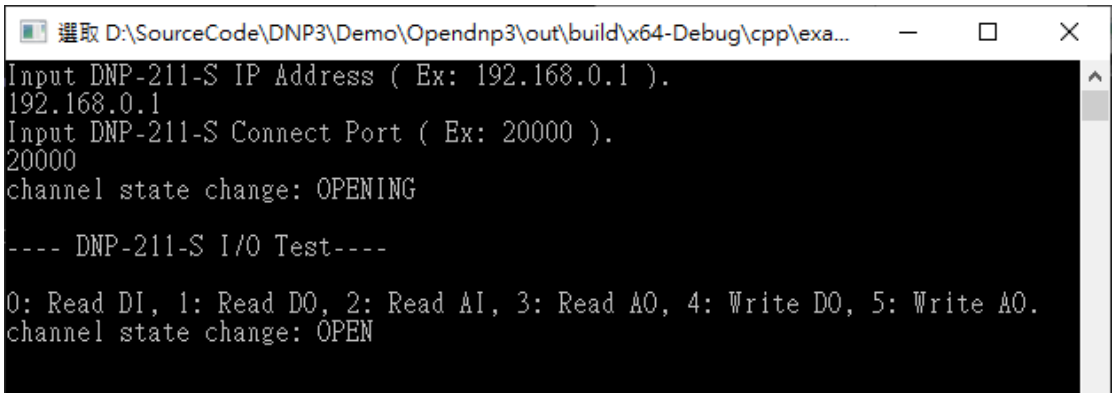
The DNP-211-S Tester is a console interface tool for simple testing of the DNP-211-S. It can test the current settings of the DNP-211-S and verify connectivity and other functions. After opening the DNP-211-S Tester, the screen will appear as follows:



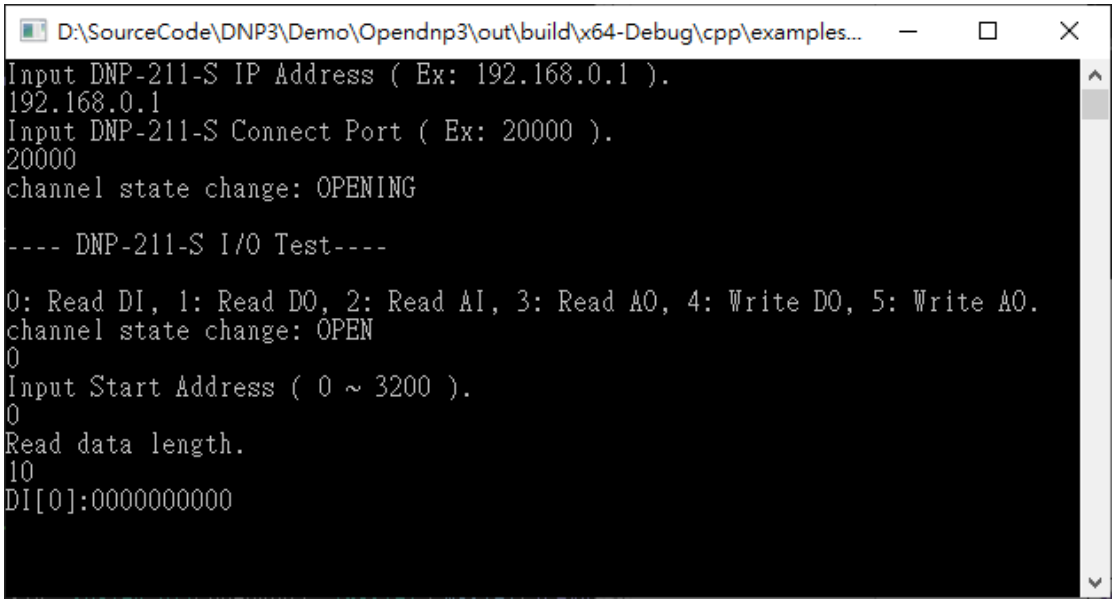
1. First, enter the DNP3 side IP address and IP port of the DNP-211-S for connection.



2. After successful connection, the following screen will appear.



3. According to the prompts, users can input 0 to 5 to perform corresponding Read / Write IO actions. For example, entering 0 will initiate Read DI. The prompt will further explain the "Start Address" and "Data Length" to input. Inputting start address 0 and data length 10, the execution screen will appear as follows.



4. At this point, you can choose other actions, such as entering 5 to prepare Write AO. Follow the prompt to input "Output Address" 0 and "Output Data" 10. The execution screen will appear as follows.