User Manual

Version 1.03 Sep 2024

DNP-211

DNP3 Master to Modbus TCP Server Gateway



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Document Revision

Version	Author	Date	Description
1.00	Ming	2021/10/06	First Released Revision
1.01	Ming	2022/06/01	Added DNP-211 Reader instructions
1.02	Ming	2023/09/28	Wiring Problems, Uploading Files and Rebooting Instructions
1.03	Ming	2024/09/02	Added Utility Data Format description

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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.

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1.3. About DNP-211

DNP-211 is a gateway that supports DNP3 master and Modbus TCP server protocol conversion. As long as the master device supports Modbus TCP protocol, it can connect the existing DNP3 network with the Ethernet-based master device. For DNP3 network, DNP-211 is a DNP3 master device. It supports several commonly used data groups and variables and can communicate with slave devices. From the perspective of Modbus TCP network, DNP-211 is a Modbus TCP server, which can receive commands from Modbus TCP client, and process these commands to reply or send related DNP3 data. All DNP3 I/O data and Modbus mapping can be configured through DNP-211 utility software.

1.4. Features

- Read / Write DNP3 outstations via Modbus TCP
- Configurable DNP3 Master
- Configurable Modbus TCP server
- Support Data Group 1, 10, 12, 20, 30, 40, 41
- Support Modbus function code 1, 2, 3, 4, 15, 16
- Provides Modbus register of connection status of DNP3 outstations
- Supports up to 32 DNP3 outstations
- Supports up to 16 Modbus client connections

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	

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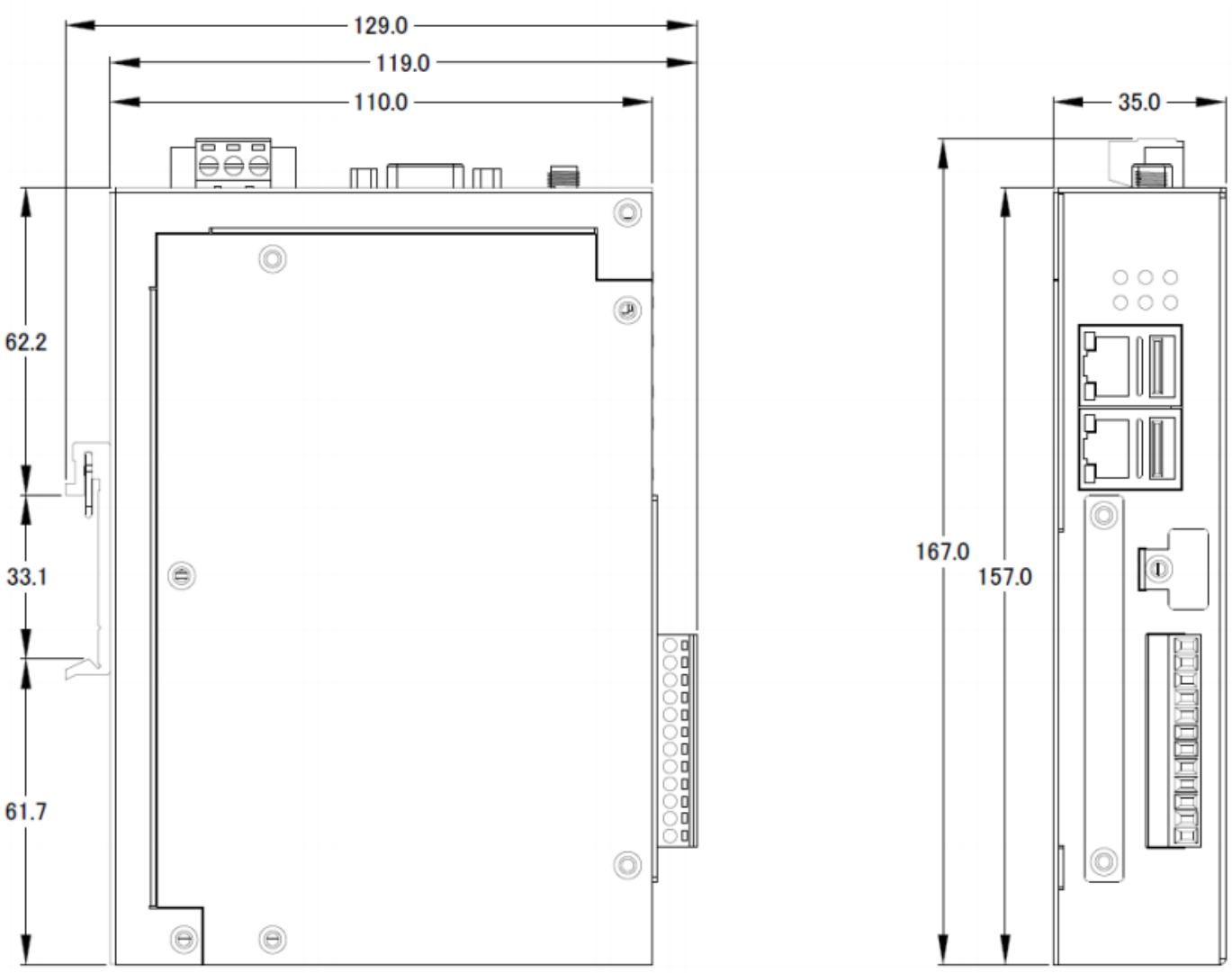
VGA		1 (reserved)
Ethernet		RJ-45 x 2, 10/100/1000 Based-TX (Auto-negotiating, Auto MDI/MDI-X, LED indicators)
USB 2.0		2 (reserved)
Console Port		RS-232 (RxD, TxD and GND); Non-isolated
ttyO2		RS-485 (Data+, Data-); Non-isolated
ttyO4		RS-232 (RxD, TxD and GND); Non-isolated
ttyO5		RS-485 (Data+, Data-); 2500 VDC isolated
Protocol		
Modbus	Identity	Modbus TCP server
	Function	1, 2, 3, 4, 15, 16
	Connection	Max. 16 Modbus TCP clients
DNP3	Identity	DNP3 master
	Connection	Max. 5 MMS clients
	Group	1, 10, 12, 20, 30, 40, 41
	Data Point	DI: 8192 DO: 8192 Count: 2048 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

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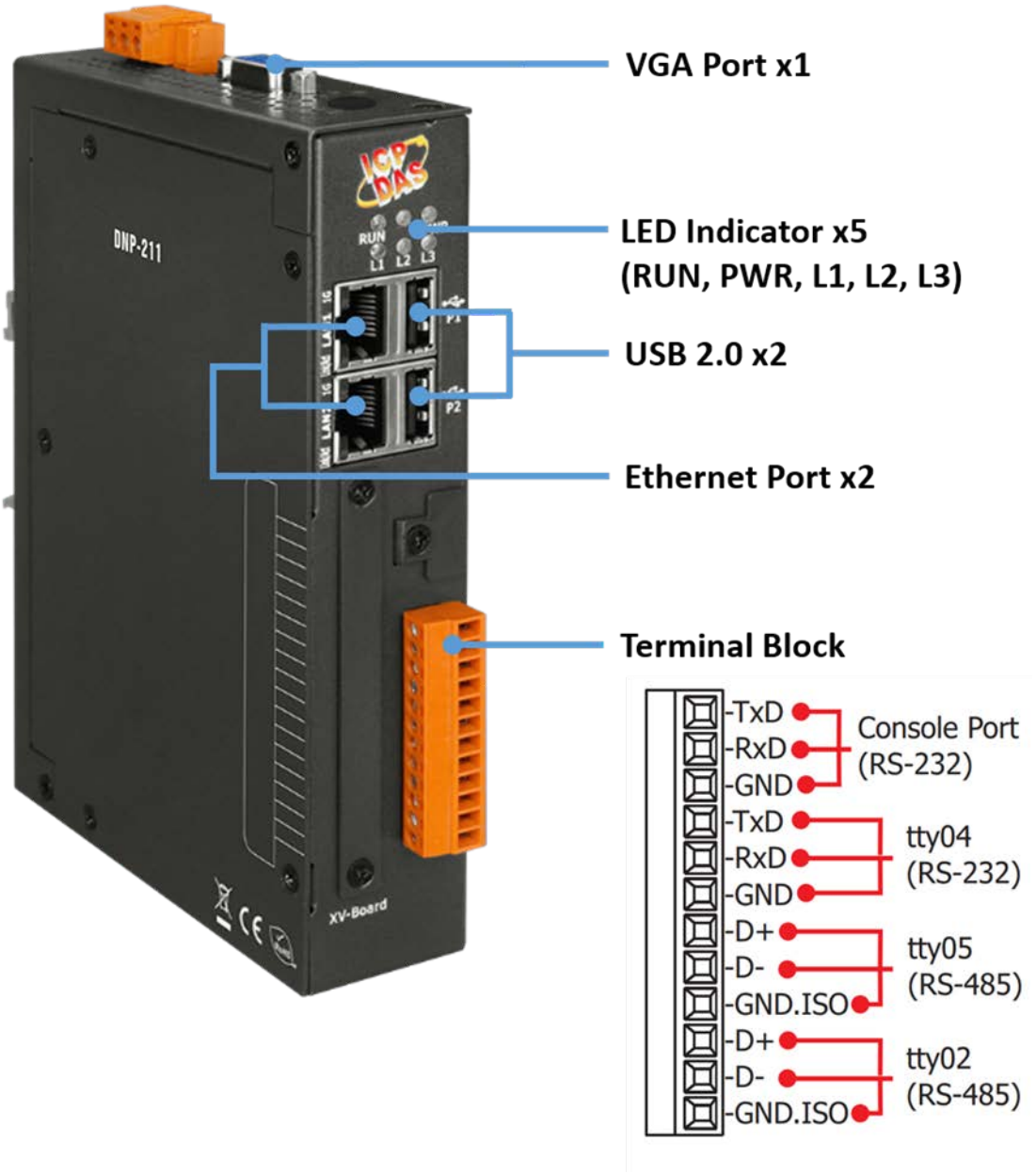
2.Hardware

2.1. Dimensions

Unit: mm



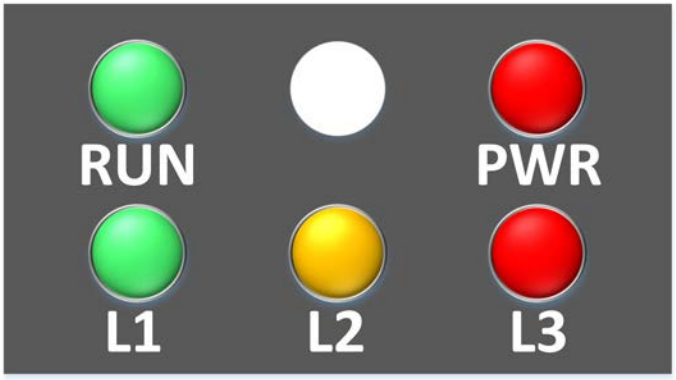
2.2. Appearance



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2.3. LED Indicator

There are five LEDs to indicate the various states of the DNP-211. Since the power-on time of DNP-211 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**	Modbus TCP disconnected
	OFF	No Warning
L3	**Flash every 500 ms**	At least one DNP3 outstation disconnected
	OFF	No Error
L1, L2, L3	**All constant light**	GatewayConfig.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.

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3. Getting Started With DNP-211

3.1. Preparations for Devices

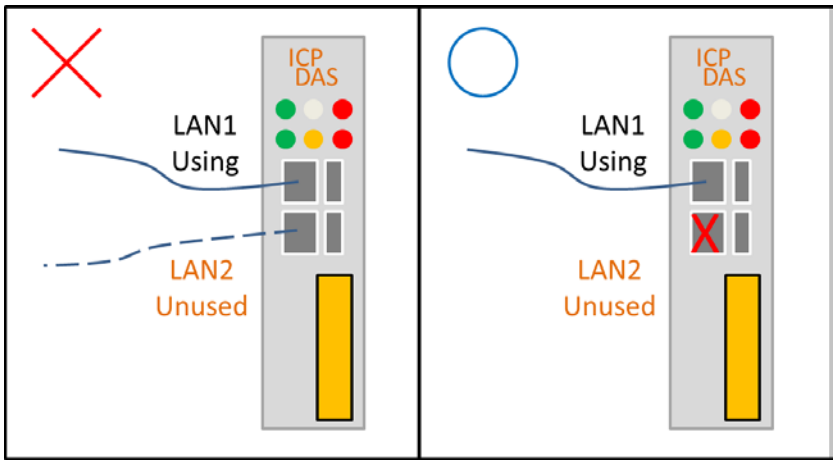
In addition to the DNP-211, please prepare the following:

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

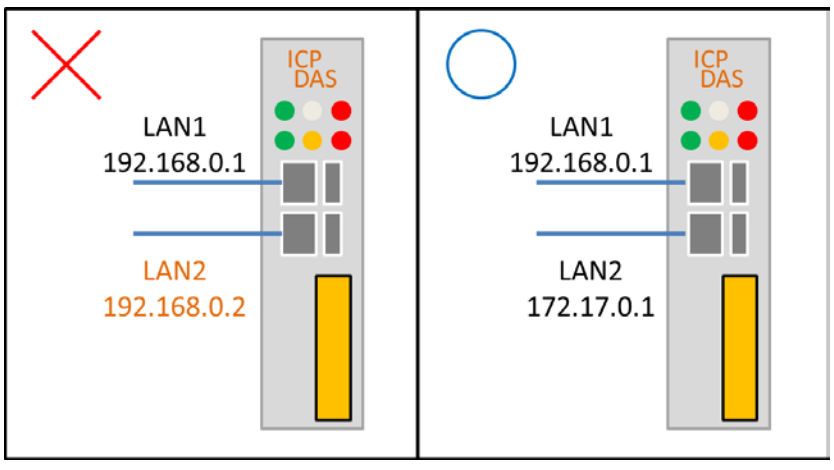
3.2. Hardware Wiring and setting rules

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.

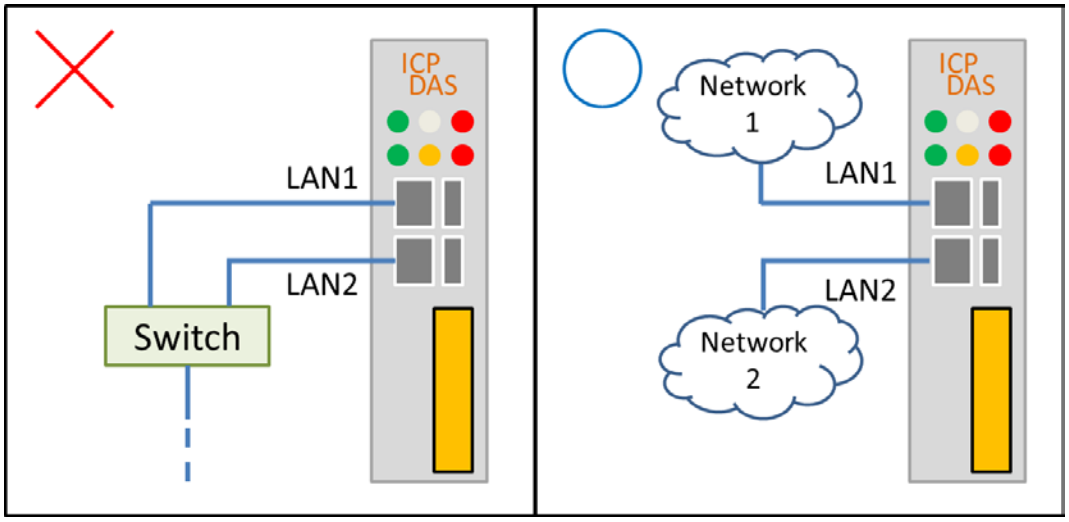


2. When both LAN1 and LAN2 are enabled, they **cannot** be set to the same network segment.

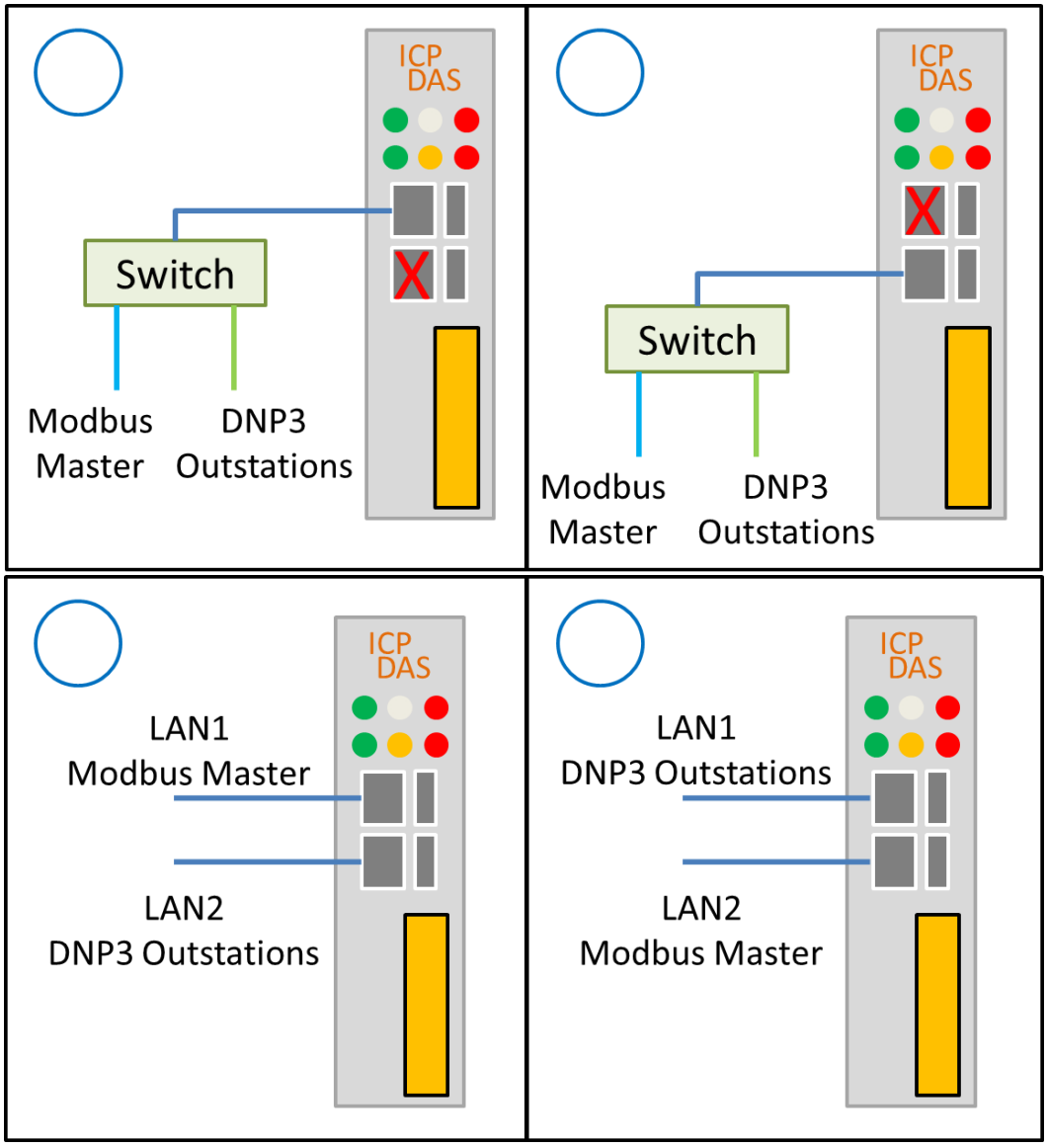


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3. When both LAN1 and LAN2 are enabled, **they must be connected to two separate networks.**



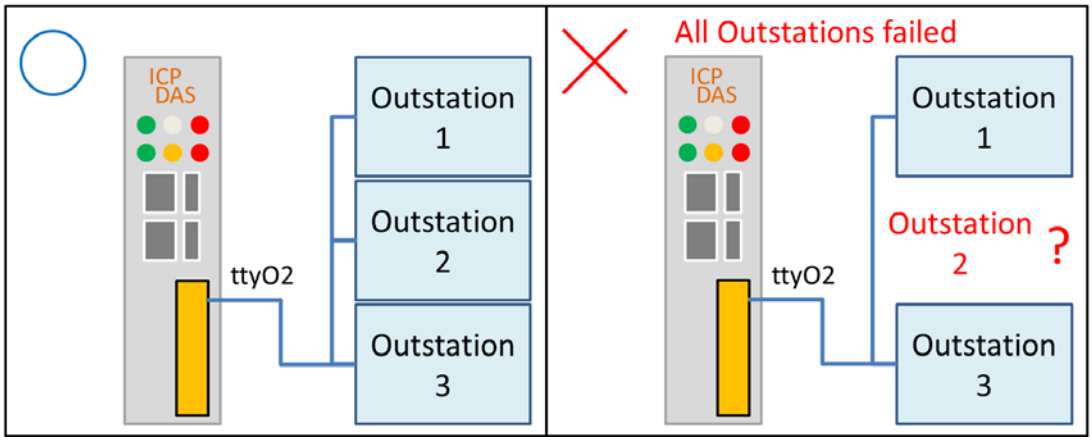
4. Modbus TCP and DNP3 devices have no fixed LAN settings.



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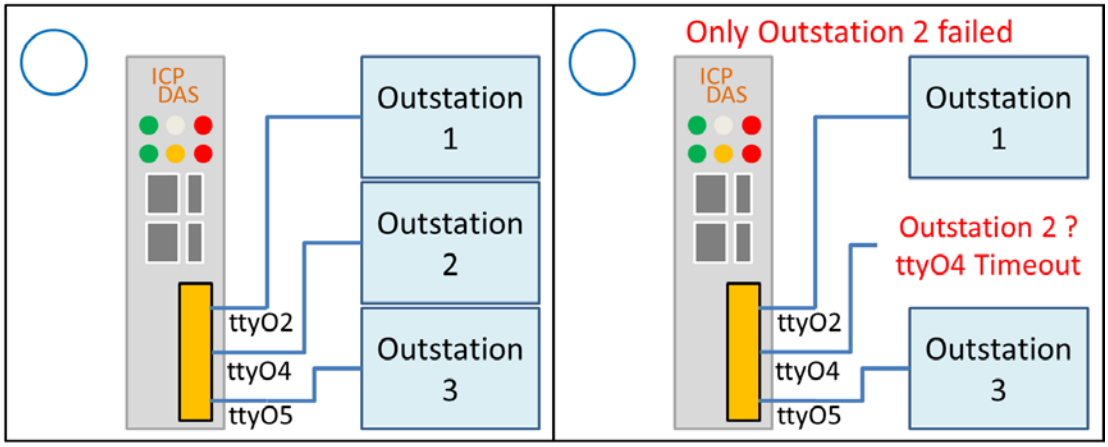
5. **When using RS-485 to connect to DNP3 devices**, all devices set to the same RS-485 port must be ensured to be connected during the initial connection when the DNP-211 is powered on.

Configuration:
Outstation 1、Outstation 2、Outstation 3 all at ttyO2



6. RS-485 DNP3 devices can be decentralized to three RS-485 ports on the DNP-211.

Configuration:
Outstation 1 at ttyO2
Outstation 2 at ttyO4
Outstation 3 at ttyO5



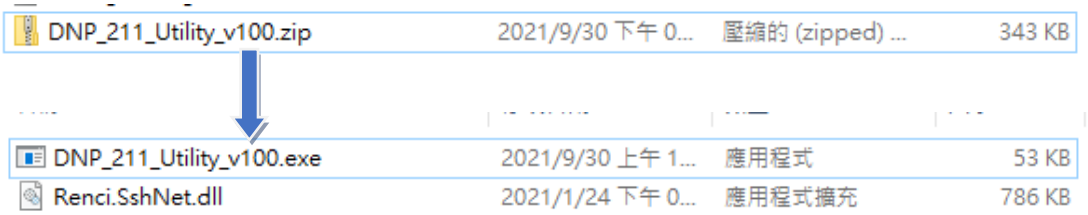
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3.3. DNP-211 Utility

3.3.1. Download DNP-211 Utility

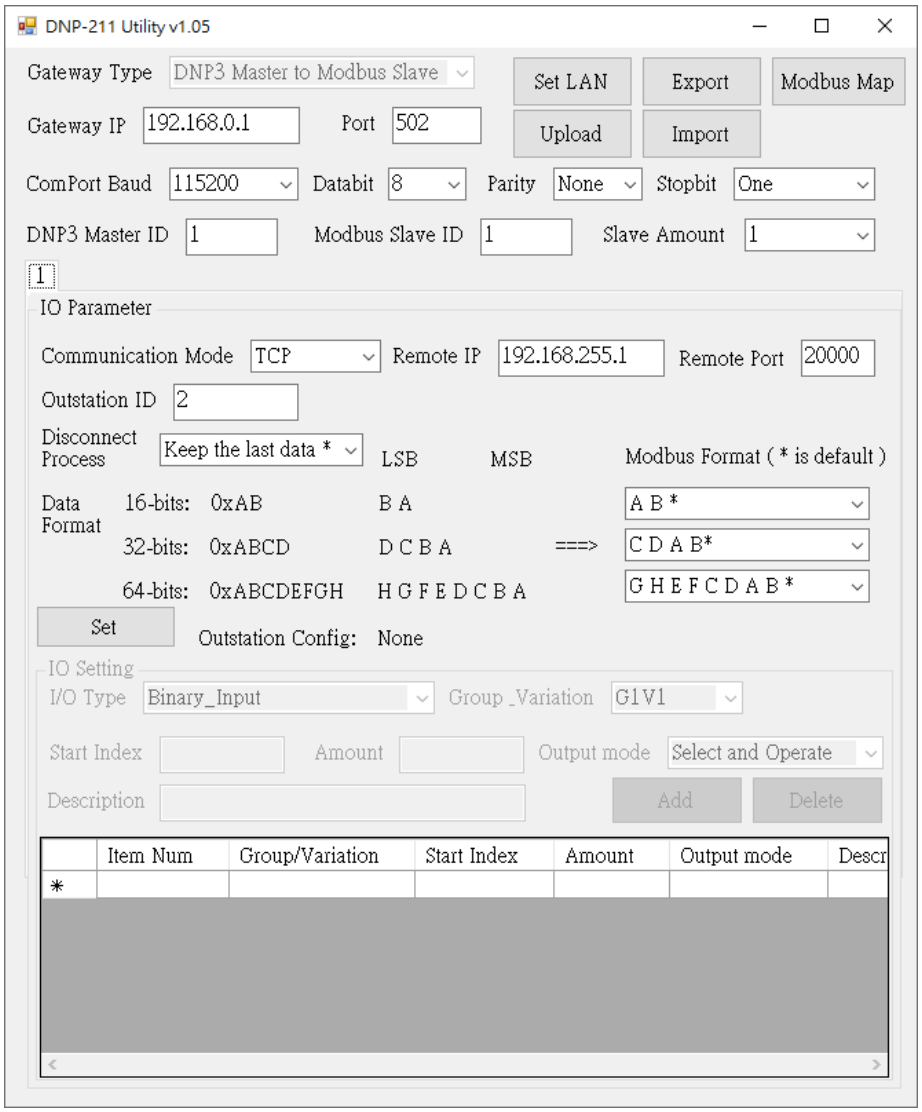
https://www.icpdas.com/en/download/show.php?num=8036&model=DNP-211

Download DNP_211_Utility_vxxx.zip file and extract it.



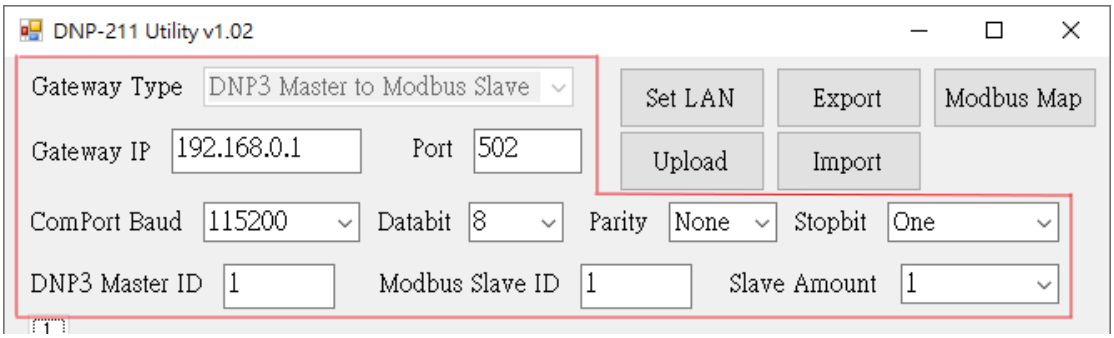
3.3.2. DNP-211 Utility Introduction

DNP-211 Utility is utility software for DNP-211 module to generate dedicated connection settings and I/O mapping table. After opening DNP_211_Utility, the screen is as follows:



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DNP-211 Communication Configure



Gateway Type: Display gateway type of the DNP-211.

Gateway IP: Modbus TCP IP address of the DNP-211 (*).

Port: Modbus TCP port of the DNP-211

ComPort Baud: Com port data baud rate of DNP3 side (ttyO2, 4, 5).

Databit: Com port data bit of DNP3 side (ttyO2, 4, 5).

Parity: Com port data parity of DNP3 side (ttyO2, 4, 5).

Stopbit: Com port data stop bit of DNP3 side (ttyO2, 4, 5).

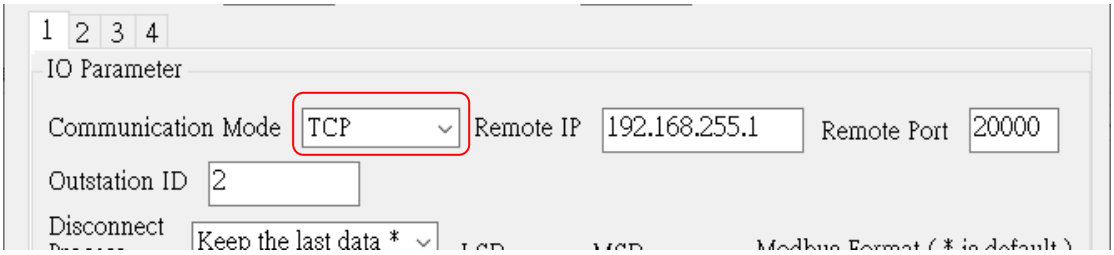
DNP3 Master ID: Master ID, cannot be the same as slave (0 ~ 65519).

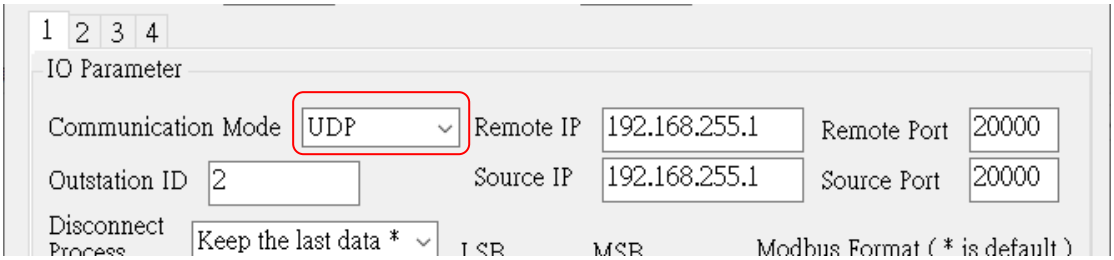
Modbus Slave ID: Modbus ID of the DNP-211 (0 ~ 255).

Slave Amount: Number of DNP3 slaves.

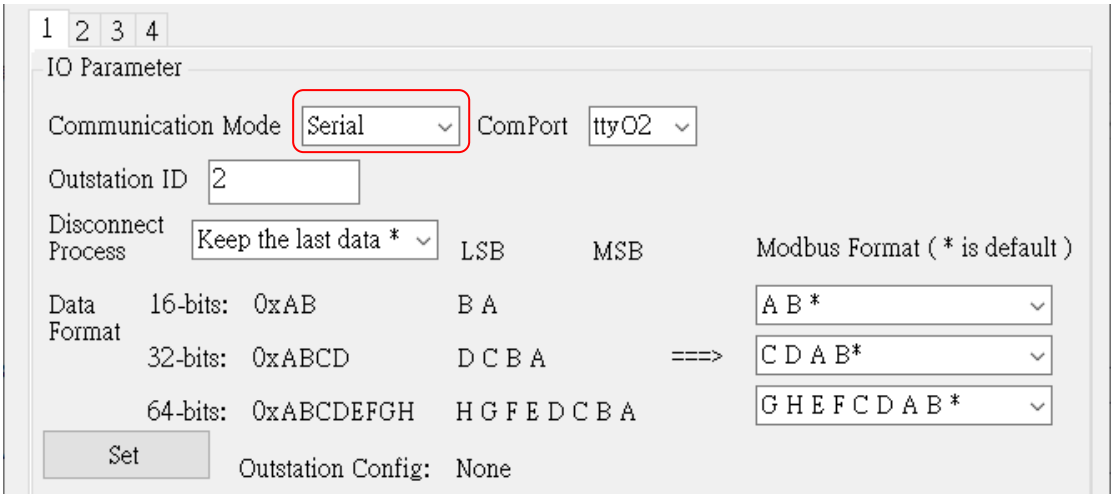
*** The IP setting here is only for the configuration file, it will not modify the IP of DNP-211. If you want to change the IP of DNP-211, you need to click the "Set LAN" button to change it.**

DNP3 Outstation Communication Configure





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Number tab: Select outstation

Communication Mode: Select connection mode (TCP, UDP, Serial)

TCP mode:

Remote IP, Remote Port: IP and port of target outstation.

UDP mode:

Remote IP, Remote Port: IP and port of target outstation.

Source IP, Source Port: IP and port of the DNP-211.

Serial mode:

ComPort: Select the Com port connected to outstation.

Outstation ID: DNP3 outstation ID (0~65519).

Disconnect Process: The data processing when DNP3 is disconnected, the default setting is to keep the last data value, and you can choose to clear the Modbus data to 0 after disconnection.

Data Format: Select the data format of Modbus Input Register and Holding Register, the affected data types are Control Relay Output Block onTime/offTime, bit16/bit32/float/double Analog Input, bit16/bit32/float/double Analog Output, and bit16/bit32 Counter as follows:

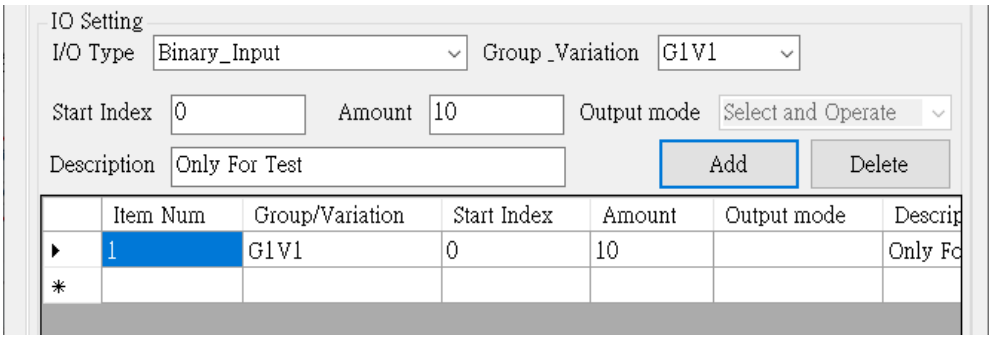
Hex Value	Format 0	Format 1	Format 2	Format 3
0x1122	11 22	22 11	--	--
0x11223344	33 44 11 22	44 33 22 11	22 11 44 33	11 22 33 44

Double Value (Hex)	0	7788556633441122	1	8877665544332211
0x1122334455667788	2	2211443366558877	3	1122334455667788

Set button: Set the connection parameter of the selected outstation.

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Outstation I/O Configure



I/O Type: Added I/O type of the slave (map with Group_Variation)

Group_Variation: Added I/O type of the slave (map with I/O Type)

Start Index: Added I/O start address at the DNP3 slave

Amount: Amount of the I/O item

Output mode: DO / AO output mode (only for write command)

Description: User’ s self-filled description

Utility Button

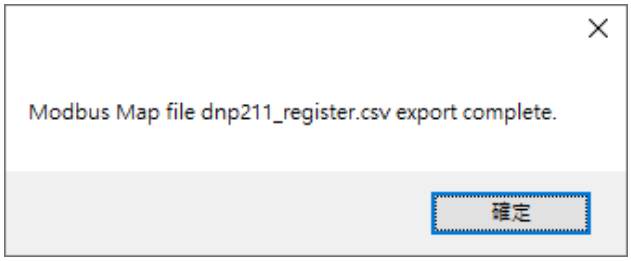


Set LAN: Configure the LAN1 and LAN2 IP Address of the DNP-211.

Import: Import the existing GatewayConfig.toml configuration file.

Export: Export the current settings to the GatewayConfig.toml.

Modbus Map: Generate a table of the currently configured Modbus address and DNP3 I/O correspondence.



Upload: Upload the GatewayConfig.toml configuration file or d2m_xxxxxxxx.tar.gz firmware file to DNP-211.

Note: After uploading the file and pressing the “OK” button, the DNP-211 will automatically reboot and update the settings or firmware. The reboot time is about 1 minute, please do not turn off the power during this period, otherwise the update will fail.

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3.4. DNP-211 Reader

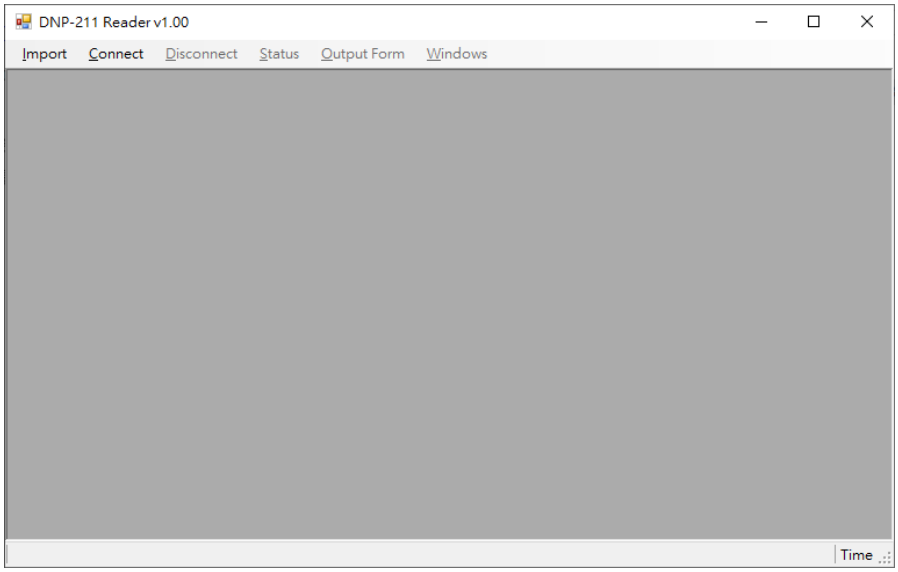
3.4.1. Download DNP-211 Reader

https://www.icpdas.com/en/download/show.php?num=8036&model=DNP-211

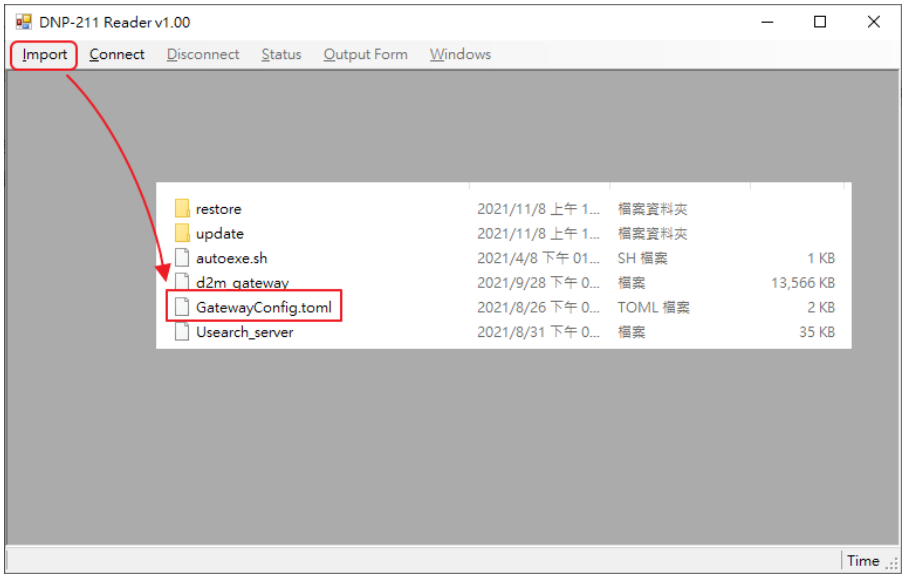
DNP-211_Reader_v100.exe 2021/7/28 下午 0... 應用程式 52 KB

3.4.2. DNP-211 Reader Introduction

DNP-211 Reader is a simple test utility for DNP-211 module. It can import the "toml" file produced by DNP-211 Utility and test the connection and I/O function. The dialog of DNP-211 Reader is as bellow:

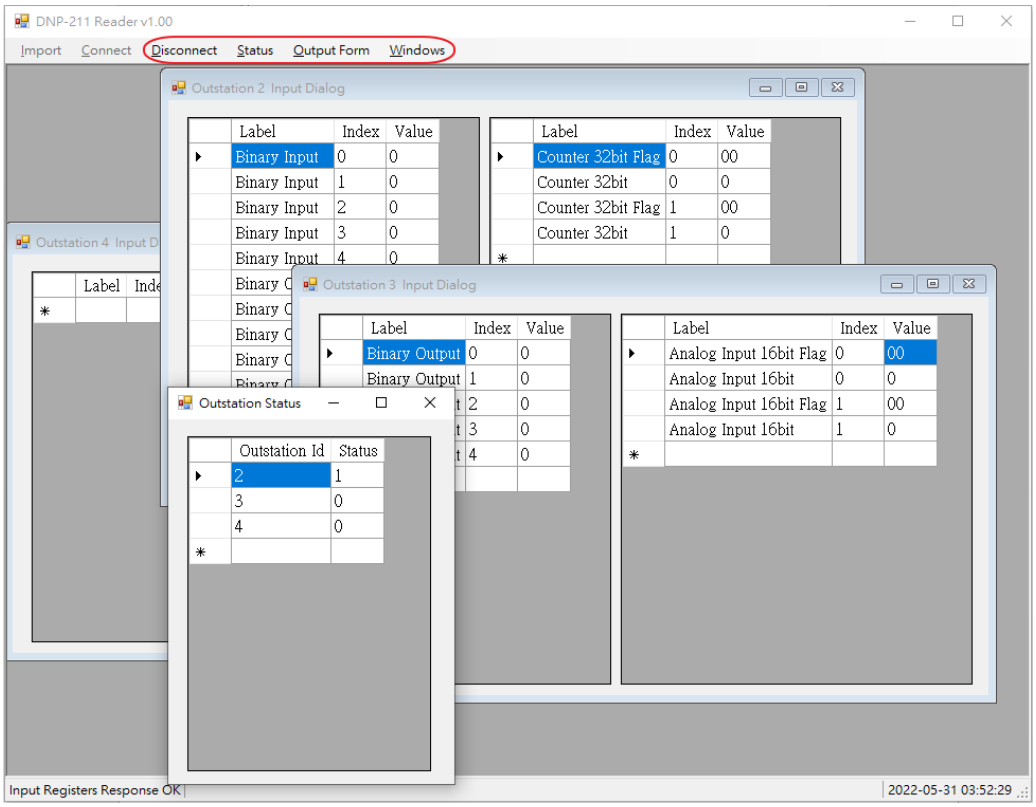


First clicked "Import" and selected the configuration file (.toml) produced by DNP-211 Utility to import.



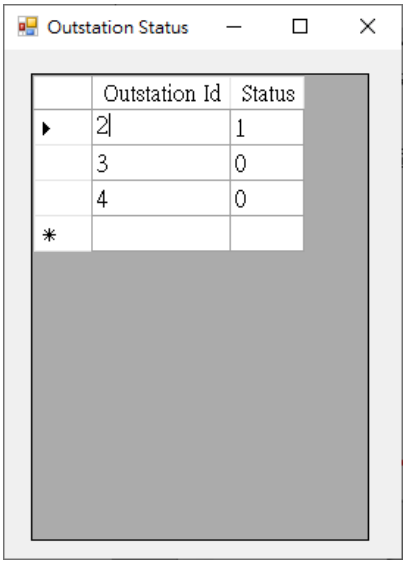
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After import the toml file, click “Connect” to connect with DNP-211 module. If successful, DNP-211 Reader will show as below.



Disconnect: Disconnect with PC and DNP-211.

Status: Connection status of all Outstations **(Modbus 30001 ~ 30032)**.



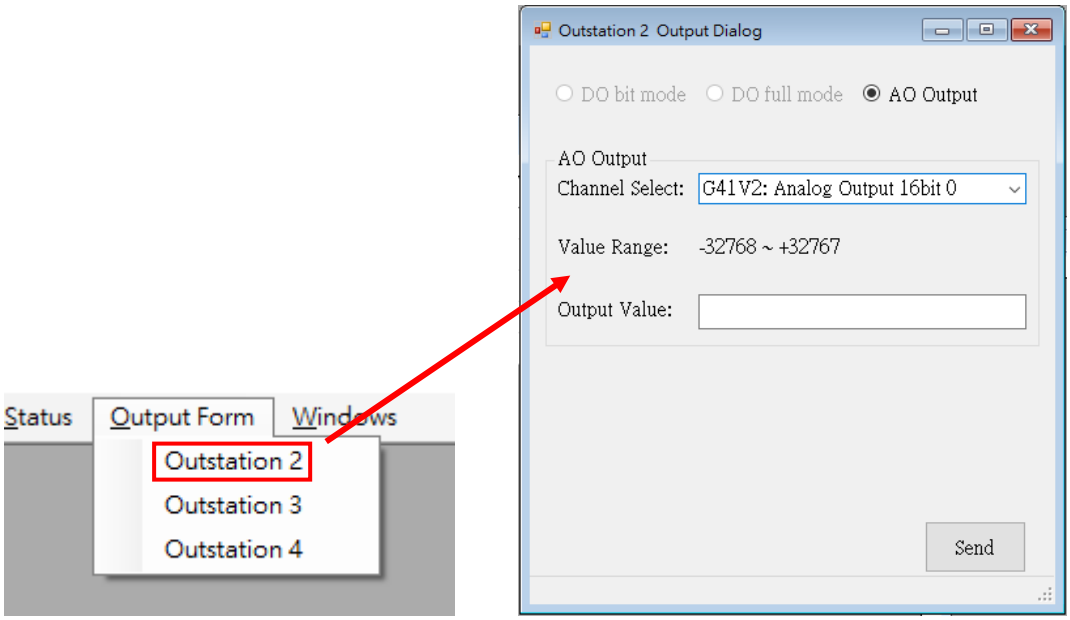
0: The setting of the DNP-211 not includes the Outstation.

1: The Outstation is waiting for connect.

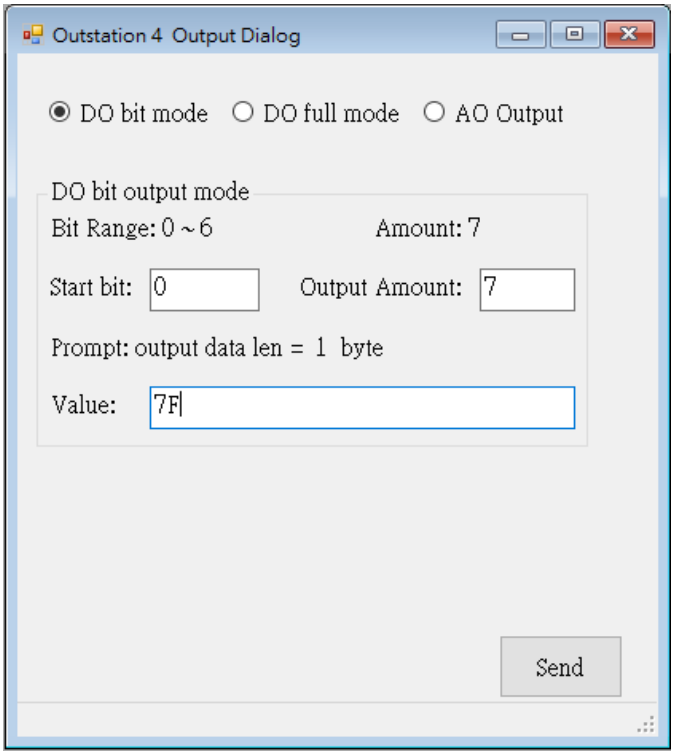
2: The Outstation is On-line.

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Output Form: Show the output dialog of every Outstation.



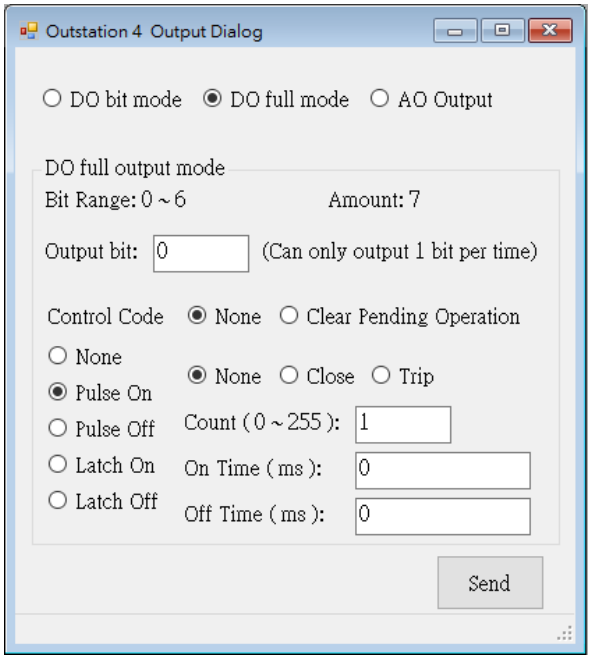
There are three output forms, DO bit, DO full and AO output.



DO bit mode:

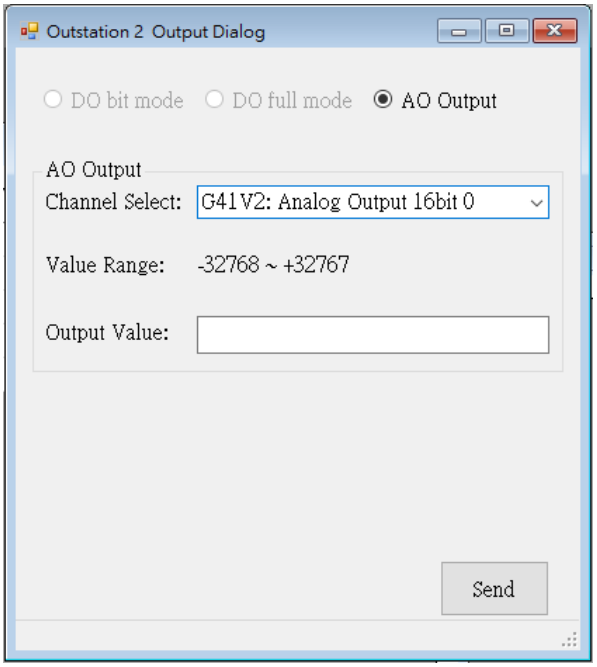
This mode can output several DO bits simply. As above, there are 7 DO points, bit0 ~ bit6. Fill the "Start bit" and "Output Amount" bits and input the output value (hex) such as 7F. Finally click "Send" to send the command, the "7F" command will let DO bit0 ~ bit6 all ON.

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DO full mode:

This mode can output only one DO bit will complex function as above. This interface only provides command options, as for the detailed description and support of each function, please refer to the instruction manual of the user’ s Outstation.

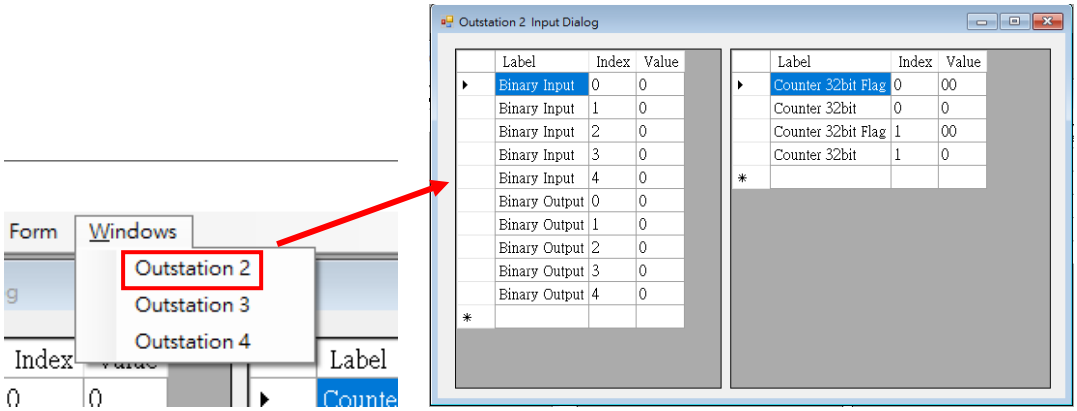


AO Output:

This mode can select AO channel to output. Fill in the decimal value to be output in the “Output Value” field, and finally press the “Send” button to output the command.

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Windows: Show input form of every Outstation.



Appendix A: Modbus Map

The Modbus Map function of DNP-211 Utility can export the mapping table of Modbus and DNP3 as below:

Register field: Modbus address, 0xxxx: DO, 1xxxx: DI, 3xxxx: AI, 4xxxx: AO

Slave field: DNP3 Outstation ID

Group field: I/O type of the Outstation

Variation field: Variation of the I/O type

Channel field: I/O channel number

Note: AI address is start from 30033, because 30001 ~ 30032 are the connection status of all Outstations.

	A	B	C	D	E	F
1	Register	Slave	Group	Variation	Channel	
2	10001	2	1	1	0	
3	10002	2	1	1	1	
4	10003	2	1	1	2	
5	10004	2	1	1	3	
6	10005	2	1	1	4	
7	10006	2	10	1	0	
8	10007	2	10	1	1	
9	10008	2	10	1	2	
10	10009	2	10	1	3	
11	10010	2	10	1	4	
12	30033	2	20	1	0	
13	30036	2	20	1	1	
14	40001	2	41	2	0	
15	40002	2	41	2	1	
16	40003	2	41	2	2	
17	10011	3	10	1	0	
18	10012	3	10	1	1	
19	10013	3	10	1	2	
20	10014	3	10	1	3	
21	10015	3	10	1	4	

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Appendix B: Mapping Rule

Function	Modbus		DNP3		Group
	Name	Data Type	Name	Data Type	
Binary Output	Coil	bit	Control Relay Output Block (CROB)	bit	12
Analog Output	Holding Register	16-bit integer	Analog Output	16 / 32 bit integer 32 / 64 bit float	41
			Control Relay Output Block (CROB)	5 words	12
Binary Input	Discrete Input	bit	Binary Input	bit	1
			CROB	bit	10
Analog Input	Input Register	16-bit integer	Analog Input	16 / 32 bit integer 32 / 64 bit float	30
			Analog Output	16 / 32 bit integer 32 / 64 bit float	40
			Binary Input with flag	16-bit integer	1
			CROB with flag	16-bit integer	10
Counter Input	Input Register	16-bit integer	Counter Input	16 / 32 bit integer	20
DNP3 Connection	Input Register	16-bit integer	Slave Status	16-bit integer	None

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