User Manual

Version 1.0.0 Dec. 2018

GRP-540M-NB

NB-IoT Gateway



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Contact us

If you encounter any problems while operating this device, feel free to contact us via mail at: service@icpdas.com. We guarantee to respond within 2 working days.

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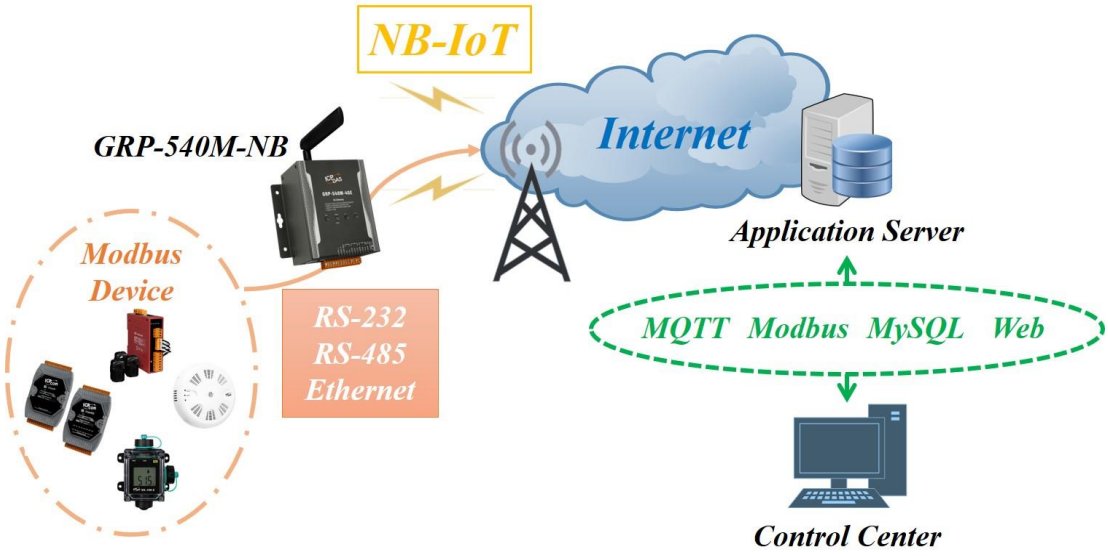
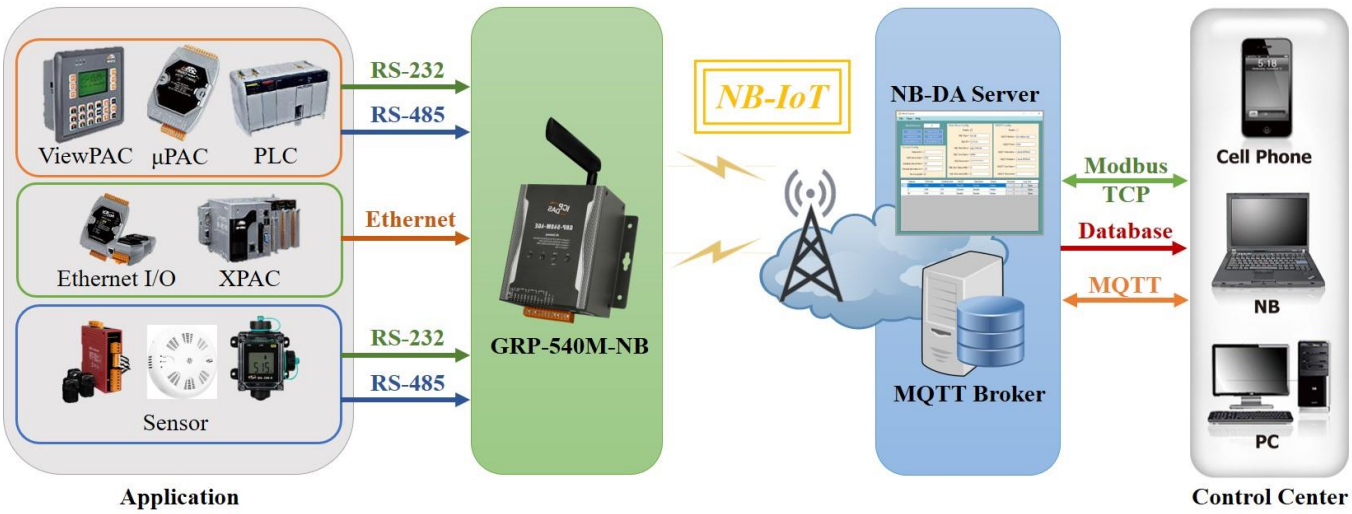
1. Introduction



The GRP-540M-NB provided by ICP DAS is a NB-IoT gateway for Ethernet and serial port. It can be used in M2M application fields to transfer the remote I/O or Modbus data via NB-IoT. Within the high performance CPU, the GRP-540M-NB can handle a large of data and are suited for the hard industrial environment. When connecting with NB-DA Server or MQTT Broker, the user can also control the devices which connected to GRP-540M-NB from the remote control center.



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1.1 Features

- Support NB-IoT
- 10/100 Base-TX compatible Ethernet controller
- COM port: COM1 (3-wire RS232), COM2 (3-wire RS232), COM3 (RS-485)
- GPS: 32 channels with All-In-View tracking
- Support Modbus RTU/TCP
- Support MQTT
- Support Micro SD card
- High reliability in harsh environments
- DIN-Rail mountable

1.2 Applications

- Home/Factory security
- Energy Management
- Temperature Monitoring

Application 1: Data Collector



Application 2: Remote Control



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2. Hardware

2.1 Specifications

Item	GRP-540M-NB
Software	
Gateway Function	Ethernet and Serial port (RS-232 x1, RS-485 x1) to NB-IoT
Embedded service	Web Server, NB-IoT Gateway
System	
CPU	ARM CPU
EEPROM	16 KB (Data Retention: 40 years; 1,000,000 erase/write cycles)
Expansion Flash Memory	SD Card (Max. 32GB SDHC)
RTC(Real Time Clock)	Provide seconds, minutes, hours, day of week/month, month and year
64-bit Hardware Serial Number	Yes
Watchdog Timer	Yes
LED Indicator	4 LEDs (RUN/PWR, NB-IoT, L1, L2)
Rotary Switch	Yes (0~9)
NB-IoT System	
Frequency Band	LTE NB-IoT B1, B3, B5, B8, B20, B28
GPS System	
Support Channels	32
Protocol Support	NMEA 0183
Comm. Interface	
Ethernet	RJ-45, 10/100 Base-TX (Auto-negotiating, Auto MDI/MDI-X, LED indicators)
COM1	RS-232 (RxD, TxD and GND); Non-isolated(Console, Debug)
COM2	RS-232 (RxD, TxD and GND); Non-isolated
COM3	RS-485 (D2+, D2-); 3000 VDC isolated
CAN	CAN Bus (CAN_H, CAN_L)
Mechanism	
Casing	Metal
Dimensions(W x L x H)	117 mm x 126 mm x 58 mm (W x L x H)
Installation	DIN-Rail / Screw
Power	
Protection	Power reverse polarity protection

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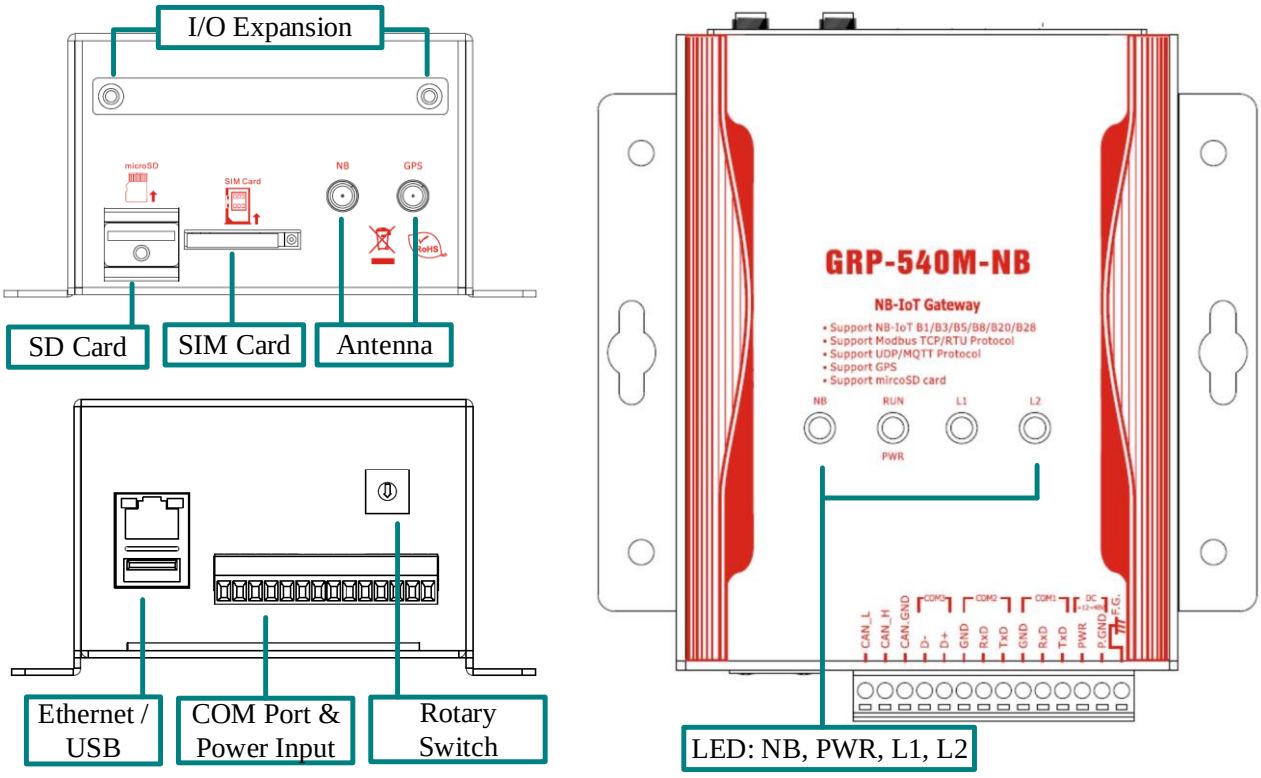
Frame Ground Protection	ESD, Surge, EFT, Hi-Pot
Required Supply Voltage	+10 V_{DC} ~ +48 V_{DC}
Power Consumption	4.8W (200 mA @ 24 V_{DC})
Environment	
Operation Temp	-25℃ to 75℃
Storage Temp	-30℃ to 80℃
Humidity	5~95% non-condensing

2.2 Appearance and pin assignments



COM Port & Power Input		
Terminal No.		Pin Assignment
Power	14	F.G.
	13	P.GND
	12	PWR
COM1	11	TxD1
	10	RxD1
	09	GND

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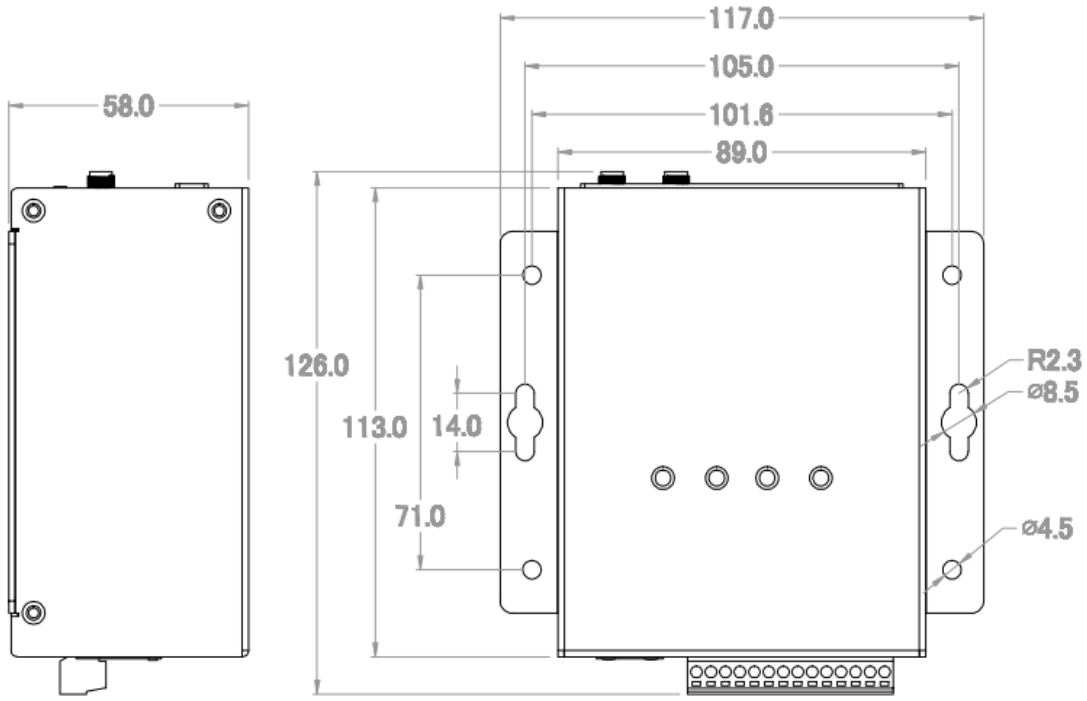
COM2	08	TxD2
	07	RxD2
	06	GND
COM3	05	D+
	04	D-
CAN	03	CAN.GND
	02	CAN_H
	01	CAN_L

2.3 Dimensions



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2.4 LED indicators

There are three LED indicators to help users to judge the various conditions of device. The description is as follows:

A. PWR(Green): Power LED to indicate whether the external power is input or not. The description is as follows:

The external power is active	The external power is not active
on	off

B. RUN(Red): RUN LED indicates if the OS is normal or fail.

Normal	Fail
Heart beat (1 sec.)	Always ON or OFF

C. L1(Green/Red): this Led indicates the status of NB-IoT Client.

Normal	Fail
500ms ON / 500ms OFF	Always ON or OFF

D. L2(Green/Red): reserve.

E. NB-IoT (Green): The LED indicates the status of NB-IoT module.
(the NB-IoT module need about 60 seconds to register network usually)

Registered	NB-IoT data transmit	Not Register
333ms ON / 3000ms OFF	50ms ON, 50ms OFF	500ms ON / 500ms OFF

2.5 Rotary Switch

There are some functions of rotary switch. The description is as follows:

A. 0: Normal mode, default position.

B. 9: Factory default IP. If you set as 9, and then reset the device, its Ethernet IP will be “192.168.255.1”. If you forgot your device IP, you can use this function to re-configure your device IP.

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2.6 Installing Device

Before using, please follow these steps to install the device below:

A. Install the antenna.

B. Plug in the normal SIM card.

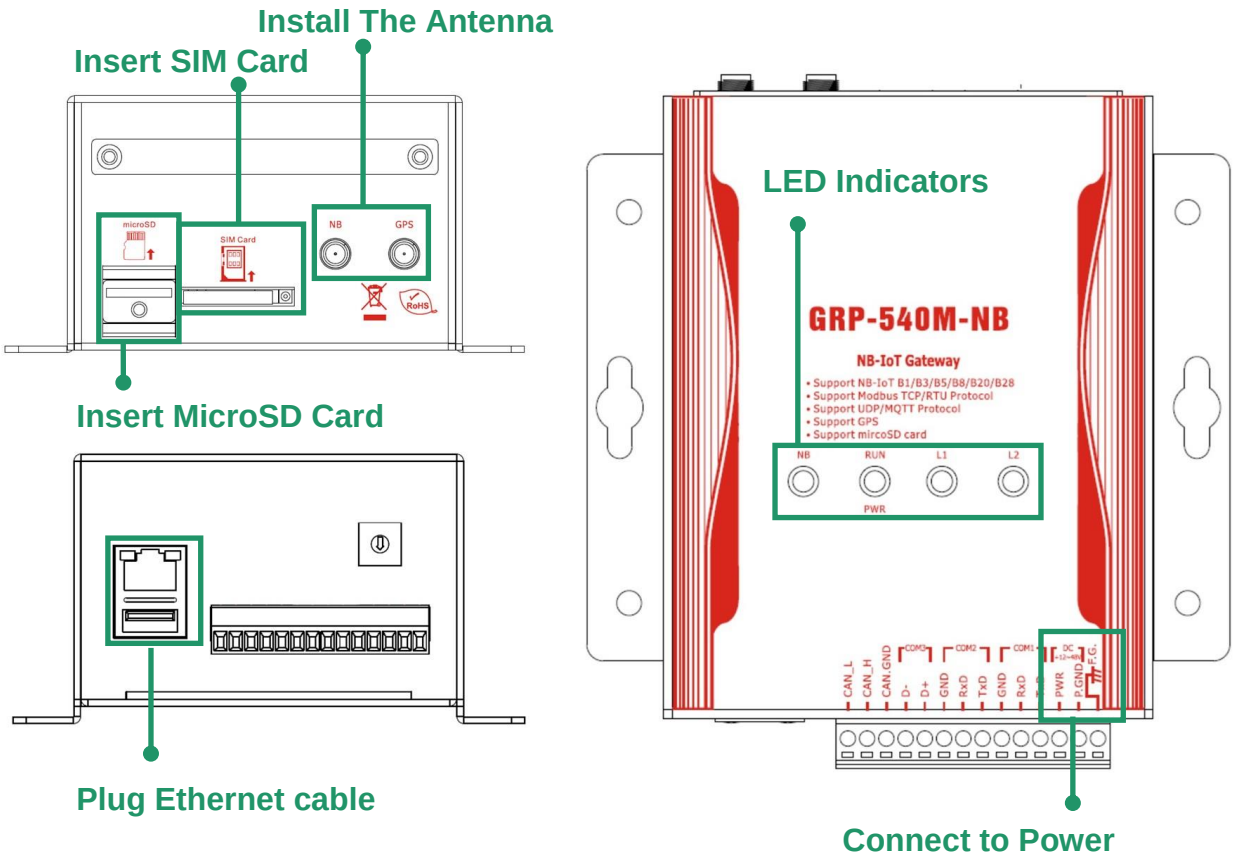
C. Plug the Ethernet cable if you need it.

D. If you want to use the Micro SD card, please insert it into the slot.

E. Connect the DC.+VS and DC.GND to the power supply.

F. Need to wait about 20 ~ 30 seconds for OS booting. After finishing the process, GRP-540M-NB would be in normal operation mode and the OS LED would blank as heart beat per 1 sec.

G. It is needed to wait about 30 ~ 60 seconds to search the NB-IoT base and register to the ISP. After finishing the process, the NB-IoT LED would blank per 3.333 secs.



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3. Web Utility

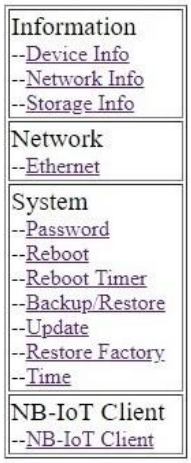
You must configure the device from web utility before using.

3.1 Login the Utility

Please login before you use the web utility. The default username is “admin”, and the default password is “admin”.

- Default IP = “192.168.255.1”
- Default Mask = “255.255.0.0”
- After login, the screenshot is showed as below:





Ethernet	
Mode	static
MAC address	44:ea:d8:9e:fe:e0
IP Address	192.168.255.1
Mask	255.255.0.0

Modem information (update when sending message)	
NB-IoT Status	NB-IoT Client enable
Register Status	Registered
Signal Quality	75%

GPS information	
GPS Status	GPS is not ready
GPS Data	$GPRMC,,V,,,,,,,,,,N*53

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3.2 Information

The user can get the basic information of the device here.

3.2.1 Device Information

This page provides basic device information:

Device Information	
Serial Number	D31893A10000
Kernel Version	3.2.14
Firmware Version	GRP-540M-NB_V1.0.0_20181010

(1) Product Name: the Name of your product.

(2) Serial Number: only one number of ICPDAS product.

(3) OS Kernel Version: Linux kernel version.

3.2.2 Network Information

This page provides basic network information:

Ethernet	
Mode	static
MAC address	44:ea:d8:9e:fe:e0
IP Address	192.168.255.1
Mask	255.255.0.0

Modem information (update when sending message)	
NB-IoT Status	NB-IoT Client enable
Register Status	Registered
Signal Quality	75%

GPS information	
GPS Status	GPS is not ready
GPS Data	$GPRMC,,V,,,,,,,,,,N*53

(1) Ethernet: Ethernet information

- Mode: static IP.

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- MAC address: a unique identifier assigned to network interfaces.
- IP Address: a computer's address under the Internet Protocol.
- Mask: Mask will be provided from Gateway provider.

(2) Modem information:

- IMEI: IMEI number of NB-IoT module.
- PIN Code: the status of PIN Code. Please refer to below:
  - ■ READY: PIN Code is ready.
  - ■ SIM PIN: need PIN code of SIM card.
  - ■ SIM PUK: need PUK code of SIM card.
  - ■ SIM failure: Access SIM Card failure.
- Register Status: Indicating machine connect to mobile network successful or not.
- Signal Quality: the NB-IoT signal quality.

Modem information will update frequently if NB-IoT client function not enable. If NB-IoT client function enable, Modem information only updates when sending message.

3.2.3 Storage Information

This page provides information about “Micro SD card”, “USB Disk”:

USB Disk	
Size	3936220 KB
used	2584 KB
Available	3933636 KB
Path (Mount Point)	/media/usbhd-sda1

Micro SD Card	
Size	31154688 KB
used	25344 KB
Available	31129344 KB
Path (Mount Point)	/media/mmcblk0p1

(1) USB Disk / SD card:

- Size: total size of storage.
- used: the size is used.
- Available: free space in the storage.
- Path: the mount point in file system.

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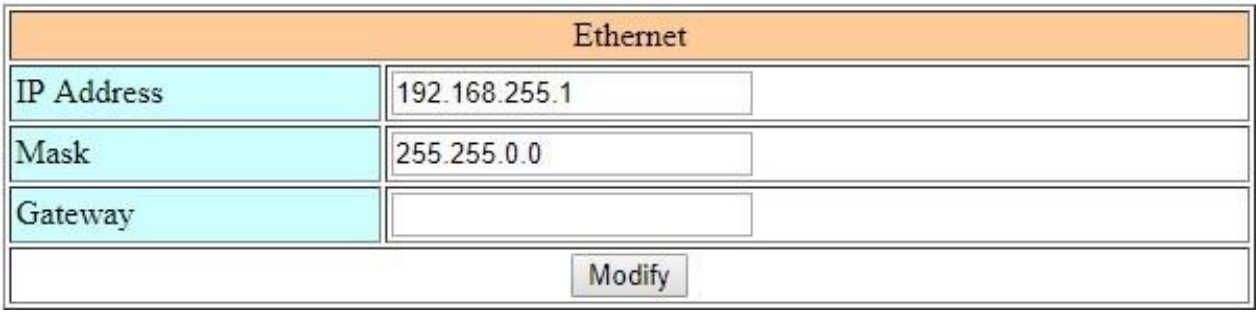
3.3 Network

The user can configure the Network functions here.

3.3.1 Ethernet

This page provides the basic settings of Ethernet:



(1) IP Address: IP of Ethernet.

(2) Mask: the Mask of the gateway.

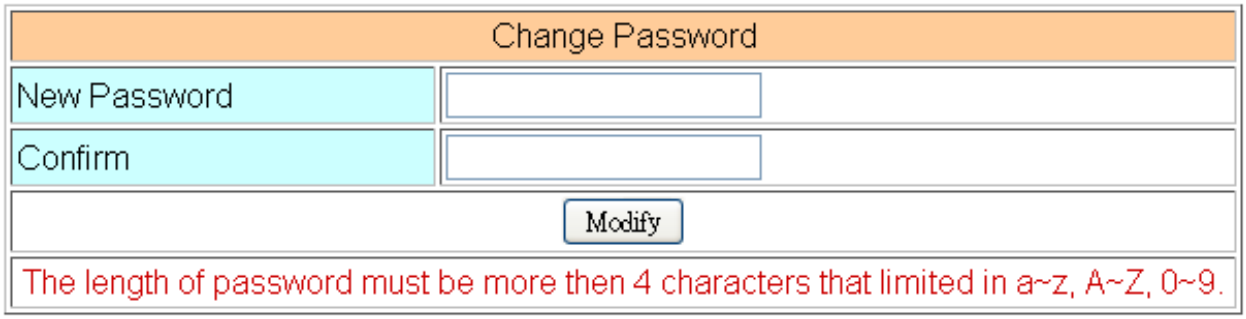
(3) Gateway: IP of the gateway.

3.4 System

The user can configure password, system parameter, reboot device and restore factory settings here.

3.4.1 Password

The user can change the password of the web utility here.



(1) Password: new password.

(2) Confirm: confirm the password again.

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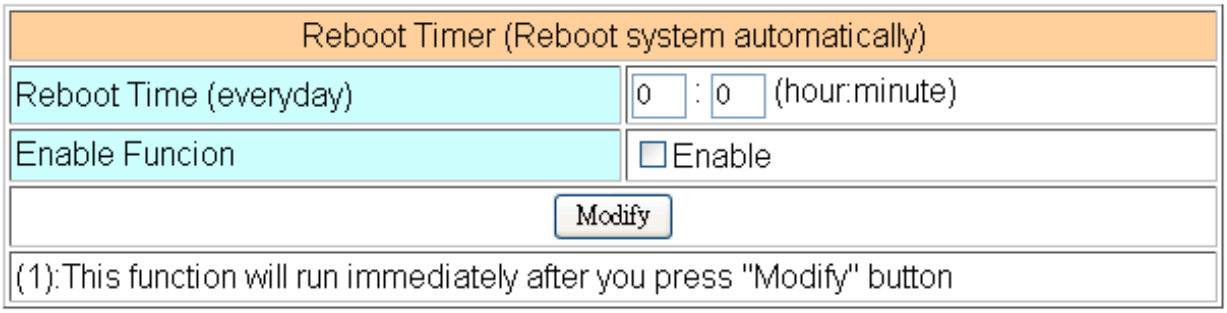
3.4.2 Reboot

The user can reboot the device here.



3.4.3 Reboot Timer

The user can use this function to reboot system automatically.

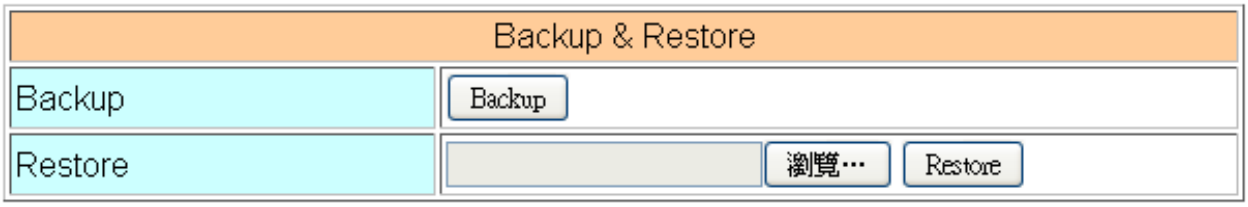


(1) Reboot Time (everyday): the time for rebooting system.

(2) Enable: Enable Reboot Timer function.

3.4.4 Backup & Restore

The user can backup the device settings and restore it here.



(1) Backup: Press “Backup” button to backup settings into your PC.

(2) Restore: Press “Browse” button to select file, and then press “Restore” button to store your settings.

3.4.5 Update

The user can update the device’s firmware by themselves. Need to go to the product page and download the update file (updateFile.tarc). Must put the update file into SD card and backup your config before update.

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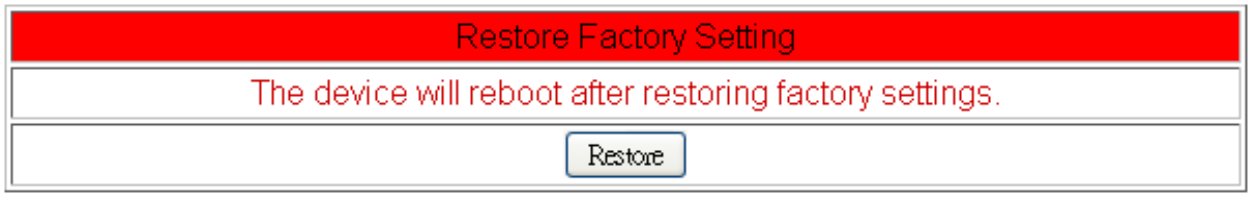
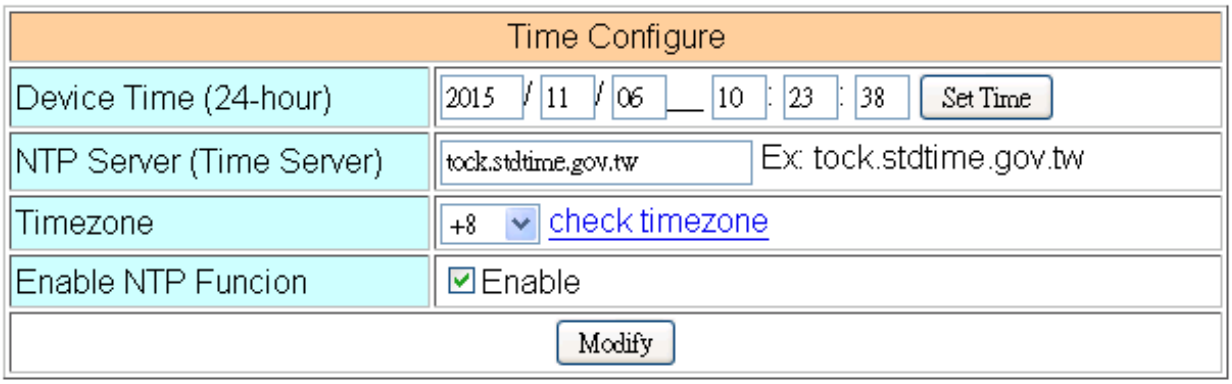
3.4.6 Restore Factory

The user can restore the device setting to factory default.



3.4.7 Time

This page provide information about the time of the device.



(1) Set Time: set the time of device the same as your computer.

(2) NTP Server: device will connect to the NTP Server to synchronize time.

(3) Timezone: if you don't know your timezone, please click the link “check timezone” to find out.

(4) Enable NTP Function: if you enable it, the device will update time automatically.

(NTP function will work only when Ethernet can go through Internet)

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3.5 NB-IoT Client

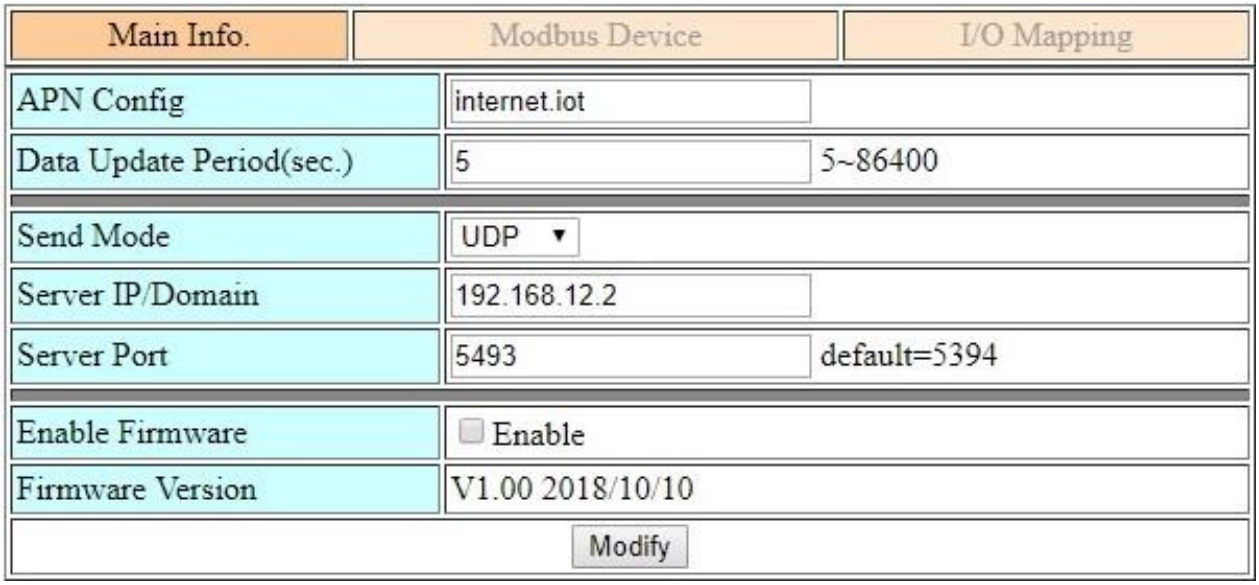
The user can configure NB-IoT Client function here. The NB-IoT Client function will connect to NB-DA Server or MQTT Broker, please refer the website for more information.

3.5.1 NB-IoT Client

The user can configure NB-IoT Client firmware function here. There are three tabs:

(1) Main Info. (2) Modbus Device (3) I/O Mapping

■ **Main Info. Tab (UDP Mode with SMS4 security):**



(1) APN Config: Access Point Name, please ask your SIM Card provider.

(2) Data Update Period (sec.): set report time interval. The device will report all data to NB-DA Server or MQTT Broker every time.

(3) Send Mode: can choose UDP or MQTT.

(4) Server IP/Domain: the IP Address or Domain Name of NB-DA Server.

(5) Server Port: the port of the server.

(6) Enable Function: enable the NB-IoT Client function.

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■ **Main Info. Tab (MQTT Mode):**

Main Info.	Modbus Device	I/O Mapping
APN Config	internet.iot	
Data Update Period(sec.)	5	5~86400
Send Mode	MQTT ▼	
Server IP/Domain	iot.eclipse.org	
Server Port	1883	default=1883
Buffer Size	512	default=512
Keep Alive	1000	default=1000, 0~65535
MQTT Version	3	default=3, can set 3 or 4
User Name		if have user name
Password		if have password
Subscribe DO	.cloud.ICPDAS.USER/0/0/D(	
Subscribe AO	.cloud.ICPDAS.USER/0/0/A(	
Publish DEVINFO	.cloud.ICPDAS.UE/0/0/DEVI	
Publish DI	.cloud.ICPDAS.UE/0/0/DI	
Publish AI	.cloud.ICPDAS.UE/0/0/AI	
Publish GPS	.cloud.ICPDAS.UE/0/0/GPS	
Publish ACK	.cloud.ICPDAS.UE/0/0/ACK	ACK for DO/AO
Use CHT platform	☐ Enable	
CHT Device ID		if use CHT platform
CHT Sensor ID		if use CHT platform
Enable Firmware	☐ Enable	
Firmware Version	V1.00 2018/10/10	
Modify		

(1) APN Config: Access Point Name, please ask your SIM Card provider.

(2) Data Update Period (sec.): set report time interval. The device will report all data to NB-DA Server or MQTT Broker every time.

(3) Send Mode: can choose UDP or MQTT.

(4) Server IP/Domain: the IP Address or Domain Name of MQTT Broker.

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(5) Server Port: the port of the MQTT Broker. (default MQTT port is 1883)

(6) Buffer Size: the buffer which is used to save the MQTT message. (include Topic and Data)

(7) Keep Alive: the peroid of MQTT's PINGREQ message.

(8) MQTT Version: set the MQTT version that will be used.

(9) User Name: the user name for MQTT connection. (if have user name)

(10) Password: the password for MQTT connection. (if have password)

(11) Subscribe DO: the MQTT topic which will be used for receiving DO message.

(12) Subscribe AO: the MQTT topic which will be used for receiving AO message.

(13) Publish DEVINFO: the MQTT topic which will be used for sending DEVINFO message.

(14) Publish DI: the MQTT topic which will be used for sending DI message.

(15) Publish AI: the MQTT topic which will be used for sending AI message.

(16) Publish GPS: the MQTT topic which will be used for sending GPS message. (GPRMC format)

(17) Publish ACK: the MQTT topic which will be used for responding ACK when received DO or AO message.

(18) Use CHT platform: enable if using CHT IoT Platform. (also need to set User Name, Password)

(19) CHT Device ID: set the Device ID which gets from CHT IoT Platform.

(20) CHT Sensor ID: set the Sensor ID which gets from CHT IoT Platform.

(21) Enable Function: enable the NB-IoT Client function.

MQTT Message Format:

- Message format for normal MQTT Broker:

Topic	for subscribe or publish, DEVINFO/GPS/DO/DI/AO/AI/ACK can use different topic
Data	all message types have different data format

- Message format for CHT Platform:

Topic	for subscribe or publish, the topic is defined by CHT Platform, DEVINFO/GPS/DO/DI/AO/AI/ACK can use different topic
Data	JSON format (define by CHT Platform, include time, Device ID, Sensor ID and data), all message types have different data format, DO/DI/AO/AI data will be "**Session ID/Type/Data**". ◆**Session ID：0~1999** ◆**Type: DO/DI/AO/AI**

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- Data Type:

Type	Application	Data	Data example
DEVINFO	Publish	RSRP, ECL, SNR, Battery level	-80,0,16,0
GPS	Publish	$GPRMC data of NMEA 0183 protocol	$GPRMC:083559.00:A:4717:11437:N:00833:91522:E:0.004:77.52:091202:::A*57
DO	Subscribe (data is published by user.)	1 byte for every DO, max data length 32, hex format	00010001000100010001000100010001000100010001 If using CHT Platform: 0/DO/00010001000100010001000100010001000100010001
DI	Publish	1 byte for every DI, max data length 32, hex format	00010001000100010001000100010001000100010001 If using CHT Platform, same as DO.
AO	Subscribe (data is published by user.)	2 bytes for every AO, max data length 32, hex format	00000001000200030004000500060007000800090020002100220023002400250026002700280029 If using CHT Platform, same as DO.
AI	Publish	2 bytes for every AI, max data length 32, hex format	00000001000200030004000500060007000800090010001100120013001400150016001700180019 If using CHT Platform, same as DO.
ACK	Publish	If received DO/AO, publish DO_ACK or AO_ACK.	DO_ACK

- DEVINFO data:

Data Type	Data Range
RSRP	-140 ~ -44 dBm
ECL	0 ~ 2
SNR	-20 ~ 30 dB
Battery level	0 ~ 100 %

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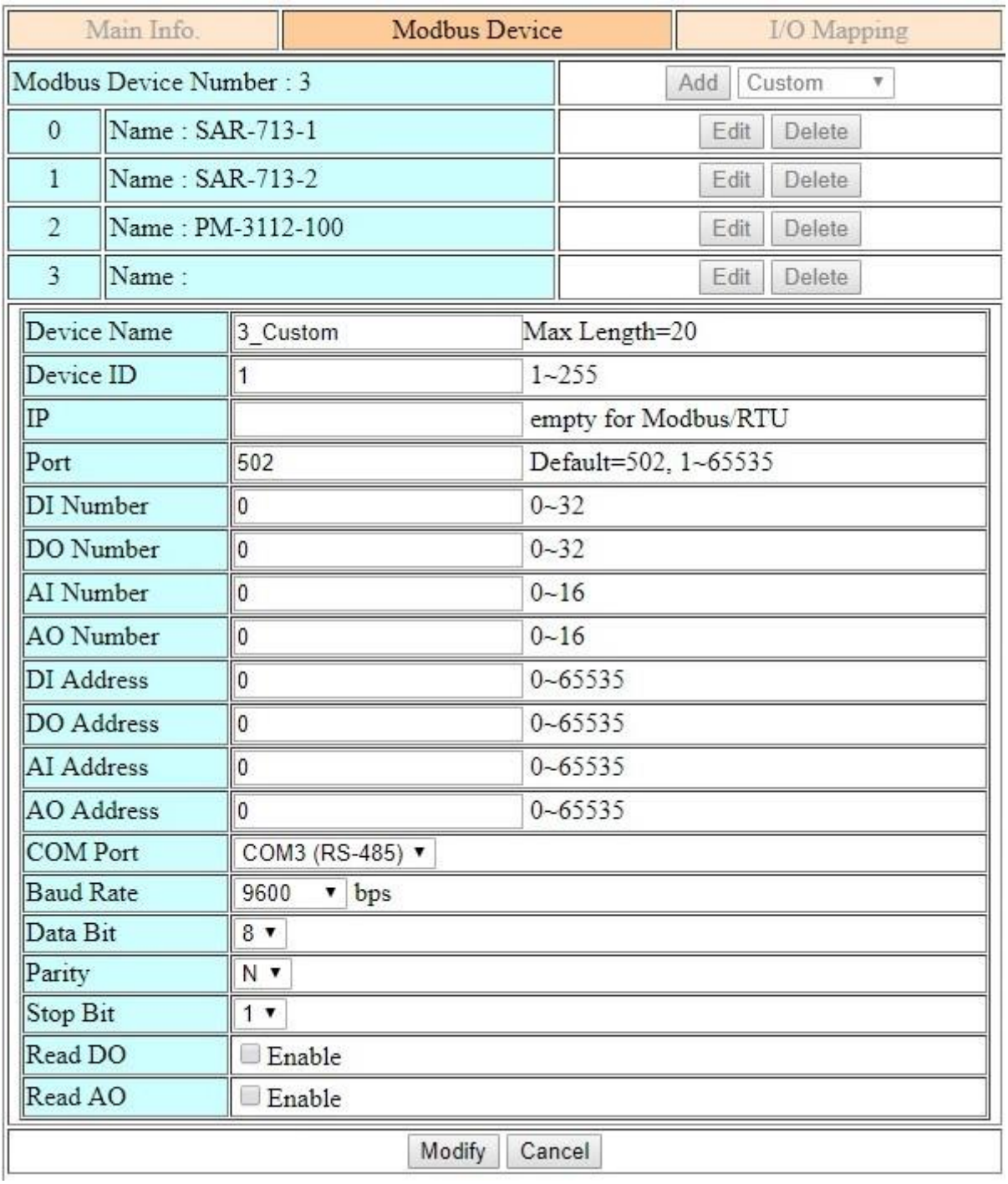
■ **Modbus Device: the interface for adding Modbus I/O device.**



(1) Modbus Device Number: display the Modbus device number here. You can choose a model in the list, and then use the "Add" button to add a new Modbus device.

(2) Device Name: the name of the Modbus device.

(3) Device ID: the Modbus ID.

(4) IP: the IP of Modbus/TCP device. Keep it empty if using Modbus/RTU device.

(5) Port: the Port number of Modbus/TCP device.

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(6) DI Number: the number of DI channel.

(7) DO Number: the number of DO channel.

(8) AI number: the number of AI channel.

(9) AO number: the number of AO channel.

(10) DI Address: the start address for reading DI value.

(11) DO Address: the start address for reading DO value.

(12) AI Address: the start address for reading AI value.

(13) AO Address: the start address for reading AO value.

(14) COM Port: can choose “COM2 (RS-232)” or “COM3 (RS-485)”.

(15) Baud Rate: the baud rate of RS-485 or RS-232.

(Notice that must set same Baud Rate for all RS-485 devices)

(16) Data Bit: the data bit of RS-485 or RS-232.

(17) Parity: the parity bit of RS-485 or RS-232.

(18) Stop Bit: the stop bit of RS-485 or RS-232.

(19) Read DO: enable if this device's DO is output data to GRP-540M-NB.

(This will let DO data combine with this device's DI data, and DO will continue after DI)

(20) Read AO: enable if this device's AO is output data to GRP-540M-NB.

(This will let AO data combine with this device's AI data, and AO will continue after AI)

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■ **I/O Mapping:**

Main Info. | Modbus Device | I/O Mapping

Session ID	0 0~1999
Auto Mapping	☑ Enable

DO	DO01	DO02	DO03	DO04	DO05	DO06	DO07	DO08
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
	DO09	DO10	DO11	DO12	DO13	DO14	DO15	DO16
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
	DO17	DO18	DO19	DO20	DO21	DO22	DO23	DO24
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
	DO25	DO26	DO27	DO28	DO29	DO30	DO31	DO32
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
DI	DI01	DI02	DI03	DI04	DI05	DI06	DI07	DI08
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
	DI09	DI10	DI11	DI12	DI13	DI14	DI15	DI16
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
	DI17	DI18	DI19	DI20	DI21	DI22	DI23	DI24
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
	DI25	DI26	DI27	DI28	DI29	DI30	DI31	DI32
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
AO	AO01	AO02	AO03	AO04	AO05	AO06	AO07	AO08
	1-1	2-1	0-0	0-0	0-0	0-0	0-0	0-0
	AO09	AO10	AO11	AO12	AO13	AO14	AO15	AO16
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
	AO17	AO18	AO19	AO20	AO21	AO22	AO23	AO24
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
	AO25	AO26	AO27	AO28	AO29	AO30	AO31	AO32
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
AI	AI01	AI02	AI03	AI04	AI05	AI06	AI07	AI08
	1-1	2-1	3-1	3-2	3-3	3-4	0-0	0-0
	AI09	AI10	AI11	AI12	AI13	AI14	AI15	AI16
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
	AI17	AI18	AI19	AI20	AI21	AI22	AI23	AI24
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
	AI25	AI26	AI27	AI28	AI29	AI30	AI31	AI32
	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0

Modify

1. Please enter all device's I/O to the mapping table.
2. The valuable I/O positions must be continuous.
3. format example:
   The 1st Device's 2nd DO is "1-2".
   You can enter "1-2" into the DO position.

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(1) Session ID: the ID which used to identify this GRP-540M-NB device.

(2) Auto Mapping: this will check all Modbus devices and auto mapping all I/O.

(3) DO/DI/AO/AI mapping table:

The mapping format is "**[Device Number]**-**[I/O Number]**".

- Device Number: the number of Modbus devices in "Modbus Device" page. (start from 1)
  (ex: the config of **Modbus Device Number 0** is the **1st** Modbus device)
- I/O Number: the number of this Modbus device's I/O. (start from 1)

NOTICE: If enabled "Read DO" or "Read AO", in addition to DO/AO's mapping table, also need to set these DO/AO to DI/AI's mapping table.

Example*:*

If the **1st Modbus Device** (the config of **Modbus Device Number 0** in "Modbus Device" page) have 2 AI and 5 AO, in addition to the "1-1" and "1-2" for AI, also need to set "1-3", "1-4", "1-5", "1-6", and "1-7" in AI table (for enable Read AO). In this case, the GRP-540M-NB will send DEVINFO, AO, AI (with 7 values--2 AI and 5 AO), and GPS messages.

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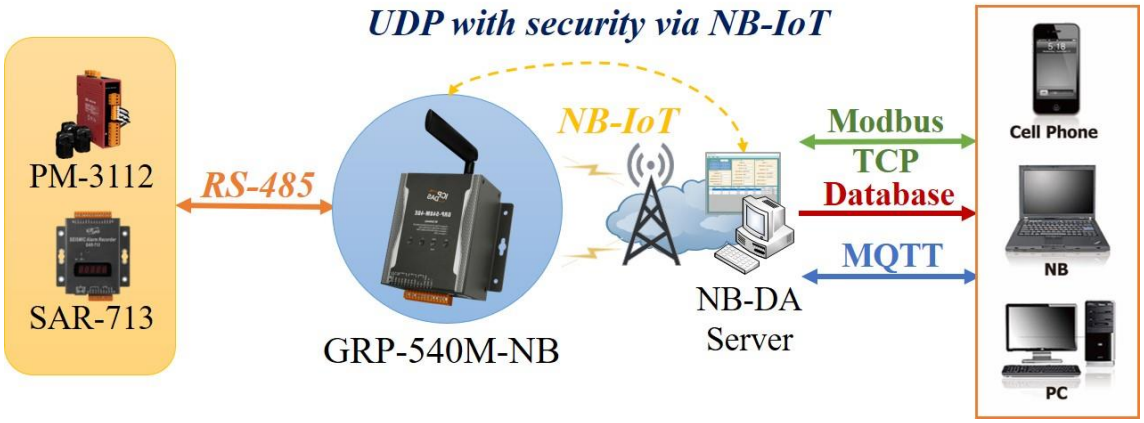
4. Example

4.1 Data Collection and Remote Control (NB-DA Server)

This example shows data collection and remote control application via NB-DA Server.
There are PM-3112 and SAR-713 in this system.



(1) Please connect your device (PM-3112 and SAR-713) to serial port of GRP-540M-NB. Baud Rate of these devices is 115200 bps, data format is 8N1 (Data bits, Parity, Stop bits). (Must attention that Baud Rate of all Modbus devices must set same value when using RS-485)

(2) If you never use NB-DA Server, please refer to NB-DA Server's website.

(3) Add devices in “Modbus Device” tab.

Main Info.	Modbus Device	I/O Mapping
Modbus Device Number : 3		Add Custom ▼
0	Name : SAR-713-1	Edit Delete
1	Name : SAR-713-2	Edit Delete
2	Name : PM-3112-100	Edit Delete

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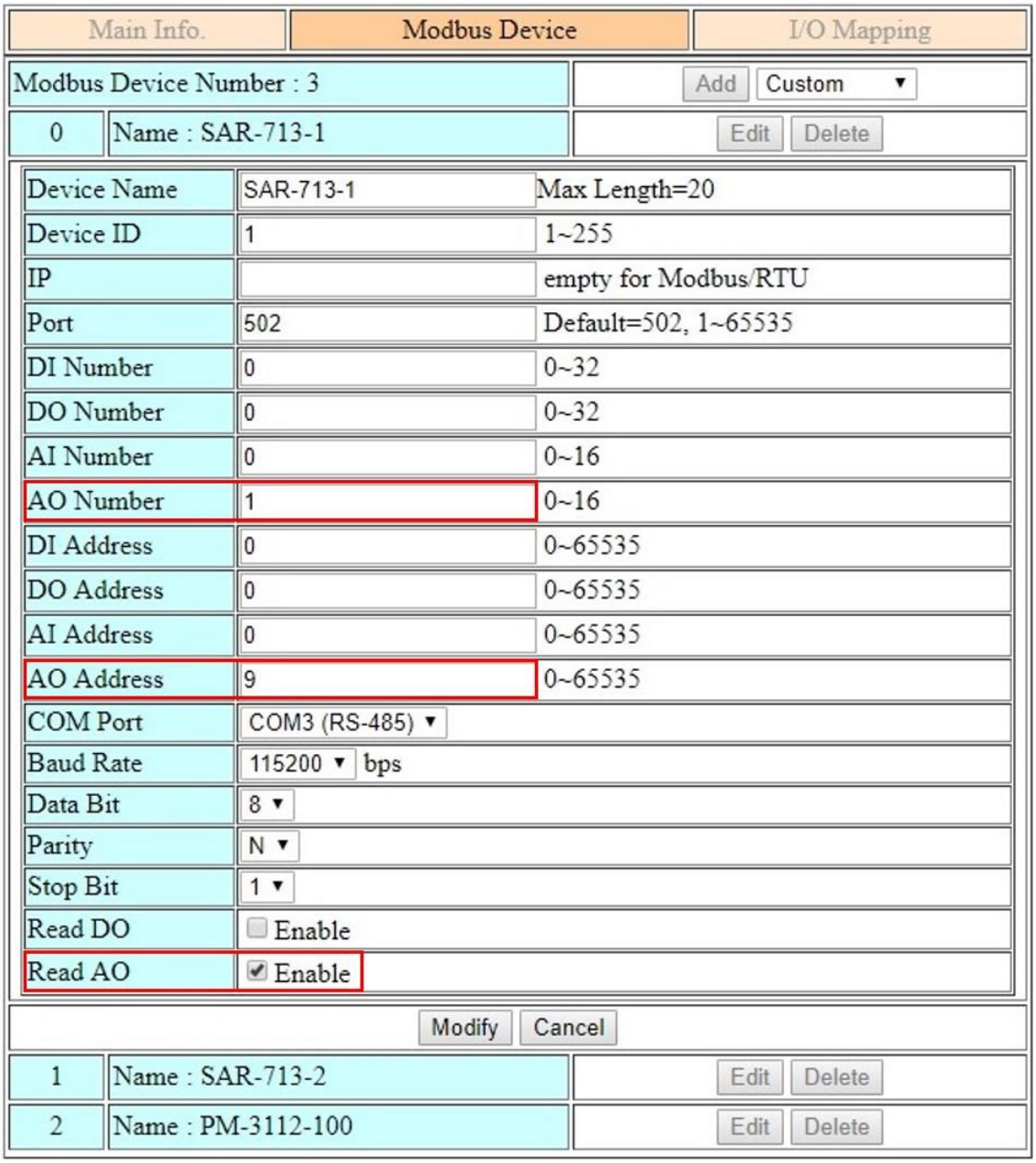
In this case, we want to use two AO values of SAR-713, but their Modbus address is not continuing. We split SAR-713's setting to two Modbus settings like below:



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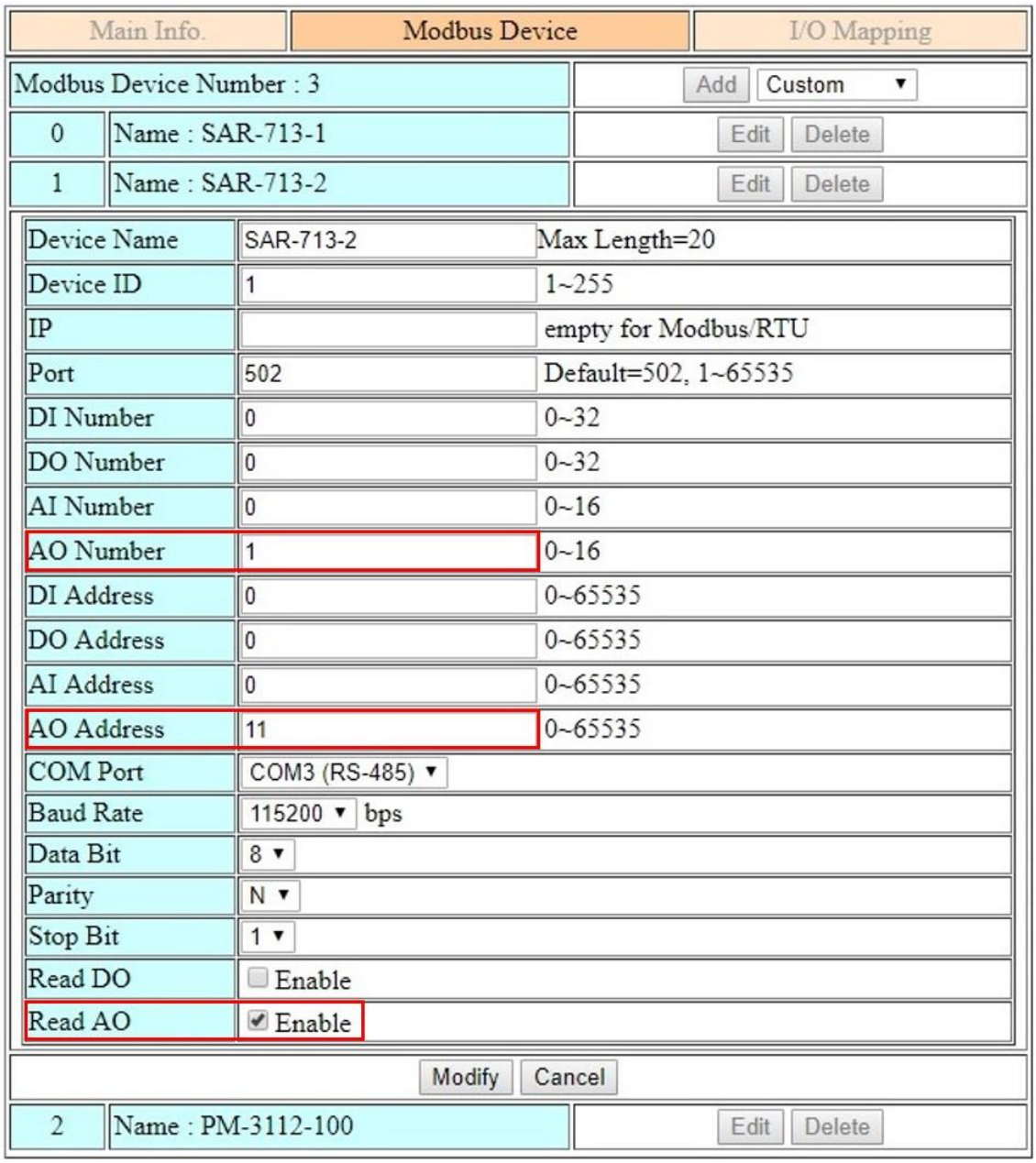
In the 1st setting, we set to read 1 AO on AO address 9, and the 2nd setting read 1 AO on address 11. Besides, the SAR-713's AO is the values we want, so "Read AO" is needed too.



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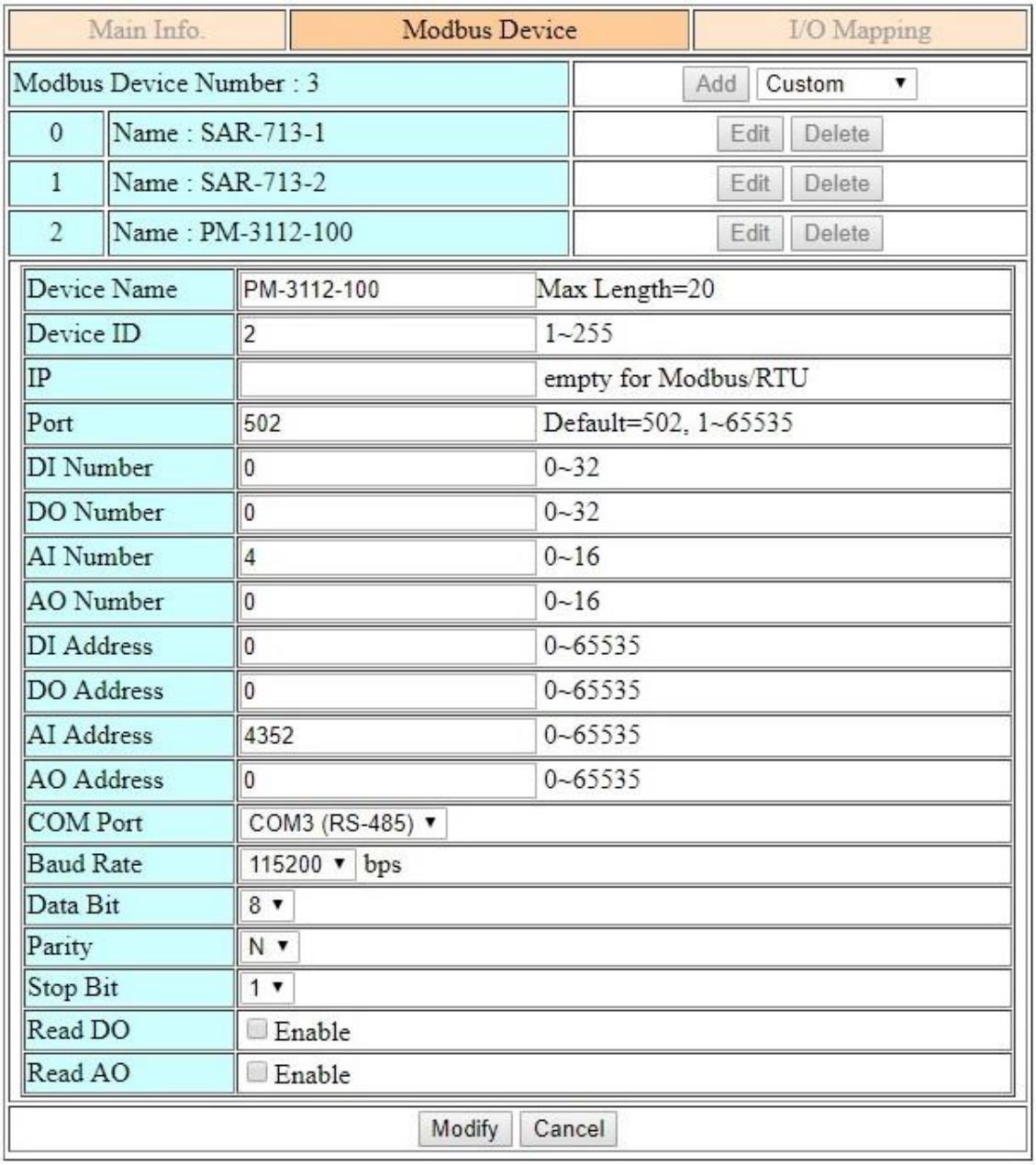
The PM-3112's setting is below, it has 4 AI need to be read:



Main Info.	Modbus Device	I/O Mapping

Modbus Device Number : 3		Add Custom ▼
0	Name : SAR-713-1	Edit Delete
1	Name : SAR-713-2	Edit Delete
2	Name : PM-3112-100	Edit Delete

Device Name	PM-3112-100	Max Length=20
Device ID	2	1~255
IP		empty for Modbus/RTU
Port	502	Default=502, 1~65535
DI Number	0	0~32
DO Number	0	0~32
AI Number	4	0~16
AO Number	0	0~16
DI Address	0	0~65535
DO Address	0	0~65535
AI Address	4352	0~65535
AO Address	0	0~65535
COM Port	COM3 (RS-485) ▼	
Baud Rate	115200 ▼ bps	
Data Bit	8 ▼	
Parity	N ▼	
Stop Bit	1 ▼	
Read DO	☐ Enable	
Read AO	☐ Enable	

Modify Cancel

(4) Set I/O mapping table:

The Session ID is used to let NB-DA Server identifies this GRP device, so must not set the same ID if using more than one device.

Because SAR-713 enable "Read AO", the AO of SAR-713 also need to be entered into AI table. There is no AI need to be read from SAR-713, so the AO become "1-1" and "2-1" to AI table and AI of PM-3112 are "3-1", "3-2", "3-3", "3-4".

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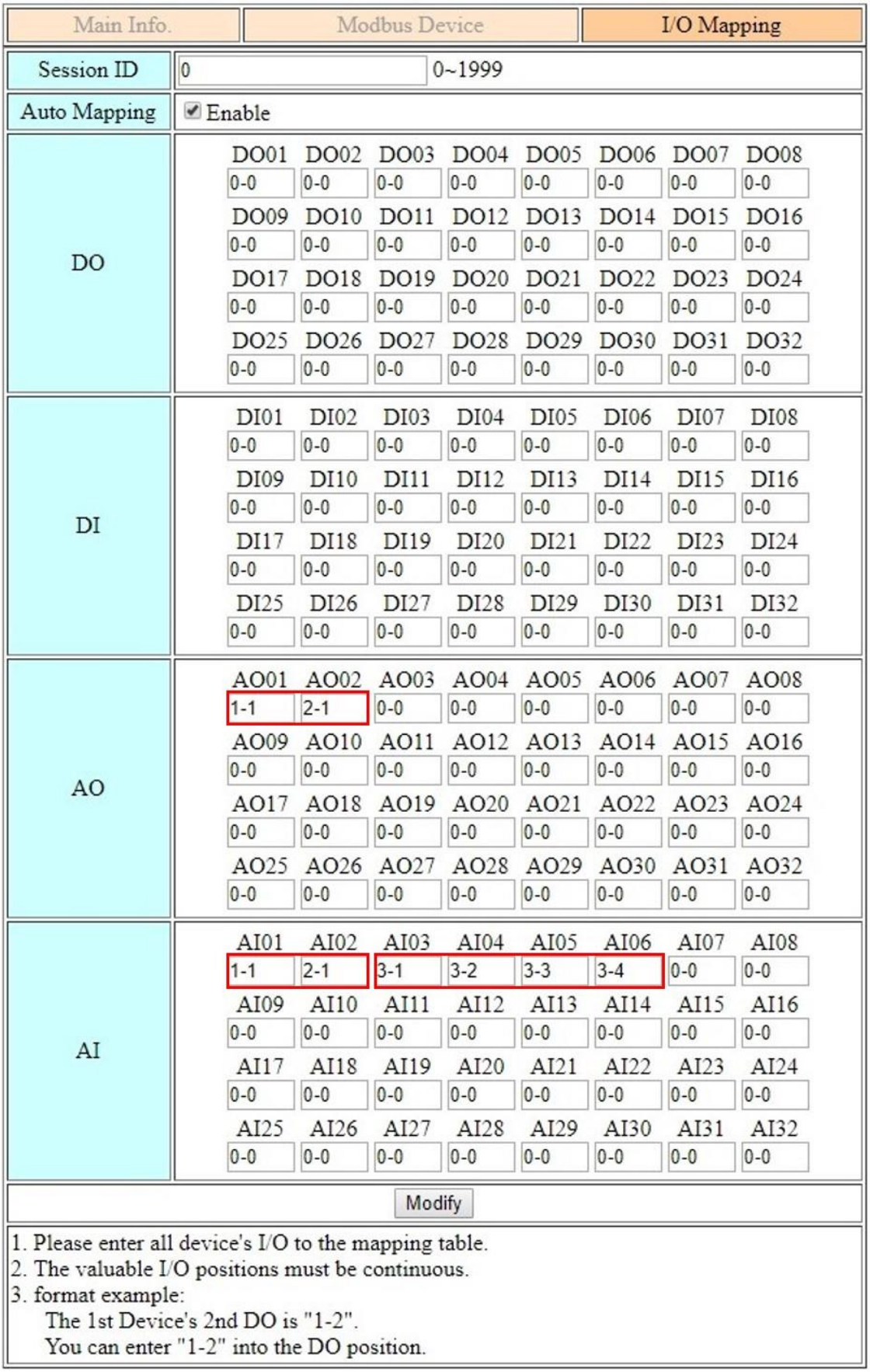

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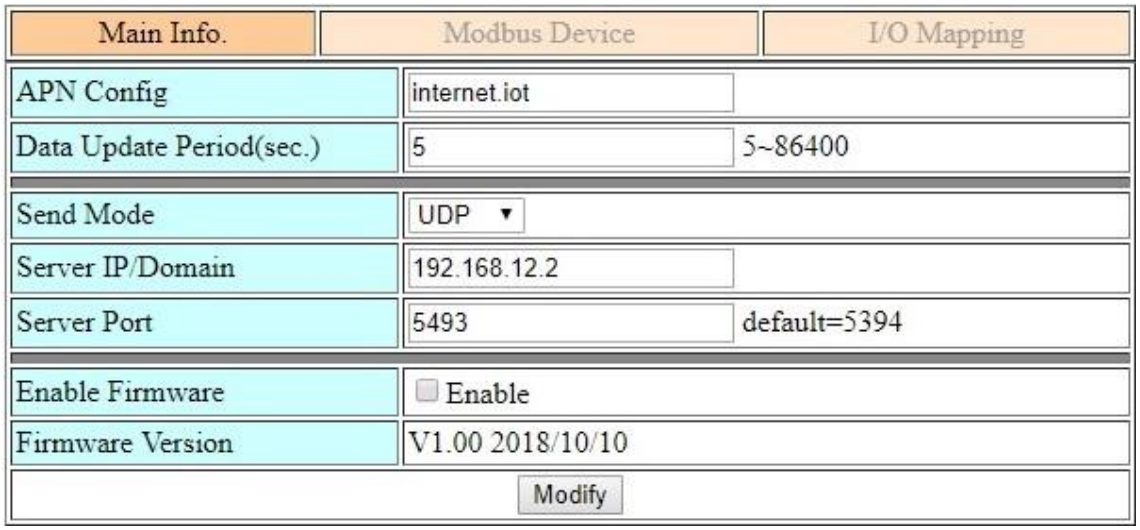
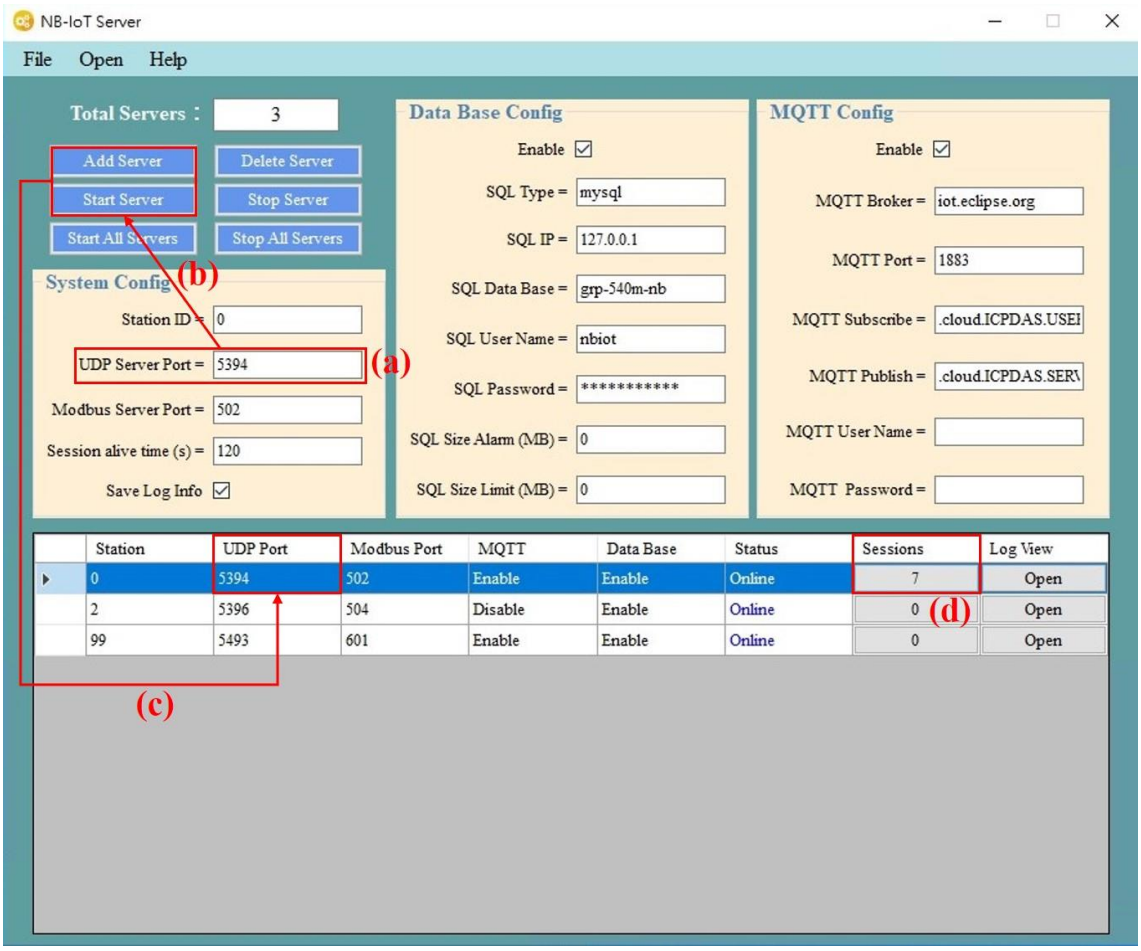
(5) Set APN of your SIM card, the IP and port for NB-DA Server, and Enable the function. Press “Modify”



(6) Setting NB-DA Server:



(a) The server port is set “5394” in GRP-540M-NB, so server must use “5394” to receive data.

(b) Click “Add Server” after all settings are ready.

(c) Choose the server and click “Start Server”.

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(d) After server start, if received data from GRP-540M-NB, we can see the Session live status on the Sessions block.

(7) After receiving data, if the server enables MQTT or Database, user can get data from access database or subscribe MQTT topic to receive data. The server also creates Modbus Server by default, user can connect Modbus Server with local IP and the port setting on server, then use Modbus TCP command to get data.

(8) If user wants to control remote DO/AO, user can change the values on the Modbus Server or publish DO/AO MQTT message to the topic which NB-DA Server subscribed.

- **[Server Side] The MQTT control message for DO/AO like below:**

Publish Topic	Publish Data (example)
[Topic of server subscribe]/[Station ID]/[Session ID]/DO	00010001000100010001000100010001000100010001 00010001000100000000000
[Topic of server subscribe]/[Station ID]/[Session ID]/AO	00000001000200030004000500060007000800090 00100011001200130014001500160017001800190 00200021002200230024002500260027000000000 00000000

1 byte for every DO, hex format, and data length must be 32. (set 00 for empty DO)

2 bytes for every AO, hex format, and data length must be 32. (set 0000 for empty AO)

- **[Server Side] The DEVINFO/DI/AI/GPS/ACK data like below:**

Publish Topic	Publish Data (example)
[Topic of server publish]/[Station ID]/[Session ID]/DEVINFO	-80,0,16,0
[Topic of server publish]/[Station ID]/[Session ID]/DI	00010001000100010001000100010001000100010001000 10001000100000000000
[Topic of server publish]/[Station ID]/[Session ID]/AI	00000001000200030004000500060007000800090010 00110012001300140015001600170018001900200021 00220023002400250026002700000000000000000
[Topic of server publish]/[Station ID]/[Session ID]/GPS	$GPRMC,083559.00,A,4717,11437,N,00833,91522,E ,0.004,77.52,091202,,,A*57

DEVINFO data include RSRP, ECL, SNR, and Battery level.

1 byte for every DI, hex format, and data length must be 32. (empty DI will be 00)

2 bytes for every AI, hex format, and data length must be 32. (empty AI will be 0000)

GPS data is “$GPRMC” message of NMEA 0183 protocol.

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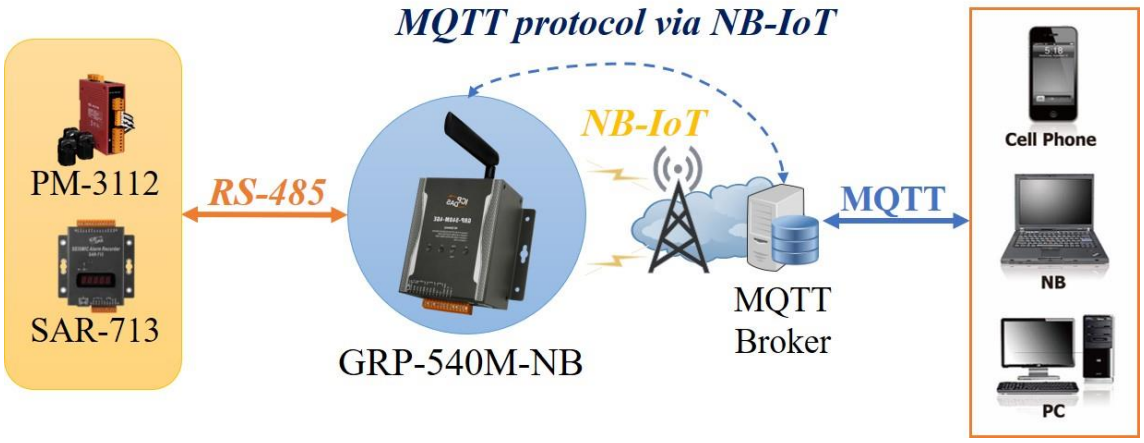
4.2 Data Collection and Remote Control (MQTT Broker)

This example shows data collection and remote control application via MQTT broker.

There are PM-3112 and SAR-713 in this system.



(1) Please connect your device (PM-3112 and SAR-713) to serial port of GRP-540M-NB. Baud Rate of these devices is 115200 bps, data format is 8N1 (Data bits, Parity, Stop bits). (Must attention that Baud Rate of all Modbus devices must set same value when using RS-485)

(2) If you never use NB-DA Server, please refer to NB-DA Server's website.

(3) Add devices in “Modbus Device” tab. (same as Example 4.1)

(4) Set I/O mapping table. (same as Example 4.1)

(5) Set APN of your SIM card, the IP/Domain and port for MQTT Broker. According to user’s application, set the topic for subscribe and publish. Enable the function and press “Modify”. (If using CHT IoT Platform, also need to set User Name, Password, Device ID, and Sensor ID, then enable “Use CHT platform”)

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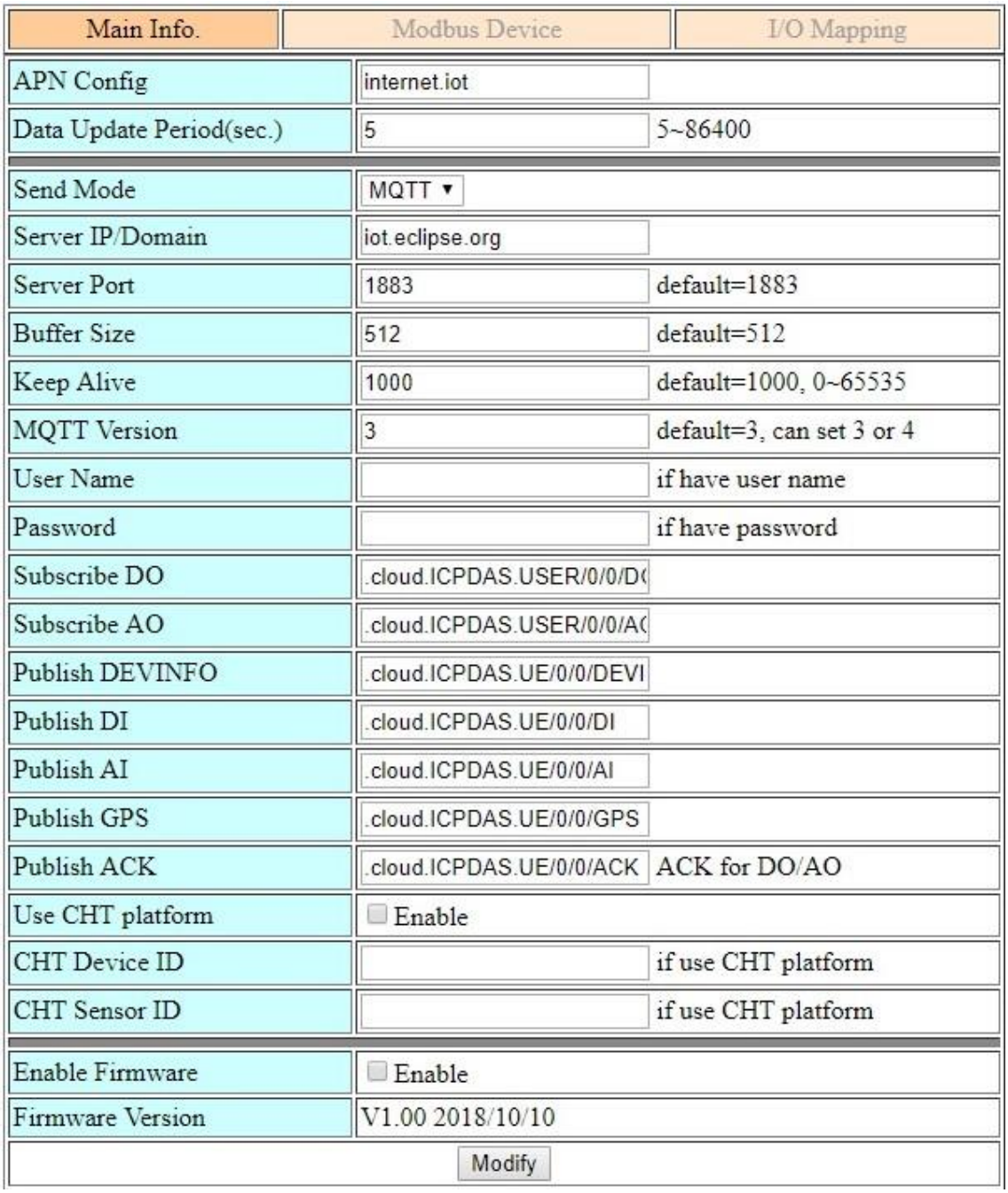

Main Info.	Modbus Device	I/O Mapping

APN Config	internet.iot	
Data Update Period(sec.)	5	5~86400
Send Mode	MQTT	
Server IP/Domain	iot.eclipse.org	
Server Port	1883	default=1883
Buffer Size	512	default=512
Keep Alive	1000	default=1000, 0~65535
MQTT Version	3	default=3, can set 3 or 4
User Name		if have user name
Password		if have password
Subscribe DO	.cloud.ICPDAS.USER/0/0/D(	
Subscribe AO	.cloud.ICPDAS.USER/0/0/A(	
Publish DEVINFO	.cloud.ICPDAS.UE/0/0/DEVI	
Publish DI	.cloud.ICPDAS.UE/0/0/DI	
Publish AI	.cloud.ICPDAS.UE/0/0/AI	
Publish GPS	.cloud.ICPDAS.UE/0/0/GPS	
Publish ACK	.cloud.ICPDAS.UE/0/0/ACK	ACK for DO/AO
Use CHT platform	Enable	
CHT Device ID		if use CHT platform
CHT Sensor ID		if use CHT platform
Enable Firmware	Enable	
Firmware Version	V1.00 2018/10/10	

Modify

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When using normal MQTT Broker, the message will be:

● **[GRP-540-NB Side] The MQTT control message for DO/AO like below:**

Publish Topic	Publish Data (example)
Set by user for DO	0001000100010001000100010001000100010001
Set by user for AO	0000000100020003000400050006000700080009 0020002100220023002400250026002700280029

1 byte for every DO, hex format, and max data length is 32.

2 bytes for every AO, hex format, and max data length is 32.

(Please check the numbers of DO/AO, don't send more or less than real I/O numbers)

● **[GRP-540-NB Side] The DEVINFO/DI/AI/GPS/ACK data like below:**

Publish Topic	Publish Data (example)
Set by user for DEVINFO	-80,0,16,0
Set by user for DI	0001000100010001000100010001000100010001000 1000100010000000000000
Set by user for AI	0000000100020003000400050006000700080009001 0001100120013001400150016001700180019002000 2100220023002400250026002700000000000000000
Set by user for GPS	$GPRMC:083559.00:A:4717:11437:N:00833:91522: E:0.004:77.52:091202:::A*57
Set by user for ACK	DO_ACK

DEVINFO data include RSRP, ECL, SNR, and Battery level.

1 byte for every DI, hex format, and max data length is 32.

2 bytes for every AI, hex format, and max data length is 32.

GPS data is "$GPRMC" message of NMEA 0183 protocol.

ACK data is published by GRP when it received DO/AO control message. (DO_ACK/ AO_ACK)

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When using CHT IoT Platform, the message will be:

● **[GRP-540-NB Side] The MQTT control message for DO/AO like below:**

Publish Topic	Publish Data (example)
Defined by CHT Platform for DO	[SessionID]/DO/00010001000100010001000100010001000100010001
Defined by CHT Platform for AO	[SessionID]/AO/00000001000200030004000500060007000800090020002100220023002400250026002700280029

(NOTICE: Need to send data with JSON format which defined by CHT platform)

1 byte for every DO, hex format, and max data length is 32.

2 bytes for every AO, hex format, and max data length is 32.

(Please check the numbers of DO/AO, don't send more or less than real I/O numbers)

● **[GRP-540-NB Side] The DEVINFO/DI/AI/GPS/ACK data like below:**

Publish Topic	Publish Data (example)
Defined by CHT Platform for DEVINFO	-80,0,16,0
Defined by CHT Platform for DI	[SessionID]/DI/0001000100010001000100010001000100010001000100010001000100010000000000000
Defined by CHT Platform for AI	[SessionID]/AI/0000000100020003000400050006000700080009001000110012001300140015001600170018001900200021002200230024002500260027000000000000000
Defined by CHT Platform for GPS	$GPRMC:083559.00:A:4717:11437:N:00833:91522:E:0.004:77.52:091202:::A*57
Defined by CHT Platform for ACK	DO_ACK

DEVINFO data include RSRP, ECL, SNR, and Battery level.

1 byte for every DI, hex format, and max data length is 32.

2 bytes for every AI, hex format, and max data length is 32.

GPS data is "$GPRMC" message of NMEA 0183 protocol.

ACK data is published by GRP when it received DO/AO control message. (DO_ACK/ AO_ACK)

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Appendix A. Revision History

This chapter provides revision history information to this document.

The table below shows the revision history.

Version	Date	Author	Description of changes
1.0.0	2018-12-05	Shepard Lee	The First Release Revision

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Appendix B. Traffic calculation for reference

This chapter provides a reference for calculating traffic, but it only calculates the traffic of data (not include the header of packets). For the real usage of traffic, please check it from the SIM Card provider.

- **UDP format:**

Data

Data	Minimum String Length (Bytes)	Maximum String Length (Bytes)
DEVINFO	49	112
DO	64	160
DI	64	160
AO	64	288
AI	64	288
GPS	112	160

- **MQTT format:**

Data + Topic length (topic is set by user)

Data	Minimum String Length (Bytes)	Maximum String Length (Bytes)
DEVINFO	11	14
DO (2 bytes for 1 DO)	2	64
DI (2 bytes for 1 DI)	2	64
AO (4 bytes for 1 AO)	4	128
AI (4 bytes for 1 AI)	4	128
GPS	23	72
ACK	6	6

- **MQTT format for CHT IoT Platform:**

JSON (77 bytes + Sensor ID length + Device ID length + Data) + Topic length (topic is set by user)

Data	Minimum String Length (Bytes)	Maximum String Length (Bytes)
DEVINFO	11	14
DO (2 bytes for 1 DO)	7	72
DI (2 bytes for 1 DI)	7	72
AO (4 bytes for 1 AO)	9	136
AI (4 bytes for 1 AI)	9	136
GPS	23	72
ACK	6	6

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Example:

If only 1 Modbus device with 1 DI is connecting to GRP-540M-NB, assume that DEVINFO and GPS data have max length, the bytes that will be transmitted is: **(1 character = 1 byte)**

- **If using UDP:**

  Data: 112+ 64 + 160 = 336 bytes

  The GRP will transmit **336 bytes** in every transmission.

- **If using MQTT:**

  Data: 14 + 2 + 72 = 88 bytes

  The GRP will transmit **88 bytes + DEVINFO topic length + DI topic length + GPS topic length** in every transmission.

- **If using MQTT (for CHT IoT Platform):**

  Data: 14 + 7 + 72 = 93 bytes, also need to add 3 messages' JSON format length (77 bytes + Sensor ID length + Device ID length).

  The GRP will transmit **JSON data length + DEVINFO topic length + DI topic length + GPS topic length** in every transmission.

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