SYSTEMBASE

ioLory

User Manual

Version 1.2 2021/09/30

www.sysbas.com

Revision History

Revision Date	Document Ver.	Pages Revised	Revised/Added/Removed	Details of Revision
2019. 01. 09	1.0	All	-	New
2020. 12. 28	1.1	All	Added/Revised	Manual Format Updated, AT Command Revised, Modbus Feature Added
2021.09.30	1.2	All	Added/Revised	Counter/PWM Feature, Modbus setup Feature Added
2022.05.19	1.3	62-64	Added	AI bit value correction

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Please be sure to read this manual before using and use the product safely and accurately.

- Pictures and photos in the manual may be different from the physical, and the document is subject to change without notice to improve performance. For the last information, please visit our website (www.sysbas.com).

- To view frequently asked questions and answers, please visit our website and find Support -Technical Support -FAQ section.

- Documents can be downloaded from the product page or Download section.

- Sellers or users should be aware of the fact that this device is intended for industrial use(Class A), not for residential use.

- This device has a potential for radio interference during use and may receive harmful interference from other devices.

- Warranty policy is included in the product packaging.

- The exchange/return of the device can be handled by the procedure described in the Warranty Policy.

1. LoRa Technology

There is a term called IoST(Internet of Small Things) as a concept of narrowing the scope of IoT. It is a technology that connects small objects which measure and process small amount of simple information such as temperature, humidity, weight and location through a wireless network. LTE-class wireless communication technology is costly and wasteful of bandwidth itself for these small items. So LPWA technology as a network for small internet has emerged and LoRa technology is the most popular wireless technology among them.

- LoRa is an abbreviation of Long Range, optimized for IoT due to low standby power and low module cost, using 900MHz of unlicensed frequency band.
- LoRa is a wireless technology of LoRa signal, a type of LPWA(Low Power Wide Area) wireless communication technology.
- LoRa can connect equipment up to 20km in open areas.
- LoRa saves time and money by eliminating the need to lay cables over long distance

Benefits that users can gain from using LoRa technology are:

- Long distance communication(up to 20km) with low installation cost
- Simple access procedure for quick installation and application
- Low-power communication which allows battery operation outdoors
- Secure through encrypted communication

2. Components

Box

ioLory (with Ejector pin)

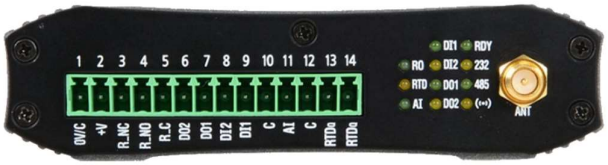
Terminal Blcok

2.5dBi Antenna
(SMA Reverse Polarity Plug)

Wall Mount

Components	Ordering Information
ioLory, 2.5dBi Antenna, Terminal Block	ioLory-1070TIL/MIX

3. Product



LED

LED	State	Operation
RO	On	Flashes when detecting Relay Out signal
	Off	No signal
RTD	On	Blinks when the Resistance Thermometer Detector operates
	Off	No signal
AI	On	Blinks when Analog In product operates
	Off	No signal
DI1	On	Flashes when detecting Digital In signal
	Off	No signal
DI2	On	Flashes when detecting Digital Input2 signal
	Off	No signal
DO1	On	Flashes when detecting Digital Out1 signal
	Off	No signal
DO2	ON	Flashes when detecting Digital Out2 signal
	Off	No signal

RDY	On	Blinks when the product operates
	Off	No signal
232	On	RS-232 Data in transmit (Console port for configuration)
	Off	No data transmission
485	On	RS-485 Data in transmit (Communication port)
	Off	No data transmission
(•))	On	LoRa Data in transmit
	Off	No data transmission

Connector

- LoRa Antenna Connector: Connect the 2.5dBi Gain Load Antenna included in the package

  (Please refer to the Appendix for connector and pin specifications)

4. Functions

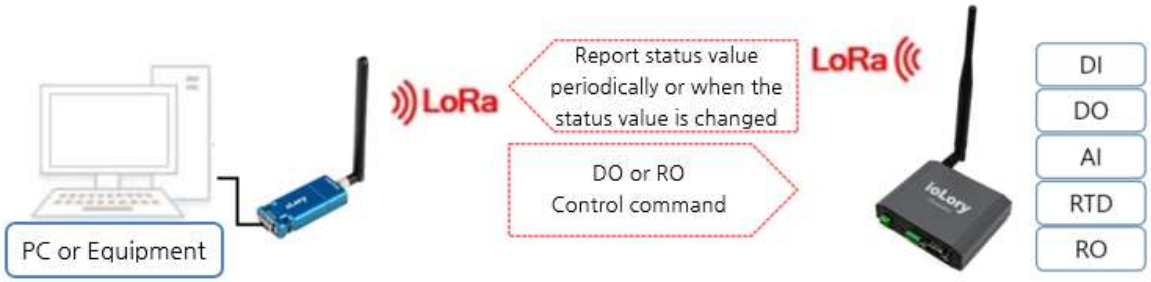
Connect the ioLory to the serial port of PC or communication equipment and apply DC 12~48V to use it. Once power is applied, it boots and the LED blinks. RDY LED will blink at 0.5 second intervals and AI, RTD LEDs blink at 1 second interval.

*** Please refer to '3. Product' for for more information on LED operation.**

ioLory does not provides a separate DC adapter. You can apply DC 12~48V / 1A or higher using terminal block.

① Sync Function

The Sync functions helps you to send each Port state information of the ioLory to the opponent LoRa equipment when the set period or state is changed.



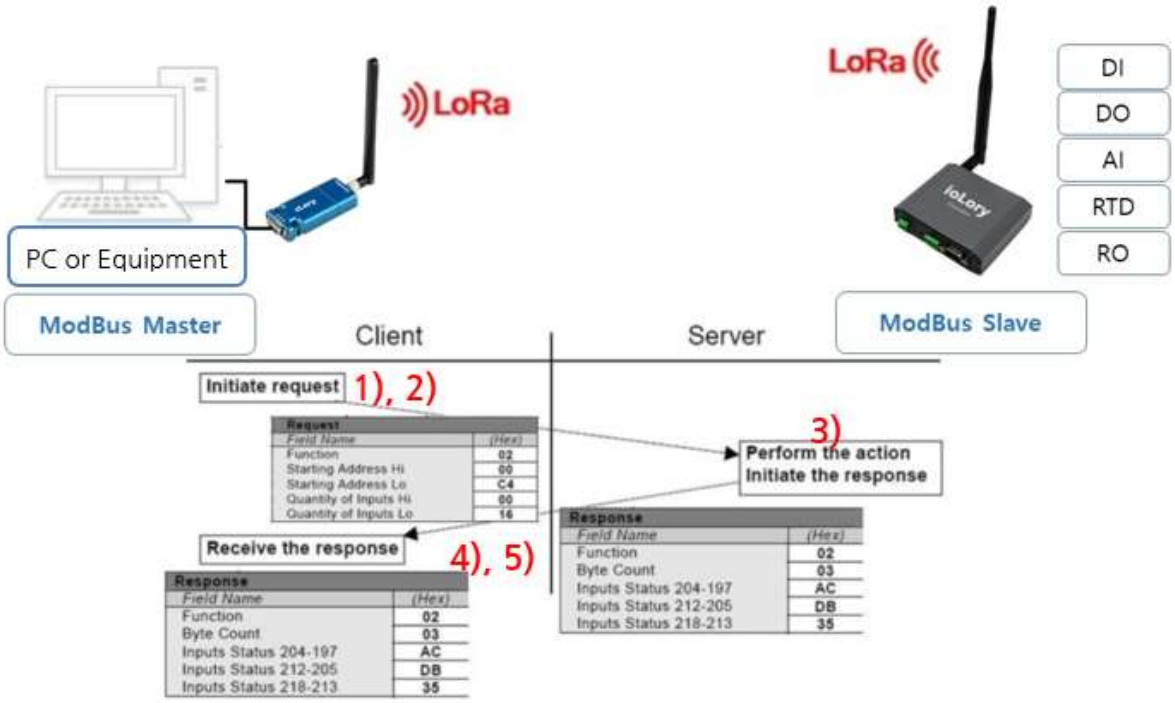
To use Sync function, you should set it up for each port through the AT command of ioLory.

*** Please refer to '7. Settings' for more information on AT Command.**

Report the status value periodically or when the status value is changed.

DO or RO control command.

② Modbus Communication Through LoRa

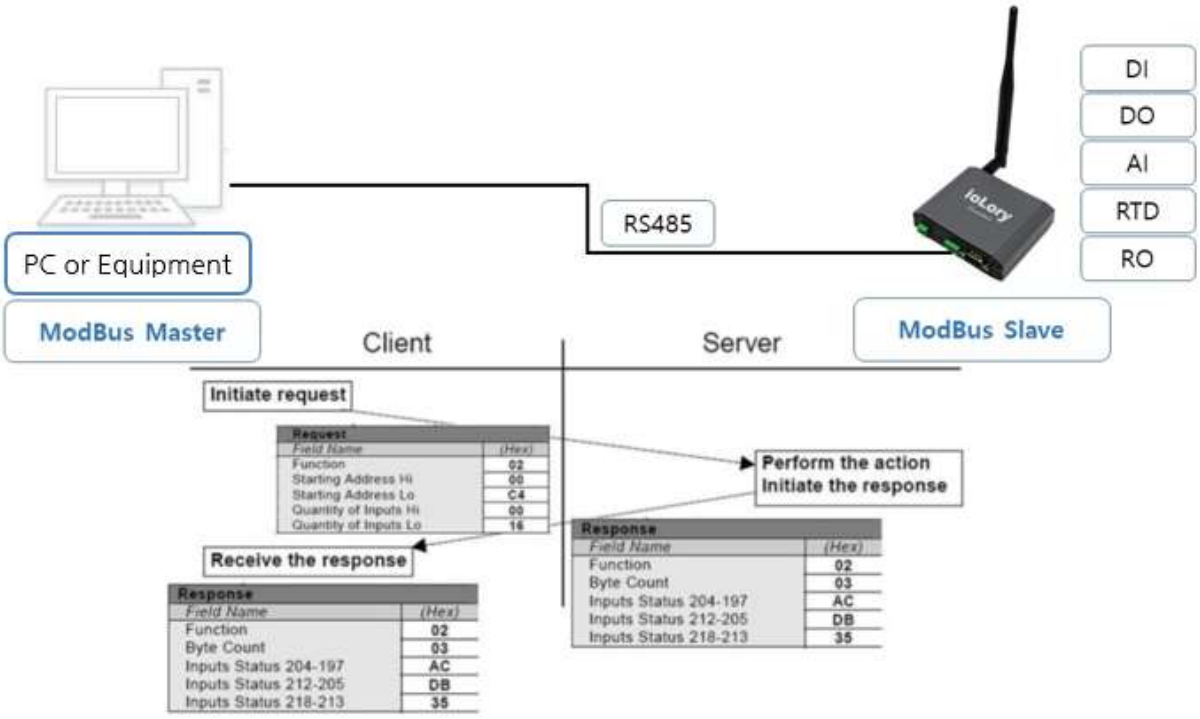


Linking with SystemBase sLory(or uLory) enables ModBus serial communication from a remote area using the LoRa network.

1) Deliver the Status Read(Function Code 03: Read Holding Register or Function Code 04: Read Input Register) function to sLory from Modbus master(PC or equipment) according to the structure of the Modbus packet. (Request)
2) sLory sends the received Modbus packet to LoRa.
3) ioLory, the Modbus Slave, analyzes the Modbus packets received through LoRa and reflects the corresponding status information(Data). (Process)
4) ioLory sends the status information of the collected sensors(DI/DO/AI/RTD/RO) to the Modbus protocol via LoRa. (Response)
5) Modbus master(PC or equipment) process the data received from the sLory. (Response Process)

By doing so, you can acquire remote IO or sensor information(DI, DO, AI, RTD, RO), and control DO or RO.

③ Modbus Communication Through RS485



ModBus Serial communication is possible in local area using RS485 connection without using LoRa network.

As shown in the figure above, you can acquire IO or sensor information(DI, DO, AI, RTD, RO) using Modbus on a Modbus master device connected with ioLory via RS485, and control DO or RO.

④ I/O Port Control

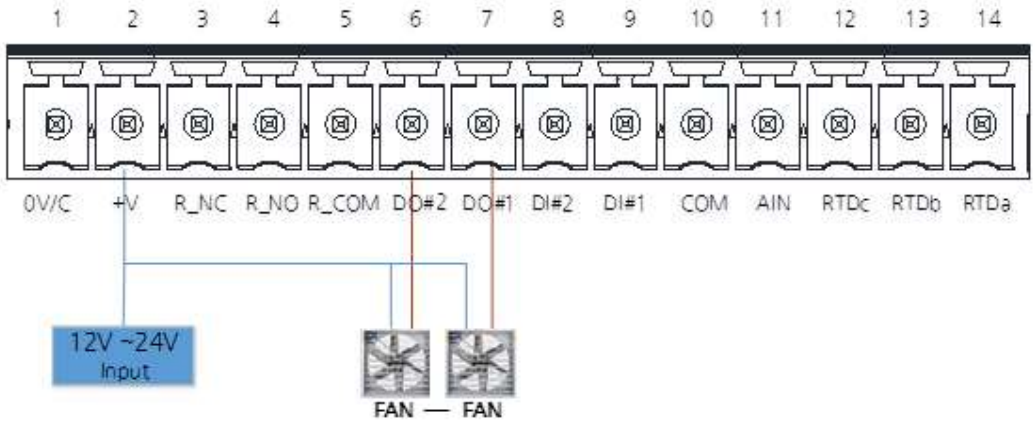
Commands are provided to Read/Write the status values of all ports included in ioLory.

The user can test all port operations within the ioLory on their own with these commands.

This is a chapter illustrating the method of setting each port, which is same, and only the part that controls each port is specified separately.

DO(Digital Output) Port

Control the external device through the two DO ports included in the ioLory.



You can check the status of DO and control it with the AT command as below.

If the state is 0, it is OFF. If the state is 1, it is ON.

The acceptable voltage of DO is 12~36VDC.

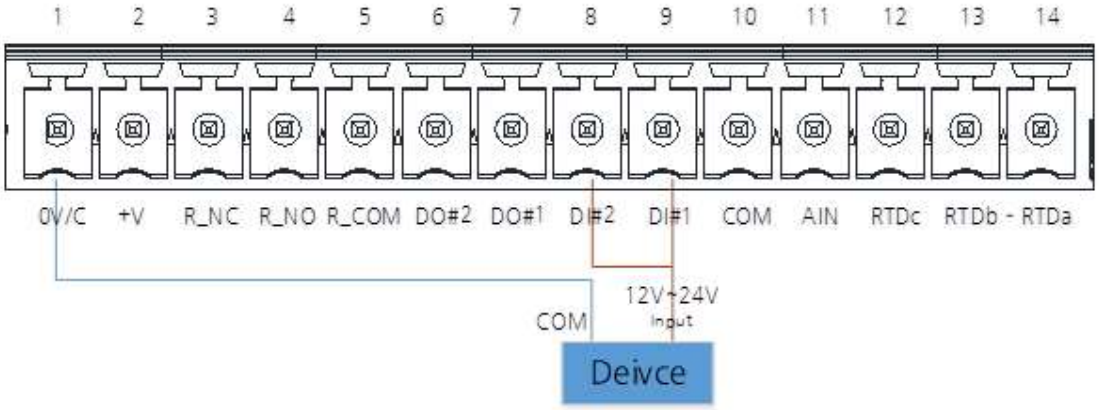
*** Please refer to "CH7. Settings" for detailed AT commands, and "APPENDIX" for wiring method and specifications.**

```
AT+DO+ST?
DO#1 Port status = 1.ON
DO#2 Port status = 1.ON

AT+DO+ST1=1                    - FAN-operate with port no.1 (DO1 LED ON)
OK. DO#1 Port status = 1.ON

AT+DO+ST2=1                    - FAN-operate with port no.2 (DO2 LED ON)
OK. DO#2 Port status = 1.ON
```

DI (Digital Input) Port



You can check the status of DI with the AT command as below.

If the state is 0, it is OFF. If the state is 1, it is ON.

There are NPN type and PNP type for DI.

The acceptable voltage of DI is 12~26VDC.

In NPN, High is recognized as 6V or higher, and Low is recognized as 0V.

In PNP, high is recognized as 2.2V or higher, and low is recognized as 1.2V or less.

The choice of NPN type and PNP type can be selected by a jumper.

*** Please refer to "CH7. Settings" for detailed AT commands, and "APPENDIX" for wiring method and specifications.**

```
AT+DI+ST?                    - Check the current operation values of DI Port no.1 and 2.
DI#1 Port status = 0.OFF
DI#2 Port status = 1.ON
```

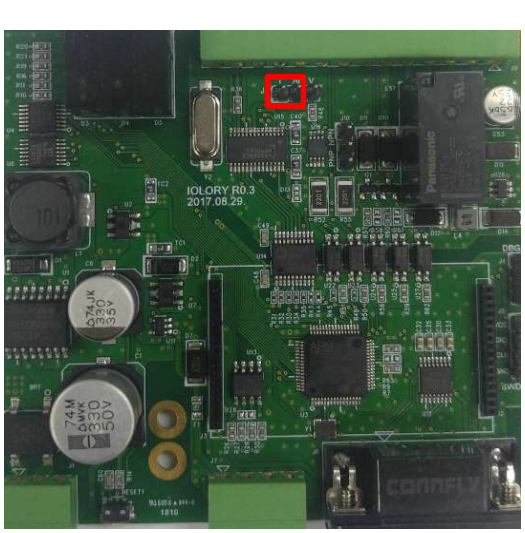
AI (Analog In) Port

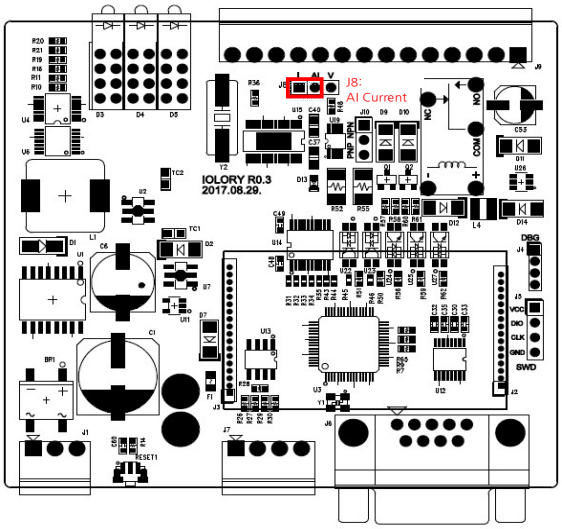
The AI port can measure DC(voltage) and Ampere(current).

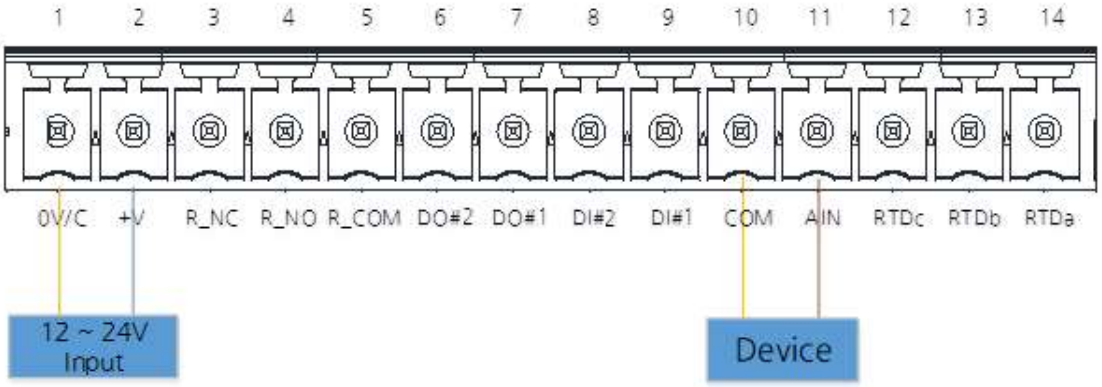
The basic setting of J8 jumper of ioLory is connected with DC(voltage).

To measure Ampere(current), two pins should be connected to the left as shown in the figure below.

The acceptable voltage and current of AI are 0(2)~10VDC or 0(1)~5VDC, 0(4)~20mA.







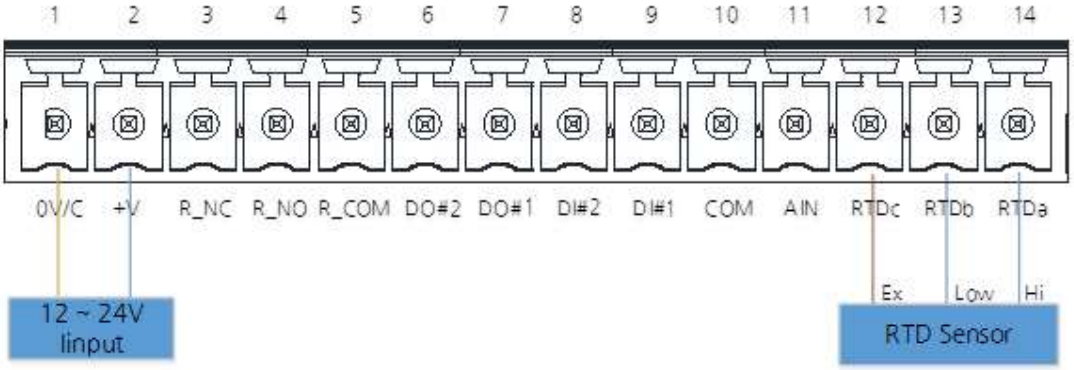
You can check the current value of the AI port with the AT command as below.

It is tabulated with voltage current values so that the AI value can be interpreted. Please refer to "APPENDIX - 5. Calibration".

*** Please refer to "CH7. Settings" for detailed AT commands, and "APPENDIX" for wiring method and specifications.**

AT+AI+ST?	- Check the current operation value of the AI port
AI status = 0xFA3F	- Status value when a voltage of 4.1[V] flows on the AI port. 0x3FFA(Little Endian), Refer to the APPENDIX 5.

RTD (Resistance Thermometer Detectors) Port



You can check the current value of the RTD port with the AT command as below.

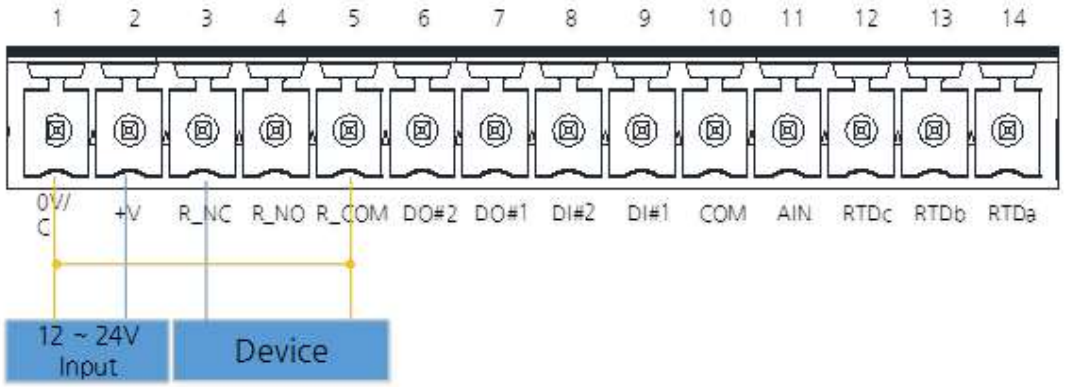
It is tabulated with temperature so that the RTD value can be interpreted. Please refer to "APPENDIX - 5. Calibration".

*** Please refer to "CH7. Settings" for detailed AT commands, and "APPENDIX" for wiring method and specifications.**

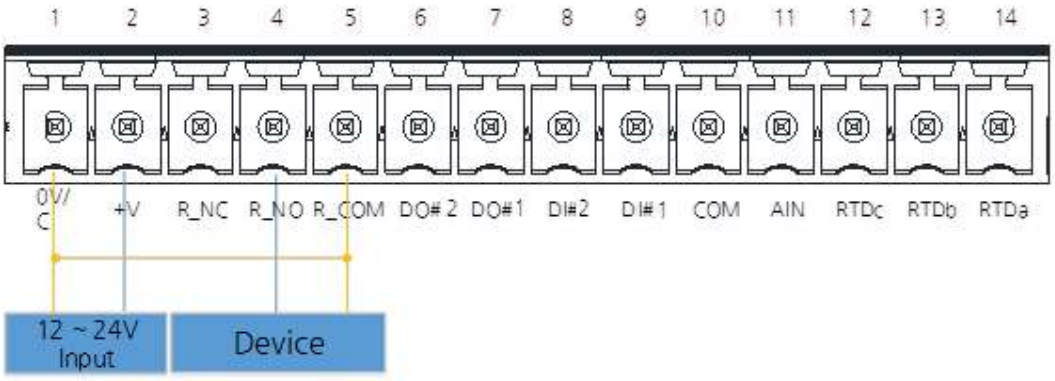
AT+RTD+ST?	- Check the current operation value of the RTD port RTD
RTD status = 0xE708	- Status value when measuring a temperature value of 100°C in the RTD port. 0x08E7(Little Endian), Refer to the APPENDIX 5.

RO (Relay Out) Port

NC Wiring



NO Wiring



You can check the status of the RO and control it with the AT command as below.

There are two modes of status: NC(Normal Closed) and NO(Normal Open).

Value 1: It is switched from the basic NO state to the NC state, and from the basic NC state to the NO state.

Value 0: It is switched from the basic NC state to the NO state, and from the basic NO state to the NC state.

*** Please refer to "CH7. Settings" for detailed AT commands, and "APPENDIX" for wiring method and specifications.**

```
AT+RO+ST?                    - Check the current operation value of the RO port
RO Port status = 1.ON


AT+RO+ST=1                   - Operate by turning the RO port ON (RO LED ON)
OK. RO Port status = 1.ON
AT+RO+ST=0                   - Stop by turning the RO port OFF (RO LED OFF)
OK. RO Port status = 0.OFF
```

5. Before Settings

ioLory provides Relay output for On/Off and RS232/485 which are widely used in the control area. It is also an ODMU(One-Device-Multi-Use) equipment that provides Digital Input/Output, Analog Input, RTD, etc. to meet data collection, control, and monitoring requirements of various measurement equipment, sensors and actuators in industrial sites

- Maximum mastery distance: 20km
- Maximum number of connectable LoRa equipment: 253
- Data format: Loket
- Broadcasting communication feature supported which can communicate multiple at once
- When a shaded area occurs in LoRa section, it can be relayed using rLory(wireless distance expansion)
- Encryption for secure wireless LoRa communication applied
- RS232(for setting) and RS485 (for Modbus) serial ports provided
- Digital Input/Output, Analog Input, Relay, RTD provided
- Amount of transmission(byte) adjustable
- Modbus RTU/ASCII(RS485 / LoRa) supported
- Industrial operating temperature - 40 to 85℃(-40 to 185℉) supported

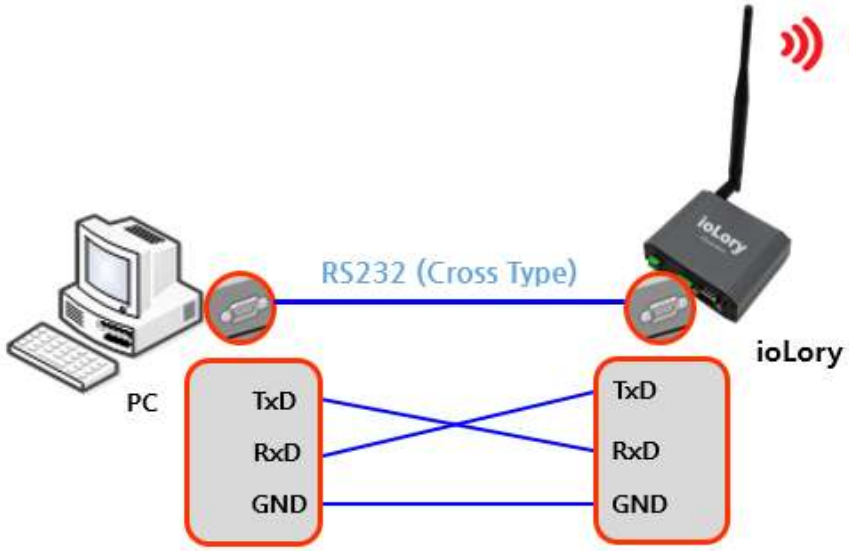
* For the full detailed specifications of ioLory, refer to the "1. Specifications" in the APPENDIX attached at the end of this manual.

6. Get Started

ioLory must set up a serial(interface, communication speed, parity bit, flow control, etc.) and LoRa(channel, bandwidth, power-output-, etc.) environment to communicate with other LoryNet devices.

There is a setting method using the AT Command.

The default serial setting environment consists of Baudrate 9600, Data Bit 8, and Stop Bit 1. Data Bit and Stop Bit cannot be changed as they are fixed.



Connect the RS232 port of the ioLory to the RS232 port on the PC in a cross type(cross cable. 2-3, 3-2, 5-5 pin wiring), and apply power to the ioLory.

① How to connect using AT Command

1. For the setting of ioLory, connect the RS232 DB9 port of the ioLory with a USB to Serial converter connected to the PC or a serial port on the PC with a cross cable.

2. Run a terminal emulator to open the COM port which the ioLory is connected with the set values of

   9600bps, Data bits=8, Parity bits=None, Stop bit=1

3. Enter +++ on the keyboard within 1 second.

```
+++
AT Mode On
```

4. In AT mode, you can check the AT Command list that allows you to control all ports with the 'AT&H' or '?' command as shown in the figure below.

```
AT&H or ? : AT Command List
AT&Z : System Reset
AT&O : AT Mode Off
AT&F : Factory Reset
AT&V : View Config
AT&E : View AES KEY, AES IV
< Common >----------------------------------
AT+MSID=<Modbus Slave ID 1~247>
AT+DID=< Destination ID 1~16777215>
< LoRa >-----------------------------------
AT+CH=<Channel No 1~20>
AT+SFT=<Spreading Factor 7~12>
< Encryption >------------------------------
AT+AES=<0,1>, 0=OFF, 1=ON
AT+AESKEY=<16 Characters> and <16 Characters AES IV>
< Serial >---------------------------------
AT+PTYPE=<Port Type (0=Loket, 1=Normal)>
AT+PAB=<Parity bit   N, O, E>
AT+BAU=<Baudrate 0~13>, 0=600bps, 1=1200bps, 2=2400bps, 3=3600bps,
       4=4800bps, 5=7200bps, 6=9600bps, 7=19200bps, 8=38400bps,
       9=57600bps, 10=115200bps, 11=230400bps, 12=460800bps, 13=921600bps
AT+485+H : RS485 Related Command List
AT+DO+H  : DO Related Command List
AT+DI+H  : DI Related Command List
AT+AI+H  : AI Related Command List
AT+RTD+H : RTD Related Command List
AT+RO+H  : RO Related Command List
```

7. Settings

ioLory has a normal communication mode and a LoryNet mode.

Normal communication mode is used when communicating between PCs or equipment through ioLory. And LoryNet mode is used when communicating with LoryNet Packet structure between equipment.

① How to Set up through Command

After connecting PC and ioLory with RS232 serial cross cable, setting the communication program to 9600bps on the PC, and entering +++ on the communication terminal, the ioLory outputs an "AT Mode On" message to indicate that it has entered AT setting mode. (To terminate AT mode, input “AT&O”, case-insensitive)

② Commands

Basic Commands

Command	Range(Default)	Description
AT&H or ?	-	Show the command list.
AT&Z	-	Restart the device.
AT&O	-	Switch to Online(Data/Loket) mode from Command mode.
AT&F	-	Factory initialize all settings and shows initial values on the screen.
AT&V	-	Show the current setting value.
AT&E	-	Show the current encryption AES KEY, AES IV. However, it does not show the initial AES KEY, AES IV value, only show the changed AES KEY, AES IV values.
AT+MSID=<Modbus Slave ID>	1~247(247)	Set the Modbus Slave ID.
AT+DID=<Destination ID>	1~16777215 (16777214)	Enter the counterpart device ID when communicating in Modbus.

LoRa Setting Commands

Command	Range(Default)	Description
AT+CH=<Channel No>	1~20 (20) 1=917.3MHz 2=917.9MHz 3=918.5MHz 4=919.1MHz 5=919.7MHz 6=920.3MHz 7=920.7MHz 8=920.9MHz 9=921.1MHz 10=921.3MHz 11=921.5MHz 12=921.7MHz 13=921.9MHz 14=922.1MHz 15=922.3MHz 16=922.5MHz 17=922.7MHz 18=922.9MHz 19=923.1MHz 20=923.3MHz	Change the LoRa channel.
AT+SFT=<Spreading Factor>	7~12 (9)	Change the LoRa Spreading Factor. SF(Spreading Factor) is a value that expresses the number of modulations of radio frequency in numbers from 7 to 12. If the SF is low, the amount of data that can be transmitted increases, but the distance becomes shorter, and if the SF is high, it is the opposite.
AT+AES=<0,1>	0~1(0)	0=OFF, 1=ON

AT+AESKEY	-	When a new key value is entered(16 Bytes), a message "You must also type IV(Initialization Vector) [16 Bytes] is output. Enter IV values consecutively(16 Bytes).

Serial Setting Commands

Command	Range(Default)	Description
AT+PTYPE=<Mode>	0~1 (1) 0=LoryNet mode 1=General data communication mode	0: Set when communicating with the LoryNet platform. 1: The default value which is set up in the case of general Data communication.
AT+PAB=<Parity bit>	N, O, E (N) N=None, O=Odd, E=Even	Set the Parity bit.
AT+BAU=<Baud rate>	1~13 (6) 1=1200bps, 2=2400bps, 3=3600bps, 4=4800bps, 5=7200bps, 6=9600bps, 7=19.2Kbps, 8=38.4Kbps, 9=57.6 Kbps, 10=115.2Kbps, 11=230.4Kbps, 12=460.8Kbps, 13=921.6Kbps	Set the Baudrate.

RS485 Setting Commands

Command	Range(Default)	Description
AT+485?	-	Check the RS485 port setting status.
AT+485+H	-	Check the RS485 setting command (help).
AT+485+PTYPE=<type>	0 ~ 1 (1)	0: Set up when communicating with the LoryNet platform. 1: Set up in the case of general Data communication.
AT+485+SYNCID=<Sync Dest ID>	1~16777215(16777214)	The DID number of the counterpart equipment to sync.
AT+485+ PAB=<Parity bit>	N, O, E (N) N=None, O=Odd, E=Even	Set the Parity bit.
AT+485+BAU=<Baud rate>	1~13 (6) 1=1200bps, 2=2400bps, 3=3600bps, 4=4800bps, 5=7200bps, 6=9600bps, 7=19.2Kbps, 8=38.4Kbps, 9=57.6 Kbps, 10=115.2Kbps, 11=230.4Kbps, 12=460.8Kbps, 13=921.6Kbps	Set the Baudrate.

DO Setting Commands

Command	Range(Default)	Description
AT+DO?	-	Check the DO port setting status.
AT+DO+H	-	Check the DO setting command(help).
AT+DO+ST?	-	The current port status of DO#1 and DO#2.
AT+DO+MODE1=<1 or 3>	1 or 3 (1)	DO#1 Mode (1=IO, 3=PWM)
AT+DO+MODE2=<1 or 3>	1 or 3 (1)	DO#2 Mode (1=IO, 3=PWM)
AT+DO+PH1=<0~1000>	0 ~ 1000 (10)	DO#1 PWM High Time, 0=None
AT+DO+PL1=<0~1000>	0 ~ 1000 (10)	DO#1 PWM Low Time, 0=None
AT+DO+PH2=<0~1000>	0 ~ 1000 (10)	DO#2 PWM High Time, 0=None
AT+DO+PL2=<0~1000>	0 ~ 1000 (10)	DO#2 PWM Low Time, 0=None
AT+DO+INIT1=<type>	0 ~ 1 (0)	Initial status of DO#1 port. 0: Initialize to OFF when the system starts. 1: Initialize to ON when the system starts.
AT+DO+INIT2=<type>	0 ~ 1 (0)	Initial status of DO#2 port. 0: Initialize to OFF when the system starts. 1: Initialize to ON when the system starts.
AT+DO+SYNCID=<Sync Dest ID>	1~16777215(16777214)	The DID number of the counterpart equipment to sync.
AT+DO+SYNCSC=<Sync Scale>	0~3	Sync Scale(Interval unit) 0=sec, 1=min, 2=hour, 3=day * If you restart the system with the 'AT&Z' command when you change the Sync Scale, it will be applied immediately.
AT+DO+SYNCINT=<Sync Interval>	1~255(0)	Sync Interval: 1~255, 0=Disabled
AT+DO+SYNCST=<Sync	0 ~ 1 (0)	Transmission condition

Trans Condition>		(0: Disabled, 1: When the status changes)
AT+DO+ST1=<0 or 1>	0 ~ 1 (0)	Change DO#1 Status(On/Off) 0: OFF, 1: ON
AT+DO+ST2=<0 or 1>	0 ~ 1 (0)	Change DO#2 Status(On/Off) 0: OFF, 1: ON

DI Setting Commands

Command	Range(Default)	Description
AT+DI?	-	Check the DI port setting status.
AT+DI+H	-	Check the DI setting command(help).
AT+DI+ST?	-	The current port status of DI#1 and DI#2.
AT+DI+MODE1=<1 or 2>	1 or 2 (1)	DI#1 Mode (1=IO, 2=Counter)
AT+DI+MODE2=<1 or 2>	1 or 2 (1)	DI#2 Mode (1=IO, 2= Counter)
AT+DI+CNT1=0	0	DI#1 Counter Clear
AT+DI+CNT2=0	0	DI#2 Counter Clear
AT+DI+SYNCID=<Sync Dest ID>	1~16777215(16777214)	The DID number of the counterpart equipment to sync.
AT+DI+SYNCSC=<Sync Scale>	0~3	Sync Scale(Interval unit) 0=sec, 1=min, 2=hour, 3=day * If you restart the system with the 'AT&Z' command when you change the Sync Scale, it will be applied immediately.
AT+DI+SYNCINT=<Sync Interval>	1~255(0)	Sync Interval: 1~255, 0=Disabled
AT+DI+SYNCST=<Sync Trans Condition>	0 ~ 1 (0)	Transmission condition (0: Disabled, 1: When the status changes)

AI Setting Commands

Command	Range(Default)	Description
AT+AI?	-	Check the AI port setting status.
AT+AI+H	-	Check the AI setting command(help).
AT+AI+ST?	-	The current value of AI.
AT+AI+SCNT=<Sampling Count>	1 ~ 10 (0)	Number of sampling(1-10). Up to 10 times.
AT+AI+MIN=<Value>	0~65535(0)	Noise filtering sub-value (ignore the lower value)
AT+AI+MAX=<Value>	0~65535(65535)	Noise filtering upper value (ignore the higher value)
AT+AI+SYNCID=<Sync Dest ID>	1~16777215(16777214)	The DID number of the counterpart equipment to sync.
AT+AI+SYNCSC=<Sync Scale>	0~3	Sync Scale(Interval unit) 0=sec, 1=min, 2=hour, 3=day * If you restart the system with the 'AT&Z' command when you change the Sync Scale, it will be applied immediately.
AT+AI+SYNCINT=<Sync Interval>	1~255(0)	Sync Interval: 1~255, 0=Disabled
AT+AI+SYNCST=<Sync Trans Condition>	0 ~ 1 (0)	Transmission condition (0: Disabled, 1: When the status changes)

RTD Setting Commands

Command	Range(Default)	Description
AT+RTD?	-	Check the RTD port setting status.
AT+RTD+H	-	Check the RTD setting command(help).
AT+RTD+ST?	-	The current value of RTD.

AT+RTD+SCNT=<Sampling Count>	1 ~ 10 (0)	Number of sampling(1-10). Up to 10 times.
AT+RTD+MIN=<Value>	0~65535(0)	Noise filtering sub-value (ignore the lower value)
AT+RTD+MAX=<Value>	0~65535(65535)	Noise filtering upper value (ignore the higher value)
AT+RTD+SYNCID=<Sync Dest ID>	1~16777215(16777214)	The DID number of the counterpart equipment to sync.
AT+RTD+SYNCSC=<Sync Scale>	0~3	Sync Scale(Interval unit) 0=sec, 1=min, 2=hour, 3=day * If you restart the system with the 'AT&Z' command when you change the Sync Scale, it will be applied immediately.
AT+RTD+SYNCINT=<Sync Interval>	1~255(0)	Sync Interval: 1~255, 0=Disabled
AT+RTD+SYNCST=<Sync Trans Condition>	0 ~ 1 (0)	Transmission condition (0: Disabled, 1: When the status changes)

RO Setting Commands

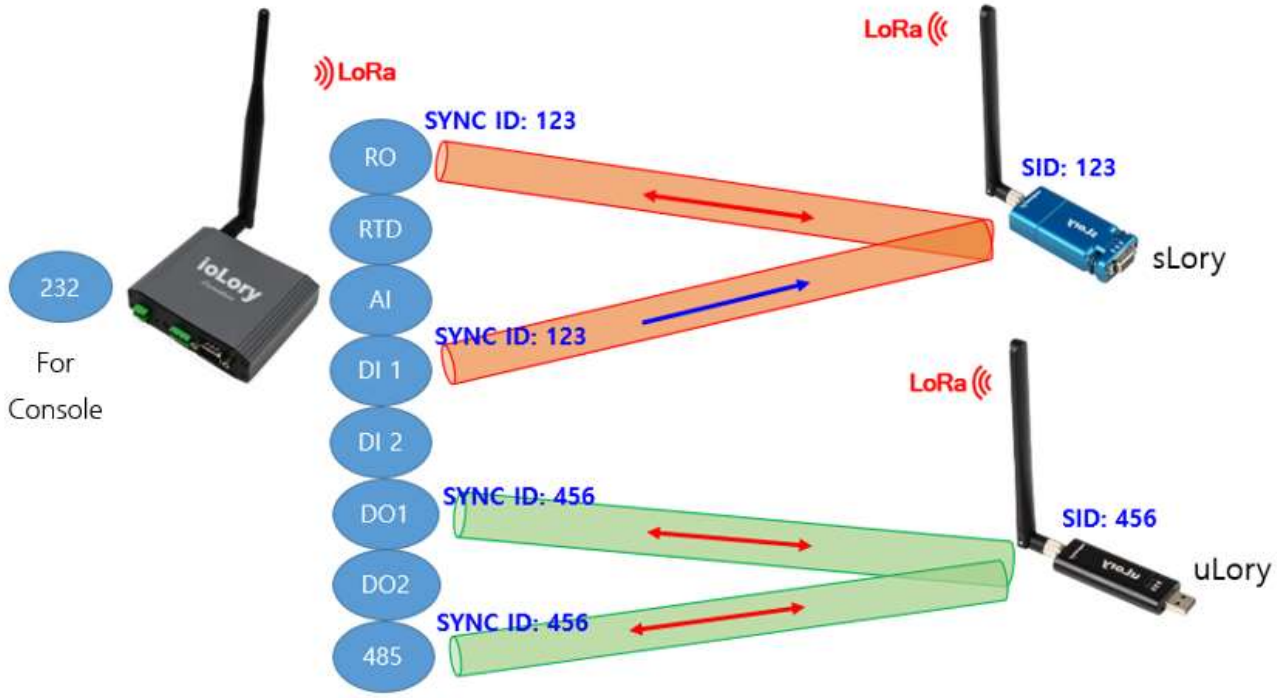
Command	Range(Default)	Description
AT+RO?	-	Check the RO port setting status.
AT+RO+H	-	Check the RO setting command(help).
AT+RO+ST?	-	The current port status of RO.
AT+RO+INIT1=<type>	0 ~ 1 (0)	Initial status of RO port. 0: Initialize to OFF when the system starts. 1: Initialize to ON when the system starts. (It might take seconds to complete the application)

AT+RO+SYNCID=<Sync Dest ID>	1~16777215(16777214)	The DID number of the counterpart equipment to sync.
AT+RO+SYNCSC=<Sync Scale>	0~3	Sync Scale(Interval unit) 0=sec, 1=min, 2=hour, 3=day * If you restart the system with the 'AT&Z' command when you change the Sync Scale, it will be applied immediately.
AT+RO+SYNCINT=<Sync Interval>	1~255(0)	Sync Interval: 1~255, 0=Disabled
AT+RO+SYNCST=<Sync Trans Condition>	0 ~ 1 (0)	Transmission condition (0: Disabled, 1: When the status changes)
AT+RO+ST=<0 or 1>	0 ~ 1 (0)	Change RO Status(On/Off) 0: OFF, 1: ON

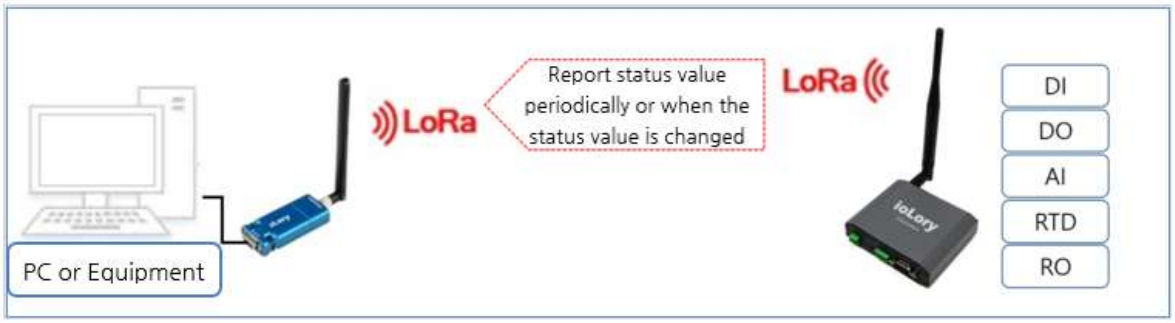
8. Examples of Settings

① How to Use Sync Function

Sync for ioLory means the status of each port. Sync can view the status value of each port or set for each port distinguishily.



How to Report the status



The status information can be reported to the higher level when the status value of a certain period or port is changed.

The command to view the current state value of each port is “at+port name(DI, DO, AI, RTD, RO)?”.

(The command to view only the status value of each port is "at+port name(DI, DO, AI, RTD, RO)+st?", case-insensitive.)

An example of the DO port is as follows.

```
at+do?
<DO Configuration>----------------------------------------
 DO#1 Port Init status = 0
 DO#2 Port Init status = 0
 DO#1 Mode = 3 (PWM Mode)
 DO#2 Mode = 1 (IO Mode)
 DO#1 PWM High Value = 1000
 DO#1 PWM Low Value = 999
 DO#2 PWM High Value = 998
 DO#2 PWM Low Value = 997
 DO SYNC Destination ID    = 200
 DO SYNC Scale (Interval Unit) = second(s)
 DO SYNC Interval (Interval Value) = 0(Not Use)
 DO SYNC Trans Condition = 1.When status changes
```

As shown in the figure above, you can check the current DO settings through the at+do? command.

1) How to check DO related setting commands

```
at+do+h
 < DO Command Help >-----------------------------------
 AT+DO? : View DO Config
 AT+DO+MODE1=<1 or 3>, 1=IO, 3=PWM
 AT+DO+MODE2=<1 or 3>, 1=IO, 3=PWM
 AT+DO+PH1=<0~1000>, DO#1 PWM High, 0=None
 AT+DO+PL1=<0~1000>, DO#1 PWM Low, 0=None
 AT+DO+PH2=<0~1000>, DO#2 PWM High, 0=None
 AT+DO+PL2=<0~1000>, DO#2 PWM Low, 0=None
 AT+DO+INIT1=<0 or 1>, 0=OFF, 1=ON
 AT+DO+INIT2=<0 or 1>, 0=OFF, 1=ON
 AT+DO+SYNCID=<Sync Dest ID 1~16777215>
 AT+DO+SYNCSC=<Sync Scale 0~3> 0=sec, 1=min, 2=hour, 3=day
```

```
AT+DO+SYNCINT=<Sync Interval 1~255> 0=Not Use
AT+DO+SYNCST=<Sync Trans Condition 0,1> 0=Not Use, 1=When status changes
AT+DO+ST? : Display Current DO#1, DO#2 Status
AT+DO+ST1=<0 or 1>, Change DO#1 Status 0=OFF, 1=ON
AT+DO+ST2=<0 or 1>, Change DO#2 Status 0=OFF, 1=ON
```

As shown in the figure above, you can check the DO setting command list with the AT+DO+H command.

2) How to Set DO-Related Things

AT+DO+MODE1=<1 or 3> 1=IO Mode, 3=PWM Mode

AT+DO+ MODE2=<1 or 3> 1=IO Mode, 3=PWM Mode

: Set the mode of DO port no.1(MODE1) and port no.2(MODE2).

If it is 1, the modes of DO port no.1 and 2 are set to the normal Digital Output mode.

If it is 3, the modes of DO port no.1 and 2 are set to PWM(Pulse Width Modulation) mode.

※ Please note that due to the product feature, Counter mode of DI#2 port and PWM mode of DO#1 port cannot be used at the same time.

AT+DO+PH1=<0 ~ 1000>, DO#1 PWM High Time, 0=None

AT+DO+LH1=<0 ~ 1000>, DO#1 PWM Low Time, 0=None

: Set the Duty ratio(PWM High Time and Low Time) of the DO port no.1 (unit: milliseconds).

AT+DO+PH2=<0 ~ 1000>, DO#1 PWM High Time, 0=None

AT+DO+LH2=<0 ~ 1000>, DO#1 PWM Low Time, 0=None

: Set the Duty ratio(PWM High Time and Low Time) of the DO port no.2 (unit: milliseconds).

AT+DO+INIT1=<0 or 1> 0=OFF, 1=ON

AT+DO+INIT2=<0 or 1> 0=OFF, 1=ON

: Set the initial state of port 1 (INIT1) and port 2 (INIT2).

If it's 0, DO port no.1 and 2 will be in 0(Off) state when the system starts.

If it's 1, DO port no.1 and 2 will be in 1(On) state when the system starts.

AT+DO+SYNCID=<Sync Dest ID 1~16777215>

: Set the SID of the opponent LoRa equipment to transmit the status via Sync function.

Since the SID of the counterpart LoRa equipment can be input for each port of the ioLory, each port can be focus on one or distribute to several ports for communication. It can also be set to the broadcast ID 16777215.

(However, for DO and DI with two ports, one Sync ID can be set.)

AT+DO+SYNCSC=<Sync Scale 0~3> 0=sec, 1=min, 2=hour, 3=day

: Set the unit time to transmit Sync data.

Sync Scale settings are reflected when the cycle to the presently set unit is rotated once. However, using AT&Z command to restart the system after setting it up, it will be reflected immediately.

AT+DO+SYNCINT=<Sync Interval 1~255> 0=Not Use

: Set the time(value) to transmit the Sync data. Periodic transmission of Sync Data is disabled when set to 0.

If it is set in seconds, it is set at least 5 seconds due to the characteristics of LoRa.

(Even if it is set to 1~4 seconds, the data is sent at least 5 seconds interval)

By combining the Sync Scale and the Sync Interval, you can set the communication cycle.

Setting the above three commands, Sync Data(status value) will be transmitted to the set DID every set time.

AT+DO+SYNCST=<Sync Trans Condition 0,1> 0=Not Use, 1=When status changes

: If you want to send the Sync Data whenever the status of DO port changes, you can use the above command.

AT+DO+ST1=<0 or 1> 0=OFF, 1=ON

AT+DO+ST2=<0 or 1> 0=OFF, 1=ON

: Change the current state of DO port no.1(ST1) and port no.2(ST2). If it is 0, it changes the port status of DO port no.1 and no.2 to 0(Off) or 1(On) status.

3) How to Check Settings

```
at+do?
<DO Configuration>-------------------------------------
 DO#1 Port Init status = 0
 DO#2 Port Init status = 0
 DO#1 Mode = 3 (PWM Mode)
 DO#2 Mode = 1 (IO Mode)
 DO#1 PWM High Value = 1000
```

```
DO#1 PWM Low Value = 999
DO#2 PWM High Value = 998
DO#2 PWM Low Value = 997
DO SYNC Destination ID    = 200
DO SYNC Scale (Interval Unit) = second(s)
DO SYNC Interval (Interval Value) = 0(Not Use)
DO SYNC Trans Condition = 1.When status changes
```

As shown in the figure above, you can check the current DO settings through the at+do? command.

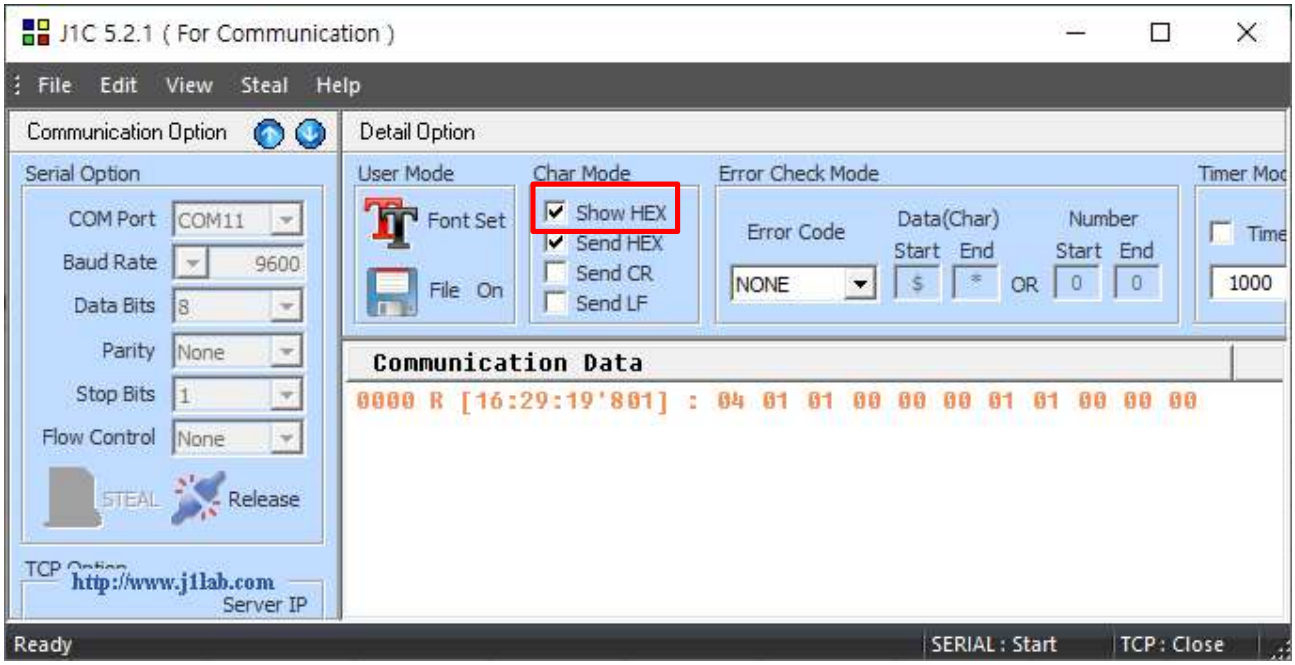
To explain the above setting,

DO port no.1 and no.2 starts at 0(Off) status when the system starts,

DO ports transmit the Sync Data(DO port status information) every 10 seconds to LoRa equipment with ID 200, and the Sync Data is also sent even when the status of the DO port changes.

4) To verify the Sync Data Transmission

Sync Data transmitted from ioLory to LoRa is outout as HEX value through the serial port of the opponent LoRa equipment(sLory or uLory).



(This is a screen using the J1C program as an example.)

For DO ports, you can see that 11byte Sync Data is transmitted periodically.

With this value, the user can express it as a status value on their own application.

To convert the received 11byte into the HEX value and view it,

〈 Packet Sample〉

When DO#1 is in IO mode and DO#2 is in PWM mode,

04 01 01 00 00 00 03 03 E6 03 E5

04: Port Table Number (please refer to the table below)

01: Do#1 Port type(IO Mode)

01: Do#1 Port status(ON)

00: Meaningless when in IO Mode.

00: Meaningless when in IO Mode.

00: Meaningless when in IO Mode.

03: Do#2 Port mode(PWM Mode)

03 E6: PWM High Time of Do#2 Port (0x03E6 = 998) - Little Endian

03 E5: PWM Low Time of Do#2 Port (0x03E5 = 997) - Little Endian

Each port has a different content and characteristic of Sync report value, so the format of the data to be transmitted is different. Please refer to the table below for more information.

〈Table - Sync Transmission Protocol for each port〉

DO/DI Packet

type	
0x1	Input/Output
0x2	Counter
0x3	PWM

data 4bytes (little endian)				
I/O	0 / 1	0x00	0x00	0x00
Counter	value[low]	value[high]	0x00	0x00
PWM	htime[low]	htime[high]	ltime[low]	ltime[high]

IOLory / IOWiFi

byte	1	2	3	4~6	7	8	9~11
	Port table Number	#1 state	#1 data		#2 state	#2 data	
DO	04	[type]	data 4byte		[type]	data 4byte	
DI	05	[type]	data 4byte		[type]	data 4byte	
AI	06	value					
RTD	07	value					
RO	08	0/1					
RS485	09	1	data				

※ Note: The Hex value cannot be verified in TeraTerm, a common communication emulator.

So the serial communication program with HEX View should be used.

Above, the convertible J1C program is used as an example.

***As above, other ports such as DO have their own characteristics settings, so you can change each state, communication cycle and state changes. For AT commands related to Sync functions for ports other than DO port, please refer to "7. Settings".**

To Control DO or RO

The status of the Output ports of the ioLory, DO(Digital Output) and RO(Relay Output), can be controlled.

In order to control the DO and RO, the opponent transmitting LoRa devices(sLory, uLory, LoryGate) which is the other side of the ioLory must communicate in the structure set by ioLory.

Control commands can be delivered to sLory via Serial and the sLory can transfer the command to the ioLory to control DO or RO. The structure(protocol) of the control command consists of 3 bytes, and the details are as follows.

Number	Content	Note
1	Port Table Number(0x04 or 0x08)	0x04: DO 0x08: RO
2	Port Number(0x01 or 0x02)	0x01: Port no.1 0x02: Port no.2
3	Status Value to Change(0x00 or 0x01)	0x00: OFF 0x01: ON

The 3byte to be transmitted must be converted into the HEX value and transmitted.

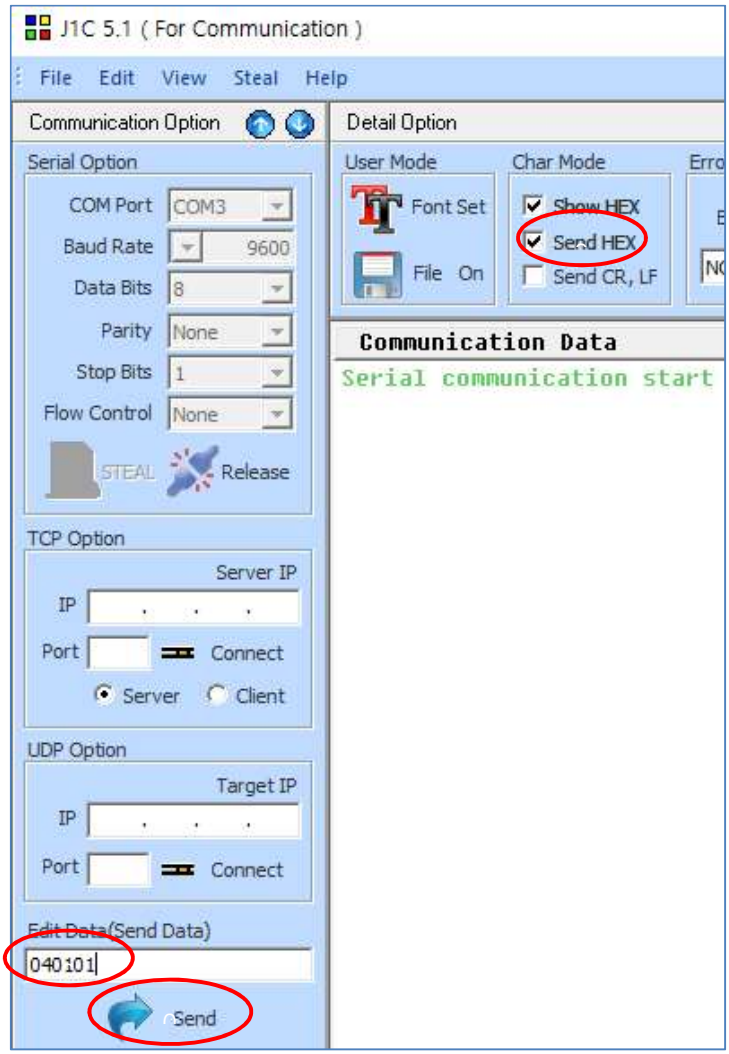
Examples of control request packets are as follows.

0x04 0x01 0x01 //Turn DO port no.1 ON

0x04 0x02 0x00 // Turn DO port no.2 OFF

0x08 0x01 0x01 // Turn RO port no.1 ON

0x08 0x01 0x00 // Turn RO port no.1 OFF



Convert the input value into HEX value and Send.

(This is a screen using the J1C program as an example.)

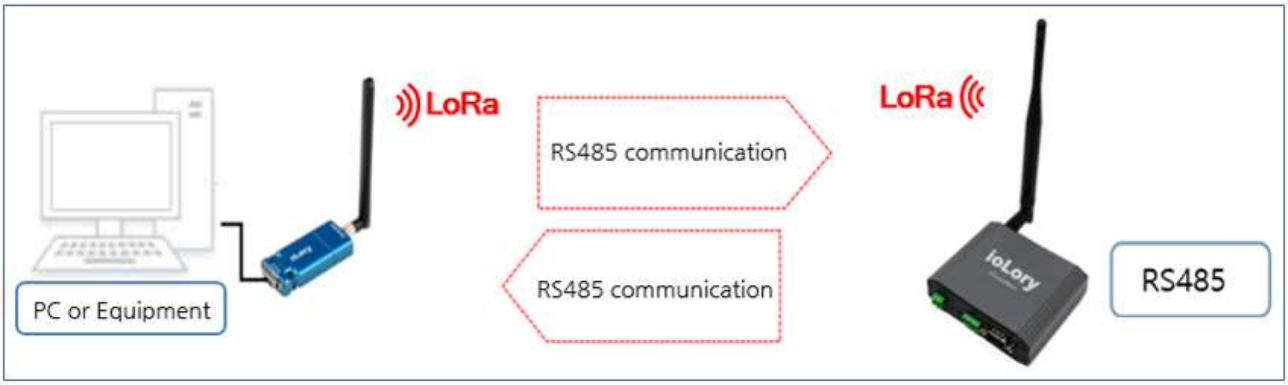
As shown in the figure above, if you convert the value "040101" into the HEX value through the serial port of the LoRa equipment on the other side of the ioLory, the value “040101” changes the status value of the corresponding port.

To interpret "040101", it is data that changes DO port no.1 to the ON state.

To Control RS485

The RS485 port in ioLory can be used as a Modbus port as a communication port, and can also be used in normal communication mode, allowing user to control the RS485 device connected to RS485.

In order to communicate with RS485 port, the opponent transmitting LoRa devices(sLory, uLory, LoryGate) which is the other side of the ioLory must communicate in the structure set by ioLory.



Through Serial, sLory can communicate with RS485 port by transmitting and receiving with ioLory via Serial.

The structure(protocol) of the data transmitted/received is as follows.

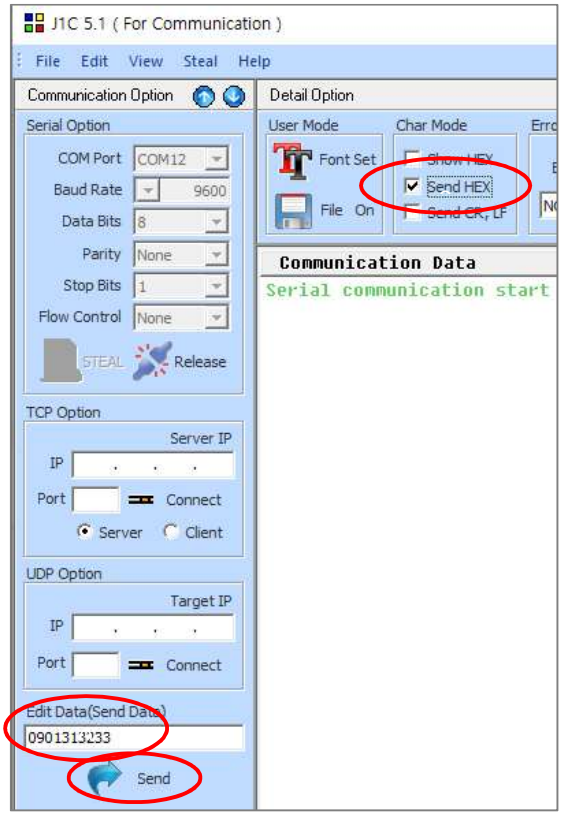
Number	Content	Note
1	Port Table Number(0x09)	0x09: RS485
2	Port Number(0x01)	0x01: RS485 port
3	Data to be received	-

Data must be converted into HEX values and transmitted.

*** The maximum amount of data transmitted and received by ioLory is 116Byte. If more data is transmitted and received, it should be divided into 116bytes for transmission and reception.**

Examples of data(transmitted/received) packets are as follows.

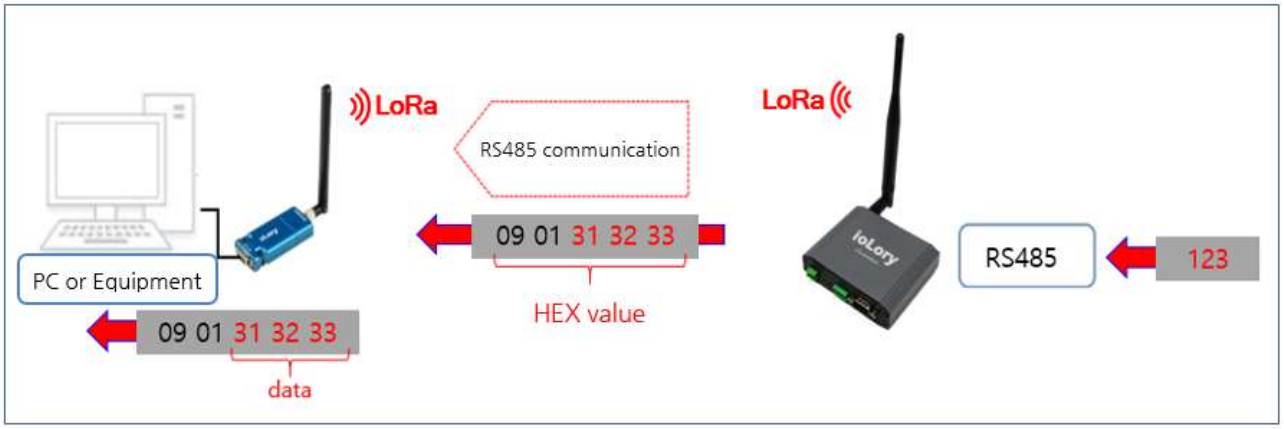
0x09 0x01 0x31 0x32 0x33 //Send data(character) 1 2 3 from RS485



Convert the input value into HEX value and Send.

(This is a screen using the J1C program as an example.)

As shown in the figure above, when the value "0901 313233" is converted into the HEX value through the serial port of the counterpart LoRa equipment of ioLory and transmitted, the value "123" corresponding to the data is transmitted and received to RS485 port.



② To Use Modbus Function

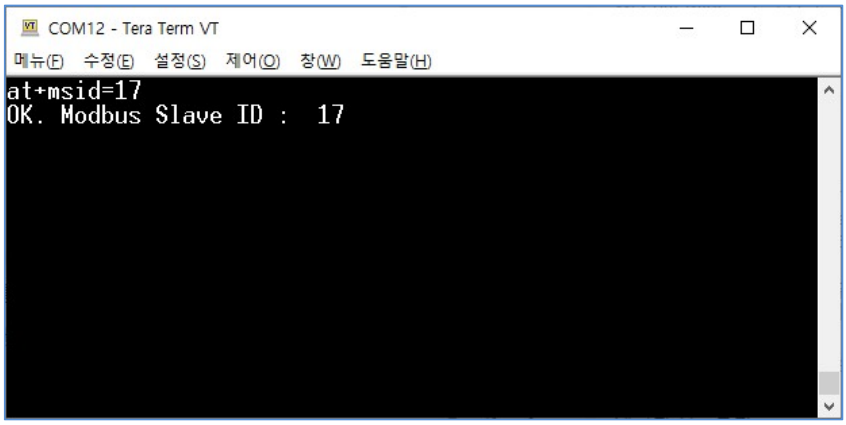
ioLory supports Modbus Serial using serial ports of the opponent LoRa devices(sLory, uLory, LoryGate).

You can control or check the status through Modbus communication from PC(application) or Modbus equipment connected to the serial port of the other products to equipment connected to each port of ioLory.

Preparations and Confirmation Matters

1) Modbus Slave ID Setting

Set Modbus Slave id with at+msid command in the console window as it acts as Modbus Slave of ioLory.

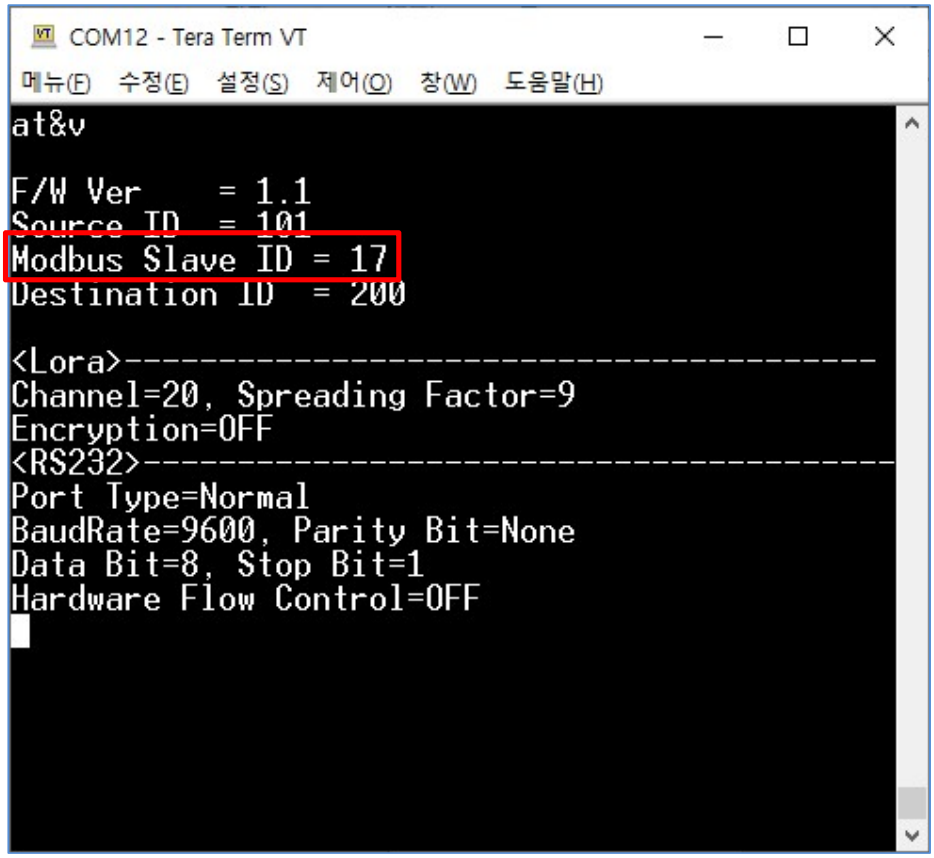


The Slave ID can be determined by the user to communicate with the Master.

*** For more information, please refer to " Example of Modbus Communication using Modbus Poll Utility" below.**

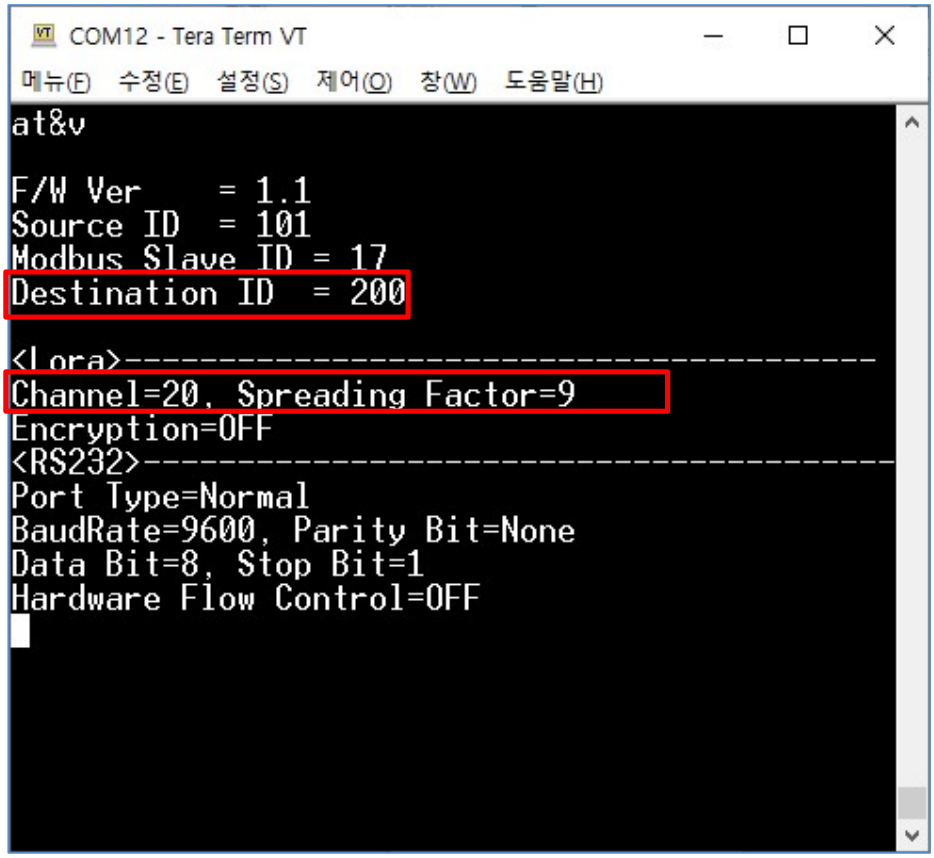
(The picture above is a screen exemplified by the Modbus Slave ID of ioLory as 17.)

The set slave id can be checked through the AT&V command.



2) How to Set LoRa-related settings

When Modbus communication is performed via LoRa, synchronize the settings related to LoRa with sLory(or uLory). (Channel, Spreading Factor, DID, etc)



3) Disable the Sync function

If the Sync function is activated for each port, you should disable it and use the Modbus function.

Otherwise, Modbus Packet and Sync data Packet will overlap and transmit, so errors may occur.

For example, the deactivation method of the DO port is,

AT+DO+SYNCINT=0; 0=Not transmitted because it is disabled.

AT+DO+SYNCST=0; 0=Not transmitted because it is disabled.

To use the Modbus function, all SYNC functions of each port(DO, DI, AI, RTD, RO) must be disabled.

*** Pleae refer to "7. Settings" for disabling Sync functions for each port.**

Modbus Register Map

Please refer to the Modbus Register Map for ioLory Registers list required for Modbus communication.

The Modbus Register Map of ioLory is as follows.

[03 : Read Holding Registers] Address 40001~40022

Addr	Data	R/W	Value	Note
0	DO#1 mode	R/W	1, 3	IO=1, PWM=3
1	DO#2 mode	R/W	1, 3	IO=1, PWM=3
2	DO#1 init	R/W	0~1	Low=0, High=1
3	DO#2 init	R/W	0~1	Low=0, High=1
4	DO#1 value	R/W	0~1	Low=0, High=1
5	DO#2 value	R/W	0~1	Low=0, High=1
6	DO#1 pwm high	R/W	0~1000	PWM=1~1000 , None=0
7	DO#1 pwm low	R/W	0~1000	PWM=1~1000 , None=0
8	DO#2 pwm high	R/W	0~1000	PWM=1~1000 , None=0
9	DO#2 pwm low	R/W	0~1000	PWM=1~1000 , None=0
10	DI#1 mode	R/W	1, 2	IO=1, Counter=2
11	DI#2 mode	R/W	1, 2	IO=1, Counter=2
12	DI#1 value	R/W	0~65535	Counter : clear=0, read=1~65535 IO : On=1, Off=0
13	DI#2 value	R/W	0~65535	Counter : clear=0, read=1~65535 IO : On=1, Off=0
14	AI sampling count	R/W	1~10	sampling=1~10
15	AI filtering min	R/W	0~65535	filtering=0~65535
16	AI filtering max	R/W	0~65535	filtering=0~65535
17	RTD sampling count	R/W	1~10	sampling=1~10
18	RTD filtering min	R/W	0~65535	filtering=0~65535
19	RTD filtering max	R/W	0~65535	filtering=0~65535
20	RO init	R/W	0~1	OFF=0, ON=1
21	RO value	R/W	0~1	OFF=0, ON=1

[04 : Read Input Registers] Address 30001~30007

Addr	Function	R/W	Value	Note
0	DO# 1 Status	R	0 ~ 1	Low=0, High=1
1	DO# 2 Status	R	0 ~ 1	Low=0, High=1
2	RO	R	0 ~ 1	OFF=0, ON=1
3	DI#1 Status	R	0 ~ 65535	Low=0, High=1, Counter=0~65535
4	DI#2 Status	R	0 ~ 65535	Low=0, High=1, Counter=0~65535
5	AI value	R	0 ~ 65535	AI value=0~65535
6	RTD value	R	0 ~ 65535	RTD value=0~65535

Example of Modbus Transmission/Reception Packet

1) Read Data - Request Port State(FC=04; Read Input Registers)

Request contents of register address #30001~30007 from the slave device of Address 17(0x11).

(Read current state of all the sensors of ioLory)

04(0x04) Read Input Register (Read Only)

Request	
Field Name	Hex
Slave Address	11
Function Code	04
Starting Address (High)	00
Starting Address (Low)	00
Number of Register (High)	00
Number of Register (Low)	07
CRC (High)	B3
CRC (Low)	58

Response	
Field Name	Hex
Slave Address	11
Function Code	04
Byte Count	0E
#30001 Register Value (High)	00
#30001 Register Value (Low)	01
#30002 Register Value (High)	00
#30002 Register Value (Low)	00
#30003 Register Value (High)	00
#30003 Register Value (Low)	00
.	.
.	.
#30007 Register Value (High)	FF
#30007 Register Value (Low)	01
CRC (High)	0C
CRC (Low)	CF

〈Request Packet〉

11 04 0000 0007 B358

11: The Slave Address (0x11: Slave ID 17)

04: The Function Code 4 (Read Input Registers)

0000: Data address of the first register requested. (0000hex = 0, + 30001 offset = input # 30001)

0007: The total number of registers requested. (7 registers #30001 to #30007 read)

B358: CRC for error check

〈Response Packet 〉

11 04 0E 0001 0000 0000 .... FF01 0CCF

11: The Slave Address (0x11: Slave ID 17)

04: The Function Code 3 (Read Input Registers)

0E: Number of data bytes to follow (7 registers x 2 bytes each = 14 bytes = 0x0E)

0001: Content of Register 30001(DO#1 port state)

0000: Content of Register 30002 (DO#2 port state)

.

.

.

.

FF01: Content of Register 30007(RTD value)

0CCF: CRC for error check

2) Read Data - Read Port Settings(FC=03; Read Holding Register)

03(0x03) Read Holding Register (Read/Write)

Request	
Field Name	Hex
Slave Address	11
Function Code	03
Starting Address (High)	00
Starting Address (Low)	00
Number of Register (High)	00
Number of Register (Low)	16
CRC (High)	C6
CRC (Low)	94

Response	
Field Name	Hex
Slave Address	11
Function Code	03
Byte Count	2C
#40001 Register Value (High)	00
#40001 Register Value (Low)	01
#40002 Register Value (High)	00
#40002 Register Value (Low)	01
#40003 Register Value (High)	00
#40003 Register Value (Low)	01
.	.
.	.
#40022 Register Value (High)	00
#40022 Register Value (Low)	00
CRC High	8C
CRC (Low)	09

〈Request Packet 〉

11 03 0000 0016 C694

11: The Slave Address (0x11: Slave ID 17)

03: The Function Code 6 (Read Holding Register)

0000: Data address for the first register requested (0000 hex = 0, + 40001 offset = input # 40001)

0016: Number of registers requested (Read 22(0x16) registers #40001 ~ #40022)

C694: CRC for error check

11 03 2C 0001 0001 0001 .... FF01 0CCF

11: The Slave Address (0x11: Slave ID 17)

03: The Function Code 3 (Read Input Registers)

2C: Number of data bytes to follow (22 registers x 2 bytes each = 44 bytes = 0x2C)

0001: Content of register 40001 (DO#1 mode)

0000: Content of register 40002 (DO#2 mode)

.

.

.

.

0000: Content of register 40022(RO state value)

0CCF: CRC for error check

3) Write Data - Write Port Settings (FC=06; Write Single Register)

06(0x06) Write Single Register

Request	
Field Name	Hex
Slave Address	11
Function Code	06
Data Address (High)	00
Data Address (Low)	01
value to write (High)	00
value to write (Low)	01
CRC (High)	1B
CRC (Low)	5A

Response	
Field Name	Hex
Slave Address	11
Function Code	06
Data Address (High)	00
Data Address (Low)	01
value written (High)	00
value written (Low)	01
CRC (High)	1B
CRC (Low)	5A

〈Request Packet〉

11 06 0001 0001 1B5A

11: The Slave Address (0x11: Slave ID 17)

06: The Function Code 6 (Preset Single Register)

0001: Data address of the register (0001 hex = 1, + 40001 offset = register # 40002(DO#2 mode))

0001: Writing value ➔ Change DO#2 Mode to IO mode

1B5A: CRC for error check

〈Response Packet〉

In the case of a normal packet, the transmission packet is received as it is(Echo).

11 06 0001 0001 1B5A

11: The Slave Address (0x11: Slave ID 17)

06: The Function Code 6 (Write Single Register)

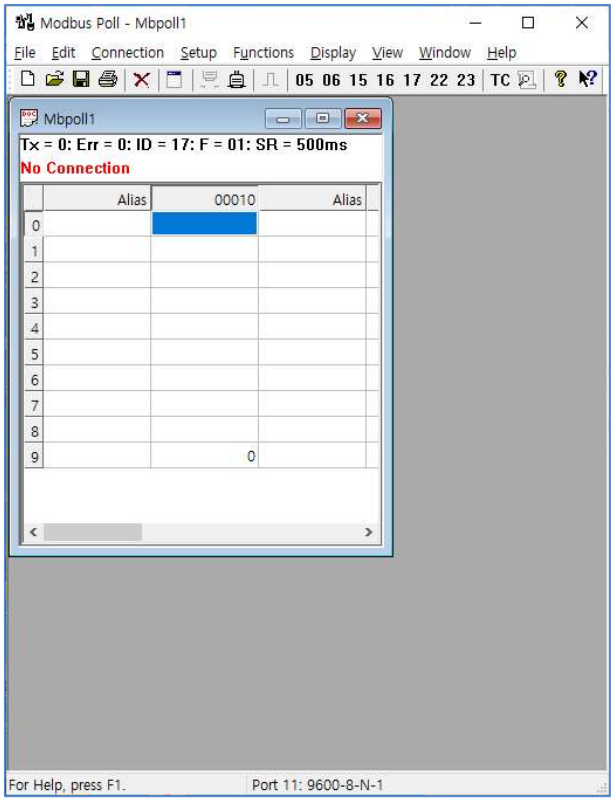
0001: The data address of the register (# 40002-40001=1)

0001: Written value

1B5A: CRC for error check

Example of Modbus Communication using Modbus Poll Utility

1) Run Modbus Poll.



2) Read/Write Definition

Select Setup → Read/Write Definition in the menu and create it with reference to the ioLory Register Map.

- Slave ID: Enter the Slave ID set to the command (AT+MSID) in ioLory.

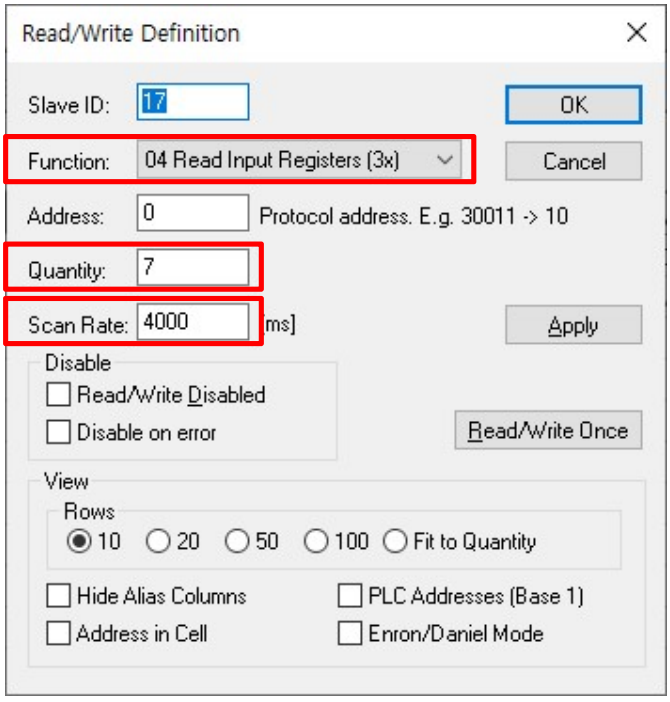
  Select Function Code.

  * Select Function:04 Read Input Registers (**3x**) to get the status and value of each port.

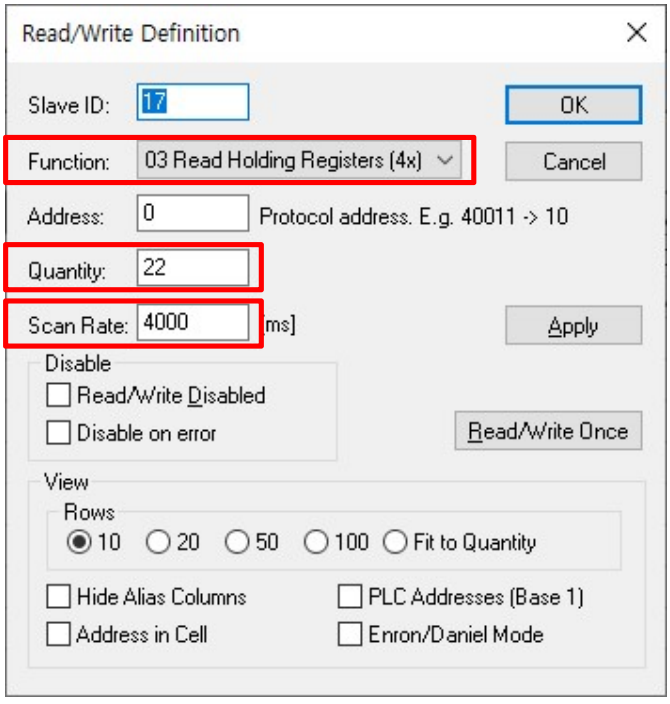
  * Select Function:03 Read Holding Registers (**4x**) to get the setting value of ioLory.

- Address: Enter the start address as '0'.
- Quantity: Enter the number of registers to be read.
- Scan Rate: Set to 4000ms or higher when using LoRa.
- Set the remaining settings as Default values.

〈Settings for importing each port state(value)〉

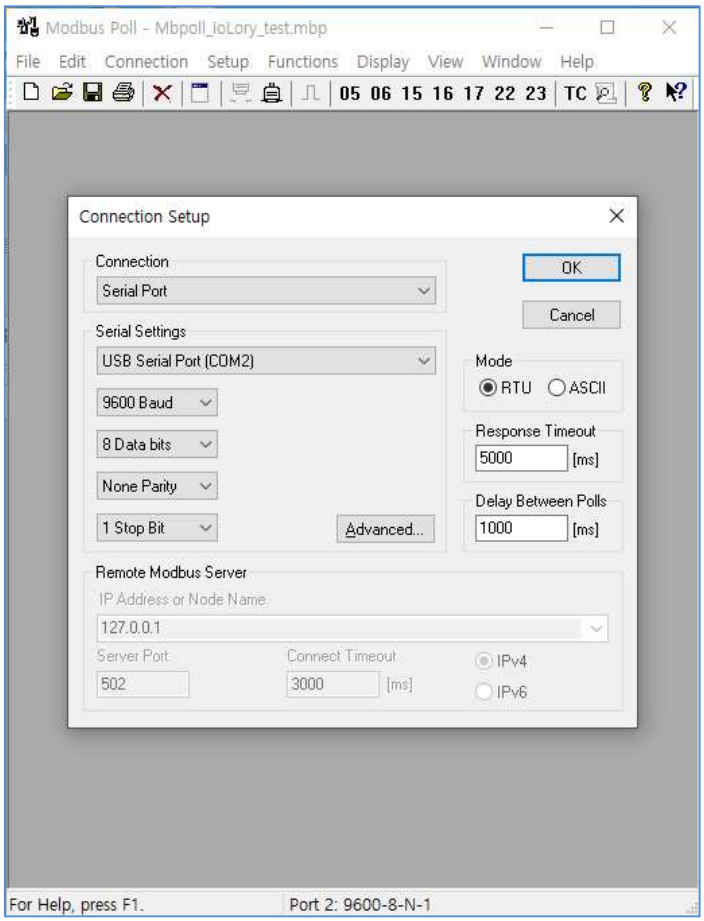


〈 Settings for importing ioLory setting value〉



3) Connection Setup

Select Connection → Connect in the menu to proceed with Modbus connection setting.

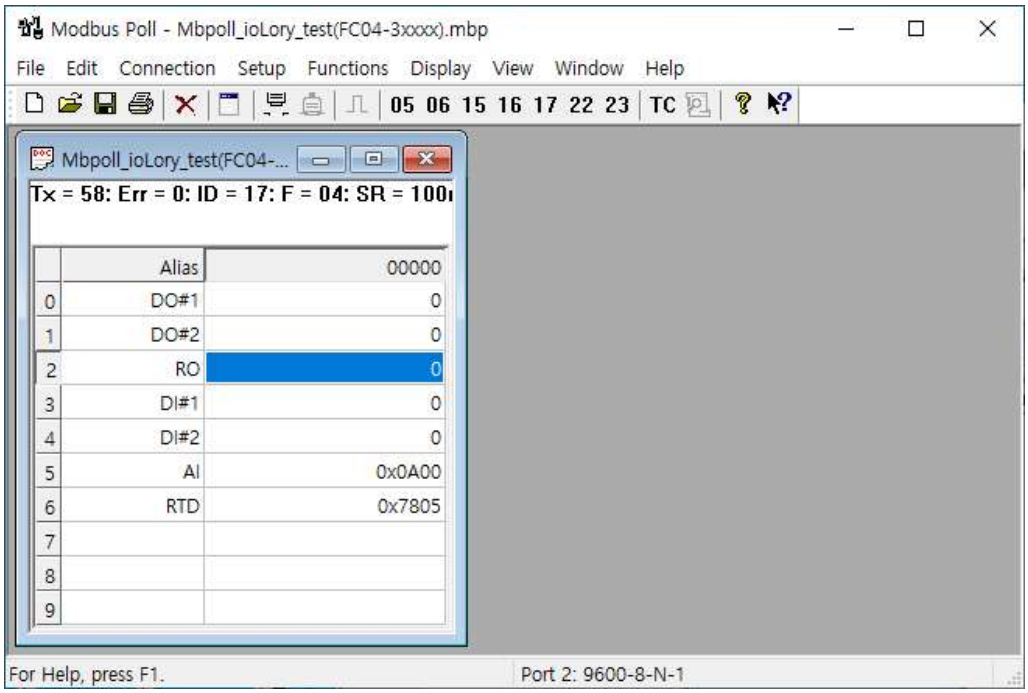


- Select the Serial Port in Connection as the Comport connected with the sLory and synchronize the sLory setting in setting to set the baud rate, data bits, parity, and stop bit.
- Select Modbus Mode(RTU/ASCII).
- Set Response Timeout. When using LoRa communication, the response may come late due to its characteristics, so set it sufficiently (more than 5,000ms).
- Set Delay Between Poll (1000ms recommended when using LoRa).
- When the setting is complete, press the OK button to try to connect.

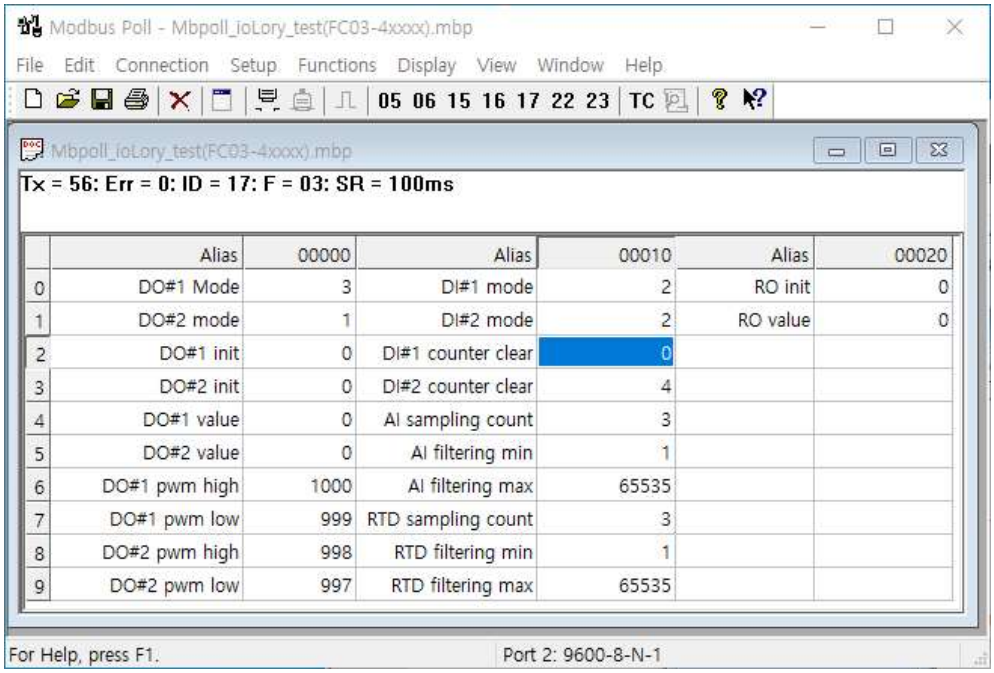
4) Check communication and check status values.

When Modbus communication is carried out normally, you can check the value received from ioLory as shown in the figure below.

〈FC04 - Result of importing port status information using Read Input Registers〉



〈FC03 - Result of importing ioLory setting information using Read Holding Registers〉



* If the user enters the alias directly in Alias, it will be easy to verify.

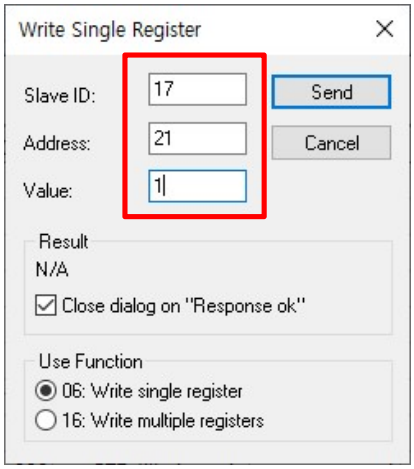
5) How to Write Data

DO#1, DO#2, and RO port can be controlled through the Modbus function, and other setting values of ioLory can be changed.

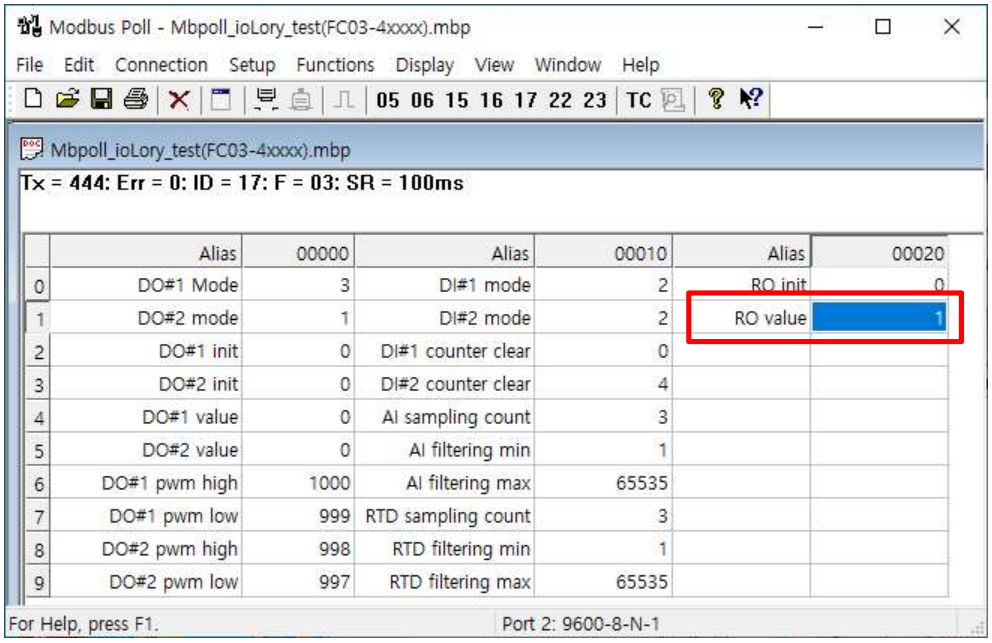
Select Function → 06:Write Single Register in the menu, write Slave ID, Address, Value, and press the Send button to send the command to the corresponding Slave ID.

Write commands are only available for Holding Register (4xxx) addresses. (Unavailable for Input Register (3xxx)

The example below means to write the #40022 (21 Address; RO Value) register value of Slave ID 17 as '1'.

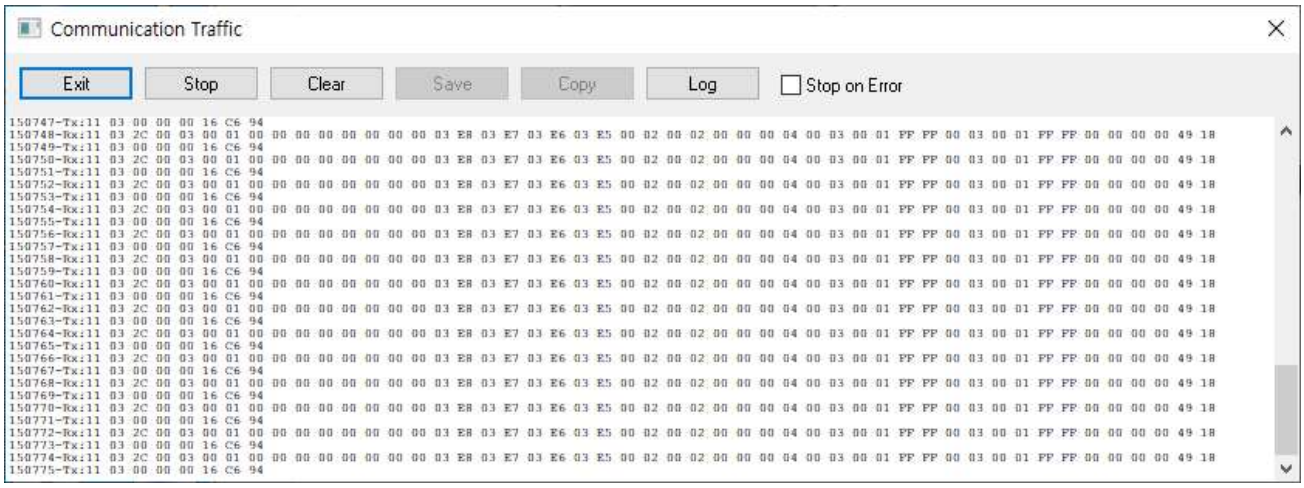


Once it is checked in Close dialog on “Response ok” and when normal control is completed, the window will automatically close, and you can check that the RO control has been completed(Status is changed to ‘1’).

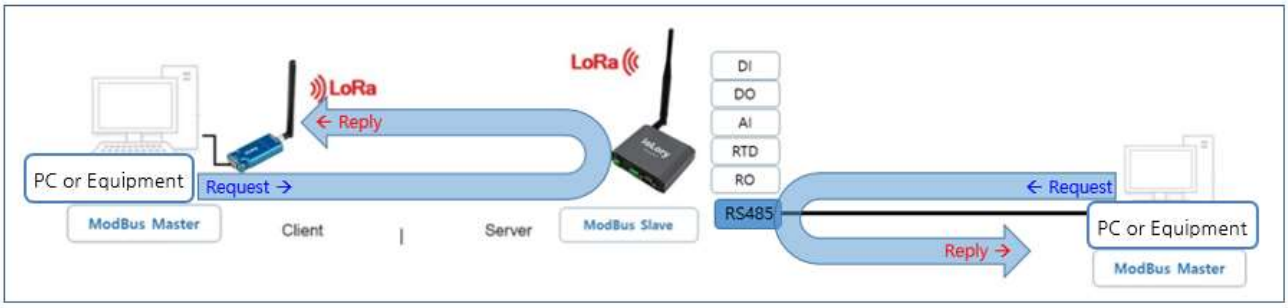


6) Debugging Communication Stats

Select Display → Communication in the menu to check the transmission and reception packets.



In addition to Modbus communication through LoRa of ioLory, data can also be transmitted and received through RS485 port of ioLory.



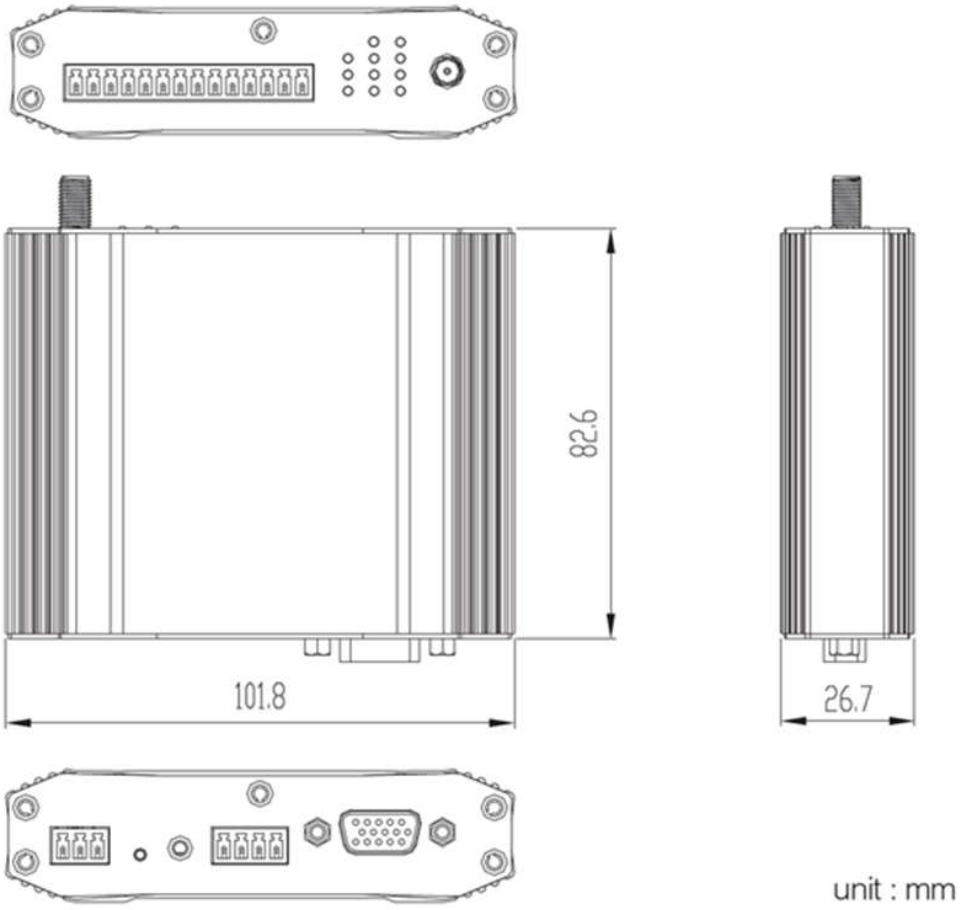
---------- APPENDIX ----------

1. Specification

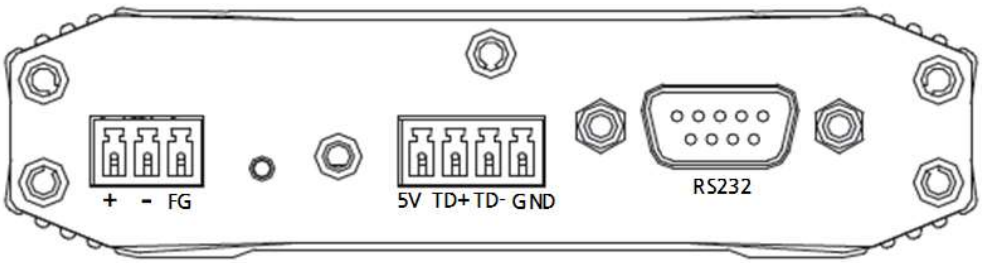
Category	Item		Specification
Wireless Interface	Frequency Band		917 ~ 923MHz(ISM Band)
	Modulation		LoRa
	Security		AES128 Encryption(Default: Disable)
	Antenna		+2.5 dBi Gain Load Antenna applied
Wired Interface	Serial	RS485	Power supply of 5V (500mA) is available using PIN no.1.
		RS232	For setup, DB9 male
	DI	Input Voltage Range: 10-26VDC Input Current: 5mA@12VDC 11mA@24VDC	Input Impedance: 2200 ohms
	DO	Maximum Voltage: 12~36VDC Maximum Current: 100mA/ch VceOn: Max. 1.1VDC	Dry method Open Collector Type (Brain Child form)
	AI	0(2)~10VDC or 0(1)~5VDC 0(4)~20mA	16 bit resolution Designed for both AIV and AII types
	RTD	RTD	Resistance Temperature Detector Temperature Sensor
	RO	Logic Voltage: 24VDC Logic Current: 42mA Max. Current: 0.5A@220VAC 1A@28VDC	Relay Output (Wet method) Relay Type(Form C, SPDT) (3 contact points applied just like BrainChild product)

Display	LED	RDY, 232, 485, LoRa, DI x2, DO x2, RO, RTD, AI
	Switch	Reset(within 1 second) or Factory Initialization(more than 3 seconds)
Operating Environment	Temperature	-40~85℃ (-40~185℉)
	Humidity	5~95%
	Sleep Mode	Provides a power cut function of a module that consumes power in a device (LoRa, Relay, Serial Driver, etc)
Power	Input Power	DC 12~48V. 1A or higher external battery connectable
	Filed Power	DC 12~24V. 1A or higher 2 contact points
	Isolation	1000~1500Vrms between field and logic
KC Certification Number		R-R-STB-ioLory17TIL

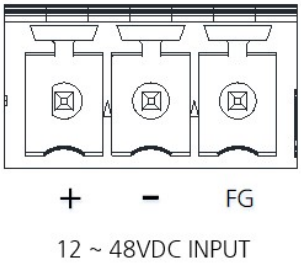
2. Dimension



3. Connector & Pin Specifications



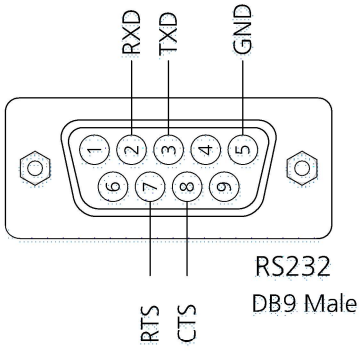
Power Port & Pin Specifications



Item	Description
V+	Power Input
V-	Power Input
FG	Frame Ground

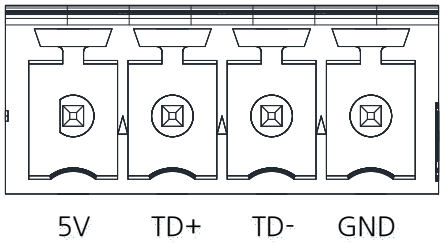
* Non-polar terminal

RS232 Port & Pin Specifications



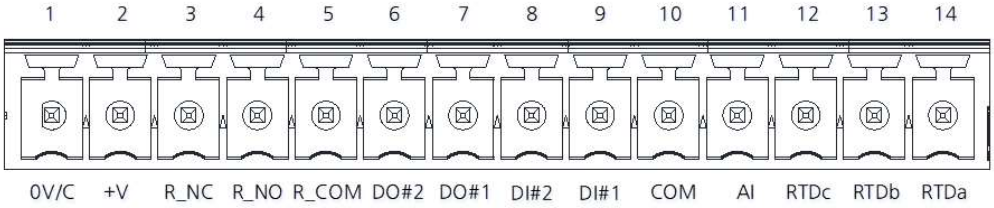
Item	Description
RXD	Receive Data
TXD	Transmit Data
GND	Ground
RTS	Request to Send
CTS	Clear to Send

RS485 Port & Pin Specifications



Item	Description
5V	5V Output (500mA)
TD+	Transmit/Receive Data +
TD-	Transmit/Receive Data -
GND	Signal Ground

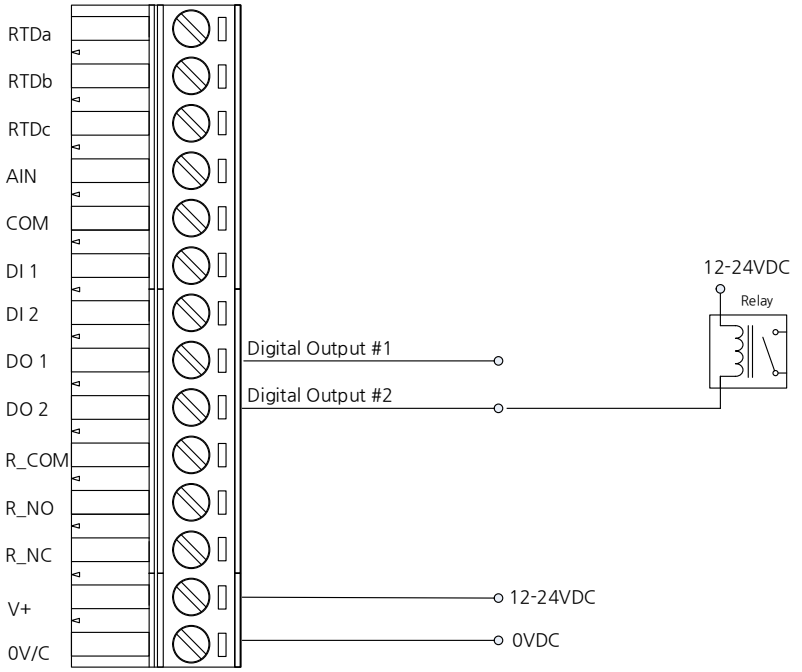
I/O Port & Pin Specifications



Item	Description
OV/C	Ground Terminal (Field Ground)
+V	12~24VDC Voltage + Terminal (12-24VDC)
R_NC	Initial Status of Relay(Relay Normally Closed)
R_NO	Operates when changing status of Relay (Relay Normally Open)
R_COM	Relay Ground Terminal (Relay Common)
DO#1	DO Port no.1 (Digital Output #1)
DO#2	DO Port no.2 (Digital Output #2)
DI#1	DI Port no.1 (Digital Input #1)
DI#2	DI Port no.2 (Digital Input #2)
A_COM	Analog Ground Terminal (Analog Common)
AIN	Analog Input Terminal (Analog Input)
RTDc	RTD Lo
RTDb	RTD Lo
RTDa	RTD Hi

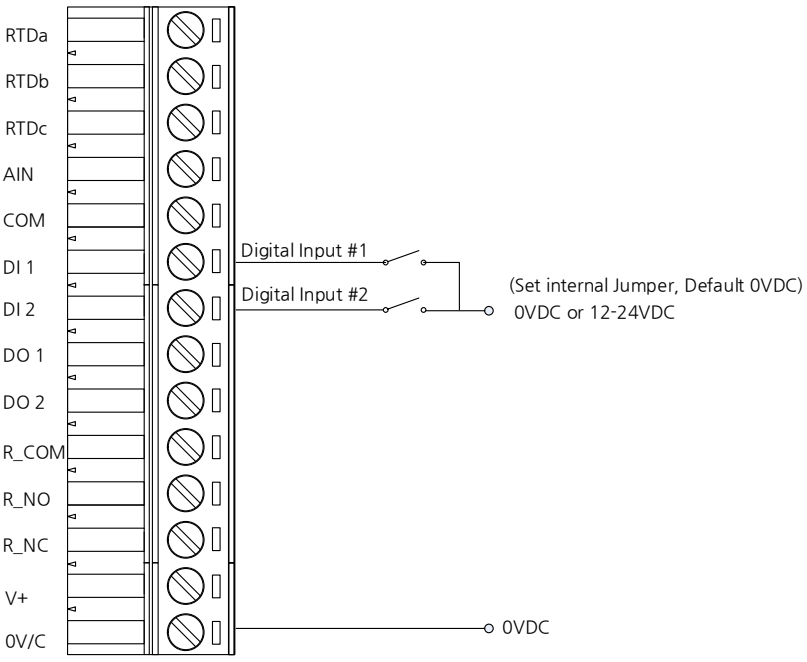
4. How to Wire

DO Wiring

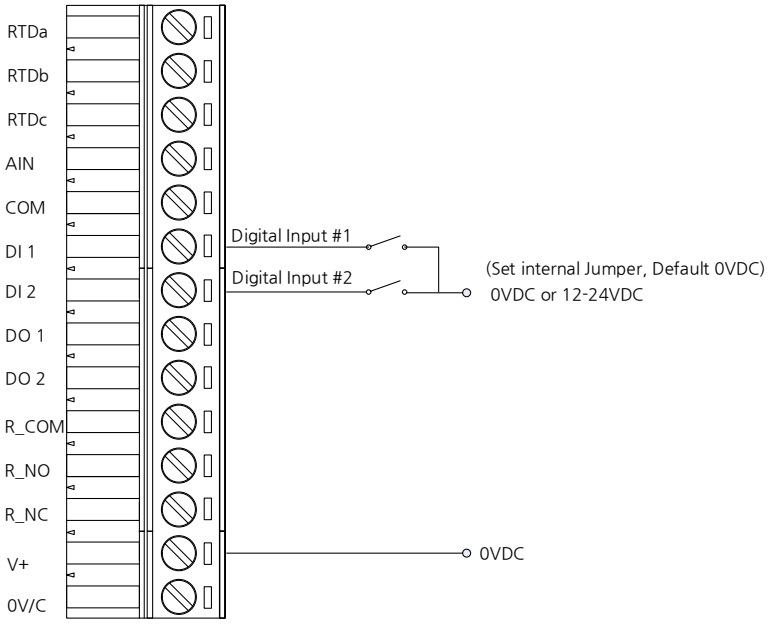


DO1 and DO2 operate normally when applying 12~24VDC to V+ and connect ground to 0V/C.

DI Wiring

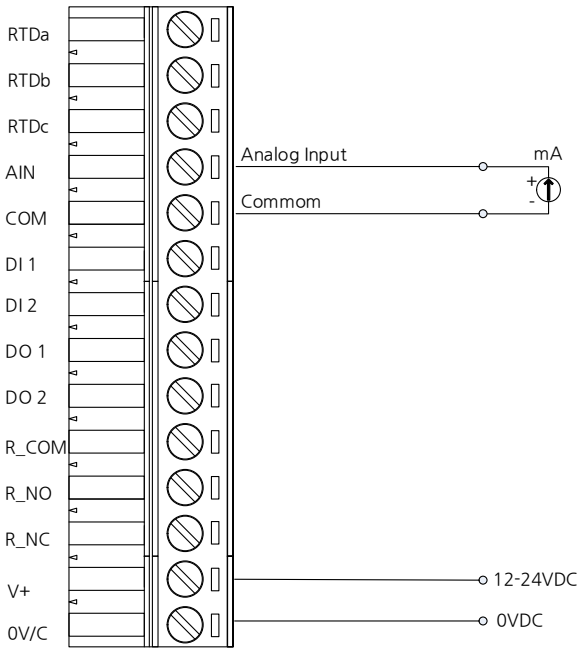


The above wiring is PNP-type. It should be connected to the jumper by the PNP as in the "Jumper Settings" guide below. DI operates normally when applying 12~24VDC to DI1 or DI2 and connect ground to 0V/C.

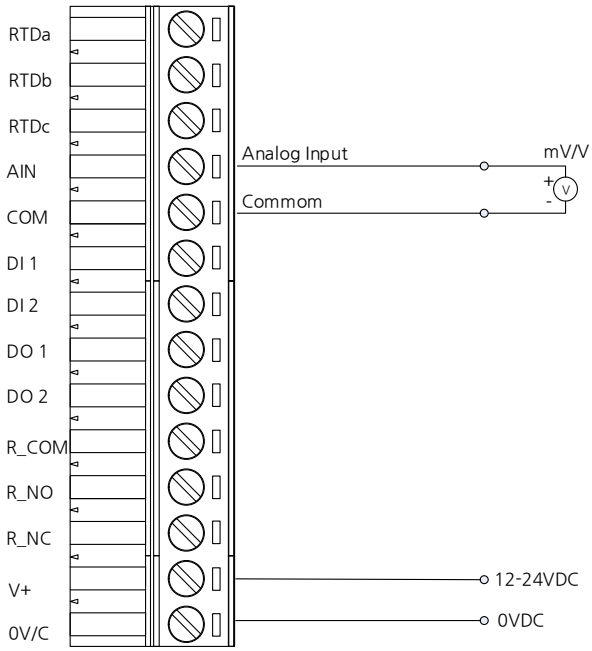


The above wiring is NPN-type. It should be connected to the jumper by NPN as in the "Jumper Settings" guide below. DI operates normally when applying 12~24VDC to DI or DI2 and connect power to V+.

AI Wiring



〈AI Ampere Mode〉



〈AI Voltage Mode〉

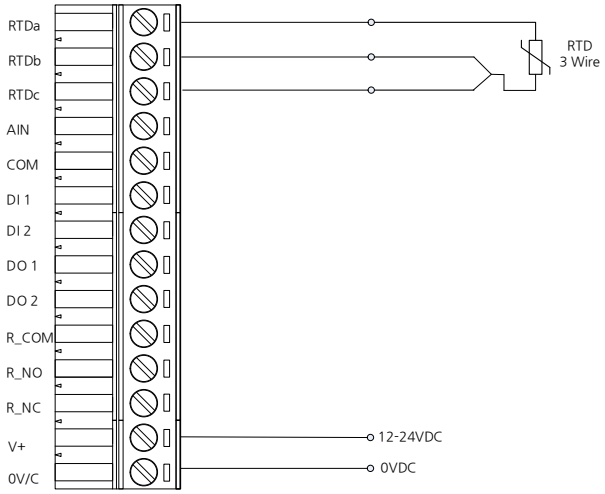
AIN operates normally when applying 12~24VDC to V+ and connect ground to COM or 0V/C.

The location of the J8 PIN must be changed according to the AI Ampere/Voltage Mode.

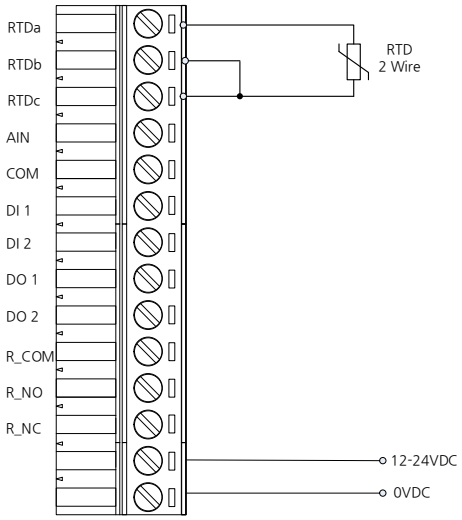
(Please refer to 4. Functions - AI(Analog In) ports)

* Please refer to “APPENDIX - 5. Calibration” for the bit value of Voltage/Current of AI.

RTD Wiring



〈For 3 lines〉



〈For 2 lines〉

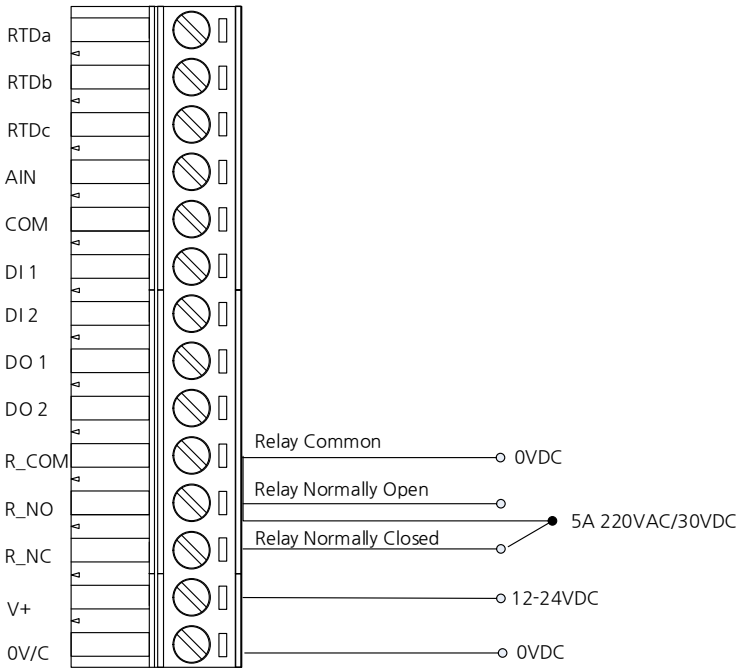
The RTD sensor value can be read normally when applying 12~24VDC to V+ and connect ground to 0V/C.

* In case of 3 lines: Connect all 3 lines.

  In case of 2 lines: Short - RTDb and RTDc lines.

* Please refer to "APPENDIX -5. Calibration" for bit values of RTD temperature values.

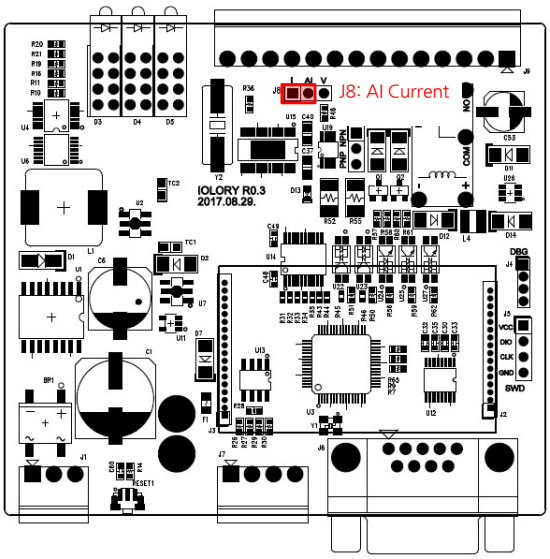
RO Wiring



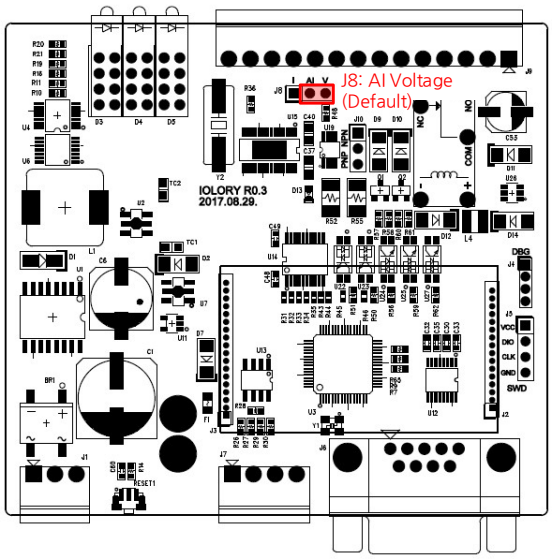
R_NO, R_NC will operate normally when applying 12~24VDC to V+ and connect ground to 0/C and R_COM.

Jumper Setting

For AI ports, select the current or voltage with the J8 jumper inside the product.



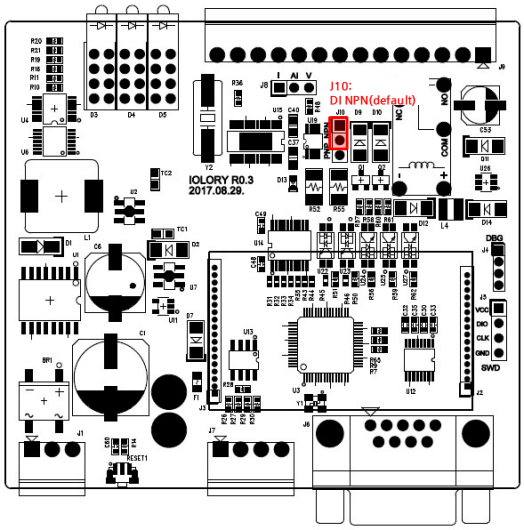
〈AI Ampere〉



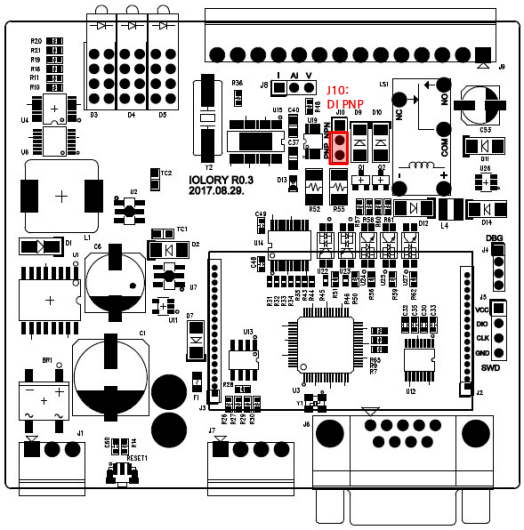
〈AI Voltage(default)〉

Item	Measuring method
AI - I	Current
AI - V	Voltage (default)

For DI ports, select the NPN or PNP input method with the J10 jumper.



〈NPN (default)〉



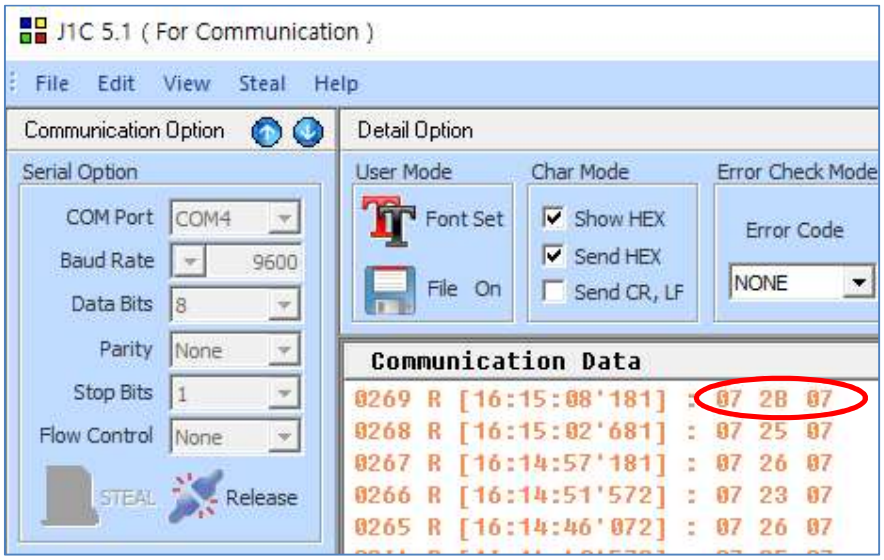
〈PNP Voltage〉

Item	Input voltage
NPN	Set - (default)

5. Calibration

Calibration is a table showing the voltage and current of AI and the temperature value of RTD according to the Bit values of **AI** and **RTD** of the ioLory. The error range of the bit value for each devices is about ±10~30, and it may be larger depending on the surrounding environment.

Example of use)



If RTD reception value is 0x**07**2B07,

07: Port Table Number of RTD

2B07: 072B Proceed Little Endian into Hex calue → Convert to DEC value: 1835 → Compare the table Bit value with 1835 → Means about 30 C°

Also check the voltage/current value by comparing the AI values with the table.

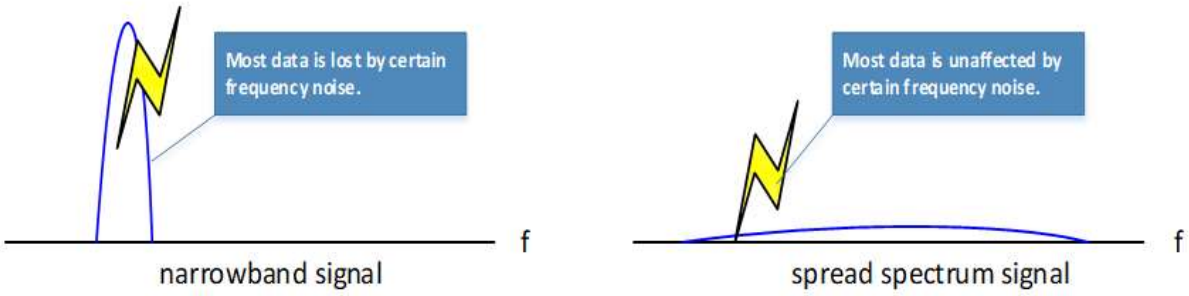
AI				RTD	
Voltage(V)	Bit Value	Current(mA)	Bit Value	Temperature(C°)	Bit Value
0.0	5	0.0	5	200	2930
0.4	1297	0.4	323	190	2878
0.8	2589	0.8	642	180	2800
1.2	3881	1.2	959	170	2721
1.6	5173	1.6	1276	160	2698
2.0	6464	2.0	1595	150	2619

2.4	7756	2.4	1912	140	2560
2.8	9048	2.8	2230	130	2467
3.2	10340	3.2	2548	120	2421
3.6	11632	3.6	2866	110	2363
4.0	12924	4.0	3183	100	2290
4.4	14216	4.4	3502	95	2271
4.8	15508	4.8	3820	90	2231
5.2	16801	5.2	4137	85	2199
5.6	18092	5.6	4455	80	2154
6.0	19384	6.0	4772	75	2139
6.4	20676	6.4	5091	70	2112
6.8	22000	6.8	5408	65	2078
7.2	23260	7.2	5726	60	2044
7.6	24554	7.6	6045	55	2007
8.0	25843	8.0	6362	50	1974
8.4	27135	8.4	6680	45	1934
8.8	28426	8.8	6998	40	1881
9.2	29718	9.2	7315	35	1859
9.6	31010	9.6	7634	30	1835
10.0	32302	10.0	7952	25	1813
		10.4	8270	20	1774
		10.8	8587	15	1753
		11.2	8906	10	1717
		11.6	9223	5	1682
		12.0	9540	0	1635
		12.4	9859	-5	1608
		12.8	10176	-10	1587
		13.2	10495	-15	1557
		13.6	10813	-20	1514
		14.0	11131	-25	1477
		14.4	11450	-30	1445

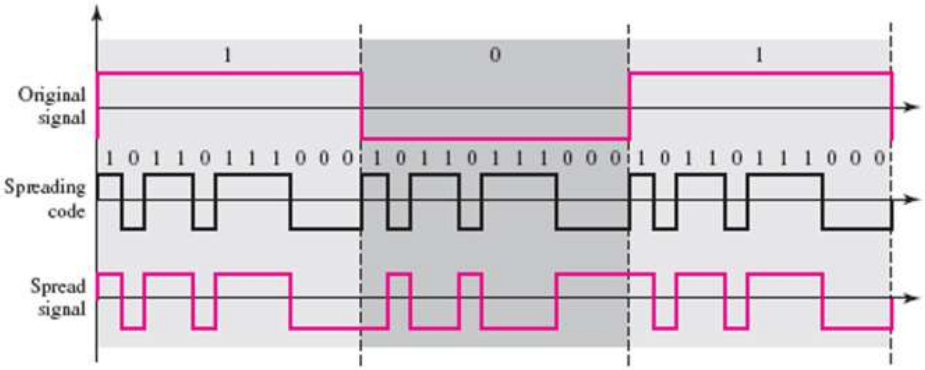
		14.8	11768	-35	1418
		15.2	12086	-40	1387
		15.6	12404	-45	1329
		16.0	12722	-50	1311
		16.4	13040	-60	1247
		16.8	13359	-70	1161
		17.2	13677	-80	1105
		17.6	13995	-90	1060
		18.0	14314	-100	991
		18.4	14633	-110	905
		18.8	14951	-120	848
		19.2	15269	-130	790
		19.6	15588	-140	741
		20.0	15906	-150	633
				-160	568
				-170	492
				-180	436
				-190	372
				-200	295

6. LoRa Spreading Factor

Spreading Factor is the value of how wide the spectrum can be spread by the Spreading Code in the original data signal band. This allows multiple radio signals to be distributed across a wide band of frequencies that are strong against external electromagnetic noises when they are shared in competition with one radio channel, thereby reducing data distortion caused by noise.



The principle of this approach is to transmit binary data signals, which will be transmitted, by modulating them with another binary code(bit pattern) called the Spreading Code, spreading them across the frequency of use. At this point, the greater the value of the spreading code, the greater the possibility that it will be restored to its original data. This value of the spreading code is the Spreading Factor.



principle of spreading signal

The higher the value of the Spreading Factor, the stronger the noise and the greater the range of distance, but the lower the transmission speed inversely.

Ch(channel) is subdivided value of Lora frequency area from 1 to 20.

SF(spreading factor) is the value dividing the number of radio frequency modulation from 7 to 12.

If SF is low, the amount of data that can be transferred increases but the distance becomes shorter, and if SF is high, it will be opposite.

7. Certification

- KC

  Number: R-R-STB-ioLory17TIL

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www.sysbas.com

Tel: +82-2-855-0501

Fax: +82-2-855-0580

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