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Warranty

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If you have any questions, please feel free to contact us via email at:

service@icpdas.com

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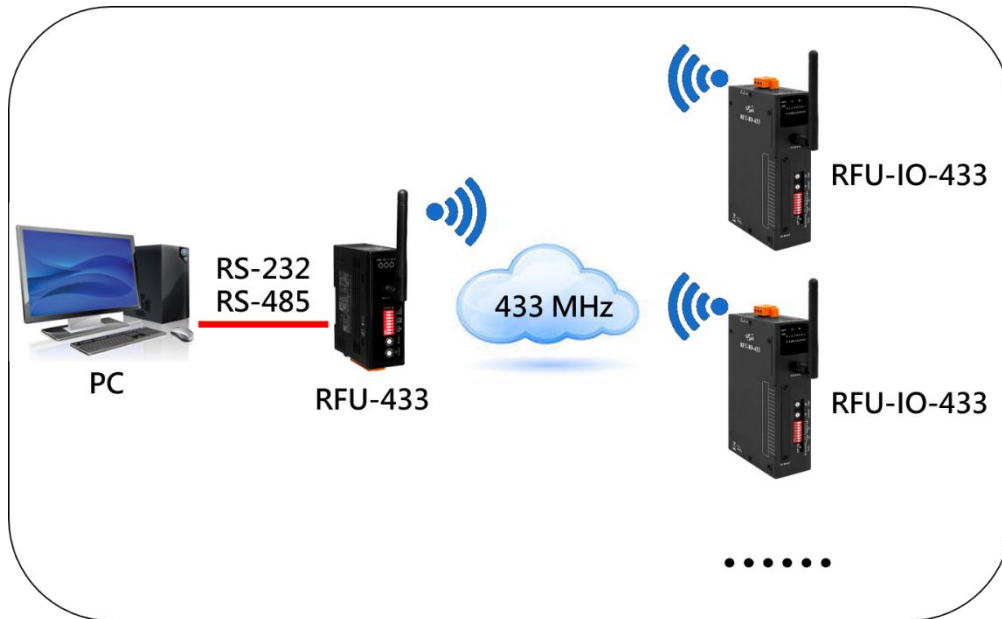
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1. Introduction

RFU-IO-433 is a 433 MHz RF wireless I/O unit that uses the Modbus communication protocol. A remote Modbus master can use a 433 MHz wireless converter, such as the RFU-433, to convert Modbus commands into 433 MHz signals to control the RFU-IO-433, thereby implementing a wireless I/O solution.



The RFU-IO-433 can achieve a transmission distance of 300 meters at a wireless baud rate of 9600 bps in a line-of-sight environment. To address potential environmental interference, the RFU-IO-433 offers multiple wireless baud rate options, ranging from 57600 bps to 650 bps, allowing users to make adjustments. Additionally, users can adjust the wireless channel and group ID to avoid interference between adjacent 433 MHz networks. The RFU-IO-433 supports repeater mode to overcome communication distance and dead zone issues. The RFU-IO-433 also provides I/O pair-connection mode for remote I/O control without a host. These features can be configured via rotary and dip switches, making system maintenance and equipment replacement simple and convenient.

1.1 Features

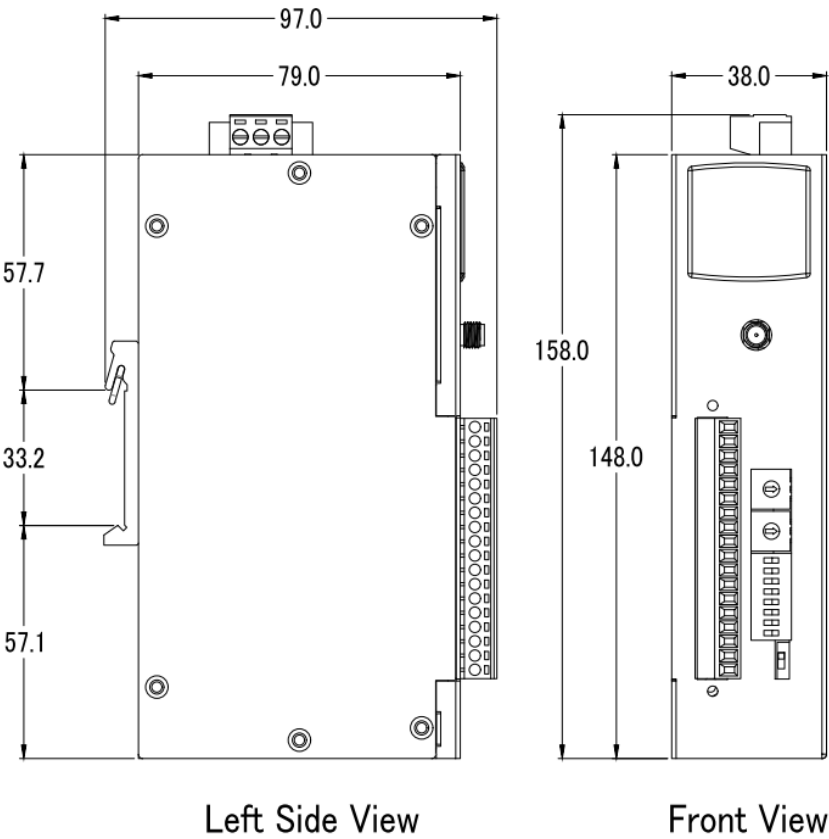
- 433 MHz Radio Frequency
- 16 RF channels with 100 kHz channel spacing
- Provides RF Baud Rates from 650 to 57600 bps
- RF output power default 10 dBm
- Provides 4 Group IDs numbered from 0 ~ 3.
- Wireless line of sight (LOS) transmission range of up to 300 meters at an RF Baud Rate of 9600 bps and output power 10 dBm.
- Modbus RTU communication protocol.
- Modbus station ID: 1 ~ 32.
- Supports XV I/O board.
- Supports I/O pair-connection mode.
- Supports repeater mode
- ESD Protection: Contact +/-4 kV
- DIN-Rail Mountable
- Operating Temperatures, -25°C ~ +75°C

1.2 Specification

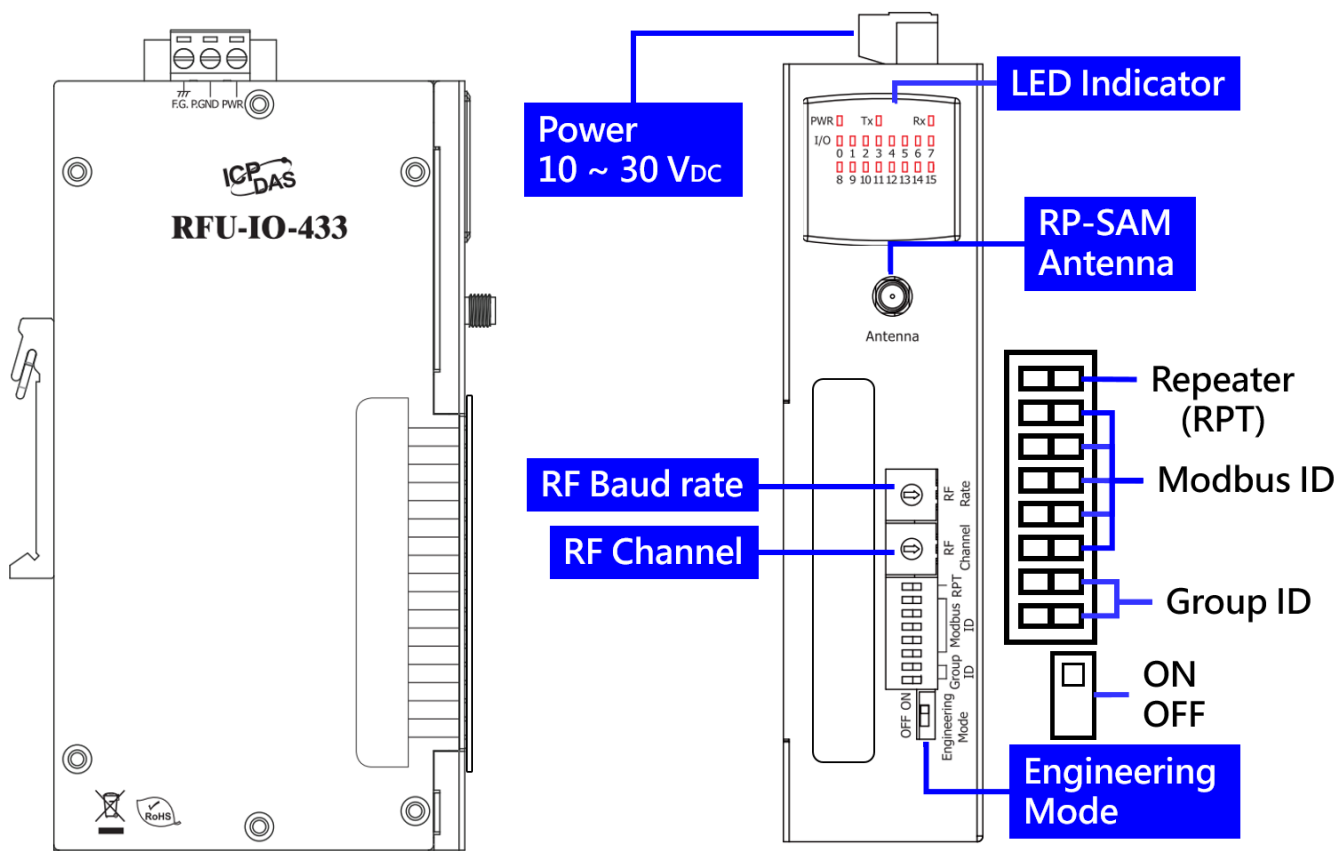
RF Interface	
Radio Frequency	433.1 MHz ~ 434.6 MHz
Channels	0 ~ 15
Baud Rate	650 ~ 57600 bps
Transmission Power	Default 10 dBm
Antenna	0 dBi Omni directional, RP-SMA
Transmission Distance (LoS)	300 m (9600 bps, output power 10 dBm)
Group ID	0 ~ 3
Protocols	Modbus RTU
Repeater	Support repeater mode
LED Indicators	
RF_Tx	Green (RF Transmit)
RF_Rx	Yellow (RF Receive)
PWR	Red (Power)
I/O LED	16 ch I/O Indicators (There are different arrangements depending on the expansion board)
EMS Protection	
ESD	+/- 4 kV Contact
EFT	+/- 1 kV
Surge	+/- 1 kV

Power	
Input Voltage Range	+10 V _{DC} ~ +30 V _{DC}
Power Consumption	1.2 W @ 24 V _{DC} (not include XV board)
Mechanical	
Dimensions (W x L x H) (not include antenna)	158 mm x 38 mm x 97 mm
Antenna Dimensions (L x Ø)	108 mm x 10 mm
Installation	DIN-Rail
Environment	
Operating Temperature	-25°C ~ +75°C
Storage Temperature	-30°C ~ +80°C
Relative Humidity	10 to 90% RH (Non-condensing)

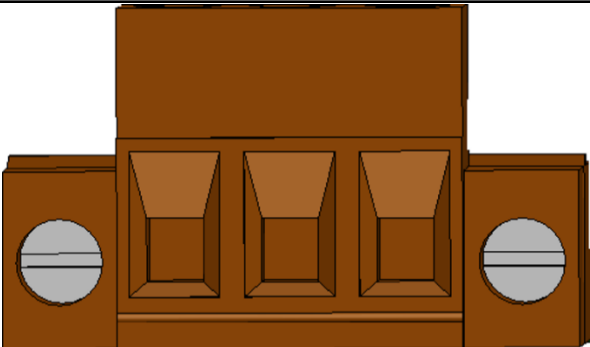
1.3 Dimensions



1.4 Appearance



Terminal Block

	Pin	Description
 +Vs GND F.G.	+Vs	Power: +10 ~ +30 V _{DC} , 1A
	GND	
	F.G.	Frame Ground

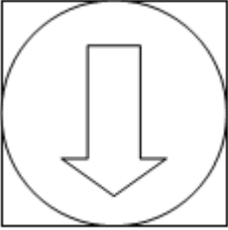
LED Indicator

LED	Behavior	Description
PWR	On	+10 ~ +30 VDC Power On
	Off	Power Off
	1000ms Flash	The XV board does not support pair-connection mode
RF_Tx	On	RF is transmitting data
	Off	RF is no data to transmit
RF_Rx	Always On	RF is receiving data, signal strength high
	100ms Flash	RF is receiving data, signal strength middle
	500ms Flash	RF is receiving data, signal strength low
	Off	RF is no data to receive
RF_Tx / RF_Rx	Interactive flashes per second	The IO version does not support Pair-connection mode.

2. Configuration

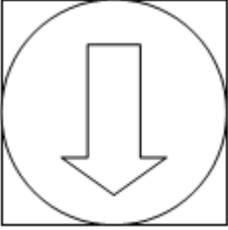
The RFU-IO-433 has the following descriptions about the rotary and dip switches in the hardware setting mode :

RF Baud Rate

Switch Name	Number	Baud Rate (bps)	Number	Baud Rate (bps)
 RF Baud Rate	1	57600	7	1200
	2	38400	8	650
	3	19200	A*	Master
	4	9600	B*	Slave
	5	4800	C*	Unresponsive Slave
	6	2400	0, 9, D, E, F	Reserve (19200)

- A, B, C are Pair-connection dedicated modes, please refer to Chapter 4 for details.

RF Channel

Switch Name	Channel	Frequency (MHz)	Channel	Frequency (MHz)
 RF Channel	0	433.1000	8	433.9000
	1	433.2000	9	434.0000
	2	433.3000	A	434.1000
	3	433.4000	B	434.2000
	4	433.5000	C	434.3000
	5	433.6000	D	434.4000
	6	433.7000	E	434.5000
	7	433.8000	F	434.6000

Group ID

Switch Name	DIP 1	DIP 2	Group ID
ON 12345678 Group ID	Off	Off	0
	<u>On</u>	Off	1
	Off	<u>On</u>	2
	<u>On</u>	<u>On</u>	3

* RFU-IO-433 units with different group IDs cannot communicate with each other.

Modbus ID

ON 12345678 ID Range: 1 ~ 32					
DIP 3	DIP 4	DIP 5	DIP 6	DIP 7	Modbus ID
Off	Off	Off	Off	Off	1
<u>On</u>	Off	Off	Off	Off	2
Off	<u>On</u>	Off	Off	Off	3
<u>On</u>	<u>On</u>	Off	Off	Off	4
Off	Off	<u>On</u>	Off	Off	5
<u>On</u>	Off	<u>On</u>	Off	Off	6
Off	<u>On</u>	<u>On</u>	Off	Off	7
<u>On</u>	<u>On</u>	<u>On</u>	Off	Off	8
Off	Off	Off	<u>On</u>	Off	9
<u>On</u>	Off	Off	<u>On</u>	Off	10
Off	<u>On</u>	Off	<u>On</u>	Off	11
<u>On</u>	<u>On</u>	Off	<u>On</u>	Off	12
Off	Off	<u>On</u>	<u>On</u>	Off	13
<u>On</u>	Off	<u>On</u>	<u>On</u>	Off	14
Off	<u>On</u>	<u>On</u>	<u>On</u>	Off	15
<u>On</u>	<u>On</u>	<u>On</u>	<u>On</u>	Off	16

Off	Off	Off	Off	<u>On</u>	17
<u>On</u>	Off	Off	Off	<u>On</u>	18
Off	<u>On</u>	Off	Off	<u>On</u>	19
<u>On</u>	<u>On</u>	Off	Off	<u>On</u>	20
Off	Off	<u>On</u>	Off	<u>On</u>	21
<u>On</u>	Off	<u>On</u>	Off	<u>On</u>	22
Off	<u>On</u>	<u>On</u>	Off	<u>On</u>	23
<u>On</u>	<u>On</u>	<u>On</u>	Off	<u>On</u>	24
Off	Off	Off	<u>On</u>	<u>On</u>	25
<u>On</u>	Off	Off	<u>On</u>	<u>On</u>	26
Off	<u>On</u>	Off	<u>On</u>	<u>On</u>	27
<u>On</u>	<u>On</u>	Off	<u>On</u>	<u>On</u>	28
Off	Off	<u>On</u>	<u>On</u>	<u>On</u>	29
<u>On</u>	Off	<u>On</u>	<u>On</u>	<u>On</u>	30
Off	<u>On</u>	<u>On</u>	<u>On</u>	<u>On</u>	31
<u>On</u>	<u>On</u>	<u>On</u>	<u>On</u>	<u>On</u>	32

Repeater Mode (RPT)

Switch Name	DIP 8	Working Mode
ON 1 2 3 4 5 6 7 8 Repeater Mode		Normal Mode Repeater Mode (Support 1 hub)*

* The repeater mode can bypass RF message from one side to another For example, if the RFU-IO-433 received a message "0x01 0x02 0x03 0x04", then the repeater will transmitted the same message to RF. **Note that, repeater mode only support 1 hub. It is therefore recommended to avoid enabling multiple repeaters in the same field.**

Engineering Mode

Switch Name	Status	Description
 Off On	Off	Normal Mode
	On*	Engineering Mode

* Engineering mode is designed for special needs, its function may not comply with the general regulations and standards. In this mode, the transmission power will be strengthened from the original 10 dbm to 19 dbm, and at the same time, the 10% message duty cycle limit will be canceled. The user can be adjusted according to the special needs of the project. But should pay attention to the possible regulatory limitations. Please use with caution.

3. Modbus Address of RFU-IO-433

Regarding the Modbus address of RFU-IO-433, the following only lists the Modbus address of RFU-IO-433. For the parts related to the expansion functions, please refer to the expansion board user manual.

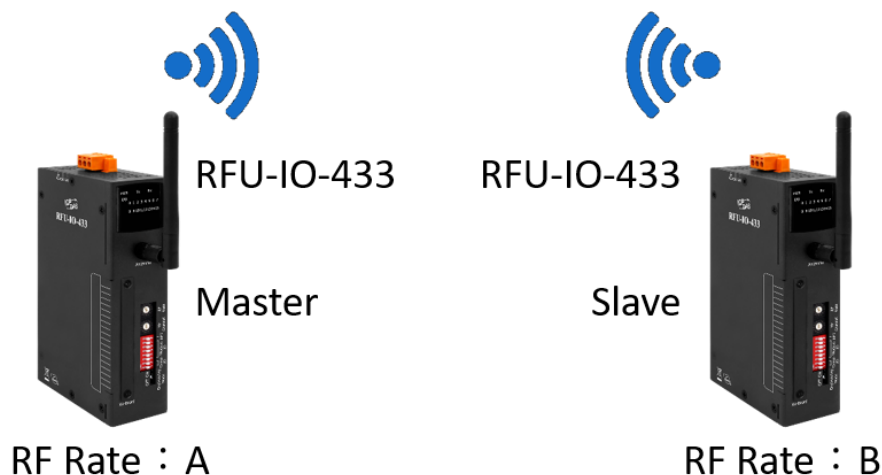
The following lists the RFU-IO-433 Modbus address description.

Parameter	Address	Len	Data	Type	Description
Firmware Version	0xA000	Word	0x0101	R	Firmware version v101
RSSI Data	0xA001	Word	0x00~0xFF	R	Refer to Appendix A
DO Channel	0xA002	Word	0 ~ 16	R/W	DO Channel Number
DO Address	0xA003	Word	0x00~0xFF	R/W	DO Start Address
DI Channel	0xA004	Word	0 ~ 16	R/W	DI Channel Number
DI Address	0xA005	Word	0x00~0xFF	R/W	DI Start Address
AO Channel	0xA006	Word	0 ~ 16	R/W	AO Channel Number
AO Address	0xA007	Word	0x00~0xFF	R/W	AO Start Address
AI Channel	0xA008	Word	0 ~ 16	R/W	AI Channel Number
AI Address	0xA009	Word	0x00~0xFF	R/W	AI Start Address

4. Pair-connection Mode

Pair-connection mode allows the RFU-IO-433 to automatically drive the corresponding DO or AO data points on a remote RFU-IO-433 by capturing the current DI or AI data. The correspondence is sequential, such that DI0 corresponds to DO0, DI1 corresponds to DO1, and so on. If the data points on both sides of the pair are not equal, for example, if one side has DI0 ~ DI7 and the other side only has DO0 ~ DO3, then DI0 ~ DI3 will correspond to DO0 ~ DO3, while DI4 ~ DI7 will be ignored. **In pair-connection mode, intervention from other Modbus masters is not allowed.** The specific usage and instructions are as follows:

4.1 One-to-one pair-connection mode



When one RFU-IO-433 has its baud rotary switch set to A and the other to B, with all other rotary and dip switches set to the same positions on both units, a one-to-one pair-connection mode will be activated upon powering on. In this mode, when there is a change in the DI/AI data on the Master unit, the corresponding DO/AO on the Slave unit will output the same response. Similarly, when there is a change in the DI/AI data on the Slave unit, the corresponding DO/AO on the Master unit will also output the same response.

4.2 One-to-many pair-connection mode



When the baud switch of one RFU-IO-433 is set to A and the baud switches of other units are set to C, with all other rotary and dip switches on all RFU-IO-433 units set to the same positions, a one-to-many pair-connection mode will be activated upon powering on. In this mode, the Slave units will not respond any messages. When there is a change in the DI/AI data on the Master unit, the corresponding DO/AO on the Slave units will output the same response. However, when there is a change in the DI/AI data on the Slave units, the Master unit will not respond.

4.3 Expansion Board with Pair-connection Mode

Pair-connection mode is based on DI, DO, AI, AO functions, so not all XV expansion boards can support it, and users should pay attention to use. Please refer to Appendix B for the support list.

When using AI / AO pair-connection, it should be noted that the voltage or

current types of both sides should be the same, otherwise the output of AI will not be equal to the output of AO. E.g., the type of AI is -10V ~ +10V, where the +10V is 0x7FFF, and the mode of AO is 0V ~ +10V, where the +10V is 0xFFFF, so that when AI reads +10V and outputs 0x7FFF to AO, AO will actually output only +5V. **To set the output mode, users may need to purchase an additional RFU-433 module.**

5. Application Example

1 - 1 Transfer



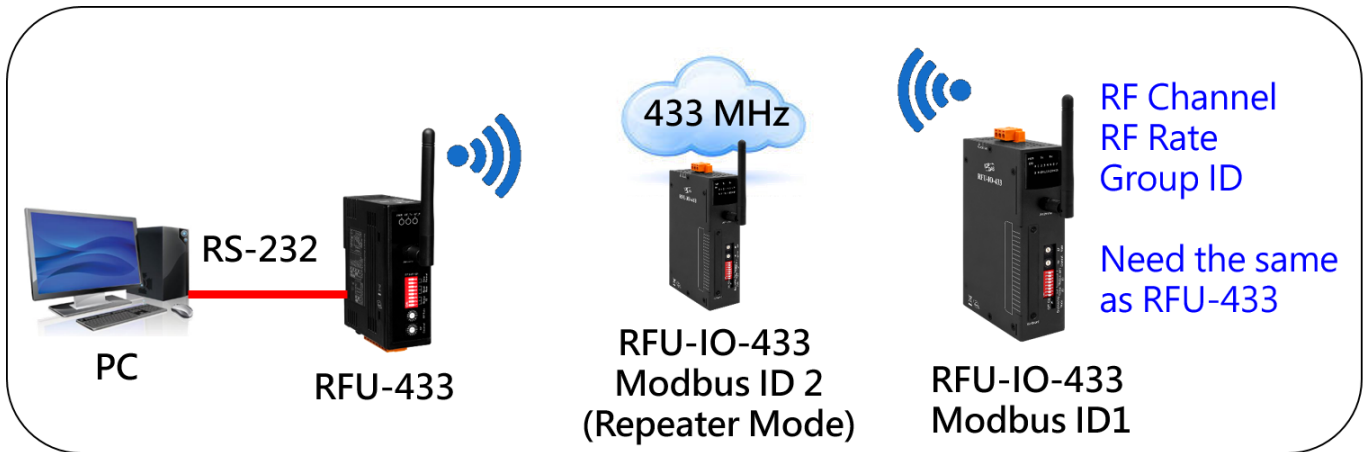
PC controls the RFU-IO-433 module of Modbus ID 1 via an RFU-433.

1 - Multi Transfer



PC controls the RFU-IO-433 modules of Modbus ID 1 ~ 4 via an RFU-433

Repeater Mode



If the distance is too far and the computer cannot communicate with the RFU-IO-433 through RFU-433, you can switch an RFU-433 or RFU-IO-433 to repeater mode and place it between the computer and the remote RFU-IO-433 module. The repeater will retransmit the wireless signal it receives, allowing the remote RFU-IO-433 module to receive the signal. **If the repeater is an RFU-IO-433, ensure that its Modbus ID remains unique.**

Read RSSI Data



Users can read address 0xA001 using Modbus function code 4 to obtain RSSI Data for verifying the current communication quality. For details on RSSI Data, please refer to Appendix A, "Explanation of RSSI Data and Signal Strength Indicators."

A. RSSI Data and Signal Strength Description

RSSI Data	dBm	Icon	Strength Description
0 ~ 89	< -85		Unconnectable or invisible
90 ~ 119	-85 ~ -71		The vast majority of terminals are not connectable
120 ~ 159	-71 ~ -53		Connectable, unstable
160 ~ 199	-53 ~ -35		Normal use
200 ~ 255	> -35		Strong signal, best experience

- RSSI Data corresponds to the dBm conversion formula:
$$\text{dBm} = -126 + (\text{RSSI Data} * 0.457)$$