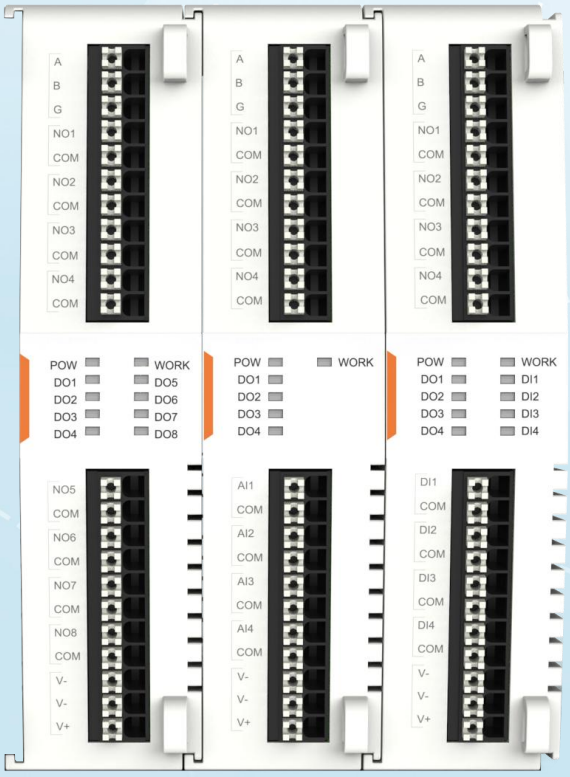
USR IOT
Be honest,Do best

USR-IOxx Series User Manual



Build a Smarter IoT world, Your Trustworthy Partner

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1. Introduction

1.1. Overview

The USR-IOxx series controller are a brand-new generation of IO modules which support data acquisition and control launched by USR. They adopt an expandable structure design, flexible matching, standard RS485 interface, and come with standard Modbus RTU protocol which enables rapid application matching. The controllers are equipped with rich indicator lights which can help users to determine the device status.

USR-IOxx series controllers have multiple models to choose from and can be flexibly combined according to different on-sites needs. It can also be combined with USR-M100 and USR-M300 to provide rich and comprehensive features.

1.2. Ordering guide

Model	USR-IO4040	USR-IO0440	USR-IO0080	USR-IO8000	USR-I00404
Power Input Range	DC12-24V	DC12-24V	DC12-24V	DC12-24V	DC12-24V
Number of DI	4	0	0	8	0
Number of AI	0	4	0	0	4
Number of DO	4	4	8	0	0
Number of AO	0	0	0	0	4
Type of AI	/	Current	/	/	Current
Signal range of AI	/	4~20mA	/	/	4~20mA
Voltage range of DI	9~36V	/	/	9~36V	/
Type of DO	Relay	Relay	Relay	/	/
Capability of DO	3A	3A	3A	/	/
Type of AO	/	/	/	/	Current / Voltage
Signal range of AO	/	/	/	/	4-20mA 0-10V
Communication port	RS485	RS485	RS485	RS485	RS485
Support extendable	√	√	√	√	√

1.3. Parameter specification

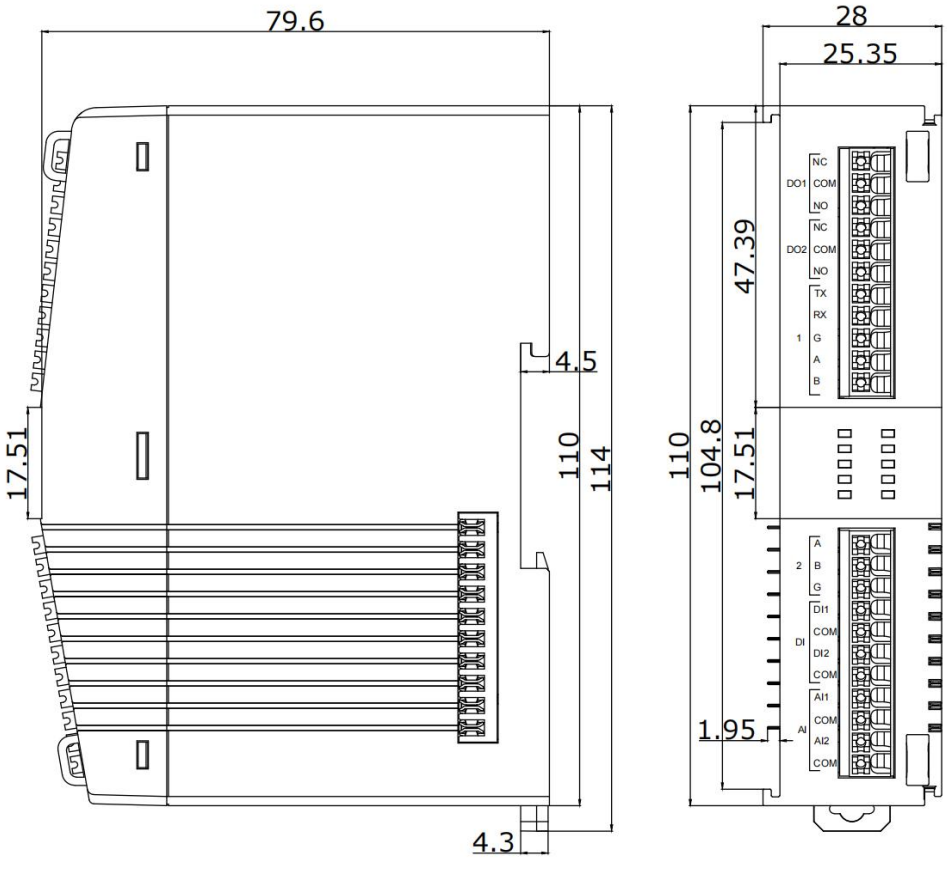
Items		Description
Interface	RS485	Default: 9600, NONE, 8, 1
		Options for band rate: 4800, 9600, 115200, 230400
		Parity bit: NONE, EVEN, ODD
		Data bits: 8
		Stop bit(s): 1, 2
Physical Specification	Dimensions	79.6*58*110(mm)
	Installation	DIN rail mounting & Panel mounting
Status LEDs	POW	Steady on: Power supply is normal Off: No power supply or abnormal power supply

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	WORK	Blinking: Power is on, and the device is ready. System is booted up and running
	DO	Steady on: The channel output is activated
	DI	Steady on: The channel is activated input signal
Power	2-pin socket	DC: 12-24V
Protection	EMC Protection	Level 3, IEC 61000
	Watchdog	Hardware & Software watchdog
	Flame retardant rating	V0, burning stops within 10 seconds on a vertical part allowing for drops of plastic that are not inflames.
Temperature	Operation temperature	-25℃ ~ +75℃
	Storage temperature	-40℃ ~ +105℃
Humility	Operation humility	5%~95% (non-condensing)
I/O	DI	Digital opto-isolated input (0 -2 V detected as logic low,9 -36 V detected as logic high)
	AI	Analog input 4-20mA
	DO	Relays, the endurance is 100,000 operations. DC contacts rating @R (at resistive load) 3A / 30V DC. AC contacts rating @R (at resistive load) 3A / 250V AC, NO
	AO	Analog output: voltage output: 0-10V, current output: 4-20mA
Modbus	Slave address	Range: 1~255 Default: 1

1.4. Dimension

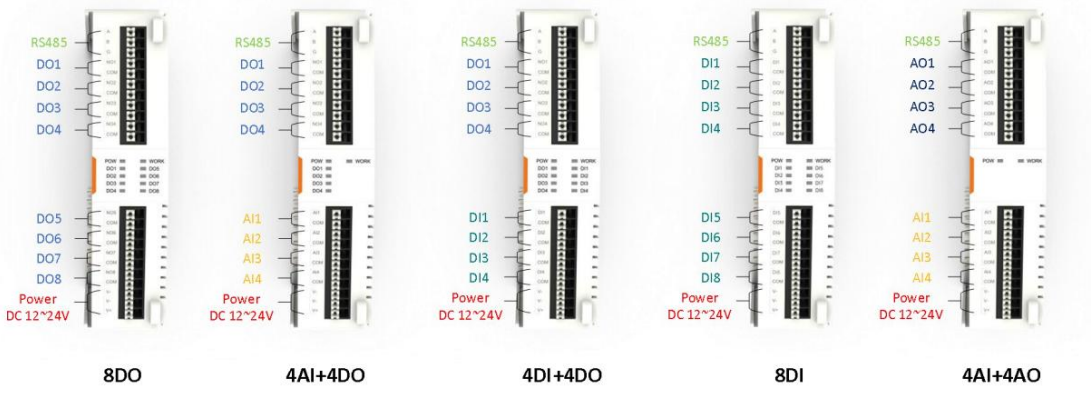
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1.5. Status LEDs

LED	Description
POW	Steady on: Power supply is normal Off: No power supply or abnormal power supply
WORK	Blinking: Power is on, and the device is ready. System is booted up and running
DO	Steady on: The channel output is activated
DI	Steady on: The channel is activated input signal

1.6. Physical interface



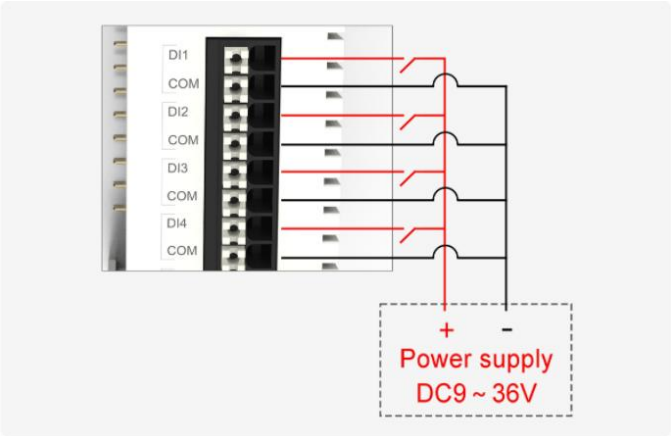
1.7. Wiring Diagram

1.7.1. Dry Contacts for DI

For dry contacts device, users need to connect the USR-IO's power in the whole circuit to detect the status of IO devices,

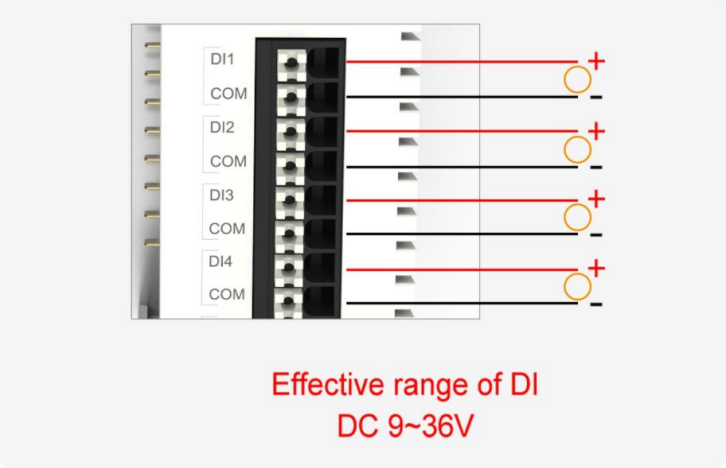
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such as detecting the status of switches, buttons, etc.



1.7.2. Wet Contacts for DI

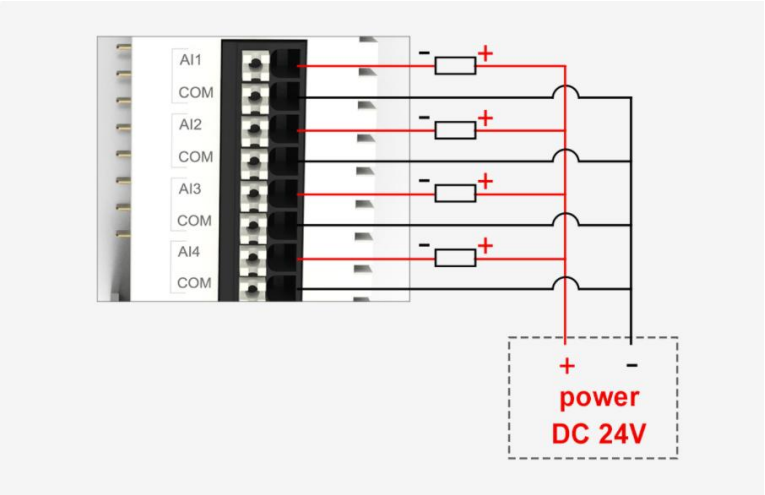
For wet contact devices, they output voltage signals such as high and low levels, pulses, etc. These devices already have an internal power source and do not require additional power supply. They can be directly connected to the terminals of the USR-IO controller, such as infrared detection, liquid level detection, smoke detection, etc. For the USR-IO controller, the input voltage range is 9-36V. If it exceeds this range, the device's status cannot be detected correctly.



1.7.3. AI Cable Wiring for 2-wire 4-20ma Sensor

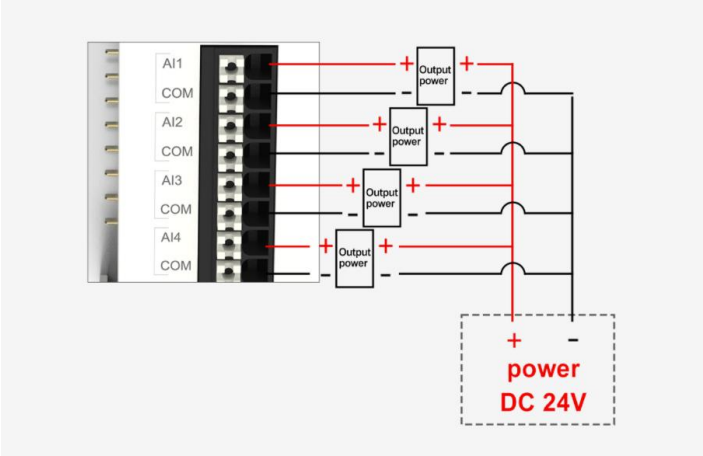
For two-wire 4-20mA sensors, the sensor itself only has 2 wiring terminals: power + and signal -. These terminals serve both as power supply and signal transmission channels. In this scenario, connecting the sensor's power + to the USR-IO's power + and the sensor's signal - to the USR-IO's AI interface, while connecting USR-IO's COM to the power -, completes the setup.

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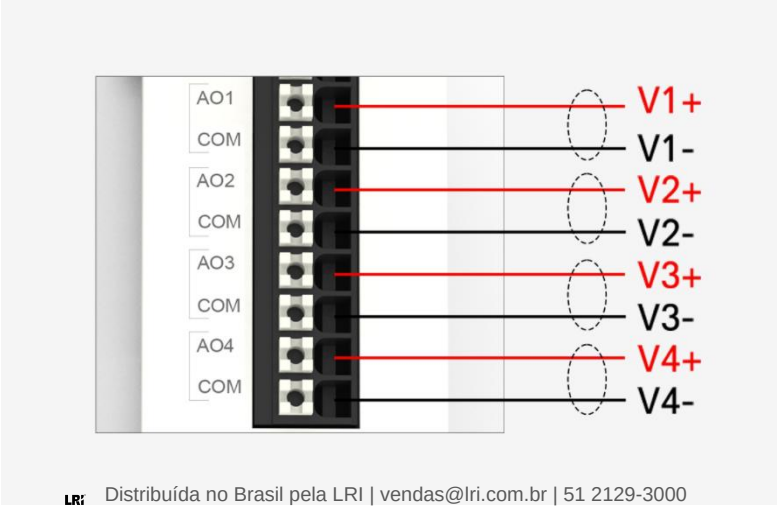
1.7.4. AI Cable Wiring for 4-wire 4-20ma Sensor

For two-wire 4-20mA sensors, the sensor itself only has 2 wiring terminals, serving as both power supply and signal transmission channels. In this scenario, connecting the AI terminal to the power supply circuit enables the detection of the analog signal.



1.7.5. Analog Output(0-10V)

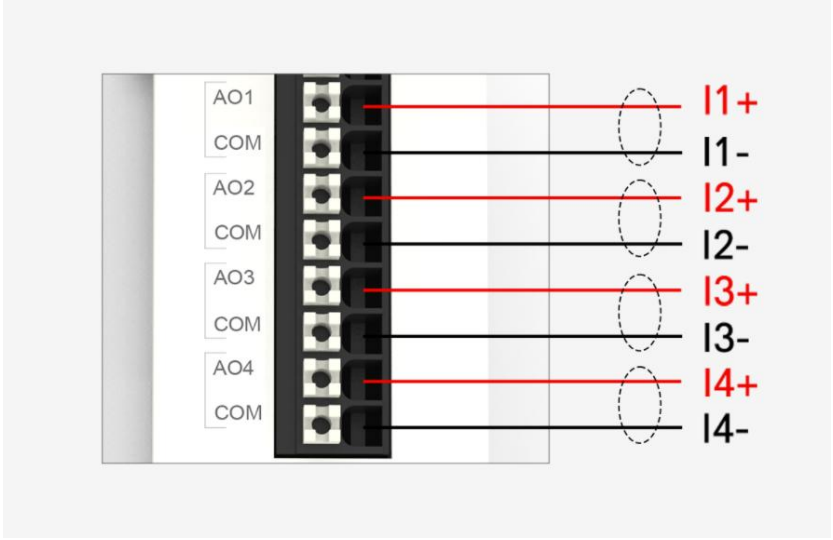
In the AO loop, there is no need to connect to a power source.



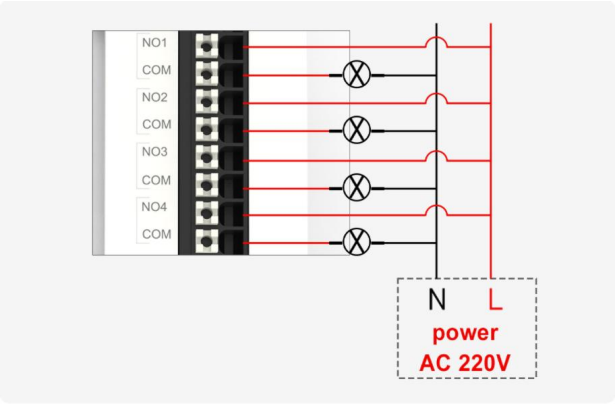
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1.7.6. Analog Output(4-20mA)

In the AO loop, there is no need to connect to a power source.

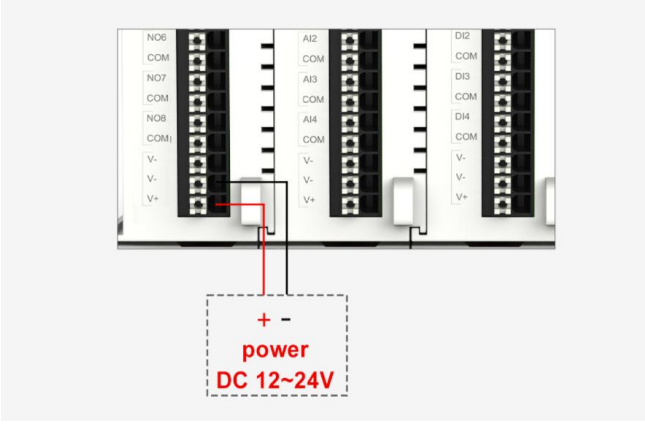


1.7.7. DO Cable Wiring



1.7.8. Cable Wiring for Power Supply

When using multiple IO controllers in combination, only one power supply is supported. Please do not connect multiple power supplies for power input.



2. Modbus RTU Protocol

USR-IOxx series controller support standard Modbus RTU protocol. Users need to know some information about the protocol.

2.1. Function code

Code (Hex)	Description	Data Access
01	Read Coil(s)	Bit access

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02	Read Discrete Input(s)	Bit access
03	Read Single or Multiple Holding Register(s)	16-bit access
04	Read input status	16-bit access
05	Write Single Coil	Bit access
06	Write single holding register	16-bit access
0F	Write multiple coils	Bit access
10	Write Single or multiple holding registers	16-bit access

2.1.1. Modbus message format

Modbus RTU message contains query message and response message. Query message is from Master device to Slave device, while the response message is from Slave device to Master device.

Query message (Hex):

Device Address	Function Code	Starting Address	Quantity	Check Code
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes
01	03	00 00	00 02	C4 0B

Response message (Hex):

Device Address	Function Code	Data length	Data 1	Data 2	Check Code
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes	2 Bytes
01	03	04	00 01	00 02	2A 32

2.2. RS485 parameters

Name	Option(s)	Default
Baud rate	4800, 9600, 115200, 230400	9600
Data bits	8	8
Stop bit(s)	1,2	1
Parity bit	None, Even, Odd	None

2.2.1. Register for storing RS485 parameters

Register type: 4x means Holding Register.

Name	Register type	Register address (Dec)	Function code (Hex)	Bit(s)	Description
Baud rate	4x	0032~0033	03, 10	32 bits	4 bytes
Data bits	4x	0034	03, 06, 10	16 bits	8
Stop bit(s)	4x	0035	03, 06, 10	16 bits	1, 2
Parity bit	4x	0036	03, 06, 10	16 bits	0: None, 1: Even, 2: Odd

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2.2.2. Example of reading and writing baud rate register:

Action	Read/write command	Response
Read baud rate	01 03 00 20 00 02 C5 C1	01 03 04 00 00 25 80 E1 03
Write band rate	01 10 00 20 00 02 04 00 01 C2 00 F1 17	01 10 00 20 00 02 40 02

Users need restart the USR-IOxx device to make the changed parameters take effect. Users can send reboot command or power cycle device to restart it.

2.3. Register for storing system parameters

Name	Register type	Register address (Dec)	Function code (Hex)	Bit(s)	Description
Slave address	4x	0017	03,06	16	Default: 1
Reboot	4x	0016	06	16	Data field: 0xFF00
SN	4x	0112~0121	03	10 Words	Length: 20 strings
Filter time for DI	4x	0048~0055	03,10	16	Range: 10~65535ms

Examples:

Action	Read/Write command	Response
Reboot	01 06 00 10 FF 00 C9 FF	01 06 00 10 FF 00 C9 FF
Read slave address:	01 03 00 11 00 01 D4 0F	01 03 02 00 01 79 84
Read SN	01 03 00 70 00 0A C4 16	01 03 14 0B D7 0C 9E 0D 02 0C A1 0B D9 0C 3E 0B D6 0D 0B 0D 69 0B D7 34 B8

2.4. I/O register

Name	Register type	Register address (Dec)	Function code (Hex)	Bit(s)	Description
DI	1x	0000~0007	02	1 bit	
AI	3x	0000~000F	04	32 bits	
DO	0x	0000~0007	01, 05, 0F	1 bit	ON: 0xFF00 OFF: 0x0000
AO output type	4x	0190~0193	03,06,10	16 bits	0-10V: 0x0001 4-20mA: 0x0004
AO output value	4x	0000~000F	03, 10	32 bits	4mA: 0x457A0000 20mA: 0x469C4000 0V: 0x00000000 10V: 0x461C4000

AI: Float 32

Examples:

I/O Action	Read/Write command	Response
Write DO	01 05 00 00 FF 00 8C 3A	01 05 00 00 FF 00 8C 3A
Read DI	01 02 00 00 00 01 B9 CA	01 02 01 00 A1 88
Read AI	01 04 00 00 00 02 71 CB	01 04 04 00 00 00 00 FB 84

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Configure AO1 as voltage mode	01 06 01 90 00 01 49 DB	01 06 01 90 00 01 49 DB
Configure AO1 as current mode	01 06 01 90 00 04 89 DB	01 06 01 90 00 04 89 DB
4 ma output configuration	01 10 00 00 00 02 04 45 7A 00 00 C7 7A	01 10 00 00 00 02 41 C8
20 ma output configuration	01 10 00 00 00 02 04 46 9C 40 00 17 09	01 10 00 00 00 02 41 C8
0 V output configuration	01 10 00 00 00 02 04 00 00 00 00 F3 AF	01 10 00 00 00 02 41 C8
10 V output configuration	01 10 00 00 00 02 04 46 1C 40 00 16 E1	01 10 00 00 00 02 41 C8

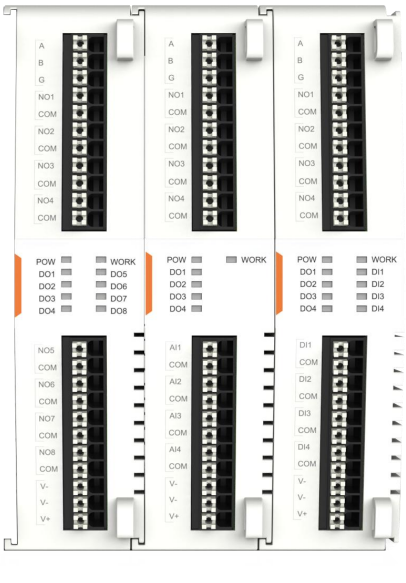
3. Combination of I/O modules

The USR-IOxx series controller support the combination of different models, and users can choose different combinations according to their needs. The products come up with an extension guide rail and extension interface component. Just push two modules together to achieve module connection.

3.1. Combination of extended I/O modules

Using this combination, the leftmost I/O module functions as the first slave. It only needs to power the first slave to implement all I/O modules. Additionally, access to all I/O modules can be achieved through the RS485 serial port of the first slave and this design can reduce wiring requirements.

The principle of assigning slave address is to assign them from left to right. Users just need to set the first module's slave address, and the address of the modules on the right are incremented by one based on the left module. For example, if the slave address of the first I/O module on the left is 10, then the second one is 11, and the third one is 12, and so on.



3.2. Combination of extended I/O modules and I/O host

USR-IOxx series controllers can be combined with USR-M100 and USR-M300 to provide rich and comprehensive features. After the I/O modules is connected to the host, the slave address and register address are uniformly allocated by the host,

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and power supply and communication are also provided by the host. Power supply and communication cable do not need to be connected. And all the I/O interface can be monitoring and debugging via the host's built-in webpage.

Note: Facing the front of the I/O module, the left side is the first slave module.



4. Reset to factory settings

Users maybe forget the parameters they have changed during the using. In this case, using the "Reload" button can restore the module to its factory default settings.

The "Reload" button is in the upside of the module. In the power-on state, pressing the "Reload" button and keeping the button pressed for 3~15 seconds, the module will be reset to factory settings.



5. Contact Us

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7. Revision History

Version	Date	Author	Description
1.0.0	2023.5.15	May, Liu	Initial
1.0.2	2024.4.28	May, Liu	Update the information of AO module

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