Nube-iO
Rubix iO Modules
Installation and User Manual

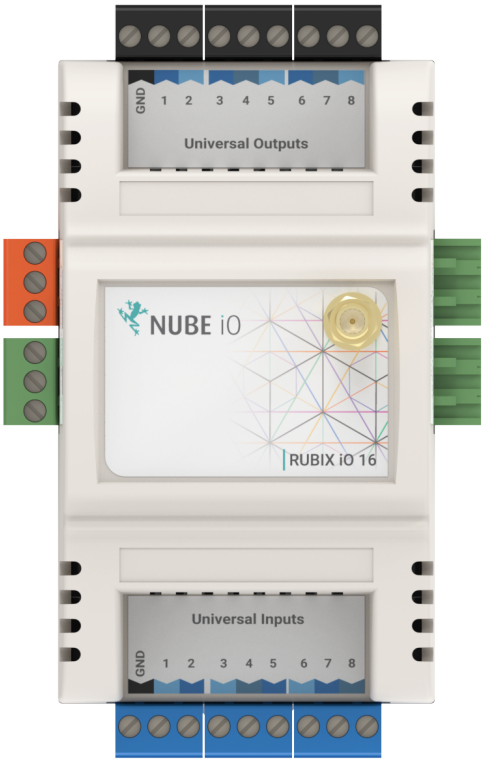


Table Of Contents

1. Document Summary

This Installation Manual contains technical specifications, installation instructions, ordering info, and communication guidelines for the Rubix iO series of controllers.

2. Product Description

The Rubix iO Modules are Nube-iO's versatile, low-cost physical Input/Output module. They provide expandable modular monitoring and control points in a small package.

With one or more modules plugged directly into the side of a Rubix Compute, or wired via RS485, these Rubix iO Modules allow for BMS implementations of any size.

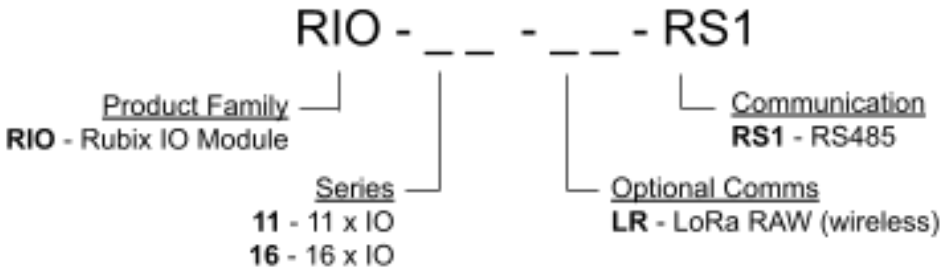
In addition to being a slave physical input/output device, the Rubix iO Modules can be configured as standalone HVAC application controllers. With configuration and monitoring of the HVAC applications via Modbus these modules allow for low cost distributed control and central monitoring of many types of systems.

The Rubix iO Modules are a pure Modbus device, making them useful in systems even beyond the Nube-iO platform.

Optional LoRa wireless version of the Rubix iO allows for wireless communication with the iO Modules. LoRa wireless technology provides a very long transmission range that is less susceptible to object interference than other wireless technologies.

When using LoRa wireless to communicate with the Rubix iO Modules the RS485 port can be used as a Modbus passthrough, this allows for wireless communication with any wired (RS485) Modbus device.

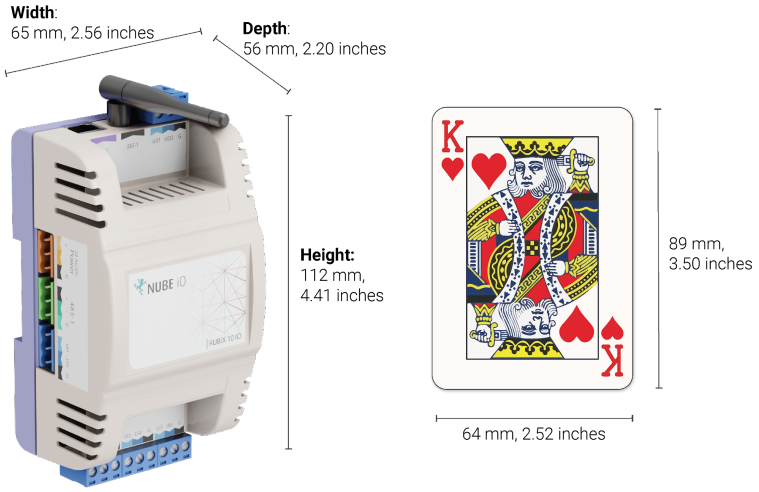
3. Ordering Information



RIO-11-RS1	Rubix iO-11 Modbus RS485 (without LoRa Wireless)
RIO-11-LR-RS1	Rubix iO-11 Modbus RS485 + LoRa Wireless
RIO-16-RS1	Rubix iO-16 Modbus RS485 (without LoRa Wireless)
RIO-16-LR-RS1	Rubix iO-16 Modbus RS485 + LoRa Wireless

4. Technical Specifications

4.1. Physical Attributes



Dimensions	**Height:** 112 mm / 4.41 inches
	Width: 65 mm / 2.56 inches
	Depth: 56 mm / 2.20 inches
Operating Temperature	0°C to 65°C
Enclosure	ABS Plastic, DIN Rail Mount, IP40 Rated

4.2. Power Requirements

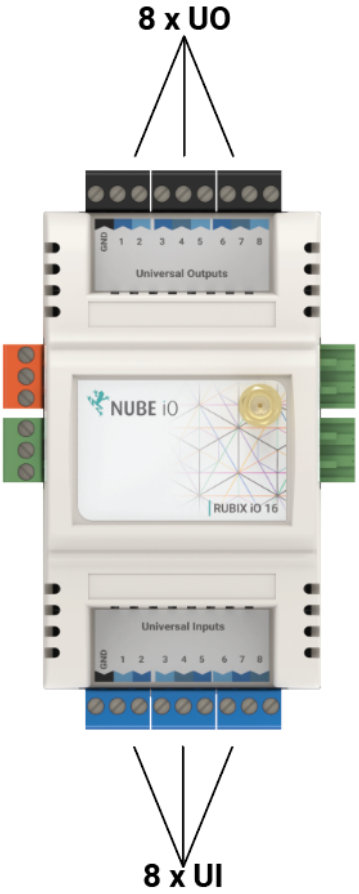
Power Via Screw Terminal	**Power Supply**	24V DC/AC ±10%
	Consumption	**Base**: 1.2W (50mA at 24 VDC) **Max**: 36W (1500mA at 24 VDC)
	Recommended Transformer Size*	1050mA / 25VA

* Transformer should be sized based on Base Current plus the power requirements of all connected output devices

4.3. Communication Options

Communication	Part	Details
Modbus RS-485	**Nube-xbee-485-3wire** All Models	**EIA-485 (BUS A,B) Three-wire, Half Duplex** **Speed**: 9600, 38400, 19200 **Data Bits**: 8 **Parity**: None, Even, Odd
LoRa	**nube-xbee-lora-RFM95** *Optional addon*	**Add in radio model** **Supported Frequencies:** AU915, US915, AS232, EU863 **Spreading Factor:** 7 **Bandwidth:** 250 kHz

4.4. Physical Inputs and Outputs



Type	IO-11 Count	IO-16 Count	Details
Universal Input (UI)	**6**	**8**	• 0 - 10 VDC Signal • 10k Thermistor • Resistance • Digital / Switch / Dry Contact • 4-20mA Signal
Universal Output (UO)	**5**	**8**	• **Analog:** 0 to 10 VDC (50ma Max) • **Digital:** 0 or 12 VDC 0V[OFF] / 12VDC[ON] (700mA Max)
Digital Output (DO)	**2***	**0**	• 0 or 12 VDC 0V[OFF] / 12VDC[ON] (700mA Max)

* The DO terminals on the IO-11 are located on the side of the controller. When Rubix iO Modules are plugged directly into each other, or to a Rubix Compute via the side connections, the DO terminals will not be available.

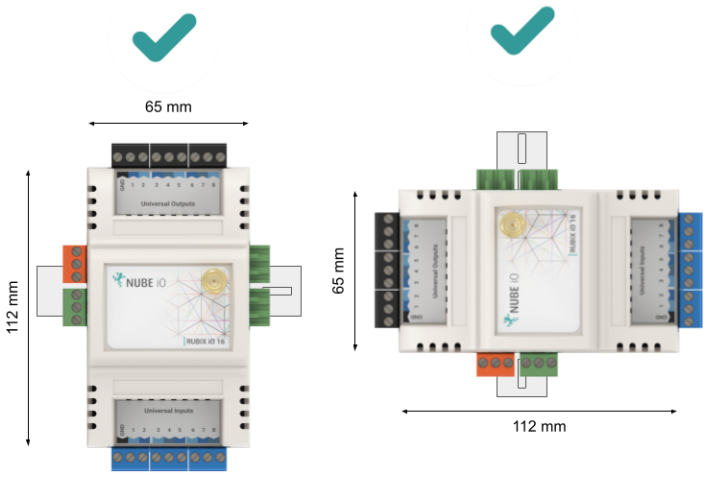
4.5. Regulatory Compliance

Manufacturer/Model	Regulatory	Notes
Nube IO / IO-11	**AS/NZS CISPR 32: 2015**	IO-11 device
Nube IO / IO-16	**AS/NZS CISPR 32: 2015**	IO-16 device
HopeRF / RFM95	**FCC:** Class B 3M Radiated	LoRa RF module

5. Installation and Configuration

5.1. Mounting

The Nube-iO iO Module is 65mm x 112mm. It is designed to be mounted on electrical DIN rail. It can be mounted vertically or horizontally. The controller should always be mounted in a location such that it will not experience very high or low temperatures, liquids or high humidity.

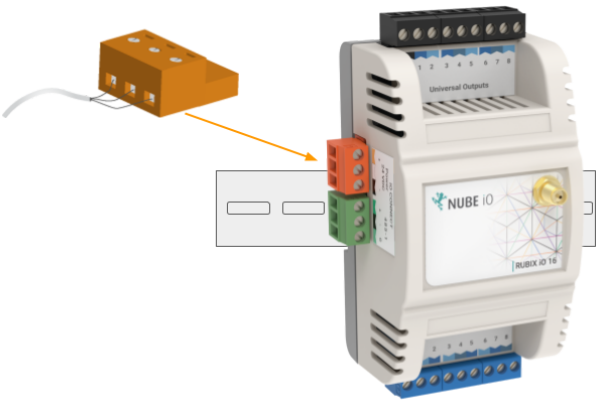


Vertical Mount Position Horizontal Mount Position

5.2. Connecting Power

The Nube-iO iO Module is powered by a 24v AC or DC power supply on the `24 AC/DC POWER` terminals as shown below.

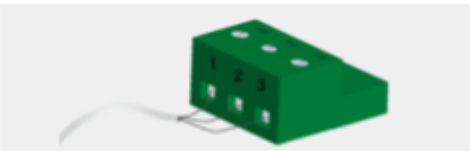
Pin 1 (+)	24v AC/DC
Pin 2 ( )	Do Not Connect*
Pin 3 (-)	AC Neutral / DC Ground



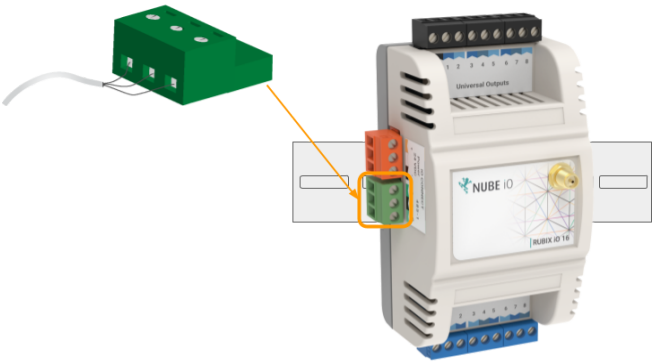
* For 24VAC Full Wave Center Tapped Transformer, see Knowledge Base Article "Rubix IO: Power Requirements and Wiring" for additional instructions.

5.3. Connecting RS-485 Network (Wired Network)

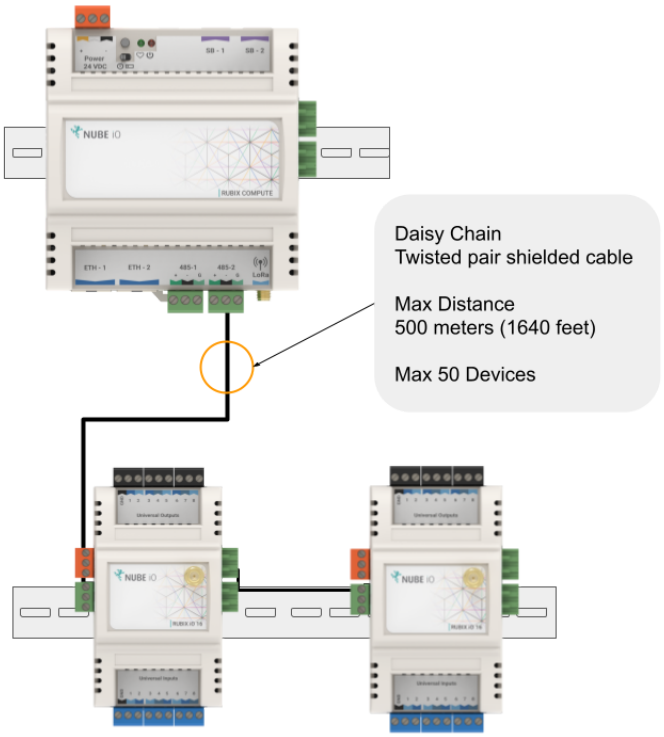
When using the wired network connection, the Nube-iO iO Module RS-485 modbus connection is used. The connector is terminated and installed as shown below.



Pin 1 (+)	**A** or **+** of RS485 Network
Pin 2 (-)	**B** or **-** of RS485 Network
Pin 3 (**G**)	**C** or **Ground**



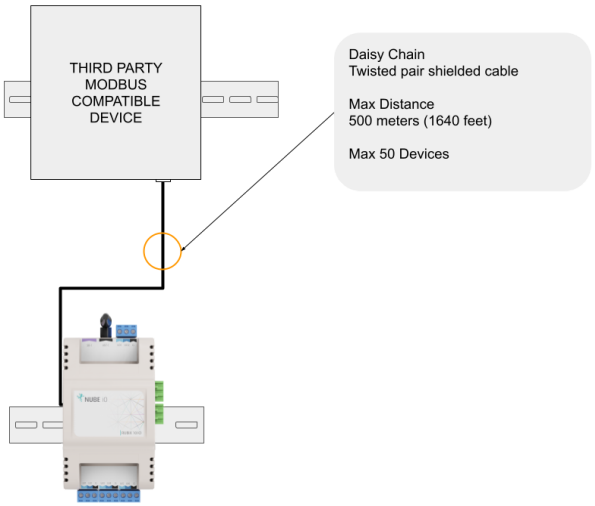
When Networking multiple Nube-iO iO Modules on an RS485 network, each controller is connected in a `Daisy Chain`. Controllers that are connected between 2 other controllers will have 2 wires (one from the previous controller and one from the next controller) in the same terminal. Ensure **A/+** and **B/-** wires are kept consistent for all controllers on the network.



5.3.1. Modbus RS485 Passthrough - Wireless Modbus Extender

Modbus RS485 Passthrough is available on IO-11 Modules equipped with a LoRa (Wireless) Comms. In this mode the wired Modbus RS485 data is sent wirelessly to the gateway.

When using a Nube-iO IO-11 as a wireless modbus passthrough, the RS485 network is connected only to the third party device and the Nube-iO iO Module, as shown below. The RS485 wiring is the same as described above.

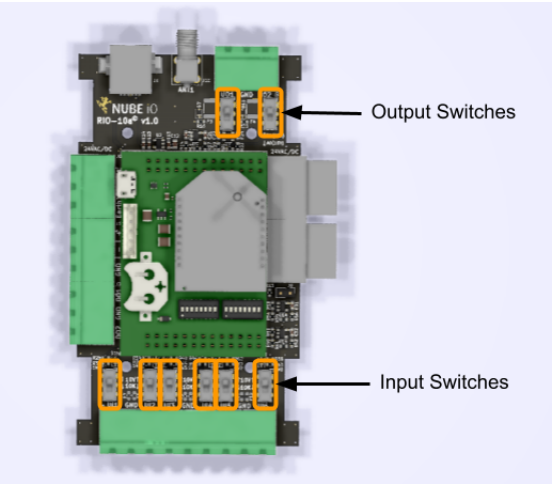


5.4. Configuring the Onboard Switches

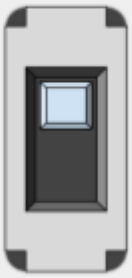
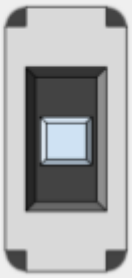
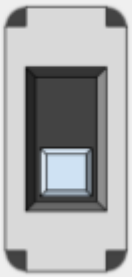
There are several physical onboard switches that must be configured correctly for proper communication and functionality. These switches are located under the front cover of the Nube-iO iO Module; to remove the front cover, use a flat blade screwdriver to gently pry the cover off at the cover join line.

5.4.1. Input and Output Type Select Switches

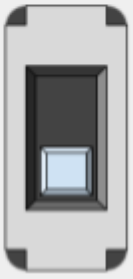
There are several switches under the cover of the Nube-iO iO Module that are used to set the Input (UI) and Output (UO) type configurations.



5.4.1.1. Input Type Select Switches

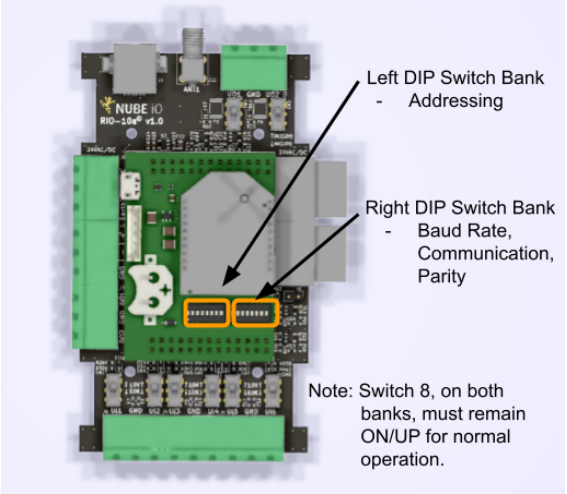
Mode	Purpose	Setting
10k Resistor **OR** **Digital (Dry Contact)**	• Thermistor Temperature Sensor. • Dry Contact / Switch / Digital	 10k Thermistor / Digital 0 - 10 VDC Analog 4-20mA
0-10 VDC	• Measuring 0-10 VDC signals	 10k Thermistor / Digital 0 - 10 VDC Analog 4-20mA
4-20mA	• Measuring 4-20mA signals	 10k Thermistor / Digital 0 - 10 VDC Analog 4-20mA

5.4.1.2. Output Type Select Switches

Mode	Purpose	Setting
Digital Output **0 / 12 VDC**	• 0VDC OR 12VDC output signal. • Drive 12VDC Relays. • Drive LEDs. • Max output current 700mA.	 0 - 12 VDC Digital 0 - 10 VDC Analog
Analog Output **0-10 VDC**	• Producing 0-10 VDC signal. • Position and Speed control for actuators or variable speed drives. • Max output current 50mA.	 0 - 12 VDC Digital 0 - 10 VDC Analog

5.4.2. DIP Configuration Switches

There are 2 banks of small DIP switches (8 DIP Switches per bank) under the cover of the Nube-iO iO Module that are used to configure various functionalities of the controller.



5.4.2.1. Left Bank DIP Switches - Modbus Addressing

The Left Bank of DIP Switches (labeled SW2) is used to set the address of the Nube-iO iO Module. The value is set as a binary number (lowest digit is DIP #1) plus 1 using DIP Switches 1 to 7. See table below for examples of address settings. 1 is DIP switch UP, and 0 is DIP switch DOWN. DIP switch #8 must remain ON/UP/1 for normal operation.

LEFT DIP SWITCH BANK (SW2)	
[Dip-Switch: 1,2 3, 4, 5, 6, 7] - Device ID / Address (as binary number + 1)	
Switch Setting	**Device ID / Address**
0000000	1
1000000	2
0100000	3
1100000	4
0010000	5
1010000	6
0110000	7
1110000	8
0001000	9
1001000	10
0101000	11
1101000	12
0011000	13
1011000	14
0111000	15
1111000	16
1111110	64
[Dip-Switch: 8] - MUST BE ON/UP/1	

5.4.2.2. Right Bank DIP Switches - Operation Modes

The Right Bank of DIP Switches (labeled SW1) is used to configure various functions of the Nube-iO iO Module. DIP switch #8 must remain ON/UP/1 for normal operation.

RIGHT DIP SWITCH BANK (SW1)	
[Dip-Switch: 1, 2] - Operation Mode	
Switch Setting	Operation Mode
00	RS485 (Wired)
10	LoRa Wireless*
01	RS485 -> LoRA Passthrough**
11	Factory Reset***
[Dip-Switch: 3, 4, 5] - Baud Rate	
Switch Setting	Baud Rate
000	38400
100	9600
010	19200
[Dip-Switch: 6, 7] - Parity	
Switch Setting	Parity
00	None
10	Even
01	Odd
[Dip-Switch: 8] - MUST BE ON/UP/1	

* LoRa is only available on IO-11-LR-RS1 models.
** Use this setting* when connecting to 3rd party Modbus Devices.
*** Set DIP switches, power cycle, then set back to operation mode setting.

5.5. Physical Input and Output Wiring

This section describes how to connect/wire physical inputs and outputs.

5.5.1. Physical Input Wiring

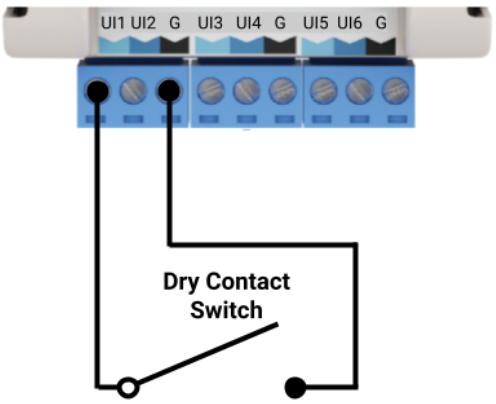
Wired Inputs consist of wired sensors or wired signals from other devices. They are wired to Digital Input (DI), or Universal Input (UI) terminals.

Wired Inputs are grouped into 2 main groups:

1. **Digital** - Only 2 possible states: either an open circuit or a closed circuit. Includes: simple switches/buttons, relays, and other types of dry contact (ex. status signals from other devices).
2. **Analog** - Many possible states based on Voltage, Resistance, or Current. Includes: Temperature, Humidity, Pressure, CO2, Position Feedback, etc…

5.5.1.1. Digital Inputs

Digital Inputs are connected between the Ground(GND) terminal and the selected UI terminal. There is no polarity for Digital Input wiring (ie. input wires can be swapped).

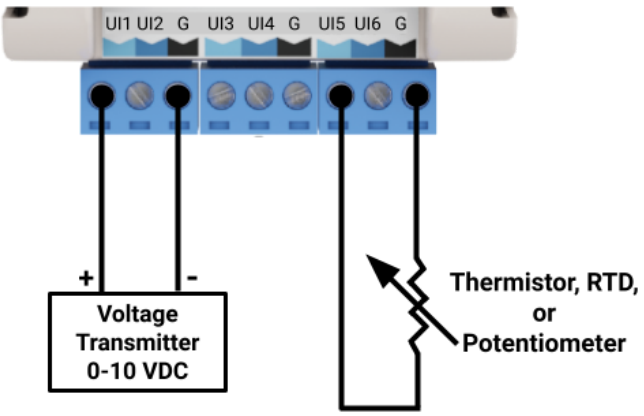


5.5.1.2. Analog Inputs

Analog Inputs are connected between the Ground(GND) terminal and the selected UI terminal. There is usually a correct polarity for Analog Inputs (ie. correct wire must be on the correct UI terminal).

There are 2 main types of Analog Inputs:

1. **Resistance** - Input is based on resistance. The most commonly used resistance input is **Thermistor** temperature sensors where resistance varies with change in temperature. There is no polarity for Resistance inputs (ie. input wires can be swapped).
2. **0-10vdc** - Input is based on DC voltage signal over the range of 0v to 10v. This voltage range is related to a defined range on the device that produces the 0-10v signal.
3. **4-20mA** - Input is based on DC current signal over the range of 4mA to 20mA. This current range is related to a defined range on the device that produces the 4-20mA signal.



5.5.2. Physical Output Wiring

Wired outputs consist of wired output signals to be sent to other devices. They are wired from the Digital Output (DO), Universal Output (UO), and Relay Output (R1, R2,etc.) terminals of controllers that support wired output points.

Wired Outputs are grouped into two main categories:

1. **Digital** – Only 2 possible states: ON or OFF. Digital Outputs can produce Voltage, or activate a Switch/Dry Contact.

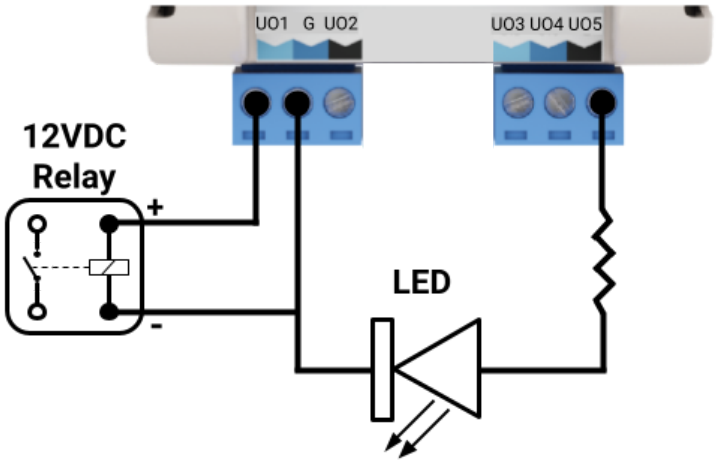
2. **Analog** – Many possible states based on a range of Voltage, or Current (specific to the output type).

5.5.2.1. Digital Outputs

Digital Outputs are connected between the Ground (GND) terminal and the selected DO or UO terminal.

There are 2 types of Digital Outputs:

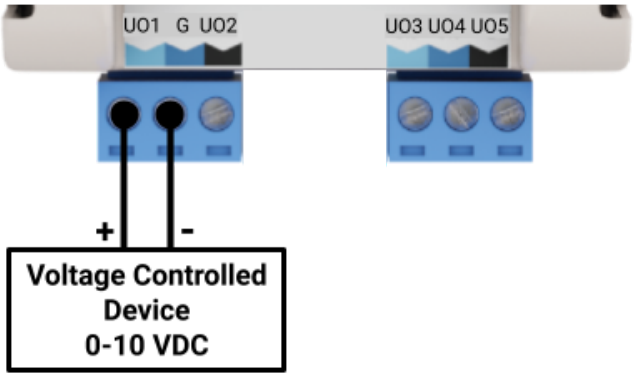
1. **Voltage** - Output is either 0v or a defined voltage level (eg. 12v DC). The Voltage Signal will be produced at the DO/UO terminal.
2. **Switched / Dry Contact / Relay** - Output is either Open Circuit (OFF) or Closed Circuit (ON). There is no polarity for this type of Digital Output.



5.5.2.2. Analog Outputs

Analog Outputs are connected between Ground (GND) terminal and the selected UO terminal. Analog Outputs are polarity sensitive, with Ground (GND) being 0v (-) and UO terminal being positive Voltage or Current (+).

0-10vdc - Output is a DC voltage signal of the range of 0v to 10v. Voltage is produced on the UO terminal.



5.6. Adding the Antenna

For LoRa Wireless communication, an antenna may be required to achieve the required range to the gateway controller. Please ensure the antenna is fitted to the top of the Nube-iO iO Module if the Rubix Compute Gateway Controller is not receiving messages from the Nube-iO iO Module.

6. Modbus Communications

Nube-iO Rubix iO Modules are a pure modbus device; All communications with the iO Modules are via modbus. Modbus settings are configured via the onboard DIP switches (see Section 5.4.2). Modbus settings on the gateway controller must match those set on the connected iO Modules. All devices on a modbus network must have the same modbus network settings.

6.1. Default Modbus Network Settings

Initially modbus settings for the iO Modules will be set as follows:

Device Address: 1
Baud rate: 38400
Parity: None
Stopbits: 1
Bytesize: 8

6.2. Modbus Points

This section describes the available modbus points that are used to interact with the iO Modules.

Rubix iO Module modbus points are grouped into two categories: **Modbus Configuration Points**, and **Modbus Value Points**.

Modbus Configuration Points are used to initially configure the types of each Universal Input (UI) and Universal Output (UO). Digital Outputs do not need configuration values as they only support Digital type.

Modbus Value Points are divided into two categories **Input Value Points**, and **Output Value Points**:

- **Input Value Points** are used to READ the values of the Universal Inputs (the units of these values depend on the associated Modbus Configuration Point).

- **Output Value Points** are used to WRITE values to the Universal/Digital Outputs; writing to these points will change the physical output terminals (the units of these values depend on the associated Modbus Configuration Point).

6.2.1. Universal Output Modbus Configuration Points

These Modbus Configuration Points are used to configure the types of each Universal Output (UO).

The following tables detail the Universal Output Type Configuration Registers and the valid config setting values.

Universal Output Configuration Values

Config Type	Write Value	Valid VALUE REGISTER Write Values for this Config Type*
0–10 VDC	1	0 to 10 ⇒ 0 to 10 VDC
Digital	2	0 = OFF, 1 = ON

* These are the values that can be written to the VALUE REGISTERS listed in Section 6.2.1.2

Universal Output Configuration Registers

Point	Description	Register	Register Type	Data Type	Function Code
U01 Config	Set type of U01	5001	Holding	UINT16	3,6,16
U02 Config	Set type of U02	5002	Holding	UINT16	3,6,16
U03 Config	Set type of U03	5003	Holding	UINT16	3,6,16
U04 Config	Set type of U04	5004	Holding	UINT16	3,6,16
U05 Config	Set type of U05	5005	Holding	UINT16	3,6,16
U06 Config*	Set type of U06	5006	Holding	UINT16	3,6,16
U07 Config*	Set type of U07	5007	Holding	UINT16	3,6,16
U08 Config*	Set type of U08	5008	Holding	UINT16	3,6,16

* IO-16 Only

6.2.2. Output Modbus Value Points

The following table details the Universal Output (UO) and Digital Output (DO) Value Registers. Writing to these registers will drive the Physical Output points. For UOs the type of each output must be configured correctly via Type Select Onboard Switches (Section 5.4.1) and Config Registers (Section 6.2.1). See Section 6.2.1 for valid Write Values for each Config Type.

Point	Description	Register	Register Type	Data Type	Function Code
U01	Set value of U01	801	Holding	FLOAT	3,6,16
U02	Set value of U02	803	Holding	FLOAT	3,6,16
U03	Set value of U03	805	Holding	FLOAT	3,6,16
U04	Set value of U04	807	Holding	FLOAT	3,6,16
U05	Set value of U05	809	Holding	FLOAT	3,6,16
U06*	Set value of U05	811	Holding	FLOAT	3,6,16
U07*	Set value of U05	813	Holding	FLOAT	3,6,16
U08*	Set value of U05	815	Holding	FLOAT	3,6,16
DO1**	Set value of DO1	501	Coil	DIGITAL	1,5,15
DO2**	Set value of DO2	502	Coil	DIGITAL	1,5,15

* IO-16 Only
** IO-11 Only

6.2.3. Universal Input Type Configuration Registers

These Modbus Configuration Points are used to configure the types of each Universal Input (UI).

The following tables detail the Universal Input Modbus Configuration Point Registers and the valid config setting values.

Universal Input Configuration Values

Config Type	Value
10k Thermistor	1
Resistance	2
0–10 VDC	3
4-20mA	4
Digital	5
Digital Hold On RISING Edge	6
Digital Hold On FALLING Edge	7
Digital Pulse Count on RISING Edge	8
Digital Pulse Count on FALLING Edge	9

Universal Input Configuration Registers

Point	Description	Register	Register Type	Data Type	Function Code
UI1 Config	Set type of UI1	5201	Holding	UINT16	3,6,16
UI2 Config	Set type of UI2	5202	Holding	UINT16	3,6,16
UI3 Config	Set type of UI3	5203	Holding	UINT16	3,6,16
UI4 Config	Set type of UI4	5204	Holding	UINT16	3,6,16
UI5 Config	Set type of UI5	5205	Holding	UINT16	3,6,16
UI6 Config	Set type of UI6	5206	Holding	UINT16	3,6,16
UI7 Config*	Set type of UI7	5207	Holding	UINT16	3,6,16
UI8 Config*	Set type of UI8	5208	Holding	UINT16	3,6,16

* IO-16 Only

6.2.4. Universal Input Modbus Value Points

The following table details the Universal Input (UI) Modbus Value Point Registers. The type of each output must be configured correctly via Type Select Onboard Switches (Section 5.4.1) and Config Registers (Section 6.2.3). See Section 6.2.3 for valid Write Values for each Config Type.

Point	Description	Register	Register Type	Data Type	Function Code
UI1	Set value of UI1	801	Input	FLOAT	4
UI2	Set value of UI2	803	Input	FLOAT	4
UI3	Set value of UI3	805	Input	FLOAT	4
UI4	Set value of UI4	807	Input	FLOAT	4
UI5	Set value of UI5	809	Input	FLOAT	4
UI6	Set value of UI6	811	Input	FLOAT	4
UI7*	Set value of UI7	813	Input	FLOAT	4
UI8*	Set value of UI8	815	Input	FLOAT	4

* IO-16 Only

7. Additional References

This section provides additional information for your reference.

7.1. Nube-iO Documentation References

Name/Code	Explanation	External Reference
Rubix Compute	Gateway Controller	Link
Edge28	Edge IO Programmable Controller	Link
Droplet	Wireless Environmental Sensor	Link
MicroEdge	Wireless Low Level Asset Monitoring Device	Link
Rubix Wires	Browser Based Flow Programming Interface	Link
Rubix Platform	Browser Based Device/Data Management Interface	

7.2. Other Technology/Service References

Name	Description	External Reference
GCP	Google Cloud Platform	Link
Edge	Edge computing is a distributed computing paradigm	Link
IO (Input/Output)	Communication process between a computer or device	Link
VPN	A virtual private network (VPN) extends a private network across a public network	Link
BACnet	BACnet is a building automation protocol	Link
MQTT	A lightweight messaging protocol for small sensors	Link
Modbus	Modbus is a building automation protocol	Link
LoRa	LoRa is a long range, low power wireless chipset and protocol	Link
LoRaWan	LoRaWan is the network layer on LoRa	Link
Haystack	Standardize semantic data models for IoT data	Link
API	Application programming interface	Link