Multi-interface Controller

UC50x Series (LTE Version)

User Guide

Safety Precautions

Milesight will not shoulder responsibility for any loss or damage resulting from not following the instructions of this operating guide.

- The device must not be remodeled in any way.
- Do not place the device close to objects with naked flames.
- Do not place the device where the temperature is below/above the operating range.
- Make sure electronic components do not drop out of the enclosure while opening.
- When installing the battery, please install it accurately, and do not install the reverse or wrong model.
- Make sure both batteries are newest when install, or battery life will be reduced.
- The device must never be subjected to shocks or impacts.

Declaration of Conformity

UC50x series is in conformity with the essential requirements and other relevant provisions of the CE, FCC, and RoHS.

For assistance, please contact

Milesight technical support:

Email: iot.support@milesight.com

Support Portal: support.milesight-iot.com

Tel: 86-592-5085280

Fax: 86-592-5023065

Address: Building C09, Software Park III, Xiamen 361024, China

Revision History

Date	Doc Version	Description
Mar. 30, 2024	V 1.0	Initial version

Contents

1. Product Introduction

1.1 Overview

UC50x series is a multi-interface controller used for data acquisition from multiple sensors. It contains different I/O interfaces such as analog inputs, digital inputs, digital outputs, serial ports and so on, which simplify the deployment and replacement of cellular networks.

UC50x series can be easily and quickly configured by NFC. For outdoor applications, it provides solar or built-in battery power supply and is equipped with IP67-rated enclosure and M12 connectors to protect itself from water and dust in harsh environments.

1.2 Features

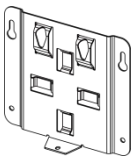
- Easy to connect with multiple wired sensors through GPIO/AI/RS232/RS485/SDI-12 interfaces
- Long transmission distance up to 15 km with line of sight
- Waterproof design including IP67 case and M12 connectors
- Solar powered and built-in battery optional
- Quick wireless configuration via NFC
- Support cumulative number report function for power saving
- Support multiple network protocols to be compatible with IoT platforms

2. Hardware Introduction

2.1 Packing List

1 × UC50x Device

2 × Data Cables (30 cm)



1 × Mounting Bracket

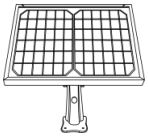
4 × Wall Mounting Kits

2 × Hose Clamps

1 × Fixing Screw

1 × Quick Guide

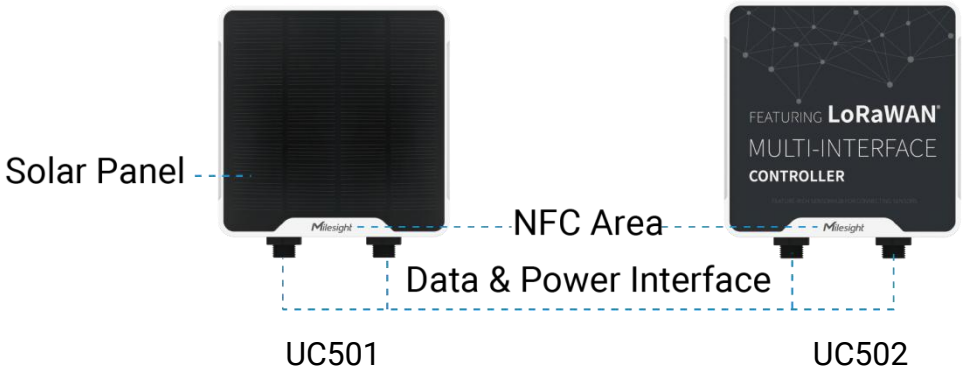
1 × Warranty Card



1 × Solar Panel Kit (Optional)

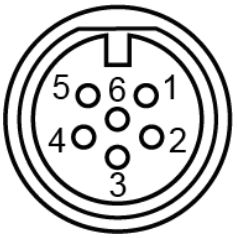
If any of the above items is missing or damaged, please contact your sales Representative.

2.2 Hardware Overview



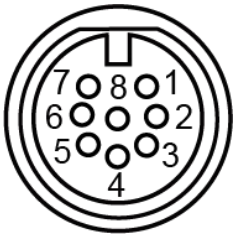
Data Interface 1:

Pin	Description
1	5V/9V/12V OUT (Switchable)
2	3.3V OUT
3	GND
4	Analog Input 1
5	Analog Input 2
6[①②]	5-24V DC IN



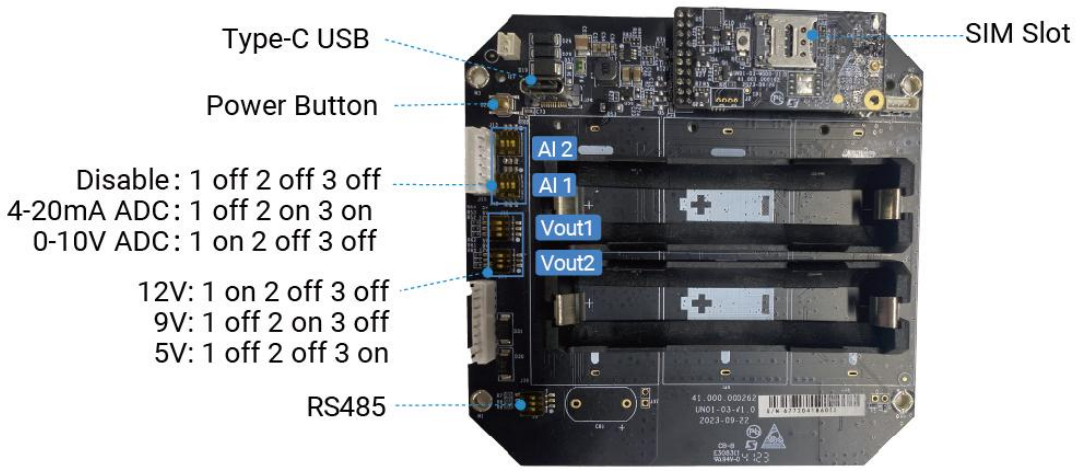
Data Interface 2:

Pin	Description	
1	5V/9V/12V OUT (Switchable)	
2	3.3V OUT	
3	GND	
4	GPIO1	
5	GPIO2	
6	RS232/RS485 (Switchable)	
7		
8	SDI-12	
Pin	**RS232**	**RS485**
6	TXD	A
7	RXD	B



① When both DC external power and batteries are connected, external power will be the preferred power supply option.
② For UC502, the DC interface can't be to charge battery.

2.3 Internal Interfaces

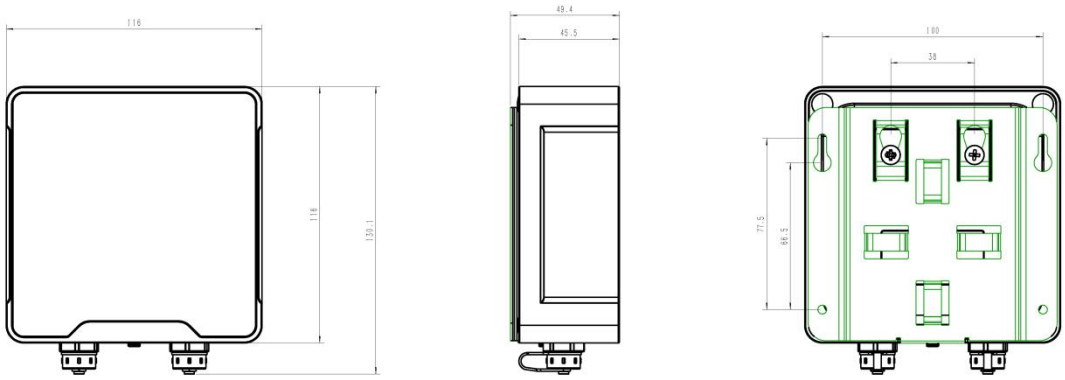


Power Button:

Function	Action	LED Indication
Turn On	Press and hold the button for more than 3s.	Off → On
Turn Off	Press and hold the button for more than 3s.	On → Off
Reset	Press and hold the button for more than 10s.	Blinks.
Check On/Off Status	Quickly press the power button.	Light On: Device is on. Light Off: Device is off.

Note: the LED indicator is under the SIM slot.

2.4 Dimensions (mm)

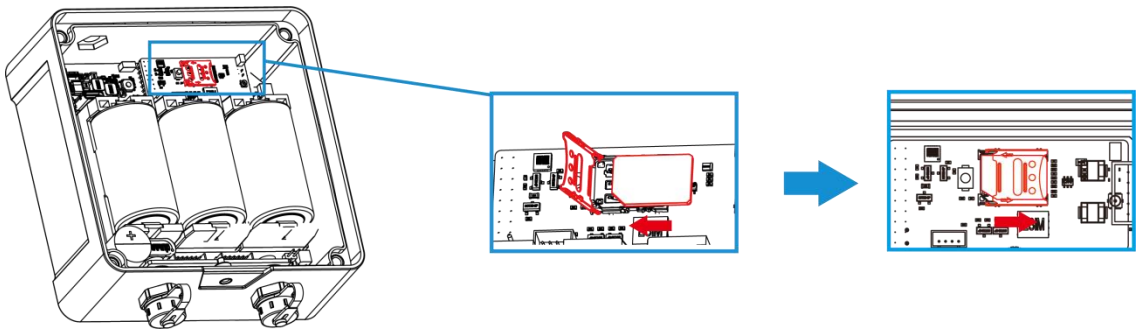


3. Hardware Adjustment

Please turn off the device before hardware adjustment.

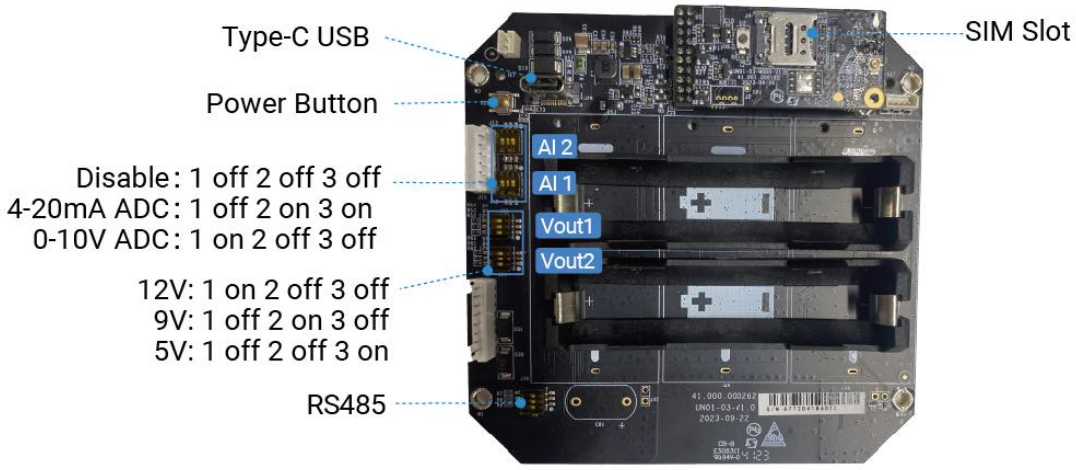
3.1 SIM Installation

Release the screw caps, screws and back cover to insert the SIM card (3FF).
Note: The device does not support hot plugging (also called hot swapping), please reboot the device after inserting the SIM card.



3.2 Hardware Switch

The default work mode of analog input is 4-20mA, and the default voltage of power output is 12V. To adjust the setting, it is necessary to change the DIP switches as required. If the default settings suit your application, please skip this chapter.



DIP Switch:

Interface	DIP Switch
Power Output	12V: 1 on 2 off 3 off 9V: 1 off 2 on 3 off 5V: 1 off 2 off 3 on
Analog Input	4-20mA ADC: 1 off 2 on 3 on 0-10V ADC: 1 on 2 off 3 off
RS485	Add 120 Ω resistor between A and B: 1 on 2 off 3 off Add 1k Ω pull-up resistor on A: 1 off 2 on 3 off Add 1k Ω pull-down resistor on B: 1 of 2 off 3 on

Note: Power output on interface 1 is used for powering analog devices, power output on interface 2 is used for powering serial port devices and SDI-12 devices.

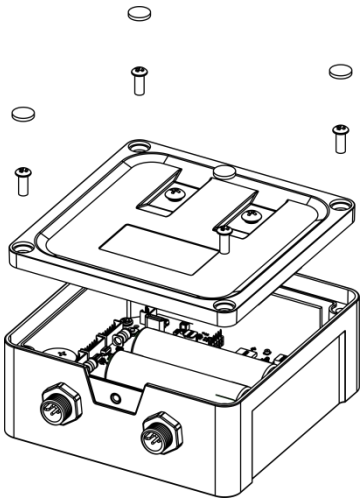
3.3 Back Cover Restore

Please follow the instructions below to screw the back cover to ensure the waterproof of the device.

1. Ensure the sealing ring is properly installed around the device, free from stains or foreign matters.
2. Put the back cover onto the device with correct direction and fix the 4 screws with the order of cross (recommended torsion: 4.5~5 kgf). When fixing the screws, initially tighten each to 80 to 90% of their full depth, and then fully tighten them all.

Screw Order

3. Fix the screw caps on the screws.



4. Operation Guide

4.1 Log in the ToolBox

UC50x series can be configured via NFC. Please select one of them to complete configuration.

1. Download and install **Milesight ToolBox** App from Google Play or Apple App Store.
2. Enable NFC on the smart phone and launch Milesight ToolBox.
3. Attach the smart phone with NFC area to the device, click **NFC read** to read device information.
4. Basic information and settings of the device will be shown on ToolBox App if it's recognized successfully. You can read and configure the device by tapping the Read/Write device on the App. In order to protect the security of the device, password validation is required when first configuration. The default password is **123456**.

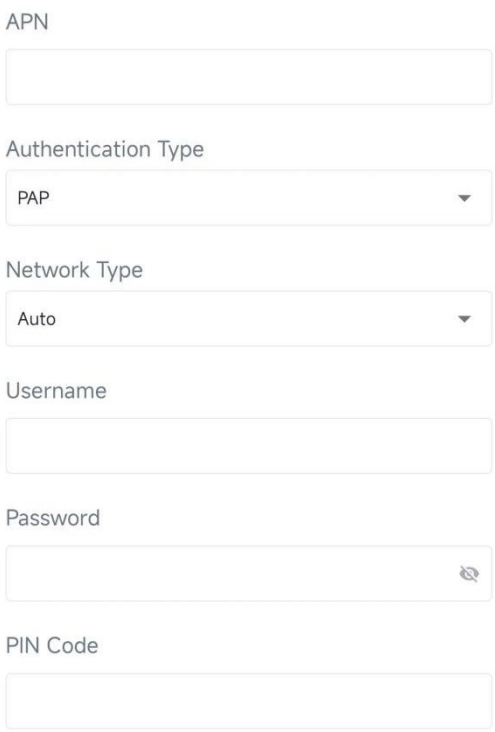
Note:

1) Ensure the location of smart phone NFC area and it's recommended to take off phone case.
2) If the smart phone fails to read/write configurations via NFC, keep the phone away and back to try again.
3) UC50x series can also be configured by dedicated NFC reader, which can be purchased from Milesight IoT.

4.2 Communication Settings

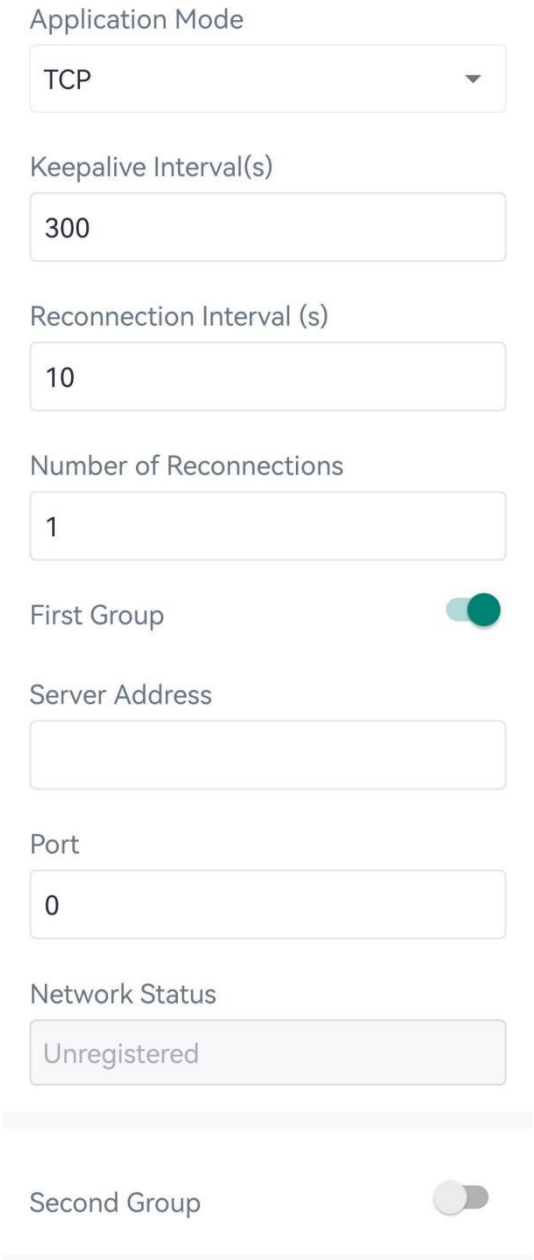
4.2.1 Cellular Settings

Cellular settings is used for configuring the transmission parameters in cellular network.



Parameters	Description
APN	The Access Point Name for dialing up network connection provided by local ISP. The max length is 31 characters.
Authentication Type	NONE, PAP and CHAP are optional.
Network Type	Select network type according to device model.
Username	The username for dialing up network connection provided by local ISP. The max length is 31 characters.
Password	The password for dialing up network connection provided by local ISP. The max length is 31 characters.
PIN Code	Enter a 4-8 characters PIN code to unlock the SIM.

4.2.2 Application Mode Settings



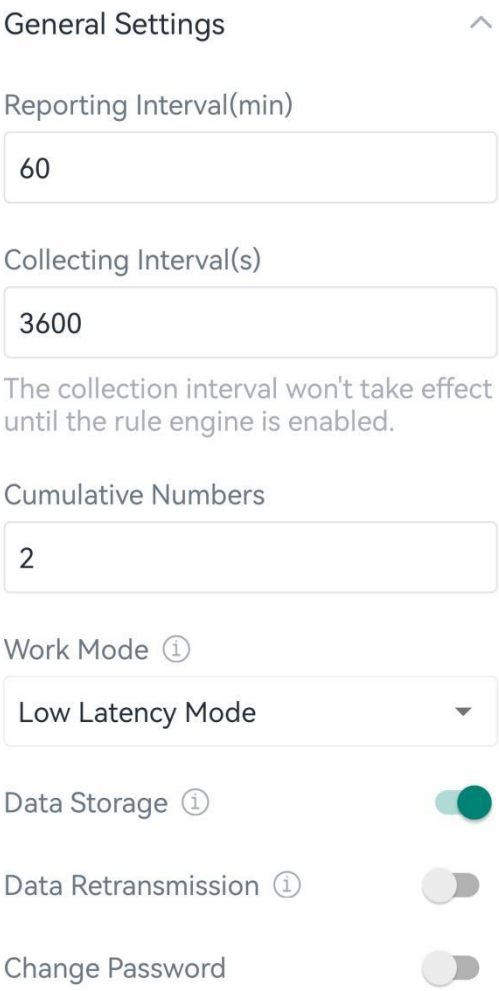
Parameters	Description
Application Mode	Select from AWS, TCP, UDP, and MQTT. **Note:** when the mode is TCP or UDP, RS232/RS485 Transparent/SDI-12 Transparent will not follow these settings.
Keepalive Interval (s)	After being connected to the server, the device will send a heartbeat packet regularly to keep alive. UDP mode does not support to configure this interval.
AWS	
Server Address	Fill in the AWS server domain name to which the data is sent.
CA File	Import the CA.crt file.
Client Certificate	Import the client certificate.

Client Key	Import the client key.
TCP/UDP	
Reconnection Interval(s)	When TCP connection fails, the device will reconnect to the server at the preset interval.
Number of Reconnections	When TCP heartbeat times run out, the device will resend heartbeat. After it reaches the preset number of reconnections, the device will reconnect to TCP server.
First/Second Group	The device supports to connect device to two different servers.
Server Address	Fill in the TCP/UDP server address (IP/domain name).
Port	Fill in the TCP/UDP server port. Range: 1-65535.
Network Status	Show the connection status of this group.
MQTT	
Broker Address	Fill in MQTT broker address to receive data.
Port	Fill in MQTT broker port to receive data.
Client ID	Client ID is the unique identity of the client to the server. It must be unique when all clients are connected to the same server.
User Credentials	
Enable	Enable user credentials.
Username	The username used for connecting to MQTT broker.
Password	The password used for connecting to MQTT broker.
TLS	
Enable	Enable the TLS encryption in MQTT communication.
Protocol	It's fixed as TLS v1.2.
CA File	Import the CA.crt file.
Client Certificate	Import the client certificate.
Client Key	Import the client key.
MQTT Topic	
Uplink Topic	Customize the uplink topic to receive periodic data.
Downlink Topic	Customize the downlink topic to send downlink command to device.
Serial Pass-through Uplink/Dowlink Topic	Customize the uplink or downlink topic when using RS232 or RS485 Active Transparent communication is enabled.

SDI-12 Pass-through Uplink/Dowlink Topic	Customize the uplink or downlink topic when SDI-12 Transparent mode is enabled.
QoS	QoS 0 – Only Once This is the fastest method and requires only 1 message. It is also the most unreliable transfer mode. QoS 1 – At Least Once This level guarantees that the message will be delivered at least once, but may be delivered more than once. QoS 2 – Exactly Once QoS 2 is the highest level of service in MQTT. This level guarantees that each message is received only once by the intended recipients. QoS 2 is the safest and slowest quality of service level.

4.3 Interface Settings

4.3.1 General Settings



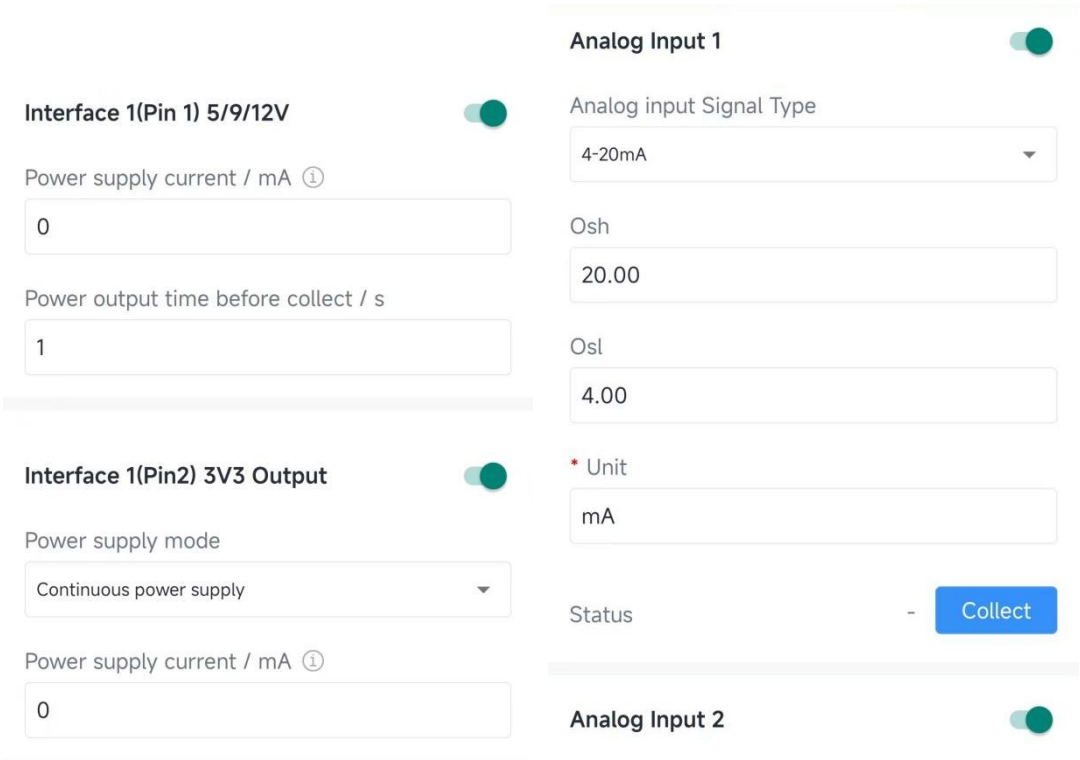
Parameters	Description
Reporting Interval	Reporting interval of transmitting data to server. Default: 360 mins, Range: 1-1440 mins. **Note:** RS232 transmission will not follow the reporting interval.
Collection Interval	The interval of collecting data when there is an alarm command. This interval must be not more than reporting interval.
Cumulative Numbers	Store this number of periodic packets to report together. Default: 2, Range: 1-10
Work Mode	Select Lower Power Mode or Low Latency Mode. **Low Power Mode:** the device will power off the cellular module to save power after sending uplinks. Only when the device sends uplinks, it can receive downlink commands. **Low Latency Mode:** the device will open reception windows regularly to receive downlink commands. The interval to open reception windows is decided by cellular operator. This mode will consume more power and

	reduce battery life.
Data Storage	Disable or enable reporting data storage locally.
Data Retransmission	When the device detects the server disconnection and re-connection, it will send the data including disconnection time. **Note:** 1) If the device is rebooted or powered off during data retransmission and the process is not completed, the device will resend all retransmitted data again after reconnecting to the network. 2) If the network is disconnected again during data retransmission, it will only send the latest disconnection data. 3) When application mode is UDP and the network is unstable, it is suggested not to use this feature. 4) Data retransmission will increase the uplinks and shorten the battery life.
Change Password	Change the password for ToolBox App to write this device.

4.3.2 Analog Input

1. Connect analog device to analog input ports on interface 1. If the analog device requires power from the UC50x, connect the power cable of analog device to the power output on interface 1.

2. Enable analog input and configure analog settings according to the requirements of the analog sensor.



Parameters	Description
Interface 1(Pin 1) 5V/9V/12V Output	Enable 5V/9V/12V power output of interface 1 to supply power to analog devices. It's 12V by default and you can change DIP switches to change voltage. **Power Output Time Before Collect:** power supply time before collecting data for terminal device initialization. Range: 0-600s. **Power Supply Current:** supply current as sensor required. Range: 0-60mA
Interface 1(Pin 2) 3.3V Output	Enable 3.3V power output of interface 1 to supply power to analog devices. **Power Supply Mode:** Select "Continuous power supply" or "Configurable power supply time". **Power Output Time Before Collect:** power supply time before collecting data for terminal device initialization. Range: 0-600s. **Power Supply Current:** supply current as sensor required. Range: 0-60mA
Analog Input 1/2	Enable or disable to collect and report the analog input data.
Analog Input Signal Type	4-20mA or 0-10V are optional. This only works when DIP switches change.
Osh/Osl	Osh is the high limit of the scale and osl is the low limit of the scale for the scaled output value. After setting, the device will upload the scaled values.

Unit	The data unit of this sensor, it just displays on ToolBox for reference.
Fetch	Click to fetch current value of sensor.

Note: analog input scaling formula
Ov = [(Osh - Osl) * (Iv - Isl) / (Ish - Isl)] + Osl
This can also be rewritten as:
Ov = [(Osh - Osl)/(Ish - Isl)/(Ish - Isl)] + Osl

The variables are pertinent to the scaling formula:
Ov = scaled output value
Iv = analog input value
Osh = high limit of the scale for the scaled output value
Osl = low limit of the scale for the scaled output value
Ish = high limit of the scale for the analog input value
Isl = low limit of the scale for the analog input value

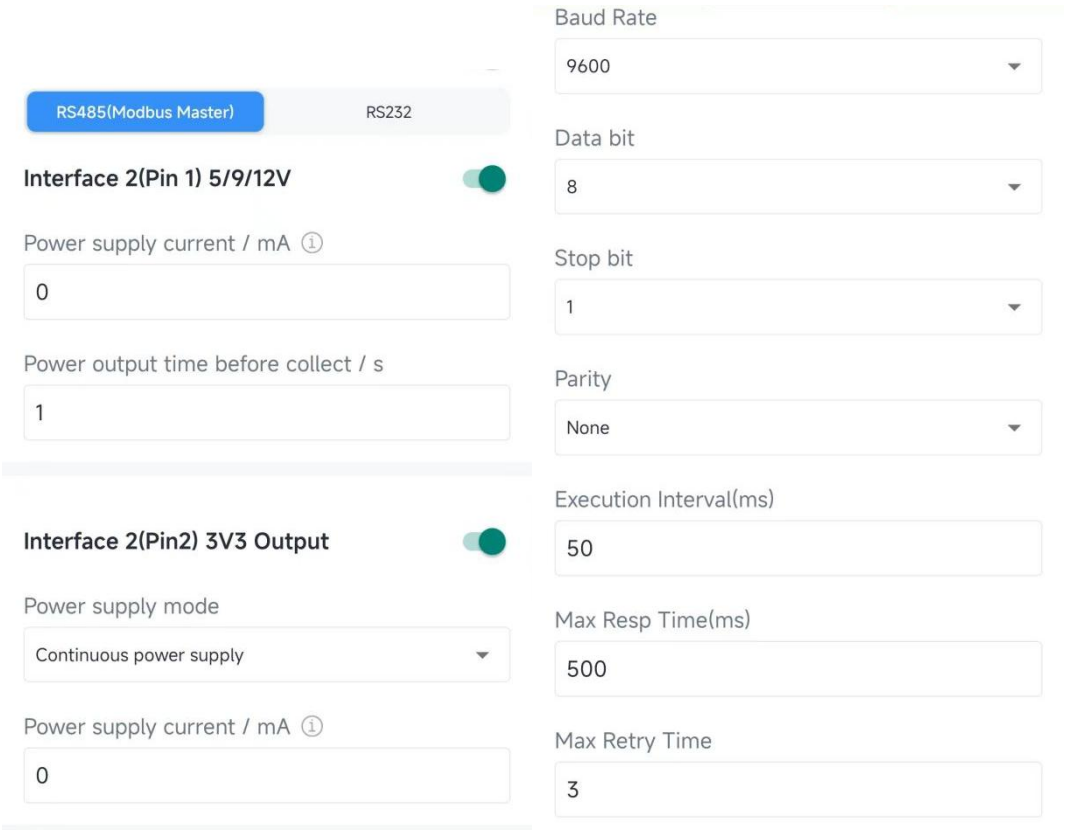
For example, a analog wind sensor can us 4-20mA to point to 0-32 m/s, the corresponding variables are: Osh=32 m/s, osl=0 m/s, Ish=20mA, Isl=4mA.
When it measures 6mA, the real wind speed is Ov= [(32 - 0) * (6 - 4) / (20 - 4)] + 0=4 m/s.

4.3.3 RS485

UC50x supports to set up communications with RS485 via two ways: Modbus channels or Transparent.

Basic Serial Settings:

The basic serial settings should be the same as RS485 terminal devices. Besides, enable the power output interface and configure the power supply parameters if the RS485 terminal device needs power supply from UC50x controller.

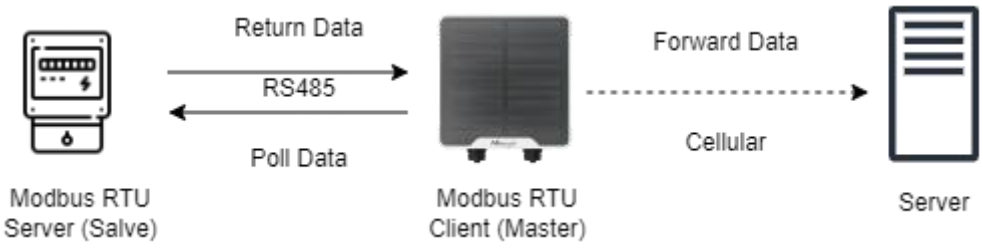


Parameters	Description
Interface 2(Pin 1) 5V/9V/12V Output	Enable 5V/9V/12V power output of interface 2 to supply power to RS485 terminal devices. It's 12V by default and you can change DIP switches to change voltage. **Power Output Time Before Collect:** power supply time before collecting data for terminal device initialization. Range: 0-600s. **Power Supply Current:** supply current as sensor required. Range: 0-60mA
Interface 2(Pin 2) 3.3V Output	Enable 3.3V power output of interface 2 to supply power to RS485 terminal devices. **Power Supply Mode:** Select "Continuous power supply" or "Configurable power supply time". **Power Output Time Before Collect:** power supply time before collecting data for terminal device initialization. Range: 0-600s. **Power Supply Current:** supply current as sensor required. Range: 0-60mA
Baud Rate	1200/2400/4800/9600/19200/38400/57600/115200 are available.
Data Bit	8 bit is available.
Stop Bit	1 bit/2 bit are available.

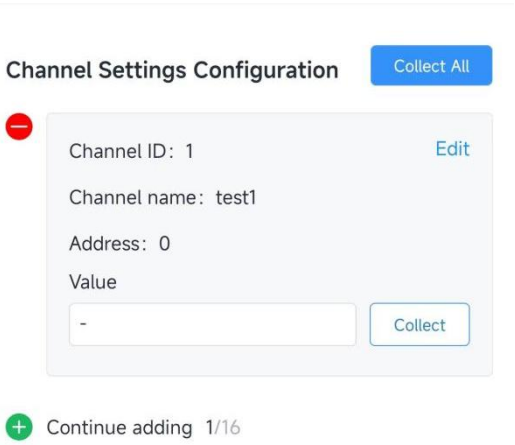
Parity	None, Odd and Oven are available.
Execution Interval	The execution interval between each Modbus command.
Max Resp Time	The maximum response time that the UC50x waits for the reply to the command. If it does not get a response after the max response time, it is determined that the command has timed out.
Max Retry Time	Set the maximum retry times after device fails to read data from RS485 terminal devices.

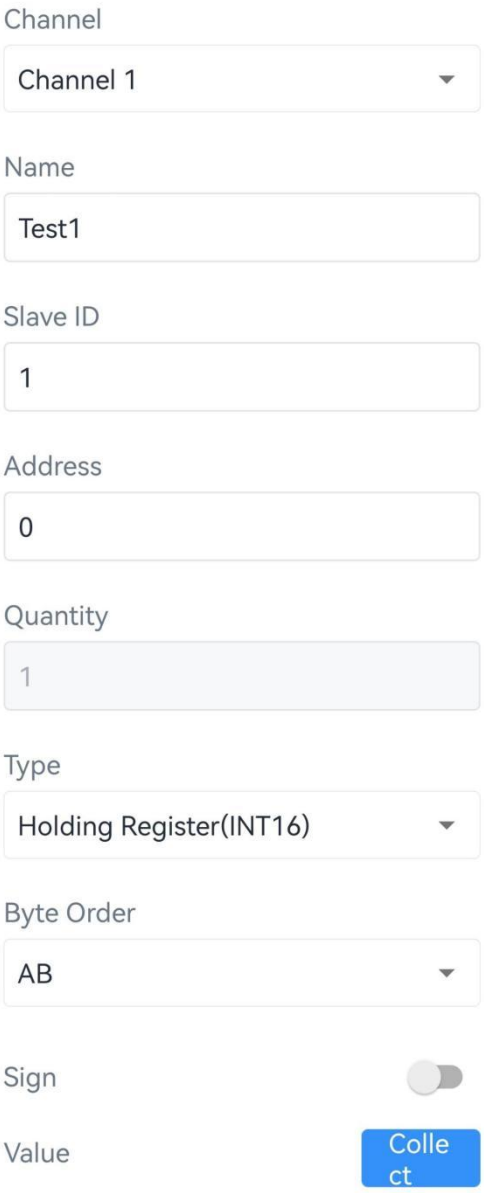
Modbus Channels:

UC50x supports to work as a Modbus RTU Client (Master) to poll the data from the RS485 device and return the data to the server.



Click "+" to add Modbus channels, then save configurations.





Parameters	Description
Channel ID	Select the channel ID you want to configure from 16 channels.
Name	Customize the name to identify every Modbus channel.
Slave ID	Set Modbus slave ID of terminal device.
Address	The starting address for reading.
Quantity	Set read how many digits from starting address. It fixes to 1.
Type	Select data type of Modbus channels.
Byte Order	Set the Modbus data reading order if you configure the type as Input Register or Holding Register. INT32/Float: ABCD, CDBA, BADC, DCBA INT16: AB,BA
Sign	The tick indicates that the value has a plus or minus sign.

Collect	After clicking, the device will send Modbus read command to test if it can read correct values. **Example:** as above setting, the device will send command: 01 03 00 00 00 01 84 0A
Fetch	Click to check the collected data.

Active Transparent:

The server can send any command to the RS485 device and the RS485 device can only react according to server commands.

Parameters	Description
RS485 Active Transparent Transmission	Enable or disable transparent feature. This only works when work mode is Low Latency Mode.
Protocol	UDP, TCP or MQTT is optional. When using MQTT protocol, it is necessary to configure the Serial Passthrough Uplink/Downlink Topics.
TCP/UDP	
Keepalive Interval(s)	After being connected to TCP server, the device will send a heartbeat packet by TCP regularly to keep alive.
Reconnection Interval (s)	When TCP connection fails, the device will reconnect to the server at the preset interval.
Number of Reconnections	When TCP heartbeat times run out, the device will resend heartbeat. After it reaches the preset number of reconnections, the device will reconnect to TCP server.
First/Second	The device supports to connect the device to two different servers.

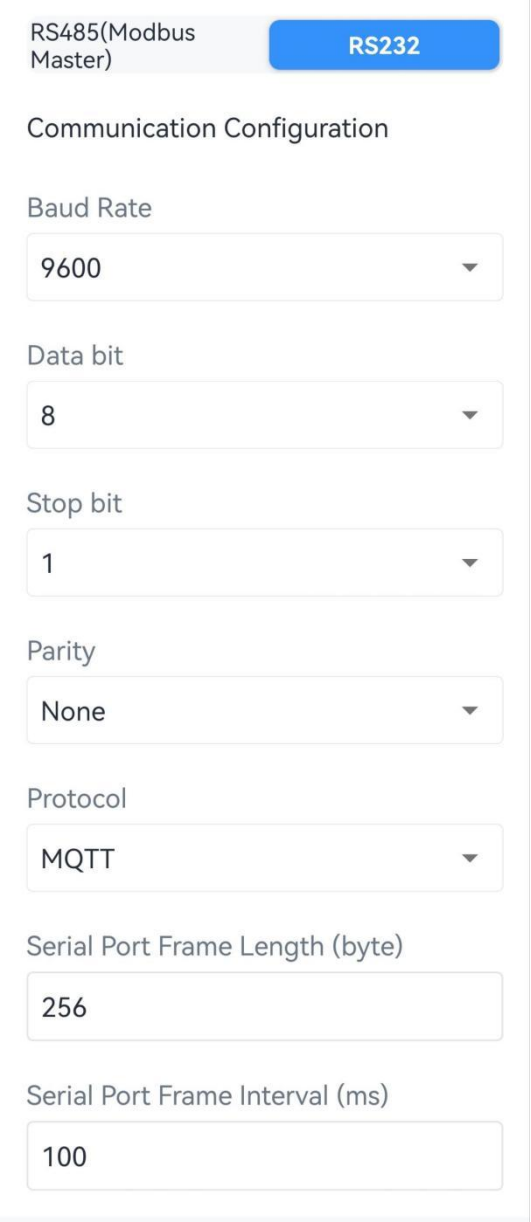
Group	
Server Address	Fill in the TCP or UDP server address (IP/domain name).
Port	Fill in the TCP or UDP server port. Range: 1-65535.
Network Status	Show the connection status between the device and the server.

4.3.4 RS232

When work mode is low power mode, the device can forward RS232 data to server and is not able to receive the downlink commands from the server immediately.

When the work mode is low latency mode, the device can support both uplinks and downlinks between RS232 device and the server.

Besides, enable the power output interface and configure the power supply parameters if the RS232 terminal device needs power supply from UC50x controller.



Parameters	Description
Baud Rate	300/1200/2400/4800/9600/19200/38400/57600/115200 are available.
Data Bit	8 bit is available.
Stop Bit	1 bit/2 bit are available.
Parity	None, Odd and Oven are available.
Packet Length (byte)	When the device receives RS232 data up to this length, it will fragment it as a single packet and send to server.
Protocol	UDP, TCP or MQTT is optional. When using MQTT protocol, it is necessary to configure the Serial Passthrough Uplink/Downlink Topics.

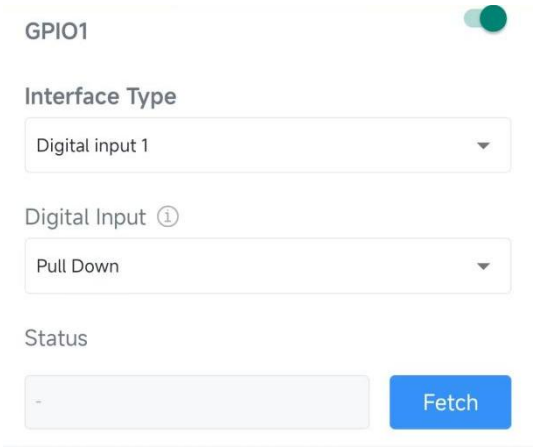
Serial Port Frame Length (byte)	When the device receives serial data up to this length, it will fragment it as a single packet and send to server.
Serial Port Frame Interval (ms)	The interval that the device sends out real serial data stored in the buffer area to public network. **Note:** data will be sent out when real serial data length reaches the preset frame length, even though it's within the serial frame interval.
TCP/UDP	
Keepalive Interval(s)	After being connected to TCP server, the device will send a heartbeat packet by TCP regularly to keep alive.
Reconnection Interval (s)	When TCP connection fails, the device will reconnect to the server at the preset interval.
Number of Reconnections	When TCP heartbeat times run out, the device will resend heartbeat. After it reaches the preset number of reconnections, the device will reconnect to TCP server.
First/Second Group	The device supports to connect device to two different servers.
Server Address	Fill in the TCP or UDP server address (IP/domain name).
Port	Fill in the TCP or UDP server port. Range: 1-65535.
Network Status	Show the connection status between the device and the server.

4.3.5 GPIO

The GPIO interface supports three working types: Digital Input, Digital Output and Pulse Counter.

Digital Input:

Digital input can be used to detect high or low status of devices.

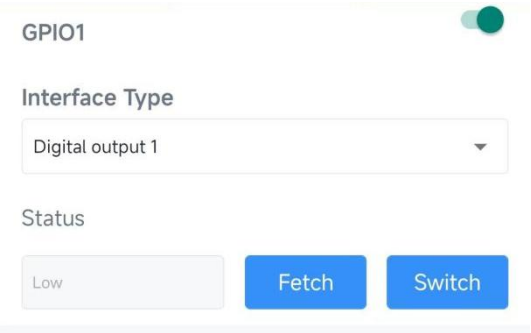


Parameters	Description

Digital Input	Initial status of digital input. **Pull Down:** rising edge will be triggered **Pull Up/None:** falling edge will be triggered
Fetch	Click to get current status of digital input.

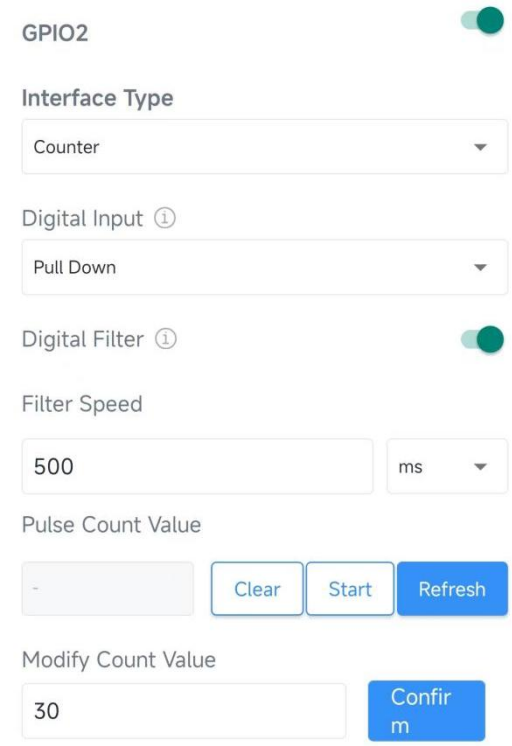
Digital Output:

Digital output will send voltage signals to control devices.



Parameters	Description
Fetch	Click to get current status of digital output.
Switch	Click to switch the digital output status to check if UC50x can trigger devices.

Pulse Counter:



Parameters	Description
Digital Input	Initial status of counter.

	Pull Down: Increase 1 when detecting rising edge **Pull Up/None:** Increase 1 when detecting falling edge
Digital Filter	It's recommended to enable when pulse period is greater than 250 us.
Start/Stop	Make the device start/stop counting. **Note:** UC50x will send non-changable counting values if you do not click **Start**.
Refresh	Refresh to get latest counter values.
Clear	Count the value from 0.
Modify the count values	Set the initial counting value and click **Confirm** to save this value.

Note:

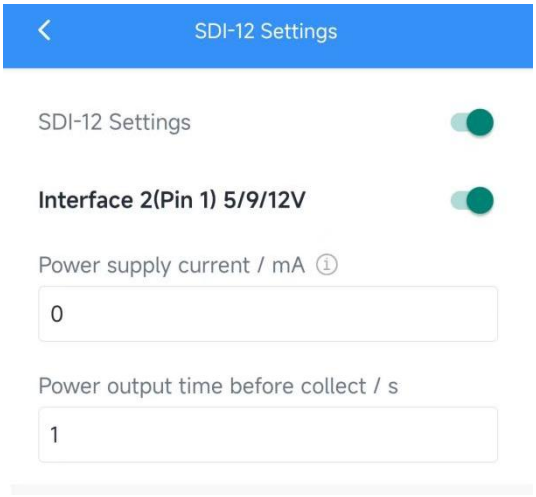
1) Reboot or re-join will not affect the counting.

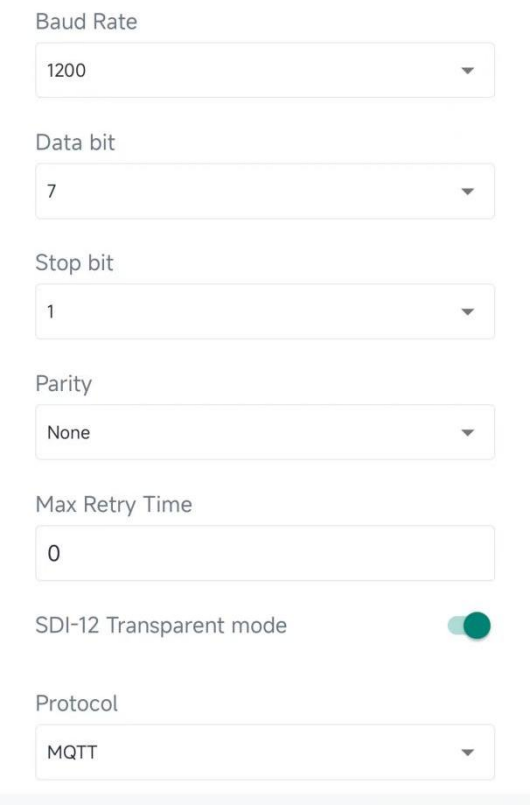
2) The pulse value supports to clear manually via ToolBox or downlink command, or clear automatically when it calculates to max value: 4294967295 (0xffffffff).

4.3.6 SDI-12

1. Connect SDI-12 sensor to SDI-12 port on interface 2. If the SDI-12 device requires power from the UC50x, connect the power cable of SDI-12 device to power output on interface 2.

2. Go to **Device > Setting > SDI-12 Settings** and attach phone to read current settings.

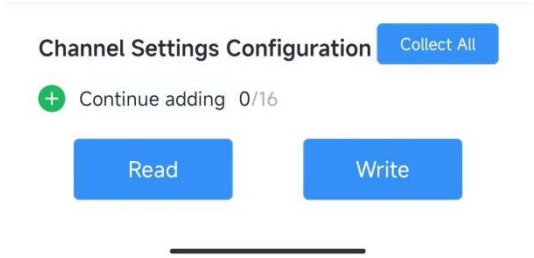




Parameters	Description
Interface 2(Pin 1) 5V/9V/12V Output	Enable 5V/9V/12V power output of interface 2 to supply power to SDI-12 sensors. It's 12V by default and you can change DIP switches to change voltage. **Power Output Time Before Collect:** power supply time before collecting data for terminal device initialization. Range: 0-600s. **Power Supply Current:** supply current as sensor required. Range: 0-100mA
Baud Rate	1200/2400/4800/9600/19200/38400/57600/115200 are available.
Data Bit	8 bit/7 bit is available.
Stop Bit	1 bit/2 bit is available.
Parity	None, Odd and Oven are available.
Max Retry Time	Set the maximum retry times after device fails to read data from SDI-12 sensors.
SDI-12 Transparent Mode	This only works when using Low Latency Mode. If this mode is enabled, the server can send SDI-12 command to SDI-12 device and the device can only react according to server commands.
Protocol	UDP, TCP or MQTT is optional. When using MQTT protocol, it is necessary to configure the Serial

	Passthrough Uplink/Downlink Topics.
TCP/UDP	
Keepalive Interval(s)	After being connected to TCP server, the device will send a heartbeat packet by TCP regularly to keep alive.
Reconnection Interval (s)	When TCP connection fails, the device will reconnect to the server at the preset interval.
Number of Reconnections	When TCP heartbeat times run out, the device will resend heartbeat. After it reaches the preset number of reconnections, the device will reconnect to TCP server.
First/Second Group	The device supports to connect device to two different servers.
Server Address	Fill in the TCP or UDP server address (IP/domain name).
Port	Fill in the TCP or UDP server port. Range: 1-65535.
Network Status	Show the connection status between the device and the server.

3. Click “+” to add channels, then attach phone to device to read the address of SDI-12 sensor.



4. Configure the SDI-12 channel and save the settings.

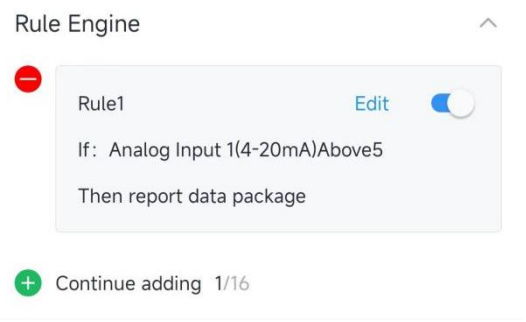
Parameters	Description
Channel ID	Select the channel ID you want to configure from 16 channels.
Name	Customize the name of each channel to easily identify them.
Address	Address of SDI-12 sensor, it is editable.
Write	Click to modify a new address to SDI-12 sensor.
SDI-12 Command	Fill in the commands to send to sensors, one channel can add 16 commands at most.
Value	Show the collected value. If it read multiple values, it will be separated by “+” or “-”.

5. Click **Collect** and attach smart phone to the device to collect data, then click **Fetch** to read the data. You can also tap **Collect All** and **Fetch All** to fetch all channel data.
6. Click **Write** to save all SDI-12 settings.

4.4 Alarm Settings

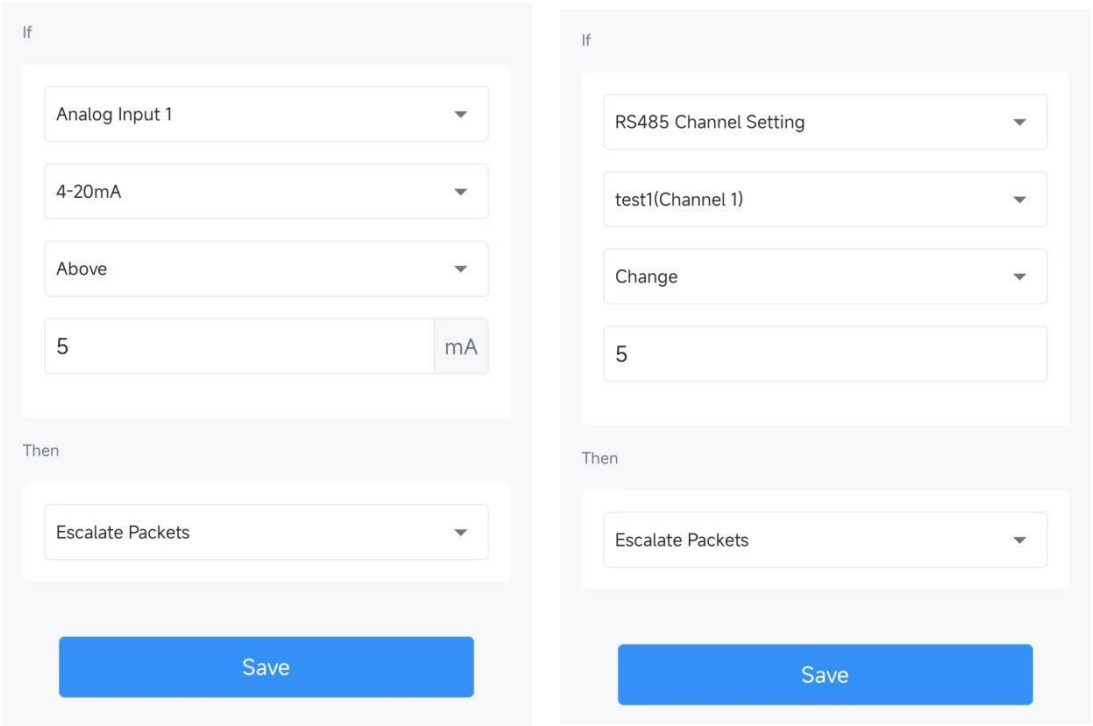
UC50x supports configuring commands to send alarm packets to servers. Each device can be added 16 threshold alarm commands at most.

1. Go to **Device > Setting > Rule Engine** to add commands.



2. Set an IF condition including the analog input values or RS485 Modbus channel values. When the value matches the condition, the device will report an alarm packet.

Note: the device will only send the alarm once. Only when the value turns back to normal and triggers the condition again, it will send a new alarm.



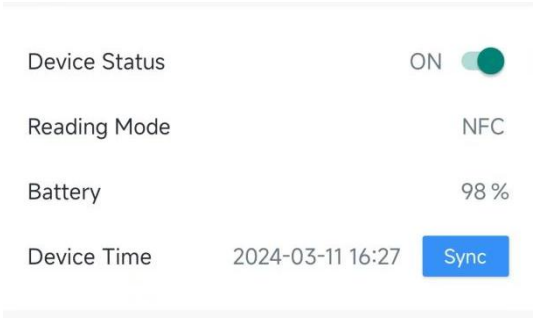
3. After setting all commands, click **Save** to write the settings.

4.5 Data Storage

UC50x series supports storing data records locally and exports data via ToolBox App. The device will record the data according to the reporting interval even if it is not connected to a network.

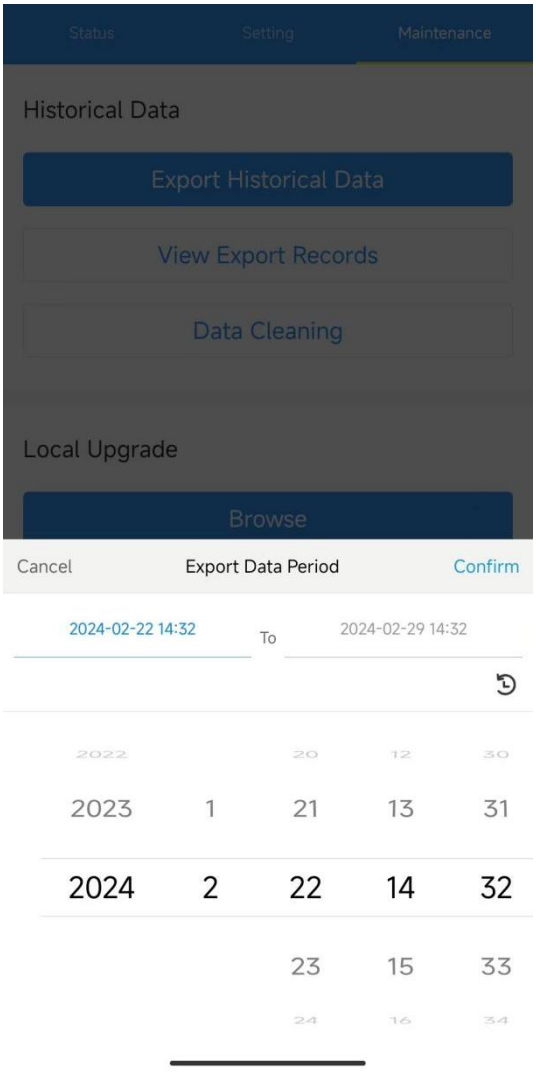
1. Ensure the device time is correct. This time can be synced from cellular operator

automatically or ToolBox App manually.



2. Go to **Device > Settings > General Settings** of ToolBox App to enable data storage feature.
3. Go to **Device > Maintenance** of ToolBox App, click **Export**, then select the data time range and click **Save** to export data.

Note: ToolBox App can only export the last 14 days' data.



4. Click **Clear** to clear all stored data inside the device if necessary.

4.6 Maintenance

4.6.1 Upgrade

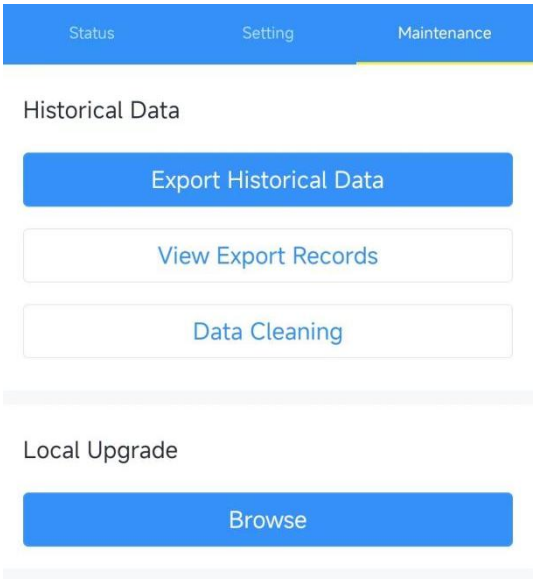
1. Download firmware from Milesight official website to your smart phone.

2. Open ToolBox App and click **Browse** to import firmware and upgrade the device.

Note:

1) Operation on ToolBox is not supported during the upgrade.

2) Only Android version ToolBox supports the upgrade feature.

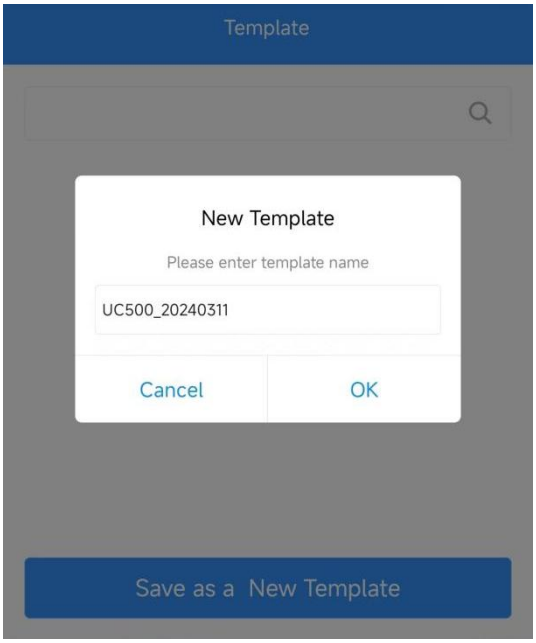


4.6.2 Backup

UC50x devices support configuration backup for easy and quick device configuration in bulk. Backup is allowed only for devices with the same model.

1. Go to **Template** page on the App and save current settings as a template. You can also edit the template file.

2. Select one template file which saved in the smart phone and click **Write**, then attach to another device to write configuration.

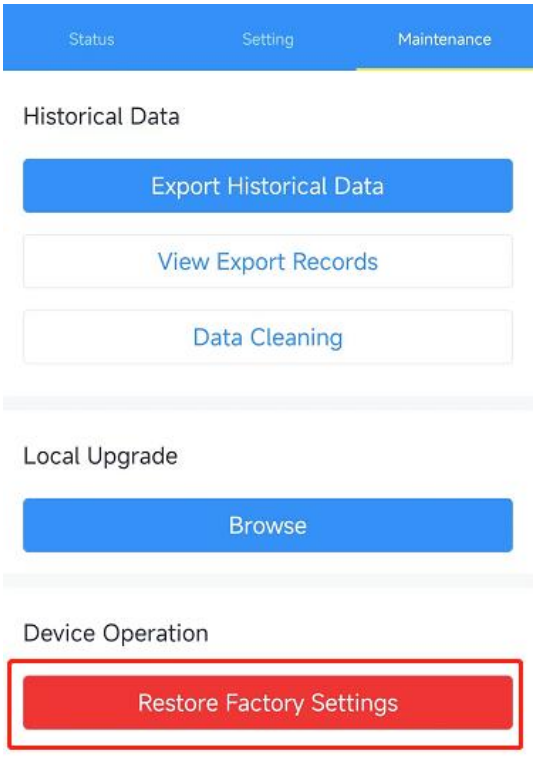


4.6.3 Reset to Factory Default

Please select one of following methods to reset device:

Via Hardware: Open the case of UC50x and hold on power button more than 10s.

Via ToolBox App: Go to **Device > Maintenance** to click **Restore Factory Settings**, then attach smart phone with NFC area to UC50x to complete reset.

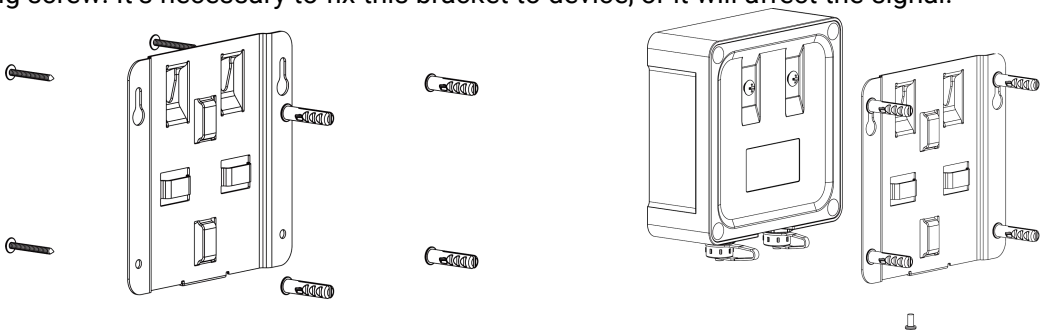


5. Installation

UC50x series support wall mounting or pole mounting. Before installation, make sure you have the mounting bracket, wall or pole mounting kits and other required tools.

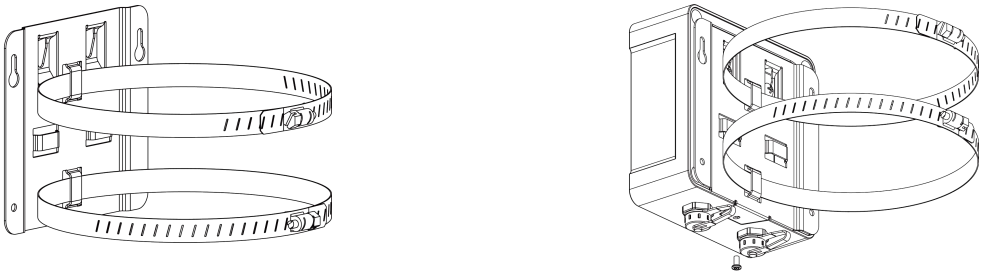
Wall Mounting:

1. Fix the wall plugs into the wall, then fix the mounting bracket to the wall plugs with screws.
2. Put the device on the mounting bracket, then fix the bottom of the device to the bracket with a fixing screw. It's necessary to fix this bracket to device, or it will affect the signal.



Pole Mounting:

1. Straighten out the hose clamp and slide it through the rectangular rings in the mounting bracket, wrap the hose clamp around the pole. After that use a screwdriver to tighten the locking mechanism by turning it clockwise.
2. Put the device on the mounting bracket, then fix the bottom of the device to the bracket with a fixing screw. It's necessary to fix this bracket to device, or it will affect the signal.



6. Device Payload

Please refer to the ***UC50x Series (LTE Version) Communication Protocol***, for decoders of Milesight IoT products please click here.

-END-