LoRaWAN® Solenoid Valve Controller

UC51x Series

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 batteries, please install it accurately, and do not install the reverse or wrong model.
- The device must never be subjected to shocks or impacts.

Declaration of Conformity

UC51x series is in conformity with the essential requirements and other relevant provisions of the CE, FCC, and RoHS.

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Revision History

Date	Doc Version	Description
Feb. 29, 2024	V 4.0	Initial version on hardware 4.x
Jan. 8, 2025	V 4.1	1. Add DI status definition feature 2. Update UI of ToolBox App 3. Remove ToolBox software configuration

Contents

1. Product Introduction

1.1 Overview

UC51x series LoRaWAN® wireless solenoid valve controller is a device used to remotely control DC latching solenoids of the valve. It contains 2 solenoid interfaces and 2 GPIO interfaces, which can be easily controlled locally or remotely.

Besides ultra-low-power LoRaWAN® technology, UC51x series also provides both solar and built-in battery power supply for uninterrupted operation. For outdoor applications, it equips with IP67-rated enclosure and M12 connectors to protect from water and dust under harsh environments.

1.2 Features

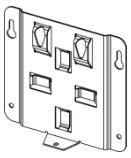
- Compatible with standard DC latching solenoids
- OPEN/CLOSE control by mobile App locally or commands remotely
- Two GPIO interfaces for flow monitoring or valve status monitoring
- Transmission distance up to 15 km with line of sight
- Waterproof design including IP67 case and M12 connectors
- Solar powered and built-in chargeable batteries
- Quick wireless configuration via NFC
- Time and flow control via Milesight IoT Cloud or Milesight Development Platform

2. Hardware Introduction

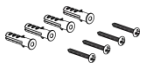
2.1 Packing List

1 × UC51x Device

2 × Data Cables (1.5m)



1 × Mounting Bracket



4 × Wall Mounting Kits

2 × Hose Clamps

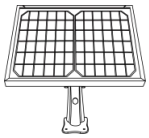
1 × Fixing Screw

1 × Quick Guide

1 × Warranty Card

1 × LoRaWAN® Magnetic Antenna (EA Version Only)

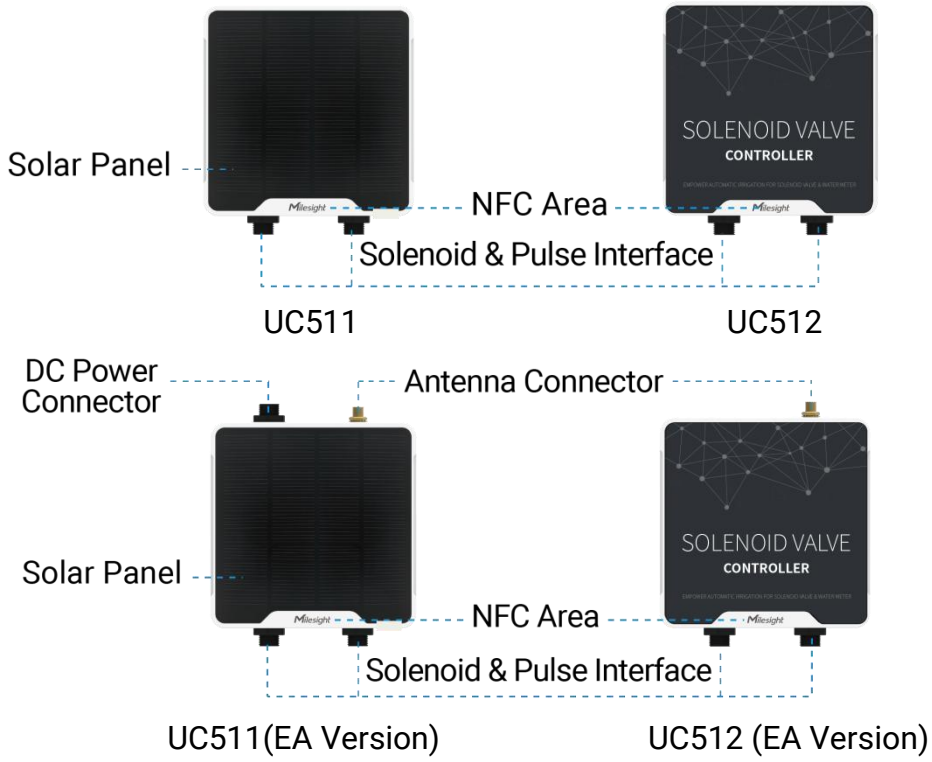
1 × Power Cable (30cm) (UC511 EA Optional)



1 × Solar Panel Kit (UC511 EA Optional)

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

2.2 Hardware Overview



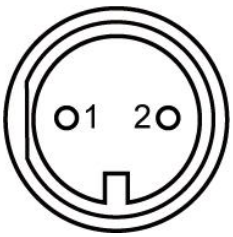
Data Interface 1&2:

Pin	Description
1	DC+/OUT1 of Solenoid Valve
2	DC-/OUT2 of Solenoid Valve
3	GND
4	INSERT BOOT[1]
5	GND
6	GPIO Interface

[1] PIN3 and PIN4 do not need to connect, see "Solenoid Valve Switch" option.

Power Interface (UC511-EA):

Pin	Description
1	VCC(5-24V)
2	GND

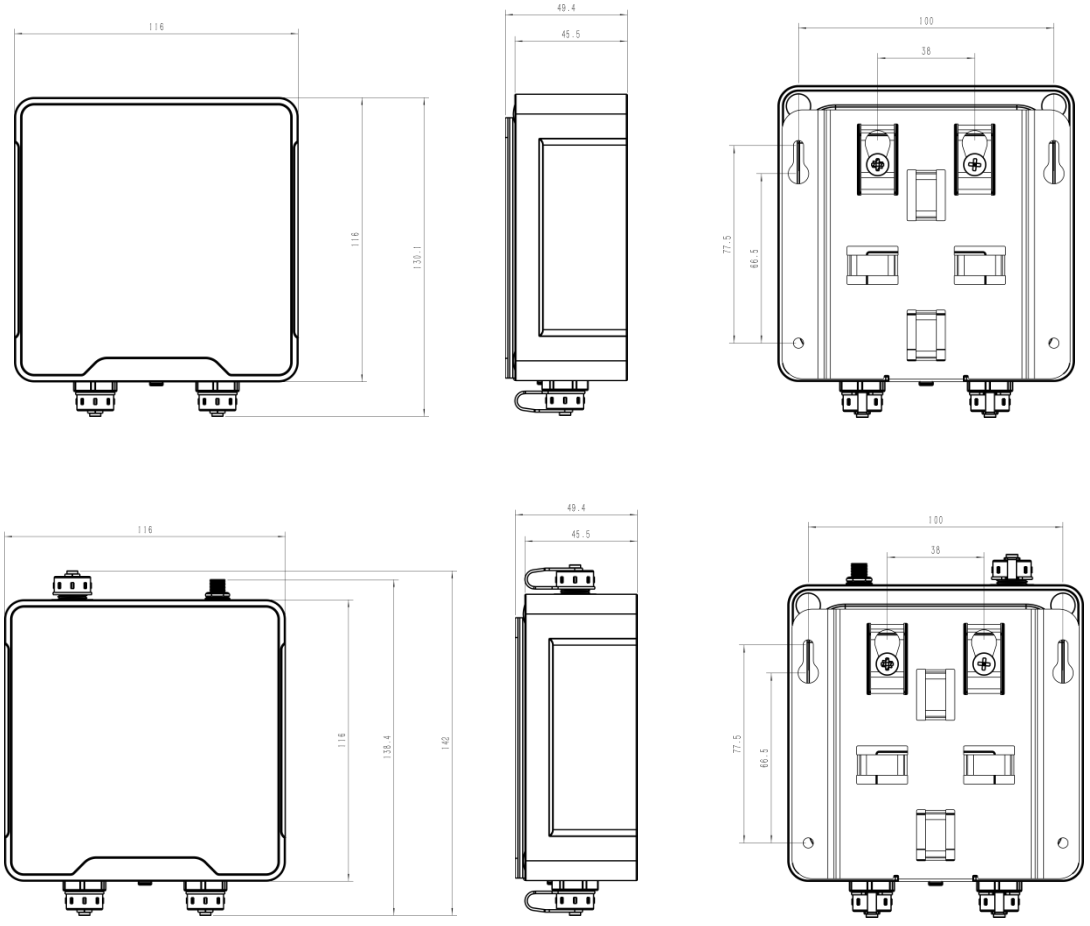


2.3 Power Button and LED Indicator

UC51X equips with a power button and a LED indicator inside for emergency reboot/reset.

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 once.	Light On: Device is on.
		Light Off: Device is off.

2.4 Dimensions (mm)

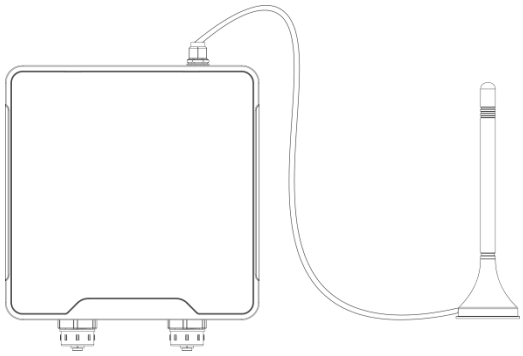


3. Hardware Adjustment

3.1 Antenna Installation (External Antenna Version Only)

Rotate the antenna into the antenna connector accordingly. To ensure a good signal, it is suggested to follow below instructions:

1) The antenna should be installed vertically, with the magnetic base attached to a metal surface.
2) Keep the antenna away from walls and ensure there are no obstacles around it. It is suggested to place the antenna near windows when used indoors.
3) Maintain a distance of more than 50cm between antennas.
4) For better coverage, it is suggested to position the antenna higher.

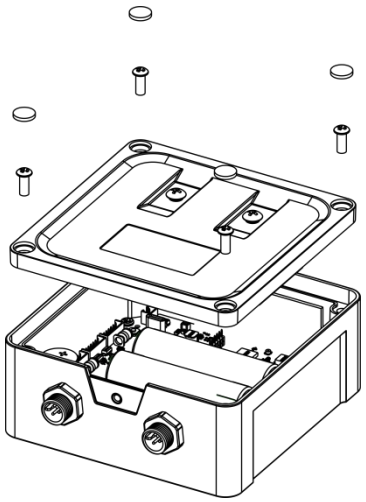


3.2 Back Cover Restore

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.
3. Fix the screw caps on the screws.

Screw Order



4. Operation Guide

4.1 Log in the ToolBox

UC51x series can be monitored and configured via NFC.

1. Download and install “Milesight ToolBox” App from Google Play or Apple App Store.
2. Enable NFC on the smartphone and launch Milesight ToolBox.
3. Attach the smartphone with NFC area to the device to read basic information.
4. Basic information and settings of devices will be shown on ToolBox if it’s recognized successfully. You can read and configure the device by tapping the button on the App. In order to protect the security of devices, password validation is required when first configuration. Default password is **123456**.

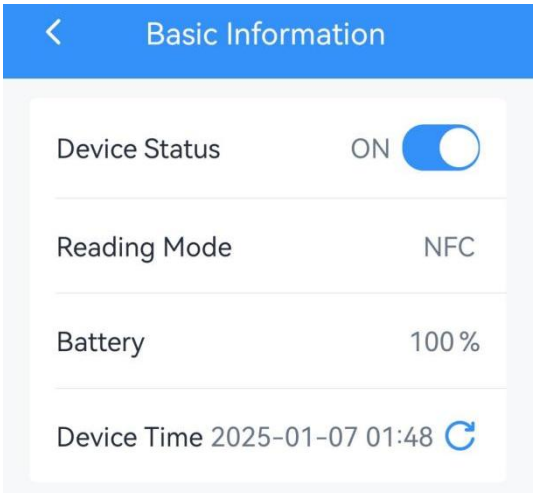
Note:

1) Ensure the location of smartphone NFC area and it’s recommended to take off phone case.
2) If the smartphone fails to read/write configurations via NFC, keep the phone away and back to try again.

4.2 Time Synchronization

ToolBox Sync:

Go to **Device > Basic Information** of ToolBox App to sync the time.



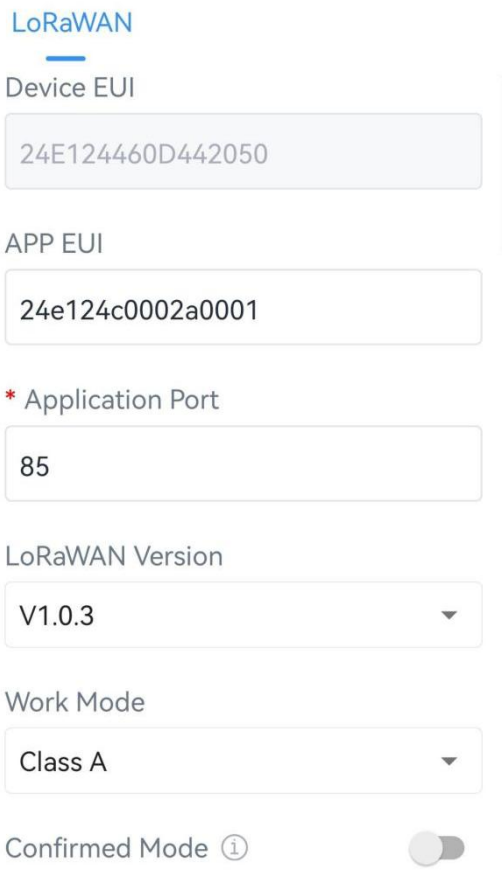
Network Server Sync:
Change device LoRaWAN® version as 1.0.3, then the device will send MAC commands to enquire the time from network server every time it joins the network. This should ensure the network server supports this feature.

4.3 LoRaWAN Settings

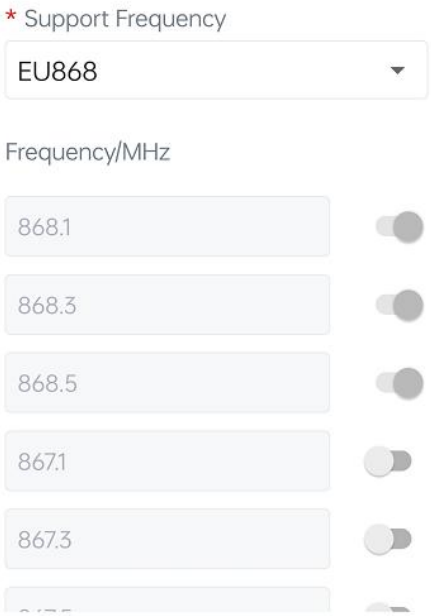
LoRaWAN settings is used for configuring the transmission parameters in LoRaWAN® network.

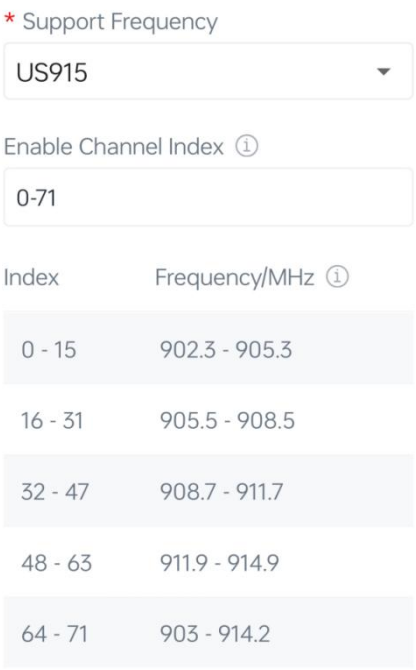
4.3.1 Basic Settings

UC51x supports basic configurations like join type, App EUI, App Key and other information. You can also keep all settings by default.



Parameters	Description
Device EUI	Unique ID of the device which can also be found on the label.
App EUI	Default App EUI is 24E124C0002A0001.
Application Port	The port used for sending and receiving data, default port is 85.
LoRaWAN Version	V1.0.2 and V1.0.3 are available.
Work Mode	Working mode of LoRaWAN® device. UC511: Class A, Class B, Class C and Class C to B are available; UC512: Class A and Class B are available. **Note:** for Class B mode, if the device does not receive beacons for more than 120 minutes, it will switch to Class A mode automatically; for Class C to B mode, if the device does not receive beacons for more than 30 minutes, it will switch to Class C mode automatically.
Join Type	OTAA and ABP mode are available.
Application Key	Appkey for OTAA mode, default is 5572404C696E6B4C6F52613230313823.
Device Address	DevAddr for ABP mode, default is the 5th to 12th digits of SN.
Network Session Key	Nwkskey for ABP mode, default is 5572404C696E6B4C6F52613230313823.

Application Session Key	Appskey for ABP mode, default is 5572404C696E6B4C6F52613230313823.
Rejoin Mode	Reporting interval ≤ 35 mins: the device will send a specific number of LinkCheckReq MAC packets to the network server every reporting interval or every double reporting interval to validate connectivity; If there is no response, the device will re-join the network. Reporting interval > 35 mins: the device will send a specific number of LinkCheckReq MAC packets to the network server every reporting interval to validate connectivity; If there is no response, the device will re-join the network. **Note:** Only OTAA mode supports rejoin mode.
Set the number of packets sent	When rejoin mode is enabled, set the number of LinkCheckReq packets sent.
Support Frequency	Select the channel plan and the frequency to send uplinks.  If frequency is one of CN470/AU915/US915, enter the index of the channel that you want to enable and make them separated by commas. **Examples:** 1, 40: Enabling Channel 1 and Channel 40 1-40: Enabling Channel 1 to Channel 40 1-40, 60: Enabling Channel 1 to Channel 40 and Channel 60 All: Enabling all channels Null: Indicates that all channels are disabled

	
ADR Mode	Allow network server to adjust datarate of the device.
Spread Factor	If ADR is disabled, the device will send data via this spread factor.
Tx Power	Tx power of the device.
RX2 Data Rate	RX2 data rate to receive downlinks or Milesight D2D commands.
RX2 Frequency	RX2 frequency to receive downlinks or Milesight D2D commands. Unit: Hz
Confirmed Mode	If the device does not receive ACK packet from network server, it will resend data once.
Ping Slot Periodicity	When the class type is Class B or Class C to B, the device will open the reception window according to this period.

Note:

1) Please contact sales for device EUI list if there are many units.

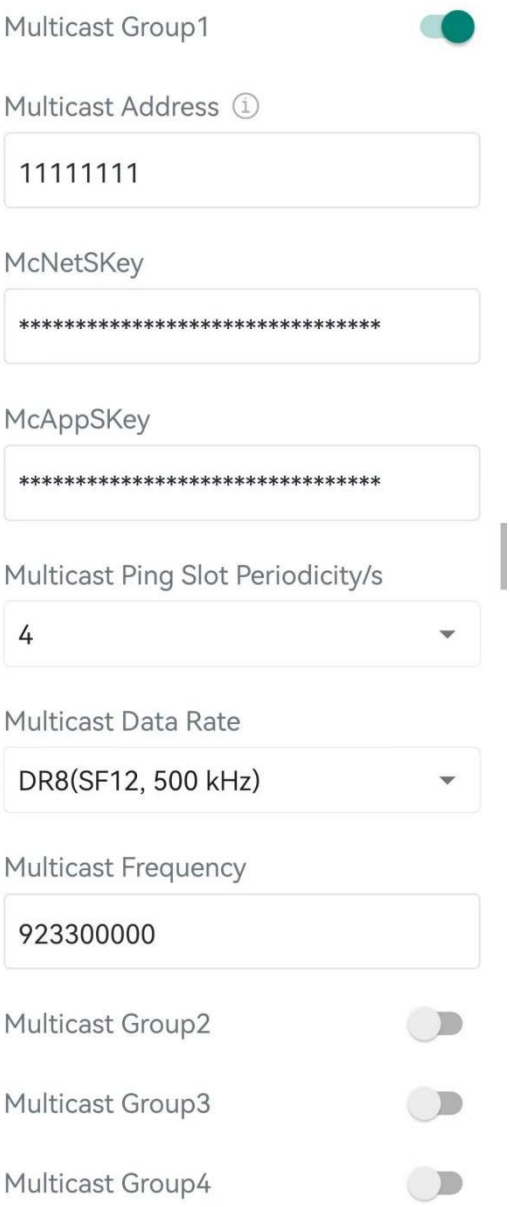
2) Please contact sales if you need random App keys before purchase.

3) Select OTAA mode if you use Milesight IoT cloud or Milesight Development Platform to manage devices.

4.3.2 Multicast Settings

UC51x supports setting up several multicast groups to receive multicast commands from network servers and users can use this feature to control devices in bulks.

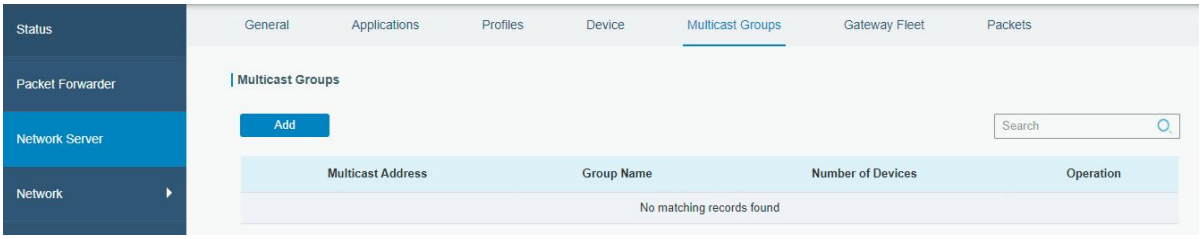
1. Ensure the work mode is Class C, Class B or Class C to B.
2. Enable Multicast Group and set a unique multicast address and keys to distinguish other groups. You can also keep these settings by default.



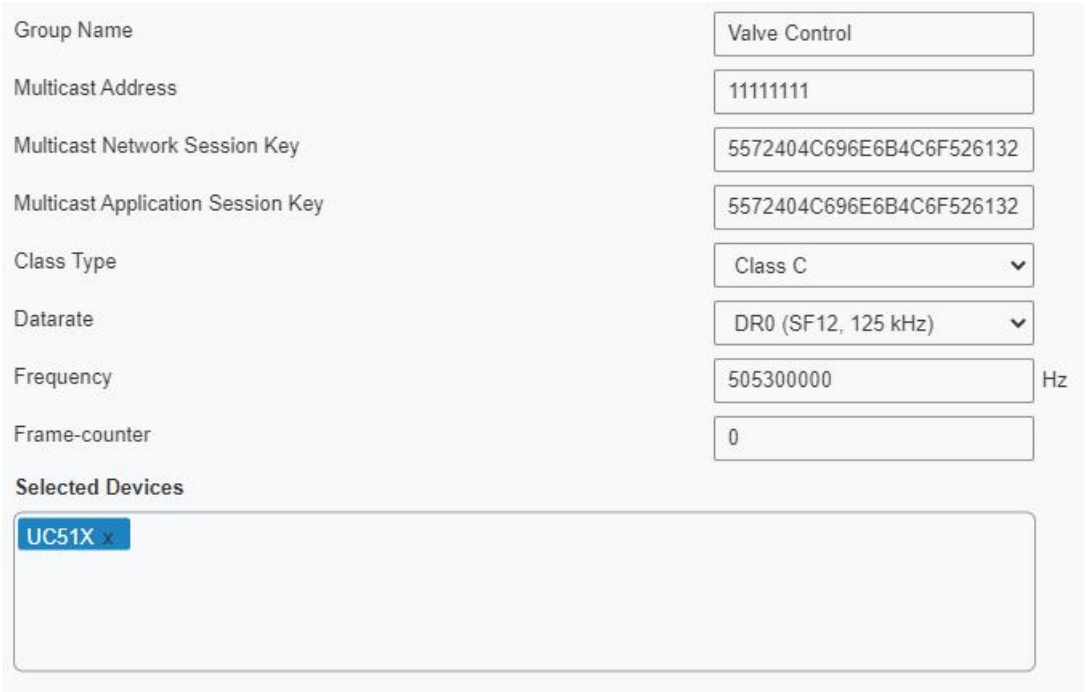
Parameters	Description
Multicast Address	Unique 8-digit address to distinguish different multicast groups.
Multicast McAppSkey	32-digit key. Default values: Multicast Group 1: 5572404C696E6B4C6F52613230313823 Multicast Group 2: 5572404C696E6B4C6F52613230313824 Multicast Group 3: 5572404C696E6B4C6F52613230313825 Multicast Group 4: 5572404C696E6B4C6F52613230313826
Multicast McNetSkey	32-digit key. Default values: Multicast Group 1: 5572404C696E6B4C6F52613230313823 Multicast Group 2: 5572404C696E6B4C6F52613230313824 Multicast Group 3: 5572404C696E6B4C6F52613230313825

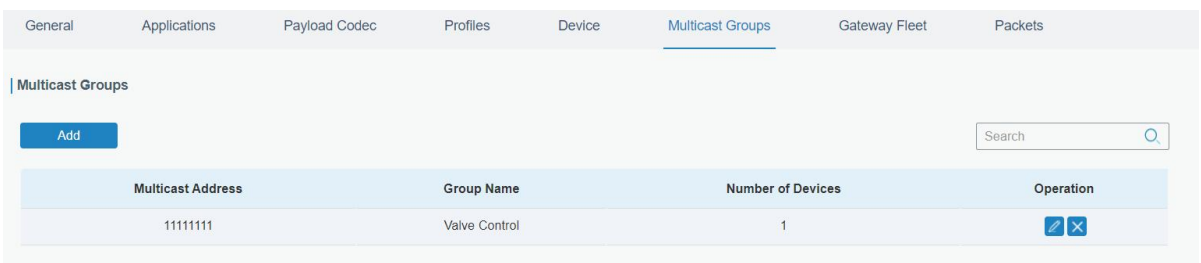
	Multicast Group 4: 5572404C696E6B4C6F52613230313826
Multicast Ping Slot Periodicity/s	The device will open the reception window according to this period to receive multicast commands.
Multicast Data Rate	The data rate to receive multicast commands. Unit: Hz
Multicast Frequency	The frequency to receive multicast commands. Unit: Hz

3. Add a multicast group on the network server. Take Milesight UG6x gateway as an example, go to **Network Server > Multicast Groups**, and click **Add** to add a multicast group.



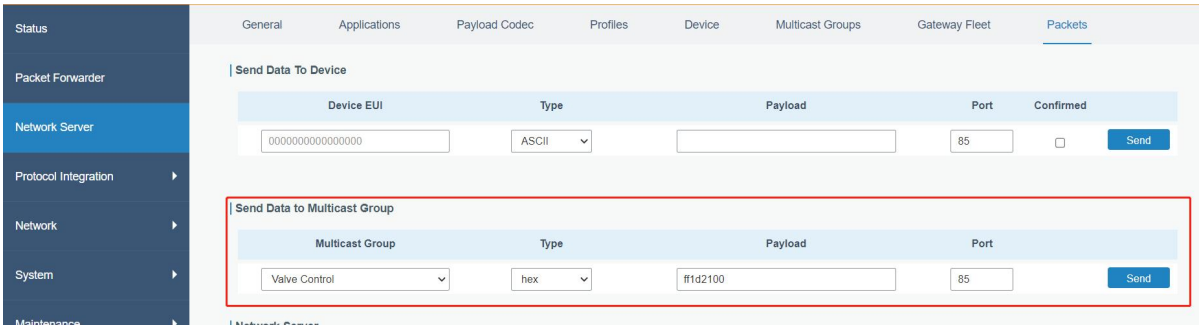
Fill in the multicast group information that is the same as device settings, and select the devices that you need to control, then click **Save**.





4. Go to **Network Server > Packets**, select the multicast group and fill in the downlink command, then click **Send**. The network server will broadcast the command to devices that belong to this multicast group.

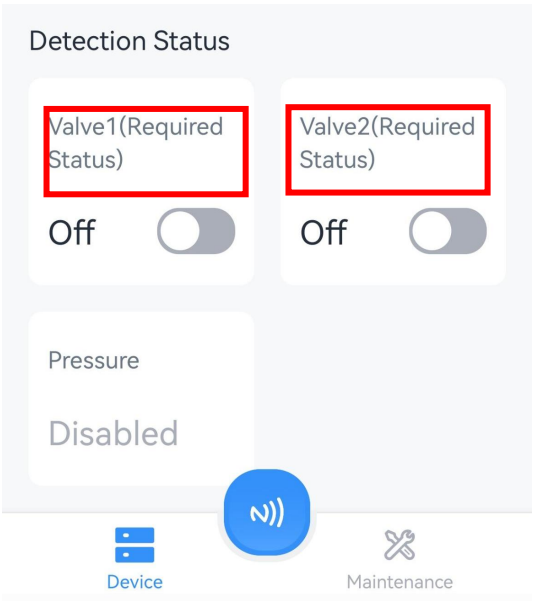
Note: ensure all devices' application ports are the same.



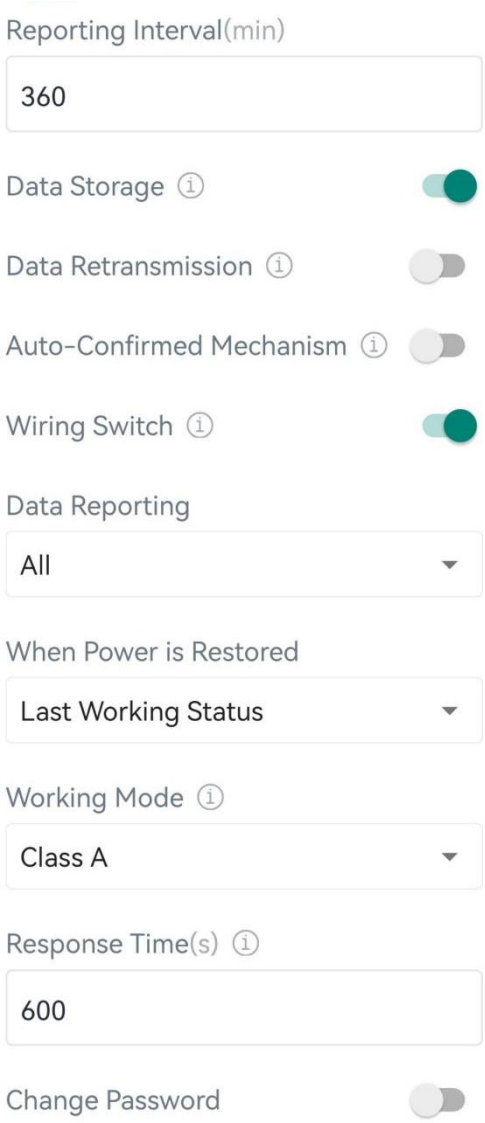
4.4 Solenoid & GPIO Settings

4.4.1 Solenoid Valve Control

UC51x series supports to control the solenoid valve via ToolBox locally. Besides, this can also be executed via downlink commands or local rules.



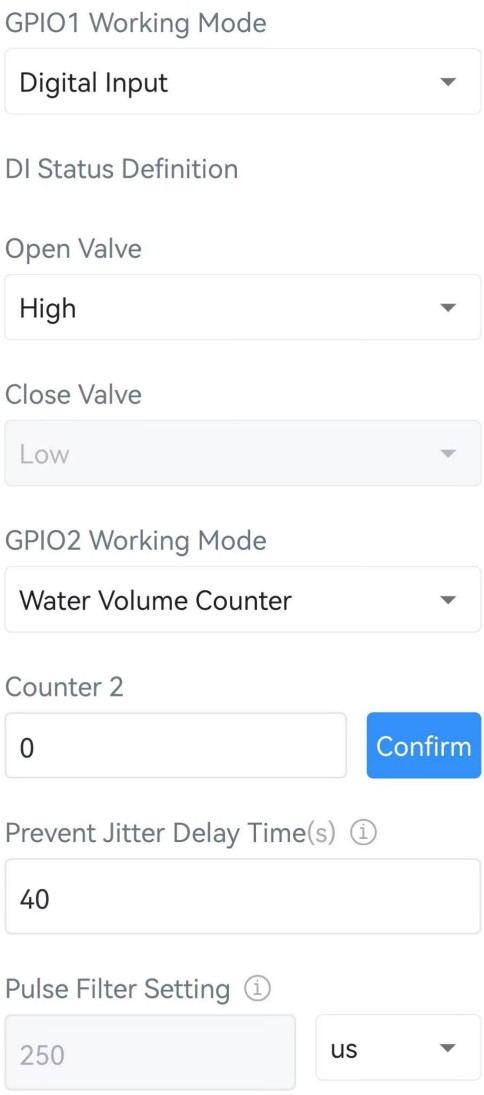
4.4.2 General Settings



Parameters	Description
Reporting Interval	Reporting interval of transmitting data to the network server. Default: 360min, Range: 1-1080 mins.
Data Storage	Disable or enable data storage locally.
Data Retransmission	Disable or enable data retransmission.
Auto-Confirmed Mechanism	After enabled, the device will reply the confirmed packet starting with “FE” to the network server when receiving downlink commands.
Wiring Switch	When this option is enabled, the UC51x will turn on automatically when a data cable is connected to any solenoid interface.
Data Reporting	Select the periodic packet report content. The options are All, Interface 1 Only, and Interface 2 Only.

	Note: every interface has a solenoid valve control interface and a GPIO interface.
When Power is Restored	If the device loses power and returns to power supply, the solenoid valve interface will be on or off according to this parameter.
Working Mode	Working mode of LoRaWAN® device. UC511: Class A, Class B, Class C and Class C to B are available; UC512: Class A and Class B are available. **Note:** for Class B mode, if the device does not receive beacons for more than 120 minutes, it will switch to Class A mode automatically; for Class C to B mode, if the device does not receive beacons for more than 30 minutes, it will switch to Class C mode automatically.
Response Time	When the class type is Class A: the device will send a blank packet to allow to receive the control commands at every Response Time interval. Range: 0-64800s, 0 means disabled. When the class type is Class B or Class C to B: the device will open the reception window according to the response time interval. **Note:** The shorter the response time, the shorter the battery life.
Change Password	Change the password for ToolBox App write this device or ToolBox software to log in the device configuration page.

4.4.3 GPIO Settings



Parameters	Description
GPIO1/2 Working Mode	Select Digital Input or Water Volume Counter (Pulse Counter). **Digital Input:** detect the real state of the valve to know if valve control takes effect. **Water Volume Counter:** connect to pulse water meter to measure the water volume.
Counter	Set the initial counting value and click **Confirm** to save this value.
DI Status Definition	When the working mode is Digital Input, set the definition of low/high status. The device will report the DI status according to this definition.
Prevent Jitter Delay Time (s)	The device will not upload GPIO status during this time to avoid frequent uplinks. This only works when GPIO working mode is Digital Input and this applies to both GPIO interfaces.
Pulse Filter Setting	Filter the pulse counting values below this rate. This only works when

	GPIO working mode is Water Volume Counter and this applies to both GPIO interfaces.

Note:

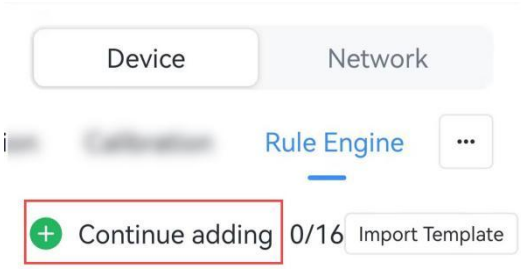
1) Reboot or re-join will not affect the counting.

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

4.5 Rule Settings

Go to **Setting > Rule Engine** page of ToolBox App or **Command** page of ToolBox software to add rules. One device supports to add 16 rules at most.

1. Add rule.

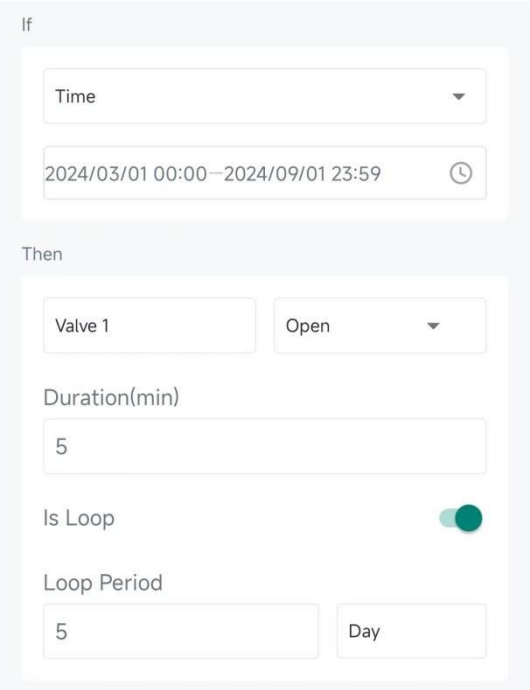


2. Set the rule as required. UC51x series supports to add below types of rules:

- Valve time schedule control

Example: During the time range 2024-3-1 0:00 to 2024-9-1 23:59, open the valve 1 at 0:00 for 5 minutes every 5 days.

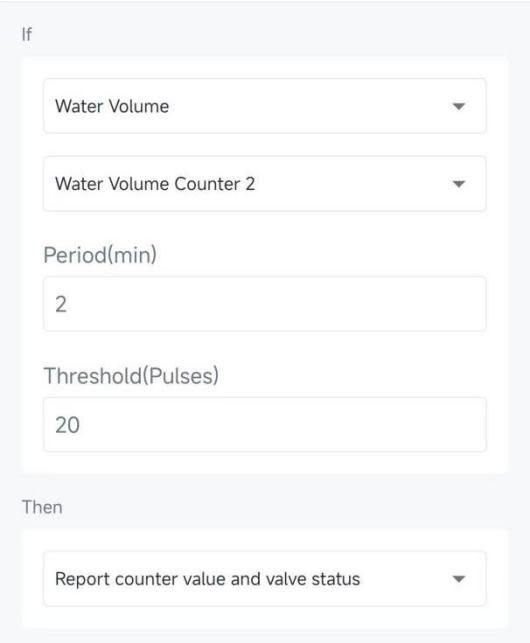
Note: Ensure the device time is correct (see section Time Synchronization).



- Water volume threshold

Example: when the GPIO2 detects 20 pulses within 2 minutes, the device will report a status packet or a custom message to network server.

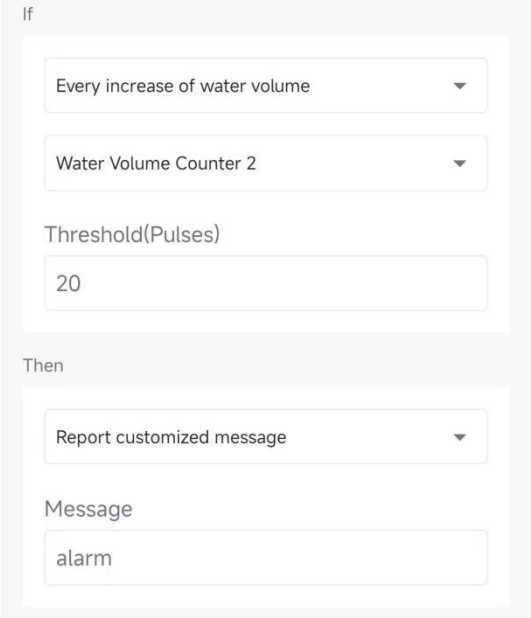
Note: the max length of custom message is 8 characters.



- Water volume increase threshold

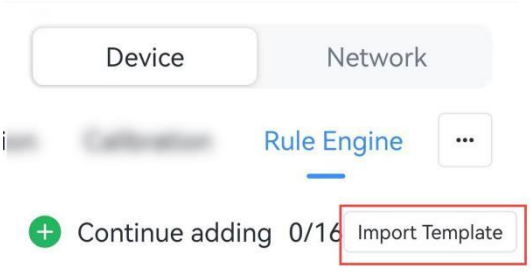
Example: Every time the counter of GPIO2 increases 20, the device will report a status packet or a custom message to the network server.

Note: the max length of custom message is 8 characters.



- Milesight D2D Agent: see Milesight D2D Settings

3. Enable or disable the rules as required.
4. Click **Write** to save the rule setting into the device.
5. Click **Export Template** to back up the rule settings into the smartphone; if you need to import the rule settings from other devices, click **Import Template** to import the setting.

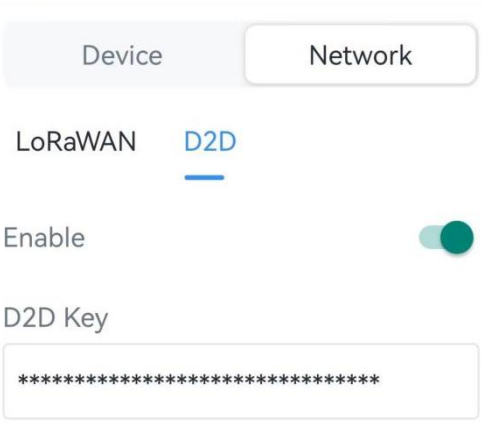


Note:
1) D2D rule has higher execute priority than types of rules.
2) When the device has multiple rules that are conflicted, the device will execute the rule with front number ID in priority.

4.6 Milesight D2D Settings (UC511 Only)

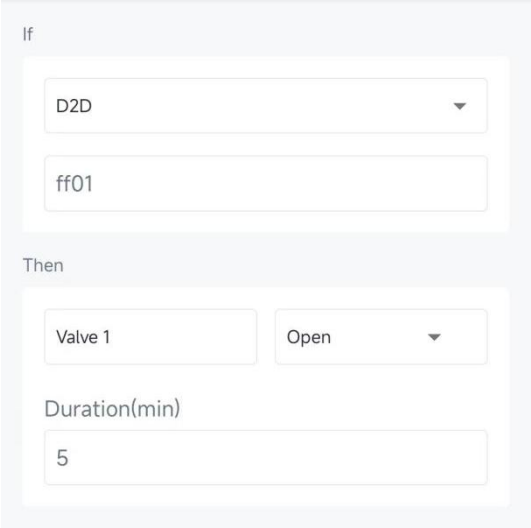
Milesight D2D protocol is developed by Milesight and used for setting up transmission among Milesight devices without a gateway. When the Milesight D2D setting is enabled, UC511 can work as a Milesight D2D agent to receive commands to control the solenoid valve status.

1. Ensure the work mode is Class C.
2. Enable Milesight D2D feature and define a unique Milesight D2D key which is the same as Milesight D2D controller devices. (Default D2D Key: 5572404C696E6B4C6F52613230313823)



3. Ensure the RX2 datarate and RX2 frequency are the same as Milesight D2D controller RX2 settings.

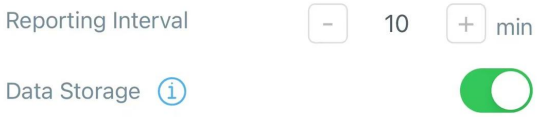
4. Set rule to work as a Milesight D2D agent.
Example: When the device receives Milesight D2D commands, it can open or close solenoid valves for some time.



4.7 Data Storage

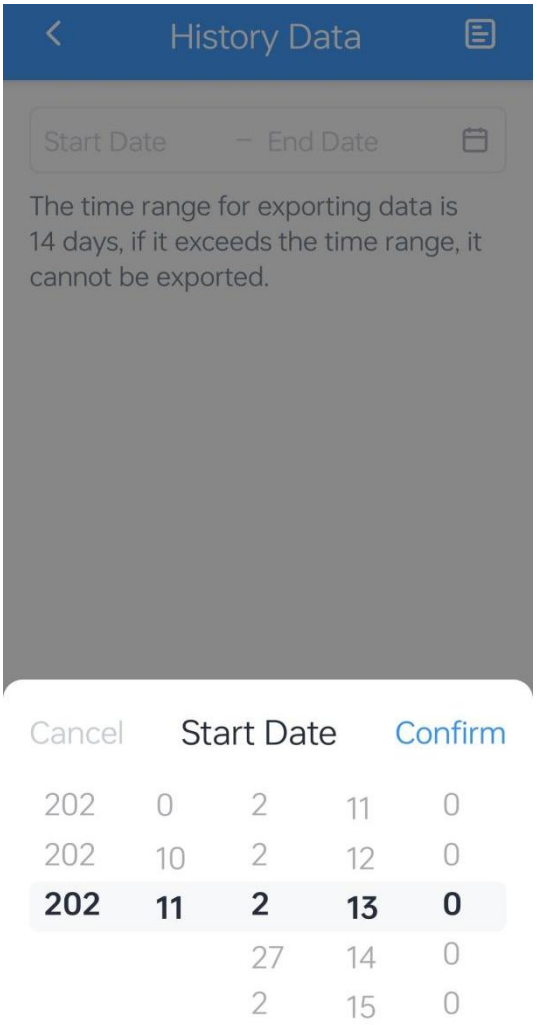
UC51x series supports storing 500 data records locally and exports data via ToolBox App or ToolBox software. The device will record the data according to the reporting interval even if it is not connected to a network.

1. Ensure the device time is correct (see section Time Synchronization);
2. Enable data storage feature.



3. Go to **Maintenance** of ToolBox App to click **History Data**, or **Maintenance > Backup and Reset** of ToolBox software to 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.



4.8 Data Retransmission

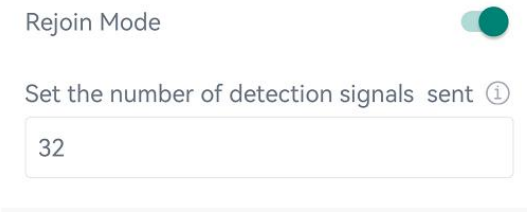
UC51x series supports data retransmission to ensure the network server can get all data even if the network is down for some times. There are two ways to get the lost data:

- Network server sends downlink commands to enquire the historical data for specified time range, see ***UC51x Series Communication Protocol;***
- When network is down if no response from LinkCheckReq MAC packets for a period of time, the device will record the network disconnected time and re-transmit the lost data after the device re-connects the network.

Here are the steps for data retransmission:

1. Enable data storage feature and data retransmission feature;

2. Enable rejoin mode feature and set the number of packets sent. Take below as example, the device will send LinkCheckReq MAC packets to the network server regularly to check if the network is disconnected; if there is no response for 8+1 times, the join status will change to de-active and the device will record a data lost time point(the time to join the network).



3. After the network connected back, the device will send the missing data, starting from the point in time when the data was lost, according to the reporting interval.

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) The retransmission data format is started with "20ce", please refer to ***UC51x Series Communication Protocol***.

4) Data retransmission will increase the uplinks and shorten the battery life.

4.9 Maintenance

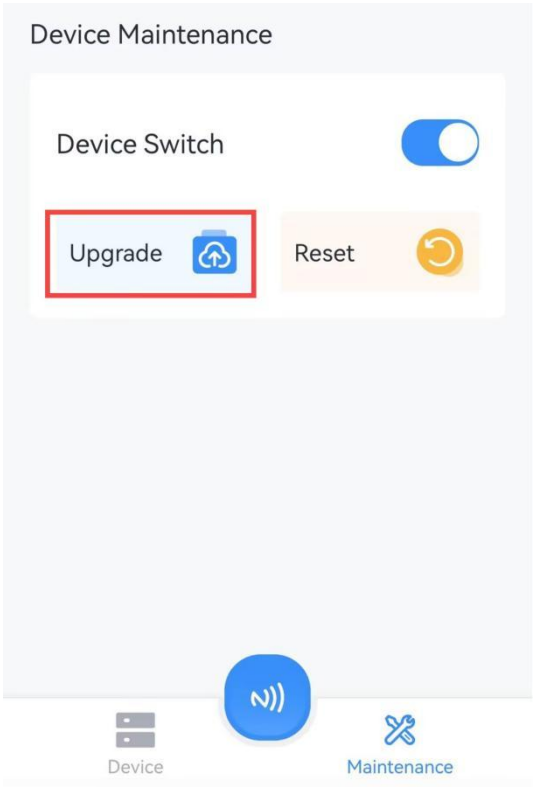
4.9.1 Upgrade

1. Download firmware from Milesight website to your smartphone.

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.

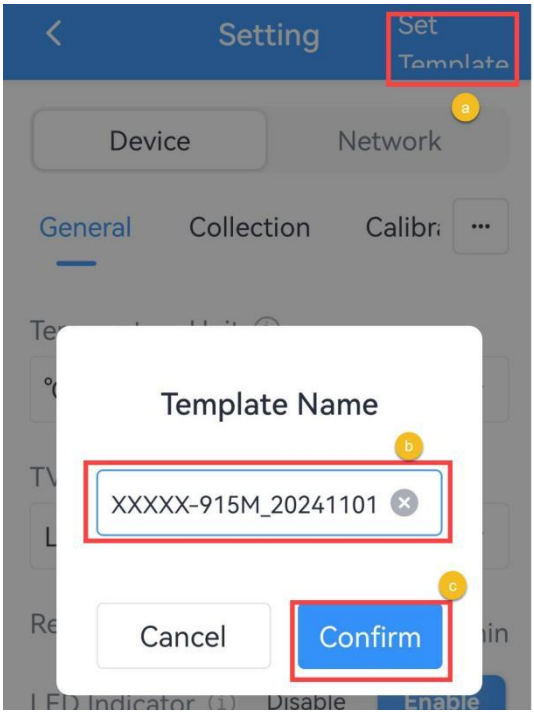


4.9.2 Backup and Restore

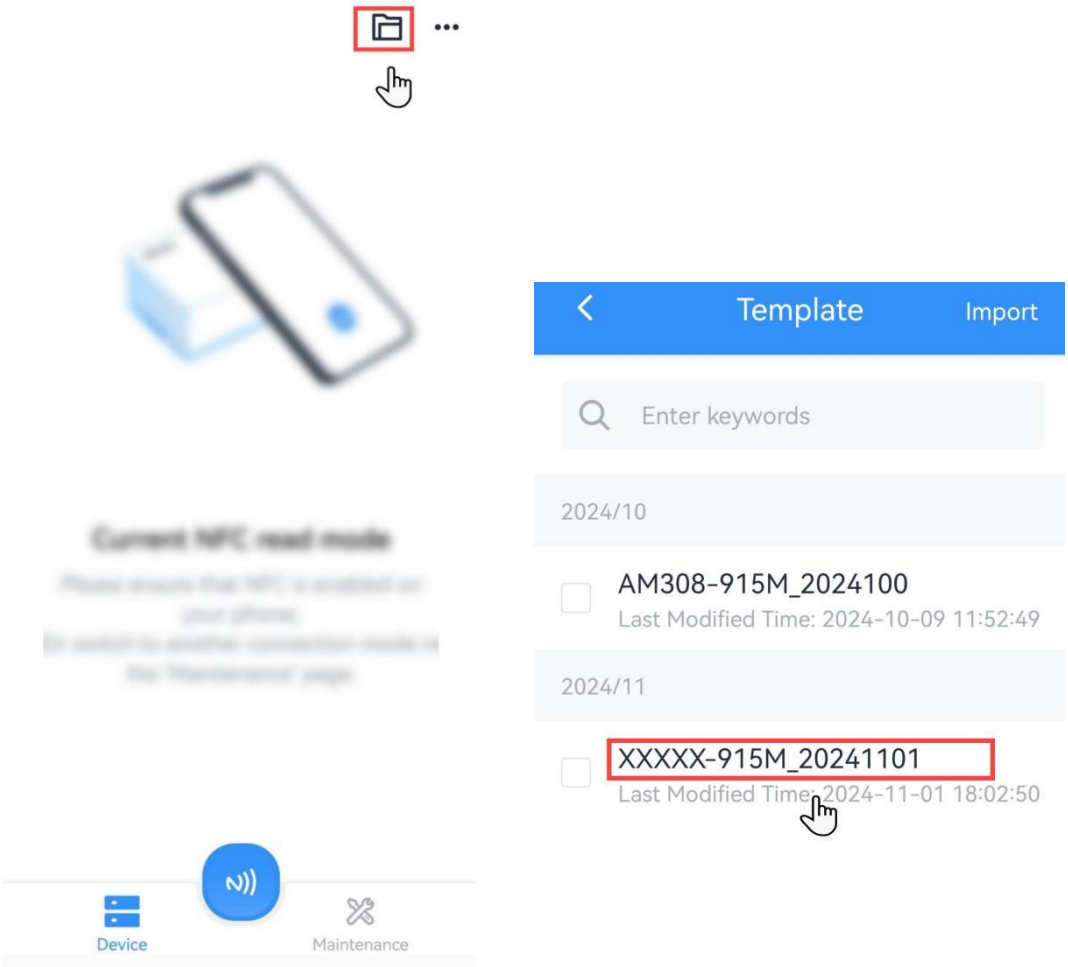
UC51x devices support configuration backup for easy and quick device configuration in bulk. Backup is allowed only for devices with the same model and LoRaWAN® frequency band.

Note: the backup file will not save rule setting, please backup rule settings.

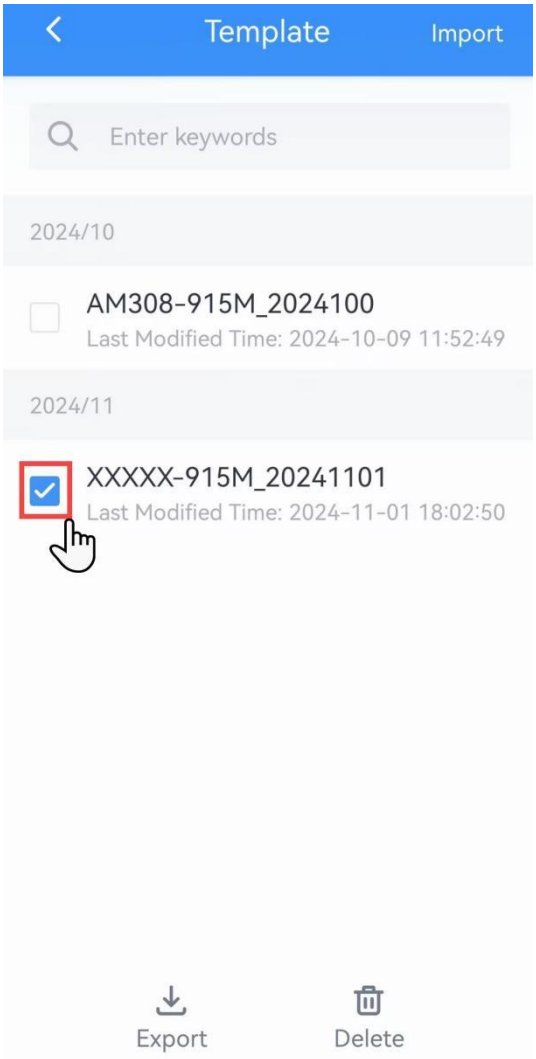
1. Attach the NFC area of smartphone to the device to read the device.
2. Go to **Settings** page on the App to edit the configuration as required, click **Set Template** to save current configuration as the template in the ToolBox App.



3. Go to **Template** page, select and click the target template, then click **Write** and attach the NFC area of smartphone to the target device to import the configuration.



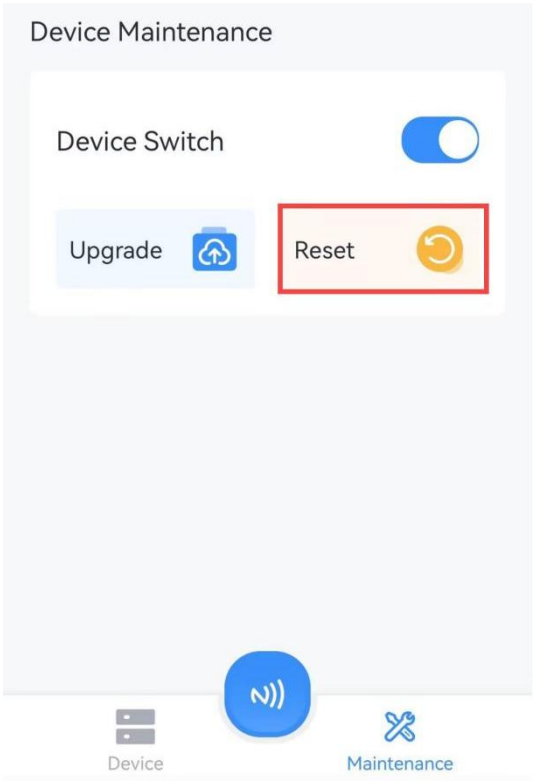
Note: Check the box of target template to delete it, or export this template as JSON format file and save it to the smartphone.



4.9.3 Reset to Factory Default

Please select one of following methods to reset device:

Via Hardware: Open the case of UC51x and hold on power button more than 10s.
Via ToolBox App: Click **Reset**, then attach smartphone's NFC area to the device.

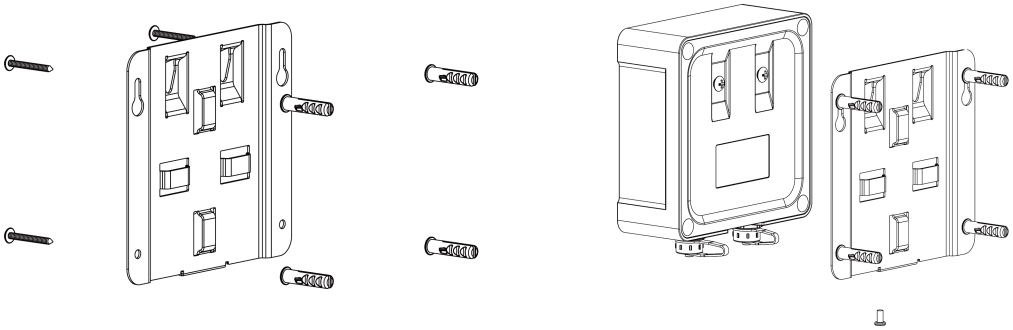


5. Device Installation

UC51x 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.

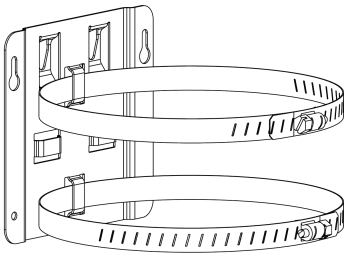


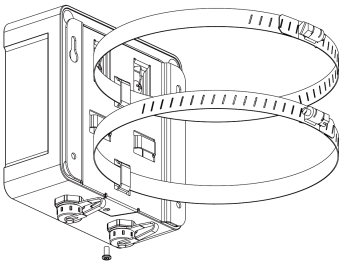
Pole Mounting:

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.



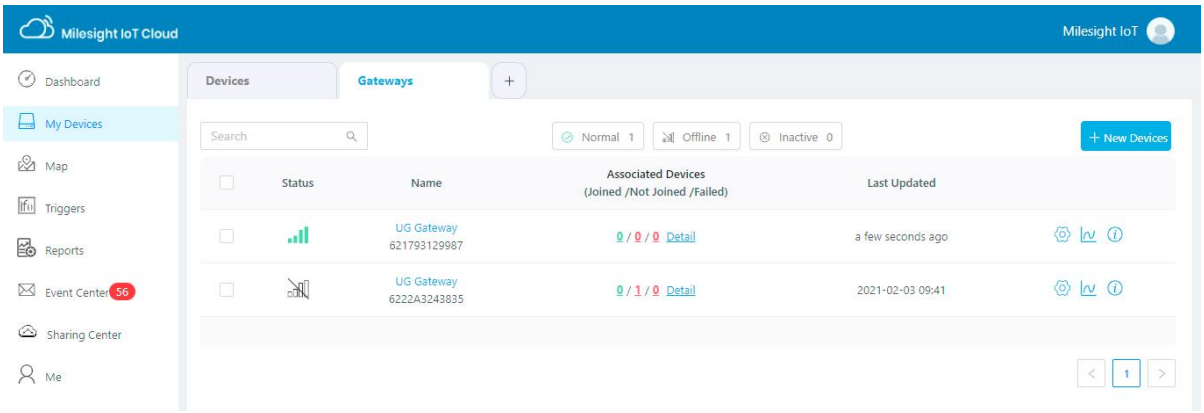


6. Milesight IoT Cloud Management

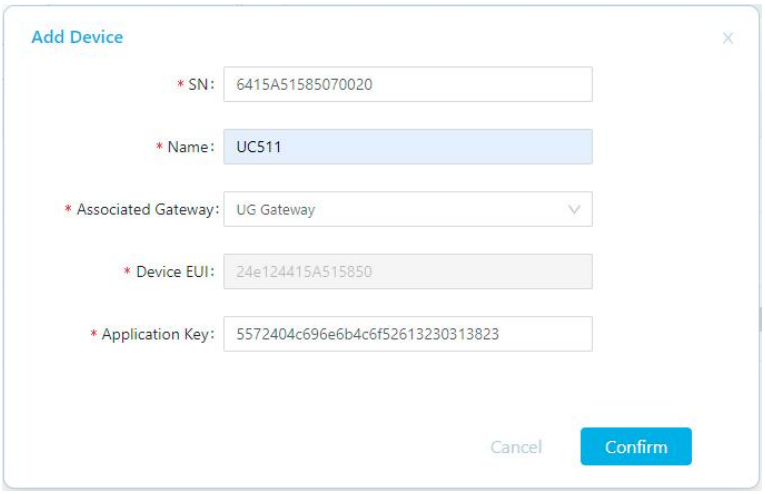
UC51x series can be managed by Milesight IoT Cloud platform. Milesight IoT cloud is a comprehensive platform that provides multiple services including device remote management and data visualization with the easiest operation procedures. Please register a Milesight IoT Cloud account before operating following steps.

6.1 Add UC51x to Cloud

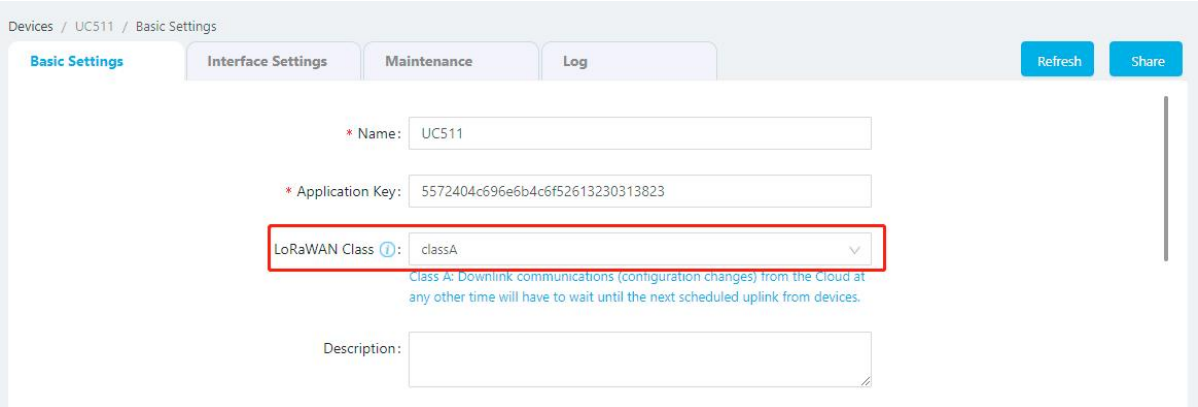
1. Ensure Milesight LoRaWAN® gateway is online in Milesight IoT Cloud. For more info about connecting gateway to cloud please refer to gateway's user guide.



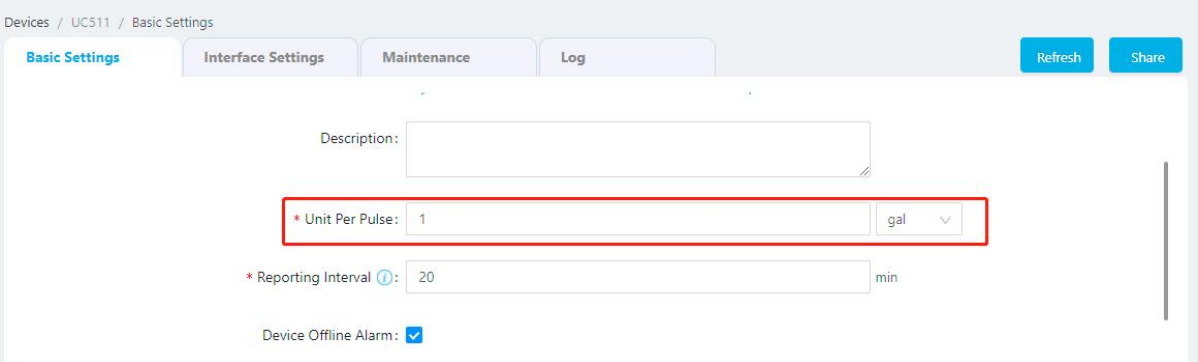
2. Go to "My Devices" page and click "+New Devices". Fill in the SN of UC51x and select associated gateway.



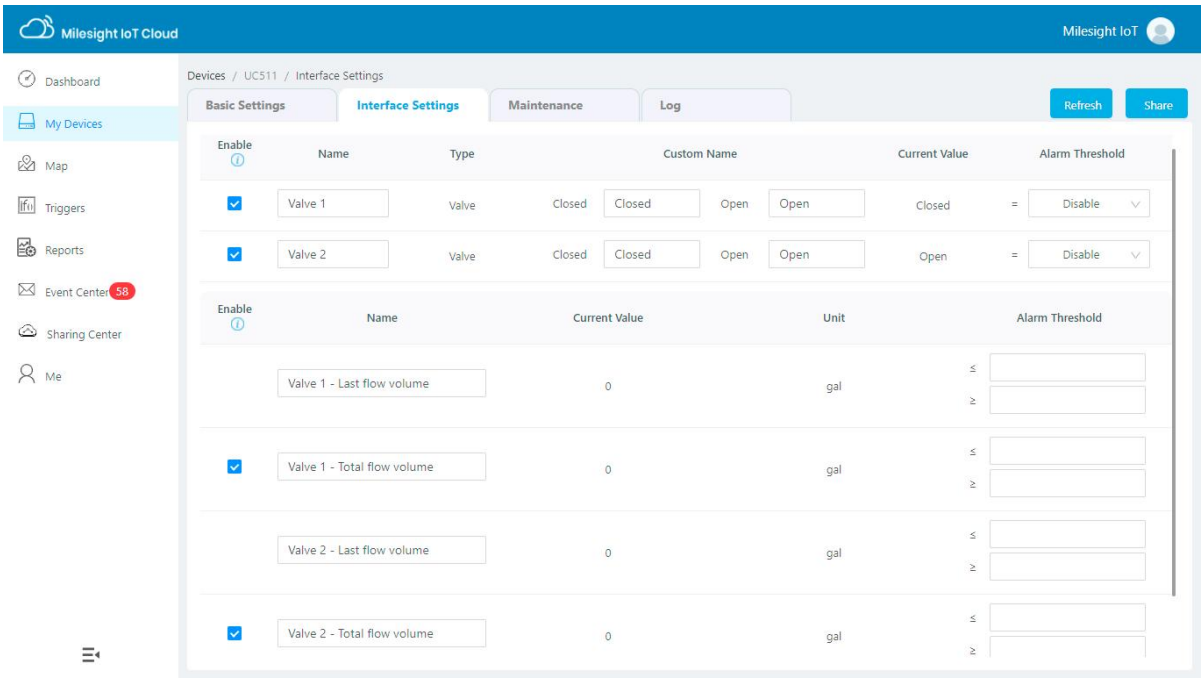
3. Click and go to “Basic Settings” to change class type the same as device settings.



Besides, configure the unit of per pulse if you connect the water meter.



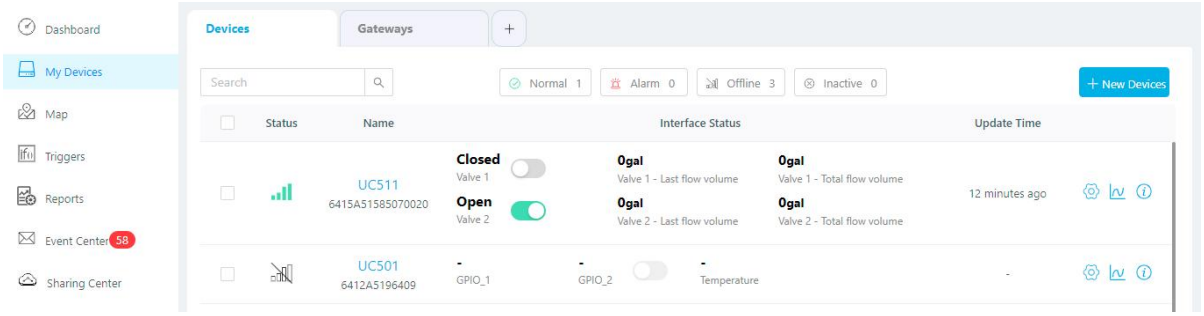
4. Click and go to “Interface Settings” to select used interfaces and customize the name and thresholds.

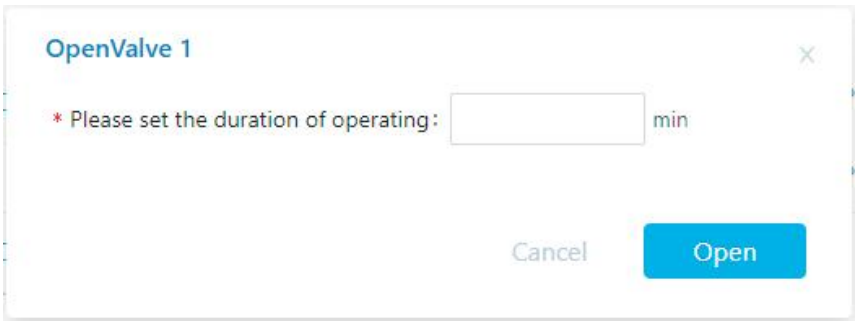


6.2 Solenoid Valve Control

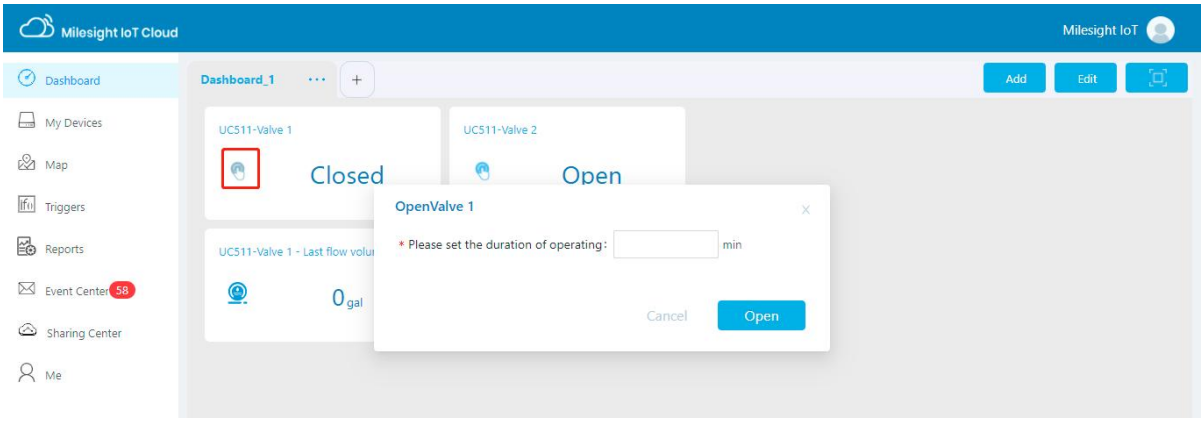
Solenoid valve can be controlled by Milesight IoT cloud webpage or App. Before control, ensure all schedule plans on device are disabled.

1. Click to open the solenoid valve and configure the duration. Note that if you enable any local plan on UC51x device, this control will not work.

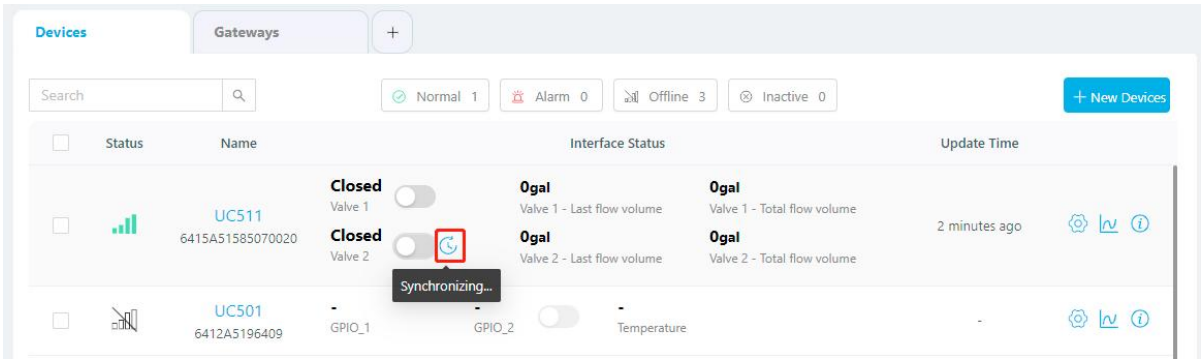




You can also add a switch on the dashboard to control the status of solenoid valves.

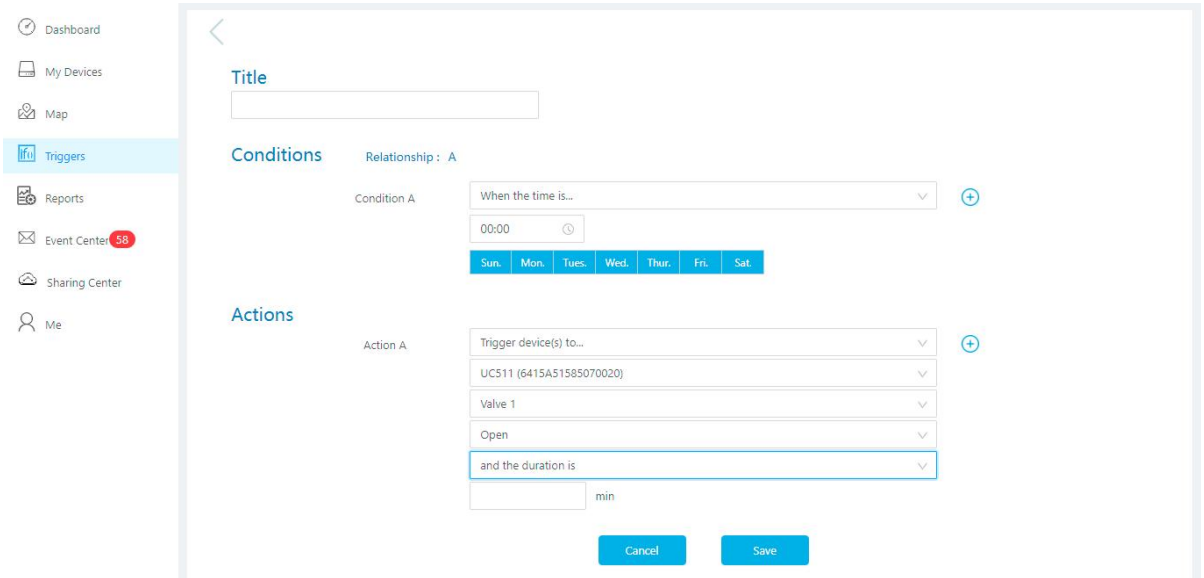


Note: If the working mode of UC51x is LoRaWAN® Class A, control commands will delay until the time icon disappear.



2. Go to “Triggers” page to add actions to trigger the solenoid valve to open for a period of time or a specific volume of water.

Note: Water volume control is only worked when you connect water meter to UC51x device.



7. Communication Protocol

UC51x Series use the standard Milesight IoT payload format based on IPSO. Please refer to the ***UC51x Series Communication Protocol***; for decoders of Milesight IoT products please click here.

-END-