# 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 battery, 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.




For assistance, please contact

Milesight technical support:

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Support Portal: support.milesight-iot.com

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## Revision History

| Date | Doc Version | Description |
|---|---|---|
| Feb. 29, 2024 | V 4.0 | Initial version on hardware 4.x |

# 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

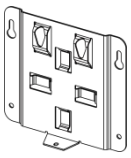
- Compatible with standard DC latching solenoids
- OPEN/CLOSE control by mobile App locally or commands remotely
- Two GPIO interfaces for flow monitoring or valve status monitoring
- Transmission distance up to 15 km with line of sight
- Waterproof design including IP67 case and M12 connectors
- Solar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

# 2. Hardware Introduction

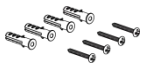
## 2.1 Packing List

1 × UC51x Device

2 × Data Cables (1.5m)



1 × Mounting Bracket



4 × Wall Mounting Kits

2 × Hose Clamps

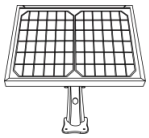
1 × Fixing Screw

1 × Quick Guide


1 × Warranty Card

1 × LoRaWAN® Magnetic Antenna (EA Version Only)

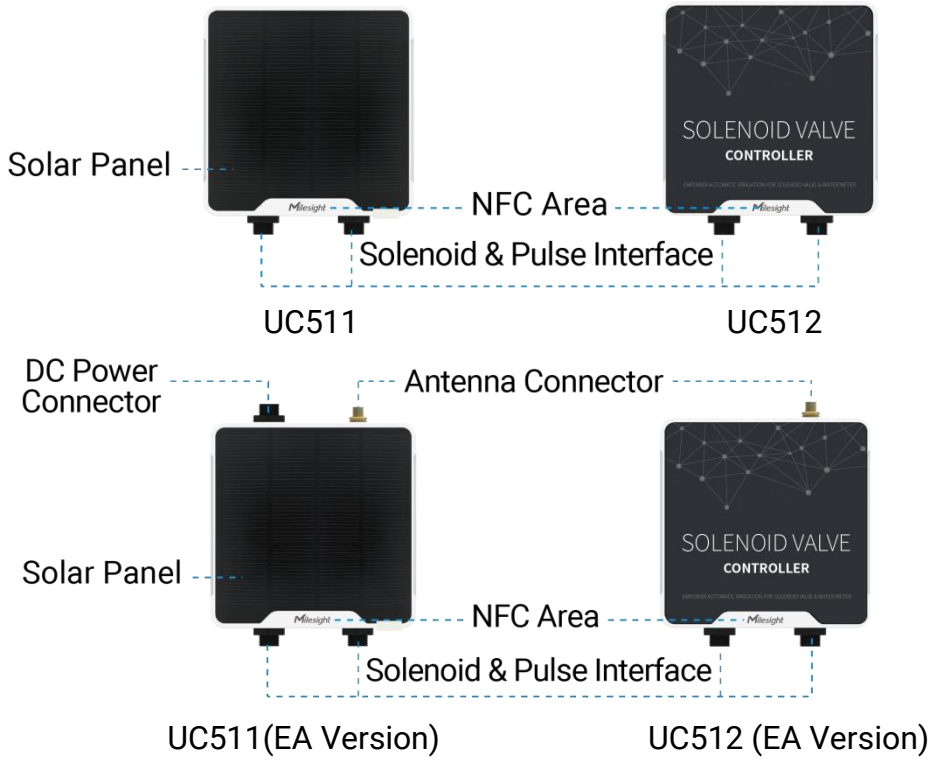
1 × Power Cable (30cm) (UC511 EA Optional)



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



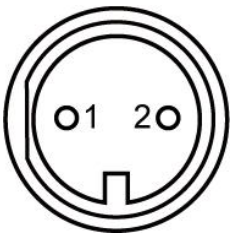

**Data Interface 1&2:**

| 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 |

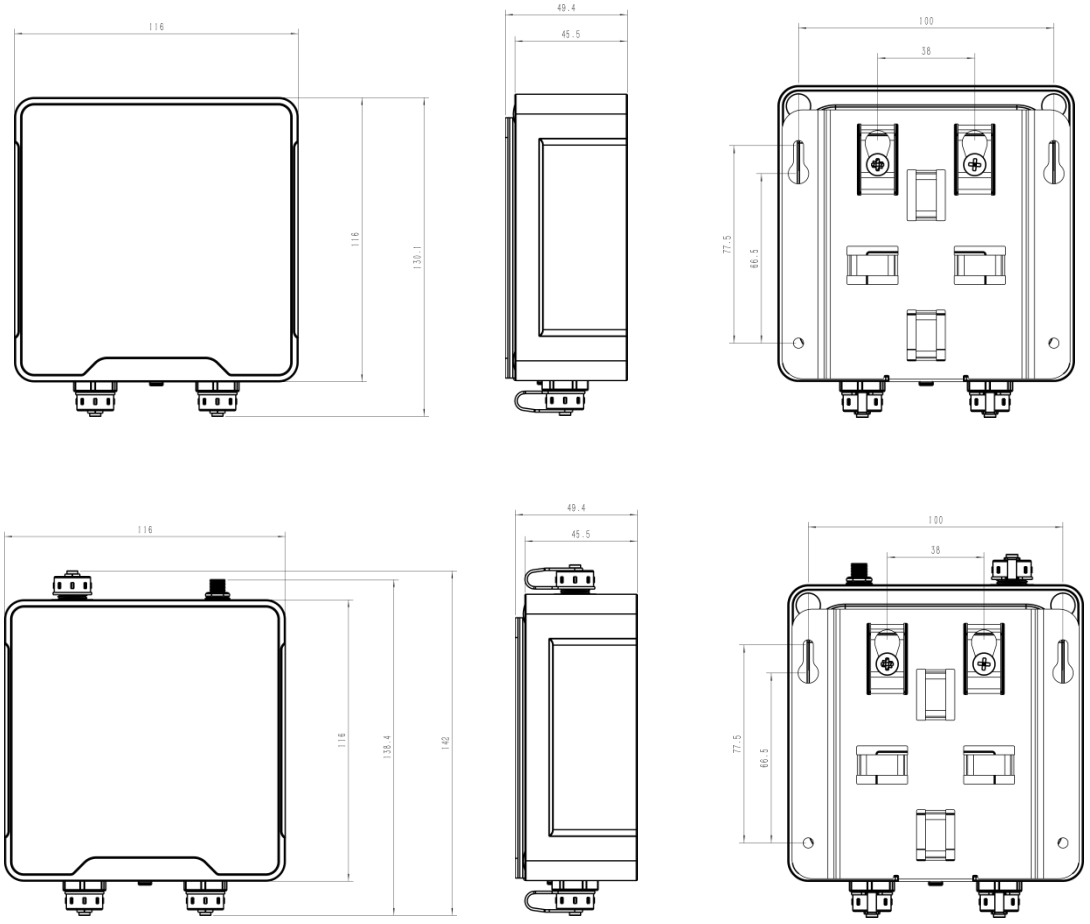



## 2.3 Power Button and LED Indicator

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

| 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. |

## 2.4 Dimensions (mm)

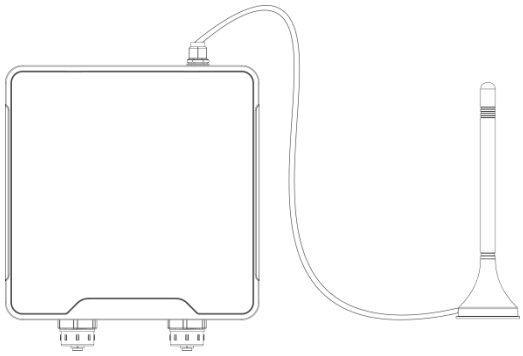


# 3. Hardware Adjustment

## 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.

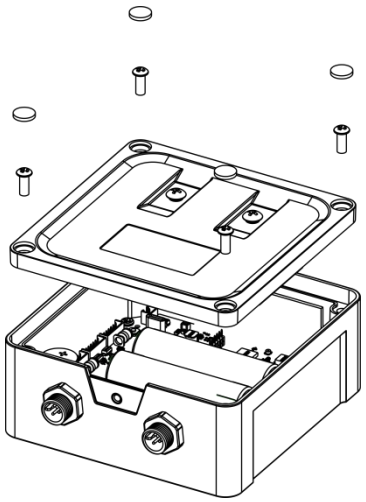


## 3.2 Back Cover Restore

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 ToolBox App or ToolBox software. Please select one of them to complete configuration.

### 4.1.1 NFC Configuration

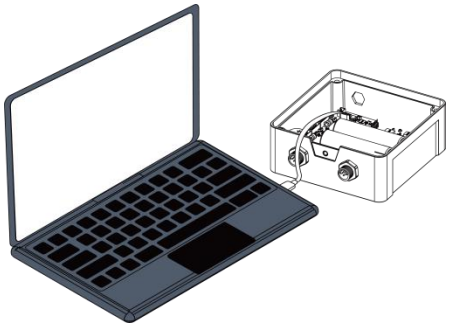
1. Download and install “Milesight ToolBox” App from Google Play or Apple App Store.
2. Enable NFC on the smartphone and launch Milesight ToolBox.
3. Attach the smartphone with NFC area to the device to read basic information.
4. Basic information and settings of devices will be shown on ToolBox if it’s 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.

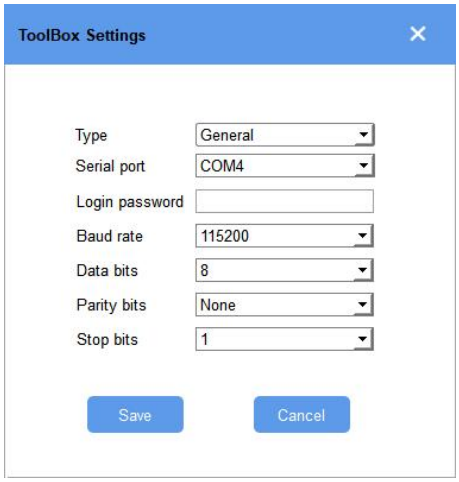
### 4.1.2 USB Configuration

1. Download ToolBox from Milesight website.
2. Open the case of UC51x and connect the UC51x to computer via type-C port.

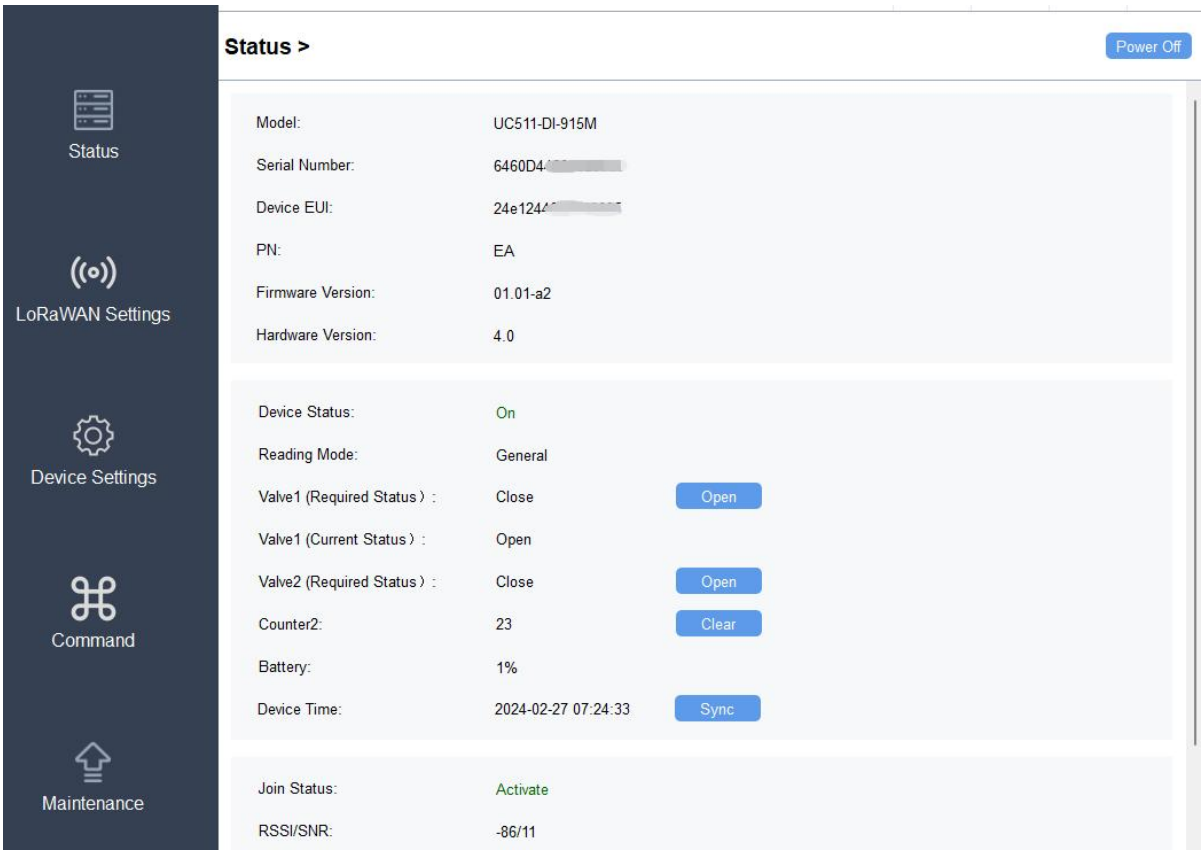


3. Open the ToolBox and select type as “General”, then click password to log in ToolBox.

(Default password: **123456**)



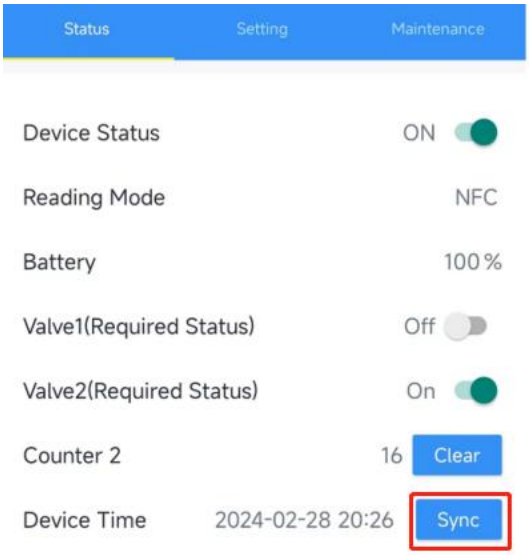

4. After logging in the ToolBox, you can click “Power On” or “Power Off” to turn on/off device and change other settings.

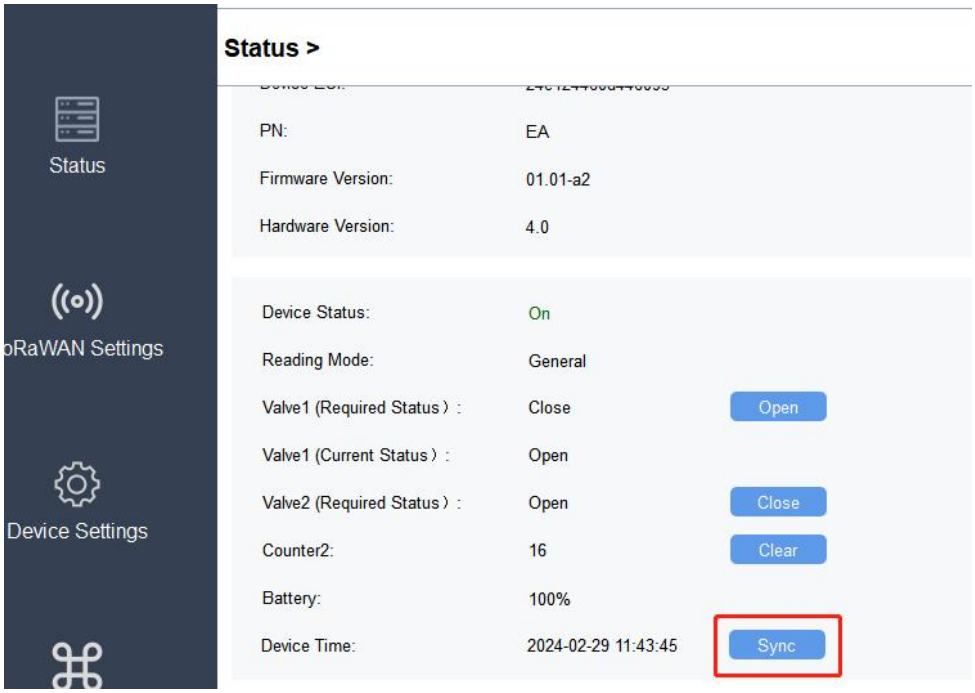



## 4.2 Time Synchronization

**ToolBox Sync:**

Go to **Device > Status** of ToolBox App to click **Sync** to sync the time, or go to **Status** page of ToolBox software to sync the time.




**Network Server Sync:**

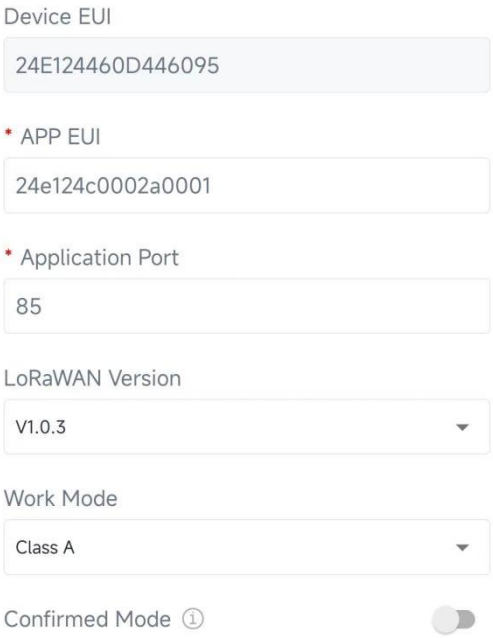
Go to **LoRaWAN Settings > Basic** of ToolBox software or **Device > Settings > LoRaWAN Settings** of ToolBox App to change device LoRaWAN® version as 1.0.3, then the device will send MAC commands to enquire the time from network server every time it joins the network. This should ensure the network server supports this feature.

## 4.3 LoRaWAN Settings

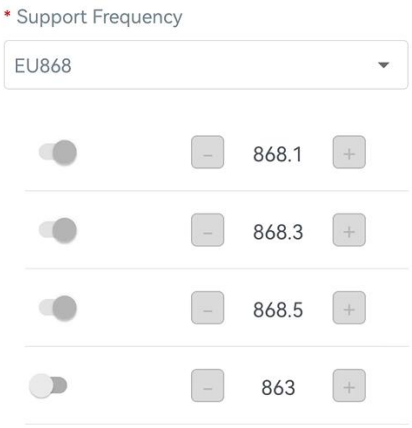
LoRaWAN settings is used for configuring the transmission parameters in LoRaWAN® network.

### 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. |
| 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 5$^{th}$ to 12$^{th}$ 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.<br>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. |
| Set the number of | When rejoin mode is enabled, set the number of LinkCheckReq packets sent. |

| | |
|---|---|
| packets sent | |
| Support Frequency | Select the channel plan and the frequency to send uplinks.<br>  <br>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.<br>**Examples:**<br>1, 40: Enabling Channel 1 and Channel 40<br>1-40: Enabling Channel 1 to Channel 40<br>1-40, 60: Enabling Channel 1 to Channel 40 and Channel 60<br>All: Enabling all channels<br>Null: Indicates that all channels are disabled<br>  |
| 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. |

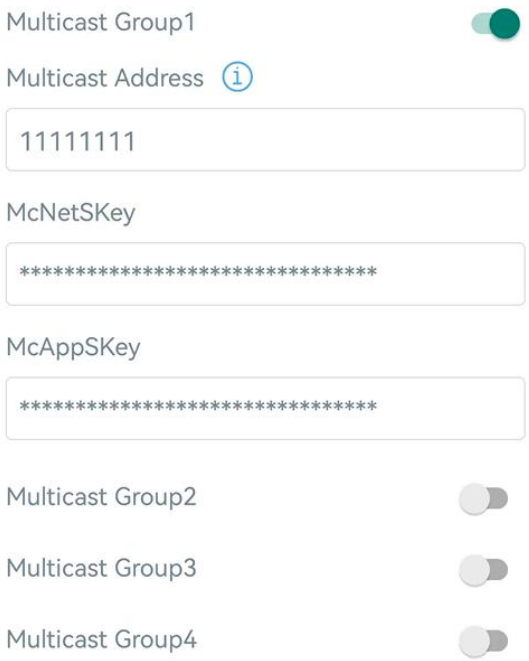
**Note:**

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 to manage devices.
4) Only OTAA mode supports rejoin mode.

### 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.

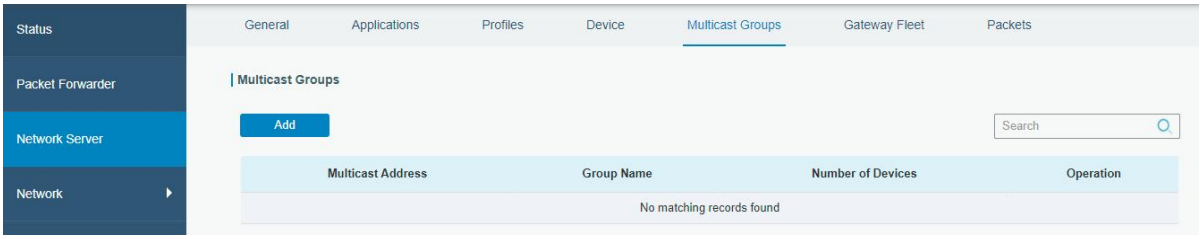
1. Ensure the work mode is Class C, Class B or Class C to B.
2. Enable Multicast Group and set a unique multicast address and keys to distinguish other groups. You can also keep these settings by default.



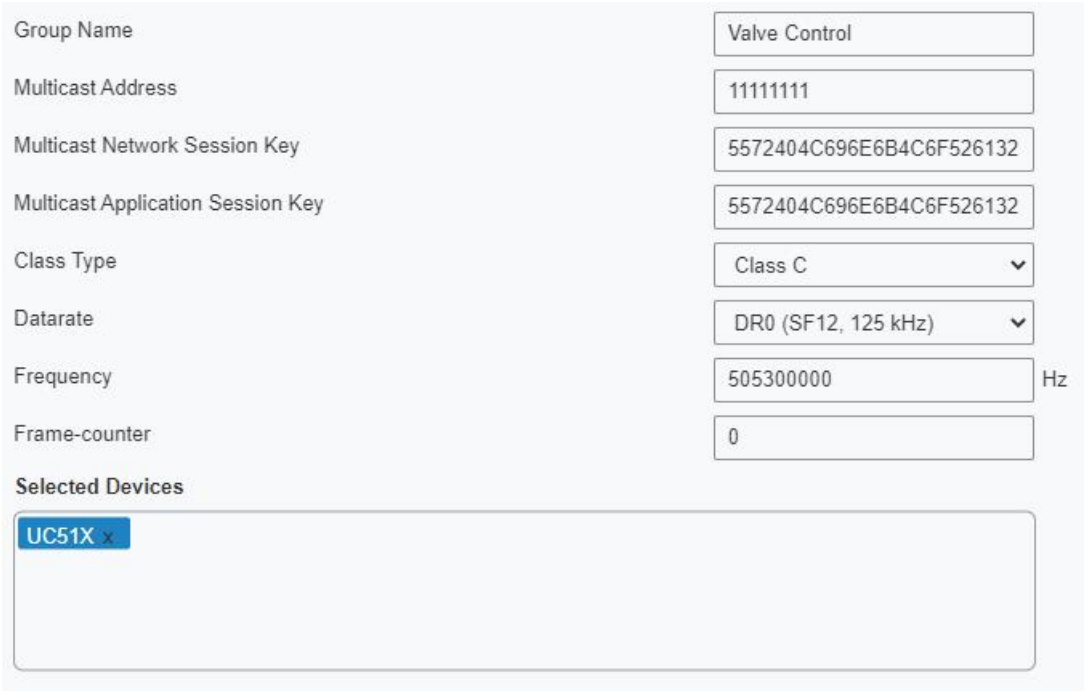

| Parameters | Description |
|---|---|
| Multicast Address | Unique 8-digit address to distinguish different multicast groups. |
| Multicast McAppSkey | 32-digit key. Default values:<br>Multicast Group 1: 5572404C696E6B4C6F52613230313823<br>Multicast Group 2: 5572404C696E6B4C6F52613230313824<br>Multicast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

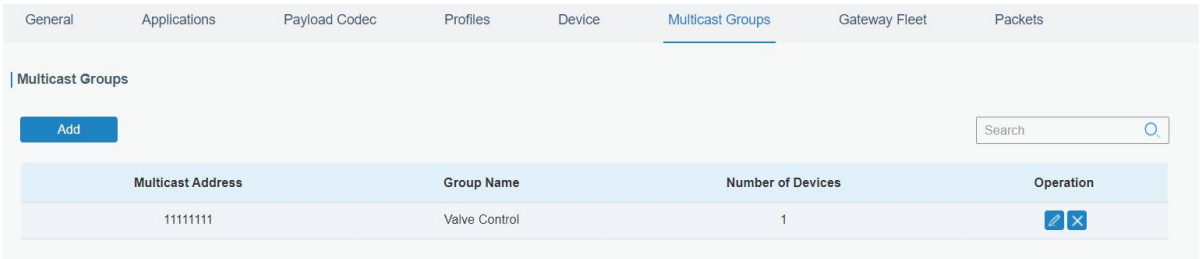
| | |
|---|---|
| McNetSkey | Multicast Group 1: 5572404C696E6B4C6F52613230313823<br>Multicast Group 2: 5572404C696E6B4C6F52613230313824<br>Multicast Group 3: 5572404C696E6B4C6F52613230313825<br>Multicast Group 4: 5572404C696E6B4C6F52613230313826 |

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.



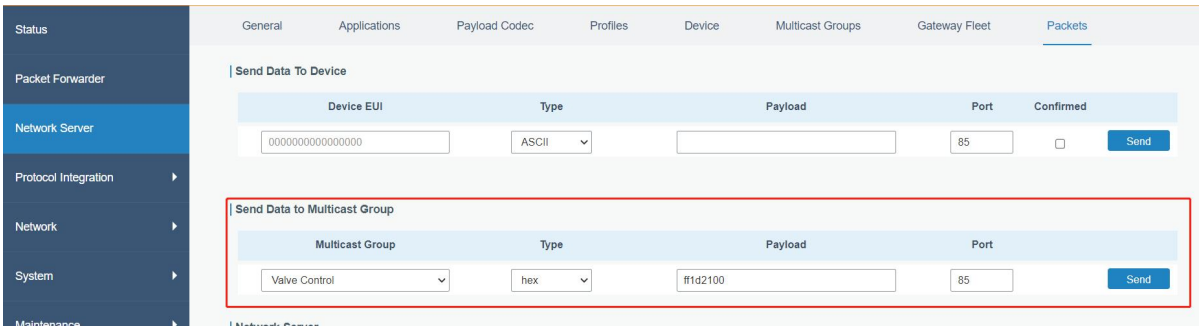

Fill in the multicast group information that is the same as device settings, and select the devices that you need to control, then click **Save**.




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.

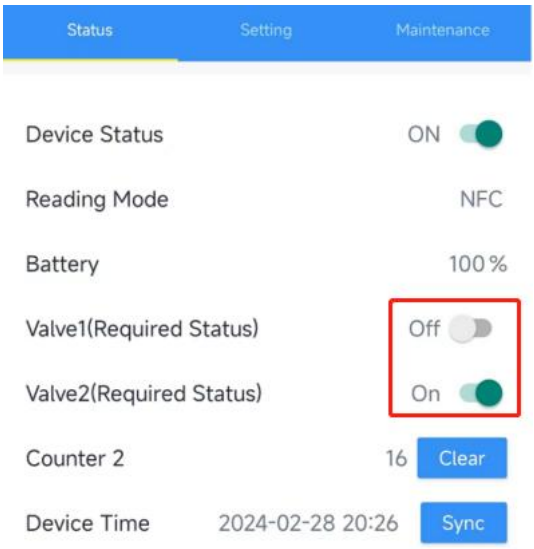



## 4.4 Solenoid & GPIO Settings

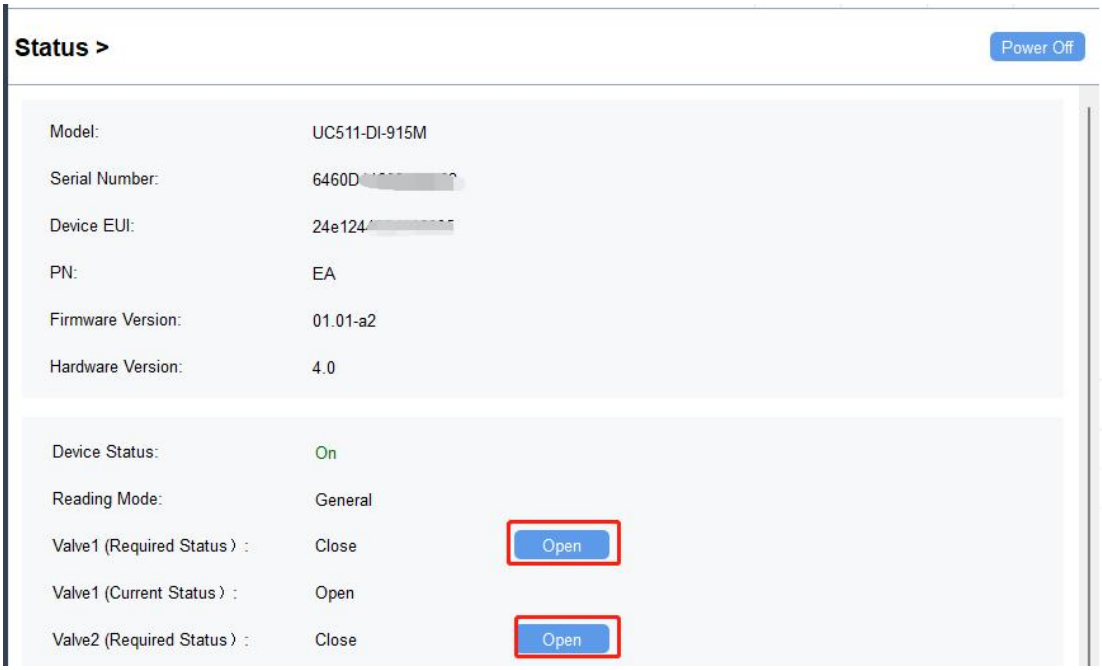
### 4.4.1 Solenoid Valve Control

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

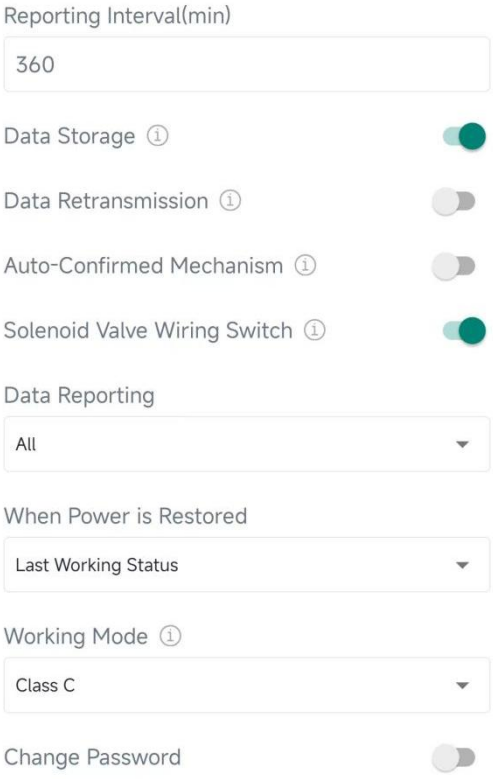
**Via ToolBox App:**




**Via ToolBox Software:**

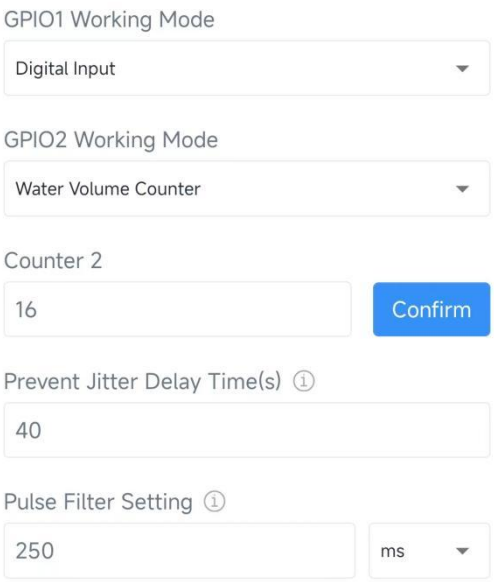



### 4.4.2 Basic Settings




| 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 | Disable or enable data retransmission. |

| | |
|---|---|
| Retransmission | |
| Auto-Confirmed Mechanism | After enabled, the device will reply the confirmed packet starting with “FE” to the network server when receiving downlink commands. |
| Solenoid Valve 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.<br>**Note:** every interface has a solenoid valve control interface and a GPIO interface. |
| Device Return to Power Supply State | If the device loses power and returns to power supply, the solenoid valve interface will be on or off according to this parameter. |
| Class Type | Working mode of LoRaWAN® device.<br>UC511: Class A, Class B, Class C and Class C to B are available;<br>UC512: Class A and Class B are available.<br>**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.<br>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.<br>**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. |




| Parameters | Description |
|---|---|
| GPIO1/2 Working Mode | Select Digital Input or Water Volume Counter (Pulse Counter).<br>**Digital Input:** detect the real state of the valve to know if valve control takes effect.<br>**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. |
| 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:**

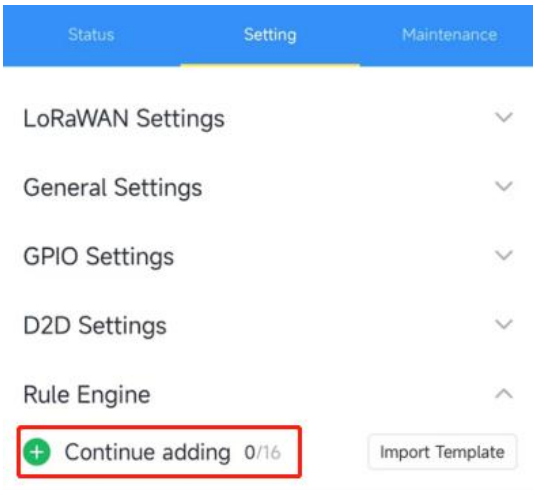
1) Reboot or re-join will not affect the counting.

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.

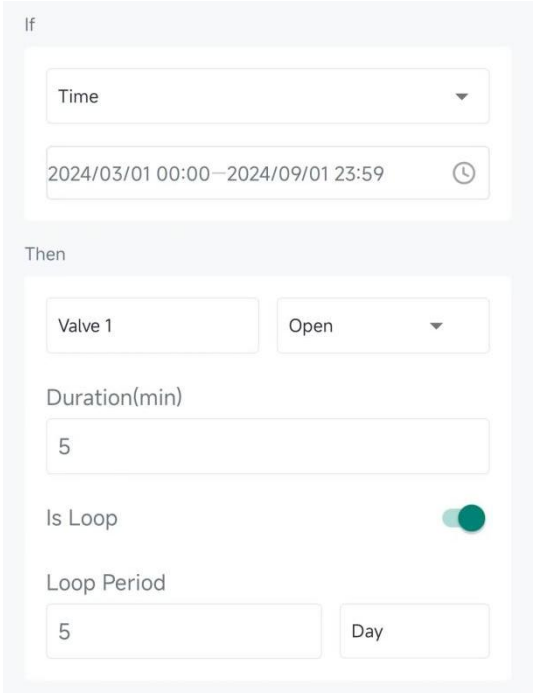



2. Set the rule as required. UC51x series supports to add below types of rules:

- 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.

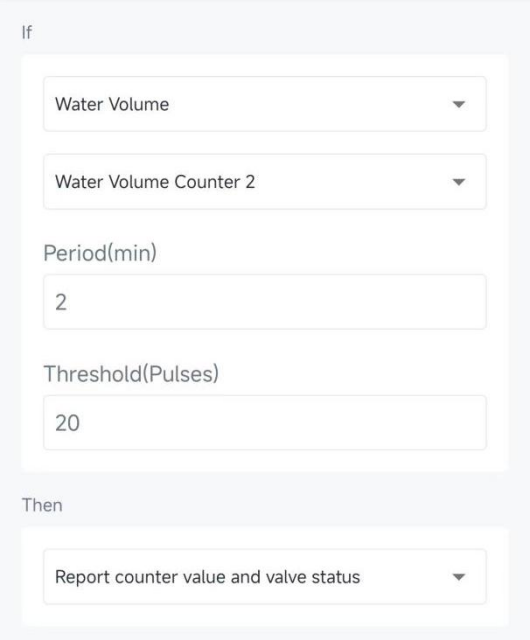
**Note:** Ensure the device time is correct (see section Time Synchronization).




- 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.

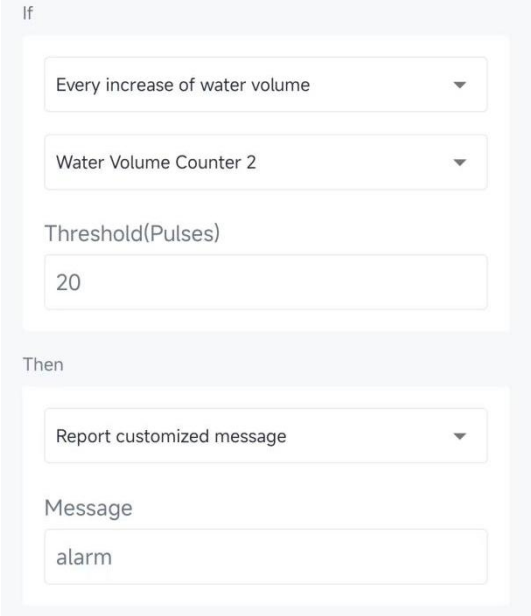
**Note:** the max length of custom message is 8 characters.




- 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.

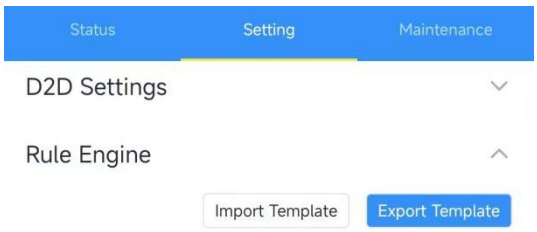
**Note:** the max length of custom message is 8 characters.




- 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. Rule Backup

**ToolBox App:** 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.




**ToolBox Software:** Click **Save Schedule** to backup the settings as a file; if you need to import this schedule from other devices, click **Select Schedule** 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

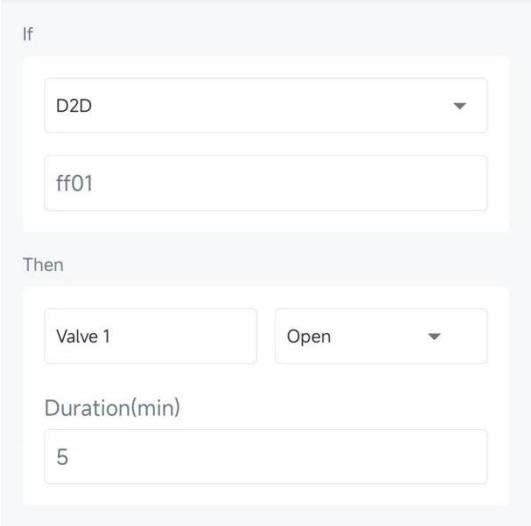
Milesight D2D protocol is developed by Milesight and used for setting up transmission among Milesight devices without a gateway. When the Milesight D2D setting is enabled, UC51x can work as a Milesight D2D agent to receive commands to control the solenoid valve status.

1. Enable Milesight D2D feature and define a unique Milesight D2D key which is the sam e as Milesight D2D controller or agent devices. (Default Milesight D2D Key: 5572404C696 E6B4C6F52613230313823)


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


3. Set rule to work as a Milesight D2D agent.

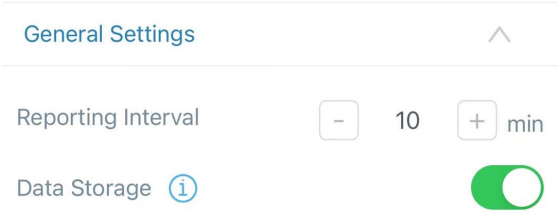
**Example:** When the device receives Milesight D2D commands, it can open or close solenoid valves for some time.




## 4.7 Data Storage

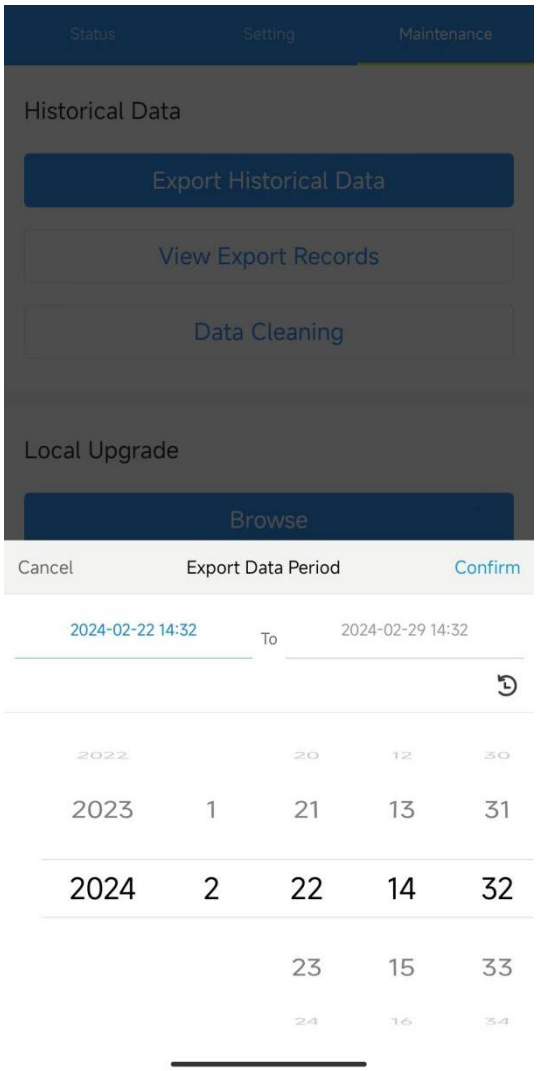
UC51x series supports storing 500 data records locally and exports data via ToolBox App or ToolBox software. The device will record the data according to the reporting interval even if it is not connected to a network.

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




3. Go to **Device > Maintenance** of ToolBox App or **Maintenance > Backup and Reset** of ToolBox software, 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. If you need to export more data, please use ToolBox software.




4. Clear all stored data inside the device as required.

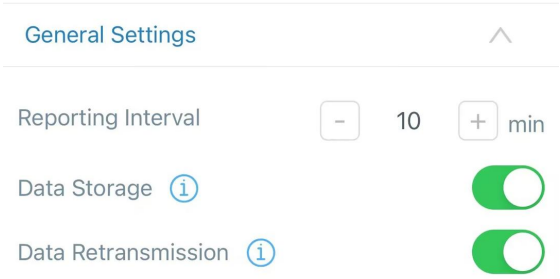
## 4.8 Data Retransmission

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:

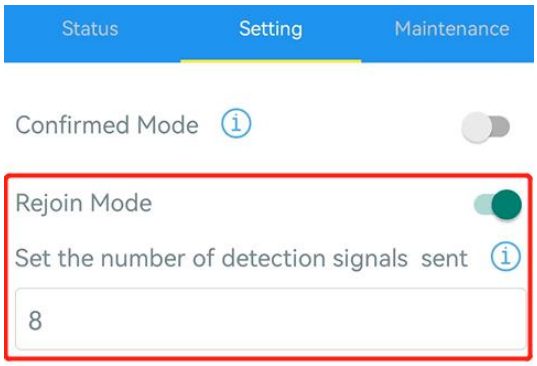
- Network server sends downlink commands to enquire the historical data for specified time range, see ***UC51x Series Communication Protocol;***
- When network is down if no response from LinkCheckReq MAC packets for a period of time, the device will record the network disconnected time and re-transmit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

**ToolBox App:**

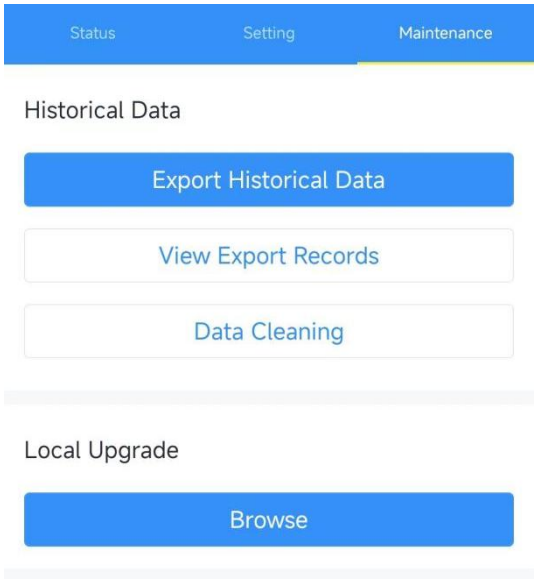
1. Download firmware from Milesight website to your smartphone.

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.

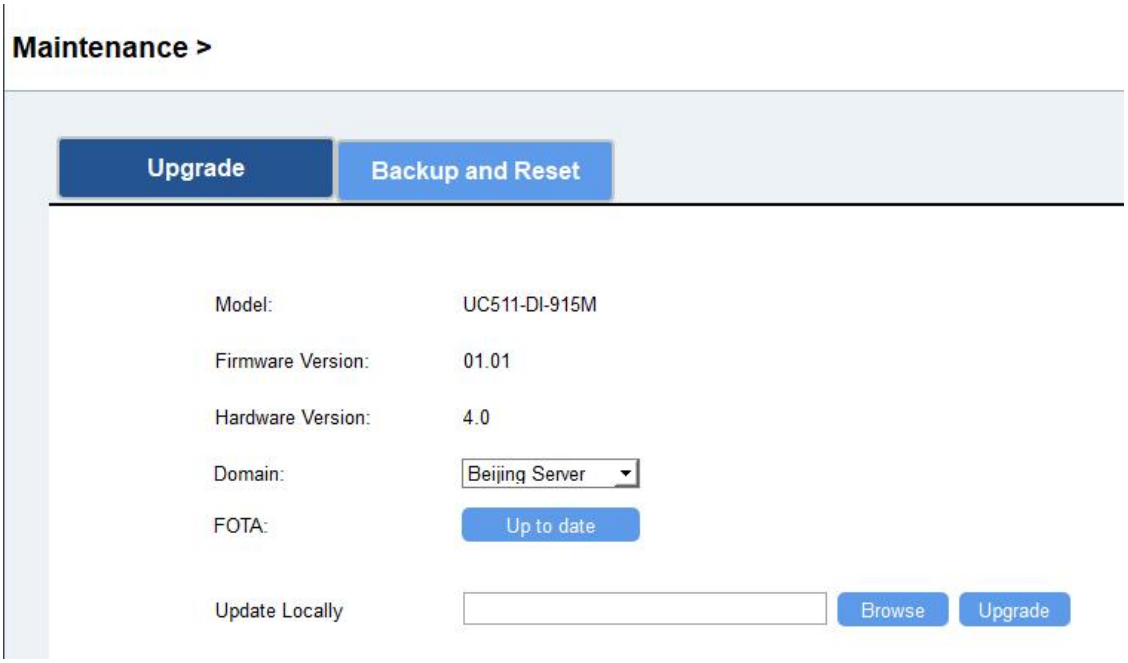
2) Only Android version ToolBox supports the upgrade feature.




## ToolBox Software:

1. Download firmware from Milesight website to your PC.

2. Go to **Maintenance > Upgrade** of ToolBox software, click **Browse** to import firmware and upgrade the device.




### 4.9.2 Backup

UC51x devices support configuration backup for easy and quick device configuration in bulk.

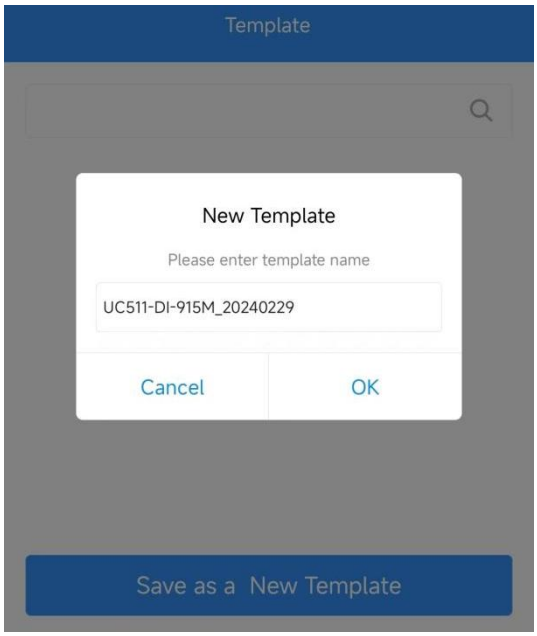
Backup is allowed only for devices with the same model and LoRaWAN® frequency band.

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

Please select one of following methods to backup device:

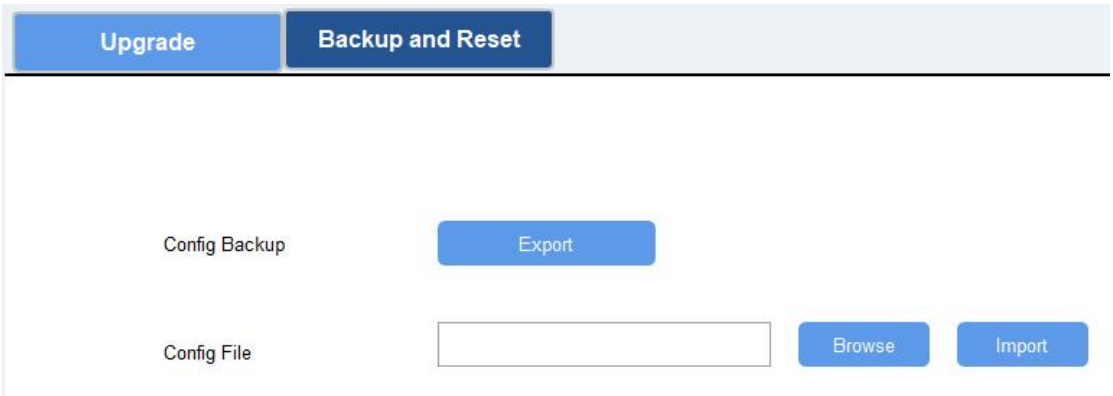
### ToolBox App:

1. Go to **Template** page on the App and save current settings as a template. You can also edit the template file.
2. Select this template and attach to another device to write configuration.




### ToolBox Software:

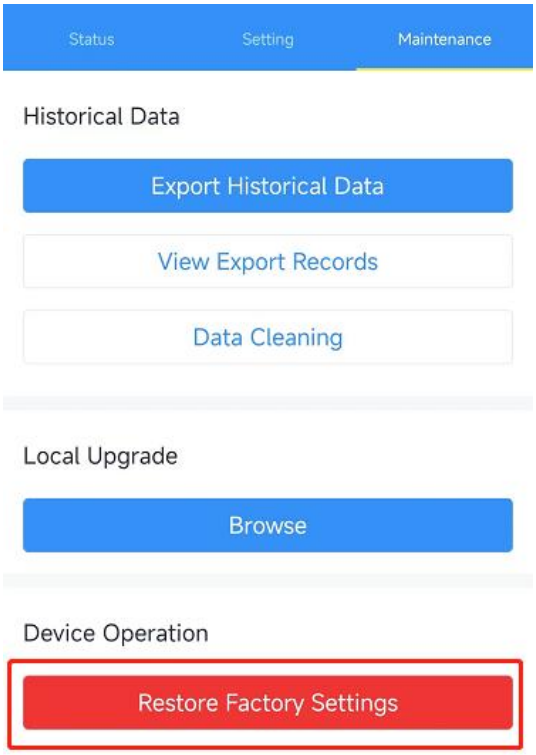
1. Go to **Maintenance > Backup and Reset**, click **Export** to save current configuration as json format backup file.
2. Click **Browse** to select backup file, then click **Import** to import the configurations.



### 4.9.3 Reset to Factory Default

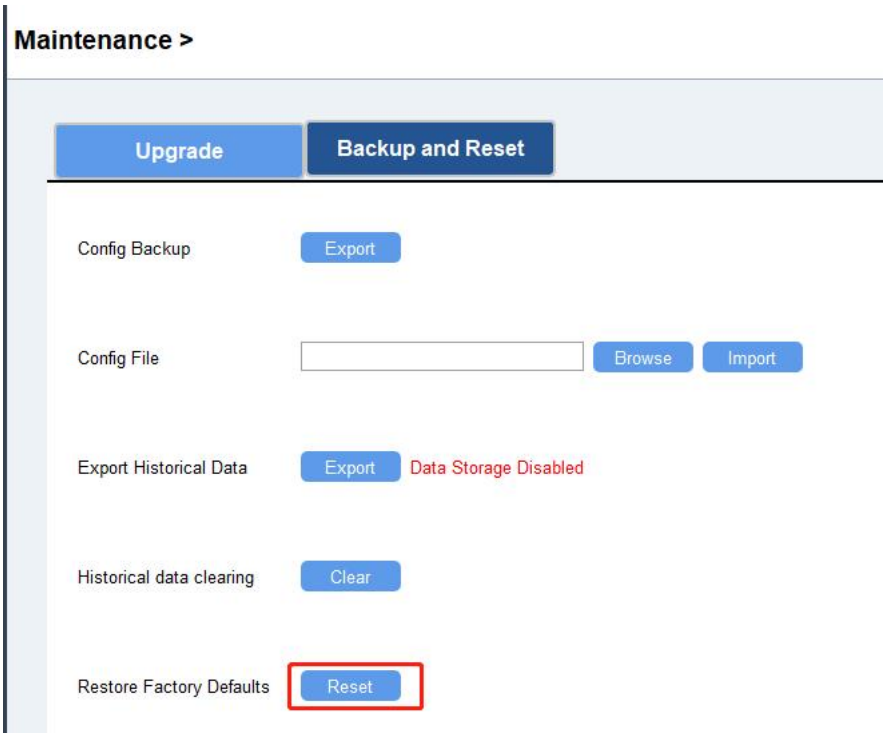
Please select one of following methods to reset device:

**Via ToolBox App:** Go to **Device > Maintenance** to click **Restore Factory Settings**, then attach smart phone with NFC area to UC51x to complete reset.




**Via Hardware:** Open the case of UC51x and hold on power button more than 10s.

**Via ToolBox Software:** Go to **Maintenance > Backup and Reset** to click **Reset**.

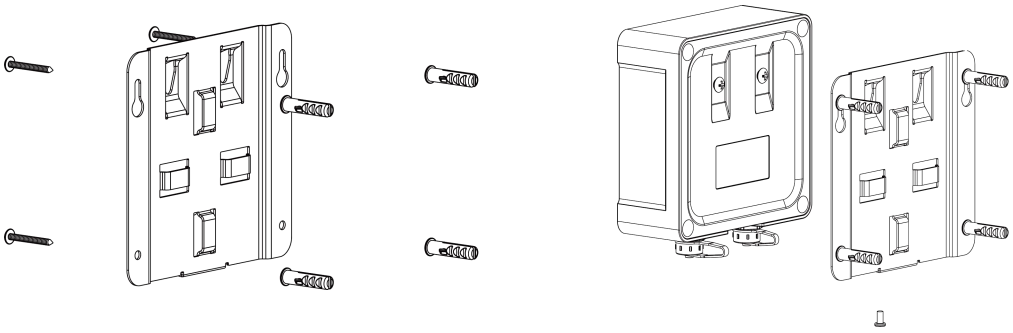


# 5. Device Installation

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.

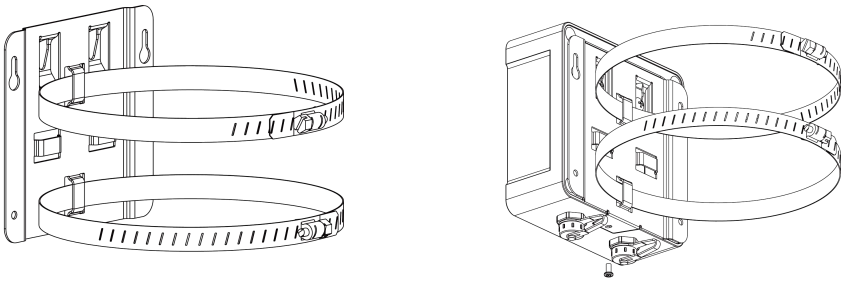
**Wall Mounting:**

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.

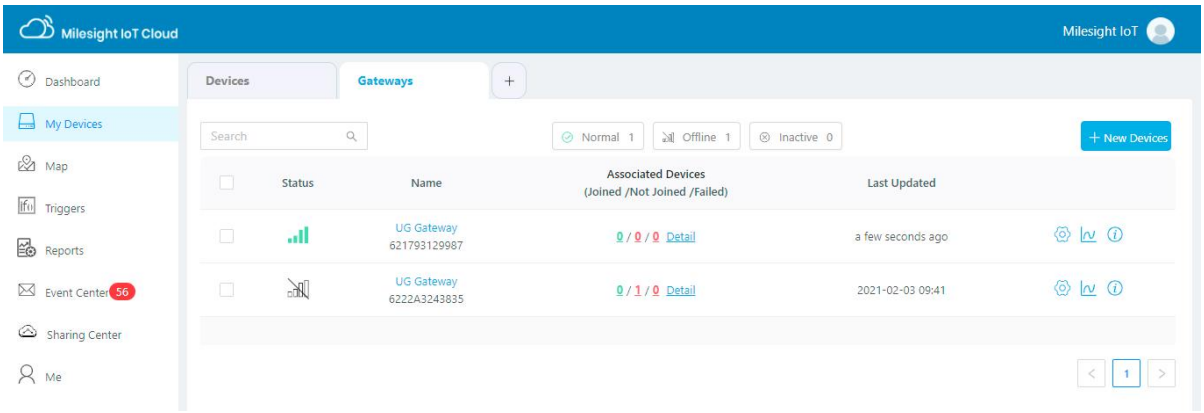


# 6. Milesight IoT Cloud Management

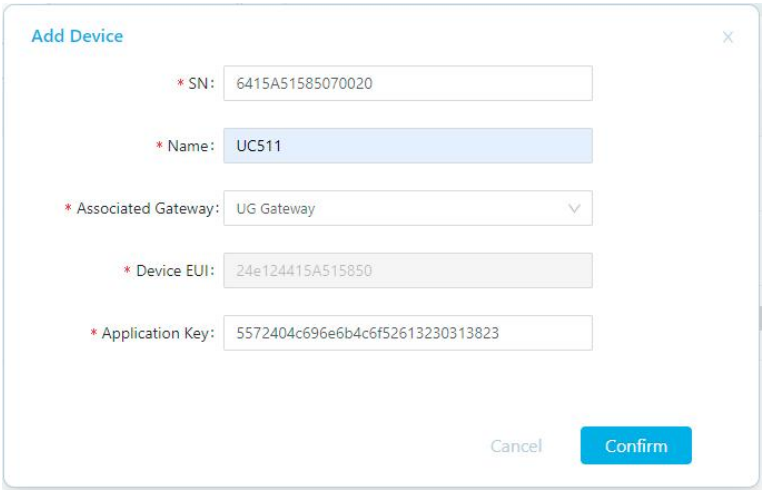
UC51x series can be managed by Milesight IoT Cloud platform. Milesight IoT cloud is a comprehensive platform that provides multiple services including device remote management and data visualization with the easiest operation procedures. Please register a Milesight IoT Cloud account before operating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

## 6.1 Add UC51x to Cloud

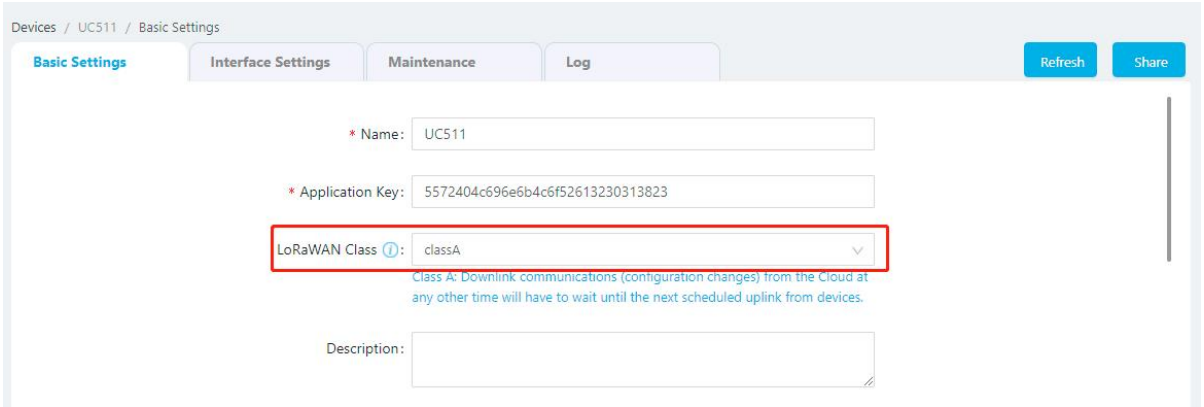
1. Ensure Milesight LoRaWAN® gateway is online in Milesight IoT Cloud. For more info about connecting gateway to cloud please refer to gateway's user guide.



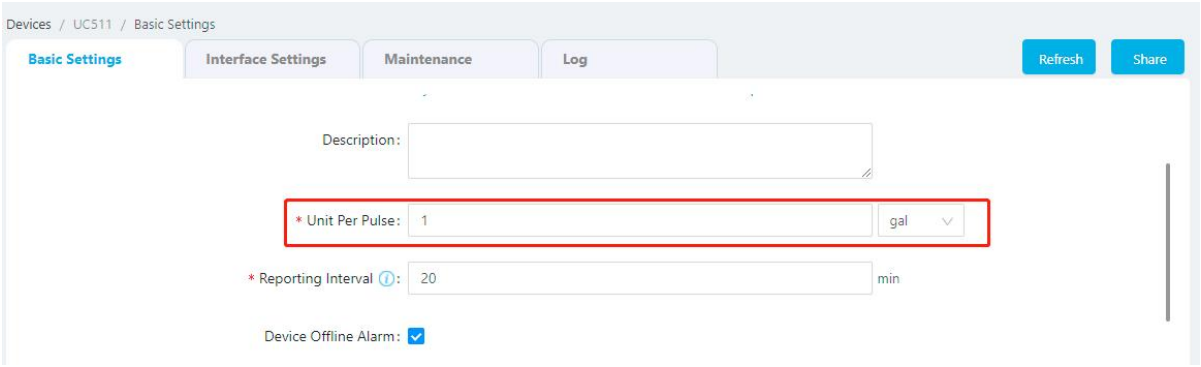

2. Go to "My Devices" page and click "+New Devices". Fill in the SN of UC51x and select associated gateway.



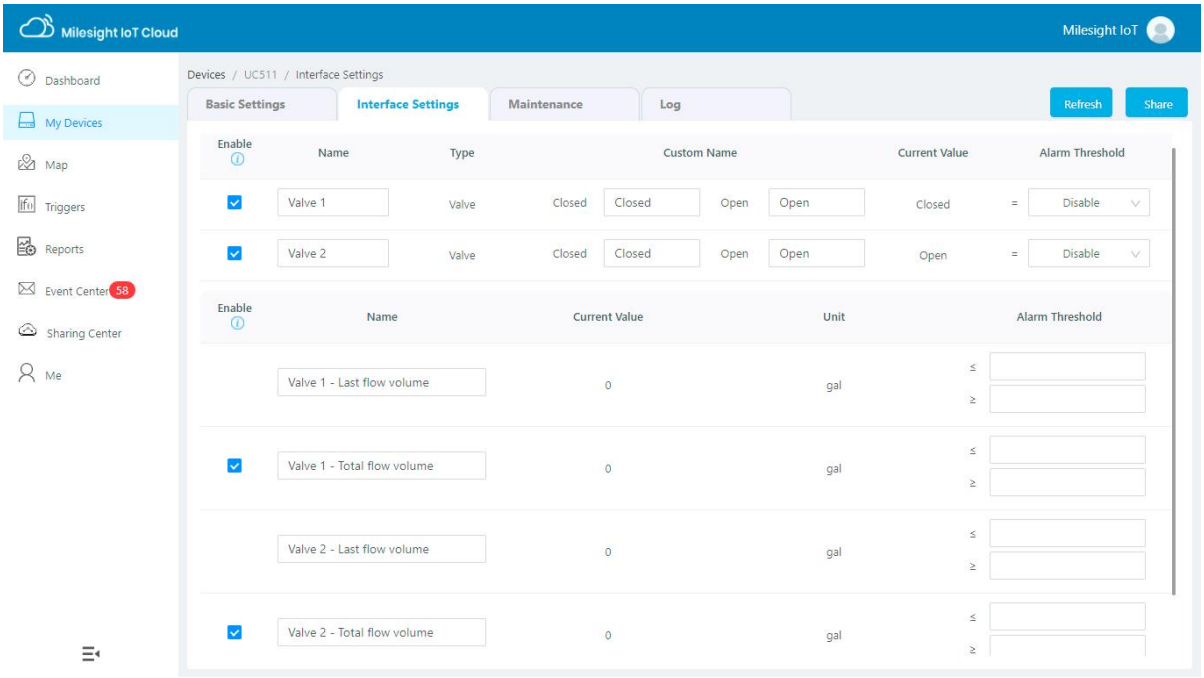

3. Click  and go to "Basic Settings" to change class type the same as device settings.




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



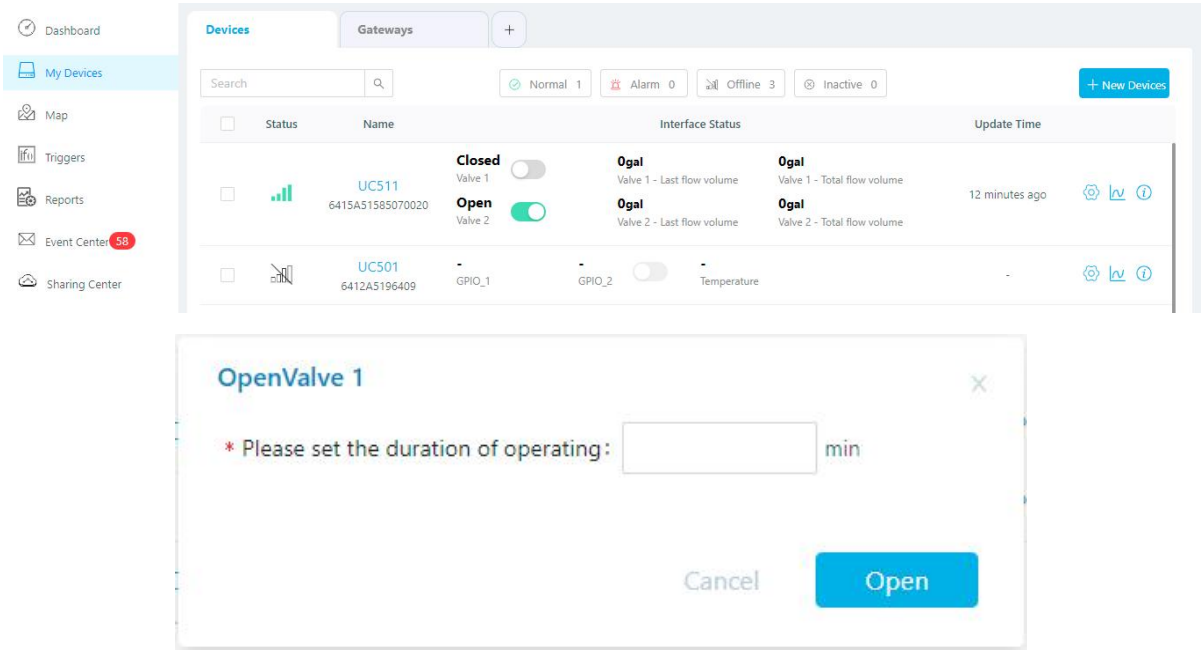

4. Click and go to “Interface Settings” to select used interfaces and customize the name and thresholds.



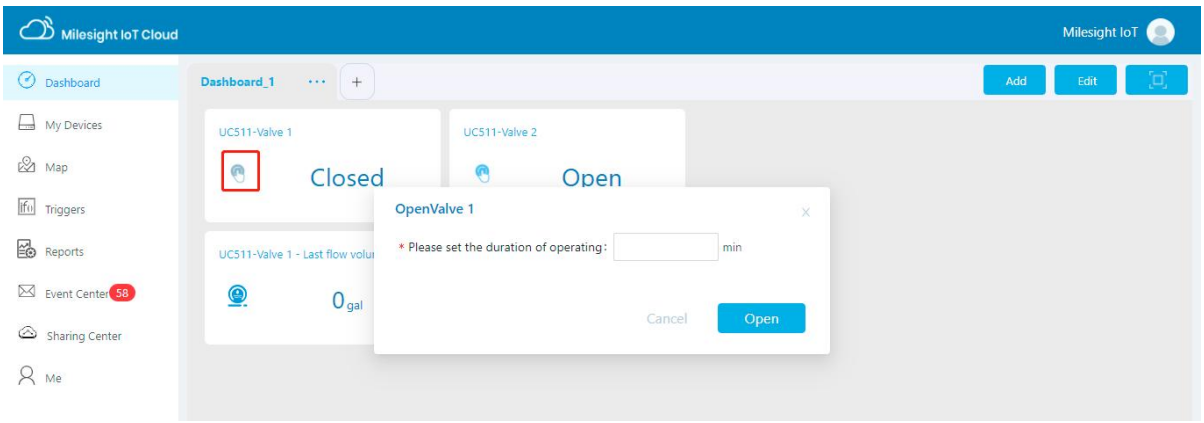

## 6.2 Solenoid Valve Control

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

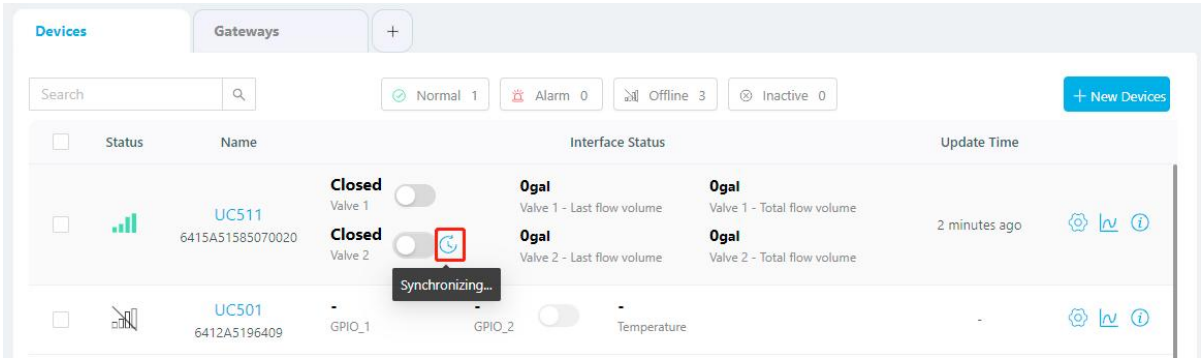
1. Click to open the solenoid valve and configure the duration. Note that if you enable any local plan on UC51x device, this control will not work.




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

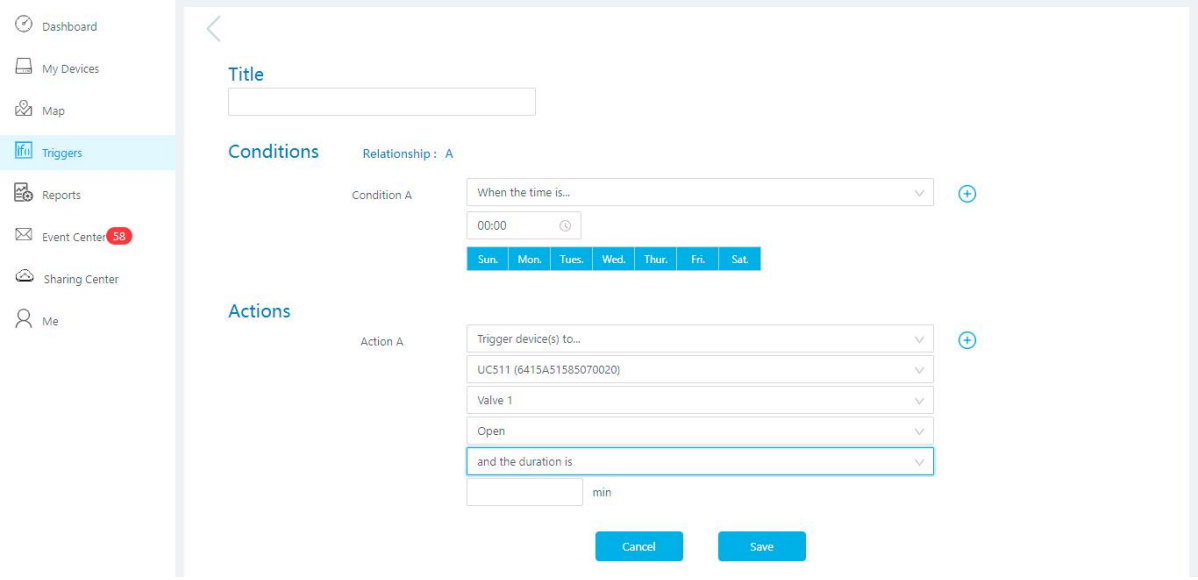



Note: If the working mode of UC51x is LoRaWAN® Class A, control commands will delay until the time icon disappear.




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. Device Payload

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-**