IoT Controller

Featuring LoRaWAN®

UC100

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.
- Power off the device when installing or wiring.
- Make sure electronic components do not drop out of the enclosure while opening.
- The device must never be subjected to shocks or impacts.

Declaration of Conformity

UC100 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
May 27, 2022	V 1.0	Initial version
Dec. 5, 2022	V 1.1	Add active pass-through feature and two-way pass-through feature on RS485

Contents

1. Product Introduction

1.1 Overview

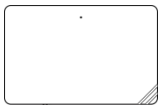
UC100 is an IoT controller used for remote control and data acquisition from Modbus RS485 devices via LoRaWAN® networks. It can read up to 16 Modbus RTU devices and support Modbus transparent transmission between server and RS485 devices as a Modbus to LoRaWAN® converter. Besides, UC100 supports multiple trigger conditions and actions which can work autonomously even when the network drops.

1.2 Features

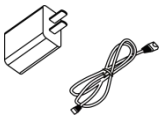
- Easy to connect with diverse wired sensors through RS485 interfaces
- Support LoRaWAN® wireless communication
- Multiple triggering conditions and actions
- Embedded watchdog for work stability
- Industrial metal case design with a wide operating temperature range
- Compliant with standard LoRaWAN® gateways and network servers
- Quick and easy management with Milesight IoT Cloud solution

2. Hardware Introduction

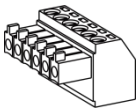
2.1 Packing List



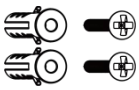
1 × UC100 Device



1 × Type-C Cable & Power Adapter



1 × Terminal Block

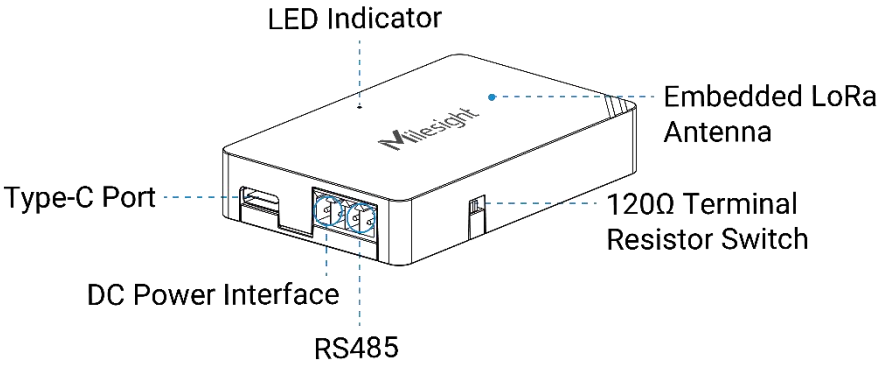


2 × Wall Mounting Kits

1 × Quick Guide

If any of the above items are missing or damaged, please contact your sales representative.

2.2 Hardware Overview



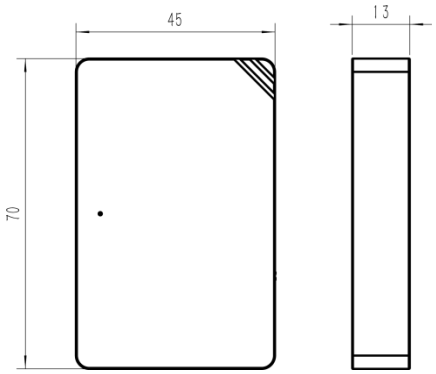
120Ω Terminal Resistor Switch: the device will add a 120Ω termination resistor to avoid data-corrupting reflections if RS485 data rate is high or cable length is long.

2.3 LED Patterns and Reset Button

The reset button is inside the device.

Device Status	LED Status
System is functioning properly	Static On
Reboot: hold the reset button inside the device for more than 3 seconds	Static On → Slowly Blinks
Reset to factory default: hold the reset button inside the device for more than 10 seconds	Static On → Quickly Blinks
Fail to acquire data from data interfaces	Slowly Blinks
Device upgrade or system error	Static On

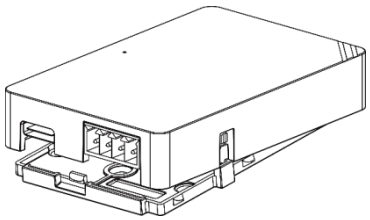
2.4 Dimensions (mm)



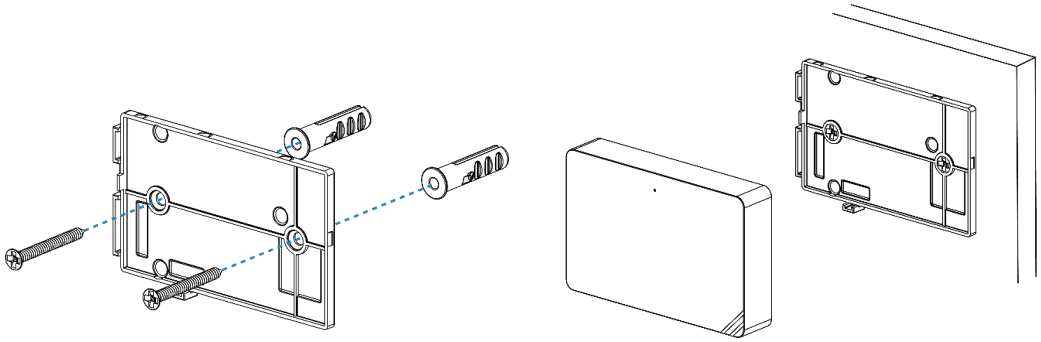
3. Device Installation

UC100 device can be placed on a desktop or mounted to a wall.

1. Take off the back cover of UC100 device, and fix the wall plugs into the wall according to the drilling position as referred.



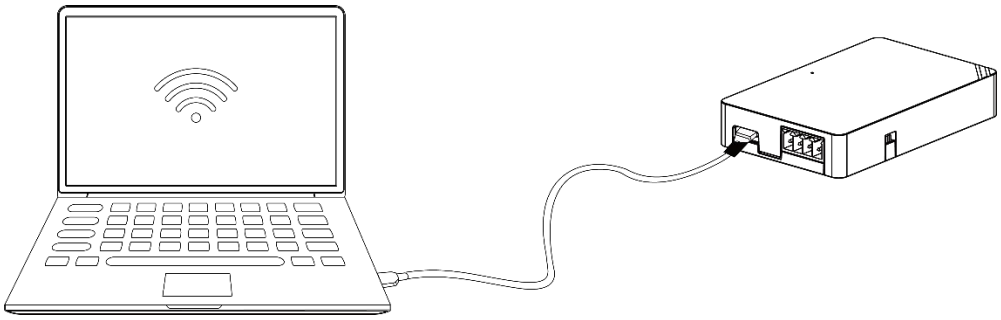
2. Screw the cover on the mounting positions and install back the device.



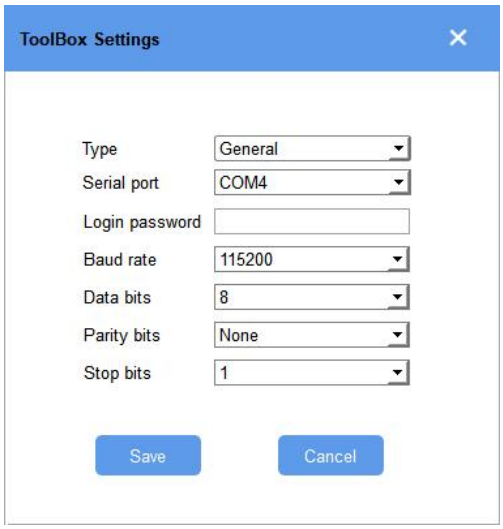
4. Operation Guide

4.1 Log in the ToolBox

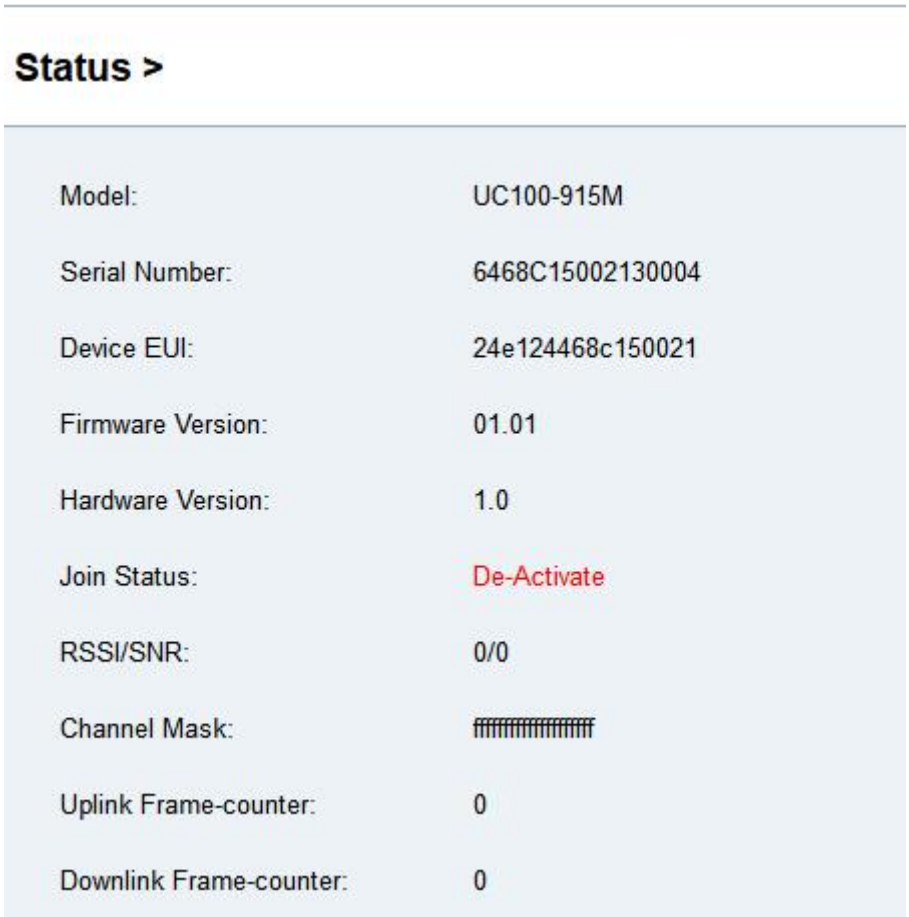
1. Download ToolBox software from Milesight IoT website.
2. Power on the UC100 device, then connect it to computer via the type-C port.



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 change device settings.

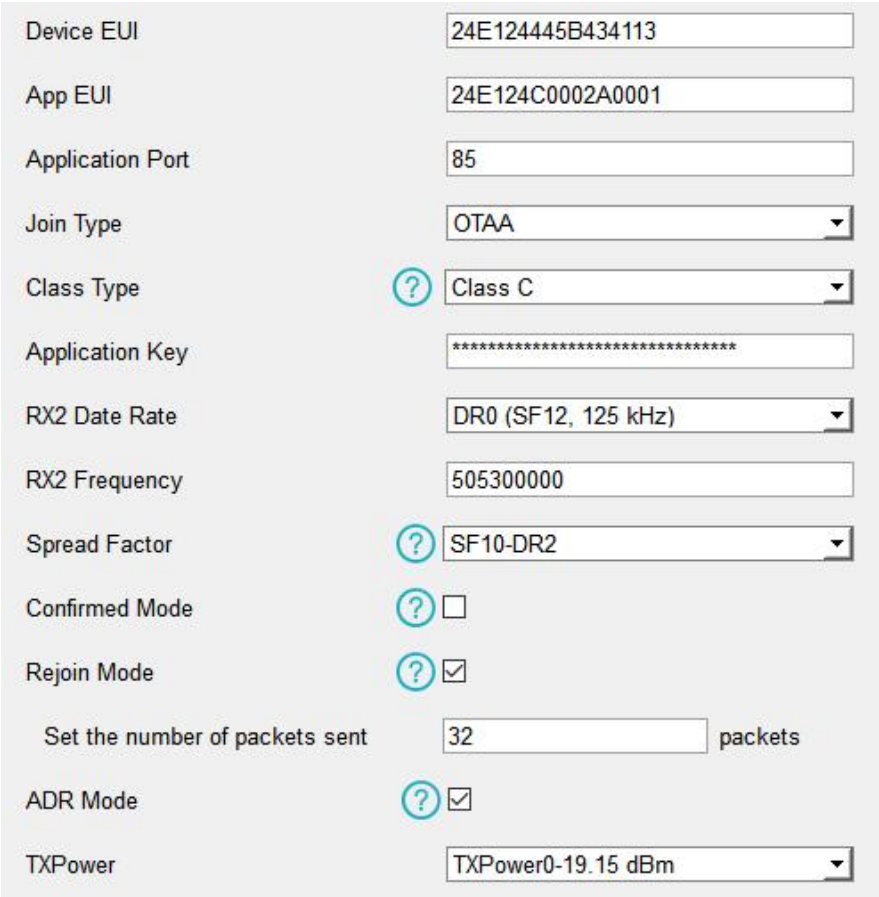


4.2 LoRaWAN Settings

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

Basic LoRaWAN Settings:

Go to **LoRaWAN Settings > Basic** to configure 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 on the label.
App EUI	Default App EUI is 24E124C0002A0001.
Application Port	The port is used for sending and receiving data, the default port is 85.
Working Mode	Fixed as Class C.
Join Type	OTAA and ABP modes 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.
RX2 Data Rate	RX2 data rate to receive downlinks.
RX2 Frequency	RX2 frequency to receive downlinks. Unit: Hz
Spread Factor	If ADR is disabled, the device will send data via this spread factor.
Confirmed Mode	If the device does not receive ACK packet from network server, it will resend data once.

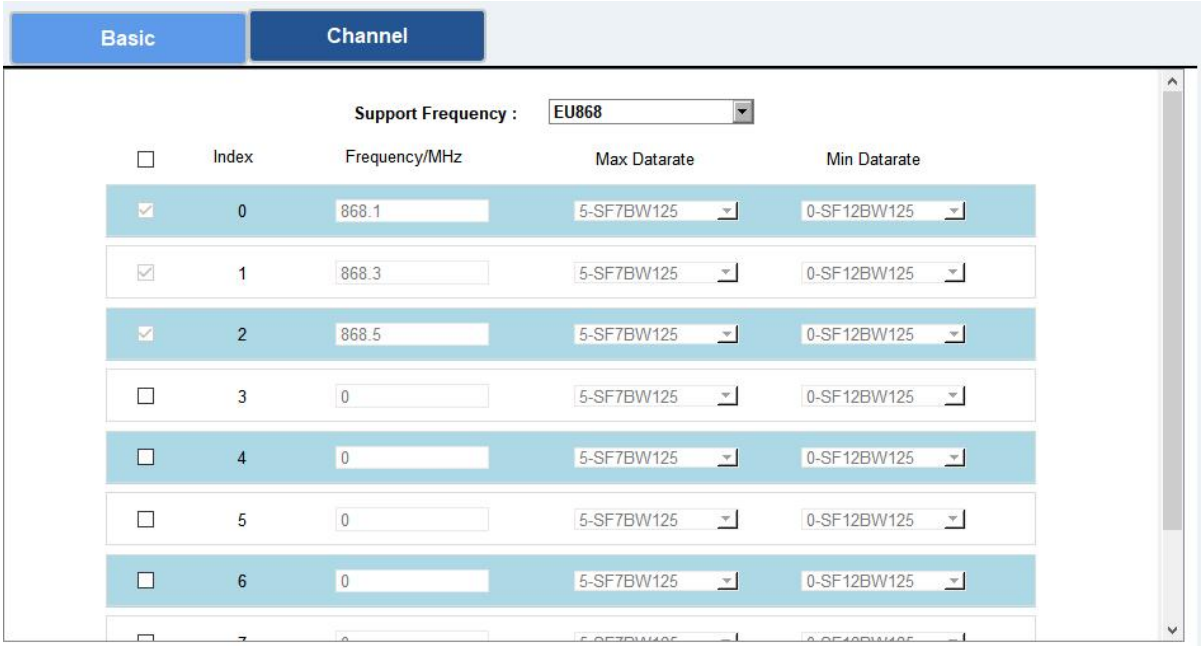
Rejoin Mode	Reporting interval ≤ 30 mins: the device will send a specific number of LinkCheckReq MAC packets to the network server every 30 mins to validate connectivity; If there is no response, the device will re-join the network. Reporting interval > 30 mins: the device will send a specific number 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 packets sent	When rejoin mode is enabled, set the number of LinkCheckReq packets sent.
ADR Mode	Allow the network server to adjust datarate of the device.
Tx Power	The transmit power of device.

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 purchasing.
3) Select OTAA mode if you use Milesight IoT Cloud to manage devices.
4) Only OTAA mode supports rejoin mode.

LoRaWAN Frequency Settings:

Go to **LoRaWAN Settings > Channel** to select supported frequency and select channels to send uplinks. Make sure the channels match what you set in the LoRaWAN® gateway.

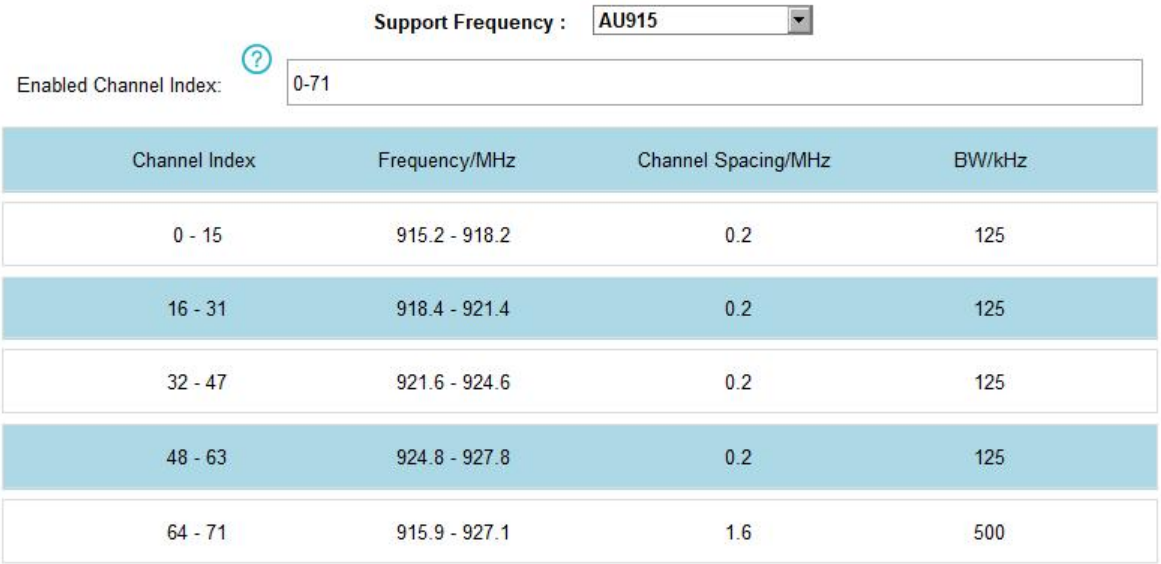


If frequency is one of CN470/AU915/US915, you can enter the index of the channel that you want to enable in the input box, making them separated by commas.

Examples:

1, 40: Enabling Channel 1 and Channel 40

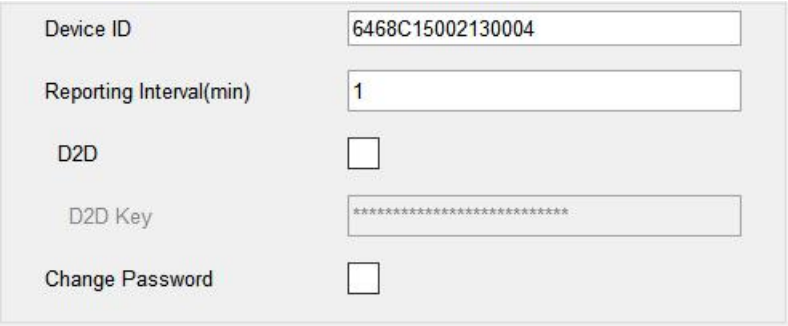
1-40: Enabling Channel 1 to Channel 40
1-40, 60: Enabling Channel 1 to Channel 40 and Channel 60
All: Enabling all channels
Null: Indicates that all channels are disabled



Channel Index	Frequency/MHz	Channel Spacing/MHz	BW/kHz
0 - 15	915.2 - 918.2	0.2	125
16 - 31	918.4 - 921.4	0.2	125
32 - 47	921.6 - 924.6	0.2	125
48 - 63	924.8 - 927.8	0.2	125
64 - 71	915.9 - 927.1	1.6	500

4.3 General Settings

4.3.1 Basic Settings



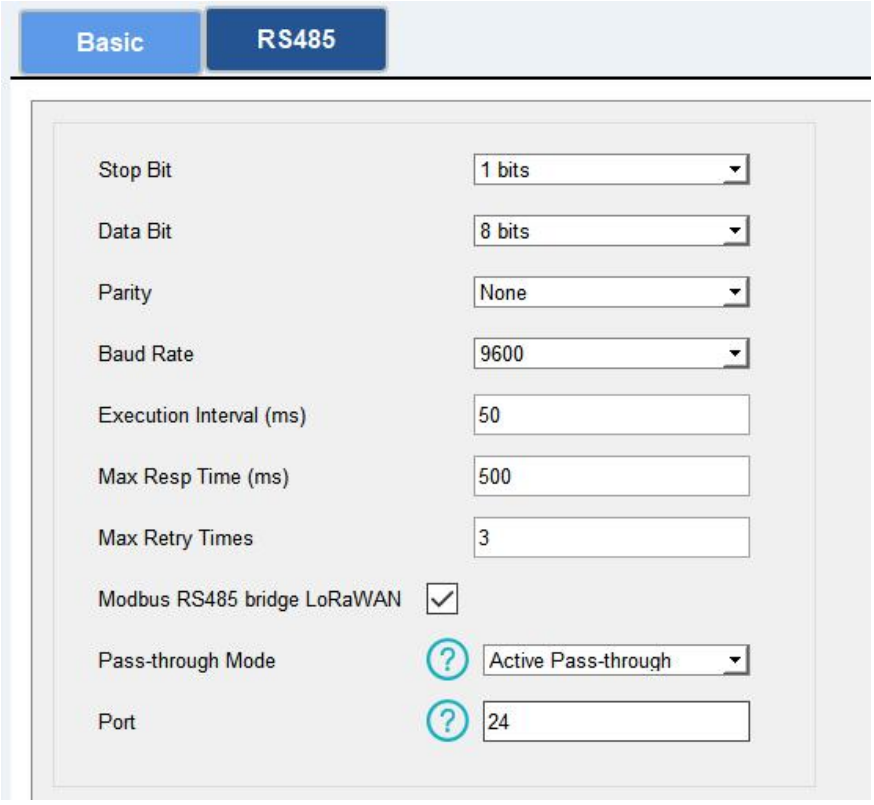
Parameters	Description
Device ID	Show the SN of the device.
Reporting Interval	Reporting interval of transmitting data to the network server. Range: 1-1080 mins, default: 20 mins
D2D	See details on chapter 4.5.
Change Password	Change the password to log in ToolBox.

4.3.2 RS485 Settings

UC100 has one RS485 port for Modbus RTU device connection.

1. Connect RS485 device to RS485 port.

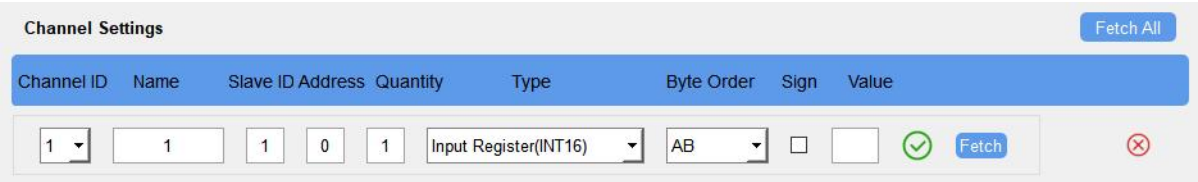
2. Go to **General > RS485** to enable RS485 and configure serial port settings. Serial port settings should be the same as the RS485 terminal devices.

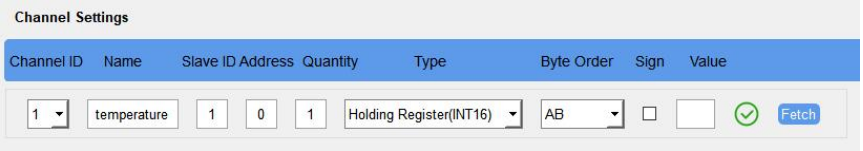


Parameters	Description
Stop Bit	1 bit/2 bit are available.
Data Bit	8 bit is available.
Parity	None, Odd and Oven are available.
Baud Rate	1200/2400/4800/9600/19200/38400/57600/115200 are available.
Execution Interval (ms)	The execution interval between each Modbus channel command.
Max Resp Time (ms)	The maximum response time that the UC100 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 (ms)	Set the maximum retry times after the device fails to read data from RS485 terminal devices.
Modbus RS485 bridge LoRaWAN	If this mode is enabled, the device will transmit data between network server and RS485 terminal devices transparently. **Port:** Select from 2-84, 86-223.

Pass-through Mode	Select pass-through mode when **Modbus RS485 bridge LoRaWAN** is enabled. **Active Pass-through:** network server can send any type of command to RS485 device and RS485 device can only react according to server commands. **Two-way Pass-through:** not only can network server send any type of command to RS485 device, but also RS485 device supports transmitting the data to the network server actively. **Note:** When **Two-way Pass-through** is enabled, Modbus channels can't be used and corresponding IF-THEN command will not work.

3. Click ⊕ to add Modbus channels, then save configurations.



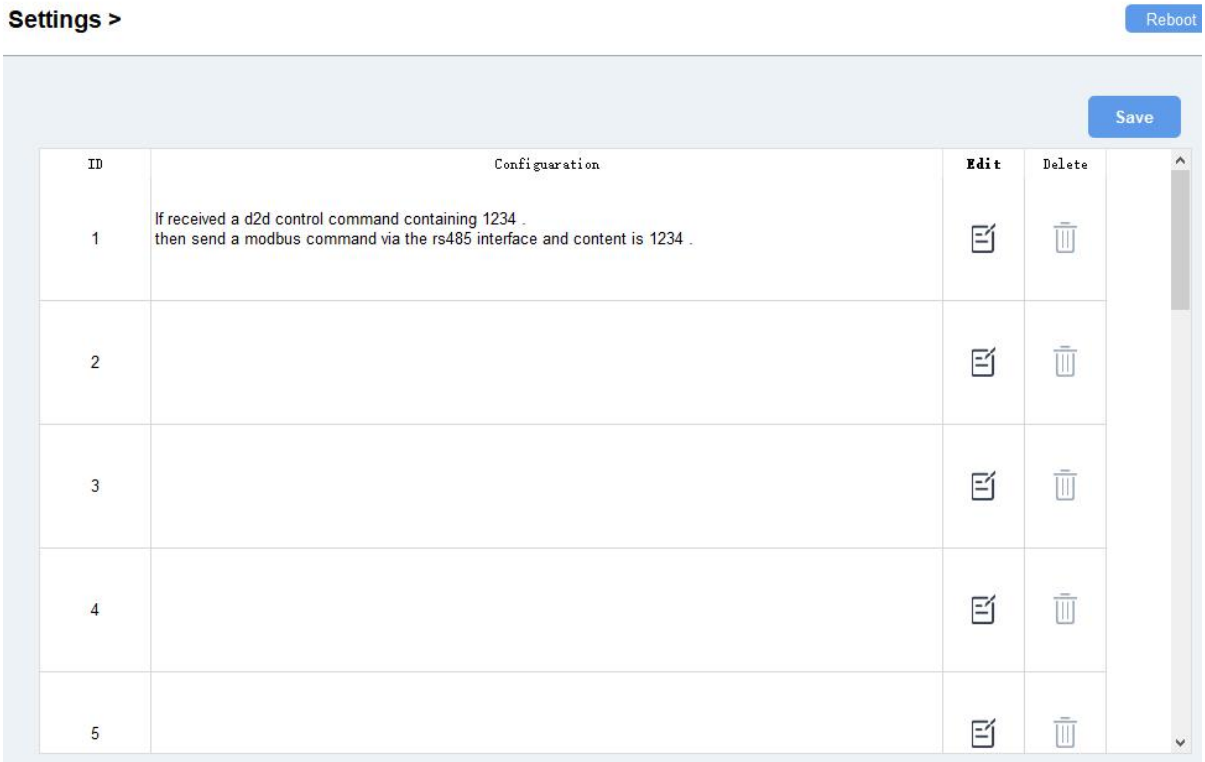
Parameters	Description
Channel ID	Select the channel ID you want to configure from 16 channels.
Name	Customize the name to identify every Modbus channel.
Slave ID	Set Modbus slave ID of a terminal device.
Address	The starting address for reading.
Quantity	Set read how many digits from starting address, it fixes to 1.
Type	Select the 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.
Fetch	After clicking, UC100 will send Modbus read command to test if it can read correct values. **Example:** as this setting, the device will send command: 01 03 00 00 00 01 84 0A 

4. Click **Fetch** to check if UC100 can read correct data from terminal devices. Note that do not click frequently since the response time of every RS485 device is differ.

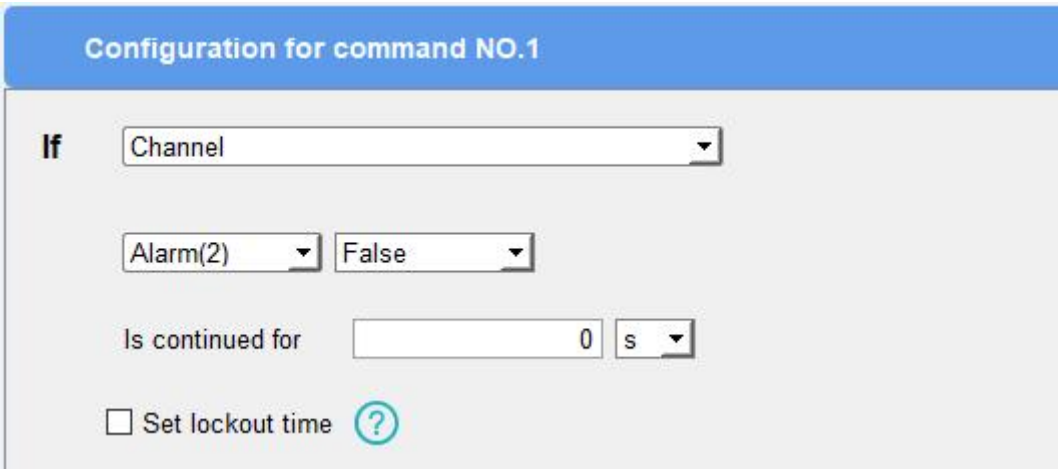
4.4 IF-THEN Command

UC100 supports configuring locally IF-THEN commands to do some actions automatically even without a network connection. One device can be added 16 commands at most.

1. Go to **Command** page, and click **Edit** to add commands.



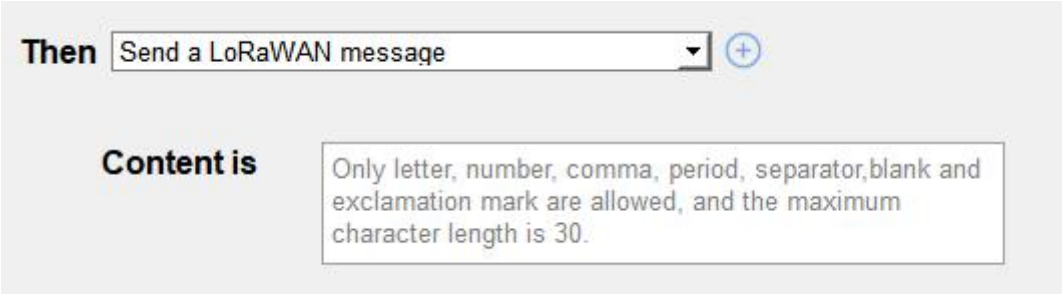
2. Set an IF condition based on the terminal device data or UC100 device status.



Condition	Description
Channel	When UC100 device gets certain response (False, True, Above, Below, Within)

	in certain RS485 channel (Channel Name + Channel ID), this command is triggered. **Is continued for**: the updated value should last for some time that is longer than a sole reporting interval. **Set lockout time:** after the lockout time, UC100 will check if the latest RS485 response matches the condition still. 0 means this IF condition will only be detected once. **Note:** The parameter will be hidden if you enable **Two-way Pass-through** feature.
Received a Milesight D2D control command	This only works with the Milesight D2D feature enabled. See details on chapter 4.5.

3. Set THEN action according to your request. You can add at most 3 actions in one command.



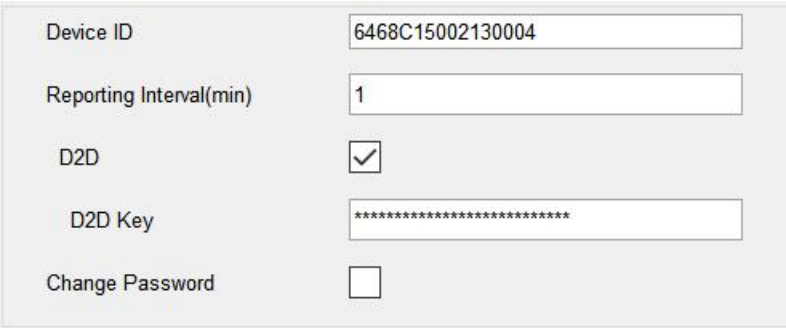
Action	Description
Send a LoRaWAN message	Send a custom message to the network server.
Restart the Device	Reboot the device.
Send a Milesight D2D control command	This only works with Milesight D2D feature enabled. See details on chapter 4.5.
Send a Modbus command via the RS485 interface	This only works with Milesight D2D feature enabled. See details on chapter 4.5.

4.5 Milesight D2D Settings

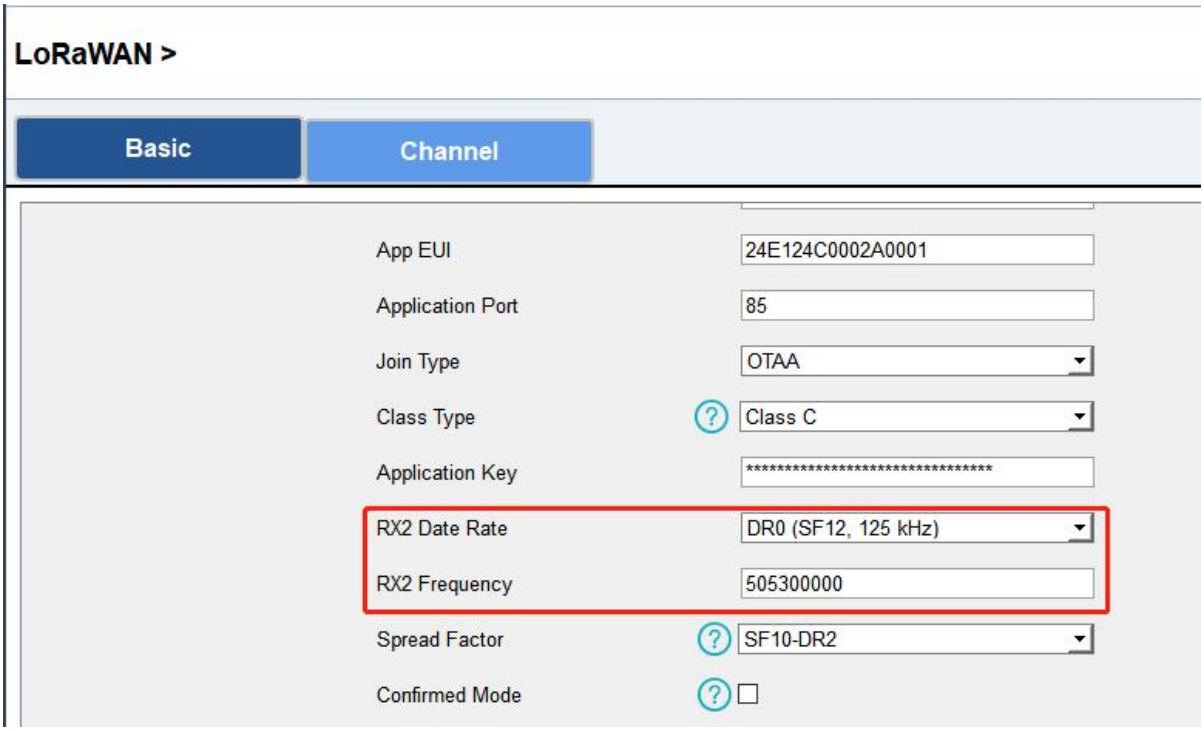
Milesight D2D protocol is developed by Milesight and used for setting up transmission among

Milesight devices without a gateway. When the Milesight D2D setting is enabled, UC100 can work as a Milesight D2D controller to send control commands to other devices or work as a Milesight D2D agent to receive commands to trigger a reboot or message to the network server.

1. Go to **General > Basic** page, enable Milesight D2D feature, and define a unique Milesig ht D2D key which is the same as Milesight D2D controller or agent devices. (Default Mil esight D2D Key: 5572404C696E6B4C6F52613230313823)

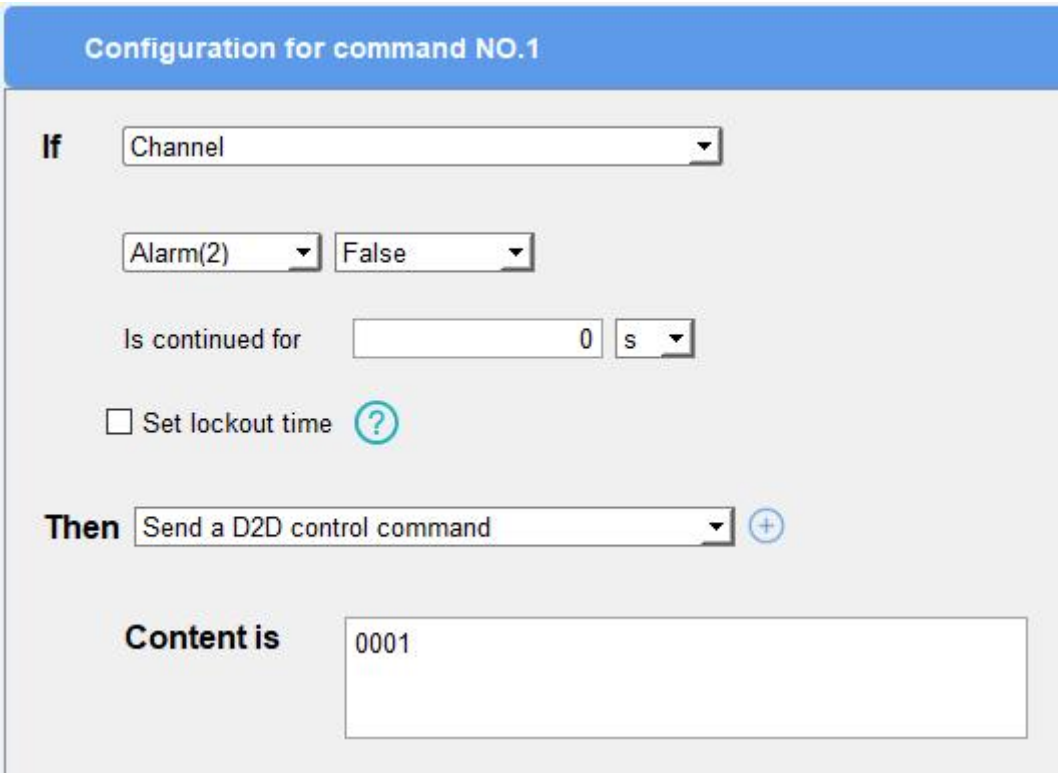


2. Go to **LoRaWAN Settings > Basic** to configure the RX2 datarate and RX2 frequency. When UC100 works as Milesight D2D controller, it will send commands as RX2 settings.

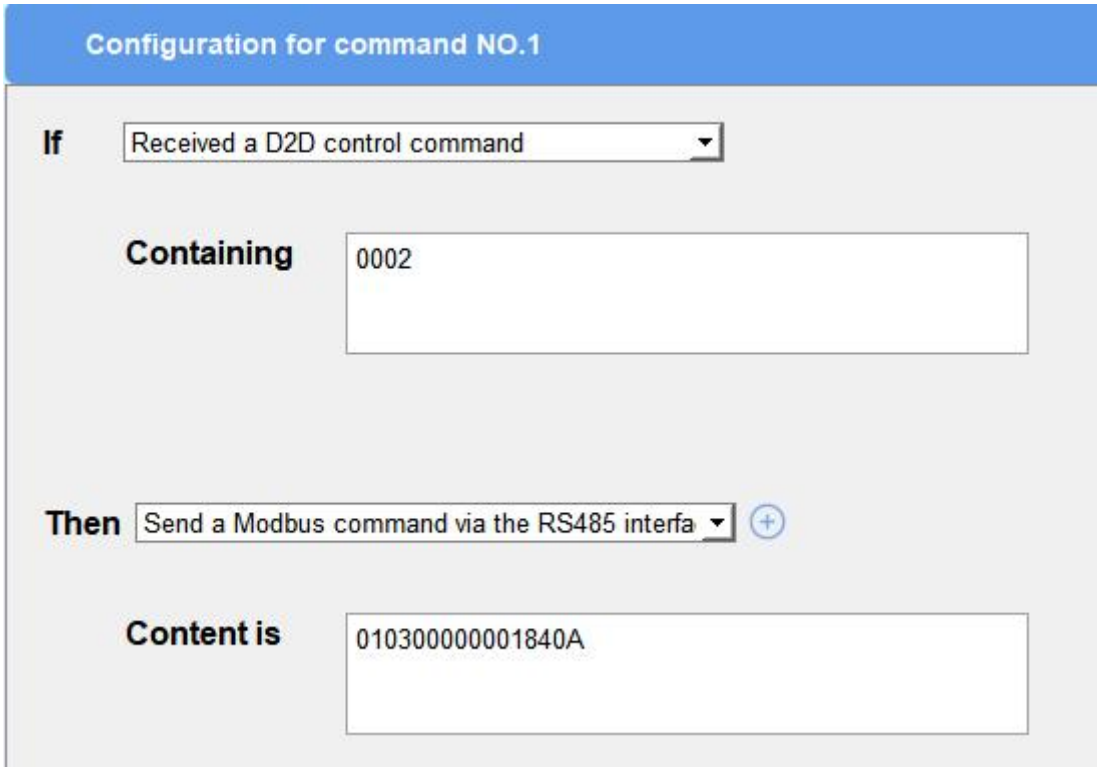


3. Go to **Command** page to set corresponding operations.

When the RS485 channel triggers, UC100 can work as Milesight D2D controller to send a control command to control the Milesight D2D agent device. The command should be a 2-byte hexadecimal number.



When UC100 receives a Milesight D2D command, it can work as a Milesight D2D agent to reboot the device or send Modbus command to RS485 terminal devices.



4.6 Maintenance

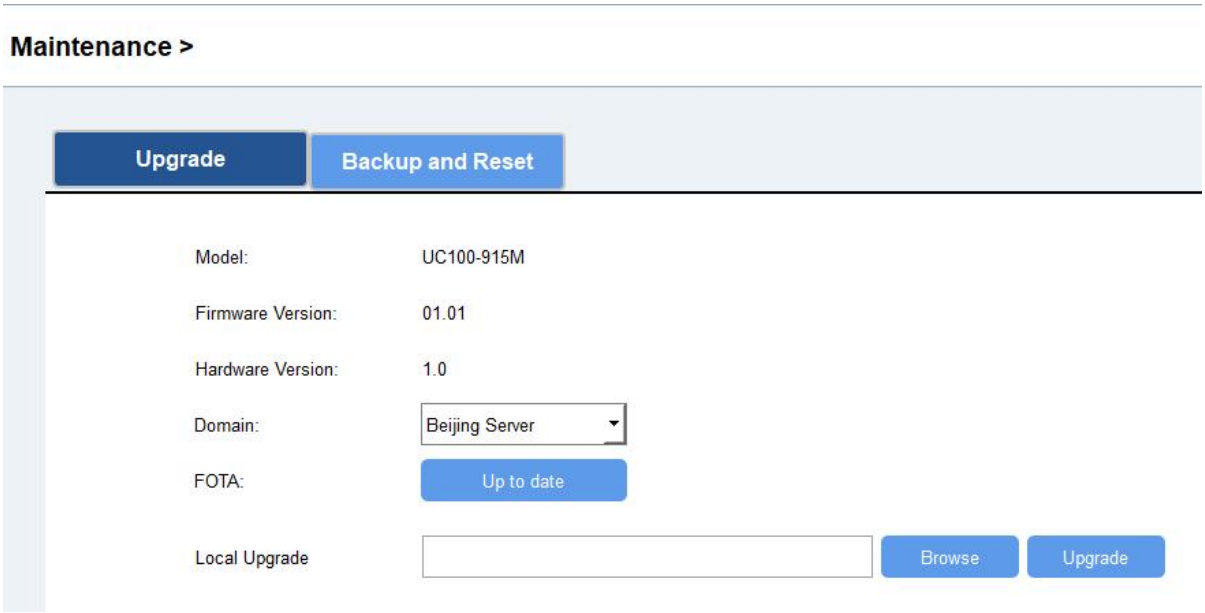
4.6.1 Upgrade

UC100 supports upgrade firmware locally via ToolBox software.

1. Download firmware from www.milesight-iot.com to your PC.

2. Go to **Maintenance > Upgrade**, click **Browse** to import firmware and upgrade the device. You can also click **Up to Date** to search for the latest firmware of the device and upgrade.

Note: Any operation on ToolBox is not allowed during upgrading, otherwise the upgrading will be interrupted, or even the device will break down.

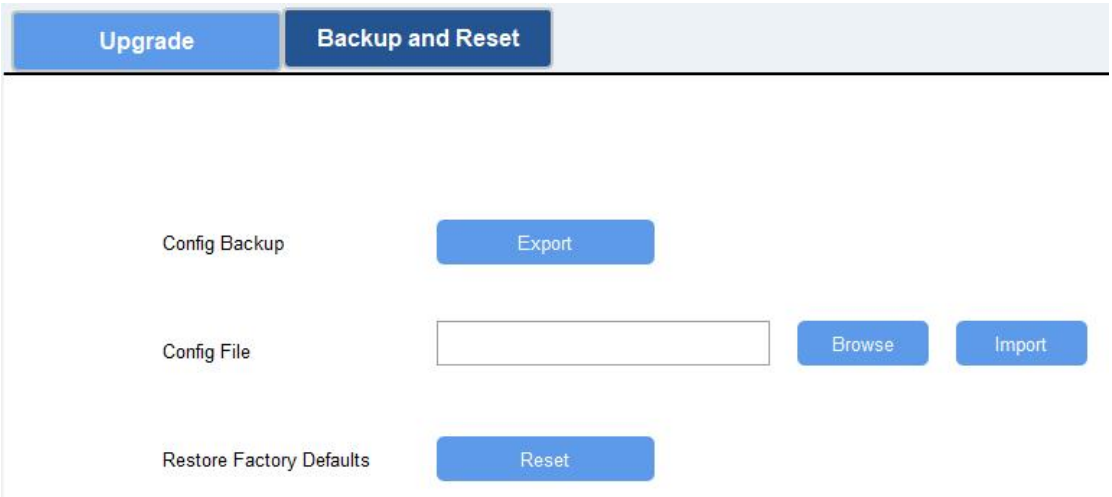


4.6.2 Backup

UC100 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.

1. Go to **Maintenance > Backup and Reset**, and click **Export** to save the current configuration as json format backup file.

2. Click **Browse** to select the backup file, then click **Import** to import the configurations.

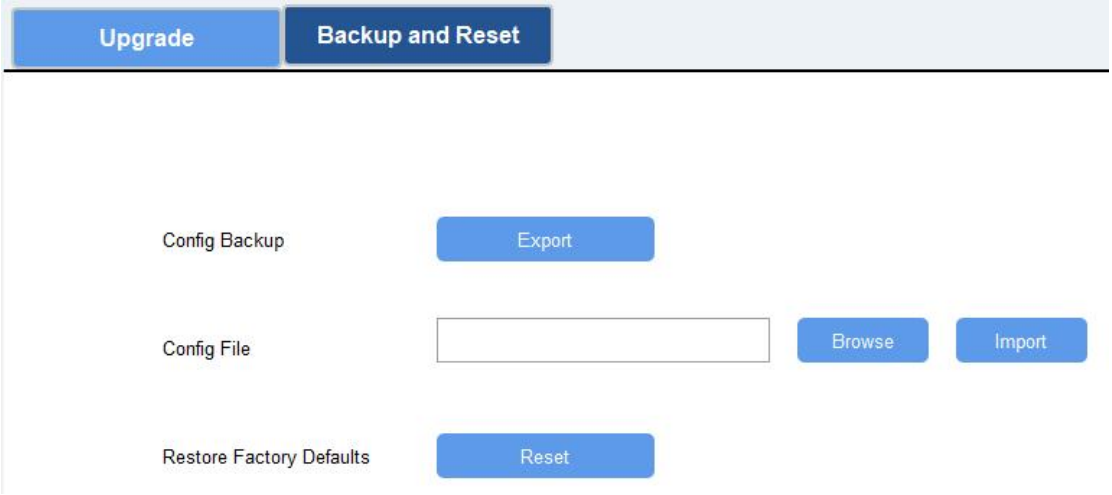


4.6.3 Reset to Factory Default

Please select one of following methods to reset device:

Via Hardware: Open the case of UC100, and hold the reset button for more than 10s until the LED blinks.

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



5. Device Payload

All data are based on the following format (HEX), the Data field should follow little-endian:

Channel1	Type1	Data1	Channel2	Type2	Data2	Channel 3	...
1 Byte	1 Byte	N Bytes	1 Byte	1 Byte	M Bytes	1 Byte	...

Among them, Data field are shown as little endian. For decoder examples, you can find them at https://github.com/Milesight-IoT/SensorDecoders.

5.1 Device Information

UC100 reports basic device information of device every time joining the network.

Channel	Type	Data Size/Byte	Description
ff	01 (Protocol Version)	1	01 => V1
	09 (Hardware Version)	2	01 20 => V1.2
	0a (Software Version)	2	01 01 => V1.1
	0b (Power event)	1	ff => powered on
	16 (Device SN)	8	64 45 B4 34 11 30 00 01 => SN is 64 45 B4 34 11 30 00 01

Example:

ff0bff ff0101 ff166445b43411300001 ff090100 ff0a0101		
Channel	**Type**	**Value**
ff	0b (Power Event)	ff (powered on)
ff	01 (Protocol Version)	01 (V1)
ff	16 (Device SN)	64 45 B4 34 11 30 00 01
ff	09 (Hardware Version)	0100 (V1.0)
ff	0a (Software Version)	0101 (V1.1)

5.2 Modbus Channel Data

UC100 reports RS485 sensor data which are fetched by Modbus channels according to reporting interval (20 mins by default). If there is not Modbus channels, UC100 will only upload Power On packet: **ff0bff**.

<table>
<tr><th>Channel</th><th>Type</th><th>Byte</th><th>Description</th></tr>
<tr><td>ff</td><td>19 (RS485)</td><td>Mutable (4-7)</td><td>Total: Byte 1+Byte 2+Byte 3+Value
Byte 1: Channel ID
Byte 2: Data Size
Byte 3: Data Type
<table>
<tr><th>Code</th><th>Data Type</th></tr>
<tr><td>00</td><td>Coil</td></tr>
<tr><td>01</td><td>Discrete</td></tr>
<tr><td>02</td><td>Input16</td></tr>
<tr><td>03</td><td>Hold16</td></tr>
<tr><td>04</td><td>Hold32</td></tr>
<tr><td>05</td><td>Hold_float</td></tr>
<tr><td>06</td><td>Input32</td></tr>
<tr><td>07</td><td>Input_float</td></tr>
<tr><td>08</td><td>Input_int32_with upper 16 bits</td></tr>
<tr><td>09</td><td>Input_int32_with lower 16 bits</td></tr>
<tr><td>0a</td><td>Hold_int32_with upper 16 bits</td></tr>
<tr><td>0b</td><td>Hold_int32_with lower 16 bits</td></tr>
</table></td></tr>
<tr><td>ff</td><td>15 (Modbus collecting exception)</td><td>1</td><td>Channel ID of failed Modbus collection.</td></tr>
</table>

Note: Channel ID can be configured in ToolBox.

Channel ID	Description
00	RS485 (Modbus Master) Channel 1
01	RS485 (Modbus Master) Channel 2
02	RS485 (Modbus Master) Channel 3
...	...
0f	RS485 (Modbus Master) Channel 16

Examples:

ff 19 07 02 03 15 00					
Channel	**Type**	**Channel ID**	**Data Size**	**Data Type**	**Value**
ff	19 (RS485)	07 => Channel 8	02 => 2 bytes	03 => Hold 16	15 00 => 00 15 = 21

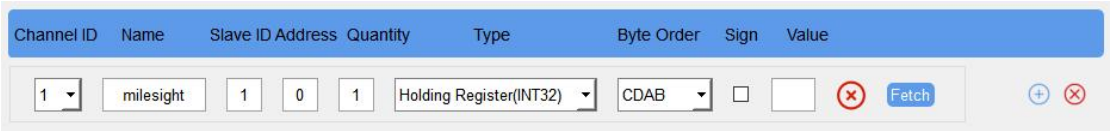
Note: When data type is holding register or input register, ToolBox can set different byte orders. Take below Modbus register response from RS485 sensors as example:

Register Address	Value (Hex)
0	00 15
1	00 20

When using different byte orders, you can use ToolBox to fetch different results, and the device will upload data with little endian order.

Data Type	Byte Order	Fetch Result	Uplink (HEX)
Holding/Input Register (INT16)	AB	21 (0x15)	15 00 (BA)
	BA	5376 (0x1500)	00 15 (AB)
Holding/Input Register (INT32)	ABCD	1376288 (0x00150020)	20 00 15 00 (DCBA)
	CDAB	2097173 (0x00200015)	15 00 20 00 (BADC)
	BADC	352329728 (0x15002000)	00 20 00 15 (CDAB)
	DCBA	536876288 (0x20001500)	00 15 00 20 (ABCD)
Holding/Input Register (INT32 with upper 16 bits)	/	21 (0x15)	15 00 00 00
Holding/Input Register (INT32 with lower 16 bits)	/	32 (0x20)	20 00 00 00

If UC100 fails to connect the Modbus data, it will send an error message.



ff 15 00		
Channel	**Type**	**Value**
ff	15 (Poll Failed)	00 => Channel 1

5.3 Downlink Command

UC100 supports downlink commands to configure the device. The application port is 85 by default.

Channel	Type	Description
ff	03(Set Reporting Interval)	2 Bytes, unit: s
	10 (Reboot)	ff (Reserved)

Examples:

1. Reporting Interval

ff 03 b0 04		
Channel	**Type**	**Value**
ff	03 (Set Reporting Interval)	b0 04 => 04 b0 = 1200 s = 20 mins

2. Reboot the device

ff 10 ff		
Channel	**Type**	**Reserved**
ff	10 (Reboot)	ff

-END-