Wall Switch

Featuring LoRaWAN®

WS50x

User Guide

Safety Precautions

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

- The installation and maintenance must be conducted by a qualified service person and should strictly comply with the electrical safety regulations of the local region.
- Ensure the breaker is powered out during the installation.
- Do not leave any object inside the switch box when installation.
- The device must not be modified in any way.
- In order to protect the security of the device, please change the device password when first configuration. The default password is 123456.
- In order to realize the best data transmission, ensure the device is within the signal range of the LoRaWAN® gateway and keep it away from metal objects and obstacles.
- Do not overload the maximum capacity to avoid damaging the device.
- The device is intended for indoor use only. Do not place the device where the temperature is below/above the operating range.
- Do not place the device close to naked flames, heat source (such as oven or sunlight), cold source, liquid, and objects with extreme temperature changes.
- Use the device in a clean environment only. Dusty or dirty environments may prevent the proper operation of this device.
- The device must never be subjected to physical shocks or strong vibration.

Declaration of Conformity

WS50x 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

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

Revision History

Date	Doc Version	Description
June 24, 2022	V 1.0	Initial version
October 26, 2022	V 1.1	Add 2-wire version model
Jan. 22, 2025	V 1.2	1. Remove 2-wire version model 2. Update ToolBox screenshots.
April 23, 2025	V 1.3	Add Milesight D2D Controller feature and dual-control example

Contents

1. Product Introduction

1.1 Overview

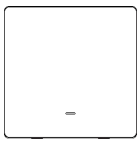
WS50x is a smart LoRaWAN® wall switch for the local and remote control of lights and electrical appliances. It adopts two standard sizes for most of international wall switch types, which can replace the traditional wall switches directly. Compliant with Milesight LoRaWAN® gateway and Milesight IoT Cloud solution, WS50x can be monitored and controlled via web page or mobile App remotely and triggered by other Milesight sensors. Besides LoRaWAN®, WS50x supports Milesight D2D communication protocol, which can set up connection quickly and be controlled without gateway. WS50x can be widely used for wireless control of indoor lights, fans, heaters, machines, etc.

1.2 Features

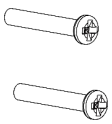
- Support local or remote control via a relay with high reliability
- Support surge protection, and overload protection to prevent the device from damage
- Collect data of current, voltage, power, and electrical consumption
- Built-in switch indicator for easy use in dark environment
- Up to 15 km communication range
- Easy configuration via NFC
- Standard LoRaWAN® technology
- Compatible with Milesight IoT Cloud and Milesight Development Platform
- Support Milesight D2D protocol to enable ultra-low latency control without gateway
- Support multicast for control in bulk

2. Hardware Introduction

2.1 Packing List



1 × WS50x Wall Switch



2 × Mounting Screws

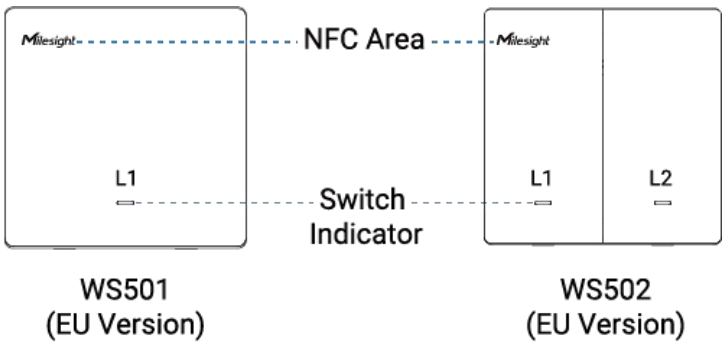
1 x Quick Start Guide

1 x Warranty Card

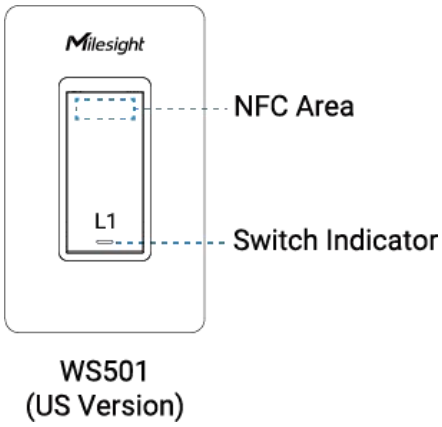
If any of the above items is missing or damaged, please contact your sales representative.

2.2 Hardware Overview

86 Type:



120 Type:

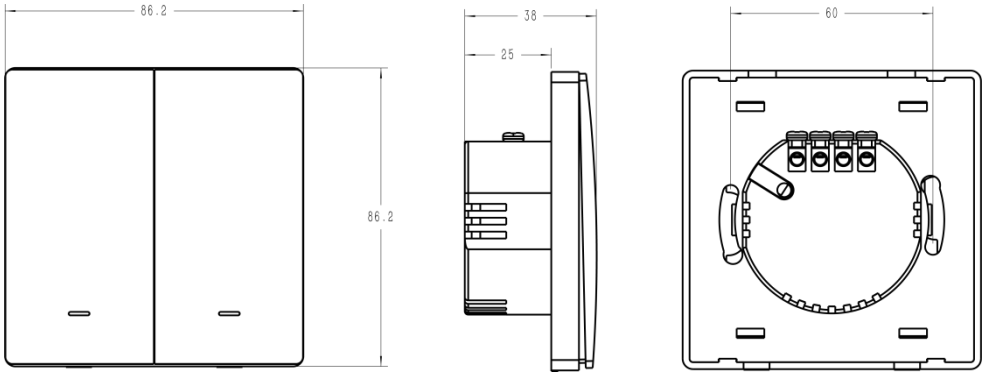


2.3 LED Patterns

Indicator	Action	Indication (Enable)
Button Indicator	Power on	Off → On
	Send a join network request packet	Blinks once quickly
	Joined the network successfully	All blinks twice slowly

2.4 Dimensions (mm)

86 Type:



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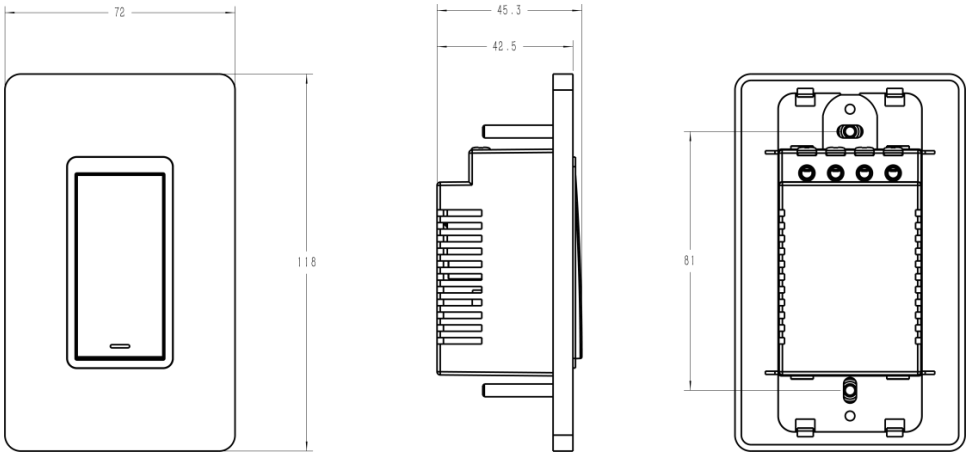
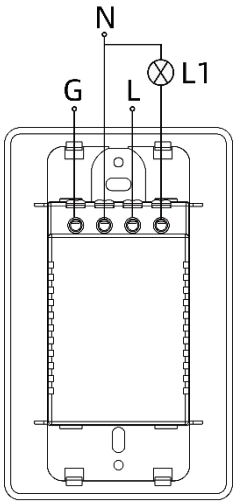
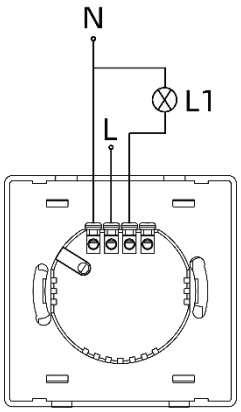


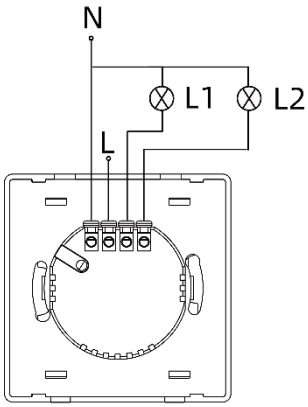
2.5 Wiring Diagram



WS501
(3W-W12-US)



WS501
(3W-W11-EU)

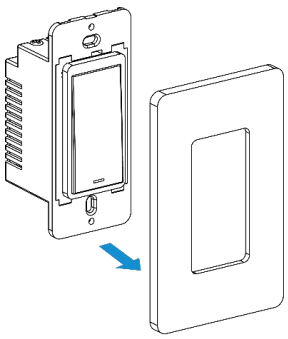


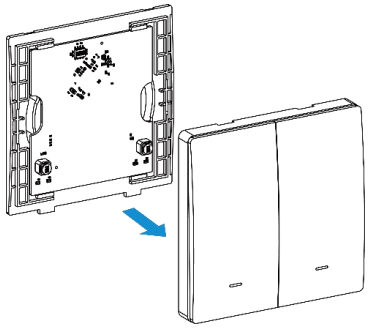
WS502
(3W-W11-EU)

3. Installation

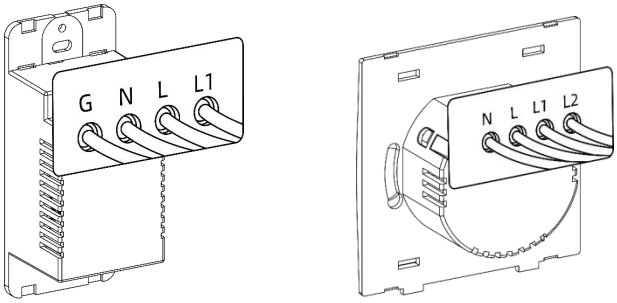
1. Ensure the circuit has been shut off and the old switch has been taken off.

2. Open the front panel of WS50x switch.

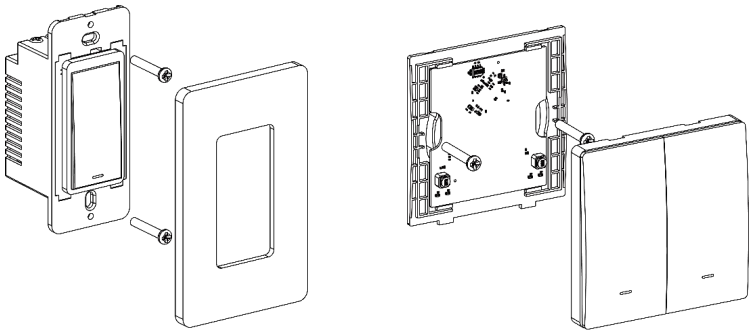




3. Connect corresponding wires to the WS50x switch.



4. Fix the WS50x switch to the switch box with mounting screws, then fix the front panel back to the device.

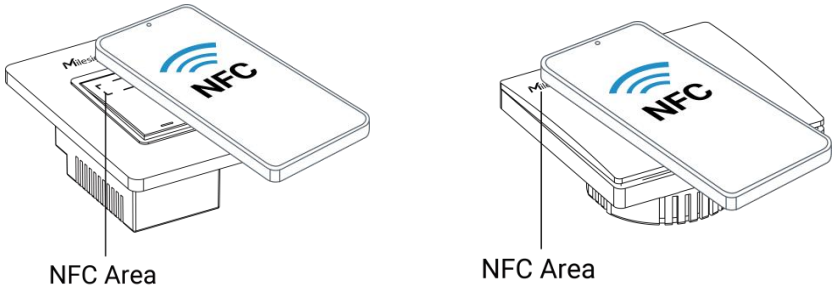


4. Operation Guide

4.1 NFC Configuration

WS50x can be configured via an NFC supported mobile phone.

1. Download and install "Milesight ToolBox" App from Google Play or Apple App Store.
2. Enable NFC on the smartphone and open Milesight ToolBox.
3. Select reading mode as NFC, then attach the smartphone to NFC area of the switch to read device information.



4. Basic information and settings of WS50x switch will be shown on the ToolBox if it's recognized successfully. You can read and configure the device by tapping the Read/Write button on the App. In order to protect the security of devices, password validation is required when first configuration. The default password is **123456**.

Note:

1) Ensure where is the NFC area on your smartphone, and it's recommended to take off the phone case.

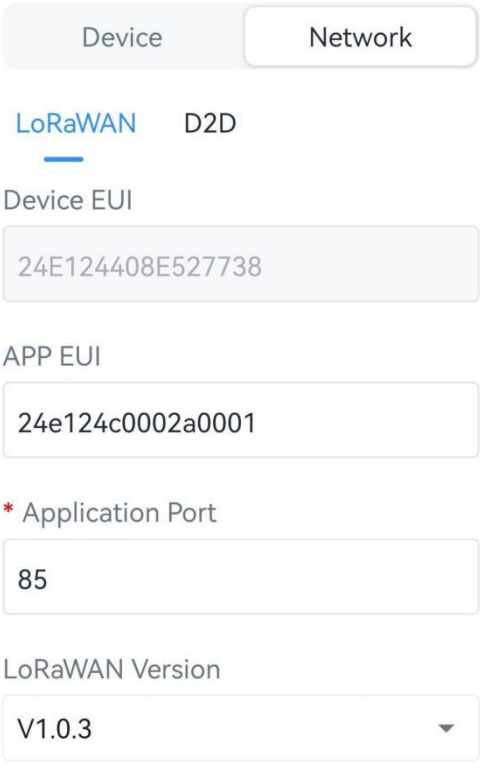
2) If the smartphone fails to read/write configurations via NFC, keep the phone away and back to try again.

4.2 LoRaWAN Settings

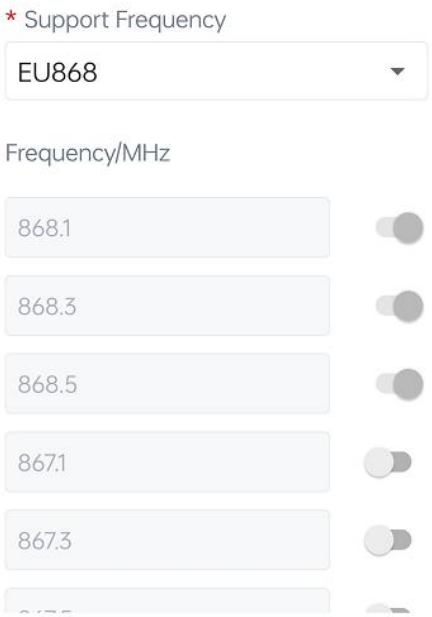
LoRaWAN settings are used to configure the data transmission parameters in the LoRaWAN® network.

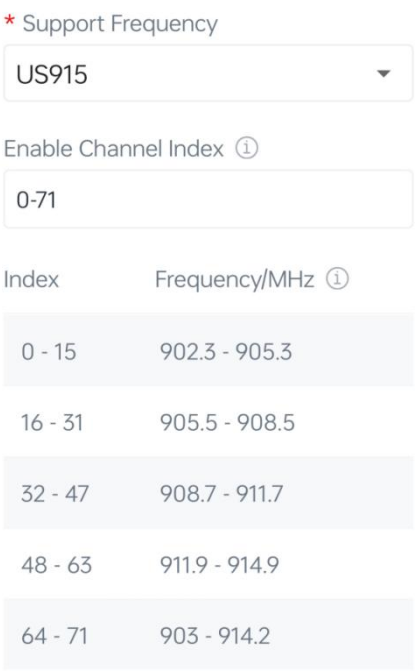
4.2.1 Basic Settings

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 which can also be found on the label.
App EUI	The default App EUI is 24E124C0002A0001.
Application Port	The port used for sending and receiving data, the default port is 85.
Join Type	OTAA and ABP modes are both available.
Application Key	The default Appkey for OTAA mode is 5572404C696E6B4C6F52613230313823.

Device Address	The default DevAddr for ABP mode is the 5th to 12th digits of SN.
Network Session Key	The default Nwkskey for ABP mode is 5572404C696E6B4C6F52613230313823.
Application Session Key	The default Appskey for ABP mode is 5572404C696E6B4C6F52613230313823.
LoRaWAN Version	V1.0.2 and V1.0.3 are available.
Work Mode	It is fixed as Class C.
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
Channel	Enable or disable the frequency to send uplinks.  If frequency is one of 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

	
Confirmed Mode	If the device does not receive ACK packet from network server, it will resend data once.
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 2*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.
ADR Mode	Allow the network server to adjust the data transmission rate of the device.
Spread Factor	If ADR is disabled, the device will send data via this spread factor.
Tx Power	Transmit power of the device.

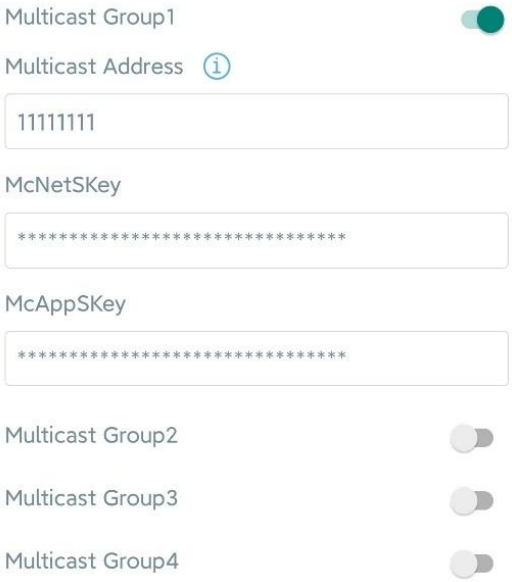
Note:

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

4.2.2 Multicast Settings

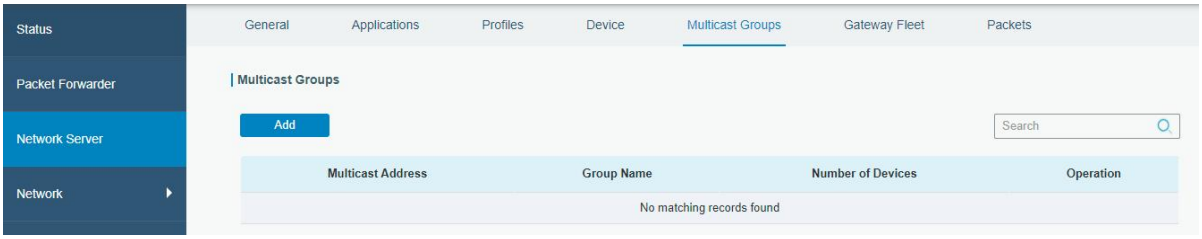
WS50x supports setting up several multicast groups to receive multicast commands from the network server ,then users can use this feature to control devices in bulks.

1. Enable Multicast Group on WS50x, and set an unique multicast address and keys to distinguish other groups. You can also keep these settings by default.

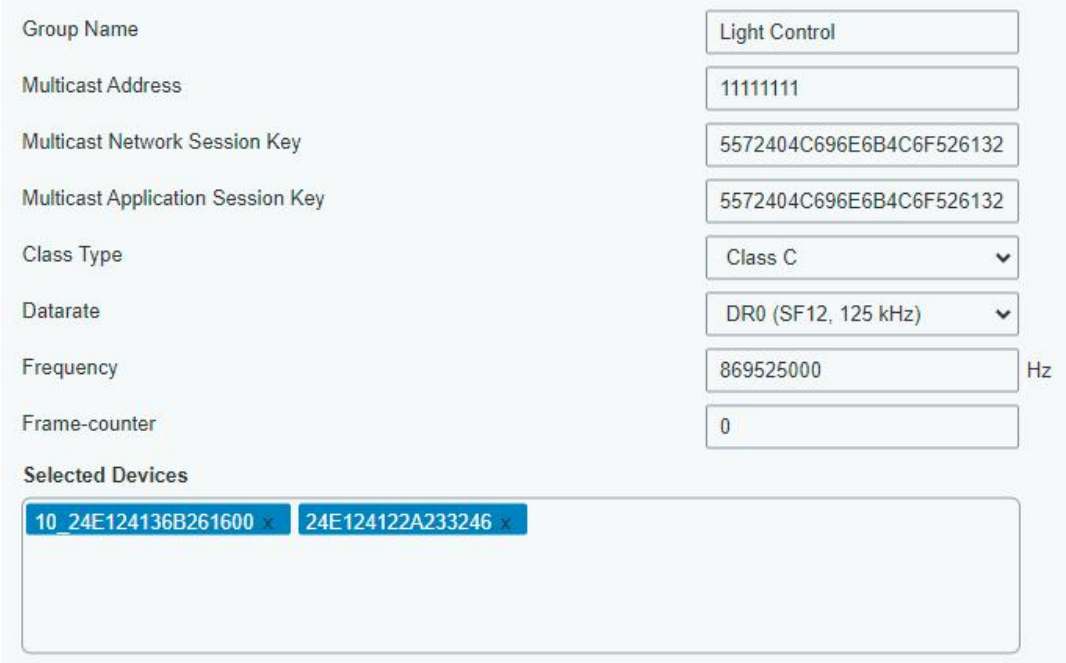


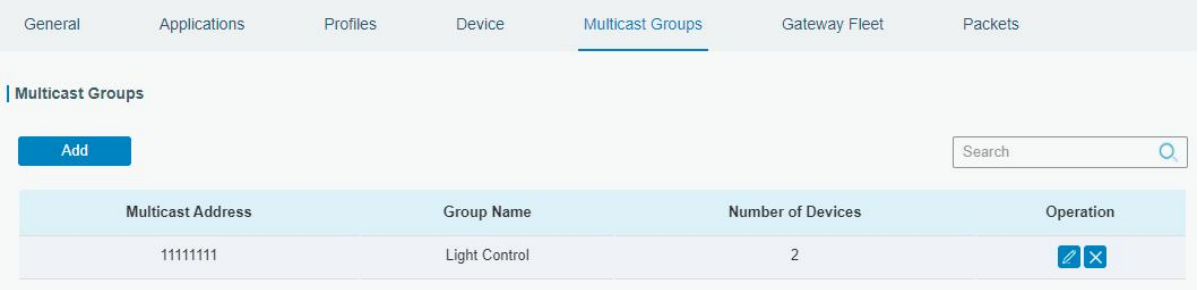
Parameters	Description
Multicast Address	Unique 8-digit address to distinguish different multicast groups.
Multicast McNetSkey	32-digit key. Default values: Multicast Group 1: 5572404C696E6B4C6F52613230313823 Multicast Group 2: 5572404C696E6B4C6F52613230313824 Multicast Group 3: 5572404C696E6B4C6F52613230313825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

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



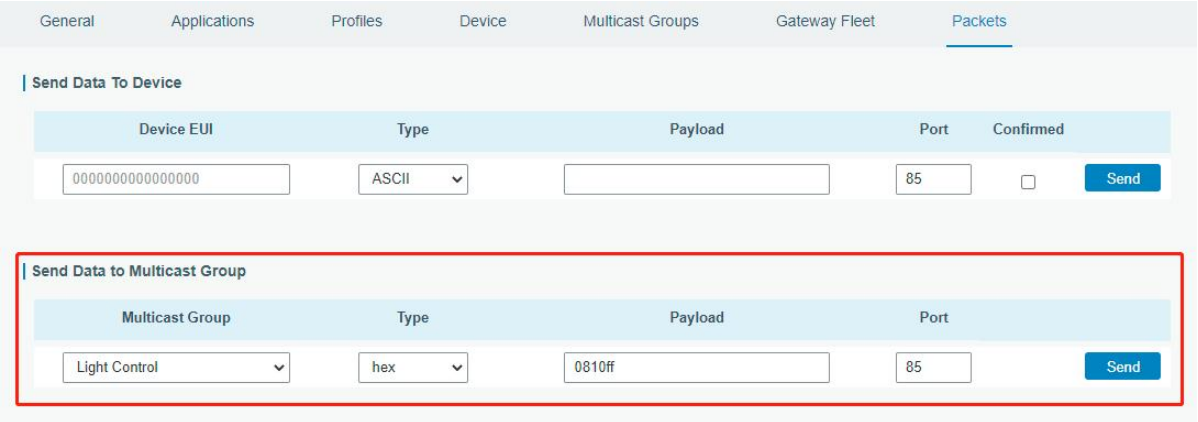
Fill in the multicast group information the same as WS50x settings, and select the devices which you need to control, then click **Save**.



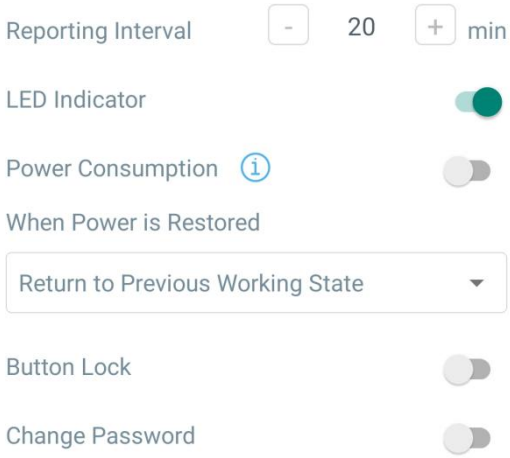


3. Go to **Network Server > Packets**, select the multicast group and fill in the downlink command, click **Send**. The network server will broadcast the command to devices that belong to this multicast group.

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



4.3 General Settings



Parameters	Description
Reporting Interval	The interval of reporting switch status and electrical parameters. Default: 20 mins, Range: 1 - 1080 mins
LED Indicator	Enable or disable the light of switch button. This will not affect the blinks when you hold on switch buttons to reset the device.
Power Consumption	Record the power consumption. If disabled, the device will stop recording and the power consumption value will stop updating.
When Power is Restored	If the device is powered off and restored, the device will change according to this parameter.
Button Lock	If enabled, all switch buttons will not be allowed to turn on/off or reset to factory default.
Change Password	Change the password for ToolBox App to write this device.

4.4 Milesight D2D Settings

Milesight D2D protocol is developed by Milesight and used for connection among Milesight devices without gateway.

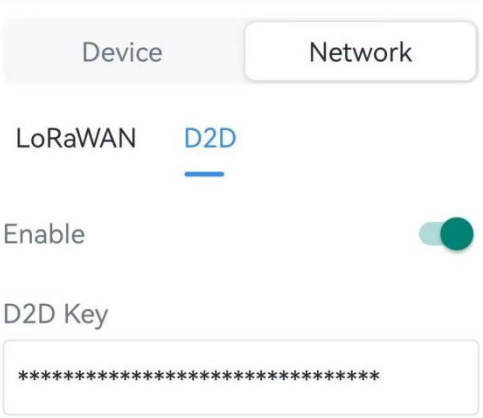
4.4.1 Milesight D2D Controller

When D2D controller setting is enabled, the device can work as Milesight D2D controller device to send commands to trigger D2D agent devices.

1. Configure RX2 datarate and RX2 frequency in LoRaWAN® settings. It is suggested to change the default RX2 frequency to avoid conflicts with other devices and set RX2 datarate between SF7 to SF10 to ensure better performance.

2. Define an unique D2D key to be the same as D2D agent devices. (Default D2D Key:

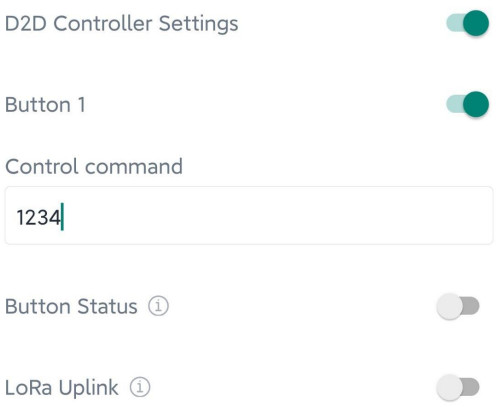
5572404C696E6B4C6F52613230313823)



3. Enable **D2D Controller Settings**, select any of button to define a 2-byte hexadecimal control command (0x0000 to 0xffff). When you press this button, WS50X will send the control command to corresponding D2D agent devices. Besides, this button can also control the light at the same time.

Note: Please do not press button frequently which may bring bad experience such as conflict and stuck key, as the button is pressed before D2D packet is completely sent.

Example: When pressing the button 1, the device will turn on L1 and send the command 1234 to Milesight D2D agent devices.

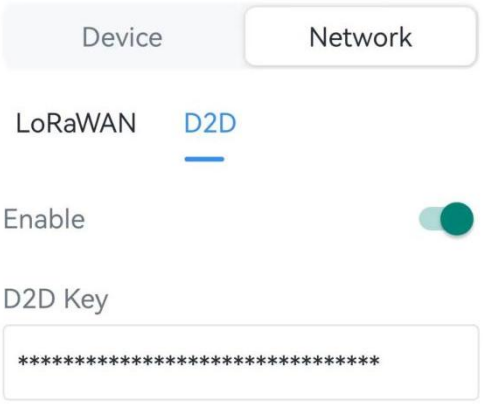


Parameters	Description
Button Status	If enabled, the D2D control command packet will contain the info of button status. This is usually used for dual control applications.
LoRa Uplink	If enabled, a LoRa Uplink packet that contains the info of button status will be sent to the network server after sending the D2D control command packet.

4.4.2 Milesight D2D Agent

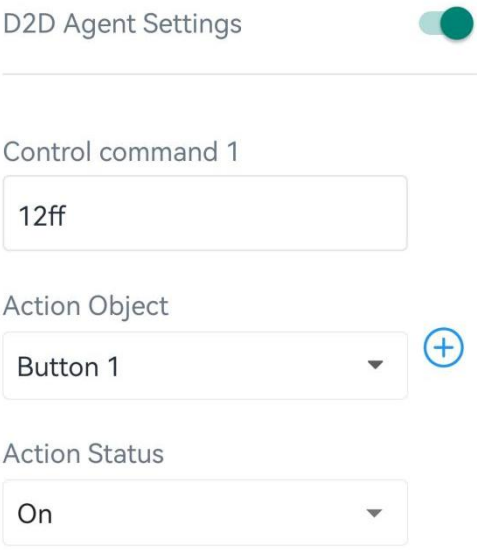
When D2D agent setting is enabled, the device can work as the Milesight D2D agent device to receive commands from Milesight D2D controller devices.

1. Ensure the RX2 datarate and RX2 frequency in LoRaWAN settings are the same as the D2D controller device.
2. Define an unique D2D key to be the same as the setting in D2D controller device. (Default D2D Key: 5572404C696E6B4C6F52613230313823)



3. Enable **D2D Agent Settings**, define a 2-byte hexadecimal control command (0x0000 to 0xffff) and command action. WS50x supports at most 16 control commands.

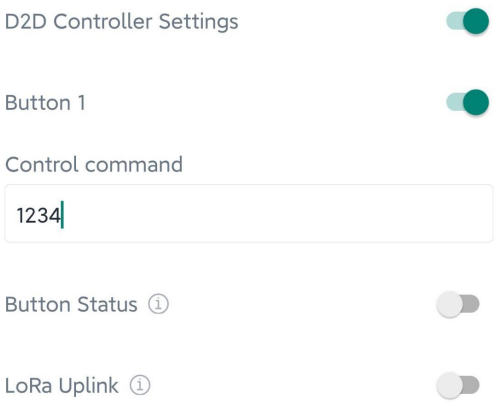
Example1: When receiving the command 12ff from Milesight D2D controller devices, turn on button 1.



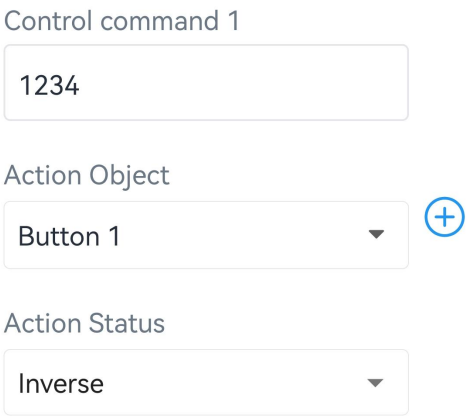
4.4.3 Dual-Control Switch Example

WS50x supports dual or more switches to control one terminal by Milesight D2D feature. Here takes an example to describe the settings of dual switches.

1. Ensure the RX2 datarate, RX2 frequency, and D2D key of both devices are the same.
2. Enable D2D Controller settings on switch 1, then select one button to configure the control command.



3. Enable D2D Agent settings on switch 2 and configure the command the same as switch 1, then select the action status as **Inverse**.



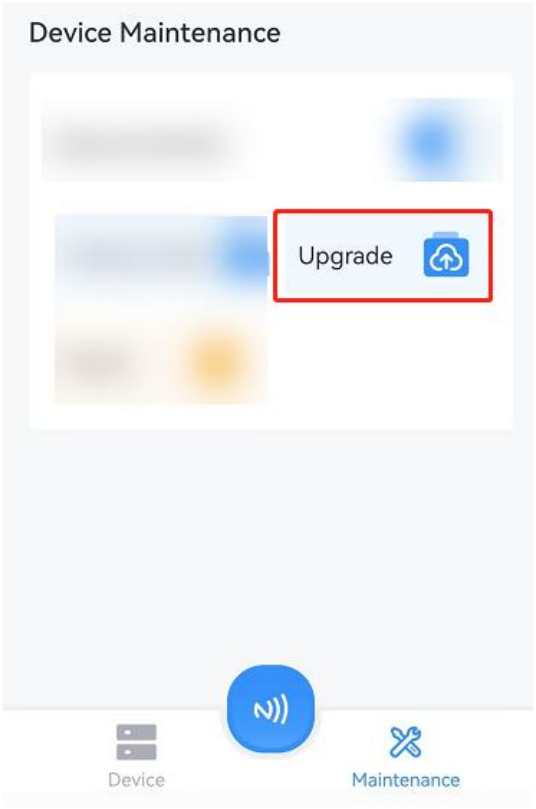
4.5 Maintenance

4.5.1 Upgrade

1. Download firmware from Milesight website to your smartphone.
2. Click **Upgrade** to import firmware and upgrade the device.

Note:

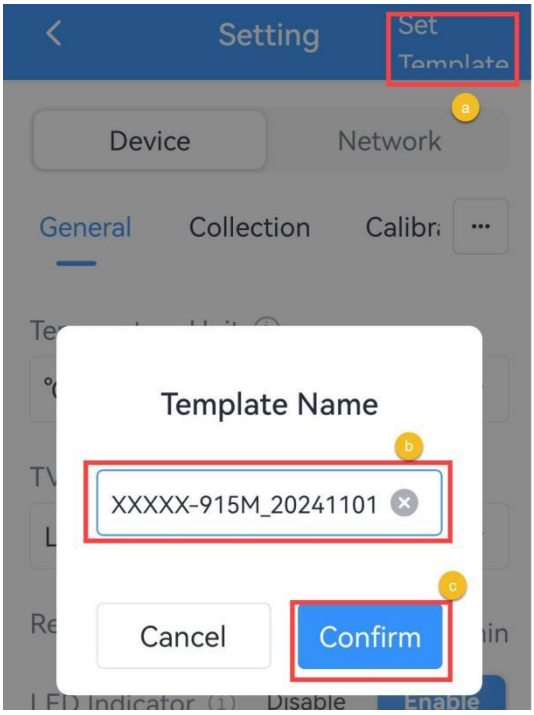
1) Operation on ToolBox is not supported during the upgrade.
2) Only Android version ToolBox supports the upgrade feature.



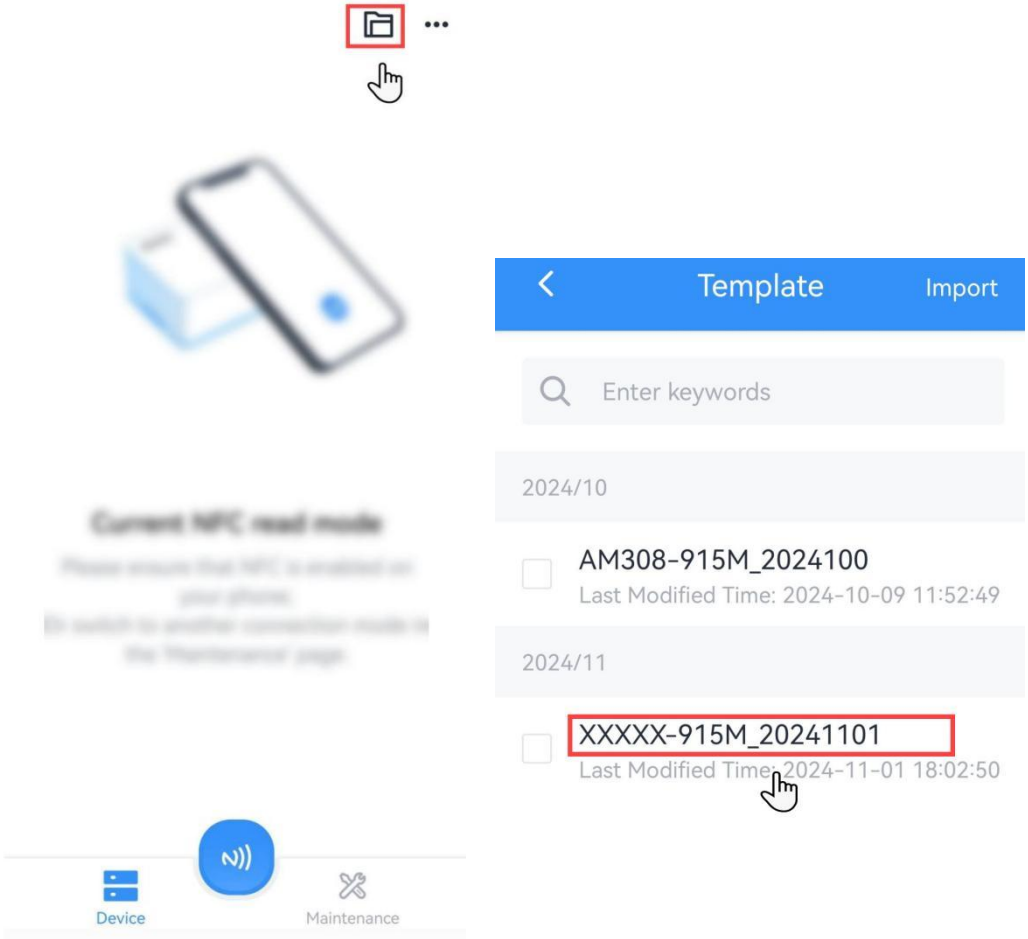
4.5.2 Backup

WS50x supports configuration backup for easy and quick device configuration in bulk. Backup is allowed only for devices with the same model and LoRaWAN® frequency band.

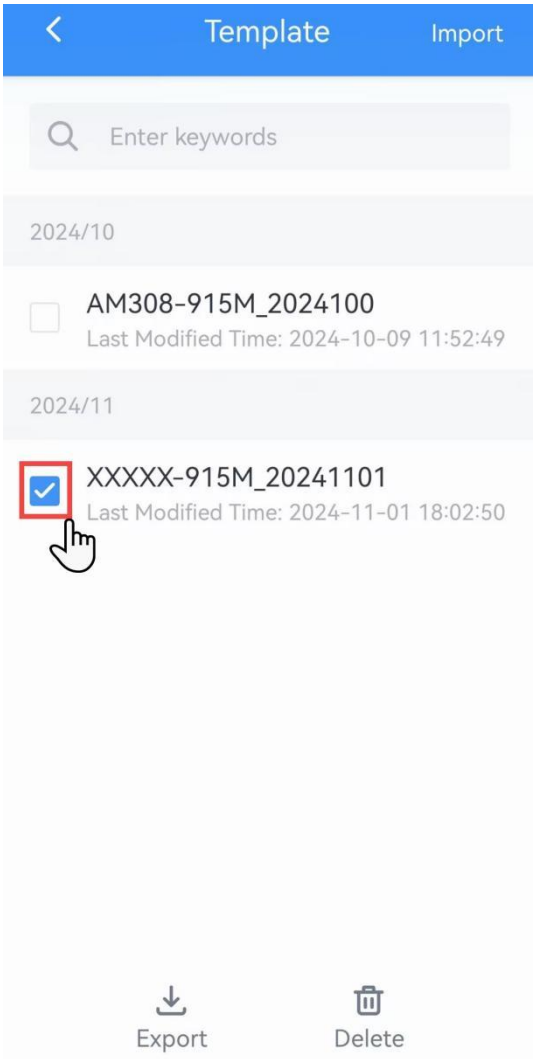
1. Attach the NFC area of smartphone to the device to read the device.
2. Go to **Settings** page on the App to edit the configuration as required, click **Set Template** to save current configuration as the template in the ToolBox App.



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.

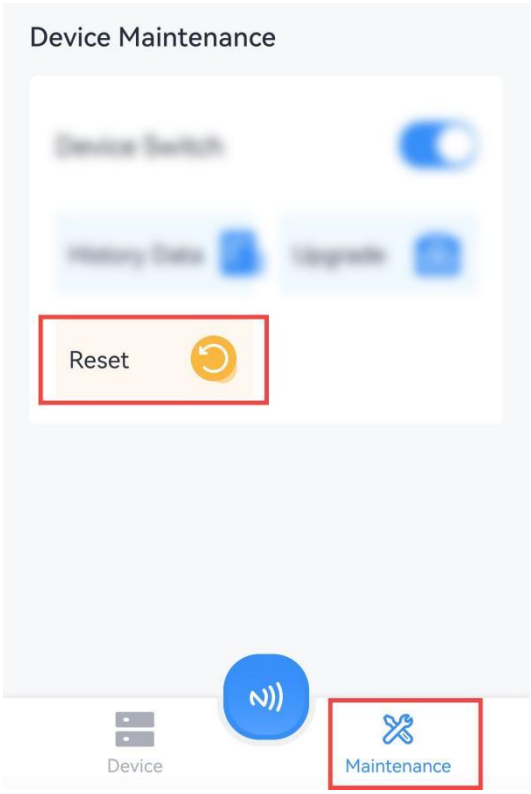


4.5.3 Reset to Factory Default

Please select one of the following methods to reset the device:

Via Hardware: Hold on any switch for more than 10s until indicator blinks, this should ensure the button lock is disabled.

Via ToolBox App: Go to **Device > Maintenance** to tap **Reset**, then attach smartphone with NFC area to the device to complete the reset.



5. Communication Protocol

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	...

For decoder examples you can find at https://github.com/Milesight-IoT/SensorDecoders.

5.1 Basic Information

WS50x reports basic information of the device whenever it joins the network.

Item	Channel	Type	Description
Protocol Version	ff	01	11=>V1.1
Hardware Version		09	01 40 => V1.4
Software Version		0a	01 14 => V1.14
Power On		0b	Device is on
Serial Number		16	Serial number of this device, 16 digits

Example:

ff0bff ff0101 ff090100 ff0a0101 ff166771c21070911328					
Channel	**Type**	**Value**	**Channel**	**Type**	**Value**
ff	0b	ff (Reserved)	ff	01	01(V1.0)

	(Power On)			(Protocol Version)	
Channel	**Type**	**Value**	**Channel**	**Type**	**Value**
ff	09 (Hardware Version)	0100 (V1.0)	ff	0a (Software Version)	0101 (V1.1)
Channel	**Type**	**Value**			
ff	16 (Serial Number)	6771c21070911328			

5.2 Sensor Data

Item	Channel	Type	Description
Voltage	03	74	UINT16/10, Unit: V
Active Power	04	80	UINT32, Unit: W
Power Factor	05	81	UINT8, Unit: %
Power Consumption	06	83	UINT32, Unit: Wh
Total Current	07	c9	UINT16, Unit: mA
Switch Status	08	29	Bit 0: status of L1 Bit 1: status of L2 (WS502 Only) Bit 2-3: reserved Bit 4: changing status of L1 Bit 5: changing status of L2 (WS502 Only) Bit 6-7: reserved

Examples:

1. Periodic report: report according to reporting interval. (20 minutes by default)

082913 058164 07c90200 0374b208 068301000000 048001000000					
Channel	**Type**	**Value**	**Channel**	**Type**	**Value**
08	29 (Switch Status)	13= 00010011 => switch 1 changed to open, switch 2 remains opened	05	81 (Power Factor)	64=> 100%
Channel	**Type**	**Value**	**Channel**	**Type**	**Value**
07	c9 (Current)	02 00=>00 02=2mA	03	74(Voltage)	b2 08=>08 b2=2226 Voltage=2226 *0.1=222.6V
Channel	**Type**	**Value**	**Channel**	**Type**	**Value**
06	83(Power Consumption)	01 00 00 00=>00 00 00 01=1 Wh=0.001 kWh	04	80 (Active Power)	01 00 00 00=>00 00 00 01=1 W

2. Switch status change report: report when any switch status changes.

082913		
Channel	**Type**	**Value**
08	29 (Switch Status)	13= 00010011 => L1 changes to on, L2 remains on

5.3 Downlink Commands

WS50x supports downlink commands to configure the device. The application port is 85 by default.

Item	Channel	Type	Description
Switch On/Off	08	-	**Byte 1:** 10 - Switch off L1 11 - Switch on L1 20 - Switch off L2 22 - Switch on L2 30 - Switch off L1 and L2 33 - Switch on L1 and L2 **Byte 2:** ff
Reporting Interval	ff	03	2 Bytes, unit: s
Reboot		10	ff
Add Delay Task		22	**Byte 1:** 00 **Byte 2-3:** delay time, unit: s **Byte 4:** 10 - Switch off L1 11 - Switch on L1 20 - Switch off L2 22 - Switch on L2 30 - Switch off L1 and L2 33 - Switch on L1 and L2 Note: WS50x supports adding only one task. Later command will cover previous command.
Delete Delay Task		23	00ff
Button On/Off Lock		25	0080-disable to turn on/off via button, 0000-enable to turn on/off via button
Power Consumption		26	00-disable, 01-enable
Reset Power Consumption		27	ff

Enquire Electrical Status		28	ff
LED Indicator		2f	00-disable 01-enable (Indicator on when button is off) 02-enable (Indicator on when button is on)
Button Reset Lock		5e	00-enable to reset via button 01-disable to reset via button

Example:

1. Switch off the L1 of WS501 or WS502.

0810ff		
Channel	**Type**	**Command**
08	-	10ff = Switch off L1

2. Set reporting interval as 20 minutes.

ff03b004		
Channel	**Type**	**Value**
ff	03 (Reporting Interval)	b0 04 => 04 b0 = 1200 s = 20 minutes

3. Add a delay task: switch on L1 after 1 minute.

ff32003c002000		
Channel	**Type**	**Value**
ff	22 (Add Delay Task)	Byte 1:00 Byte 2-3: 3c 00 => 00 3c = 60 s = 1 min Byte 4: 11 => Switch on L1

4. Delete the delay task.

ff2300ff		
Channel	**Type**	**Value**
ff	23 (Delete Delay Task)	00ff

5. Disable the collection and upload of power consumption.

ff2600		
Channel	**Type**	**Value**
ff	26 (Power Consumption)	00 = disable

6. Reboot the device.

ff10ff		
Channel	**Type**	**Value**
ff	10 (Reboot)	ff

7. Disable button indicators.

ff2f00		
Channel	**Type**	**Value**
ff	2f (LED Indicator)	00=Disable

-END-