Milesight

WS201

Smart Fill Level Monitoring Sensor

User Guide

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Chapter 1. Preface

Copyright Statement

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Milesight reserves the right to change this guide and the specifications without prior notice. The latest specifications and user documentation for all Milesight products are available on our official website http://www.milesight.com

Safety Instruction

These instructions are intended to ensure that user can use the product correctly to avoid danger or property loss. Milesight will not shoulder responsibility for any loss or damage resulting from not following the instructions of this operating guide.

CAUTION:
Injury or equipment damage may be caused if any of these cautions are neglected.

- The device is not intended to be used as a reference sensor, and Milesight will not should responsibility for any damage which may result from inaccurate readings.
- The device must not be disassembled or 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.
- In order to protect the security of the device, please change device password when first configuration. The default password is 123456.

Revision History

Release Date	Version	Revision Content
March 17, 2023	V1.0	Initial version

Chapter 2. Product Introduction

Overview

WS201 is a wireless fill-level monitoring sensor that securely monitors a small container's fill level especially tissue boxes. Equip with the ToF technology with a high-focusing detecting range, WS201 is best suited for close-range sensing applications with great accuracy. Its ultra-low power consumption and standby mode ensure a durable battery life.

With a special structure design and damp-proof coating, WS201canwork stably in the metal environment and multiple scenarios. Built-in NFC makes it more operable and easy to configure. Compatible with Milesight LoRaWAN® gateway, and Milesight Development Platform, users can know the containers' status and fill level in real-time and manage them effectively and remotely.

WS201 can be widely used for airport, hotel, shopping malls, scenic spot, etc.

Features

- High-focusing detection ranges from 1 to 55 cm with great accuracy based on Time-of-Flight technology
- Non-contact detection with wireless deployment
- Allow reporting the remaining amount by percentage with pre-set alarm thresholds
- Ultra-low power consumption with standby mode, ensuring a durable battery life
- Easy to install with its ultra-compact size and equip with NFC configuration
- Highly adaptive to most tissue boxes with a stable signal
- Damp-proof coating inside the device to ensure it works well in various conditions of bathrooms and other scenarios
- Function well with standard LoRaWAN® gateways and network servers
- Compliant with Milesight IoT Cloud and Milesight Development Platform

Chapter 3. Hardware Introduction

Packing List

1 × WS201 Device

1 × CR2450 Battery

1 × 3M Tape

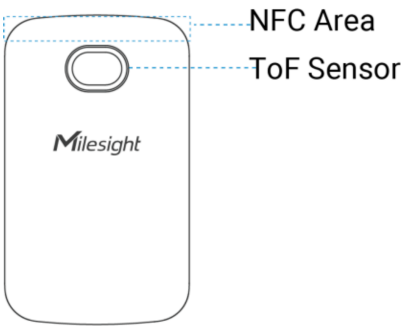
1 × Mirror Cleaning Cloth

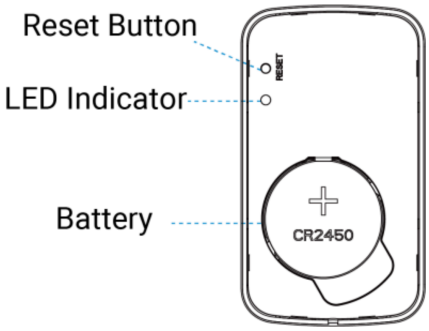
1 × Quick Start Guide

Note:

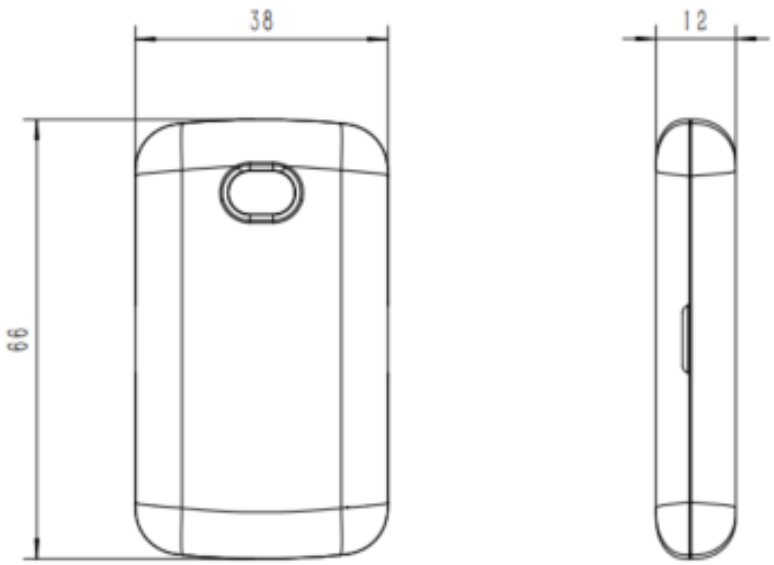
If any of the above items is missing or damaged, please contact your sales representative.

Hardware Overview





Dimension (mm)



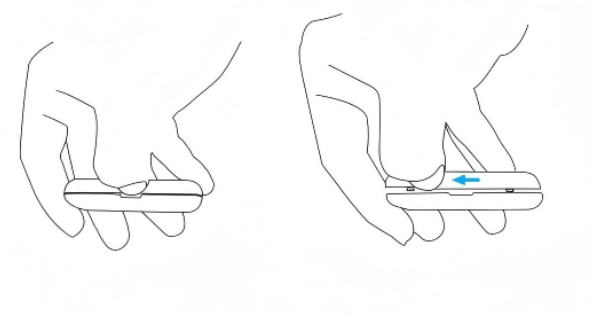
Reset Button & LED Indicator Patterns

The device equips with a reset button inside the device, please remove the cover for emergency reset or reboot. Usually, users can use NFC to complete all steps.

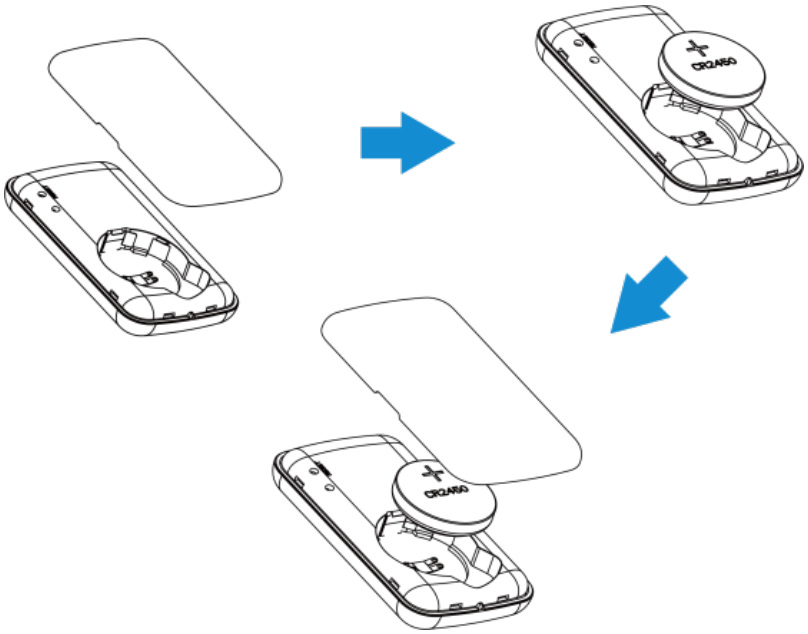
Function	Action	LED Indicator
Reboot	Press and hold the reset button for more than 3 seconds.	Blinks slowly
Reset to Factory Default	Press and hold the button for more than 10 seconds.	Blinks quickly
Check Status	Quickly press the reset button.	Light On: Device is On.
		Light Off: Device is Off.

Chapter 4. Power Supply

1. Insert your fingernail or other tools into the center groove and slide it towards the end, then remove the back cover of the device.



2. Insert the battery into the battery slot with the positive facing up. After inserting, the device will power on automatically.



3. Align the holes on the rear cover with the WS201, and reinstall the cover to the device.

Chapter 5. Quick Start

This chapter describe the steps to quickly configure this device to set up the connection with LoRaWAN® gateway and network server. If you requires more advanced settings, please refer to operation guide chapter.

Access the Sensor via NFC

1. Download and install “Milesight ToolBox” App from Google Play or Apple Store on an NFC-supported smartphone.
2. Enable NFC function on the smartphone.
3. Launch Milesight ToolBox, and select the default mode as NFC.
4. Attach the smart phone with NFC area to the device and click to read device information. Basic information, data, and settings of the device will be shown on the Milesight ToolBox App if it’s recognized successfully.
5. Adjust the settings on the App, then attach the smartphone with NFC area to the device and click **Write** to write the settings. After writing, reread the device to check if the configuration is written well.

Note:

- Ensure the location of smartphone NFC area and it’s recommended to take off phone case.
- If the smart phone fails to read/write configurations via NFC, keep the phone away and back to try again.
- The default device password is 123456. Please change a new password for security.

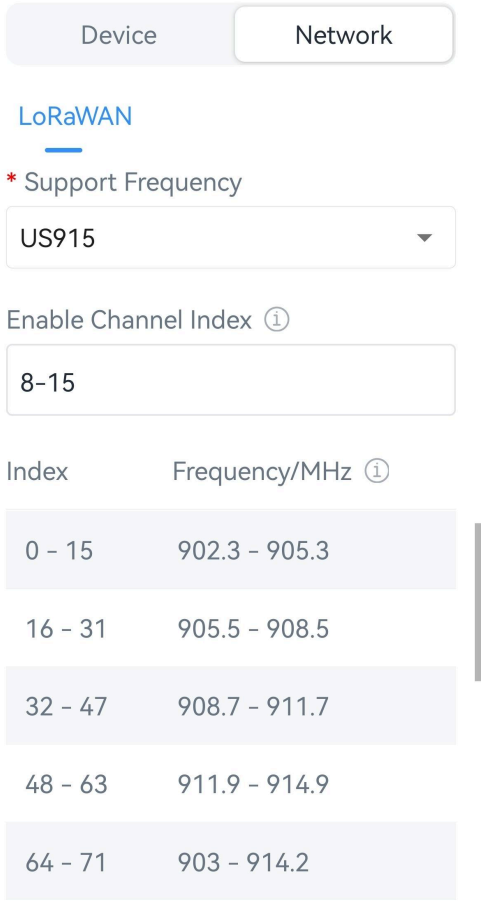
Configure the Network Setting

1. Go to **Network** settings page, select the join type as OTAA or ABP as required.

> **Note:**
> OTAA mode is required if you connect device to Milesight IoT Cloud or Milesight Development Platform.

2. Select supported frequency the same as LoRaWAN® gateway.

> **Note:**
> Set the channel index as 8-15 for US915 or AU915 if using default settings of Milesight gateways.

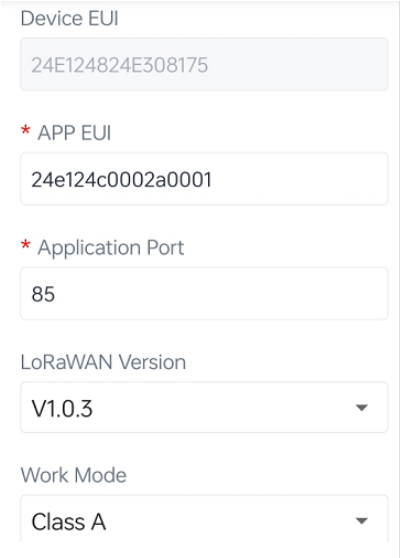


3. Keep other settings by default and click **Write** to save the settings.

Chapter 6. Operation Guide

LoRaWAN® Settings

Configure AppEUI, Join Type, Application Key, and other information. You can also keep all the default settings.

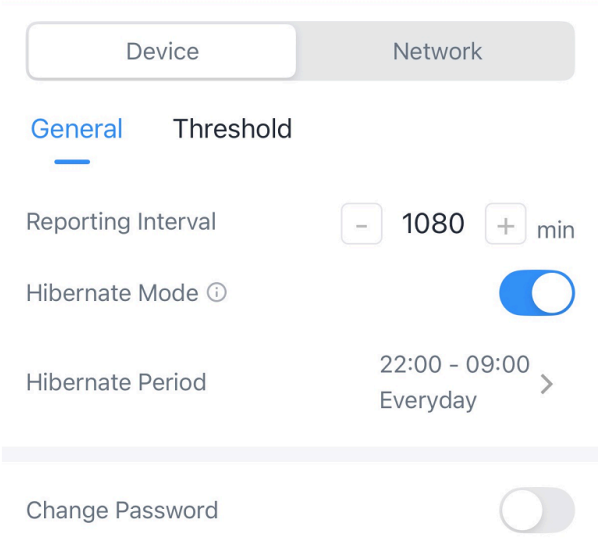


Parameters	Description
Device EUI	Unique ID of the device which can be found on the device. **Note:** please contact sales for device EUI list if you have many units.
App EUI	The default App EUI (join EUI) is 24E124C0002A0001.
Application Port	The port used for sending and receiving data, the default port is 85.
LoRaWAN® Version	V1.0.2 and V1.0.3 are available.
Work Mode	It's fixed as Class A.
Confirmed Mode	If the device does not receive ACK packet from network server, it will resend data once.
Join Type	OTAA and ABP mode are available.

Parameters	Description
	Note: it's necessary to select OTAA mode if connecting device to Milesight IoT Cloud or Milesight Development Platform.
Application Key	Appkey for OTAA mode, default value: "Device EUI" + "Device EUI" (since Q4 of 2025). Example: 24e124123456789024e1241234567890 **Note:** • The default value of earlier devices is 5572404C696E6B4C6F52613230313823. • Please contact sales before purchase if you require random App Keys.
Network Session Key	Nwkskey for ABP mode, the default is 5572404C696E6B4C6F52613230313823.
Application Session Key	Appskey for ABP mode, the default is 5572404C696E6B4C6F52613230313823.
Device Address	DevAddr for ABP mode, default is the 5th to 12th digits of SN.
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 rejoin 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.

Parameters	Description
	Note: 1. Only OTAA mode supports rejoin mode. 2. The actual sending number is **Set the number of packets sent** +1.
Channel Mode	Select **Standard-Channel** mode or **Single-Channel** mode. When **Single-Channel** mode is enabled, only one channel can be selected to send uplinks.
Supported Frequency	Enable or disable the frequency to send uplinks. If frequency is one of CN470/AU915/US915, enter the index of the channel 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: Indicate that all channels are disabled
ADR Mode	Enable or disable network server to adjust Spreading Factor, Bandwidth an Tx Power to optimize data rates, airtime and energy consumption in the network.
Spreading Factor	If ADR mode is disabled, the device will send uplink data following this SF parameter. The higher the spreading factor, the longer the transmission distance, the slower the transmission speed and the more the consumption.
Tx Power	Tx power (transmit power) refers to the strength of the outgoing signal transmitted by the device. This is defined by LoRa alliance.
RX2 Data Rate	RX2 data rate to receive downlinks.
RX2 Frequency	RX2 frequency to receive downlinks. Unit: Hz

General Settings



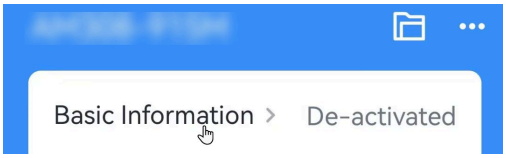
Parameters	Description
Reporting Interval	The time interval for reporting people counting data and battery level to the network server. Default: 1080 min, Range: 60 - 1080 min.
Hibernate Mode	Disable or enable Hibernate mode and configure the Hibernation Period. It will stop detecting and reporting when hibernating.
Hibernate Period	Set hibernation period.
Change Password	Change the password for ToolBox App to write this device.

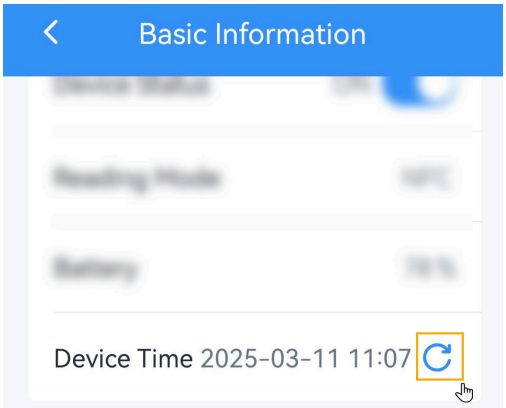
Time Synchronization

This section describes how to sync the time of the device.

Sync via ToolBox App

After reading the device via Milesight ToolBox App, sync the device time with time zone from the smart phone.





Sync via Network Server

This requires to ensure the LoRaWAN® network server supports device time synchronization feature. Example: Milesight gateway embedded NS.

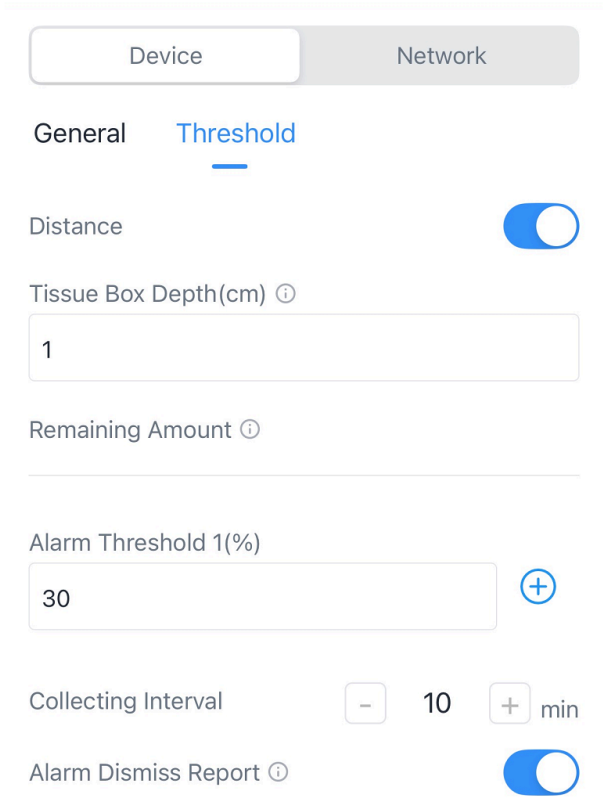
1. Set the LoRaWAN® version of the device to V1.0.3.
2. Connect the device to the network server. After joining the network, the device will send a DeviceTimeReq MAC command to enquire the time from network server.

Note:

- This only supports to get the time but not time zone. The time zone can be configured by ToolBox App or downlink command.
- The device will send the DeviceTimeReq command every 5 days since the last sync.

Threshold Settings

When the difference between Tissue Box Depth and Distance is smaller than the Remaining Amount Alarm Value,the device will report the threshold alarm packet instantly.



Parameters	Description
Tissue Box Depth	The distance value from the bottom of the container to the sensor. Range: 1.0~55.0cm
Remaining Amount	Set the threshold condition. Remaining Amount Alarm Value = Tissue Box Depth * Alarm Threshold
Alarm Threshold	Set the value of alarm threshold, the default value is 30% and two alarm thresholds are the most. Range: the integer from 0 to 100.
Collecting Interval	Collecting interval of ToF sensor detecting the distance. Default: 30min; Range: 1 - 1080min
Alarm Dismiss Report	When the remaining amount changes from outside the threshold to within the threshold, a alarm dismiss packet will be reported.

Maintenance

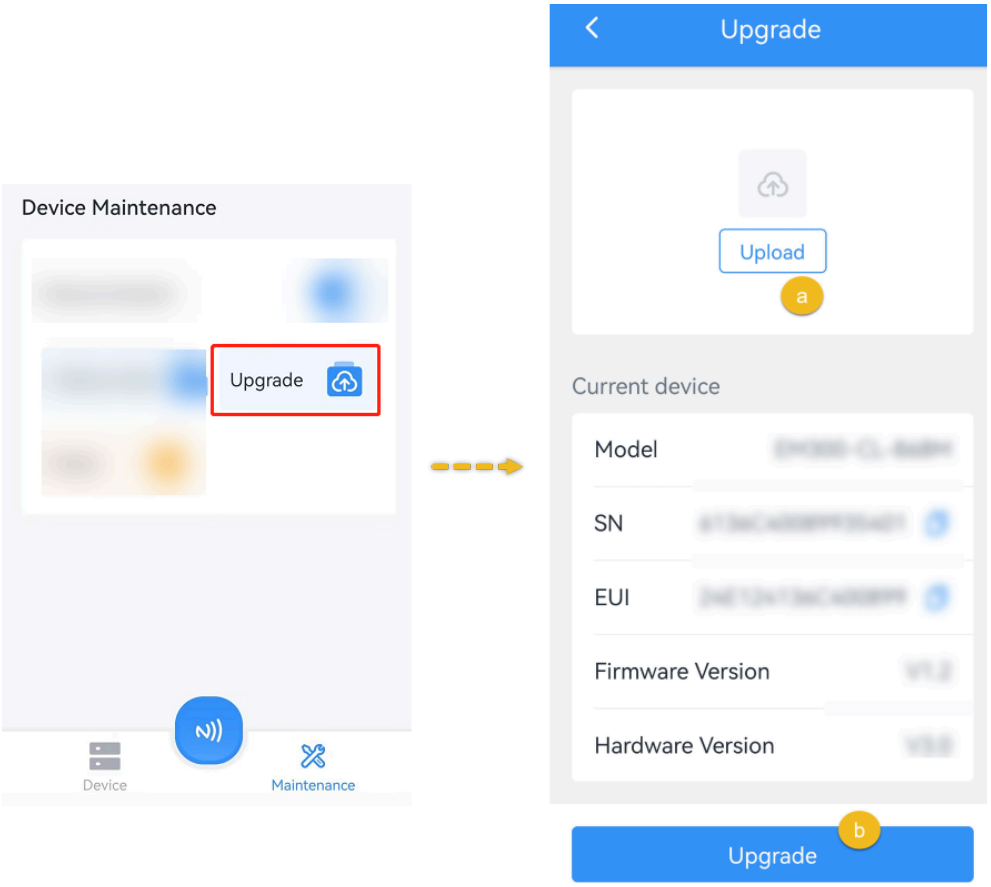
Upgrade

This chapter describes the steps to upgrade the device via ToolBox App.

1. Download firmware from Milesight official website to your smartphone.
2. Read the target device via ToolBox App, click **Upgrade** to upload the firmware file.
3. Click **Upgrade** to upgrade the device.

Note:

- Operation on ToolBox is not supported during an upgrade.
- Only Android version ToolBox supports the upgrade feature.



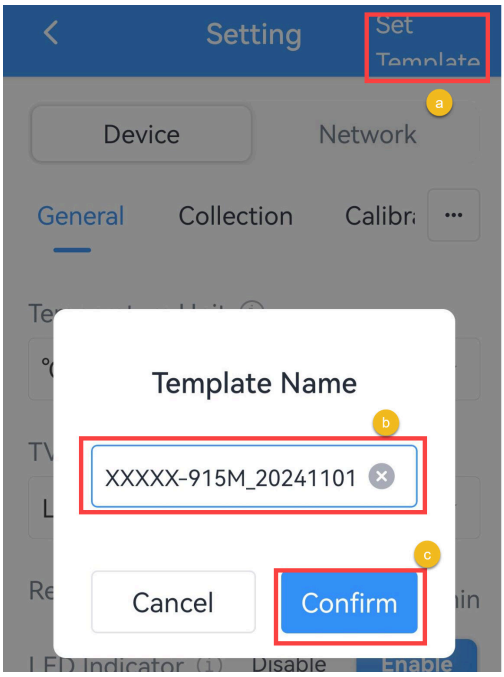
Backup and Restore

This device supports configuration backup for easy and quick device configuration in bulks. Backup and restore is allowed only for devices with the same model and frequency band.

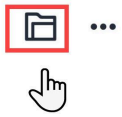
Backup and Restore

1. Launch ToolBox App, attach the NFC area of smartphone to the device to read the configuration.

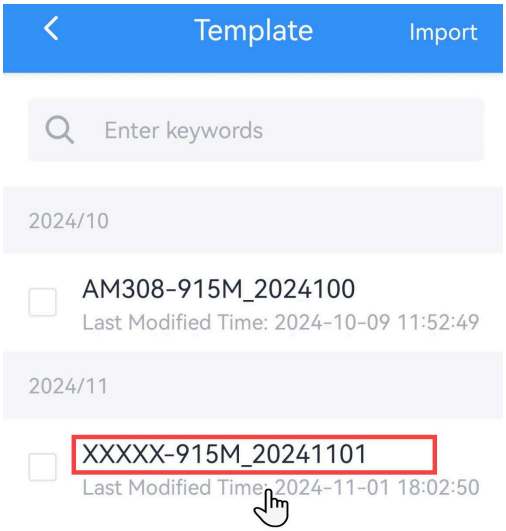
2. Edit the configuration as required, click **Set Template** to save current configuration as a template to the ToolBox App.



3. Go to **Device >Template** page.



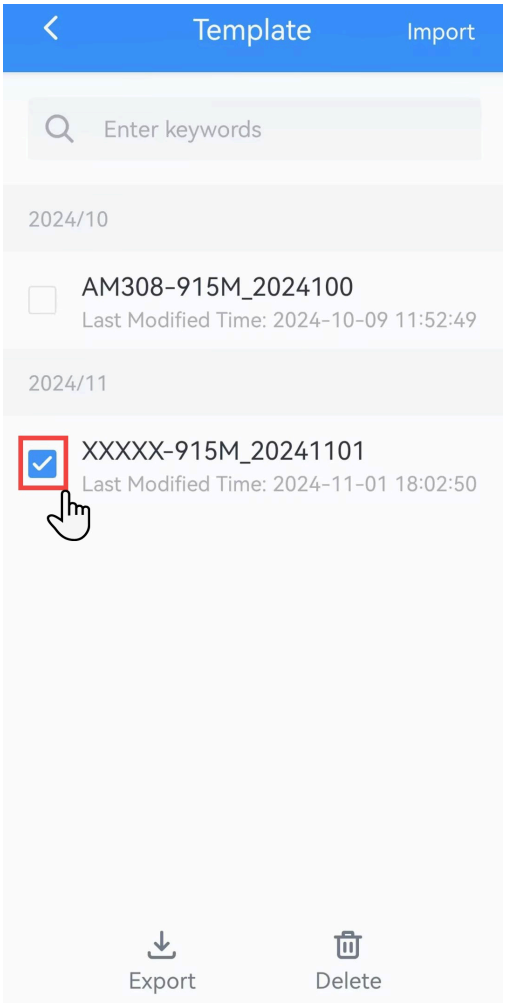
4. Select and click the target template, click **Write** to import the configuration to target devices.



Export and Delete Template

1. Check the box of the target template.

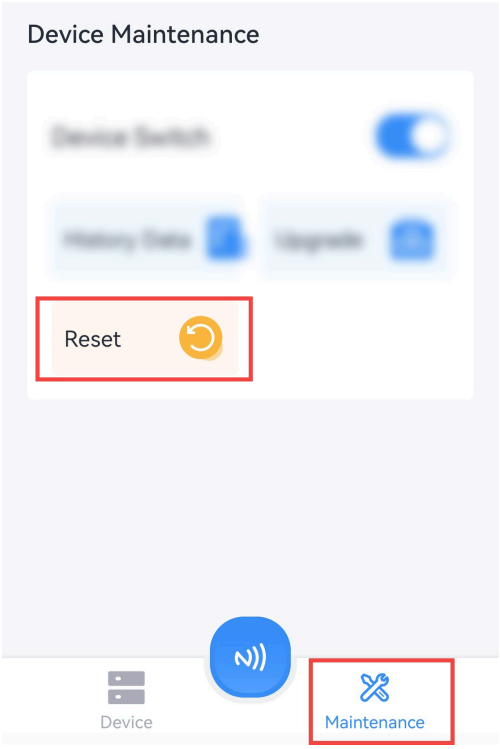
2. Click **Export** to export this template as JSON format file and save it to the smartphone, click **Delete** to delete this template from your ToolBox App.



Reset to Factory Default

Via Hardware: Hold on the reset button for more than 10s until the LED indicator quickly blinks.

Via ToolBox App: Click **Reset** and attach the smartphone to device to reset the device.


Device Maintenance
Reset
Device
Maintenance

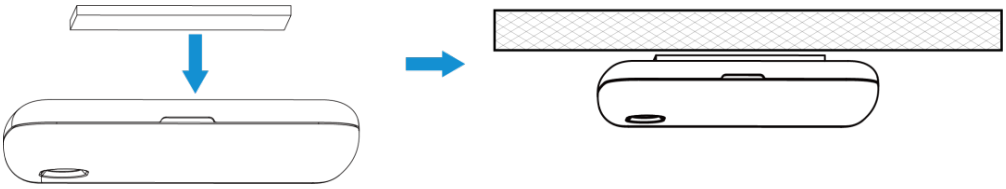
Chapter 7. Installation

Installation preparations and requirements:

- In order to provide the best data transmission, please ensure the device is within the signal range of the LoRaWAN® gateway and keep it away from metal objects and obstacles.
- Avoid strong light, like direct sunlight or IR LED, in the detection area.
- Do not install the device close to glass or mirror.
- Do not touch the lens of the sensor directly to avoid leaving the fingerprint on it.
- The detecting performance will be affected if there's dust on the lens. Please use the mirror cleaning cloth to clean the lens if needed.
- The device must be placed in a horizontal position on the top of the objects so that it has a clear path to the object.
- Prevent the device from water.

Installation Steps:

Paste 3M tape to the back of WS201, then remove the protective layer and place it on a flat surface.



After installation, please remove the protective film.

Chapter 8. Uplink Packets and Downlink Commands

Overview

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

Channel1	Type1	Data1	Channel2	Type2	Data2	Channel3	...
1 Byte	1 Byte	N Bytes	1 Byte	1 Byte	N Bytes	1 Byte	...

For decoder examples please find files on https://github.com/Milesight-IoT/SensorDecoders.

Uplink Packets

Basic Information

The device will report a basic information packet whenever joining the network.

Item	Channel	Type	Byte	Description
Power On	ff	0b	1	Device is on
Protocol Version	ff	01	1	Example: 01=V1
Serial Number	ff	16	8	16 digits
Hardware Version	ff	09	2	Example: 03 10 = V3.1
Software Version	ff	0a	2	01 14 => V1.14
Device Type	ff	0f	1	00: Class A, 01: Class B, 02: Class C, 03: Class C to B

Example:

ff0bff ff0101 ff166791d19604050005 ff090100 ff0a0101 ff0f00		
Channel	**Type**	**Value**
ff	0b	Power On: ff
ff	01	Protocol Version: 01(V1)
ff	16	SN: 6791d19604050005

ff0bff ff0101 ff166791d19604050005 ff090100 ff0a0101 ff0f00		
Channel	**Type**	**Value**
ff	09	Hardware Version: 0100 (V1.0)
ff	0a	Software Version: 0101(V1.1)
ff	0f	Device Type: 00(Class A)

Periodic Report

The device supports the sensor data according to reporting interval.

Item	Channel	Type	Byte	Description
Battery Level	01	75	1	UINT8, Unit: %
Distance	03	82	2	UINT16, Unit: mm
Remaining Amount	04	d6	1	UINT8, Unit: %, ff=threshold setting disabled

Examples:

Report as reporting interval (1080 minutes by default).

017562 03821b00 04d62e		
Channel	**Type**	**Value**
01	75	Battery Level: 62=>98%
03	82	Distance: 1b 00 => 00 1b => 27mm
04	d6	Remaining Amount: 2e => 46%

Alarm Report

The device supports to report below types of alarm report packets.

Item	Channel	Type	Byte	Description
Distance	03	82	2	UINT16, Unit: mm
Remaining Amount	04	d6	1	UINT8, Unit: %, ff=threshold setting disabled

Example:

Threshold alarm packet: report when the counting value reaches the threshold.

03821800 04d614		
Channel	**Type**	**Value**
03	82	Distance: 18 00 => 00 18 => 24mm
04	d6	Remaining Amount: 14 => 20%

Downlink Commands

This device supports downlink commands for configuration and control. The downlink application port is 85 by default.

General Setting

Item	Channel	Type	Byte	Description
Reboot	ff	10	1	ff
Collecting Interval	ff	02	2	UNIT16, Unit: s
Reporting Interval	ff	03	2	UNIT16, Unit: s
Tissue Box Depth	ff	76	2	Unit: min
Hibernate Period	ff	75	6	Byte 1: 00-disable, 01-enable Byte 2-3: Start Time Byte 4-5: End Time Byte 6: Bit0=1 Bit7~Bit1: Sunday~Monday

Example:

1. Reboot the device.

```
ff10ff
```

2. Set reporting interval as 70 minutes.

ff036810		
Channel	**Type**	**Value**
ff	03	68 10 => 10 68 = 4200s = 70 minutes

3. Enable hibernate mode and set the time period as 8:00-21:00 from Monday to Sunday.

ff75 01 e001 ec04 ff		
Channel	**Type**	**Value**
ff	75	01=> Enable hibernate mode e0 01 => 01 e0 = 480 minutes = 8 hours = 8:00 ec 04 => 04 ec = 1260minutes =21 hours = 21:00 ff = 1111 1111 = Enable hibernate mode from Monday to Sunday

4. Set Tissue Box Depth as 500mm.

ff76 f401		
Channel	**Type**	**Value**
ff	76	f4 01=> 01 f4 => 500mm

Alarm Setting

Item	Channel	Type	Byte	Description
Threshold Alarm	ff	06	9	Byte 1: **Bit0~Bit2:** 000 **Bit3~Bit5:** 001=Alarm Threshold 1 010=Alarm Threshold 2

Item	Channel	Type	Byte	Description
				Bit6: 0-disable the Alarm Threshold 1-enable the Alarm Threshold **Bit7:** 0-disable alarm dismiss report 1-enable alarm dismiss report Byte 2-3: 0000 Byte 4-5: Max. value Byte 6-9: 00000000

Example:

Enable alarm threshold 1, enable alarm dismiss report and set the value of alarm threshold 1 to 50%.

ff06 c8 0000 3200 00000000		
Channel	**Type**	**Value**
ff	06	c8 => 11 001 000: 11= enable alarm dismiss report and enable alarm threshold; 001 = Alarm Threshold 1 Max. value: 32 00 => 00 32 => 50%

Chapter 9. Services

Milesight provides customers with timely and comprehensive technical support services. End-users can contact your local dealer to obtain technical support. Distributors and resellers can contact directly with Milesight for technical support.

Technical Support Mailbox: iot.support@milesight.com

Online Support Portal: https://support.milesight-iot.com

Resource Download Center: https://www.milesight.com/iot/resources/download-center/

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