Milesight

Smart Fill Level Monitoring Sensor

Featuring LoRaWAN®

WS201

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 disassembled or remodeled in any way.
- To ensure the security of your device, please change the device password during the initial configuration. The default password is 123456.
- 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 inverse or wrong model.
- The device must never be subjected to shocks or impacts.

Declaration of Conformity

WS201 conforms with the essential requirements and other relevant provisions of the CE, FCC, and RoHS.

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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
March 17, 2023	V 1.0	Initial version

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1. Product Introduction

1.1. 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.

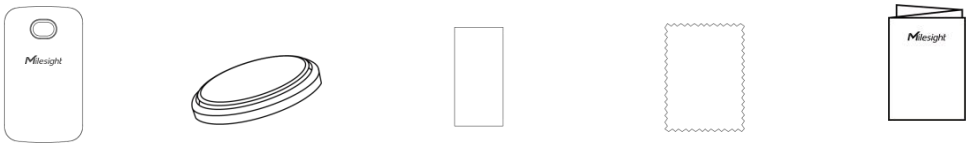
With a special structure design and damp-proof coating, WS201 can work stably in the metal environment and multiple scenarios. Built-in NFC makes it more operable and easy to configure. Compatible with Milesight LoRaWAN® gateway and IoT Cloud solution, users can know the containers' status and fill level in real-time and manage them effectively and remotely.

1.2. 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 equipped 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 bathrooms and other scenarios
- Function well with standard LoRaWAN® gateway and network servers
- Compliant with Milesight IoT Cloud

2. Hardware Introduction

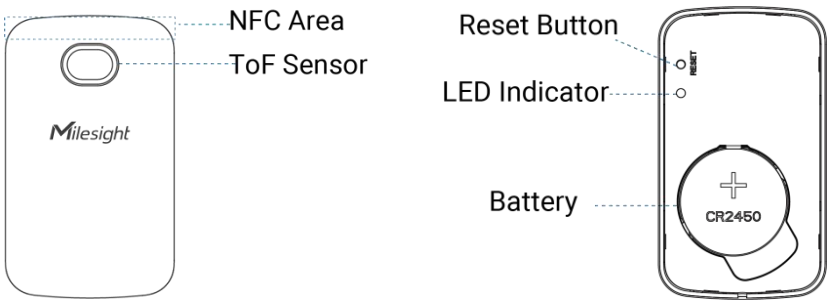
2.1. Packing List



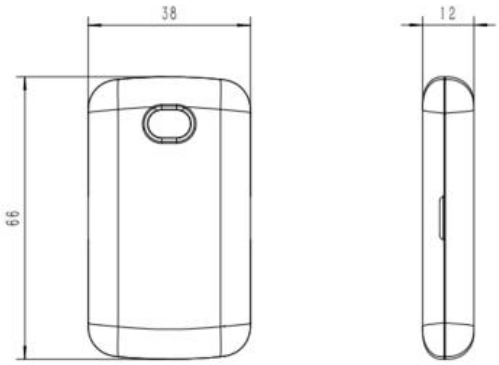
1 × WS201 Device	1 × CR2450 Battery	1 × 3M Tape	1 × Mirror Cleaning Cloth	1 × Quick Start Guide

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

2.2. Hardware Overview



2.3. Dimensions (mm)



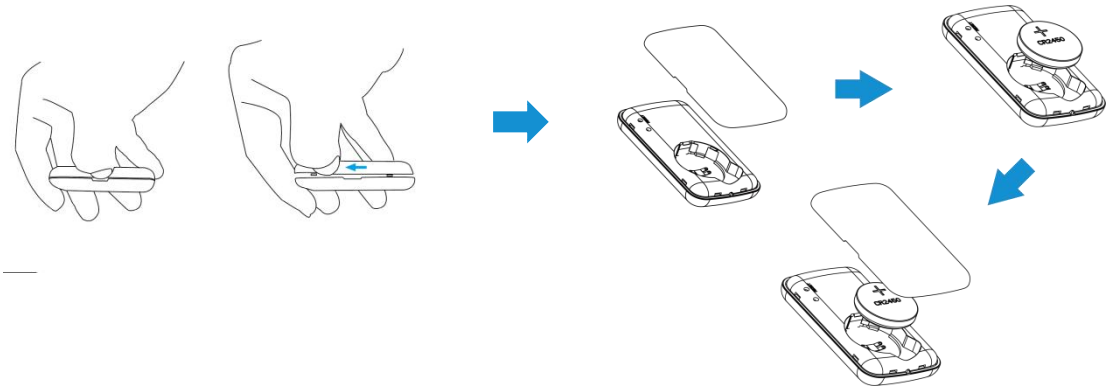
2.4. Reset Button & LED Indicator Patterns

WS201 sensor 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 On/Off Status	Quickly press the reset button.	Light On: Device is On.
		Light Off: Device is Off.

3. 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.



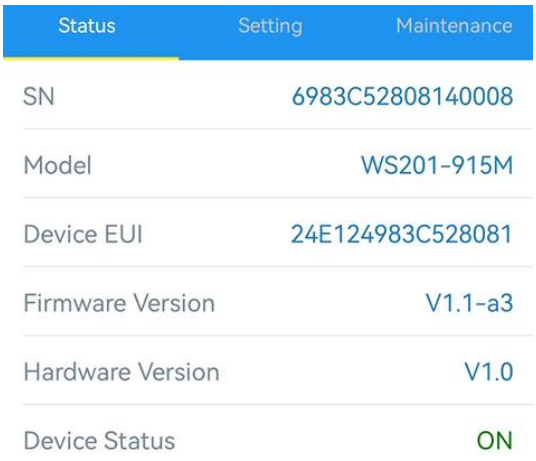
4. Operation Guide

4.1. NFC Configuration

WS201 can be configured via NFC.

1. Download and install “Milesight ToolBox” App from Google Play or App Store.
2. Enable NFC on the smartphone and open “Milesight ToolBox” App.
3. Attach the smartphone with the NFC area to the device to read the basic information.

4. Basic information and settings of devices will be shown on ToolBox if it’s recognized successfully. You can read and write the device by tapping the button on the App. Password validation is required when configuring devices via an unused phone to ensure security. The default password is **123456**.

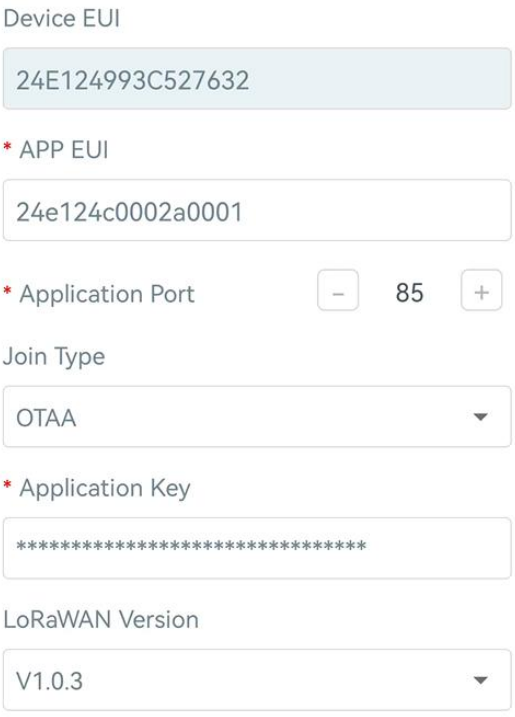


Note:

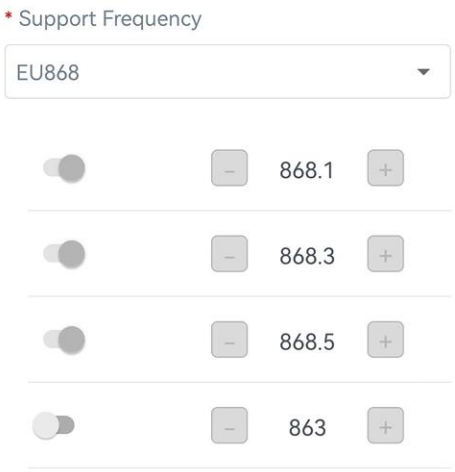
1) Ensure the location of the smartphone NFC area and it's recommended to take off the phone case.
2) If the smartphone fails to read/write configurations via NFC, move it away and try again later.
3) WS201 can also be configured by a dedicated NFC reader provided by Milesight IoT.

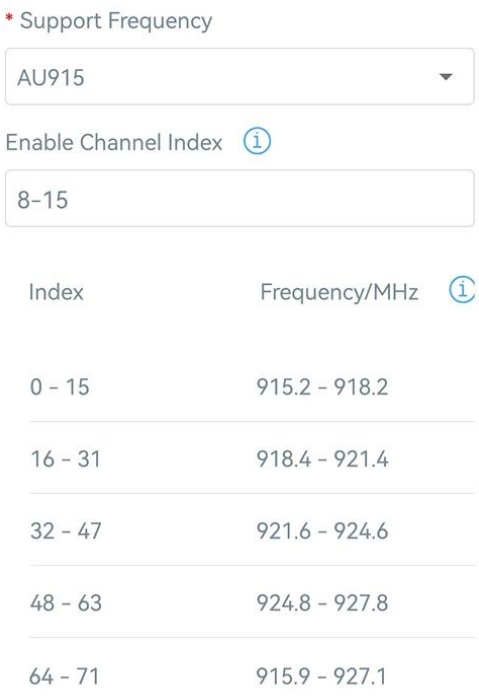
4.2. LoRaWAN Settings

Go to **Device > Setting > LoRaWAN Settings** of ToolBox App to configure join type, App EUI, App Key and other information. You can also keep all settings by default.



Parameters	Description
Device EUI	The device's unique ID 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 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.
LoRaWAN Version	V1.0.2 and V1.0.3 are available.
Work Mode	It's fixed as Class A.
RX2 Data Rate	RX2 data rate to receive downlinks.
RX2 Frequency	RX2 frequency to receive downlinks. Unit: Hz
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. Please enable Single-Channel mode if you connect the device to DS7610 IoT Display.
Channel	Enable or disable the frequency to send uplinks.  If the frequency is one of CN470/AU915/US915, enter the index of the channel that you want to enable and make them separated by commas. **Examples:** 1, 40: Enabling Channel 1 and Channel 40 1-40: Enabling Channel 1 to Channel 40 1-40, 60: Enabling Channel 1 to Channel 40 and Channel 60 All: Enabling all channels Null: Indicates that all channels are disabled

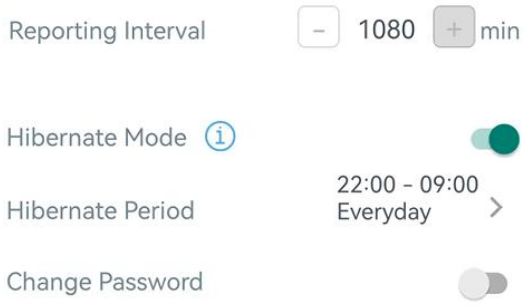
	
Spread Factor	If ADR is disabled, the device will send data via this spread factor.
Confirmed Mode	If the device does not receive an ACK packet from the network server, it will resend data once.
Rejoin Mode	Reporting interval ≤ 30 mins: the device will send a specific number of LinkCheckReq MAC packets to the network server every 30 mins to validate connectivity; if there is no response, the device will rejoin 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 rejoin 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. This only works with Standard Channel Mode.
Tx Power	Transmit power of the device.

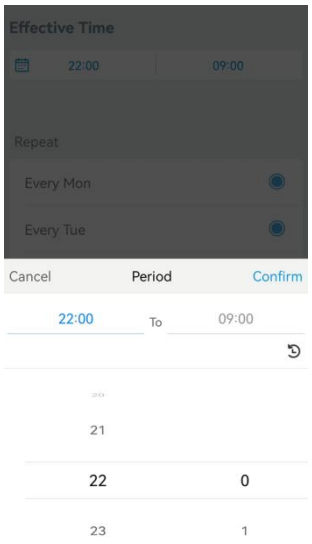
Note:

1) Please contact sales for the 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. Basic Settings

Go to **Device > Setting > General Settings** to change the reporting interval, etc.

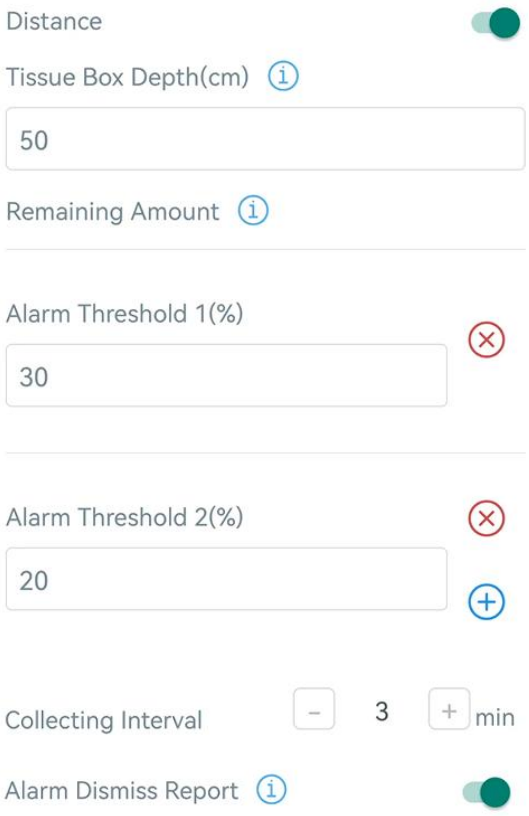


Parameters	Description
Reporting Interval	Reporting interval of transmitting data to the network server. Range: 60~1080 mins; Default: 1080 mins
Hibernate Mode	Enable or disable hibernate mode. When the feature is enabled, the device will hibernate during the hibernate period and the sensor will not detect distance and not reports.
Hibernate Period	Set the time period and repeated frequency of hibernate mode. 
Change Password	Change the password for ToolBox app or software to read/write this device.

4.4. Threshold Settings

Go to **Device > Settings > Threshold Settings** to enable the threshold settings. When the difference between Tissue Box Depth and Distance is smaller than the Remaining Amount Alarm

Value, WS201 will report the alarm.



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.

4.5. Maintenance

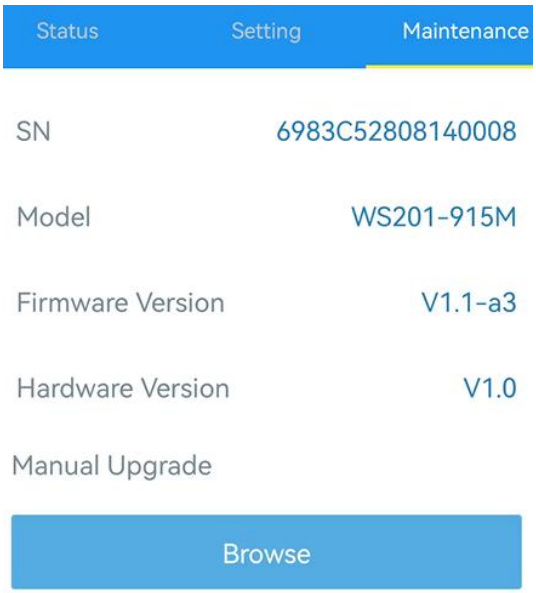
4.5.1. Upgrade

1. Download firmware from Milesight website to your smartphone.

2. Open Toolbox App, go to **Device > Maintenance** and click **Browse** to import firmware and upgrade the device.

Note:

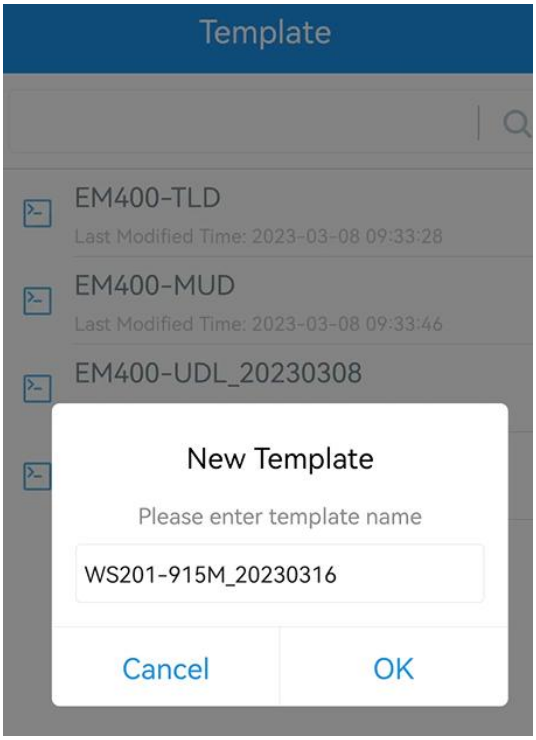
1) Operation on ToolBox is not supported during a firmware upgrade.
2) Only the Android version of ToolBox supports the upgrade feature.



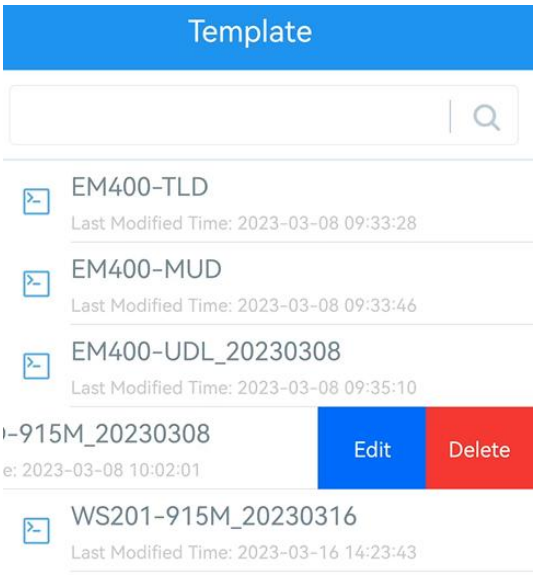
4.5.2. Backup

WS201 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. Go to **Template** page on the App and save the current settings as a template. You can also edit the template file.
2. Select one template file saved in the smartphone and click **Write**, then attach the smartphone to another device to write the configuration.



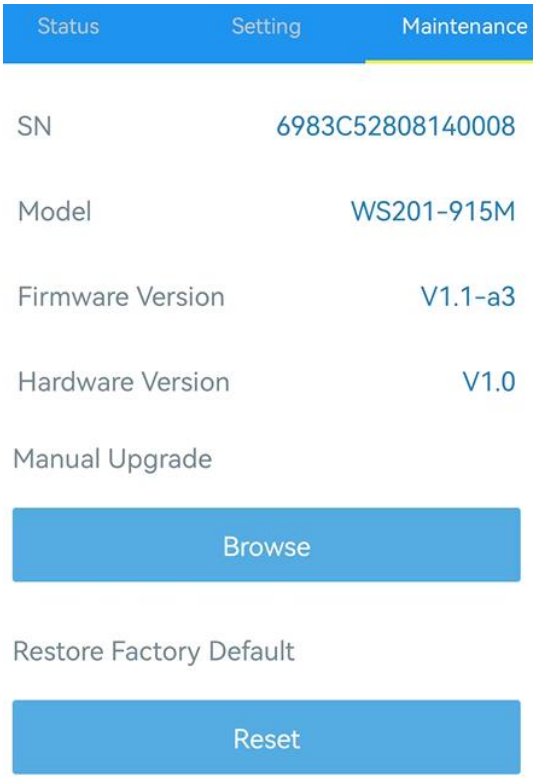
Note: Slide the template item left to edit or delete the template. Click the template to edit the configurations.



4.5.3. Reset to Factory Default

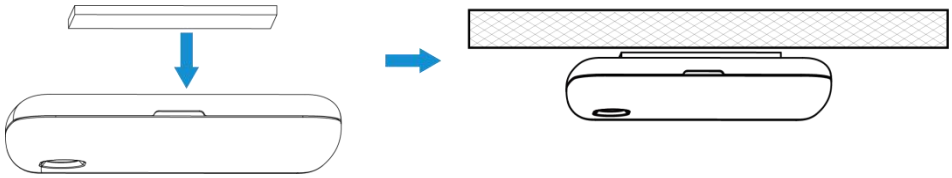
Please select one of the following methods to reset the device:

Via Hardware: Hold on the reset button (internal) for more than 10s.
Via ToolBox App: Go to **Device > Maintenance** to click **Reset**, then attach the smartphone with NFC area to the device to complete the reset.



5. Installation

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



Installation Note

- 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.
- After installation, please remove the protective film.
- 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.

6. 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	...

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

6.1. Basic Information

WS201 reports basic information about the sensor every time it joins the network.

Channel	Type	Description
ff	01(Protocol Version)	01=>V1
	09 (Hardware Version)	01 40 => V1.4
	0a (Software Version)	01 14 => V1.14
	0b (Power On)	Device is on
	0f (Device Type)	00: Class A, 01: Class B, 02: Class C
	16 (Device SN)	16 digits

Example:

ff0bff ff0101 ff166983c52121810000 ff090100 ff0a0101 ff0f00

Channel	Type	Value	Channel	Type	Value
ff	0b (Power On)	ff (Reserved)	ff	01 (Protocol Version)	01 (V1)
Channel	**Type**	**Value**	**Channel**	**Type**	**Value**
ff	16 (Device SN)	6983c52121 810000	ff	09 (Hardware version)	0100 (V1.0)
Channel	**Type**	**Value**	**Channel**	**Type**	**Value**
ff	0a (Software version)	0101 (V1.1)	ff	0f (Device Type)	00 (Class A)

6.2. Sensor Data

WS201 reports sensor data according to reporting interval (1080 mins by default).

Channel	Type	Description
01	75 (Battery Level)	UINT8, Unit: %
03	82 (Distance)	INT16, Unit: mm
04	d6 (Remaining)	UINT8 Note: if the threshold setting is disabled, the

		device will report this as FF.

Example:

1. Periodic Packet

017564 03821b00 04d62e					
Channel	**Type**	**Value**	**Channel**	**Type**	**Value**
01	75 (Battery)	64 => 100%	03	82 (Distance)	1b 00 => 00 1b => 27mm
Channel	**Type**	**Value**	**Channel**	**Type**	**Value**
04	d6 (Remaining Amount)	2e => 46%			

2. Threshold Alarm Packet

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

6.3. Downlink Commands

WS201 supports downlink commands to configure the device. The application port is 85 by default.

Channel	Type	Description
ff	10 (Reboot)	ff (Reserved)
	03 (Set Reporting Interval)	2 Bytes, unit: s
	02 (Set Collecting Interval)	2 Bytes, unit: s
	06 (Set Threshold Alarm)	9 Bytes, CTRL(1B)+0000(2B)+Max(2B)+00000000(4B) CTRL: Bit2~Bit0=000 Bit5~Bit3: Alarm Threshold 001=Alarm Threshold 1 010=Alarm Threshold 2 Bit6: 0=disable the Alarm Threshold 1=enable the Alarm Threshold

		Bit7: 0=disable alarm dismiss report 1=enable alarm dismiss report
	76 (Set Tissue Box Depth)	2 Bytes, unit: mm
	75 (Set Hibernate Period)	6 Bytes, Enable(1B)+Start_Time(2B)+Over_Time(2B)+ Week_Day(1B) Week_Day: CTRL Bit0=1 Bit7~Bit1: Sunday~Monday

Example:

1. Set reporting interval as 70 minutes.

ff036810		
Channel	**Type**	**Value**
ff	03 (Set Reporting Interval)	68 10 => 10 68 = 4200s = 70 minutes

2. Reboot the device.

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

3. 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 (Set Threshold Alarm)	CTRL = c8 = 11 001 000 11= enable alarm dismiss report and enable alarm threshold 001 = Alarm Threshold 1 32 00 => 00 32 => 50%

4. Set Tissue Box Depth as 500mm.

ff76 f401

Channel	Type	Value
ff	76 (Set Tissue Box Depth)	f4 01=> 01 f4 => 500mm

5. 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 (Set Hibernate Period)	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

-END-