



EM500-SWL User Guide



Safety Precautions

Ursalink 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.
- ❖ Please clarify your application environment before deployment, in case the device can function well.
- ❖ The device is not intended to be used as a reference sensor, and Ursalink will not should responsibility for any damage which may result from inaccurate readings.
- ❖ Do not place the device cable close to objects with naked flames.
- ❖ Do not place the device, cable and sensor where the temperature is below/above the operating range.
- ❖ Make sure electronic components do not drop out of the enclosure while opening.
- ❖ When closing the lid, make sure the lid is fitted the right way, so that the enclosure is properly sealed.
- ❖ When installing the battery, please install it accurately, and do not install the reverse or wrong model.
- ❖ The device must never be subjected to shocks or impacts.

Declaration of Conformity

Ursalink EM500-SWL is in conformity with the essential requirements and other relevant provisions of the CE, FCC, and RoHS.



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Revision History

Date	Doc Version	Description
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Sept. 16, 2020	V 1.1	Document structure change

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1. Overview

1.1 Description

EM500-SWL is an outdoor environment monitoring sensor mainly used to measure liquid level data through wireless LoRa network. EM500-SWL device is battery powered and designed for multiple mounting ways. It is equipped with NFC (Near Field Communication) and can easily be configured by a smartphone or a PC software.

Sensor data are transmitted in real-time using standard LoRaWAN protocol. LoRaWAN enables encrypted radio transmissions over long distance while consuming very little power. The user can obtain sensor data and view the trend of data change through Ursalink Cloud or through the user's own Network Server.

1.2 Features

- Large measurement range for liquid level measurement
- Up to 11km communication range
- Easy configuration via NFC
- Standard LoRaWAN support
- Ursalink Cloud compliant
- Low power consumption with 19000mAh replaceable battery

1.3 Specifications

LoRaWAN	
Frequency	EU433/CN470/IN865/RU864/EU868/US915/AU915/KR920/AS923
Tx Power	20dBm
Sensitivity	-147dBm @300bps
Mode	OTAA/ABP Class A
Antenna	Embedded Ceramic Antenna
Temperature Measurement	
Pressure Type	Gauge Pressure
Range	EM500-SWL-W003: 3m H ₂ O EM500-SWL-W005: 5m H ₂ O EM500-SWL-W010: 10m H ₂ O (Customizable up to 200m and for other liquid)
Accuracy	± 0.5% FS
Physical Characteristics	
Cable Length	At least should be 1-1.5m longer than measuring range

Power Supply	19000 mAh Li-SoCl ₂ battery
Battery Life	4.5 year (10 min interval, SF12) >10 year (10 min interval, SF7)
Operating Temperature	Transceiver: -30°C to +70°C Pressure Sensor: -10°C to +60°C
Relative Humidity	0% to 100% (non-condensing)
Dimension	Transceiver: 105.4 × 71 × 69.5 mm (Waterproof connector is not included) Level Sensor: 122 × φ26 mm
Mounting	Pole, wall, DIN rail

2. Hardware Introduction

2.1 Packing List



1 × EM500-SWL

(Include sensor)



2 × Mounting

Screws



1 × Hose

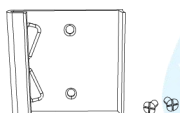
Clamp



1 × Warranty Card



1 × Quick Guide



1 × DIN Rail (Optional)



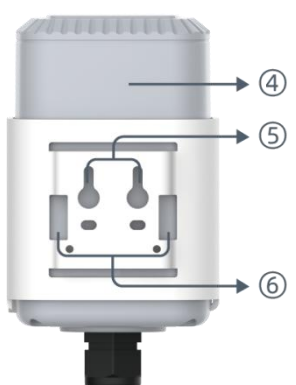
If any of the above items is missing or damaged, please contact your Ursalink sales representative.

2.2 Transceiver Overview



Front View:

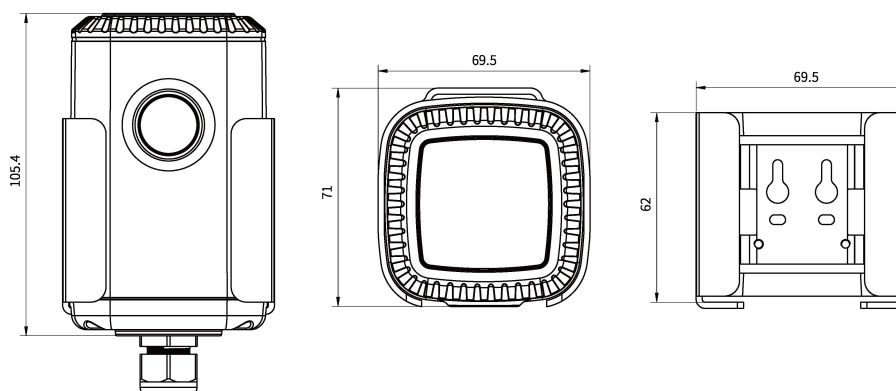
- ① LoRa Antenna (Internal)
- ② NFC Area
- ③ Water-proof Connector with Vent



Back View:

- ④ Battery (Internal)
- ⑤ Wall Mounting Holes
- ⑥ Pole Mounting Holes

2.3 Dimensions(mm)

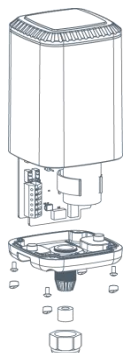


3. Assembly and Preparation

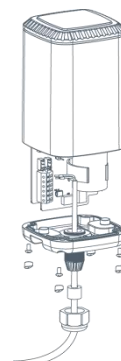
3.1 Sensor Assembly

Follow the steps below to connect light sensor cable to EM500 transceiver if they are separated.

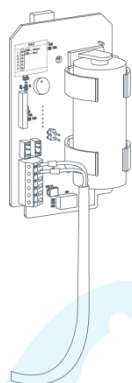
1. Take off the mounting bracket, remove the cap, rubber seal and the screws on the bottom of the device, and then take off the enclosure cover.



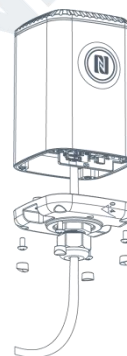
2. Pass the cable through the cap, rubber seal and the enclosure cover.



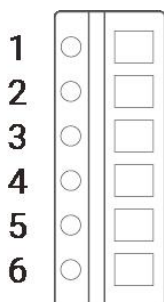
3. Pull out the motherboard, insert and lock the wires accordingly (see the label on the motherboard or following picture).



4. Put the motherboard back and restore everything in its due position.



Pinouts:

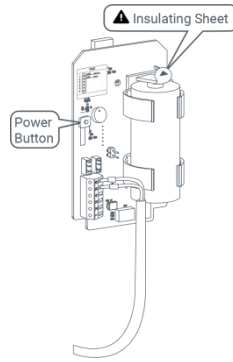


PIN	Color	Description
1	Red	GND
2	--	--
3	---	--
4	White	B
5	Yellow	A
6	Black	VOUT=12V

3.2 Insulating Sheet Disassembly

Pull out the insulating sheet on the side of the battery and check if electrode of the battery is reversed.

Note: Refer to [Chapter 4](#) to check if EM500 can be turned on via power button.



4. Turn ON/OFF and Reset (Power Button)

! The LED indicator is inside the device. EM500-SWL can also be turned on/off and reset via Mobile APP or Toolbox.

Function	Action	LED Indication
Turn On	Press and hold the button for more than 3 seconds.	Off → Static Green
Turn Off	Press and hold the button for more than 3 seconds.	Static Green -> Off
Reset	Press and hold the button for more than 10 seconds. Note: EM500 will automatically power on after reset.	Blink 3 times.
Check On/Off Status	Quickly press the power button.	Light On: Device is on.
		Light Off: Device is off.

5. Sensor Configuration

Ursalink EM500-SWL sensor can be monitored and configured via one of the following methods:

- Mobile APP (NFC);
- Windows software (NFC or Type-C port).

In order to protect the security of sensor, password validation is required when first configuration. Default password is **123456**.

5.1 Configuration via Smartphone APP

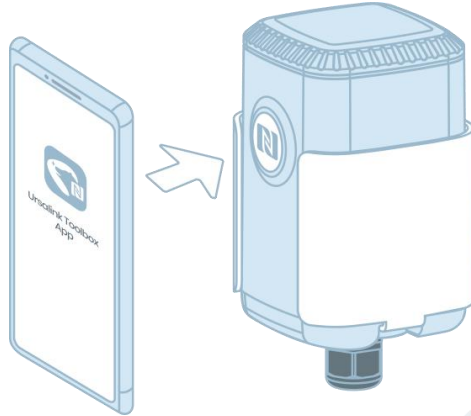
Preparation:

- Smartphone (NFC supported)
- Toolbox APP: APP can be downloaded on Google Play or Apple Store.

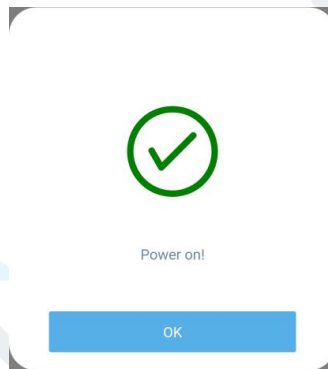
5.1.1 Read/Write Configuration via NFC

1. Enable NFC on the smartphone and open "Toolbox" APP.
2. Attach the smartphone with NFC area to the device to read basic information.

Note: Ensure your smartphone NFC area and it is recommended to take off phone case before using NFC.



3. Click "Write" to change the configuration of EM500 and attach the smartphone with NFC area to the device until the APP shows a successful prompt.



4. Go to "Device" > "Status" and click "Read" and attach the smartphone with NFC area to the device to read real-time data of sensor.

Status	Setting	Upgrade
SN	6126A10745740084	
Model	EM500-SWL-W003-865	
Device EUI	24e124126a107457	
Firmware Version	V1.2	
Hardware Version	V1.0	
Device Status	ON <input checked="" type="checkbox"/>	
Join Status	Activated	
RSSI/SNR	-47/14	
Liquid Level (Water)	2.03 m	
Battery	100 %	
Channel Mask	0007	
Uplink Frame Counter	1354	

Read

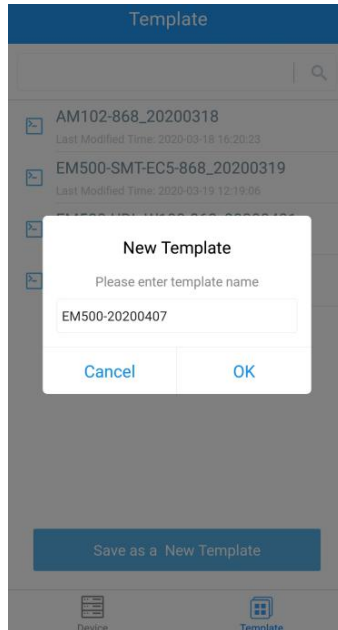
Device
Template

5.1.2 Template Configuration

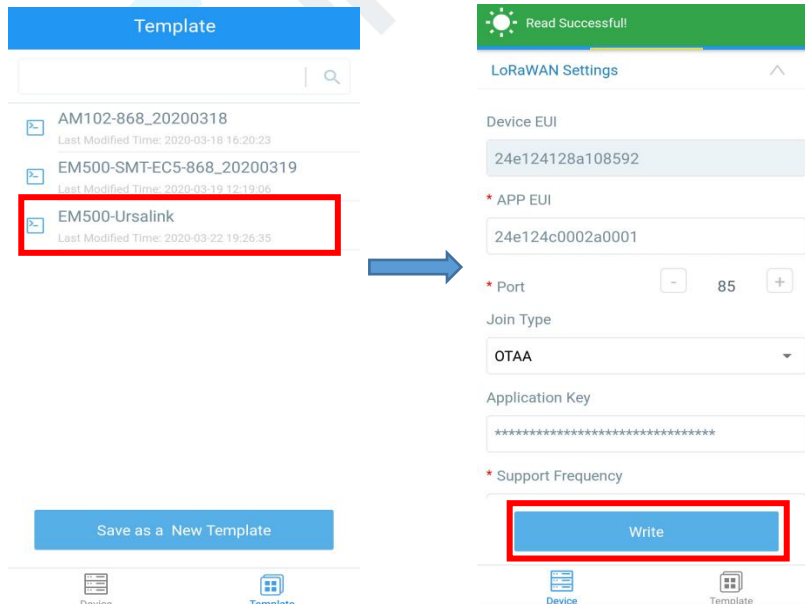
Template settings are used for easy and quick device configuration in bulk.

Note: Template function is allowed only for sensors with the same model and LoRa frequency band.

1. Go to “Template” page on the APP and save current settings as a template.



2. Attach the smartphone with NFC area to another device.
3. Select the template file from Toolbox APP and tap “Write”.



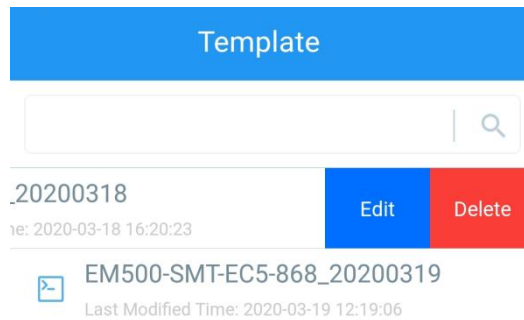
4. Keep the two devices close until the APP shows a successful prompt.



Write successfully!

OK

- Slide the template item to the left to edit or delete the template.



5.2 Configuration via PC

Preparation:

- Dedicated NFC Reader or Type-C USB cable
- PC (Windows 10 is recommended)
- Toolbox: <https://www.ursalink.com/en/software-download/>

5.2.1 Log in the Toolbox

Make sure “Toolbox” is downloaded on your computer. Select one of the following methods to log in Toolbox.

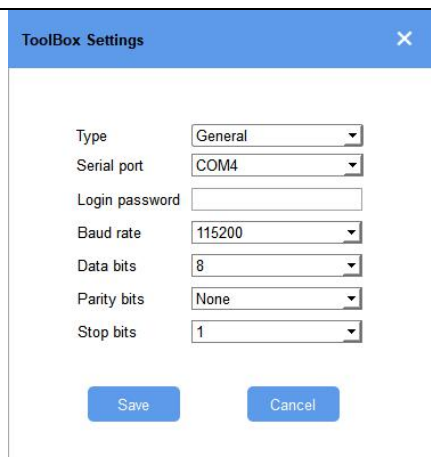
Type-C Connection

- Connect the EM500-SWL to computer via type-C port.



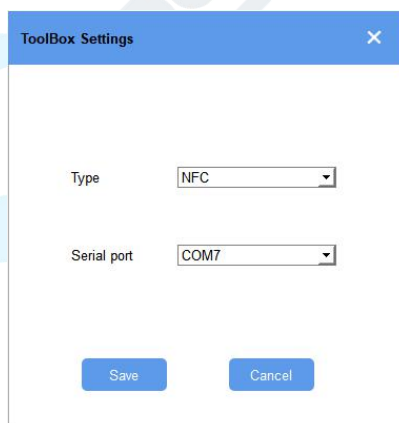
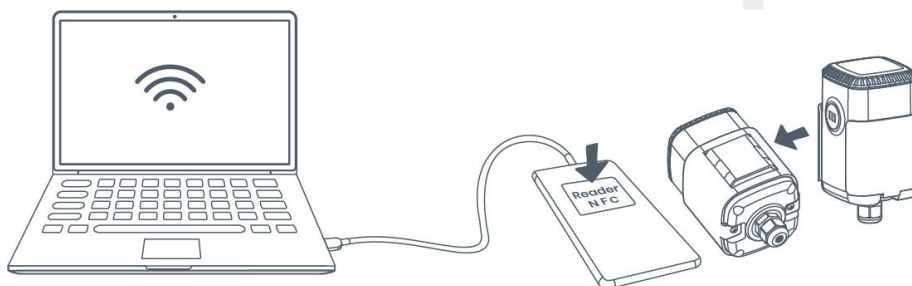
Type-C port is inside the transceiver of the EM500-SWL.

- Select type as “General” and click password to log in Toolbox. (Default password: 123456)



NFC Connection

1. Connect the NFC reader to computer, then attach the EM500-SWL to NFC area of the reader.
2. Select type as "NFC" and serial port as NFC reader port on Toolbox.



5.2.2 Basic Configuration

1. Click "Read" to read current data of the sensor.



2. When you perform one of the following operations, type the password and click “Enter”, then wait a few seconds until toolbox shows a successful prompt. (Password is not needed if you connect it via type-C port)

- Turn on/off the sensor
- Reset the sensor
- Click “Write” to change settings
- Upgrade

LoRaWAN > Read Write

Basic **Channel**

Device EUI: 24E124128A215862

Verify Password [X]

Password: [.....] [X]

Enter

Please put the NFC antenna close to the NFC reader.

Regular Report Confirmed ?

ADR Mode

Save

Downlink Frame-counter: 1

Success Firmware Version: 01.01

5.2.3 Template Settings

Note: Template function is allowed only for sensors with the same model and LoRa frequency band.

1. Go to “Maintenance -> Template and Reset” page in Toolbox.
2. Click “Export” to save the current settings as a template.
3. Click “Browse” to select the correct template from computer.
4. Click “Import” to import the template to the device.



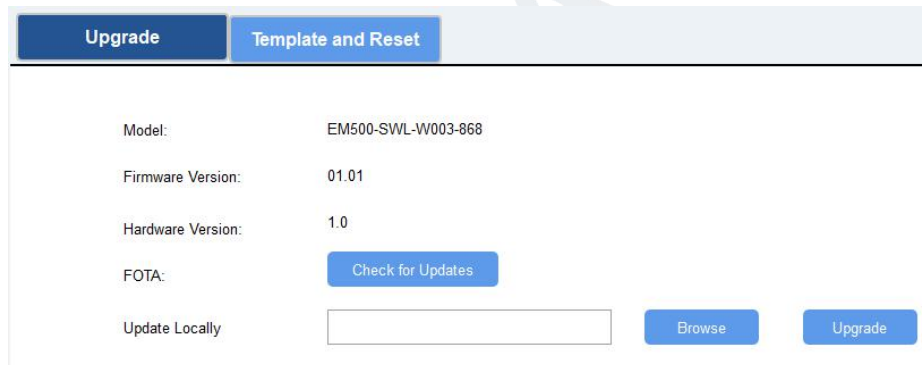
The screenshot shows the 'Template and Reset' tab. It contains three rows of controls:

- Template:** A label followed by an 'Export' button.
- Config File:** A text input field, a 'Browse' button, and an 'Import' button.
- Restore Factory Defaults:** A label followed by a 'Reset' button.

5.2.4 Upgrade

1. Download firmware on your computer.
2. Go to “Maintenance -> Upgrade” page in Toolbox.
3. Click “Browse” and select the firmware from computer.
4. Click “Upgrade” to upgrade the device.

Note: If NFC connection is selected, please keep the two devices close and don't move them in order to get the best connectivity as possible when upgrading.



The screenshot shows the 'Upgrade' tab. It displays device information and upgrade options:

- Model:** EM500-SWL-W003-868
- Firmware Version:** 01.01
- Hardware Version:** 1.0
- FOTA:** A 'Check for Updates' button.
- Update Locally:** A text input field, a 'Browse' button, and an 'Upgrade' button.

5.3 Configuration Examples

5.3.1 LoRaWAN Channel Settings

The configuration of LoRaWAN channel of EM500-SWL must match the LoRaWAN gateway's. Refer to [Appendix](#) to check default channel settings of EM500-SWL.

Mobile APP Configuration:

Open Toolbox APP and go to “Device ->Setting -> LoRaWAN Settings” to change the frequency and channels.

Software Configuration:

Log in Toolbox and go to “LoRaWAN Settings -> Channel” to change frequency and channels.

Note: 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:

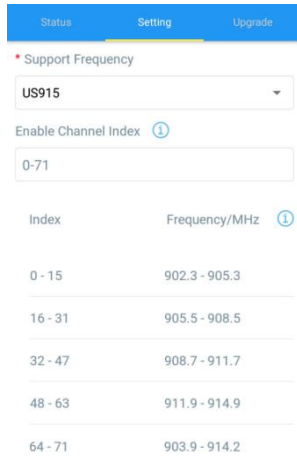
1, 40: Enabling Channel 1 and Channel 40

1-40: Enabling Channel 1 to Channel 40

1-40, 60: Enabling Channel 1 to Channel 40 and Channel 60

All: Enabling all channels

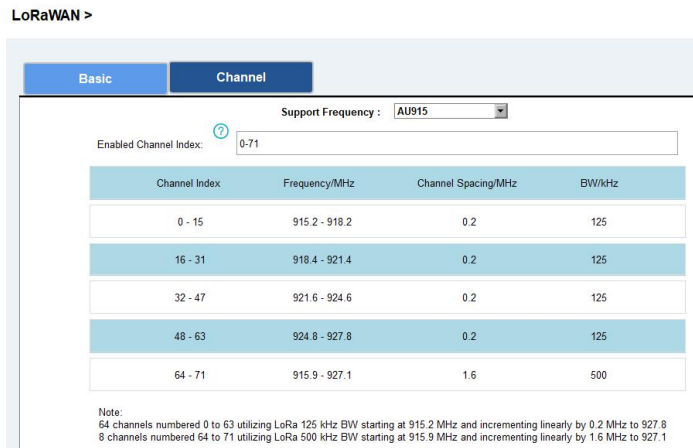
Null: Indicates that all channels are disabled



Support Frequency: US915

Enable Channel Index: 0-71

Index	Frequency/MHz
0 - 15	902.3 - 905.3
16 - 31	905.5 - 908.5
32 - 47	908.7 - 911.7
48 - 63	911.9 - 914.9
64 - 71	903.9 - 914.2



Support Frequency: AU915

Enabled Channel Index: 0-71

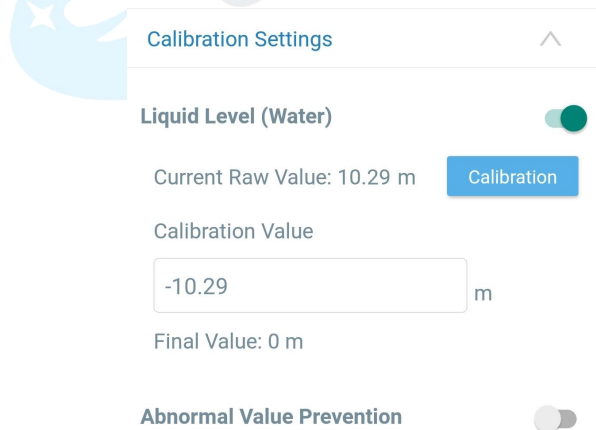
Channel Index	Frequency/MHz	Channel Spacing/MHz	BW/kHz
0 - 15	915.2 - 918.2	0.2	125
16 - 31	918.4 - 921.4	0.2	125
32 - 47	921.6 - 924.6	0.2	125
48 - 63	924.8 - 927.8	0.2	125
64 - 71	915.9 - 927.1	1.6	500

Note:
64 channels numbered 0 to 63 utilizing LoRa 125 kHz BW starting at 915.2 MHz and incrementing linearly by 0.2 MHz to 927.8
8 channels numbered 64 to 71 utilizing LoRa 500 kHz BW starting at 915.9 MHz and incrementing linearly by 1.6 MHz to 927.1

5.3.2 Data Calibration Settings

Mobile APP Configuration:

Open Toolbox APP and go to “Device -> Setting -> Calibration Settings” to enable the calibration and input the calibration value.



Calibration Settings

Liquid Level (Water)

Current Raw Value: 10.29 m

Calibration Value

m

Final Value: 0 m

Abnormal Value Prevention

Software Configuration:

Log in Toolbox and go to “Device Settings -> Basic -> Calibration Settings” to enable the calibration and type the calibration value.

Calibration Settings

Liquid Level Calibration	<input checked="" type="checkbox"/>		
Current Raw Value	10.19 m	Calibration	
Calibration Value	<input style="width: 80%;" type="text" value="-10.19"/>	m	
Final Value	0	m	
Abnormal Value Prevention	<input type="checkbox"/>		

5.3.3 Alarm Settings

EM500-SWL will upload the current data instantly after the threshold is triggered.

Mobile APP Configuration:

Open Toolbox APP and go to “Device -> Setting -> Threshold Settings” to enable the threshold settings and input the threshold.

Threshold Settings ^

When the value meets the threshold, the device will report the value immediately.

Liquid Level (Water)

Over / m

Below / m

Collecting Interval - 1 + min

Software Configuration:

Log in Toolbox and go to “Device Settings -> Basic -> Threshold Settings” to enable the calibration and input the calibration value.

Threshold Settings ?

Liquid Level	<input checked="" type="checkbox"/>		
Over	<input style="width: 80%;" type="text" value="0"/>	m	
Below	<input style="width: 80%;" type="text" value="0"/>	m	
Data Collecting Interval	<input style="width: 80%;" type="text" value="1"/>	min	

6. Installation

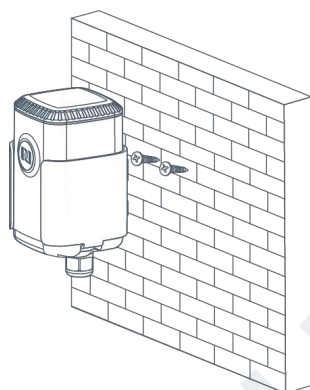
6.1 Transceiver Installation

6.1.1 Wall Mounting

1. Attach the mounting bracket to the wall and mark the two holes(around 16mm) on the wall.

Note: The connecting line of two holes must be a horizontal line.

2. Drill the holes according to the marks and screw the mounting screws into the wall.
3. Mount the device on the wall.

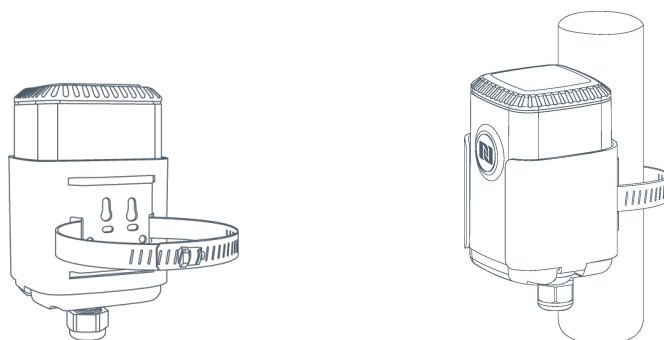


6.1.2 Pole Mounting

1. Loosen the hose clamp by turning the locking mechanism counter-clockwise.

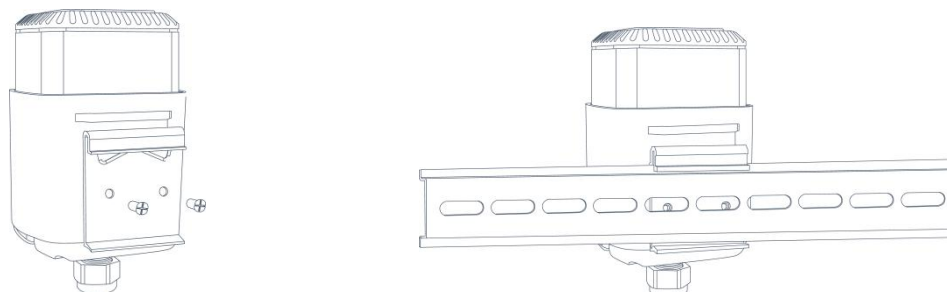


1. Straighten out the hose clamp and slide it through the rectangular holes in the mounting bracket, wrap the hose clamp around the pole.
2. Use a screwdriver to tighten the locking mechanism by turning it clockwise.



6.1.3 DIN Rail Mounting

Use 2 pieces of M3 × 6 flat head Phillips screws to fix the DIN rail to the device, and then hang the DIN rail on the mounting bracket. It is necessary to choose a standard bracket.

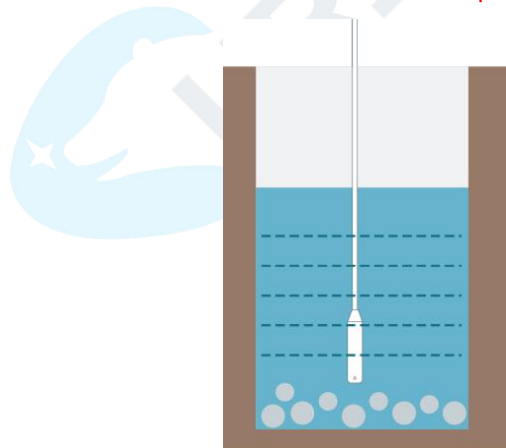


6.2 Sensor Installation

Lower the sensor via cable into the media until it is close to the bottom of tanks or ponds. Be careful not to hit the bottom hard or touch hard objects like sand or sludge since it will damage the sensor.

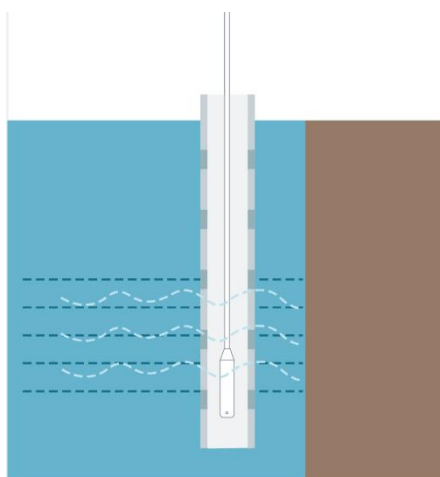
Note:

- Ensure the gas holes of transmitter do not be blocked while mounting or using it.
- To prevent the separation of level sensor and transceiver due to water shock and gravity, please fix the sensor cable with a fixed bracket or wrap it around the pole.



If the sensor is to be used in a well or other locations with turbulence or other disturbances, it is advisable to install a pipe to protect the sensor. Several holes should be drilled at different heights of the pipe in order to let water flow into and remove hydrodynamic pressure.

Note: The pipe can't be placed bend.



7. Payload Format

All data are based on following format:

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

Please refer to decoder example: <https://github.com/Ursalink-CN/ursalink-decoder>

Uplink Packet(HEX)

Channel	Type	Data Example	Unit
01	75(Battery Level)	64 => 100	%
03	77 (Water Level)	02 00 => 00 02 = 2	cm
FF	01(Ursalink Protocol Version)	01=> V1.0	/
	09 (Hardware Version)	01 40=> V1.4	
	0a(Software Version)	01 14=> V1.14	
	0b(Device Restart Notification)	ff (reserved)	
	0f(Device Type)	00 => Class A	
	16 (Device SN)	64 10 90 82 43 75 00 01 =>Device SN is 6410908243750001	

Downlink Packet(HEX)

Channel	Type	Data Example	Unit
FF	03(Set Reporting Interval)	b0 04 => 04 b0 = 1200	s

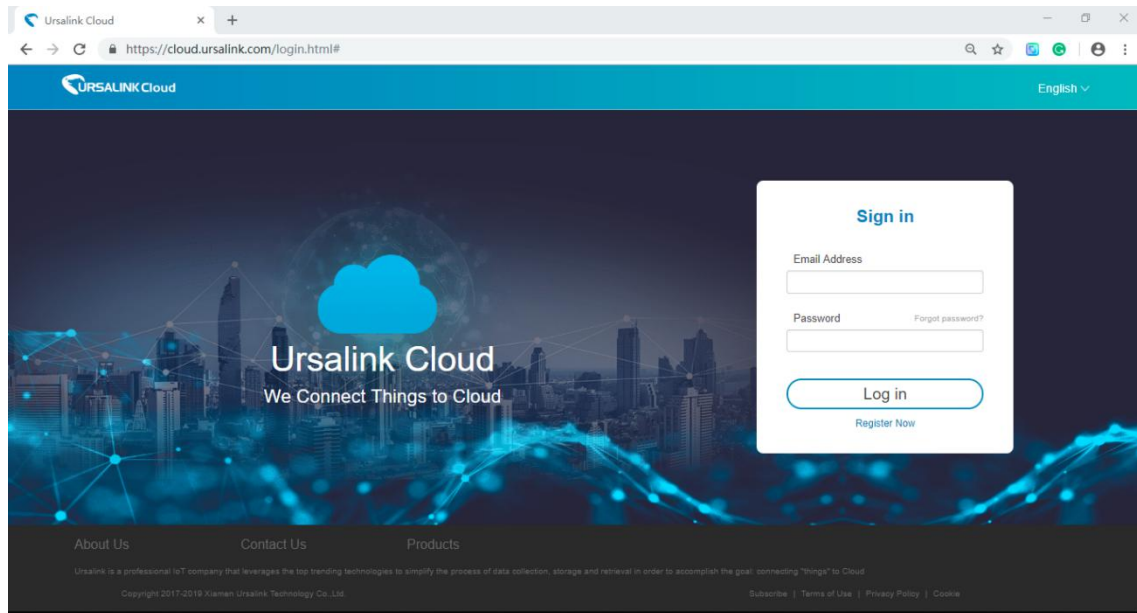
8.Sensor Management via Ursalink Cloud

Ursalink cloud is a comprehensive platform that provides multiple services including device remote management and data visualization with the easiest operation procedures.

8.1 Ursalink Cloud Registration

Register and log in Ursalink Cloud.

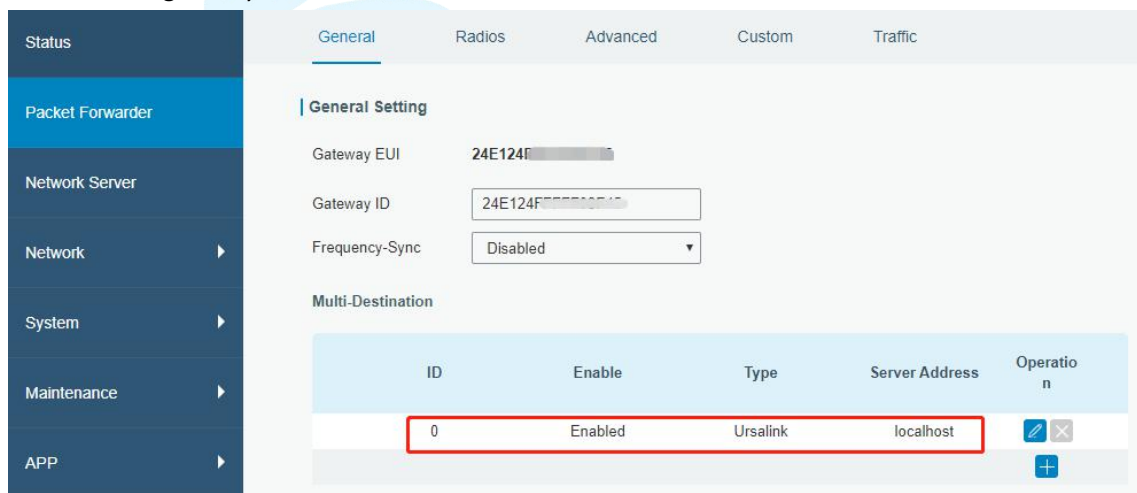
Ursalink Cloud URL: <https://cloud.ursalink.com/login.html>






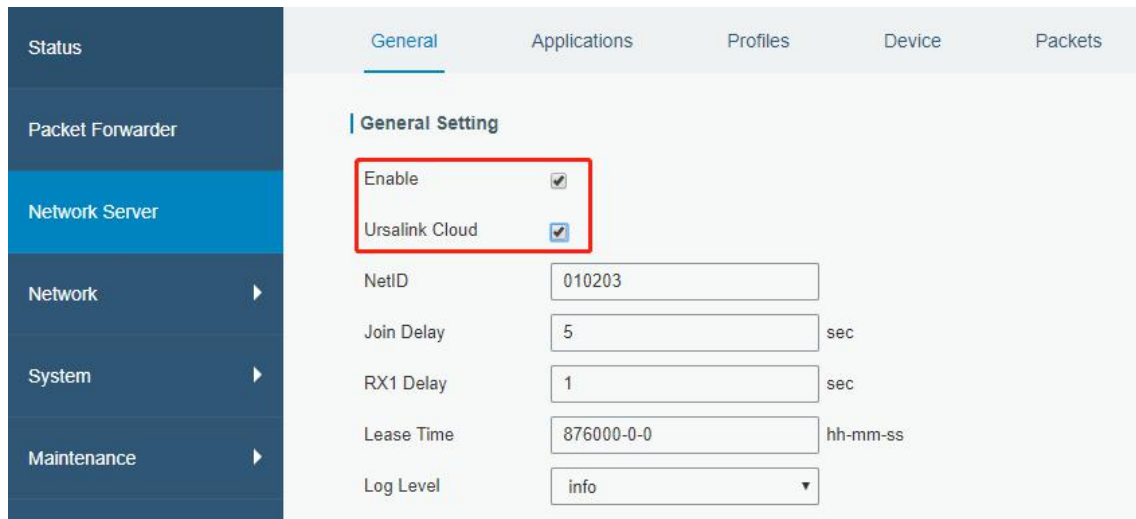
8.2 Add a Ursalink LoRaWAN Gateway

1. Enable “Ursalink” type network server and “Ursalink Cloud” mode in gateway web GUI.

Note: Ensure gateway has accessed the Internet.



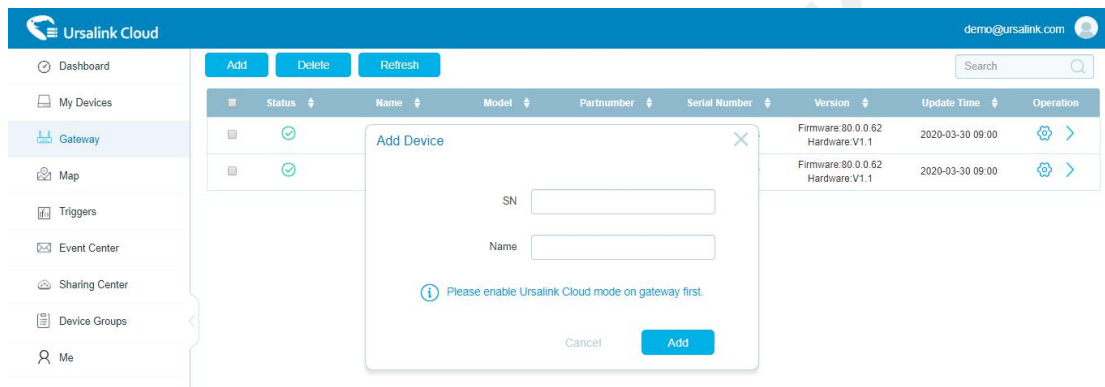
ID	Enable	Type	Server Address	Operation
0	Enabled	Ursalink	localhost	 
				



The screenshot shows the configuration page for the EM500-SWL device. The left sidebar contains navigation options: Status, Packet Forwarder, Network Server (highlighted), Network, System, and Maintenance. The main content area is titled 'General Setting' and includes the following fields:

- Enable**:
- Ursalink Cloud**:
- NetID**: 010203
- Join Delay**: 5 sec
- RX1 Delay**: 1 sec
- Lease Time**: 876000-0-0 hh-mm-ss
- Log Level**: info

2. Go to “My Devices->Gateway” of Ursalink Cloud and click “Add” to add gateway to Ursalink Cloud via SN.



The screenshot shows the 'Ursalink Cloud' interface. The left sidebar includes: Dashboard, My Devices, Gateway (selected), Map, Triggers, Event Center, Sharing Center, Device Groups, and Me. The main area shows a table of gateways with columns: Status, Name, Model, Partnumber, Serial Number, Version, Update Time, and Operation. An 'Add Device' dialog box is open, containing input fields for SN and Name, and a message: "Please enable Ursalink Cloud mode on gateway first." The dialog has 'Cancel' and 'Add' buttons.

3. Check if gateway is online in Ursalink Cloud.



The screenshot shows the 'Gateway' section of the Ursalink Cloud interface. The table displays the following data:

Status	Name	Model	Partnumber	Serial Number	Version	Update Time	Operation
✓	231	UG85-L00E-EU888	L00E-EU888	6217501111111	Firmware:80.0.0.62 Hardware:V1.1	2020-03-30 09:00	⚙️ >
✓	621793195782	UG85-L01CE-CN470	L01CE-CN470	6217501111111	Firmware:80.0.0.62 Hardware:V1.1	2020-03-30 09:00	⚙️ >

8.3 Add EM500-SWL to Cloud

1. Go to “Device->My Devices” and click “Add Device”. Fill in the SN of EM500-SWL and select associated gateway.

Add Device
✕

SN

Name

Associated Gateway

Device EUI

Application Key

Cancel
Add

2. After EM500-SWL is connected to Ursalink Cloud, Click or “History Data” to check the data on Ursalink cloud.

The screenshot shows the URSALINK Cloud interface. On the left is a navigation menu with options: Device, My Devices, Gateway, Map, Device Groups, Event Center, and Account. The main content area displays details for a device named 'My Device'. The status is 'Online' (green checkmark). Key information includes: SN: 000000000000, Model: UC11-T1, Temp: 25.8 °C, Humidity: 50.0 %, and Update Time: 2019-09-18 11:26. Below this, a 'History Data' graph shows temperature (blue line) and humidity (yellow line) over time from 02:30 on 09-17 to 11:26 on 09-18. The temperature remains relatively stable around 25-30°C, while humidity fluctuates between 45% and 55%. Additional device metrics listed include RSSI: -59dBm, SNR: 9.5dB, Battery: 100%, Group Name: -, Associated Gateway: 621700101000, Device EUI: 24e124127, Firmware: v1.99, and Hardware: v1.2.

Appendix

Default LoRaWAN Parameters

DevEUI	24E124 + 2 nd to 11 th digits of SN e.g. SN = 61 26 A1 01 84 96 00 41 Then Device EUI = 24E124126A101849
AppEUI	24E124C0002A0001
Appport	0x55
NetID	0x010203
DevAddr	The 5 th to 12 th digits of SN e.g. SN = 61 26 A1 01 84 96 00 41 Then DevAddr = A1018496
AppKey	5572404C696E6B4C6F52613230313823
NwkSKey	5572404C696E6B4C6F52613230313823
AppSKey	5572404C696E6B4C6F52613230313823

Default Uplink Channels

Model	Channel Plan	Channel Settings/MHz
EM500-SWL-433	EU433	433.175, 433.375, 433.575
EM500-SWL-470	CN470	470.3~489.3 (All 95 channels)
EM500-SWL-868	EU868	868.1, 868.3, 868.5
EM500-SWL-915	AU915	915.2~927.1 (All 72 channels)

-END-