



# EM500-SMT 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-SMT 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
April 7, 2020	V 1.0	Initial version
August 17, 2020	V 1.1	Document structure change

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## 1. Overview

### 1.1 Description

EM500-SMT is an outdoor environment monitoring sensor mainly used to measure soil status through wireless LoRa network. EM500-SMT 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

- A portable, robust and waterproof solution for smart agricultural applications
- 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

Model	EM500-SMT-EC5	EM500-SMT-MEC20
<b>Measurement</b>		
<b>Moisture</b>		
Range	0-100% RH	
Accuracy	±2%	±2%(0~50%), ±3%(50%~100%)
Resolution	0.5%	0.03%(0~50%), 1%(50%~100%)
<b>Temperature</b>		
Range	—	-40°C ~80°C
Accuracy	—	±0.5°C
Resolution	—	0.1°C
<b>Electrical Conductivity</b>		
Range	—	0~20000 μs/cm

Accuracy	—	±3%(0~10000 μs/cm), ±5%(10000~20000 μs/cm)
Resolution	—	10μs/cm(0~10000 μs/cm) 50μs/cm(10000~20000 μs/cm)
<b>LoRaWAN</b>		
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	
<b>Physical Characteristics</b>		
Cable Length	5m(EC5), 2m(MEC20)	
Power Supply	19000 mAh Li-SoCl <sub>2</sub> battery	
Operating Temperature	-30°C to +60°C(EC5) -30°C to +70°C(MEC20)	
Relative Humidity	0% to 100% (non-condensing)	
Mounting	Pole, wall, DIN rail	

## 2. Hardware Introduction

### 2.1 Packing List



1 × EM500-SMT

(Include sensor)



2 × Mounting

Screws



1 × Hose

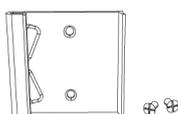
Clamp



1 × Warranty Card



1 × Quick Guide



1 × DIN Rail (Optional)



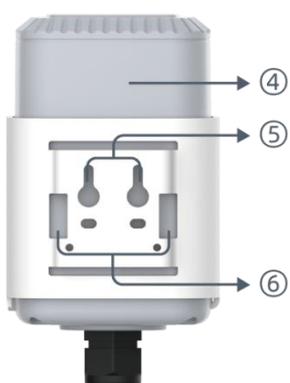
**If any of the above items is missing or damaged, please contact your Ursalink sales representative.**

## 2.2 Transceiver Overview



### Front View:

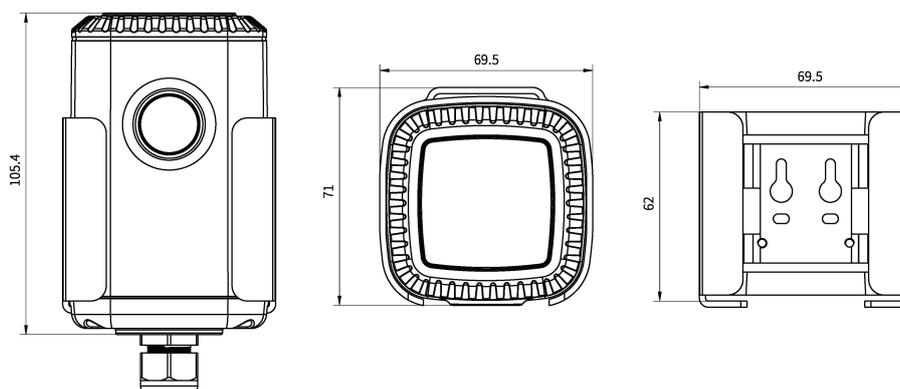
- ① LoRa Antenna (Internal)
- ② NFC Area
- ③ Water-proof Connector



### Back View:

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

## 2.3 Dimensions(mm)



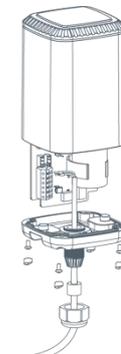
## 3. Assembly and Preparation

### 3.1 Sensor Assembly

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

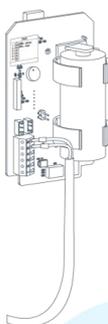
1. Take off the mounting bracket, remove the cap, rubber seal and the screws on the bottom of the device, and then take off the enclosure cover.

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

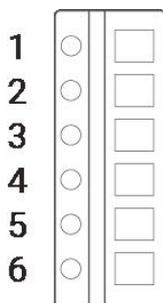


3. Pull out the motherboard, insert and lock the wires accordingly (see the label on the motherboard or following picture).

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



**Pinouts:**



**EM500-SMT-EC5:**

PIN	Color	Description
1	Bare wire	GND
2	Yellow	AIN
3	---	--
4	--	--
5	--	--
6	Brown	VOUT=12V

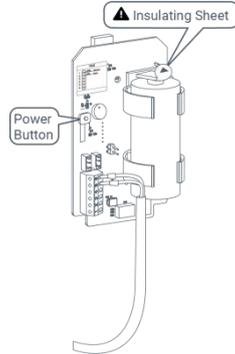
**EM500-SMT-MEC20:**

PIN	Color	Description
1	Black	GND
2	---	--
3	---	--
4	White	B
5	Yellow	A
6	Red	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-SMT 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. <b>Note:</b> 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-SMT 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 turning on/off the sensor or changing configuration. Default password is **123456**.

## 5.1 Configuration via Smartphone APP

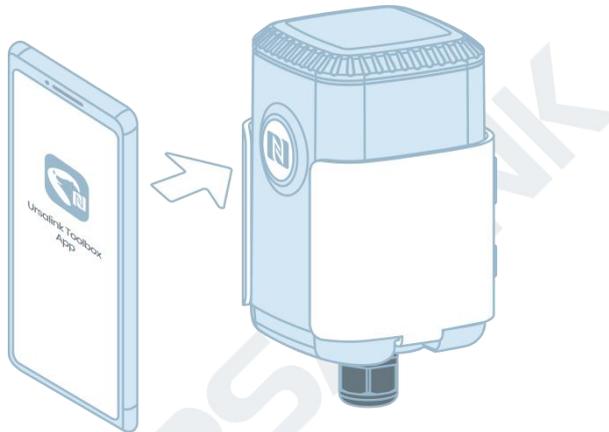
### Preparation:

- Smartphone (NFC supported)
- Toolbox APP: download and install from Google Play or Apple Store.

### 5.1.1 Read/Write Configuration via NFC

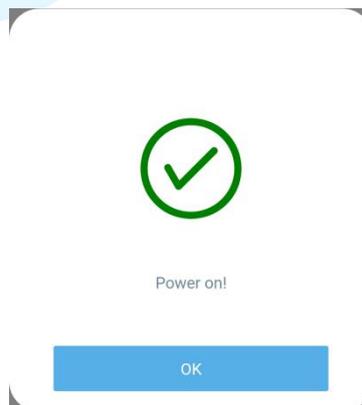
1. Enable NFC on the smartphone and open "Toolbox" APP.
2. Attach the smartphone with NFC area to the device to read basic information.

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



3. When you perform one of the following operations, enter the password and attach the smartphone with NFC area to the device until the APP shows a successful prompt.

- Turn on/off the sensor
- Reset the sensor
- Tap "Write" to change settings in "Device > Settings".



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

Status	Setting	Upgrade
SN	6126A13767160030	
Model	EM500-SMT-EC5-915	
Device EUI	24e124126a137671	
Firmware Version	V1.3	
Hardware Version	V1.1	
Device Status	ON 	
Join Status	Activated	
RSSI/SNR	-81/12	
Soil Moisture	22.0 %	
Battery	100 %	
Channel Mask	0000000000000ff00	
Uplink Frame Counter	792	

Read

  
 Device

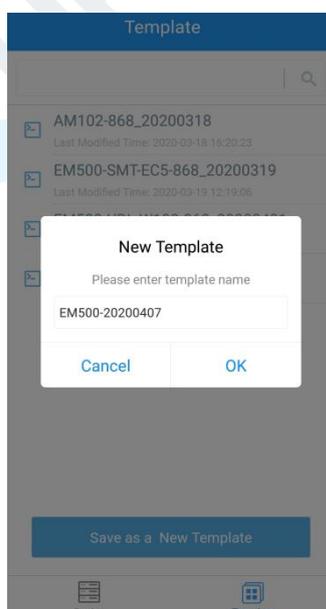
  
 Template

### 5.1.2 Template Configuration

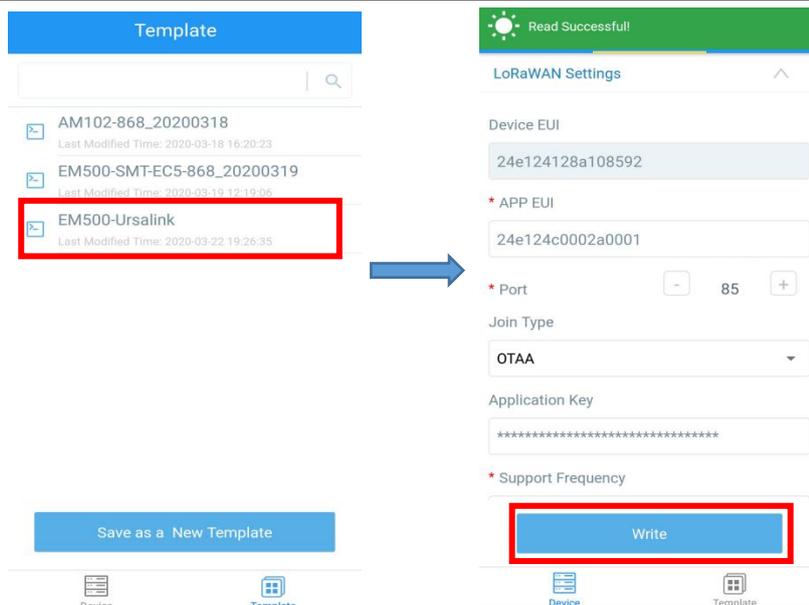
Template settings are used for easy and quick device configuration in bulk.

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

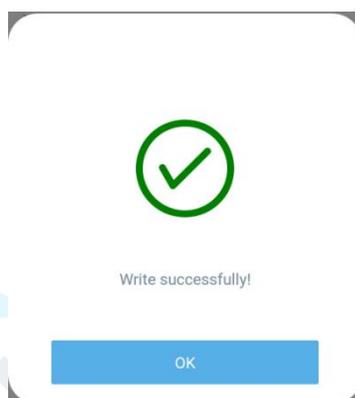
1. Go to “Template” page on the APP and save current settings as a template.



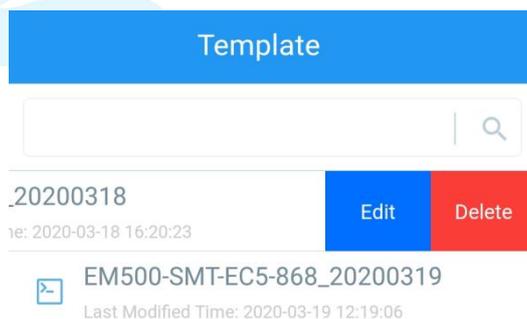
2. Attach the smartphone with NFC area to another device.
3. Select the template file from Toolbox APP and tap “Write”.



4. Enter password of this device and keep the two devices close until the APP shows a successful prompt.



5. 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)
- 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.

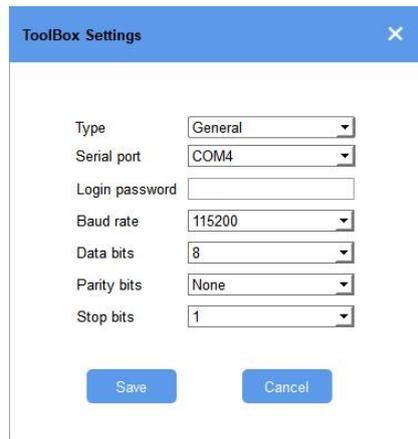
### Type-C Connection

1. Connect the EM500-SMT to computer via type-C port.



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

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



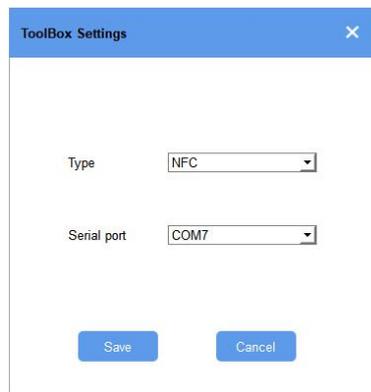
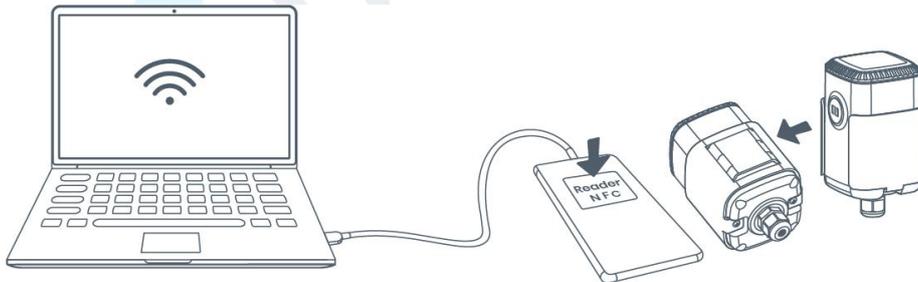
The screenshot shows the 'ToolBox Settings' dialog box with the following configuration:

Type	General
Serial port	COM4
Login password	
Baud rate	115200
Data bits	8
Parity bits	None
Stop bits	1

Buttons: Save, Cancel

### NFC Connection

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



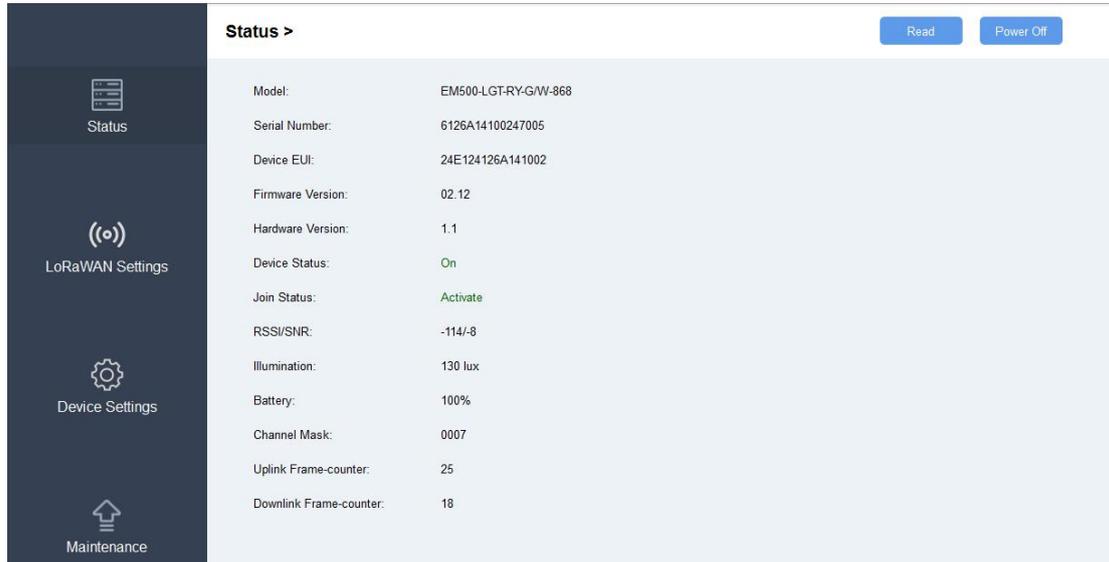
The screenshot shows the 'ToolBox Settings' dialog box with the following configuration:

Type	NFC
Serial port	COM7

Buttons: Save, Cancel

## 5.2.2 Basic Configuration

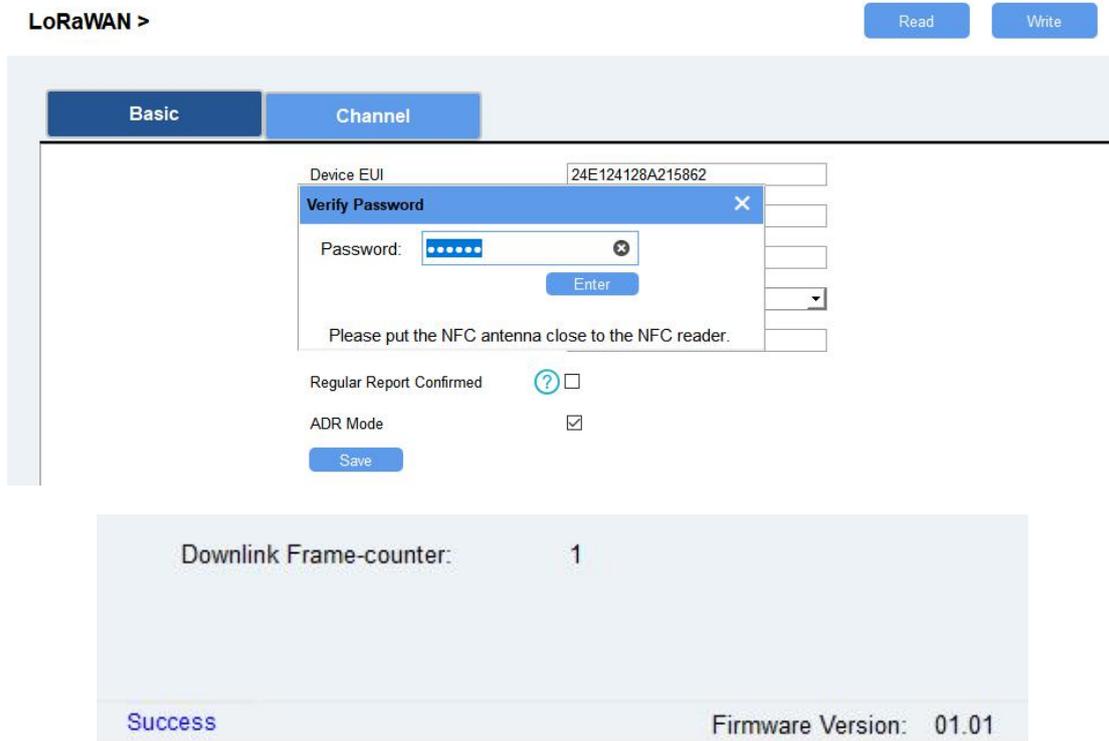
1. Click “Read” to read current data of the sensor.



Status >	
Model:	EM500-LGTRY-GW-868
Serial Number:	6126A14100247005
Device EUI:	24E124126A141002
Firmware Version:	02.12
Hardware Version:	1.1
Device Status:	On
Join Status:	Activate
RSSI/SNR:	-114/-8
Illumination:	130 lux
Battery:	100%
Channel Mask:	0007
Uplink Frame-counter:	25
Downlink Frame-counter:	18

2. When you perform one of the following operations, enter the password and 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



LoRaWAN > Read Write

**Basic** **Channel**

Device EUI: 24E124128A215862

**Verify Password**

Password:

Enter

Please put the NFC antenna close to the NFC reader.

Regular Report Confirmed

ADR Mode

Save

Downlink Frame-counter: 1

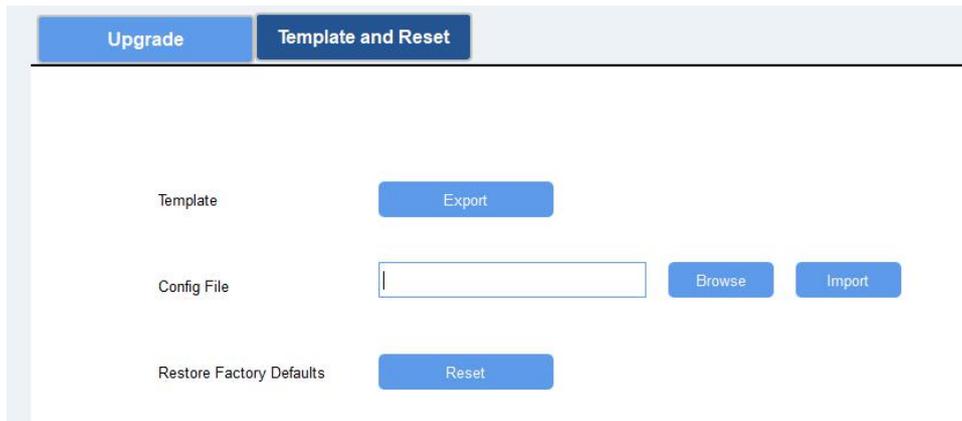
**Success** Firmware Version: 01.01

## 5.2.3 Template and Reset

### 5.2.3.1 Template Configuration

**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.



The screenshot shows the 'Template and Reset' interface. At the top, there are two tabs: 'Upgrade' and 'Template and Reset'. Below the tabs, there are three sections:

- Template:** A blue button labeled 'Export' is positioned to the right of the 'Template' label.
- Config File:** A text input field is followed by two blue buttons: 'Browse' and 'Import'.
- Restore Factory Defaults:** A blue button labeled 'Reset' is positioned to the right of the 'Restore Factory Defaults' label.

3. Click “Browse” to select the correct template from computer.
4. Click “Import” to import the template to the device.

### 5.2.4.2 Reset

Go to “Maintenance -> Template and Reset” page in Toolbox, then click the “Reset” to reset the device to the factory settings.



The screenshot shows the 'Template and Reset' interface, similar to the previous one. The 'Reset' button under the 'Restore Factory Defaults' section is highlighted with a red rectangular box.

## 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.

**Upgrade >**

Upgrade
Backup and Reset

Model: EM500-SMT-MEC20-915

Firmware Version: 02.13

Hardware Version: 1.2

FOTA: Up to date

Update Locally:  Browse Upgrade

## 5.3 Configuration Examples

### 5.3.1 LoRaWAN Channel Settings

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

**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

Status
Setting
Upgrade

\* Support Frequency

US915

Enable Channel Index  ⓘ

0-71

Index	Frequency/MHz <span style="font-size: x-small;"> ⓘ</span>
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

**LoRaWAN >**

Basic
Channel

Support Frequency : AU915

Enabled Channel Index:   ⓘ

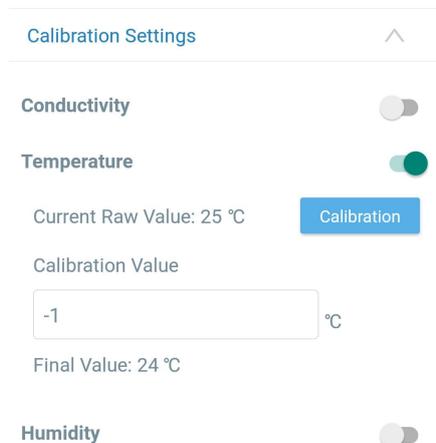
Channel Index	Frequency/MHz	Channel Spacing/MHz	BW/kHz
0 - 15	915.2 - 918.2	0.2	125
16 - 31	918.4 - 921.4	0.2	125
32 - 47	921.6 - 924.6	0.2	125
48 - 63	924.8 - 927.8	0.2	125
64 - 71	915.9 - 927.1	1.6	500

**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

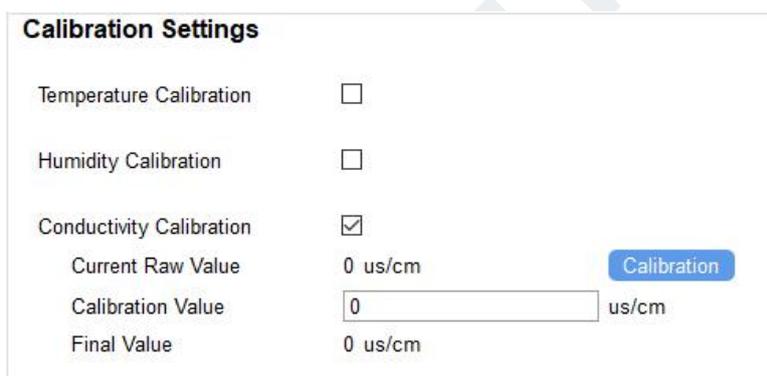
#### Mobile APP Configuration:

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



#### Software Configuration:

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



### 5.3.3 Alarm Settings

EM500-SMT 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.

**Conductivity**

Over / us/cm

Below / us/cm

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** ?

Conductivity	<input checked="" type="checkbox"/>	
Over	<input type="text" value="0"/>	us/cm
Below	<input type="text" value="0"/>	us/cm
Data Collecting Interval	<input type="text" value="1"/>	min

## 6. Installation

### 6.1 Transceiver Installation

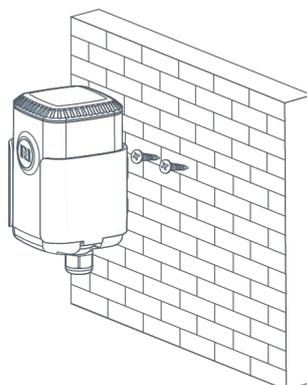
#### 6.1.1 Wall Mounting

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.

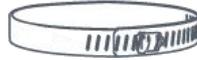
2. Drill the holes according to the marks and screw the mounting screws into the wall.

3. Mount the device on the wall.

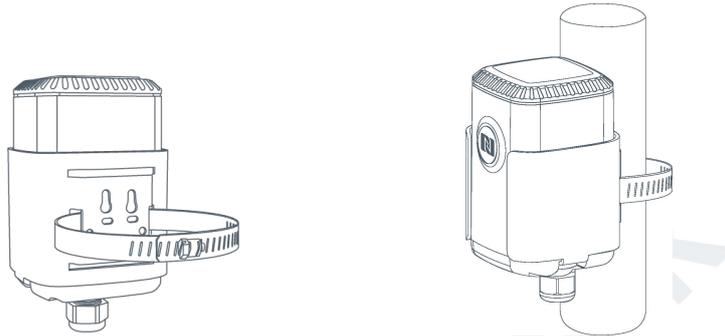


### 6.1.2 Pole Mounting

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

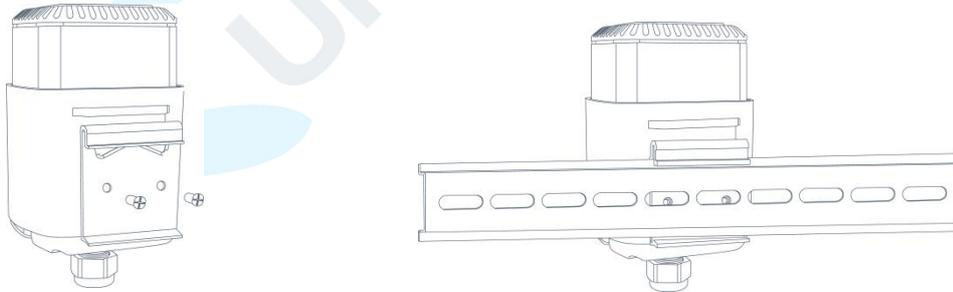


1. Straighten out the hose clamp and slide it through the rectangular holes in the mounting bracket, wrap the hose clamp around the pole.
2. Use a screwdriver to tighten the locking mechanism by turning it clockwise.



### 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

EM500-SMT should be considered following notes to insure proper installation:

- Abnormal data may show up if sensor prongs are exposed in the air.
- It is possible to get sticks, bark, roots or other material stuck between the sensor prongs, which will severely affect the sensor data readings. Any air gaps or excessive soil compaction around the sensor can also influence the readings.
- Do not install the sensor adjacent to large metal objects.
- Be careful when inserting the sensor into dense soil, as the prongs will break if excessive sideways force is used.

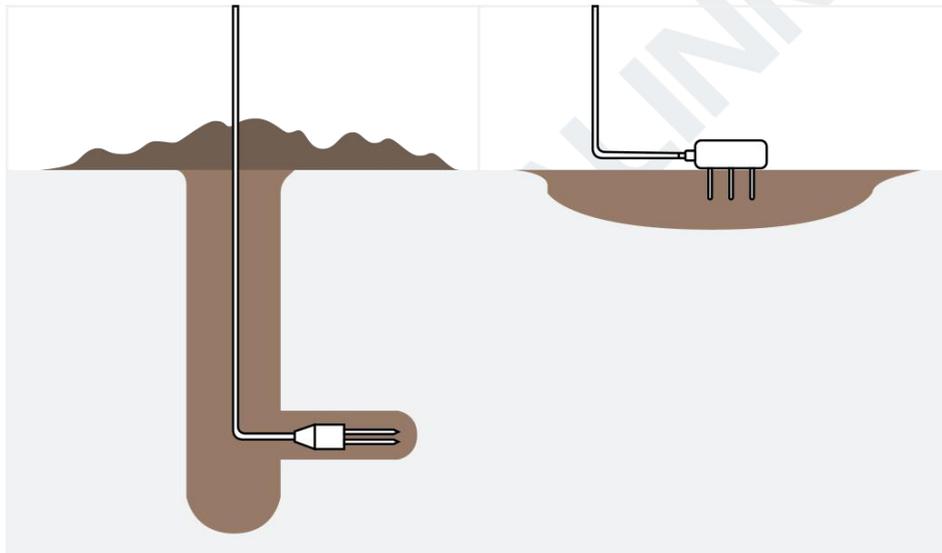
- When installing the sensor in a lightning prone area, please check your lightning protection.
- When removing the sensor from the soil, do not pull it out of the soil by the cable. Doing so may break internal connections and make the sensor unusable.

### 6.2.1 Horizontal Installation

1. Excavate a hole or trench a few centimeters deeper than the depth at which the sensor is to be installed.
2. At the installation depth, shave off some soil from the vertical soil surface exposing undisturbed soil.
3. Insert the sensor into the undisturbed soil surface until the entire sensor is inserted. The tip of each prong has been sharpened to make it easier to push the sensor into the soil. Be careful with the sharp tips!

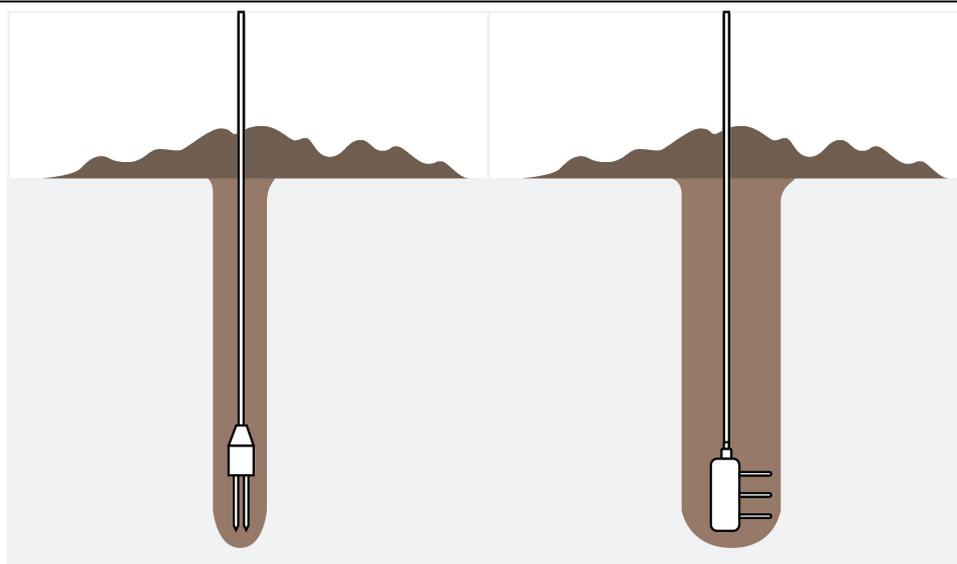
**Note:** If there is difficulty inserting the sensor, loosen or wet the soil.

4. Backfill the trench taking care to pack the soil back to natural bulk density around the sensor body.



### 6.2.2 Vertical Installation

1. Drill a hole to the depth at which the sensor is to be installed.
2. Insert the sensor into the undisturbed soil at the bottom of the drilled hole using a hand or any other implement that will guide the sensor into the soil at the bottom of the hole.
3. After inserting the sensor, backfill the hole, and take care to pack the soil back to natural bulk density while not damaging the overmolding of the sensor and the sensor cable in the process.



## 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	67(Temperature)	1901 => 01 19 => 281 Hum=281*0.1=28.1	°C
04	68 (Moisture)	73 => 115 Moisture=115*0.5=57.5	%RH
05	7F(Electrical Conductivity)	F0 00 => 00 F0 =240	µs/cm
FF	01(Ursalink Protocol Version)	01=> V1.0	/
	09 (Hardware Version)	01 40=> V1.4	
	0a(Software Version)	01 14=> V1.14	
	0b(Power on Notification)	ff	
	0c (Power off Notification)	ff	
	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

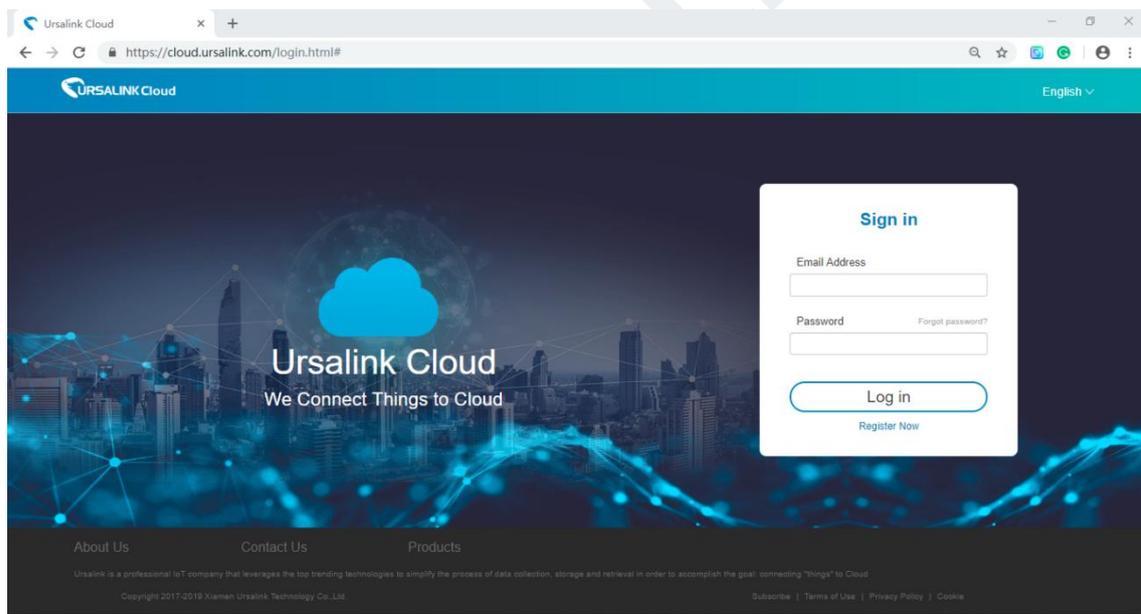
## 8.Sensor Management via Ursalink Cloud

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.

**General Setting**

Gateway EUI: 24E124F[redacted]

Gateway ID: 24E124F[redacted]

Frequency-Sync: Disabled

**Multi-Destination**

ID	Enable	Type	Server Address	Operation
0	Enabled	Ursalink	localhost	[edit] [delete]
[add]				

**General Setting**

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.

Ursalink Cloud

demo@ursalink.com

Dashboard | My Devices | **Gateway** | Map | Triggers | Event Center | Sharing Center | Device Groups | Me

Buttons: Add, Delete, Refresh

Table Headers: Status, Name, Model, Partnumber, Serial Number, Version, Update Time, Operation

Table Data:

Status	Name	Model	Partnumber	Serial Number	Version	Update Time	Operation
[check]					Firmware: 80.0.0.62 Hardware: V1.1	2020-03-30 09:00	[gear] [arrow]
[check]					Firmware: 80.0.0.62 Hardware: V1.1	2020-03-30 09:00	[gear] [arrow]

Modal: Add Device

SN: [input]  
Name: [input]

Message: Please enable Ursalink Cloud mode on gateway first.

Buttons: Cancel, Add

3. Check if gateway is online in Ursalink Cloud.

Ursalink Cloud

demo@ursalink.com

Dashboard | My Devices | **Gateway** | Map | Triggers

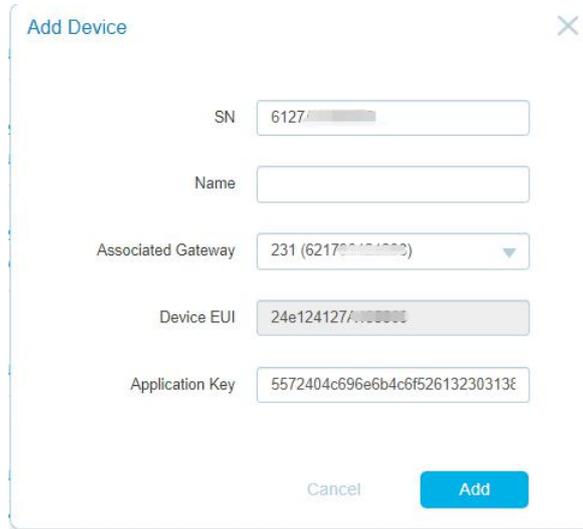
Buttons: Add, Delete, Refresh

Table Headers: Status, Name, Model, Partnumber, Serial Number, Version, Update Time, Operation

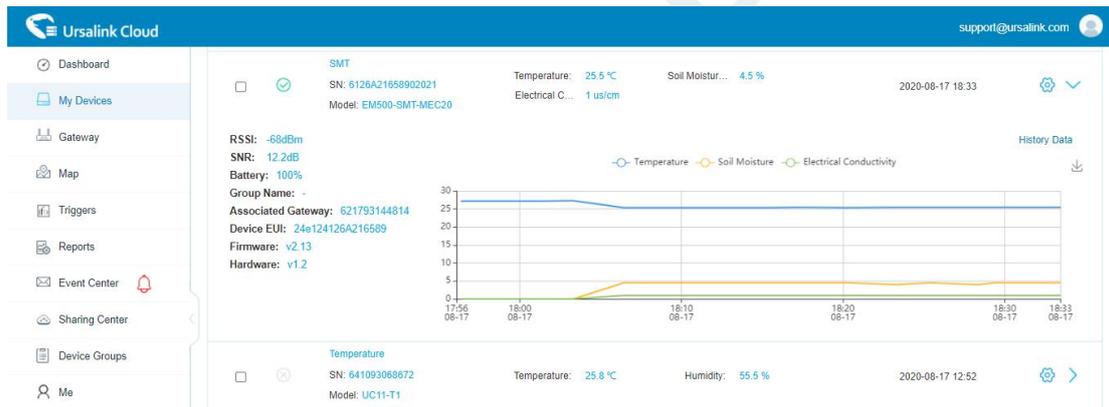
Status	Name	Model	Partnumber	Serial Number	Version	Update Time	Operation
[check]	231	UG85-L00E-EU888	L00E-EU888	62178[redacted]	Firmware: 80.0.0.62 Hardware: V1.1	2020-03-30 09:00	[gear] [arrow]
[check]	621793195782	UG85-L01CE-CN470	L01CE-CN470	62178[redacted]	Firmware: 80.0.0.62 Hardware: V1.1	2020-03-30 09:00	[gear] [arrow]

## 8.3 Add EM500-SMT to Cloud

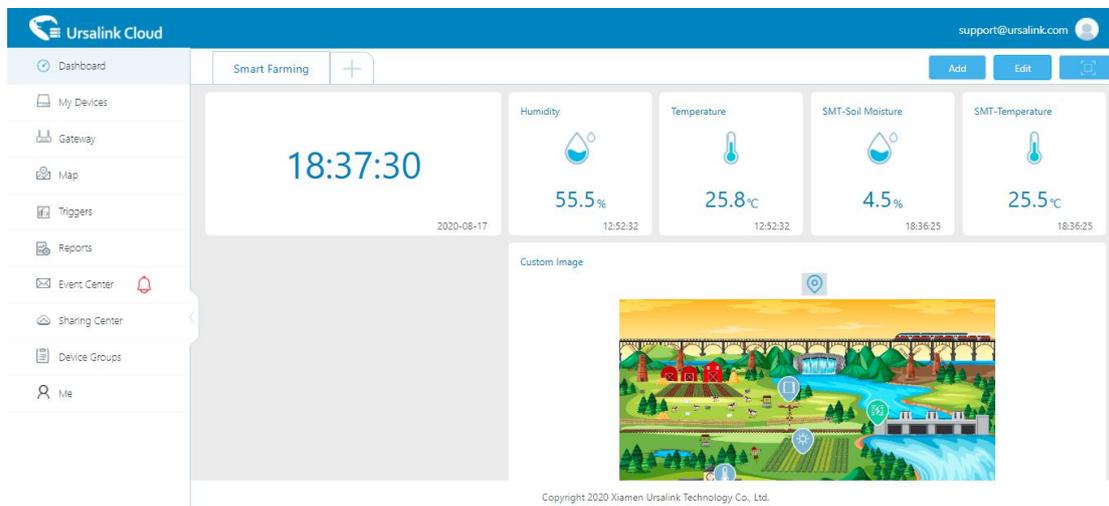
1. Go to “Device->My Devices” and click “Add Device”. Fill in the SN of EM500-SMT and select associated gateway.



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



3. Go to “Dashboard” page to add widgets to the dashboard.



## Appendix

### Default LoRaWAN Parameters

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

### Default Uplink Channels

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

**-END-**