



# Outdoor Environment Monitoring Sensor

Featuring LoRaWAN®

**EM500 Series**

User Guide



## Applicability

This guide is applicable to EM500 series sensors shown as follows, except where otherwise indicated.

Model	Description
EM500-CO <sub>2</sub>	Carbon Dioxide Sensor
EM500-LGT	Light Sensor
EM500-PP	Pipe Pressure Sensor
EM500-PT100	PT100 Temperature Sensor
EM500-SMT	Soil Moisture Sensor
EM500-SMTC	Soil Moisture Moisture, Temperature and Conductivity Sensor
EM500-SWL	Submersible Level Sensor
EM500-UDL	Ultrasonic Distance/Level Sensor

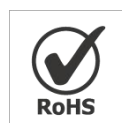
## Safety Precautions

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.
- ❖ In order to protect the security of the device, please change device password when first configuration. The default password is 123456.
- ❖ 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.
- ❖ 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.

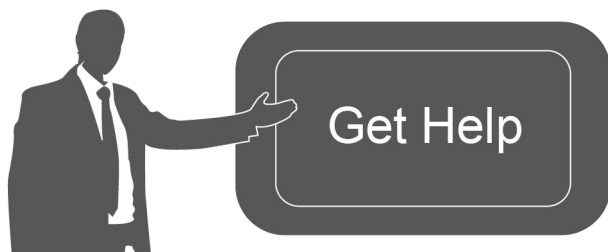
## Declaration of Conformity

EM500 series 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
Nov. 23, 2020	V 1.0	Initial version
Dec. 7, 2021	V 1.1	Content update
Apr. 11, 2022	V 1.2	1. EM500-SMT/SMTC supports soil type selection 2. Add wirings of EM500-PP-G1/2M-4842 and EM500-SWL-4846W 3. Support RX2 datarate and frequency settings

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# 1. Product Introduction

## 1.1 Overview

EM500 series is a sensor mainly used for outdoor environment through wireless LoRa network. EM500 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<sup>®</sup> protocol. LoRaWAN<sup>®</sup> 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 Milesight IoT Cloud or through the user's own Network Server.

## 1.2 Features

- Up to 15 km communication range
- Easy configuration via NFC
- Standard LoRaWAN<sup>®</sup> support
- Milesight IoT Cloud compliant
- Low power consumption with 19000mAh replaceable battery

# 2. Hardware Introduction

## 2.1 Packing List



1 × EM500 Device  
(Include Mounting  
Bracket)



2 × Wall Mounting  
Kits



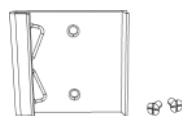
2 × Fixing Screws



4 × Rubber Screw  
Caps



1 ×  
Hose Clamp



1 ×  
DIN Rail Kit (Optional)



1 ×  
Warranty Card



1 ×  
Quick Guide



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

## 2.2 Hardware Overview

EM500 series sensors is made up of a LoRa transceiver and a sensor. Among them, ultrasonic sensors and gas sensors are combined with LoRa transceiver.



### Front View of EM500:

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



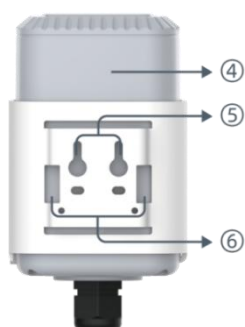
### Front View of EM500-CO<sub>2</sub>:

- ① LoRa Antenna (Internal)
- ② NFC Area
- ③ Vent Tube



### Front View of EM500-UDL:

- ① LoRa Antenna (Internal)
- ② NFC Area
- ③ Ultrasonic Horn

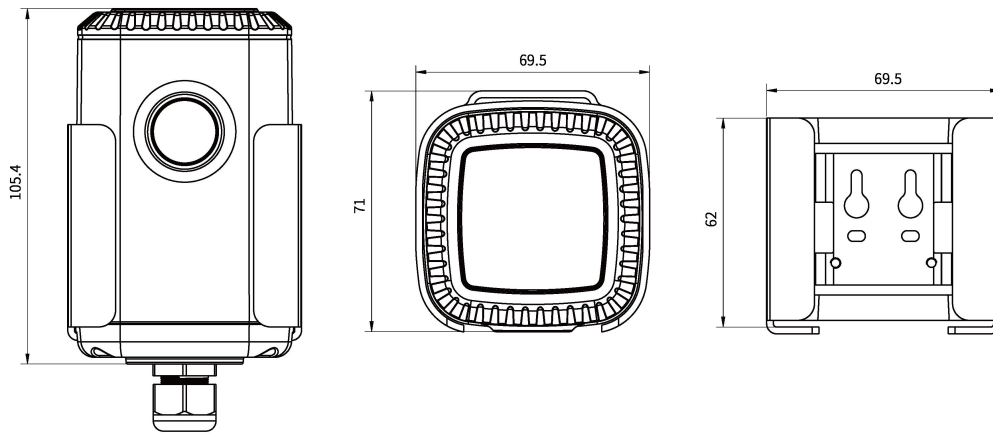


### Back View:

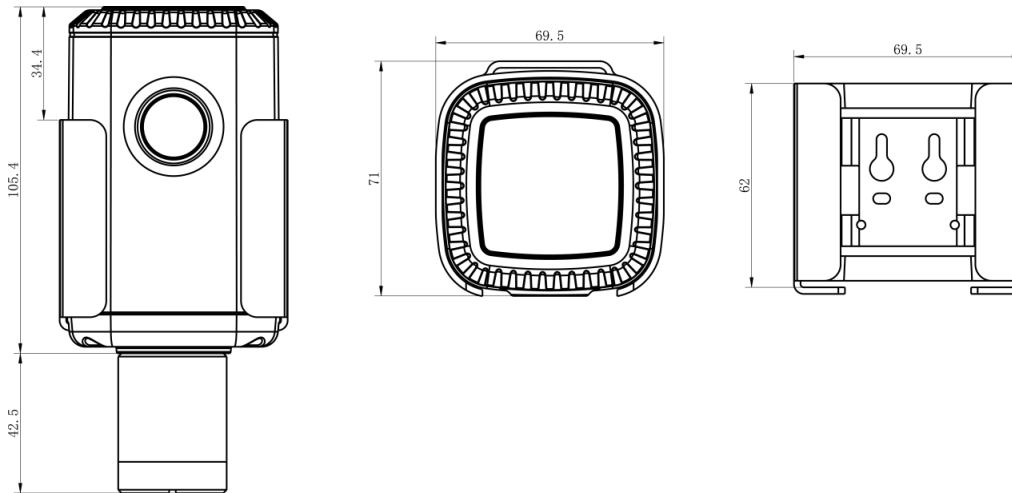
- ④ Battery (Internal)
- ⑤ Wall Mounting Holes
- ⑥ Pole Mounting Holes

## 2.3 Dimensions(mm)

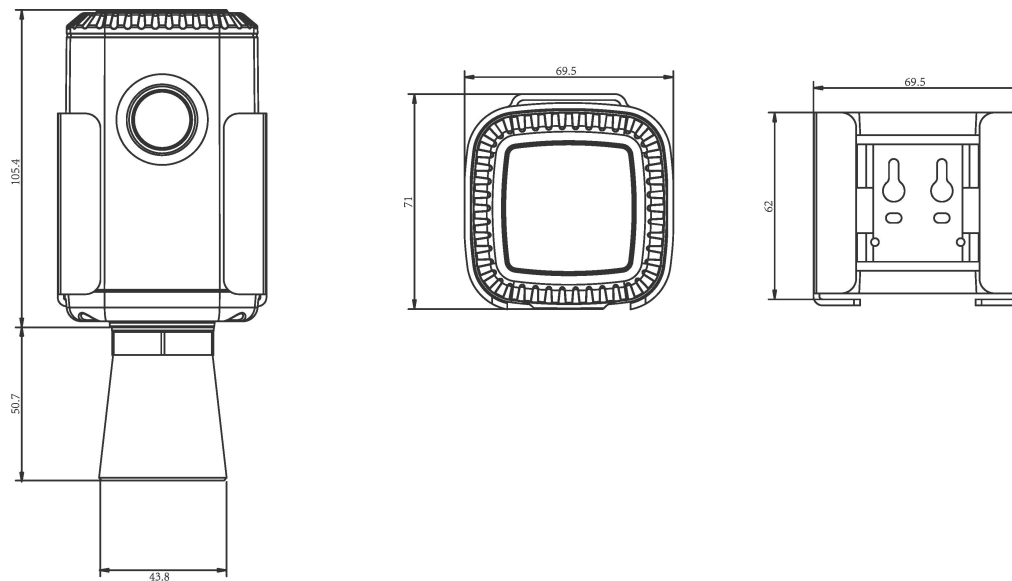
### EM500



### EM500-CO<sub>2</sub>



### EM500-UDL



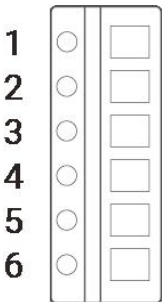
## 2.4 Power Button

**Note:** The LED indicator and power button are inside the device. Switch on/off and reset can also be configured via NFC.

Function	Action	LED Indication
Turn On	Press and hold the button for more than 3 seconds.	Off → On
Turn Off	Press and hold the button for more than 3 seconds.	On → Off
Reset	Press and hold the button for more than 10 seconds.	Blink 3 times.
Check On/Off Status	Quickly press the power button.	Light On: Device is on. Light Off: Device is off.

## 2.5 Pinouts

For parts of EM500 sensors, you need to connect the sensor part to EM500 transceiver according to the pinouts. You can also find pinouts label on the motherboard.



PIN	LGT	PP-4780/S WL	PP-4842/SW L-4846W	PT100	SMT	SMTC
1	Black/GND	Red/GND	White/GND	White/GND	Black/GND	Black/GND
2	---	---	Red/AIN	---	Yellow/AIN	---
3	---	---	---	---	---	---
4	Blue/B	White/B	---	Red/PT1	---	White/B
5	Green/A	Yellow/A	---	Red/PT2	---	Yellow/A
6	Red/VOUT	Black/VOUT	Black/VOUT	---	Brown/VOUT	Red/VOUT

**Note:**

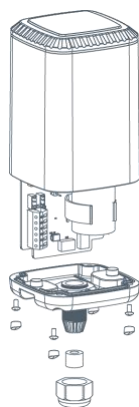
- 1) For EM500-SMT sensor, VOUT=2.5 V; for other sensors, VOUT=12V;
- 2) For EM500-SMTC sensor, it has a green cable which does not need to connect to EM500 transceiver, please cut off it or insulated wrap it.

## 3. Device Assembly

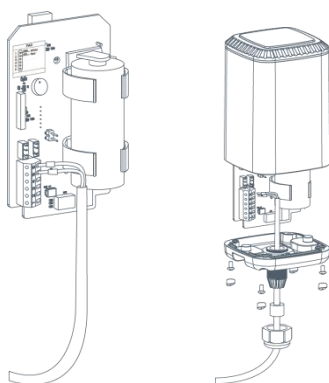
For parts of models, you need to connect sensor to the EM500 transceiver to make the whole device work.

1. Take off the mounting bracket on the transceiver, remove the screws, rubber seal and cover on the bottom of the device.

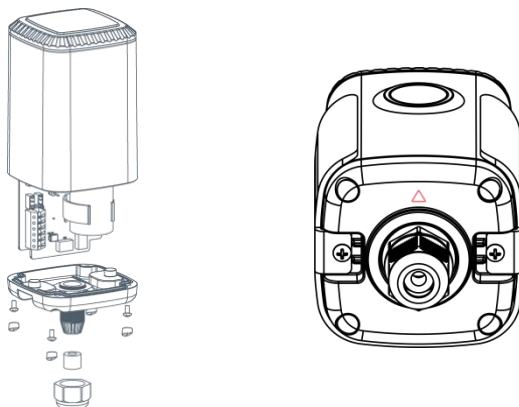




2. Lock the sensor wires to the block according to the label on the motherboard or [chapter 2.5](#), then pass the sensor cable through the cap, rubber seal and cover.



3. Put the motherboard back and restore everything to its due position. When restoring the cover, ensure the arrow faces the front of the transceiver.



**Note:** Rubber seal and rubber screw caps should be installed accordingly, or the water will come into the device.

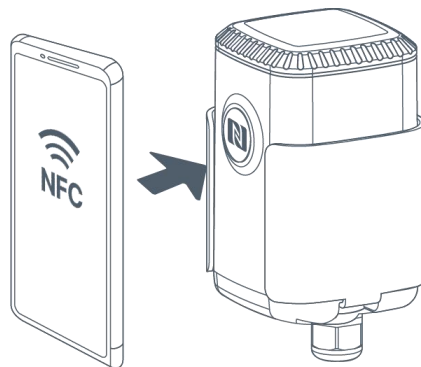
## 4. Operation Guide

### 4.1 Log in the ToolBox

EM500 series can be monitored and configured via ToolBox App or ToolBox software. **Before configuration, ensure the insulating sheet inside the device has be pulled out and battery is not placed reversed.**

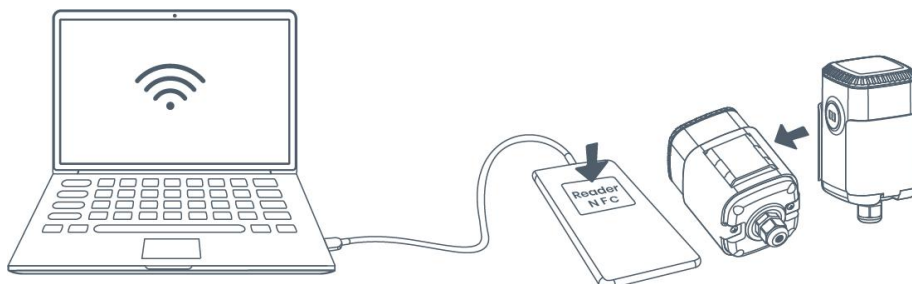
#### 4.1.1 NFC Configuration

1. Download and install “Milesight ToolBox” App from Google Play or Apple App Store.
2. Enable NFC on the smartphone and launch Milesight ToolBox.
3. Attach the smartphone with NFC area to the device to read device information. Basic information and settings of the device will be shown on ToolBox App if it’s recognized successfully. You can read and configure the device by tapping the Read/Write device on the App. In order to protect the security of the device, please change password when first configuration. The default password is **123456**.



**Note:**

- 3) Ensure the location of smartphone NFC area and it’s recommended to take off phone case.
- 4) If the smartphone fails to read/write configurations via NFC, keep the phone away and back to try again.
- 5) EM500 series can also be configured by dedicated NFC reader, which can be purchased from Milesight IoT.



### 4.1.2 USB Configuration

1. Download ToolBox software from [www.milesight-iot.com](http://www.milesight-iot.com).
2. Release the enclosure of the EM500 transceiver, then connect the device to a computer via Type-C port.



3. Open the ToolBox and select type as "General", then click password to log in ToolBox. (Default password: **123456**)

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

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

Buttons: Save, Cancel

4. After logging in the ToolBox, you can click "Power On" or "Power Off" to turn on/off device and change other settings.

**Status >** Power Off

Model:	EM500-SMTC-868M
Serial Number:	6126A39347142028
PN:	MEC20
Device EUI:	24e124126a393471
Firmware Version:	02.25
Hardware Version:	1.3
Device Status:	On
Join Status:	De-Activate
RSSI/SNR:	0/0
Temperature:	0°C
Humidity:	0%
Conductivity:	Disabled
Battery:	100%

## 4.2 LoRaWAN Settings

LoRaWAN settings is used for configuring the transmission parameters in LoRaWAN® network.

### Basic 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.

Device EUI	<input type="text" value="24E124126A393471"/>
App EUI	<input type="text" value="00250C0000010001"/>
Application Port	<input type="text" value="85"/>
Join Type	<input type="text" value="OTAA"/>
Application Key	<input type="text" value="*****"/>
Spread Factor	<input type="text" value="SF10-DR2"/>
Confirmed Mode	<input checked="" type="checkbox"/>
Rejoin Mode	<input checked="" type="checkbox"/>
Set the number of packets sent	<input type="text" value="32"/> packets
ADR Mode	<input type="checkbox"/>
TXPower	<input type="text" value="TXPower0-16 dBm"/>

Parameters	Description
Device EUI	Unique ID of the device which can also be found on the label.
App EUI	Default App EUI is 24E124C0002A0001.
Application Port	The port used for sending and receiving data, default port is 85.
Join Type	OTAA and ABP mode are available.
Application Key	Appkey for OTAA mode, default is 5572404C696E6B4C6F52613230313823.
Device Address	DevAddr for ABP mode, default is the 5 <sup>th</sup> to 12 <sup>th</sup> digits of SN.
Network Session Key	Nwkskey for ABP mode, default is 5572404C696E6B4C6F52613230313823.
Application Session Key	Appskey for ABP mode, default is 5572404C696E6B4C6F52613230313823.
RX2 Data Rate	RX2 data rate to receive downlinks.
RX2 Frequency	RX2 frequency to receive downlinks. Unit: Hz
Spread Factor	If ADR is disabled, the device will send data via this spread factor.
Confirmed Mode	If the device does not receive ACK packet from network server, it will resend

	data 3 times at most.
Rejoin Mode	Reporting interval $\leq$ 30 mins: device will send specific mounts of LoRaMAC packets to check connection status every 30 mins; If no reply after specific packets, the device will re-join. Reporting interval $>$ 30 mins: device will send specific mounts of LoRaMAC packets to check connection status every reporting interval; If no reply after specific packets, the device will re-join.
ADR Mode	Allow network server to adjust datarate of the device.
Tx Power	Transmit power of device.

**Note:**

- 1) Please contact sales for 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.

**LoRaWAN Frequency Settings:**

Go to **Setting->LoRaWAN Settings** of ToolBox App to select supported frequency and select channels to send uplinks. Make sure the channels match the LoRaWAN® gateway.

<input type="checkbox"/>	Index	Frequency/MHz	Max Datarate	Min Datarate
<input checked="" type="checkbox"/>	0	868.1	5-SF7BW125	0-SF12BW125
<input checked="" type="checkbox"/>	1	868.3	5-SF7BW125	0-SF12BW125
<input checked="" type="checkbox"/>	2	868.5	5-SF7BW125	0-SF12BW125
<input type="checkbox"/>	3	0	5-SF7BW125	0-SF12BW125
<input type="checkbox"/>	4	0	5-SF7BW125	0-SF12BW125
<input type="checkbox"/>	5	0	5-SF7BW125	0-SF12BW125
<input type="checkbox"/>	6	0	5-SF7BW125	0-SF12BW125
<input type="checkbox"/>	7	0	5-SF7BW125	0-SF12BW125

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 :

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:**

For -868M model, default frequency is EU868;

For -915M model, default frequency is AU915.

### 4.3 Basic Settings

Go to “**Device Settings -> Basic**” of ToolBox software or “**Device -> Settings -> General Settings**” of ToolBox App to change the reporting interval, etc.

Reporting Interval  min

Temperature Unit

Change Password

Parameters	Description
Reporting Interval	Reporting interval of transmitting data to network server.Default: 10 mins, Range: 1-1080 mins.
Temperature Unit	For EM500-CO <sub>2</sub> /SMTC/PT100 sensor, change the temperature unit displayed on the ToolBox. <b>Note:</b> 1) The temperature unit in the reporting package is fixed as °C. 2) Please modify the threshold settings if the unit is changed.

Pressure Unit	<p>For EM500-PP sensor, change the pressure unit displayed on the ToolBox.</p> <p><b>Note:</b></p> <p>1) The pressure unit in the reporting package is fixed as kPa.</p> <p>2) Please modify the threshold settings if the unit is changed.</p>
Soil Type	<p>For EM500-SMT/SMTC sensor, change the suitable soil type. It only works with hardware V2.0 and above.</p> <p><b>SMT:</b> Mineral soil, potting soil and rockwool are optional.</p> <p><b>SMTC:</b> Mineral soil, sandy soil, clay and organic soil are optional.</p>
Change Password	<p>Change the password for ToolBox App or software to read/write this device.</p>

## 4.4 Advanced Settings

### 4.4.1 Data Collection Settings

Go to “**Device Settings->Basic**” of ToolBox software or “**Device -> Settings -> Data Collection Settings**” of ToolBox App to select the data you need to monitor. **This feature is only supported by EM500-CO<sub>2</sub> and EM500-SMTC sensors.**

#### Data Collection Settings

Temperature&Humidity

Conductivity

### 4.4.2 Calibration Settings

#### Numerical Calibration:

ToolBox supports numerical calibration for all items. Go to “**Device Settings -> Basic**” of ToolBox software or “**Device -> Settings -> Calibration Settings**” of ToolBox App to type the calibration value and save, the device will add the calibration value to raw value.

Temperature Calibration	<input checked="" type="checkbox"/>
Current Raw Value	0 °C
Calibration Value	<input type="text" value="-1"/> °C
Final Value	-1 °C
Humidity Calibration	<input type="checkbox"/>

### CO<sub>2</sub> Calibration:

For EM500-CO<sub>2</sub>, ToolBox provides more calibration methods:

**Manual Calibration:** Put the device in an open outdoor environment for more than 10 minutes and click this button to calibrate the CO<sub>2</sub> value.

**Factory Calibration Restored:** Clean the manual calibration and turn back to factory calibration.

CO2 Calibration	<input checked="" type="checkbox"/>
<div style="background-color: #4a90e2; color: white; padding: 5px; text-align: center; margin-bottom: 5px;">Manual Calibration <span style="float: right;">?</span></div> <div style="background-color: #4a90e2; color: white; padding: 5px; text-align: center; margin-bottom: 5px;">Factory Calibration Restored <span style="float: right;">?</span></div>	
Current Raw Value	462 ppm
Calibration Value	<input type="text" value="0"/> ppm
Final Value	462 ppm

### Abnormal Value Prevention:

For EM500-PT100/SWL/UDL, ToolBox provides abnormal value prevention feature for accurate results. If the current value exceeds the range of previous value, the sensor will discard the current value and remeasure again. Take 20% as example, if last value is 5 and max range is 10, the next value should be within the range 3-7, or the sensor will measure again.

Abnormal Value Prevention	<input checked="" type="checkbox"/>
Maximum Range:	50 m
Set Value <span style="font-size: small;">(i)</span> :	20 %
<input type="range" value="20"/>	

### 4.4.3 Threshold Settings

Go to “**Device Settings->Basic**” of ToolBox software or “**Device->Setting->Threshold Settings**” of ToolBox App to enable the threshold settings and input the threshold. EM500 series will upload the current data instantly after the threshold is triggered.



Temperature	<input checked="" type="checkbox"/>
Over	<input type="text" value="0"/> °C
Below	<input type="text" value="0"/> °C
Data Collecting Interval	<input type="text" value="1"/> min

## 4.5 Maintenance

### 4.5.1 Upgrade

#### ToolBox Software:

1. Download firmware from [www.milesight-iot.com](http://www.milesight-iot.com) to your PC.
2. Go to “**Maintenance -> Upgrade**” of ToolBox software, click “**Browse**” to import firmware and upgrade the device. You can also click “Up to Date” to search for the latest firmware of the device and upgrade.

#### Maintenance >

Upgrade Backup and Reset

---

Model:	EM500-SMTC-868M
Firmware Version:	02.25
Hardware Version:	1.3
Domain:	<input type="text" value="Beijing Server"/>
FOTA:	<input type="button" value="Up to date"/>
Update Locally	<input type="text"/> <input type="button" value="Browse"/> <input type="button" value="Upgrade"/>

#### ToolBox App:

1. Download firmware from [www.milesight-iot.com](http://www.milesight-iot.com) to your smartphone.
2. Open ToolBox App and click “Browse” to import firmware and upgrade the device.

#### Note:

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

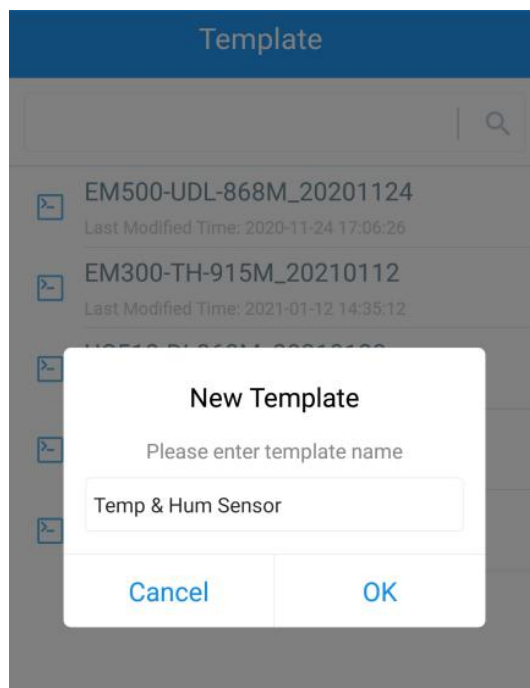
Status	Setting	Maintenance
SN	6126A39347142028	
Model	EM500-SMTC-868M	
Firmware Version	V2.25	
Hardware Version	V1.3	
Manual Upgrade		

[Browse](#)

### 4.5.2 Backup

EM500 devices support configuration backup for easy and quick device configuration in bulk. Backup is allowed only for devices with the same model and LoRa frequency band.

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



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

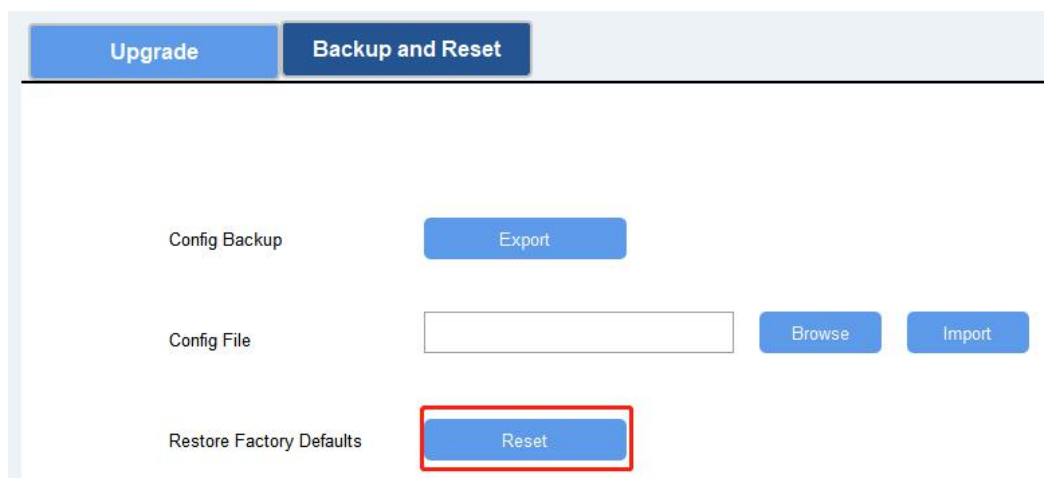
Template	
<input type="text"/>	<input type="text"/>
<input type="checkbox"/> EM500-UDL-868M_20201124 Last Modified Time: 2020-11-24 17:06:26	
<input type="checkbox"/> EM300-TH-915M_20210112 Last Modified Time: 2021-01-12 14:35:12	
<input type="checkbox"/> UC512-DI-868M_20210128 Last Modified Time: 2021-01-28 16:57:20	
<input type="checkbox"/> UC501-470M_20210201 Last Modified Time: 2021-02-01 11:29:43	
<input type="checkbox"/> M_20210208 Last Modified Time: 2021-02-08 16:44:37	<input type="button" value="Edit"/> <input type="button" value="Delete"/>

### 4.5.3 Reset to Factory Default

Please select one of following methods to reset device:

**Via Hardware:** Hold on power button (internal) for more than 10s.

**Via ToolBox Software:** Go to "Maintenance->Backup and Reset" to click "Reset".



**Via ToolBox App:** Go to "Device->Maintenance" to click "Reset", then attach smart phone with NFC area to device to complete reset.

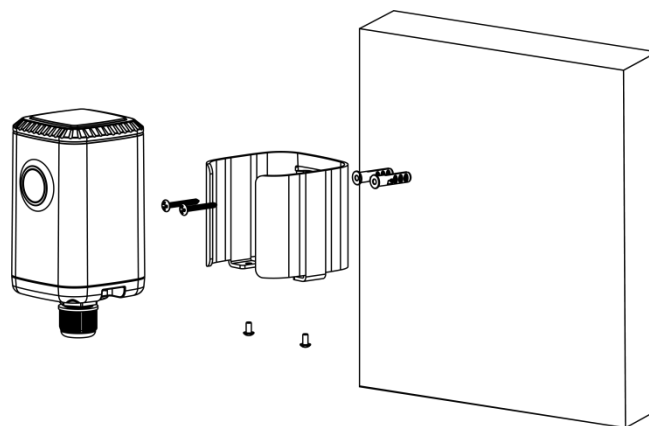
Status	Setting	Maintenance
SN	6126A39347142028	
Model	EM500-SMTC-868M	
Firmware Version	V2.25	
Hardware Version	V1.3	
Manual Upgrade		
<a href="#">Browse</a>		
Restore Factory Default		
<a href="#">Reset</a>		

## 5. Installation

EM500 transceiver support wall, pole and DIN rail mounting. Before installation, ensure the mounting bracket has fixed to the device via screws.

### Wall Mounting:

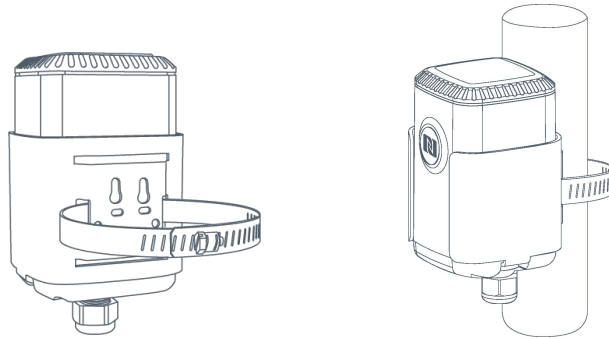
1. Drill 2 holes on the wall according to the mounting bracket, then fix the wall plugs into the wall.
2. Fix the mounting bracket to the wall via screws.
3. Put the device onto the mounting bracket, then fix the device to the bracket with 2 fixing screws.



### Pole Mounting:

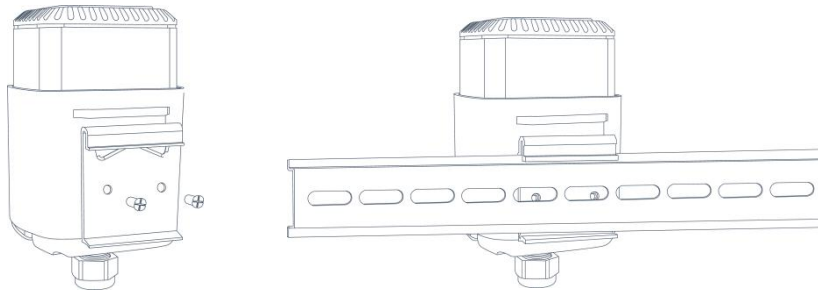
Straighten out the hose clamp and slide it through the rectangular holes in the mounting bracket,

wrap the hose clamp around the pole. After that use a screwdriver to tighten the locking mechanism by turning it clockwise.



### DIN Rail Mounting:

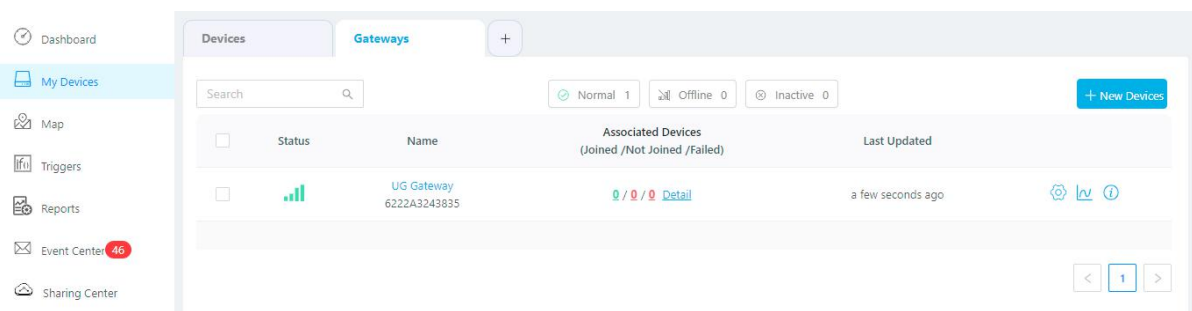
Use 2 pcs of M3 × 6 flat head Phillips screws to fix the mount clip to the bracket, and then hang the device to the DIN rail. The width of DIN rail is 3.5 cm.



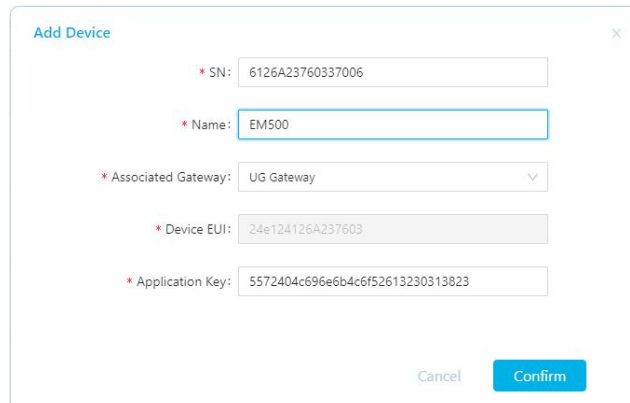
## 6. Milesight IoT Cloud Management

EM500 series can be managed by Milesight IoT Cloud platform. Milesight IoT cloud is a comprehensive platform that provides multiple services including device remote management and data visualization with the easiest operation procedures. Please register a Milesight IoT Cloud account before operating following steps.

1. Ensure Milesight LoRaWAN® gateway is online in Milesight IoT Cloud. For more info about connecting gateway to cloud please refer to gateway's user guide.



2. Go to “My Devices” page and click “+New Devices”. Fill in the SN of device and select an associated gateway.



**Add Device**

\* SN: 6126A23760337006

\* Name: EM500

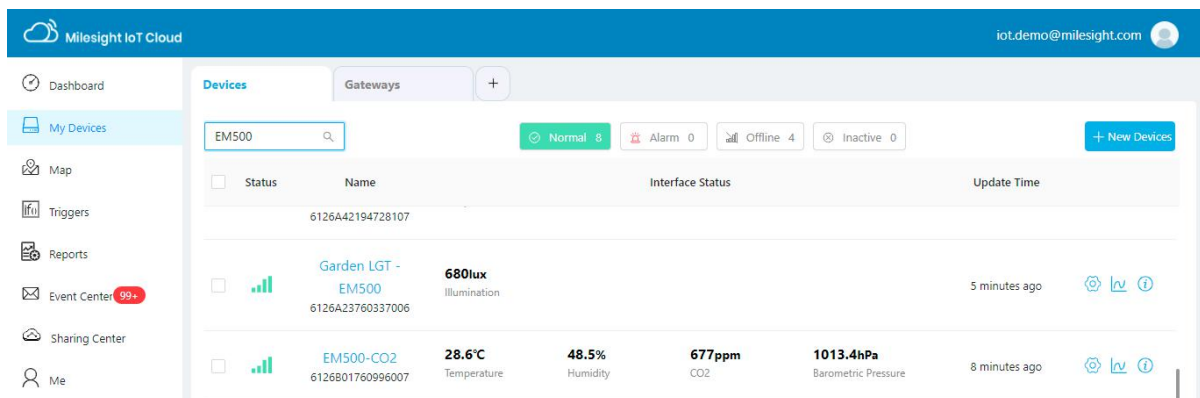
\* Associated Gateway: UG Gateway

\* Device EUI: 24e124126A237603

\* Application Key: 5572404c696e6b4c6f52613230313823

Cancel Confirm

3. After the device is online in Milesight IoT Cloud, you can check the data via webpage or mobile App and create dashboard for it.



Milesight IoT Cloud

iot.demo@milesight.com

Dashboard

My Devices

Map

Triggers

Reports

Event Center 99+

Sharing Center

Me

Devices

Gateways

EM500

Normal 8

Alarm 0

Offline 4

Inactive 0

+ New Devices

Status	Name	Interface Status	Update Time
	6126A42194728107		
	<b>Garden LGT - EM500</b> 6126A23760337006	<b>680lux</b> Illumination	5 minutes ago
	<b>EM500-CO2</b> 6126801760996007	<b>28.6°C</b> Temperature <b>48.5%</b> Humidity <b>677ppm</b> CO2 <b>1013.4hPa</b> Barometric Pressure	8 minutes ago

## 7. Device Payload

EM500 Series use the standard Milesight IoT payload format based on IPSO. Please refer to the **EM500 Series Communication Protocol**; for decoders of Milesight IoT products please click [here](#).

-END-