



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

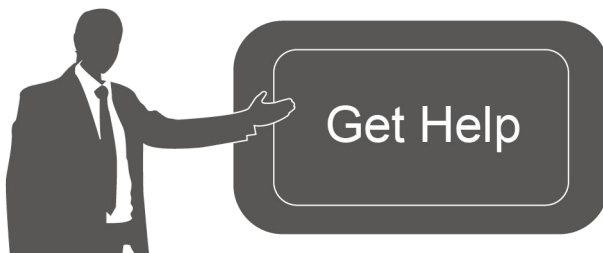
Ursalink EM500-CO<sub>2</sub> is in conformity with the essential requirements and other relevant provisions of the CE, FCC, and RoHS.



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## Revision History

Date	Doc Version	Description
August 12, 2020	V 1.0	Initial version

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## 1. Overview

### 1.1 Description

EM500-CO<sub>2</sub> is a sensor mainly used for outdoor environment through wireless LoRa network. EM500-CO<sub>2</sub> 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

- Integrated multiple sensors like CO<sub>2</sub>, barometric pressure, temperature and humidity
- 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
Sensors	
CO <sub>2</sub>	
Range	400 - 5000 ppm
Accuracy	±30 ppm or ±3 % of reading
Resolution	1ppm
Barometric Pressure	
Range	300 - 1100 hPa (-40°C - 85°C)
Accuracy	±1 hPa

Resolution	1hPa
<b>Temperature</b>	
Range	-30°C to + 70°C
Accuracy	0°C to + 70°C (+/- 0.3°C), -30°C to 0°C (+/- 0.6°C)
Resolution	0.1°C
<b>Humidity</b>	
Range	0% to 100% RH
Accuracy	10% to 90% RH (+/- 3%), below 10% and above 90% RH (+/- 5%)
Resolution	0.1%
<b>Physical Characteristics</b>	
Power Supply	19000 mAh Li-SoCl <sub>2</sub> battery
Operating Temperature	-30°C to +70°C
Relative Humidity	0% to 100% (non-condensing)
Dimension	147.9 × 71 × 69.5 mm
Mounting	Pole, wall, DIN rail

## 2. Hardware Introduction

### 2.1 Packing List



1 × EM500-CO<sub>2</sub>



2 × Mounting

Screws



1 × Hose

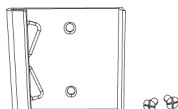
Clamp



1 × Warranty Card



1 × Quick Guide



1 × DIN Rail (Optional)



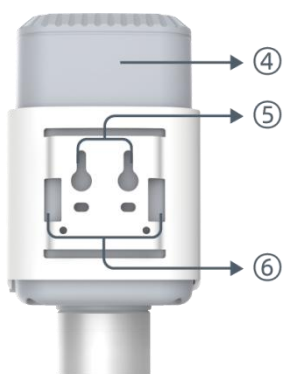
If any of the above items is missing or damaged, please contact your Ursalink sales representative.

## 2.2 Product Overview



### Front View:

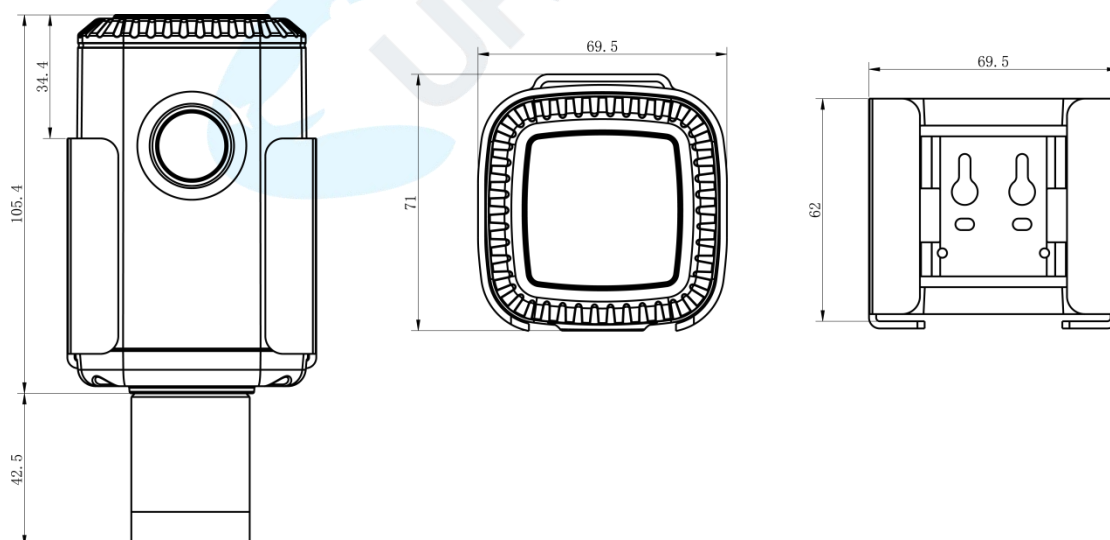
- ① LoRa Antenna (Internal)
- ② NFC Area
- ③ Vent Tube



### Back View:

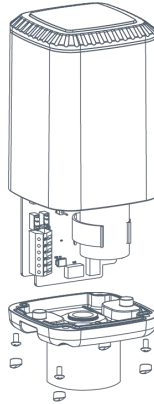
- ④ Battery (Internal)
- ⑤ Wall Mounting Holes
- ⑥ Pole Mounting Holes

## 2.3 Dimensions(mm)



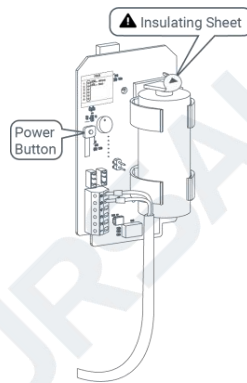
### 3. Insulating Sheet Disassembly

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



2. 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-CO<sub>2</sub> 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-CO<sub>2</sub> 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

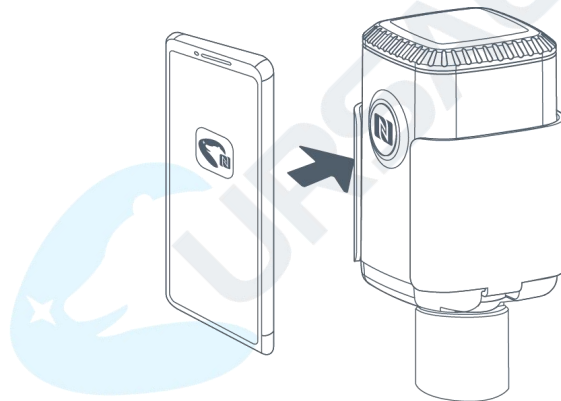
#### Preparation:

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

#### 5.1.1 Read/Write Configuration via NFC

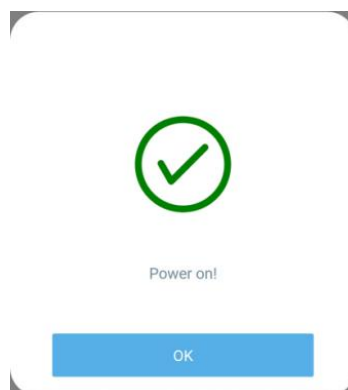
1. Enable NFC on the smartphone and open "Toolbox" APP.
2. Attach the smartphone with NFC area to the device to read basic information.

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



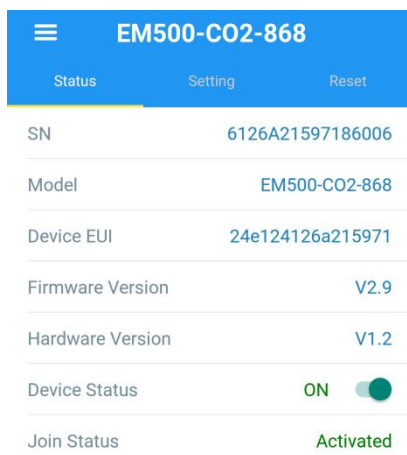
3. When you perform one of the following operations, enter the password and attach the smartphone with NFC area to the device until the APP shows a successful prompt.

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





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



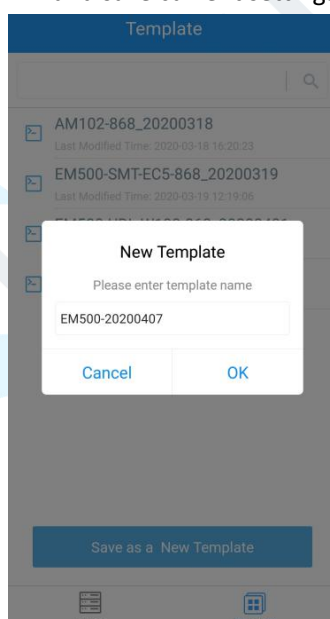
EM500-CO2-868		
Status	Setting	Reset
SN	6126A21597186006	
Model	EM500-CO2-868	
Device EUI	24e124126a215971	
Firmware Version	V2.9	
Hardware Version	V1.2	
Device Status	ON <input checked="" type="checkbox"/>	
Join Status	Activated	

### 5.1.2 Template Configuration

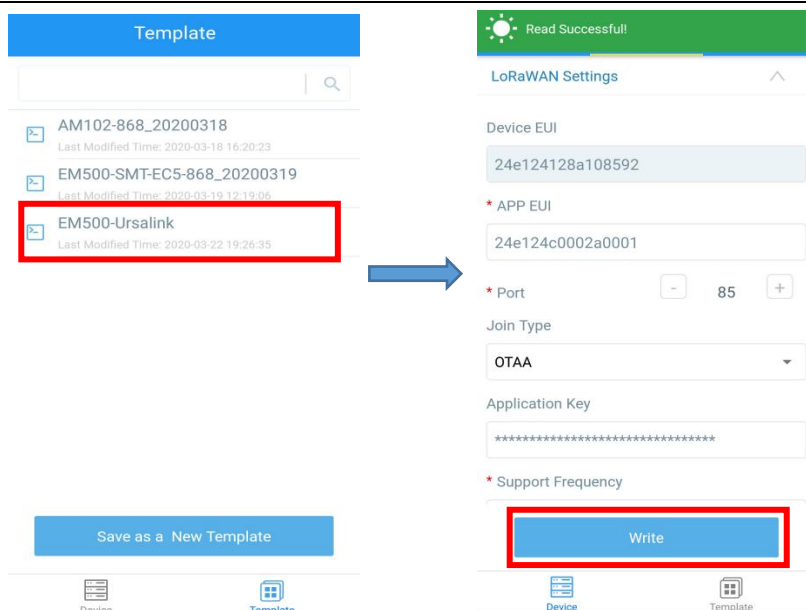
Template settings are used for easy and quick device configuration in bulk.

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

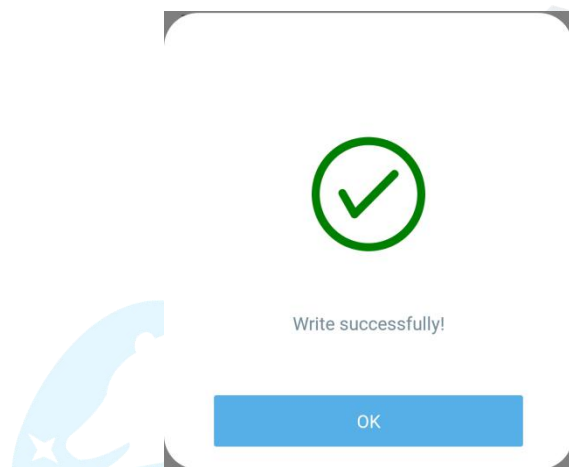
1. Go to “Template” page on the APP and save current settings as a template.



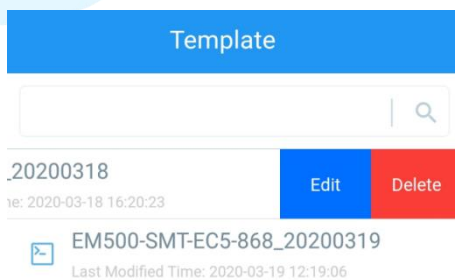
2. Attach the smartphone with NFC area to another device.
3. Select the template file from Toolbox APP and tap “Write”.



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

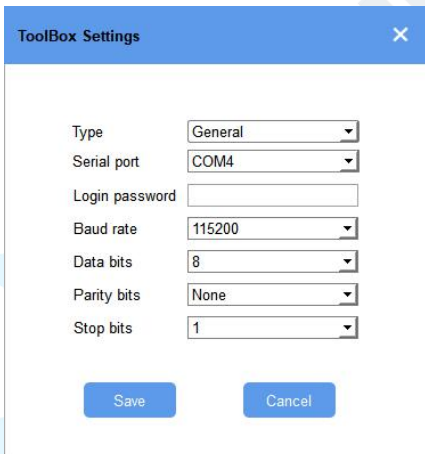
Make sure “Toolbox” is downloaded on your computer. Select one of the following methods to log in Toolbox.

#### Type-C Connection

1. Connect the EM500-CO<sub>2</sub> to computer via type-C port.

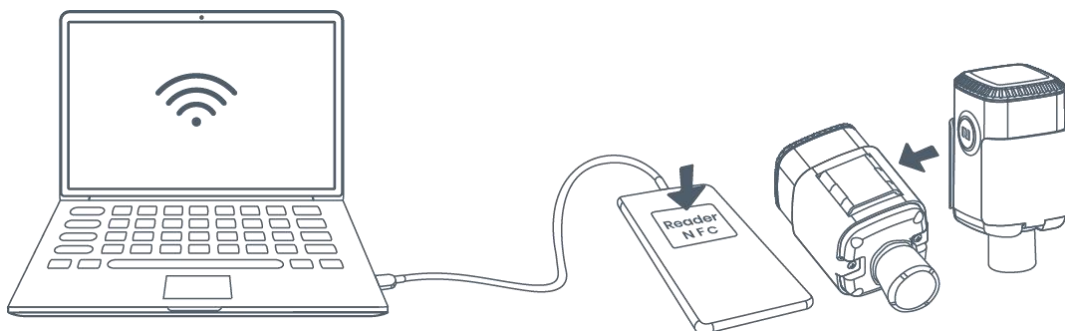
 Type-C port is inside the transceiver of the EM500-CO<sub>2</sub>.

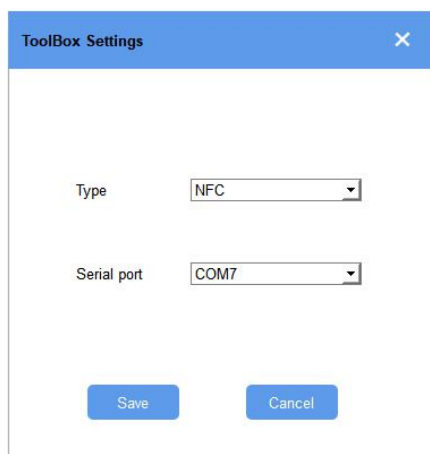
2. Select type as “General” and click password to log in Toolbox. (Default password: 123456)



#### NFC Connection

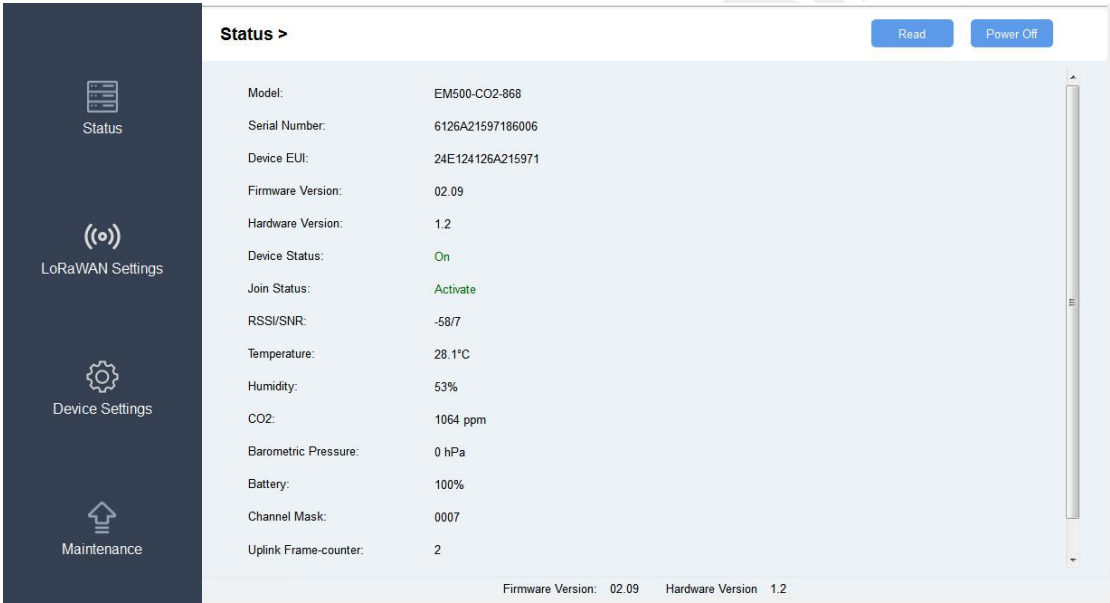
1. Connect the NFC reader to computer, then attach the EM500-CO<sub>2</sub> to NFC area of the reader.
2. Select type as “NFC” and serial port as NFC reader port on Toolbox.





## 5.2.2 Basic Configuration

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



Status >	
Model:	EM500-CO2-868
Serial Number:	6126A21597186006
Device EUI:	24E124126A215971
Firmware Version:	02.09
Hardware Version:	1.2
Device Status:	On
Join Status:	Activate
RSSI/SNR:	-58/7
Temperature:	28.1°C
Humidity:	53%
CO2:	1064 ppm
Barometric Pressure:	0 hPa
Battery:	100%
Channel Mask:	0007
Uplink Frame-counter:	2

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

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.

Upgrade
Template and Reset

Template Export

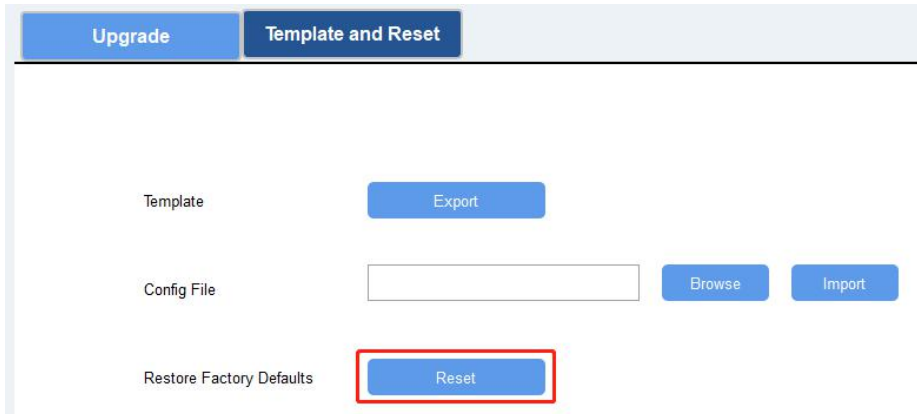
Config File  Browse Import

Restore Factory Defaults Reset

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

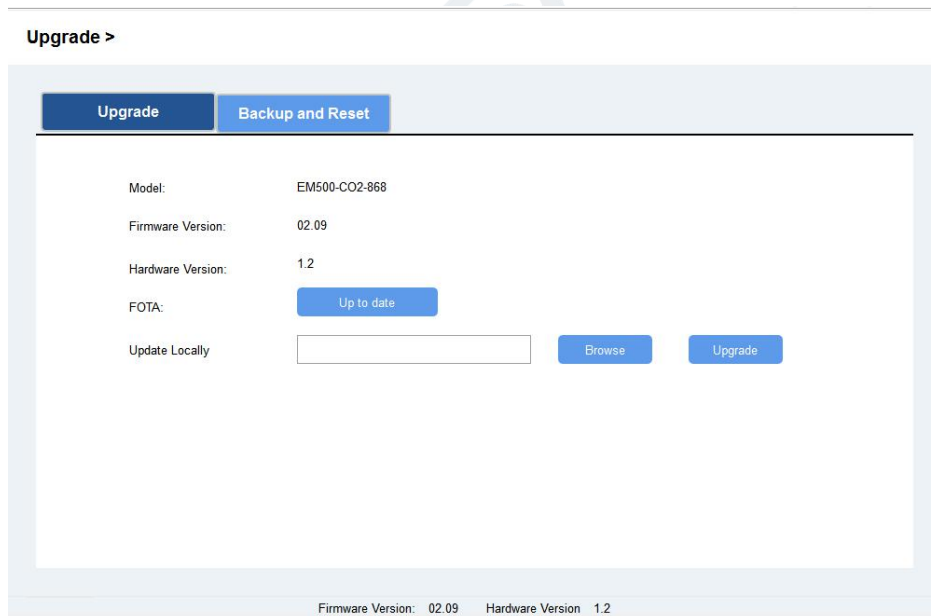
Go to “Maintenance -> Template and Reset” page in Toolbox, then click the “Reset” to reset the device to the factory settings.



### 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.



## 5.3 Configuration Examples

### 5.3.1 LoRaWAN Channel Settings

The configuration of LoRaWAN channel of EM500-CO<sub>2</sub> must match the LoRaWAN gateway's. Refer to [Appendix](#) to check default channel settings of EM500-CO<sub>2</sub>.

**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:**

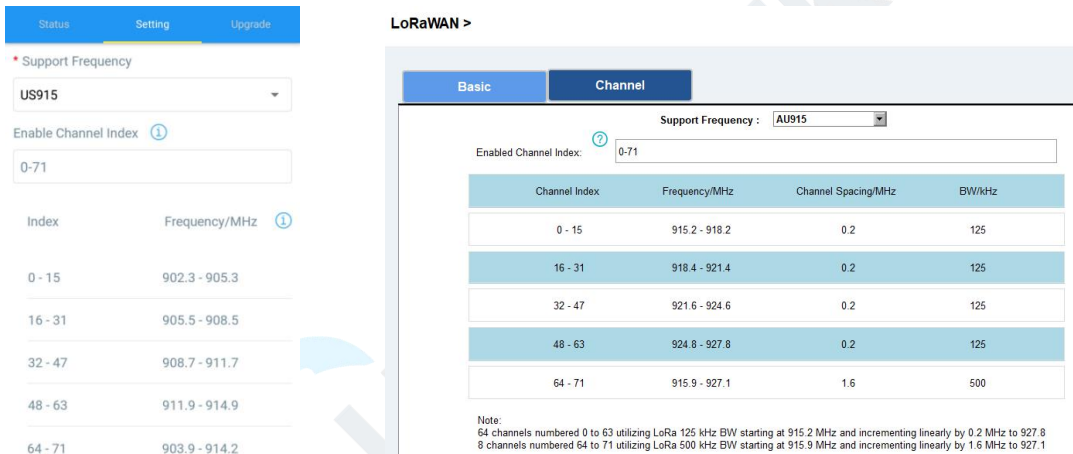
1, 40: Enabling Channel 1 and Channel 40

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



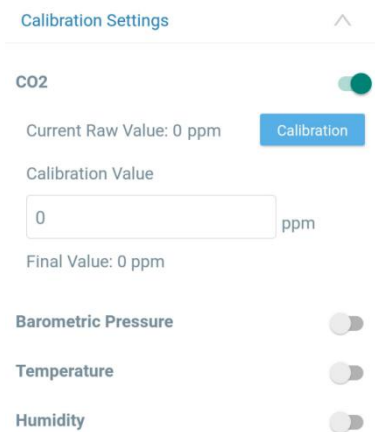
Channel Index	Frequency/MHz	Channel Spacing/MHz	BW/kHz
0 - 15	915.2 - 918.2	0.2	125
16 - 31	918.4 - 921.4	0.2	125
32 - 47	921.6 - 924.6	0.2	125
48 - 63	924.8 - 927.8	0.2	125
64 - 71	915.9 - 927.1	1.6	500

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

CO2

Current Raw Value: 0 ppm

Calibration Value

ppm

Final Value: 0 ppm

Barometric Pressure

Temperature

Humidity

**Software Configuration:**

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

**Calibration Settings**

Temperature Calibration

Humidity Calibration

CO2 Calibration

Current Raw Value 0 ppm Calibration

Calibration Value  ppm

Final Value

Barometric Pressure Calibration

**5.3.3 Alarm Settings**

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

CO2

Over / ppm

Below / ppm

Collecting Interval  3  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** ?

CO2

Over  ppm

Below  ppm

Data Collecting Interval  min



## 6. Installation

EM500-CO<sub>2</sub> should be considered following notes to insure proper installation:

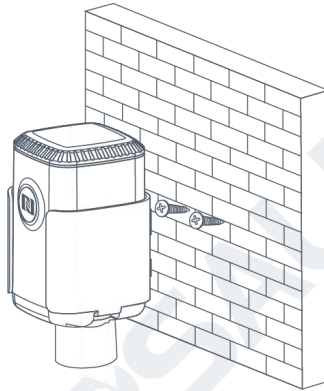
- CO<sub>2</sub> sensor should be mounted no higher than 12-18 inches above the floor since CO<sub>2</sub> is heavier than normal air and will flow down.
- Installation should be considered the layout of a space. Enclosed spaces or varying spaces are recommended to install one more sensor.

### 6.1 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.

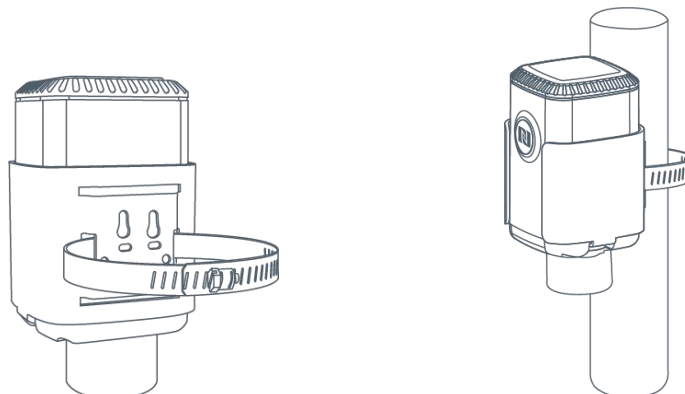


### 6.2 Pole Mounting

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

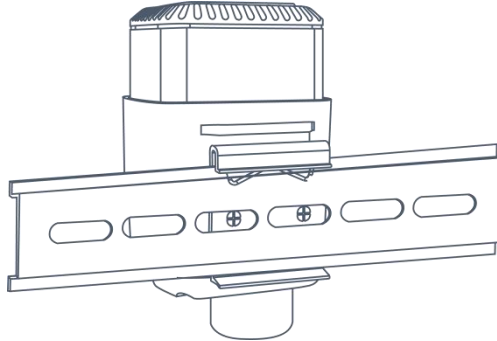


2. Straighten out the hose clamp and slide it through the rectangular holes in the mounting bracket, wrap the hose clamp around the pole.
3. Use a screwdriver to tighten the locking mechanism by turning it clockwise.



## 6.3 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.



## 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)	10 01 => 01 10 = 272 Temp=272*0.1=27.2	°C
04	68(Humidity)	71=>113 Hum=113*0.5=56.5	%
05	7D(CO <sub>2</sub> )	67 04=> 04 67=1127	ppm
06	73(Barometric Pressure)	68 27=> 27 68 =10088 10088*0.1=1008.8	hPa
FF	01(Ursalink Protocol Version)	01=> V1.0	/
	08 (Device SN)	64 10 90 82 43 75 00 01 =>Device SN is 6410908243750001	
	09 (Hardware Version)	01 01=> V1.01	
	0a(Software Version)	01 14=> V1.14	
	0b(Device Restart Notification)	ff (reserved)	
	0f(Device Type)	00 => Class A	

## Downlink Packet(HEX)

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

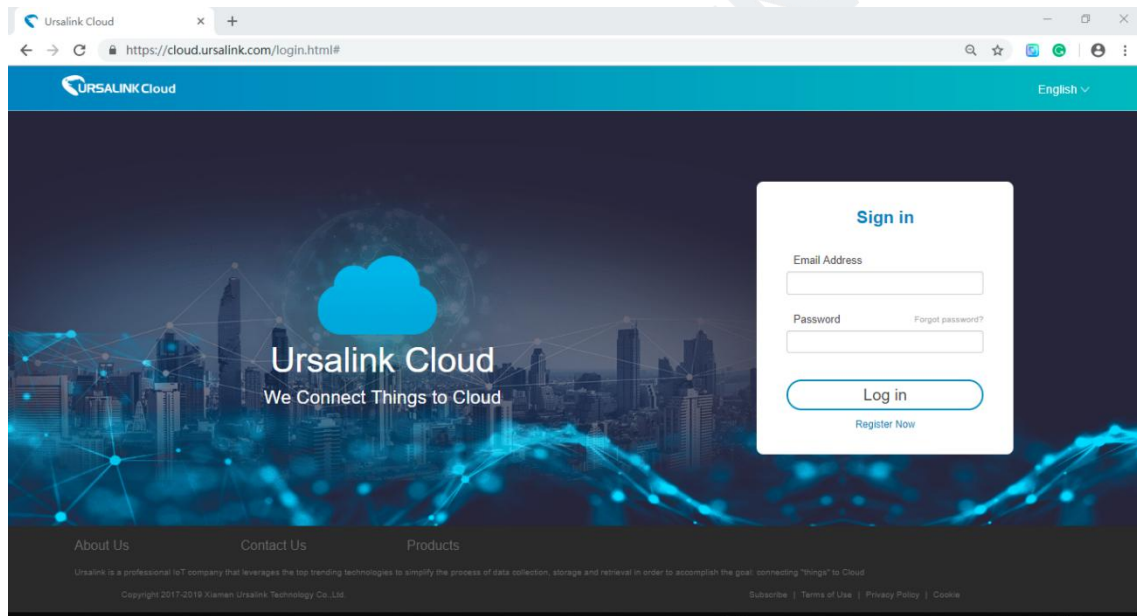
## 8.Sensor Management via Ursalink Cloud

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	[Edit] [Delete]
[Add]				

Enable  
 Ursalink Cloud

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

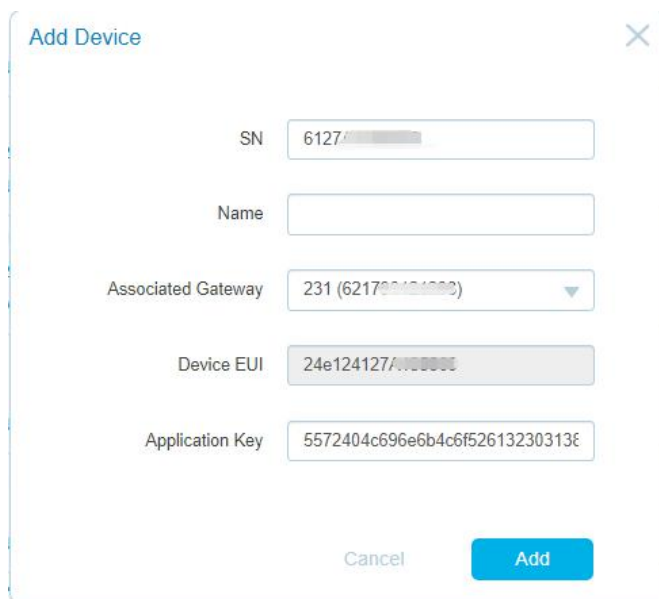
2. Go to “My Devices->Gateway” of Ursalink Cloud and click “Add” to add gateway to Ursalink Cloud via SN.


3. Check if gateway is online in Ursalink Cloud.

Status	Name	Model	Partnumber	Serial Number	Version	Update Time	Operation
Online	231	UG85-L00E-EU868	L00E-EU868	621793195782	Firmware: 80.0.0.62 Hardware: V1.1	2020-03-30 09:00	[Settings] [Refresh]
Online	621793195782	UG85-L01CE-CN470	L01CE-CN470	621793195782	Firmware: 80.0.0.62 Hardware: V1.1	2020-03-30 09:00	[Settings] [Refresh]

## 8.3 Add EM500-CO<sub>2</sub> to Cloud

1. Go to “Device->My Devices” and click “Add Device”. Fill in the SN of EM500-CO<sub>2</sub> and select associated gateway.



2. After EM500-CO<sub>2</sub> is connected to Ursalink Cloud, Click  or “History Data” to check the data on Ursalink cloud.



## 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-CO <sub>2</sub> -433	EU433	433.175, 433.375, 433.575
EM500-CO <sub>2</sub> -470	CN470	470.3~489.3 (All 95 channels)
EM500-CO <sub>2</sub> -868	EU868	868.1, 868.3, 868.5
EM500-CO <sub>2</sub> -915	AU915	915.2~927.1 (All 72 channels)

### Carbon Dioxide Levels and Guidelines

CO <sub>2</sub> Level	Description
400ppm	Normal outdoor air level.
400-1000ppm	Typical level indoors with good ventilation.
1000-2000ppm	Poor air quality - requires ventilation.
≥2000ppm	Headaches, sleepiness and stagnant, stale, stuffy air. Poor concentration, loss of attention, increased heart rate and slight nausea may also be present.
5000ppm	Workplace exposure limit (as 8-hour TWA) in most jurisdictions.
>40000ppm	Exposure may lead to serious oxygen deprivation resulting in permanent brain damage, coma, even death.

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