

EM500 Series User Guide



Xiamen Milesight IoT Co., Ltd.

Applicability

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

Model	Description		
EM500-CO2	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 remodeled in any way.
- 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



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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[®] 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 Milesight IoT Cloud or through the user's own Network Server.

1.2 Features

- Up to 11km communication range
- Easy configuration via NFC
- Standard LoRaWAN[®] support
- Milesight IoT Cloud compliant
- Low power consumption with 19000mAh replaceable battery

2. Hardware Introduction

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.

2.1 Hardware Overview



Front View of EM500: ①LoRa Antenna (Internal) ②NFC Area ③Water-proof Connector



Front View of EM500-CO₂: ①LoRa Antenna (Internal)

LoRa Antenna (Internal
NFC Area
Vent Tube



Front View of EM500-UDL: ①LoRa Antenna (Internal) ②NFC Area ③Ultrasonic Horn



Back View: (Description) Battery (Internal) Wall Mounting Holes Pole Mounting Holes

2.2 Dimen<mark>sio</mark>ns(mm)

EM500







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EM500-CO₂





2.3 Power Button Descriptions

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

3. Basic Configuration

EM500 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 configuring via unused phone. Default password is **123456**.

3.1 Configuration via Smartphone APP

Preparation:

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

3.1.1 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 the location of smartphone NFC area and it is recommended to take off phone case before using NFC.



≡ EM50	0-UDL-86	68M
SN	6126/	A21775363003
Model	EM	500-UDL-868M
PN		W100
Device EUI	24e1	24126a217753
Firmware Version		V2.25
Hardware Version		V1.2
Device Status		Off 🌑

3. Change the on/off status or parameters, then attach the smartphone with NFC area to the device until the APP shows a successful prompt.



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.

≡ EM50	0-UDL-868M	
Model	EM500-UDI	-868M
PN		W100
Device EUI	24e124126a2	17753
Firmware Version		V2.25
Hardware Version		V1.2
Device Status	ON	•
Join Status	De-ac	tivated
RSSI/SNR		0/0
Distance / Level	2	2.170 m
Battery		100 %
	Read	
Device	Template	20 C

3.1.2 Template Configuration

Template settings only work 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",keep the two devices close until the



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



3.2 Configuration via PC

Preparation:

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

3.2.1 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. Open the case of EM500 and connect the EM500 to computer via type-C port.



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

Туре	General	•
Serial port	COM4	•
_ogin passw	ord	
Baud rate	115200	•
Data bits	8	•
Parity bits	None	<u> </u>
Stop bits	1	•

NFC Connection

1. Connect the NFC reader to computer, then attach the EM500 to NFC area of the reader.



2. Select type as "NFC" and serial port as NFC reader port on Toolbox.

ToolBox Settings		×
Type Serial port	NFC _	
Save	Cancel	

3.2.2 Basic Configuration

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

Status >		Read	Power Off
Model:	EM500-UDL-868M		
Serial Number:	6126A21775363003		
PN:	W100		
Device EUI:	24E124126A217753		
Firmware Version:	02.25		
Hardware Version:	1.2		
Device Status:	On		
Join Status:	Activate		
RSSI/SNR:	-51/9		
Distance / Level:	0.685 m		
Battery:	100%		
Channel Mask:	0007		
Uplink Frame-counter:	2		
Downlink Frame-counter:	0		

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 need 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 Verify Password	24E124128A215862	
	Password:	Enter	
	Please put the NFC a	ntenna close to the NFC reader.	
	Regular Report Confirmed		
	ADR Mode		
D	ownlink Frame-counter:	1	
Succes	55	Firmware Version	r: 01.01

3.2.3 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.

Upgrade	Template and Res	et		
Template		Export		
Config File	I		Browse	Import
Restore Factory	Defaults	Reset		

3.2.4 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 >	
Status	Upgrade Backt	up and Reset
	Model:	EM500-UDL-868M
	Firmware Version:	02.27
((o))	Hardware Version:	1.3
LURAWAN Settings	Domain:	Beijing Server
	FOTA:	Up to date
Ś	Update Locally	Browse Upgrade
Device Settings		
^		
Ŷ		
Maintenance		
		Firmware Version: 02.27 Hardware Version 1.3

4. Advanced Feature Description

4.1 LoRaWAN Settings

Parameters	Description	Default		
Device EUI	Unique ID of the sensor. It can be found on the label.	On the label		
App EUI	App EUI of the sensor.	24E124C0002A0001		
Application Port	The port used for sending or receiving data. Default:	85		
	OTAA or ABP mode.			
Join Type	Note: If you use Milesight IoT cloud to manage sensors, please select OTAA mode.	ΟΤΑΑ		
Application Key	Appkey of the sensor.	5572404C696E6B4C 6F52613230313823		
Network ID	NetID of the sensor used for identifying LoRaWAN networks.	0x010203		
Device Address	DevAddr of the sensor.	The 5 th to 12 th digits of SN.		
Network	N. J. Luci Caller and a	5572404C696E6B4C		
Session Key	NWKSKEY OF THE SENSOF.	6F52613230313823		
Application	Appellow of the concer	5572404C696E6B4C		
Session Key	Appskey of the sensor.	6F52613230313823		
Spread Factor	Select spread factor from SF7 to SF12.	SF10-DR2		
Confirmed	If the sensor does not receive ACK package			
Mode	from network server, it will resend data 3 times	Disabled		
	most.			
Rejoin Mode	Sensor will send specific mounts of LoRaMAC packages to check connection status regularly. If no reply after specific packages, the sensor will re-ioin.	Enabled, 8 packages		
ADR Mode	ADR Mode Allow network server to adjust datarate of the sensor.			
Support	LoRaWAN region	EU868		
Frequency		AU915		

Channel	Enable or disable LoRa channels. 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	Appendix
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4.2 Basic Settings

Parameters	Description			
Reporting Interval	Interval of sending sensor data. Default: 10min.			
Change Decoward	Change the password of logging Toolbox (Windows) and parameter			
Change Password	modify(mobile APP).			

4.3 Calibration

Parameters		Description
Distance / Level Calibration Current Raw Value Calibration Value Final Value	✓ 6.895 m -1 m 5.895 m	After saving the calibration value, the sensor will add the calibration value to raw value and send the final value.
Measure Outliers Calibr Maximum Range Outlier Range Outlier Value	ation 2 10 m ? ± 2 % ? ± 200 mm	If current value exceeds the outlier range/values, the sensor will re-collect the value. Note: This item is only for EM500-UDL.

4.4 Threshold and Alarm

Parameters	Description		
Over/Below	Maximum/minimum data to trigger the alarm. After triggered, sensor will send current data ignoring report interval.		
Data Collecting Interval	The sensor will detect and check whether the value is triggered again after data collecting interval.		

5. Milesight IoT Cloud Management

EM500 sensors 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.

5.1 Add a Milesight Gateway

1. Enable "Milesight" type network server and "Milesight IoT Cloud" mode in gateway web GUI. **Note:** Ensure gateway has accessed the Internet.

Status	General Radios	Advanced	Custom	Traffic	
Packet Forwarder	General Setting				
Network Server	Gateway EUI 24E1. Gateway ID 24E	24FF:			
Network	Frequency-Sync Dis	abled	•		
System	Multi-Destination				
Maintenance	ID	Enable	Туре	Server Address	Operation
	0	Enabled	Milesight	localhost	
APP 🕨					+
	_				
Status	General	Applications	Profiles	Device	Gateways
Packet Forwarder	General Setting				
Network Server	Enable Milesight IoT Clou	✓			
Network	NetID	010203			
	Join Delay	5		sec	
System	RX1 Delay	1		sec	
Maintananca	Lease Time	8760-0-0		hh-mm-ss	
Maintenance	Log Level	info	~		

2. Go to "My Devices" page and click "+New Devices" to add gateway to Milesight IoT Cloud via SN. Gateway will be added under "Gateways" menu.

🕐 Dashboard	Device	es	Gate	ways	History	+					
My Devices	Searc	h	٩		⊘ Normal 1	Alarm 1	Offline 1 🛛 🛞) Inactive 3		+ New	Devices
🖄 Мар			The board for an	Add Device			×			Contract Contra	
Triggers		\otimes	具头设备-EN 6136A39023						5	@ M	1
Reports		\otimes	UC3X52-虚 61151109	* SN				sociated with your	i.e	@ lv	(1)
Event Center 30			UC3X5	* Name						M 1.	0
△ Sharing Center		₀đN,	6123A124						15 minutes ago	(c) [V	U
2 ме		Ä	AM102- 6128A2175			Cancel Con	firm	ux lination	a few seconds ago	@ <u>~</u>	(1)
				CO2	TVOC	Barometri	c Pressure				
			4	27°C Temperature	51% Humidity	O Activity Le	evel (PIR)	2lux Illumination			
≡•											

3. Check if gateway is online in Milesight IoT Cloud.

🕑 Dashboard	Devices Gateways	History +		
My Devices	Search Q	⊘ Normal 1 🕅 Offline 0 ⊗ Inactive 1	+ New	v Devices
🖄 Map	Status Name	Associated Devices (Joined /Not Joined /Failed)	Last Updated	
If Triggers	UG85-915 621694470052	2/2/0 More	- @ l	⊻ ()
Event Center 30	UG8555 6217A3163763	Device is not bound, please power on the device, after that, it will be associated with your account automatically	2020-08-18 16:42 🙆 🕻	⊻ ()
Sharing Center				

5.2 Add EM500 to Milesight IoT Cloud

1. Go to "My Devices" page and click "+New Devices". Fill in the SN of EM500 and select

associated ga <mark>teway.</mark>		
	Add Device	×
	SN	6127
	Name	
	Associated Gateway	231 (621700/01002)
	Device EUI	24e124127/
	Application Key	5572404c696e6b4c6f526132303138
		Cancel Add

2. After EM500 is connected to Milesight IoT Cloud, you could check the device information and data and create dashboard for it.

② Dashboard	Devices	Gateways	Histo	ory	+			
My Devices	Search	٩	0 N	ormal 1 🙇 Alar	m 1	⊗ Inactive 3		+ New Devices
Map Ifu Triggers		AM102-915 6128A2175966	26.9℃ Temperature 797ppm CO2	50.5% Humidity 209ppb TVOC	22 Activity Level (PIR) 1012.3hPa Barometric Pressure	57lux Illumination	a minute ago	ଡ <u>ଜ</u> ଏ
Event Center 30	o al	Am102-915 6128A2391618	27°C Temperature 632ppm CO2	50.5% Нитідіту 103ррь ТVOC	1 Activity Level (PIR) 1013hPa Barometric Pressure	2lux Illumination	a few seconds ago	@ <u>M</u> @
≺ Me		Am100-915 6127A1782908		D	evice is inactive!		2	@ <u>M</u> @
								< 1 >
≣∙								

6. Sensor Payload

All data are based on following format(HEX):

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

6.1 Basic Information

EM500 sensors report basic information of sensor everytime joining the network.

Channel	Туре	Data Example	Description
ff	01(Milesight Protocol Version)	01	V1
	09 (Hardware Version)	01 40	V1.4
	0a(Software Version)	01 14	V1.14
	Of(Device Type)	00	Class A
	16 (Device SN)	64 10 90 82 43 75 00 01	Device SN is 6410908243750001

6.2 Sensor Data

EM500 sensors report sensor data according to reporting interval (10min by default). Battery level is reported every 24 hours.

EM500-CO₂

Channel	Туре	Data Example	Description
01		64	64=>100
	/S(Battery Level)		Battery level =100%

02	67 (Temperature)	10 01	10 01 => 01 10 = 272
03			Temp=272*0.1=27.2°C
0.4	68(Humidity)	71	71=>113
04			Hum=113*0.5=56.5%
05	7d (CO ₂)	67 04	67 04 => 04 67 =1127 ppm
06	73 (Barometric Pressure)	68 27	68 27=>27 68=10088 Pressure=10088*0.1=1008.8hPa

EM500-LGT

Channel	Туре	Data Example	Description
01	75(Battery Level)	64	64=>100
01			Battery level =100%
03	94 (Light)	50 00 00 00	50 00 00 00=>00 00 00 50=80 lux
1500-PP	0-PP		

EM500-PP

Channel	Туре	Data Example	Description
01		64	64=>100
01	/5(Battery Level)		Battery level =100%
03	7b (Pressure)	0a 00	0a 00=>00 0a=10kPa

EM500-PT<mark>10</mark>0

Channel	Туре	Data Example	Description
01 75		64	64=>100
	/5(Battery Level)		Battery level =100%
03	67 (Temperature)	10 01	10 01 => 01 10 = 272
			Temp=272*0.1=27.2°C

EM500-SMT/SMTC

Channel	Туре	Data Example	Description
01	75(Battery Level)	64	64=>100
			Battery level =100%

03	67 (Temperature)	10 01	10 01 => 01 10 = 272 Temp=272*0.1=27.2°C
04	68(Moisture)	71	71=>113 Hum=113*0.5=56.5%
05	7d (Conductivity)	f0 00	f0 00 => 00 f0 =240 µs/cm

EM500-SWL

Channel	Туре	Data Example	Description
01	75(Battery Level)	64	64=>100
			Battery level =100%
03	77 (Water Level)	02 00	02 00=>00 02=2cm

EM500-UDL

Channel	Туре	Data Example	Description
			64=>100
01	/5(Battery Level)	64	Battery level =100%
03	82 (Distance)	1e 00	1e 00=>00 1e=30mm

6.3 Downlink Commands

EM500 sensors support downlink commands to configure the device. Application port is 85 by default.

Channel	Туре	Data Example	Description
ff	03(Set Reporting Interval)	b0 04	b0 04 => 04 b0 = 1200s

Appendix

Default LoRaWAN Parameters

	24E124 + 2 nd to 11 th digits of SN
DevEUI	e.g. SN = 61 26 A1 01 84 96 00 41
	Then Device EUI = 24E124126A101849
AppEUI	24E124C0002A0001

Appport	0x55
NetID	0x010203
	The 5 th to 12 th digits of SN
DevAddr	e.g. SN = 61 26 A1 01 84 96 00 41
	Then DevAddr = A1018496
АррКеу	5572404C696E6B4C6F52613230313823
NwkSKey	5572404C696E6B4C6F52613230313823
AppSKey	5572404C696E6B4C6F52613230313823

Default Uplink Channels

Ink Channels		
Model	Channel Plan	Channel Settings/MHz
EM500-470M	CN470	470.3~489.3(All 95 channels)
EM500-868M	EU868	868.1, 868.3, 868.5
	RU864	868.9, 869.1
	IN865	865.0625, 865.4025, 865.6025
EM500-915M	AU915	915.2~927.1 (All 72 channels)
	US915	902.3~914.2 (All 72 channels)
	KR920	922.1, 922.3, 922.5
	AS923	923.2, 923.4

-END-