



Contents [[hide](#)]

- [1 Milesight EM300-CL Capacitive Level Sensor](#)
- [2 Specifications](#)
- [3 Product Introduction](#)
- [4 Product Usage Instructions](#)
- [5 Safety Precautions](#)
- [6 Declaration of Conformity](#)
- [7 Revision History](#)
- [8 Product Introduction](#)
- [9 Features](#)
- [10 Hardware Introduction](#)
- [11 Operation Guide](#)
- [12 Advanced Settings](#)
- [13 Maintenance](#)
- [14 Installation](#)
- [15 Battery Replacing](#)
- [16 Communication Protocol](#)
- [17 Frequently Asked Questions](#)
- [18 Documents / Resources](#)
 - [18.1 References](#)



Milesight EM300-CL Capacitive Level Sensor



Specifications

- Product: Capacitive Level Sensor
- Model: EM300-CL
- Safety Standards: CE, FCC, RoHS
- Password: Default – 123456

Product Introduction

Overview:

The Capacitive Level Sensor EM300-CL is designed for high sensitivity real-time liquid level status monitoring with high stability and timely alarm capabilities. It offers strong anti-interference ability and high accuracy based on electrode pad with 2 electrodes.

Features:

- High sensitivity real-time liquid level status monitoring
- High stability and a timely alarm function
- Strong anti-interference ability
- High accuracy with an electrode pad featuring 2 electrodes

Product Usage Instructions

Installation:

- **EM300 Device Installation:**

Follow the provided guidelines for installing the EM300 device accurately.

- **Sensor Installation:**

Properly install the sensor according to the instructions to ensure accurate readings.

- **Battery Replacing:**

When replacing the battery, make sure to install it accurately and use the correct model to avoid any issues.

Communication Protocol:

- **Basic Information:**

Refer to the communication protocol section for basic information on the device's communication standards.

- **Sensor Data:**

Learn how to access and interpret sensor data for monitoring liquid levels effectively.

- **Downlink Commands:**

Understand and utilize downlink commands for controlling the device as needed.

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 should not be held responsible for any damage that 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 it the reverse or the wrong model.

- The device must never be subjected to shocks or impacts.

Declaration of Conformity

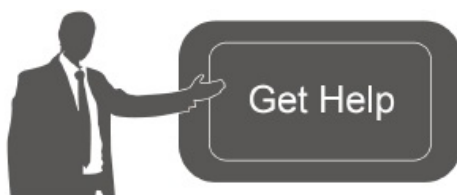
EM300-CL conforms with the essential requirements and other relevant provisions of the CE, FCC, and RoHS.



Copyright © 2011-2024 Milesight. All rights reserved.

All information in this guide is protected by copyright law. No organization or individual shall copy or reproduce the whole or part of this user guide by any means without written authorization from Xiamen Milesight IoT Co., Ltd.

For assistance, please contact



Milesight technical support:

- Email: iot.support@milesight.com
- Support Portal: support.milesight-iot.com
- Tel: 86-592-5085280
- Fax: 86-592-5023065
- Address: Building C09, Software Park III,

Revision History

Date	Doc Version	Description
Oct. 31, 2023	V 1.0	Initial version
Nov. 15, 2024	V 1.1	Add calibration settings.

Product Introduction

Overview

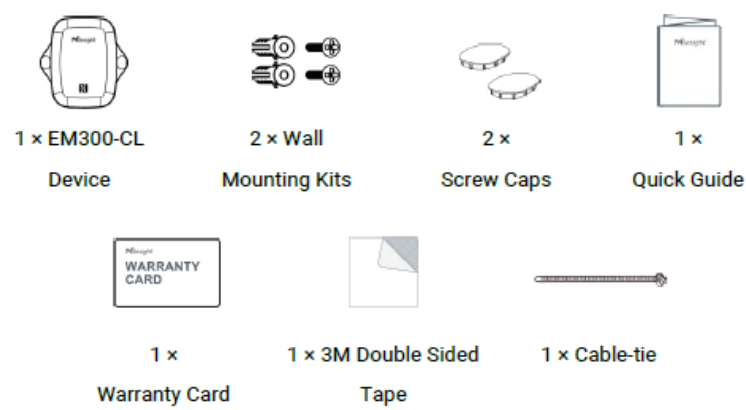
- EM300-CL is a non-contact liquid level sensor based on LoRaWAN®, which relies on capacitive sensing principle. It is mainly used to monitor hand wash in restrooms and sending out alarms when there is insufficient hand wash left.
- An alarm will be triggered when the hand wash level approaches the electrode detection sheet, signaling hand wash insufficiency. It can be seamlessly integrated with containers of different shapes and sizes to alert and assure that hand wash is replenished on time, promoting the good operation of the smart hygiene and cleaning management system.
- In addition, with LoRaWAN® technology that supports low power consumption, it allows the built-in high-capacity battery to last for several years without replacement. Moreover, EM300-CL is compatible with both Milesight's gateway and Milesight IoT Cloud to achieve remote monitoring and smart data management, allowing water conservation.

Features

- High sensitivity real-time liquid level status monitoring, high stability, and timely alarm
- Strong anti-interference ability and high accuracy based on the electrode pad with 2 electrode plates
- Non-contact liquid level detection for hygiene purposes
- The minimalist and lightweight electrode pad design allows for convenient installation
- IP67 waterproof performance for high applicability
- A built-in 4000mAh replaceable battery and works for 10 years without replacement
- Equipped with NFC for easy configuration
- Ultra-wide-distance transmission up to a line of sight of 10km
- Compliant with standard LoRaWAN® gateways and network servers
- Quick and easy management with Milesight IoT Cloud and Milesight Development Platform

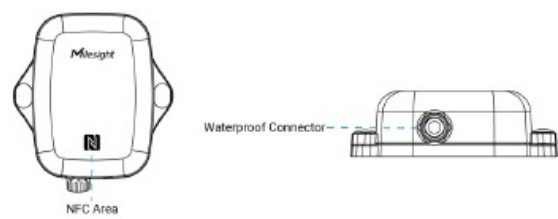
Hardware Introduction

Packing List



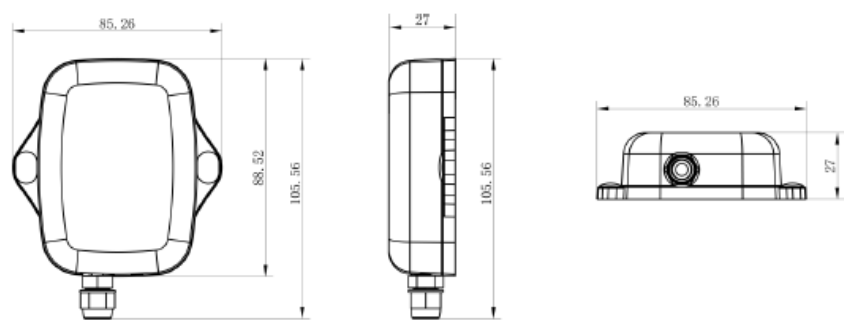
If any of the above items are missing or damaged, please contact your sales representative.

Hardware Overview

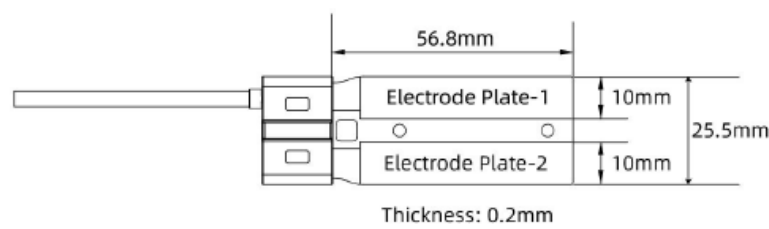


Dimensions(mm)

Transceiver:



Electrode Detection Sheet:



Power Button

There is an LED indicator and a power button inside the device for emergency reboot or reset.

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.	Blinks quickly.
Check On/Off Status	Quickly press the power button once.	Light On: Device is on.
		Light Off: Device is off.

Operation Guide

NFC Configuration

EM300-CL can be monitored and configured via NFC. Please refer to the following steps to complete the configuration.

1. Download and install the “Milesight ToolBox” App from the Google Play or the App Store.
2. Enable NFC on the smartphone and launch Milesight ToolBox.
3. Attach the smartphone with NFC area to the device and click NFC Read 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:

1. Ensure the location of the smartphone NFC area, and it's recommended to take off the phone case.
2. If the smartphone fails to read/write configurations via NFC, keep the phone away and back to try again.

LoRaWAN Settings

The device supports to configure join type, App EUI, App Key and other information. You can also keep all settings by default.

Device EUI

24E124862E211417

* APP EUI

24e124c0002a0001

* Application Port

85

LoRaWAN Version

V1.0.3

Work Mode

Class A

Confirmed Mode ⓘ ☐

Parameters	Description
Device EUI	Unique ID of the device, which can also be found on the label.
App EUI	The default App EUI is 24E124C0002A0001.
Application Port	The port used for sending and receiving data, the default port is 85.

Join Type	<p>OTAA and ABP modes are available.</p> <p>Note: Select OTAA mode if you use Milesight IoT Cloud or Milesight Development Platform to manage devices.</p>
Application Key	Appkey for OTAA mode, default is 5572404C696E6B4C6F52613230313823.
Device Address	DevAddr for ABP mode, default is the 5th to 12th digits of SN.
Network Session Key	Nwkskey for ABP mode, default is 5572404C696E6B4C6F52613230313823.
Application Session Key	Appskey for ABP mode, default is 5572404C696E6B4C6F52613230313823.
LoRaWAN Version	V1.0.2 and V1.0.3 are available.
Work Mode	It's fixed as Class A.

RX2 Data Rate	RX2 data rate to receive downlinks.
RX2 Frequency	RX2 frequency to receive downlinks. Unit: Hz

Supported Frequency	<p>Enable or disable the frequency to send uplinks. If frequency is one of CN470/AU915/US915, enter the index of the channel to enable in the input box, making them separated by commas.</p> <p>Examples:</p> <p>1, 40: Enabling Channel 1 and Channel 40</p> <p>1-40: Enabling Channel 1 to Channel 40</p> <p>1-40, 60: Enabling Channel 1 to Channel 40 and Channel 60. All: Enabling all channels</p> <p>Null: Indicate that all channels are disabled</p> <div><p>Enable Channel Index ⓘ</p><div>0-71</div><table><thead><tr><th>Index</th><th>Frequency/MHz ⓘ</th></tr></thead><tbody><tr><td>0 - 15</td><td>902.3 - 905.3</td></tr><tr><td>16 - 31</td><td>905.5 - 908.5</td></tr><tr><td>32 - 47</td><td>908.7 - 911.7</td></tr><tr><td>48 - 63</td><td>911.9 - 914.9</td></tr><tr><td>64 - 71</td><td>903 - 914.2</td></tr></tbody></table></div>	Index	Frequency/MHz ⓘ	0 - 15	902.3 - 905.3	16 - 31	905.5 - 908.5	32 - 47	908.7 - 911.7	48 - 63	911.9 - 914.9	64 - 71	903 - 914.2
Index	Frequency/MHz ⓘ												
0 - 15	902.3 - 905.3												
16 - 31	905.5 - 908.5												
32 - 47	908.7 - 911.7												
48 - 63	911.9 - 914.9												
64 - 71	903 - 914.2												
Spread Factor	If ADR is disabled, the device will send data via this spread factor.												
Confirmed Mode	If the device does not receive an ACK packet from the network server, it will resend the data once.												

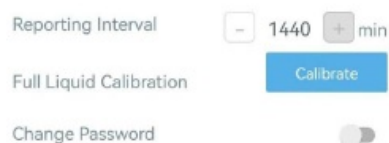
Rejoin Mode	<p>Reporting interval ≤ 35 mins: the device will send a specific number of LinkCheckReq MAC packets to the network server every reporting interval or every double reporting interval to validate connectivity; If there is no response, the device will re-join the network.</p> <p>Reporting interval > 35 mins: the device will send a specific number of LinkCheckReq MAC packets to the network server every reporting interval to validate connectivity; If there is no response, the device will re-join the network.</p> <p>Note: Only OTAA mode supports rejoin mode.</p>
-------------	--

Set the number of packets sent.	<p>When the rejoin mode is enabled, set the number of LinkCheckReq packets to send.</p> <p>Note: the actual sending number is set to the number of packets sent + 1.</p>
ADR Mode	Allow the network server to adjust the data rate of the device.
Tx Power	The transmit power of the device.

Note:

1. Please contact sales for the device EUI list if there are many units.
2. Please contact sales if you need random App keys before purchase.

Basic Settings

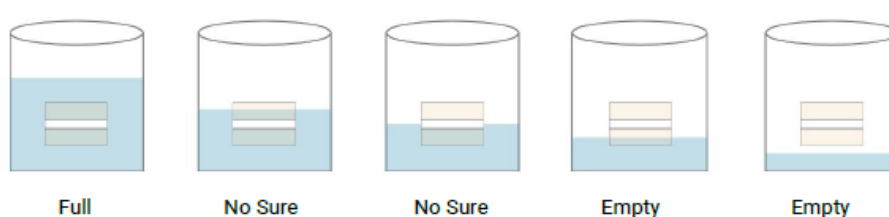


Parameters	Description
Reporting Interval	The reporting interval of transmitting the battery level and liquid status to network server. Range: 1-1440 mins, Default: 1440 mins
Full Liquid Calibration	<p>When the liquid is full, click the Calibrate button to record the full status. After calibration, the device will report a calibration result packet.</p> <p>Note:</p> <ol style="list-style-type: none"> 1) The device will calibrate automatically after turning on for 20 minutes. 2) The alarm feature will not work if the liquid calibration has not been performed. 3) Please recalibrate it if the full liquid height changes.
Change Password	Change the password for the Toolbox App to write this device.

Advanced Settings

Calibration Settings

EM300-CL detects the liquid level status by judging the capacitance difference values of the two electrode sheets.



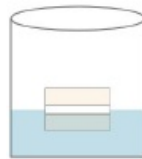
If the device reports error level status, please refer to the checklist below:

- The sensor meets the installation requirements.
- The full liquid calibration is operated.

If it still does not work, please complete the steps below to adjust the judgment values.

1. Change the reporting interval to 1 minute.
2. Fill the target container with liquid to ensure the liquid level is in the middle of the two electrode sheets.

Note: If the detection liquid is too thick and hangs on the side wall of the container, please wait for the liquid to settle before calibration.



3. Wait for more than 1 minute, then read the device to record the current value $\Delta C1$.

Device		Network
General Alarm Calibration		
C1:Capacitance value of electrode sheet 1		
C1':Calibration Value	54.08	
C1:Current Value	54	
C2:Capacitance value of electrode sheet 2		
C2':Calibration Value	55.81	
C2:Current Value	55.8	
$\Delta C= C1-C2 $		
$\Delta C'$:Calibration Value	1.73	
ΔC :Current Value	1.8	

4. Add the liquid to the full level of the container, then wait for more than 1 minute and read the device to record the current value $\Delta C2$.
5. Calculate the judgment value result: $|\Delta C2-\Delta C1|$. Example: $\Delta C1=-89$, $\Delta C2=-58$, the result is 31.
6. Write the result to the full liquid judgment value.

Alarm Value Setting ⓘ

Full liquid judgment value $|\Delta C' - \Delta C|$

31

7. Reduce the liquid to below the electrode sheets, or add the liquid to full, then wait for more than 1 minute to read the device to check if the liquid level status is correct.

Alarm Settings

Alarm Reporting ☒

Collecting Interval 10 min

Alarm Reporting Times 3

Alarm Dismiss Report ⓘ ☐

Parameters	Description
Alarm Reporting	After being enabled, the device will report the alarm packet when the liquid level of the container is lower than the installation height of the detection electrode sheet. Only when the alarm is dismissed and re-triggered, the device will send the alarm again.
Status Detection Interval	The interval to detect liquid status after the alarm triggers.
Alarm Reporting Times	Alarm packet reports times after the alarm triggers.
Alarm Dismiss Report	After being enabled, the device will report the alarm dismiss packet once When the liquid in the container is changed to full.

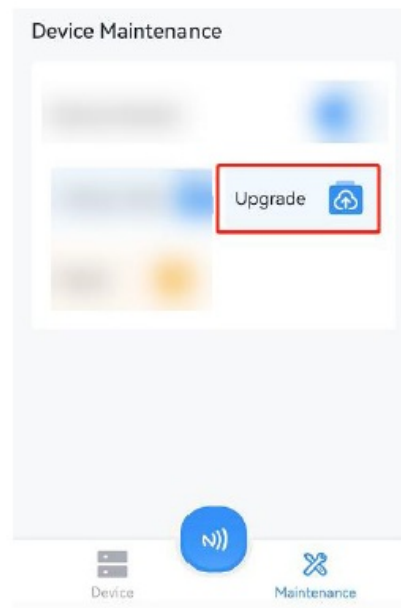
Maintenance

Upgrade

1. Download firmware from the Milesight website to your smartphone.
2. Open the Toolbox App and click Browse to import firmware and upgrade the device.

Note:

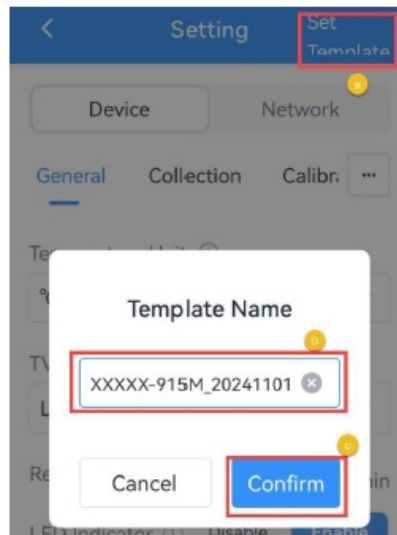
1. Operation on ToolBox is not supported during an upgrade.
2. Only the Android version of Toolbox supports the upgrade feature.



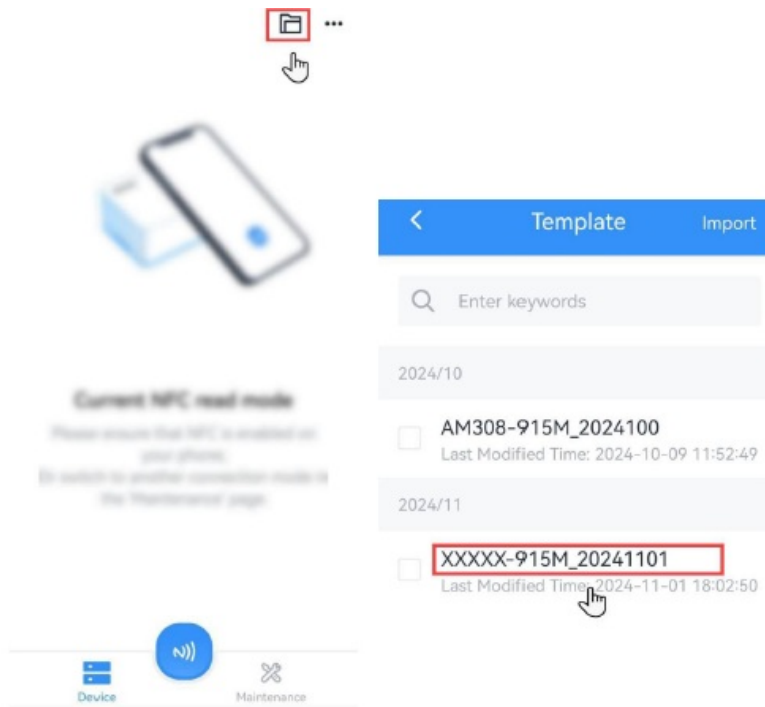
Backup

EM300 devices support configuration backup for easy and quick device configuration in bulk. Backup is allowed only for devices with the same model and LoRaWAN® frequency band.

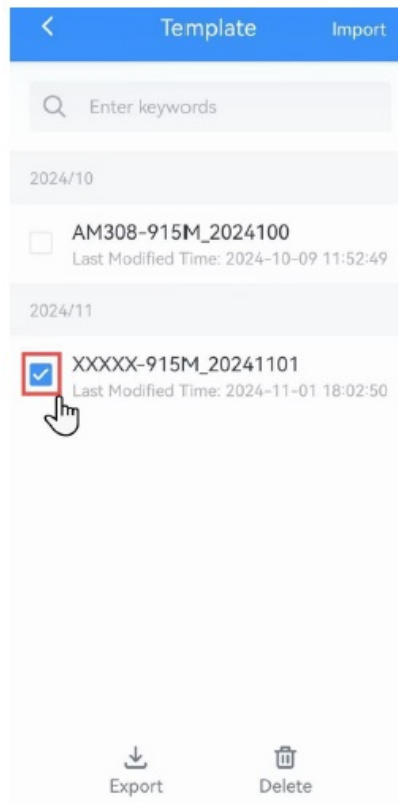
1. Attach the NFC area of the smartphone to the device to read the device.
2. Go to the Settings page on the App to edit the configuration as required, and click Set Template to save the current configuration as a template in the Toolbox App.



- Go to the Template page, select and click the target template, then click Write, and attach the NFC area of the smartphone to the target device to import the configuration.



Note: Check the box of the target template to delete it, or export this template as a JSON format file and save it to your smartphone.

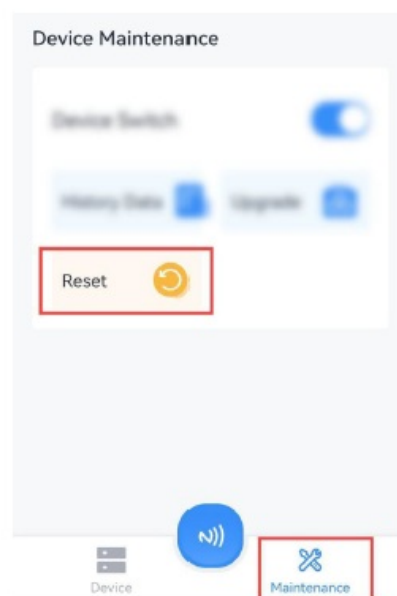


Reset to Factory Default

Please select one of the following methods to reset the device:

Via Hardware: Hold on power button (internal) for more than 10 seconds until the LED blinks.

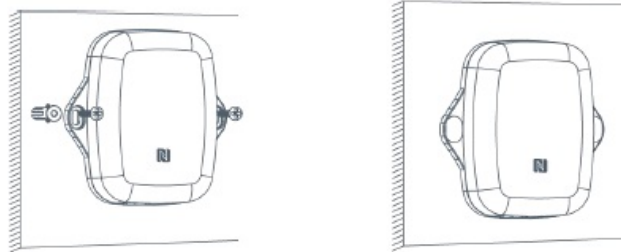
Via ToolBox App: Go to Device > Maintenance to click Reset, then attach a smart smartphone with an NFC area to the device to complete the reset.



Installation

EM300 Device Installation

1. Attach EM300 device to the wall and mark the two holes on the wall. The connecting line of two holes must be a horizontal line.
2. Drill the holes according to the marks and screw the wall plugs into the wall.
3. Mount the EM300 to the wall via mounting screws.
4. Cover the mounting screws with screw caps.



Besides, it can also be mounted to a wall via 3M tape or be mounted to a pole via cable-tie.

Sensor Installation

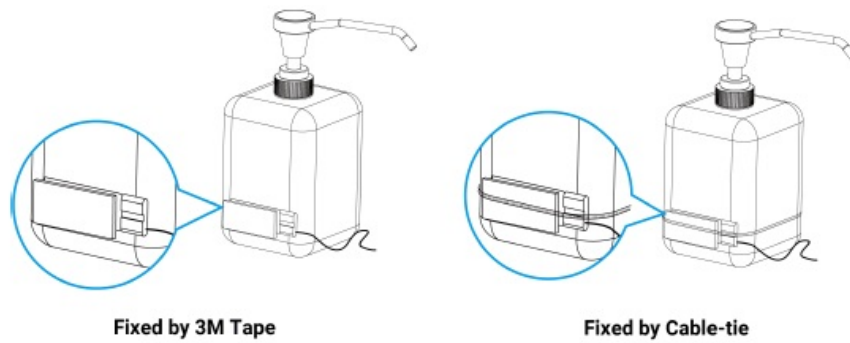
Installation Requirements

- This product is not applicable to metal conductive metal containers, absorbent non-metal material containers (cement, wood board, ceramic, tiles, bricks, etc.) or liquid in bags.
- This product is applicable to the containers made up of insulating non-metallic materials and with flat surfaces and uniform thickness, like plastic, glass, acrylic, etc.
- It is suggested that the side walls of the container do not exceed 3mm.
- Avoid the detection electrode sheet facing the liquid inlet or the path of the liquid inlet flow.
- Clean the container to avoid the detection results being affected by silt or other debris.

Installation Steps

1. Attach the detection electrode sheet to the wall of the container seamlessly, aligning it with the bottom of the container to detect the liquid capacity.

2. Fix the detection electrode sheet by a 3M tape or a cable-tie. The protective foam is faced outside.

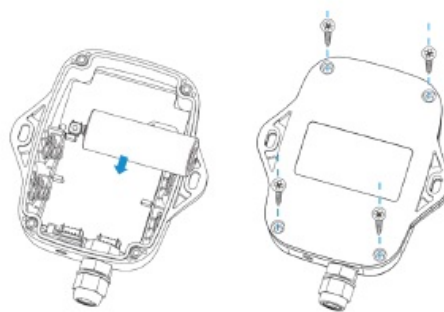


Factors Affecting Accuracy

- Avoid detection electrode sheet to be attached by detection liquids, or this will affect the detection results.
- If the detection liquid is too thick, it will hang to the side wall of container, and will delay the time of leak detection and alarm.
- Keep the distance between the detection electrode sheets more than 15cm to avoid detection interference if you have two EM300-CL sensors.

Battery Replacing

When the batteries have run out of power, please remove the back cover to replace the batteries.



Note:

- EM300 provides 4000mAh version and 8000mAh version. Please do not install 2 batteries on the 4000mAh version, and vice versa. Otherwise, it will cause inaccurate power calculations.
- To reduce the interference of NFC transmission, it is suggested that the battery be

installed in the upper location (see figure).

- The device can only be powered by the ER18505 Li-SoCl₂ battery. The alkaline battery is not supported.
- The battery should be removed or replaced from the device if it is not used for an extended period.
- Ensure all batteries being replaced are the newest; otherwise, it may shorten battery life or cause inaccurate power calculations.

Communication Protocol

All data are based on the following format (HEX), the Data field should follow little-endian:

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

For decoder examples, please find the files on <https://github.com/Milesight-IoT/SensorDecoders>.

Basic Information

EM300 series sensors report basic information about the sensor whenever joining the network.

Item	Channel	Type	Description
Power On	ff	0b	ff this means the device is on
Protocol Version		01	01=>V1
Hardware Version		09	01 40 => V1.4
Software Version		0a	01 14 => V1.14
Device Type		0f	00: Class A, 01: Class B, 02: Class C

Device SN		16	16 digits
-----------	--	----	-----------

Example:

ff0bff ff0101 ff166136c40091605408 ff090300 ff0a0101 ff0f00					
Channel	Type	Value	Channel	Type	Value
ff	0b (Power On)	ff	ff	01 (Protocol Version)	01 (V1)
Channel	Type	Value	Channel	Type	Value
ff	16 (Device SN)	6136c40091605408	ff	09 (Hardware Version)	0300 (V3.0)
Channel	Type	Value	Channel	Type	Value
ff	0a (Software Version)	0101 (V1.1)	ff	0f (Device Type)	00 (Class A)

Sensor Data

Item	Channel	Type	Description
------	---------	------	-------------

Battery Level	01	75	UINT8, Unit: %
Liquid Level Status	03	ed	00: Uncalibrated, 01: Full, 02: Empty, ff: Sensor error or not connected
Calibration Status	04	ee	00: Failure; 01: Success
Liquid Level Alarm	83	ed	2 Bytes, Byte 1: 00=Uncalibrated, 01=Full, 02=Empty, ff=Sensor error or not connect Byte 2: 01=Alarm, 00=Alarm dismiss

Examples:

1. Periodic packet: reports according to the reporting interval (1440 min by default).

017564 03ed01					
Channel	Type	Value	Channel	Type	Value
01	75	Battery level: 64 => 100%	03	ed	Liquid status: 01=full

2. Alarm packet: reports according to alarm settings.

83ed00		
Channel	Type	Value
83	ed	Liquid status: 01=empty

3. Low battery level packet: reports when battery level is below 1%.

017501		
Channel	Type	Value
01	75	Battery level: 01 => 1%

Downlink Commands

EM300-CL supports downlink commands to configure the device. The application port is 85 by default.

Command	Channel	Type	Byte	Description
Reboot	ff	10	1	ff
Reporting Interval	ff	8e	3	00 + Interval Time(2B), unit: min
Status Detection Interval	ff	bb	3	00 + Interval Time(2B), unit: min Note: This interval time should be less than the reporting interval.

Alarm Reporting	ff	7e	5	CTRL (1B) + 0000 + Alarm Reporting Times (2B) CTRL: 00=Disable, 01 = Enable alarm reporting, disable alarm dismiss report 81 = Enable alarm reporting and alarm dismiss report
Full Liquid Calibration	ff	62	1	ff

Change Capacitance Value	ff	bf	9	<p>Byte 1: 00=All Calibration Values, 02=C1', 04=C2', 06=$\Delta C'$</p> <p>01= All Judgement Values, 03=Full Liquid Judgement Value, 05=Liquid Shortage Judgement Value, 07=Liquid Shortage 1 Judgement Value, 09=Liquid Shortage 2 Judgement Value</p> <p>When changing calibration values:</p> <p>Byte 2-3: C1', UINT16/100 Byte 4-5: C2', UINT16/100 Byte 6-7: $\Delta C'$, UINT16/100 Byte 6-9: 0000</p> <p>When changing judgment values:</p> <p>Byte 2-3: Full Liquid Judgement Value</p> <p>$\Delta C' - \Delta C$, UINT16/100</p> <p>Byte 4-5: Liquid Shortage Judgement Value $\Delta C' - \Delta C$, UINT16/100</p> <p>Byte 6-7: Liquid Shortage 1 Judgement</p>
--------------------------	----	----	---	--

fe	be	02	<p>Byte 1-2: Full Liquid Judgement Value $\Delta C' - \Delta C$, UIN T16/100</p> <p>Byte 3-4: Liquid Shortage Judgement Value $\Delta C' - \Delta C$, UIN T16/100</p> <p>Byte 5-6: Liquid Shortage 1 Judgement Value $(C1' - C1) \& (C2' - C2)$, UIN T16/100</p> <p>Byte 7-8: Liquid Shortage 2 Judgement Value $(C1' - C1) \& (C2' - C2)$, UIN T16/100</p>
----	----	----	---

Examples:

1. Set the reporting interval to 20 minutes.

ff8e 00 1400		
Channel	Type	Value
ff	8e (Reporting Interval)	14 00=>00 14=>20 mins

2. Reboot the device.

ff10ff		
Channel	Type	Value
ff	10	ff

3. Enable alarm reporting, set reporting times to 5, and enable alarm dismiss report.

ff7e 81 0000 0500		
Channel	Type	Value

ff	7e	81 = Enable alarm reporting and alarm dismiss report 0500=>00 05=5 reporting times
----	----	---

4. Enquire about the calibration value.

ffbe00		
Channel	Type	Value
ff	be	00=Capacitance Calibration Value of Electrode Sheets

Reply:

febe 00 2015cd15ad00		
Channel	Type	Value
fe	be	00=Capacitance Calibration Value of Electrode Sheets C1': 2015=>1520=5408/100=54.08 C2': cd15=>15cd=5581/100=55.81 $\Delta C'$: ad00=>00ad=173/100=1.73

5. Set the full liquid judgment value as 0.8.

ffbf 03 5000 0000 0000 0000		
Channel	Type	Value
ff	bf	03 = Full Liquid Judgement Value Full Liquid Judgement Value: 50 00=>00 50=80/100=0.8

Frequently Asked Questions

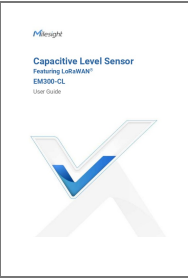
• **Q: What should I do if I encounter inaccurate readings from the device?**

A: Ensure that the device is properly installed and calibrated according to the instructions provided in the user manual. If issues persist, contact Milesight technical support for assistance.

• **Q: How can I change the default password of the device?**



A: To change the default password (123456), refer to the device’s configuration settings as outlined in the user guide.

Documents / Resources

	<p>Milesight EM300-CL Capacitive Level Sensor [pdf] User Guide</p> <p>EM300-CL, EM300-CL Capacitive Level Sensor, EM300-CL, Capacitive L evel Sensor, Level Sensor, Sensor</p>
---	--

References

- [User Manual](#)

 Capacitive Level Sensor, EM300-CL, EM300-CL Capacitive Level Sensor, Level Sensor, Milesight,
 Milesight Sensor

Leave a comment

Your email address will not be published. Required fields are marked *

Comment *

Name

Email

Website

☐ Save my name, email, and website in this browser for the next time I comment.

Post Comment

Search:

e.g. whirlpool wrf535swhz

Search

[Manuals+](#) | [Upload](#) | [Deep Search](#) | [Privacy Policy](#) | [@manuals.plus](#) | [YouTube](#)

This website is an independent publication and is neither affiliated with nor endorsed by any of the trademark owners. The "Bluetooth®" word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. The "Wi-Fi®" word mark and logos are registered trademarks owned by the Wi-Fi Alliance. Any use of these marks on this website does not imply any affiliation with or endorsement.