



Radar Distance / Level Sensor

EM410-RDL

User Guide



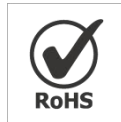
Safety Precautions

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 the device password when first configuration. Default password is 123456.
- ❖ The device is not intended to be used as a reference sensor, and Milesight won't should responsibility for any damage which may result from inaccurate readings.
- ❖ Do not place the device near naked flames, heat source (such as oven), or expose it to sunlight, cold source, liquid, and with extreme temperature changes.
- ❖ Do not place the device in places where the temperature is below/above the operating range.
- ❖ Remove the battery from the device if it is not to be used for an extended period. Otherwise, the battery might leak and damage the device.
- ❖ The device must never be subjected to shocks or impacts.

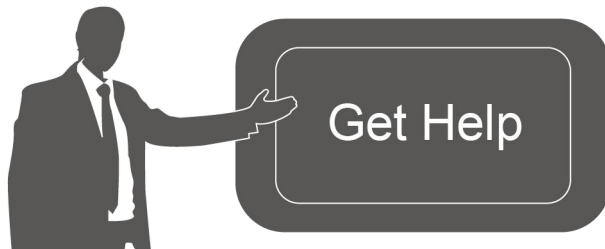
Declaration of Conformity

EM410-RDL 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
Sept. 12, 2024	V1.0	Initial version

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1. Product Introduction

1.1 Overview

EM410-RDL is a non-contact Radar Distance/Level Sensor that adopts Millimeter Wave Radar technology. By measuring millimeter-wave signals at higher frequencies, it provides more stable performance over longer distances, and is less affected by environmental conditions. It can detect the distance between the sensor and liquid of various types, unaffected by temperature, dust, condensate etc. With IP68 waterproof and sealed enclosure, it can withstand the worst environment, while maintaining the measurement accuracy, and does not require routine maintenance.

Milesight offers LoRaWAN[®] version and Cellular version to meet different communication needs. The LoRaWAN[®] version can be integrated with Milesight LoRaWAN[®] gateway and Milesight Development Platform, enabling remote and visual management of all sensor data. The Cellular version supports multiple application modes to be compatible with IoT platforms.

EM410-RDL can be used in sewers, rivers, impounding reservoir, storage tanks and other locations that require to measure distance and level.

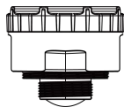
1.2 Features

- 8° Radar beam angle can be focused on the target fluid, enabling accurate measurement of liquid level
- Wide measuring range of 0.3m to 12m with small blind zone
- Not affected by dust, condensate, temperature, acoustic noise, etc
- Non-invasive liquid level monitoring, can detect hazardous or non-hazardous liquids
- External antenna or internal antenna versions are optional for various applications
- Built-in 3-axis accelerometer sensor to monitor device tilt status
- Support to check radar-echo curve and one-click diagnostic to calibrate the distance, ensuring the accurate measurement under different environments
- Support blind zone alarm when the ranging results are within the blind zone
- Adopt PVDF material, offering excellent corrosion resistance, wear resistance and compressive strength for harsh environments
- IP68 waterproof design, resistant in fresh water to a maximum depth of 1m for up to 48 hours
- Thread design for common tank installation without extra accessories needed
- Store up to 4,000 historical records locally and support retransmission to prevent data loss
- Easy configuration via NFC and Bluetooth

- Support management and OTA upgrade via Milesight Development Platform
- Function well with standard LoRaWAN® gateways and network servers (LoRaWAN® Version Only)
- Support cumulative number report function for power saving (Cellular Version Only)
- Support multiple network protocols to be compatible with IoT platforms (Cellular Version Only)

2. Hardware Introduction

2.1 Packing List



1 ×
EM410-RDL Sensor



1 ×
Mounting Bracket



1 ×
Bubble Level



1 ×
Waterproof Tape



1 × G1¹/₂ Nut



4 × Wall Mount
Screw Kits



1 ×
O-ring Seal



1 × ER34615
Li-SoCl₂ Battery



1 × SMB Magnetic Antenna
(External Antenna Version
Only)



1 ×
Antenna Cable Gland
(External Antenna
Version Only)



1 ×
Warranty Card

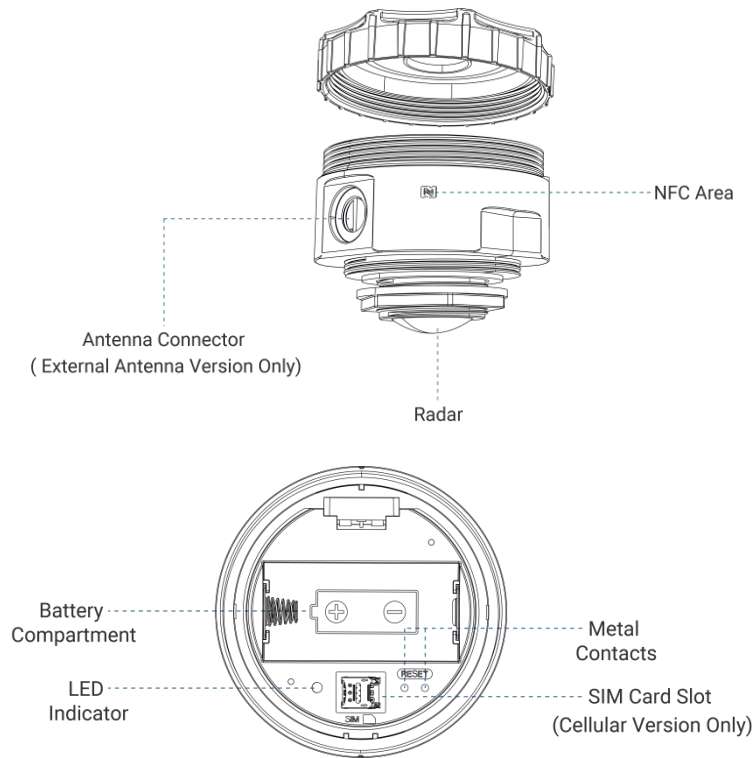


1 ×
Quick Guide



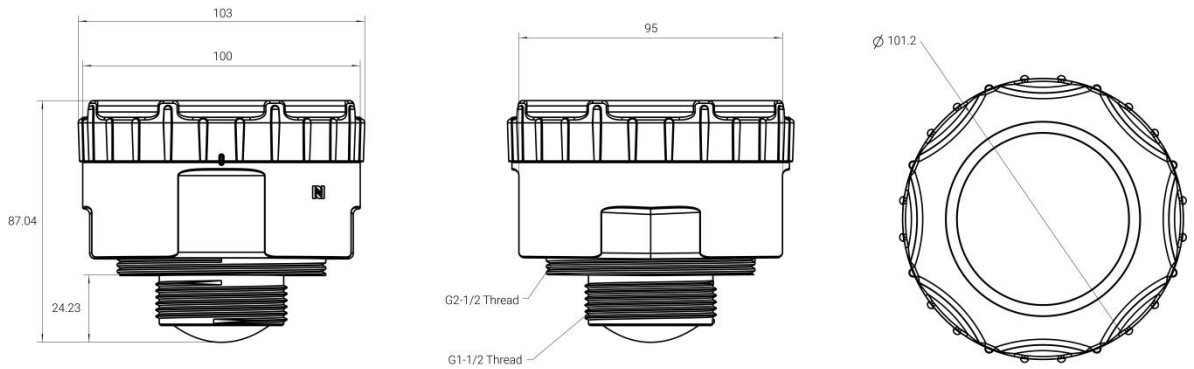
If any of the above items is missing or damaged, please contact your sales representative.

2.2 Hardware Overview

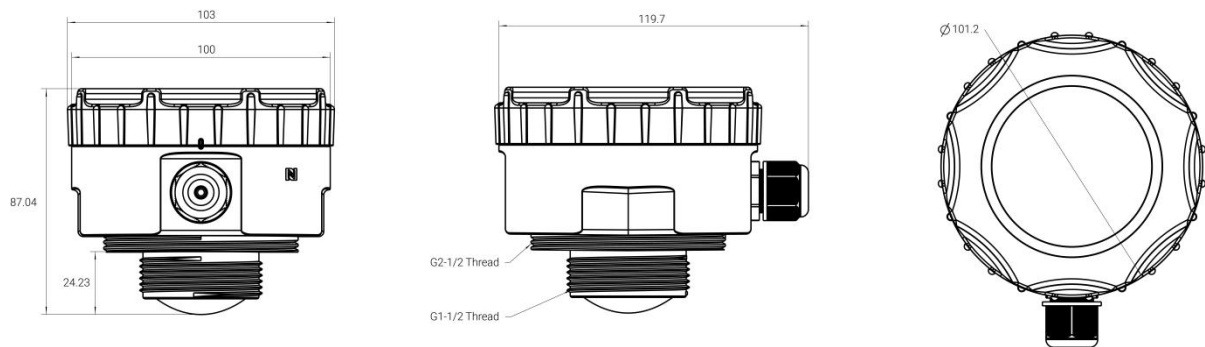


2.3 Dimensions (mm)

Internal Antenna Version:



External Antenna Version:



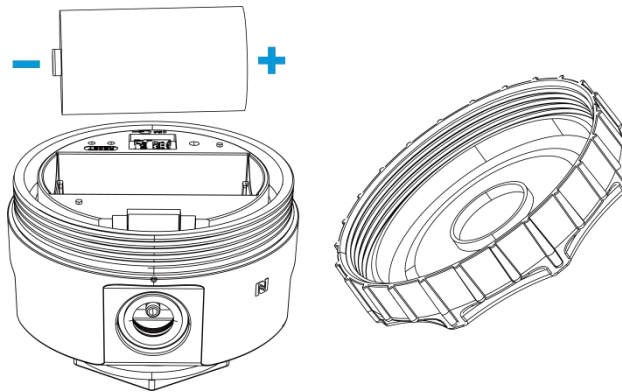
2.4 LED Indicator Descriptions

Function	Action	LED Indication
Power On	Install the New Battery	Lights up for 3s
Power Off	Remove Battery	Turns off
Reboot	Create short circuit with the two metal contacts for over 3s	Blinks Slowly
Reset to Factory Default	Create short circuit with the two metal contacts for over 10s	Blinks Quickly
Check On/Off Status	Create short circuit with the two metal contacts within 3s	Light On: Device is on
		Light Off: Device is off

3. Accessories Installation

3.1 Battery Installation

Unscrew the top cover counterclockwise, install the batteries according the following picture, the device will turn on automatically and the LED indicator will turn on for 3s.

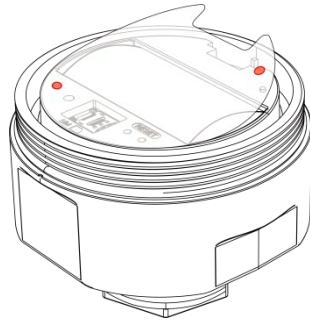


Note:

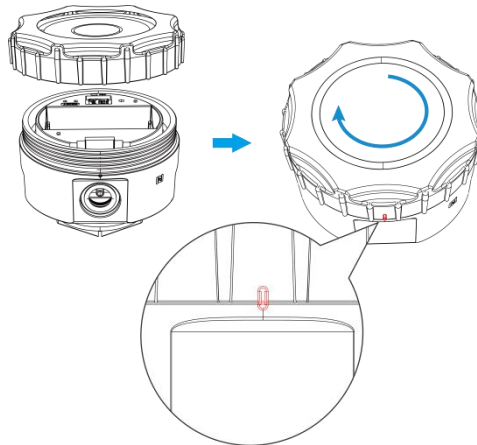
- The device can only be powered by ER34615 Li-SoCl₂ battery. The alkaline battery is not supported.
- The battery should be removed from the device if it is not used for an extended period.

3.2 Waterproof Cover Fixed

Attach the waterproof cover to the device with aligning the two red dots as shown in the diagram, and press waterproof cover firmly with your hand.

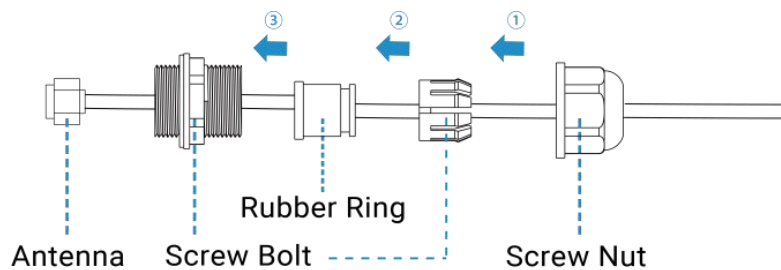


Screw the top cover clockwise until the edge marks are aligned.

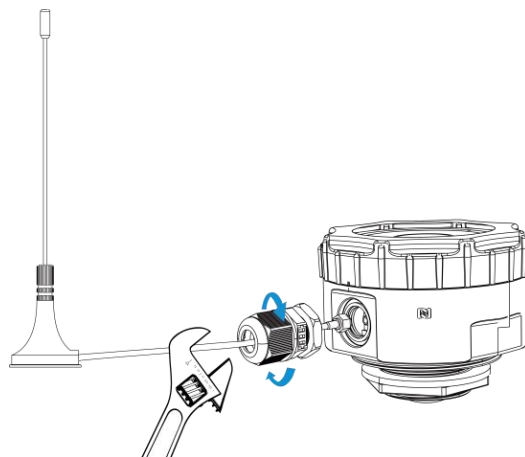


3.3 Antenna Installation (External Antenna Version Only)

Install the waterproof connector as shown in the diagram:



And then connect the antenna to antenna connector of the device and use an adjustable wrench to tighten the waterproof connector.



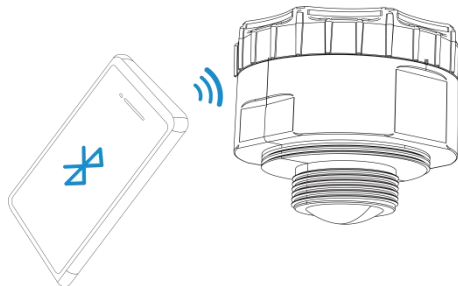
4. Operation Guide

4.1 NFC & Bluetooth Configuration

After the device is powered on, it can be configured via Bluetooth or NFC. Bluetooth is recommended for the first time installation.

Bluetooth Configuration:

1. Download and install “Milesight ToolBox” App on an Bluetooth-supported smart phone.
2. Enable Bluetooth and location function on the smart phone.
3. Open “Milesight ToolBox” App, select Bluetooth method and search for the target device to connect, and then enter the Bluetooth password to read/write the device until App shows a successful prompt. It's suggested to configure a device password for security. (Default password: 123456)

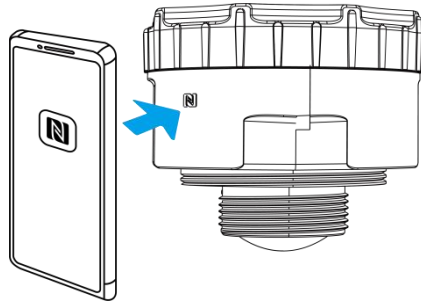


Note:

- 1) The Bluetooth connection will be terminated if there's no data interaction within 3 minutes. It will request to connect again.
- 2) The device can connect to only one phone via Bluetooth. For example, if the device is connected to smart phone A via Bluetooth, the connection will be terminated after it is connected to smartphone B.

NFC Configuration:

1. Download and install “Milesight ToolBox” App on an NFC-supported smart phone.
2. Enable NFC on the smartphone and open “Milesight ToolBox” App.
3. Open “Milesight ToolBox” App, attach the smartphone with NFC area to read/write the device until App shows a successful prompt. It's suggested to configure a device password for security. (Default password: 123456)



4. Basic information and settings of devices will be shown on ToolBox if it's recognized successfully.

Note:

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

4.2 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.

LoRaWAN Settings ^

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	Default App EUI is 24E124C0002A0001.
Application Port	The port used for sending and receiving data, default port is 85.
LoRaWAN Version	V1.0.2, V1.0.3 are available.
Work Mode	It's fixed as Class A.
Confirmed Mode	If the device does not receive ACK packet from network server, it will resend data once.
Join Type	OTAA and ABP mode are available.
Application Key	Appkey for OTAA mode, default is 5572404C696E6B4C6F52613230313823.
Rejoin Mode	<p>Reporting interval \leq 35 mins: the device will send a specific number of LinkCheckReq MAC packets to the network server every reporting interval or 2*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 rejoin mode is enabled, set the number of LinkCheckReq packets sent.</p> <p>Note: the actual sending number is Set the number of packets sent + 1.</p>
Network Session Key	Nwkskey for ABP mode, default is 5572404C696E6B4C6F52613230313823.
Application Session Key	Appskey for ABP mode, default is 5572404C696E6B4C6F52613230313823.
Device Address	DevAddr for ABP mode, default is the 5 th to 12 th digits of SN.
Channel	Enable or disable the frequency to send uplinks.

* Support Frequency

EU868

868.1

868.3

868.5

863

If frequency is one of CN470/AU915/US915, enter the index of the channel that you want to enable and make 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

AU915

Enable Channel Index ⓘ

8-15

Index	Frequency/MHz ⓘ
0 - 15	915.2 - 918.2
16 - 31	918.4 - 921.4
32 - 47	921.6 - 924.6
48 - 63	924.8 - 927.8
64 - 71	915.9 - 927.1

ADR Mode	Allow network server to adjust datarate of the device.
Spread Factor	If ADR is disabled, the device will send data via this spread factor.
Tx Power	Transmit power of device.
RX2 Data Rate	RX2 data rate to receive downlinks.
RX2 Frequency	RX2 frequency to receive downlinks. Unit: Hz

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.

4.3 General Settings

Go to **Device > Setting > General Settings** of ToolBox App to change the reporting interval, etc.

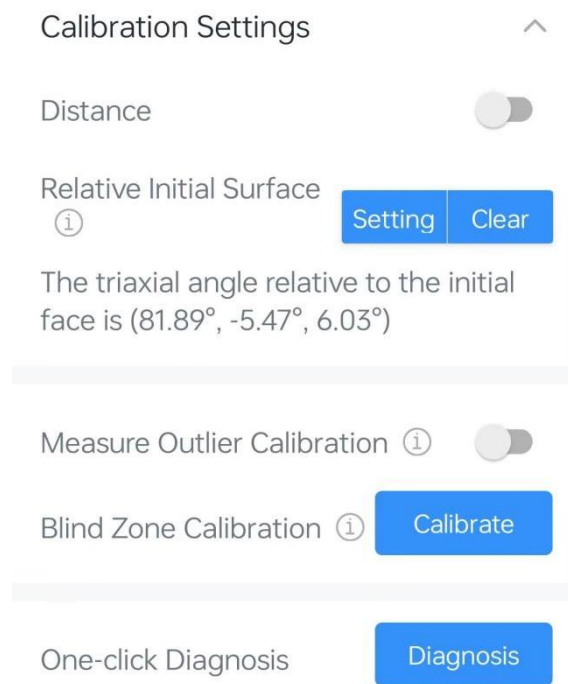
Parameters	Description
Reporting Interval	Reporting interval of transmitting data to server. Default: 1440 minutes, range: 1~1440 minutes.
Scenario Mode	Select from Standard Mode, Rainwater Well or Wastewater Well. General: Suitable for calm liquid surfaces Rainwater Well: Suitable for rainwater well Wastewater Well: Suitable for wastewater well
Measurement Range(m)	The maximum distance between target surfaces and device.
Tilt & Distance Switch	When detecting that the offset angle is greater than 15 degrees, turn off the distance measuring function.
Data Storage	Disable or enable data storage locally.

Data Retransmission	Enable or disable data retransmission.
Change Password	Change the password for ToolBox App to access this device.

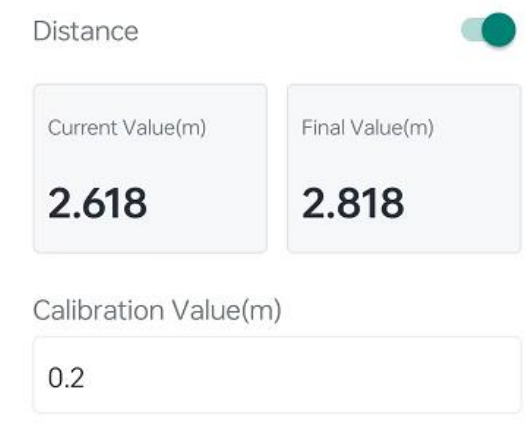
4.4 Advanced Settings

4.4.1 Calibration Settings

Go to **Device > Setting > Calibration Settings** to enable calibration.



- **Numerical Calibration:** users can define calibration value to correct every distance.



- **Relative Initial Surface:** Click **Setting** to read the triaxial angle relative to the current surface, to adjust the current device position as "Normal".

Relative Initial Surface Setting Clear

The triaxial angle relative to the initial face is (0.06°, 0.28°, -89.76°)

- **Measure Outlier Calibration:** users can define either outlier range or outlier value. When the device distance value exceeds the outlier range (or range) compared to the previous value, the device will measure the distance once again. $\text{Outlier Value} = \text{Max.Range} * \text{Outlier Range}$.

Measure Outlier Calibration

Maximum Range: 6 m

Outlier Range(%)

10

Outlier Value(m)

0.6

- **Blind Zone Calibration:** If calibrated, an alarm packet will be reported once if the liquid level distance falls within the blind zone. Please ensure there is not any objects within the blind zone when calibration and it is recommended to calibrate it after device installation.

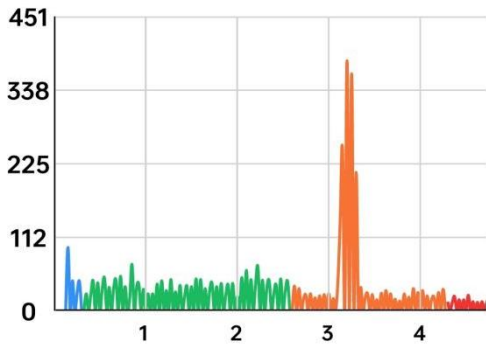
Blind Zone Calibration Calibrate

- **One-click Diagnosis:** This only appears when connecting device via Bluetooth mode. When the collected distance is not consistent with the actual situation, you can use this function.

One-click Diagnosis Diagnosis

Step 1: Click Diagnosis to show the current Radar Echo Curve. If the collected distance has only one value, it means the nearest signal amplitude is equal to the strongest signal. If two values appear, it means one represents the nearest signal amplitude and another represents the strongest signal.

Radar Echo Curve Collection Time:09-02 16:56:14

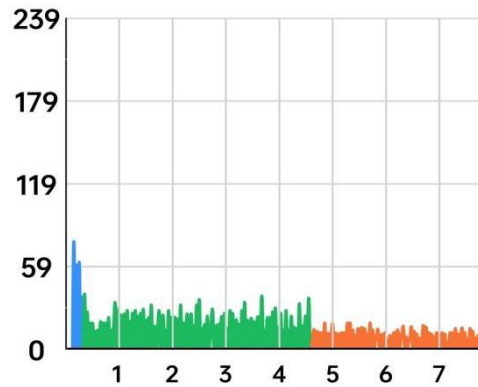


X-axis: Distance Y-axis: Signal Amplitude

After selecting the final distance value that you consider accurate, click "Confirm." If there is still no accurate final distance value, please use "Manual Diagnosis."

3.24m

Radar Echo Curve Collection Time:09-10 15



X-axis: Distance Y-axis: Signal Amplitude

After selecting the final distance value that you consider accurate, click "Confirm." If there is still no accurate final distance value, please use "Manual Diagnosis."

5.325m 8.23m

Step 2: Choose a collected distance value that is closer to the actual distance, and click

to finish configuration or click to get a new collected distance.

Step 3: If the distance value is still not accurate, click **Manual Diagnosis** to set the relevant parameters:

Final Distance 2.937m

Radar Echo Signal Quality ⓘ

10

Algorithm Threshold Sensitivity ⓘ

0.8

Peak Sorting ⓘ

Strongest Peak ▼

Parameters	Description
Radar Echo Signal Quality	If the liquid level has significant foam, numerous foreign objects, or the measurement signal is unstable and the peak is not clear, adjust this value upwards. Note: The larger the value, the greater the power consumption.
Algorithm Threshold Sensitivity	The device requires only one target to measure. When a large number of targets are detected, the sensitivity can be appropriately decreased; when no targets are detected, the sensitivity can be appropriately increased.
Peak Sorting	According to the radar echo curve and the actual scene situation, the peak with the nearest signal amplitude or the strongest peak can be selected as the effective target.

Note: If appear "Disabled", reset **Relative Initial Surface** or disable **Tilt & Distance Switch**.

Step 4: When adjusting parameters, click [Refresh Final Distance](#) to confirm the final distance value. Once you've obtain the desired final distance value, click the arrow on the upper left corner to return to the home page.

4.4.2 Threshold Settings

Go to **Device > Setting > Threshold Settings** to configure distance threshold or distance shifts threshold settings.

Threshold Settings ^

Distance

Over / m
1.500

Below / m
1.000

Distance Shifts Threshold ⓘ

Distance Shifts Over(m)
0.200

Collecting Interval(min)

1

Alarm Reporting Times

1

Alarm Dismiss Report ⓘ



Parameters	Description
Distance	When the distance is over or below the threshold value, the device will report alarm packets.
Distance Shifts Threshold	When this function is enabled, the device will report alarm packets when the absolute value of the difference between the two collected values exceeds the set threshold.
Collecting Interval(min)	The interval to detect distance, this should be smaller than or equal to the reporting interval.
Alarm Reporting Times	Set the number of alarm reports to be sent after the threshold is triggered, the default is 1.
Threshold Dismiss Report	When the collected distance value changes from outside the threshold to within the threshold, a threshold release packet will be reported.

4.4.3 Data Storage

EM410-RDL sensor supports storing more than 2000 data records locally and exporting data via ToolBox App. The device will record the data according to the reporting interval even not joining to network.

Here are the steps for storage:

1. Ensure the device time is correct, click **Sync** to sync the time.

Device Position Normal

Temperature 20.0 °C

Device Time 2024-09-05 17:30

Sync

2. Enable **Data Storage** feature.

General Settings ^

Reporting Interval(min)

2

Scenario Mode i

General ▼

Measurement Range(m) i

10

Tilt & Distance Switch i

Data Storage i

3. Click **Export Historical Data**, then select the data period and click **Confirm** to export data. The maximum export data period on ToolBox App is 14 days.

Export Historical Data

Cancel Export Data Period Confirm

2023-10-18 17:14 To 2023-10-25 17:14

🔄

2021	8	16	15	12
2022	9	17	16	13
2023	10	18	17	14
		19	18	15
		20	19	16

4.4.4 Data Retransmission

EM410-RDL sensor supports data retransmission to ensure the network server can get all data even if the network is down for some time. There are two ways to get the lost data:

- Network server sends downlink commands to enquire the historical data for specifying time range, refer to section [Historical Data Enquiry](#).
- When the network is down if no response from LinkCheckReq MAC packets for a period of time, the device will record the network disconnected time and re-transmit the lost data after the device re-connects the network.

Here are the steps for retransmission:

1. Ensure the device time is correct, please click **Sync** to sync the time.

Device Status	ON
Reading Mode	BLE 
Battery	100 %
Distance	2.649 m Collect
Device Position	Normal
Temperature	20.0 °C
Device Time	2024-09-05 17:30 Sync

2. Enable **Data Storage** and **Data Retransmission** feature.

Measurement Range(m) ⓘ

Tilt & Distance Switch ⓘ

Data Storage ⓘ

Data Retransmission ⓘ

Change Password

3. Go to **Device > Setting > LoRaWAN Settings** to enable rejoin mode and set the number of packets sent. For example, the device will send LinkCheckReq MAC packets to the network server regularly to check any network disconnection; if there is no response for 32+1 times, the join status will change to de-activated and the device will record a data lost time point (the time it reconnected to the network).

Rejoin Mode

Set the number of detection signals sent ⓘ

4. After the network connection is restored, the device will send the lost data from the point in

time when the data was lost according to the data retransmission interval (600s by default).

Note:

- 1) If the device is rebooted or re-powered when data retransmission is not completed, the interrupted retransmission data will be retransmitted first after the network is reconnected to the network, and then the newly triggered retransmission data will be transmitted.
- 2) If the network is disconnected again during data retransmission, it will only send the latest disconnection data.
- 3) The retransmission data format is started with "20ce", please refer to section [Historical Data Enquiry](#).
- 4) Data retransmission will increase the uplinks and shorten the battery life.

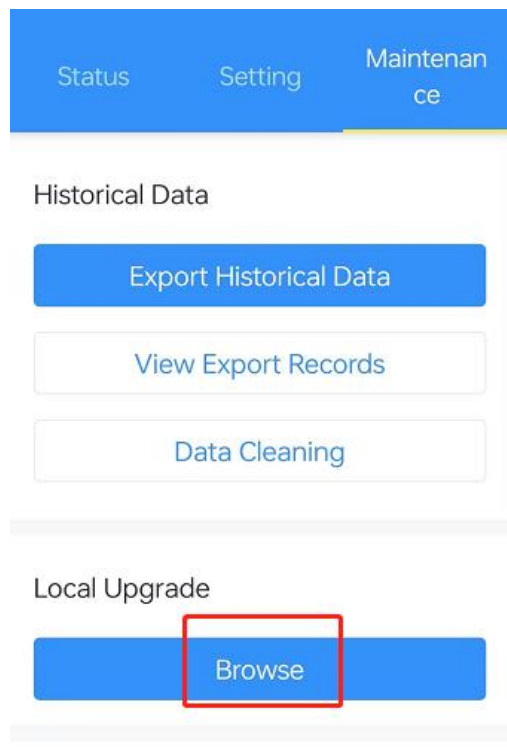
4.5 Maintenance

4.5.1 Upgrade

1. Download firmware from Milesight website to your smartphone.
2. Open Toolbox App, go to **Device > Maintenance** and click **Browse** to import firmware and upgrade the device.

Note:

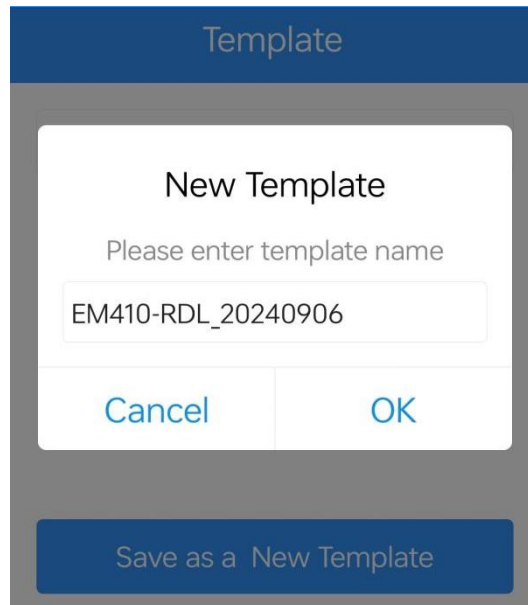
- 1) The device only supports upgrade via Bluetooth.
- 2) Operation on ToolBox is not supported during a firmware upgrade.



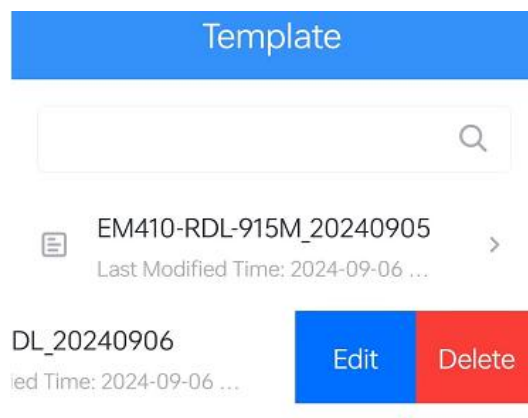
4.5.2 Backup

EM410-RDL supports configuration backup for easy and quick device configuration in bulk. Backup is allowed only for devices with the same model and 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.

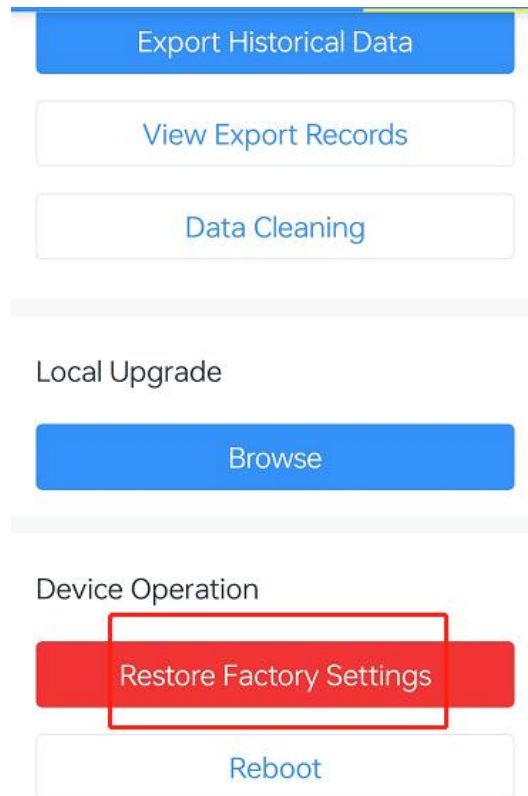


Note: Slide the template item left to edit or delete the template. Click the template to edit the configurations.



4.5.3 Reset to Factory Default

Go to **Device > Maintenance** to click **Restore Factory Settings**.

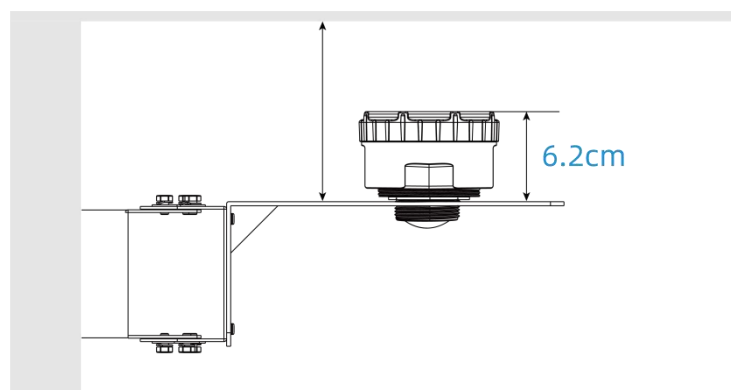


5. Installation

5.1 Mounting Bracket Installation

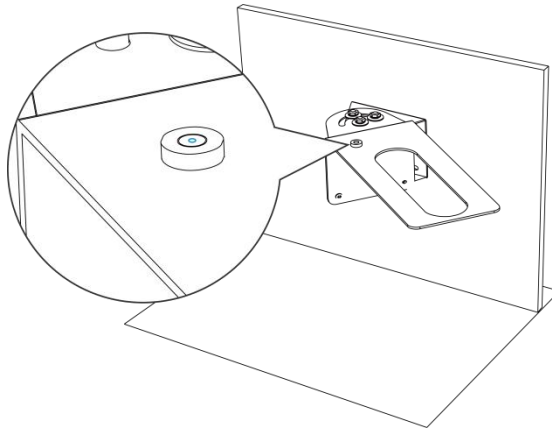
Step 1: Locate Position

- Avoid placing the device near any metal objects, water outlets, stairs and other obstacles;
- Please consider the height of the equipment and other factors (such as the thickness of the manhole cover) to ensure that the equipment does not interfere with normal usage after installation.



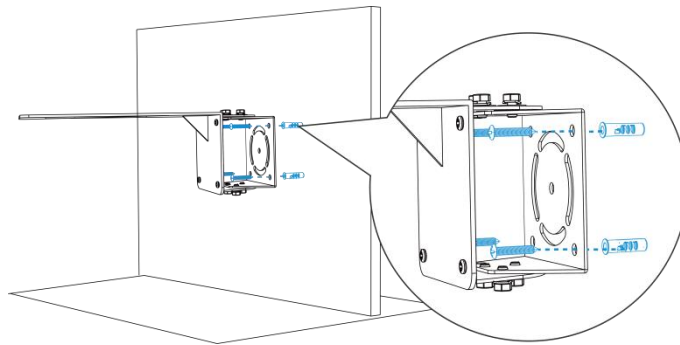
Step 2: Adjust Level

Attach the bubble level to the bracket surface to ensure the bracket is parallel.

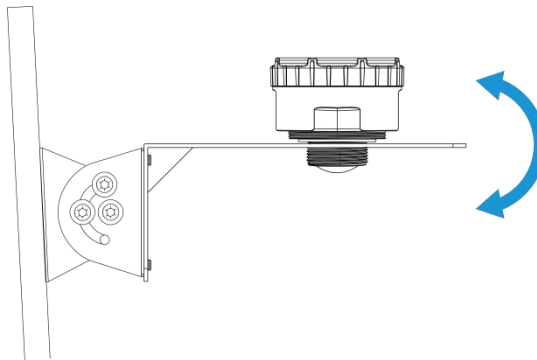


Step 3: Fix Mounting Bracket

Drill 4 holes according to the mounting bracket holes. Fix the wall plugs to the wall holes, then fix the mounting bracket to the wall plugs via mounting screws.

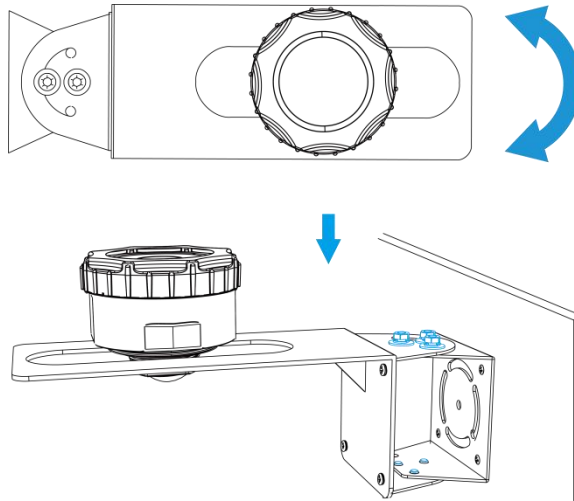


Note: If the wall is tilted, adjust the bracket component direction to 90° as below:



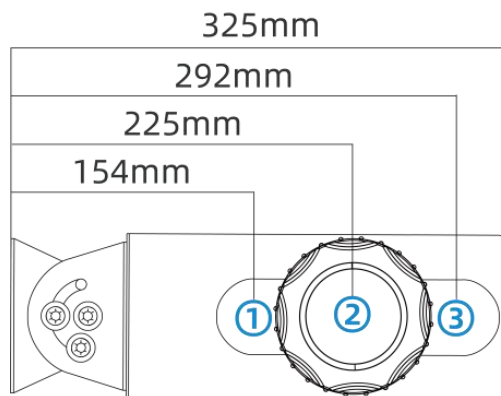
Step 4: Adjust Mounting Bracket Angle

Loosen the two nuts on both the upper and lower tracks of the bracket, adjust the bracket to the appropriate angle, then use a wrench to tighten all six nuts with flat washers.



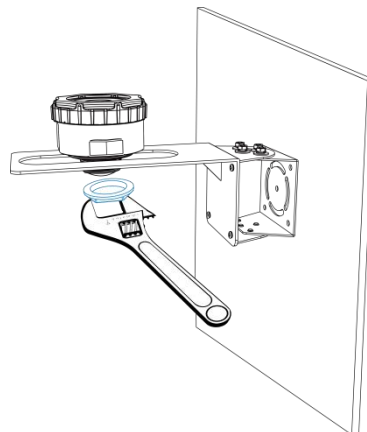
Step 5: Select the device installation location on the bracket according to the installation height.

Installation Height	Recommend Location
1 ~ 2m	1
2.1 ~ 3m	2
3.1 ~ 6m	3



Step 6: Fix Device

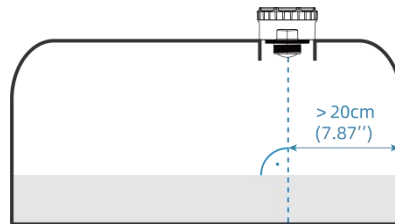
Place the device onto the mounting bracket, adjust it to an appropriate position, and then tighten it with G1 $\frac{1}{2}$ nut. The torque for tightening the G1 $\frac{1}{2}$ nut with a wrench should not exceed 4 N •m.



5.2 Tank Installation

Step 1: Locate the Device Installation Position

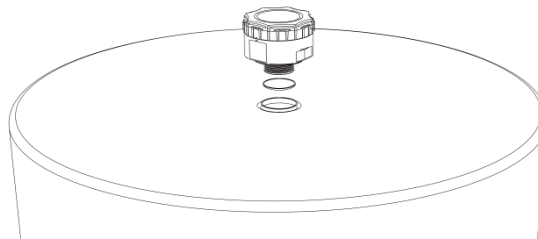
- Place it away from the tank wall more than 20cm;
- Perpendicular to the measured liquid and with no obstacles between the device and the measured liquid.



Step 2: Fix Device

The device has G1 1/2" and G2 1/2" thread opening to allow it to be screwed into an existing applicable thread opening of a tank. An O-ring is supplied and should be used to ensure a watertight seal.

When tanks' mounting hole is unavailable or where it is undesirable to cut a mounting hole in the tank, an adapter can be installed on the top surface of the tank and the sensor can be mounted on this adapter. Adapters for different sized need to be purchased separately. The device should be threaded and screwed onto the adapter firmly to make a good seal. The O-ring shown below seals the non-invasive adapter to the bottom of the sensor's main enclosure.



Installation Note:

1. The installation location of the device should avoid strong vibrations, direct sunlight, and exposure to rain or snow.
2. Do not place the device near objects that emit intense heat, strong electromagnetic fields, or radioactive materials.
3. It is recommended to attach the magnetic base of external antenna to a manhole cover or other metal surface to ensure a good signal.
4. After installation, please check the tilt status and distance measurement in the ToolBox App, and adjust the installation position, direction, or related parameters based on the results:

Advances Settings.

6. Communication Protocol

All data are based on 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 files on <https://github.com/Milesight-IoT/SensorDecoders>.

6.1 Basic Information

EM410-RDL sensor reports basic information whenever it joins the network.

Channel	Type	Byte	Description
ff	0b (Power On)	1	ff
	01 (Protocol Version)	1	01=>V1
	fe (Reset Report)	1	ff
	16 (Device SN)	8	16 digits
	09 (Hardware Version)	2	01 00 => V1.0
	0a (Firmware Version)	2	01 14 => V1.14
	0f (Device Type)	1	00: Class A
	ff (TSL Version)	2	0100

Example:

ff0bff ff0101 ffefff ff166862e21141780013 ff090100 ff0a0101 ff0f00 ffff0100					
Channel	Type	Value	Channel	Type	Value
ff	0b (Power On)	ff (Reserved)	ff	01 (Protocol Version)	01 (V1)
Channel	Type	Value	Channel	Type	Value
ff	fe (Reset Report)	ff	ff	16 (Device SN)	6791d19 6040500 05
Channel	Type	Value	Channel	Type	Value
ff	09 (Hardware Version)	0100 (V1.0)	ff	0a (Firmware Version)	0101 (V1.1)
Channel	Type	Value	Channel	Type	Value
ff	0f (Device Type)	00 (Class A)	ff	ff (TSL Version)	0100 (V1.0)

6.2 Sensor Data

Channel	Type	Byte	Description
01	75(Battery Level)	1	UINT8, Unit: %, [1-100]
04	82(Distance)	2	INT16, Unit: mm
05	00(Device Position)	1	00: Normal, 01: Tilt(horizontal offset angle $\geq 15^\circ$)
06	c7(Radar Signal Strength)	2	INT16*0.01, Unit: dBm
84	82(Distance)	3	<ul style="list-style-type: none"> ● Byte 1-2: Distance, INT16, Unit: mm ● Byte 3: 01-Alarm; 00-Alarm dismiss
94	82(Distance Shifts Threshold)	5	<ul style="list-style-type: none"> ● Byte 1-2: Distance, INT16, Unit: mm ● Byte 3-4: Distance Shifts, INT16, Unit: mm ● Byte 5: 02
b4	82(Blind Zone)	3	<ul style="list-style-type: none"> ● Byte 1-2: Distance, INT16, Unit: mm ● Byte 3: <ul style="list-style-type: none"> ➤ 00-Alarm dismiss ➤ 01-Alarm <ul style="list-style-type: none"> ■ No target within 30cm, report distance as fffd ■ Have target within 30cm, report the distance ➤ 02-Cannot collect the target, report distance as fffd ➤ 03-Sensor Abnormal, report distance as ffff
20	ce(Historical Data)	11	<ul style="list-style-type: none"> ● Byte 1-4: Unix Timestamp ● Byte 5-6: Distance, INT16, Unit: mm ● Byte 7-8: Temperature, INT16*0.1, Unit: °C ● Byte 9-10: Distance Mutation, INT16, Unit: mm ● Byte 11: Alarm Status <ul style="list-style-type: none"> ➤ Bit0: Threshold Alarm ➤ Bit1: Threshold Alarm Dismiss ➤ Bit2: Blind Zone Alarm

			<ul style="list-style-type: none"> ➤ Bit3: Blind Zone Alarm Dismiss ➤ Bit4: Distance Shifts Threshold Alarm ➤ Bit5: Device Position ➤ Bit6-7: 00
--	--	--	--

Examples:

1. Periodic packet:

017562 0482aa0c 06c70303 050000					
Channel	Type	Value	Channel	Type	Value
01	75 (Battery Level)	62=>98%	04	82 (Distance)	aa0c => 0caa =>3242 mm
Channel	Type	Value	Channel	Type	Value
06	c7(Radar Signal Strength)	03 03=> 771*0.01=7.71 dBm	05	00(Device Position)	00: Normal

2. Threshold Alarm: report when distance reaches the threshold.

8482 c827 01 9482 c827850c 02		
Channel	Type	Value
84	82 (Distance)	Distance: c8 27 => 27 c8 =10184mm = 10.184m 01= Alarm
94	82(Distance Shifts Threshold)	Distance Shifts Threshold: c8 27 => 27 c8 =10184mm = 10.184m 85 0c => 0c 85=3205mm = 3.205m 02=Alarm

3. Blind Zone alarm packet: report when the target value reaches the blind zone.

b482 ac00 01		
Channel	Type	Value
b4	82(Blind Zone)	ac 00 => 00 ac = 172mm = 0.172m 01=calibrated distance

6.3 Downlink Commands

EM410-RDL supports downlink commands to configure the device. Application port is 85 by default.

Channel	Type	Byte	Description
ff	10 (Reboot)	1	ff (Reserved)
	bd(UTC Time Zone)	2	INT16/60

28(Query Device Status)	1	01
8e (Reporting Interval)	3	<ul style="list-style-type: none"> ● Byte 1: 00 ● Byte 2-3: Reporting Interval, UINT16, Unit: min, Range: 1~1440
1b(Measurement Range)	5	<ul style="list-style-type: none"> ● Byte 1: <ul style="list-style-type: none"> ➢ 00 = General Mode; ➢ 01 = Rainwater Well Mode; ➢ 02 = Wastewater Well Mode ● Byte 2-3: 0000 ● Byte 4-5: Max. Measuring Range, UINT16, Unit: mm
3e (Tilt & Distance Switch)	1	01 = Enable; 00 = Disable
68(Data Storage)	1	01 = Enable; 00 = Disable
69(Data Retransmission)	1	01 = Enable; 00 = Disable
6a(Data Retransmission Interval)	3	<ul style="list-style-type: none"> ● Byte 1: 00 ● Byte 2-3: Interval time, Unit: s
ab(Distance Calibration)	3	<ul style="list-style-type: none"> ● Byte 1: 01-Enable; 00-Disable ● Byte 2-3: Calibration Value, INT16, Unit: mm
1c(Recollecting of Measure Outlier Calibration)	2	<ul style="list-style-type: none"> ● Byte 1: Recollecting Times, UINT 8, Range: 1~3 ● Byte 2: Recollecting Interval, UNIT 8, Unit: s, Range: 1~10
06 (Set Threshold Alarm)	9	<ul style="list-style-type: none"> ● Byte 1: <ul style="list-style-type: none"> ➢ Bit2~Bit0: <ul style="list-style-type: none"> 000-disable 001-below 010-over 011-within 100-below or over ➢ Bit5~Bit3: <ul style="list-style-type: none"> 001-Distance threshold alarm; 010-Distance shifts threshold alarm

			<ul style="list-style-type: none"> ➤ Bit6: 0 ➤ Bit7: <ul style="list-style-type: none"> 0-disable threshold dismiss report 1-enable threshold dismiss report ● Byte 2-3: Min. Value, INT16, Unit: mm ● Byte 4-5: Max. Value or distance shifts value, INT16, Unit: mm ● Byte 6-9: 00000000
	f2(Alarm Reporting Times)	2	UINT16, Range: 1~1000, Default: 1
	27(Clear History Data)	1	01
	2a(Device Calibration)	1	01-Blind Zone Calibration
f9	12 (Scenario Mode)	1	00 = General Mode; 01 = Rainwater Well Mode; 02 = Wastewater Well Mode
	39(Collecting Interval)	2	Unit: min, Range: 1~1440
	14(Radar Echo Signal Quality)	2	INT16, Range: -10~35
	15(Algorithm Threshold Sensitivity)	2	INT16*0.1, Range: 0.1~1
	16(Peak Sorting)	1	00-Nearest Peak; 01-Strongest Peak

Example:

- Set time zone as UTC-4.

ffbdc0fd		
Channel	Type	Value
ff	bd	c0 fd => fd c0 = -240/60=-4 the time zone is UTC-4

- Set reporting interval as 4 minutes.

ff8e 00 0400		
Channel	Type	Value
ff	8e (Reporting Interval)	04 00 => 00 04 = 4 minutes

- Reboot the device.

ff10 ff		
Channel	Type	Value
ff	10 (Reboot)	ff (Reserved)

4. Set the device as Wastewater Well mode.

f912 02		
Channel	Type	Value
f9	12 (Scenario Mode)	02 = Wastewater Well Mode

5. Disable "Tilt & Distance Switch" feature.

ff3e 00		
Channel	Type	Value
ff	3e (Tilt & Distance Switch)	00 = disable

6. When the distance is below 1m or over 10m, the sensor will send threshold alarm.

ff06 8c e803 1027 00000000		
Channel	Type	Value
ff	06 (Set Threshold Alarm)	8c=10 001 100: 100=below or over 001=Distance threshold alarm 10=enable threshold dismiss report Min: e8 03 => 03 e8 = 1000 mm = 1m Max: 10 27 => 27 10 = 10000 mm =10m

7. When the distance shifts is over 0.5m, the sensor will send threshold alarm.

ff06 8c 0000 f401 00000000		
Channel	Type	Value
ff	06 (Set Threshold Alarm)	8c=10 010 010: 010=over 010=Distance shifts threshold alarm 10=enable threshold dismiss report Min: 0000 Distance shift value: f4 01 => 01 f4 = 500 mm=0.5m

6.4 Historical Data Enquiry

EM410-RDL supports sending downlink commands to enquire historical data for specified time point or within a certain time range. Before utilizing this feature, it is import to make sure **the**

device time is correct and data storage feature was enable to store the data.

Command format:

Channel	Type	Byte	Description
fd	6b (Enquire data in time point)	4	unix timestamp
	6c (Enquire data in time range)	8	<ul style="list-style-type: none"> ● Byte 1-4: Start time, unix timestamp ● Byte 5-8: End time, unix timestamp
	6d (Stop query data report)	1	ff
ff	6a(Report Interval)	3	<ul style="list-style-type: none"> ● Byte 1: 01 ● Byte 2-3: Unit: s, Range: 30~1200s (60s by default)

Reply format:

Channel	Type	Byte	Description
fc	6b/6c	1	00: data enquiry success; 01: time point or time range invalid; 02: no data in this time or time range.
20	ce (Historical Data)	11	<ul style="list-style-type: none"> ● Byte 1-4: Unix Timestamp ● Byte 5-6: Distance, INT16, Unit: mm ● Byte 7-8: Temperature, INT16*0.1, Unit: °C ● Byte 9-10: Distance Shifts, INT16, Unit: mm ● Byte 11: Alarm Status <ul style="list-style-type: none"> ➤ Bit0: Threshold Alarm ➤ Bit1: Threshold Alarm Dismiss ➤ Bit2: Blind Zone Alarm ➤ Bit3: Blind Zone Alarm Dismiss ➤ Bit4: Distance Shifts Threshold Alarm ➤ Bit5: Device Position ➤ Bit6-7: 00

Note:

1. The device only uploads no more than 300 data records per range inquiry.
2. When enquiring about the data in time point, it will upload the data that is the closest to the search point within the reporting interval range. For example, if the device's reporting interval is 10 minutes and users send a command to search for 17:00's data, if the device finds there is data stored in 17:00, it will upload these data. If not, it will search for data between 16:50 to 17:10 and upload the data which is the closest to 17:00.

Example:

1. Enquire historical data between 2024/9/7 15:28:22 to 2024-9-11 15:28:22.

fd6c 9600dc66 9646e166		
Channel	Type	Value
fd	6c (Enquire data in time range)	Start time: 9600dc66 => 66dc0096 = 1725694102s =2024/9/7 15:28:22 End time: 9646e166 => 66e14696 =1726039702 s =2024-9-11 15:28:22

Reply:

fc6c00		
Channel	Type	Value
fc	6c (Enquire data in time range)	00: data enquiry success

20ce b443e166 ac0c be00 0000 20			
Channel	Type	Time Stamp	Value
20	ce (Historical Data)	b443e166 => 66e143b4 = 1726038964s = 2024-9-11 15:16:04	Distance: ac0c => 0cac =3244mm=3.244m Temperature: be00 => 00be = 190*0.1=19°C Distance shifts: 0000 Alarm Status: 20=0010 0000=>Tilt

-----END-----