

# Ultrasonic Distance Sensor

## EM400-UDL

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 close to objects with naked flames.
- ❖ Do not place the device in where the temperature is below/above the operating range.
- ❖ Make sure both batteries are newest when install, or battery life will be reduced.
- ❖ The device must never be subjected to shocks or impacts.

## Declaration of Conformity

EM400-UDL 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                    |
|----------------|-------------|--------------------------------|
| March 16, 2023 | V 1.0       | Initial version                |
| June 15, 2023  | V 1.1       | Add EM400-UDL NB/Cat M Version |

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## 1. Product Introduction

### 1.1 Overview

EM400-UDL is a designed non-contact ultrasonic distance sensor. With this low power consumption technology, EM400-UDL can work up to 10 years with two 9000 mAh batteries. With multiple probes optional and different detecting ranges, it can satisfy different requirements.

With high protection IP rating and waterproof enclosure, EM400-UDL is widely used for outdoor applications such as water level, fill level of tanks and silos, presence of objects or snow level. Combining with Milesight IoT Cloud solution, users can manage all sensor data remotely and visually.

### 1.2 Features

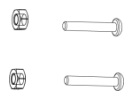
- Optional probes vary from 25 to 1000cm for multiple applications
- Equipped with NTC thermistor for the detection and alarm of burning
- Built-in 3-axis accelerometer sensor to monitor device tilt status
- Damp-proof coating inside and IP67 waterproof enclosure for outdoor applications
- Built-in two 9000 mAh replaceable batteries and work for 10 years without replacement
- Equipped with NFC for one touch configuration, support card emulation mode
- Equipped with GNSS positioning (NB version only)
- Function well with standard LoRaWAN<sup>®</sup> gateways and network servers (LoRaWAN<sup>®</sup> version only)
- Compatible with Milesight IoT Cloud (LoRaWAN<sup>®</sup> version only)

## 2. Hardware Introduction

### 2.1 Packing List



1 × EM400-UDL  
Device



2 × Mounting  
Kits



1 × Warranty  
Card

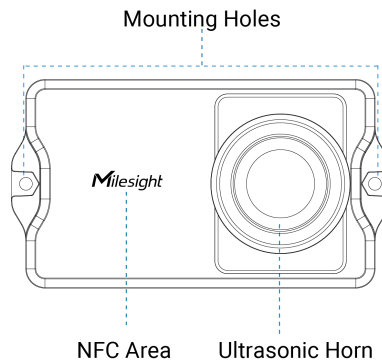


1 ×  
Quick Guide

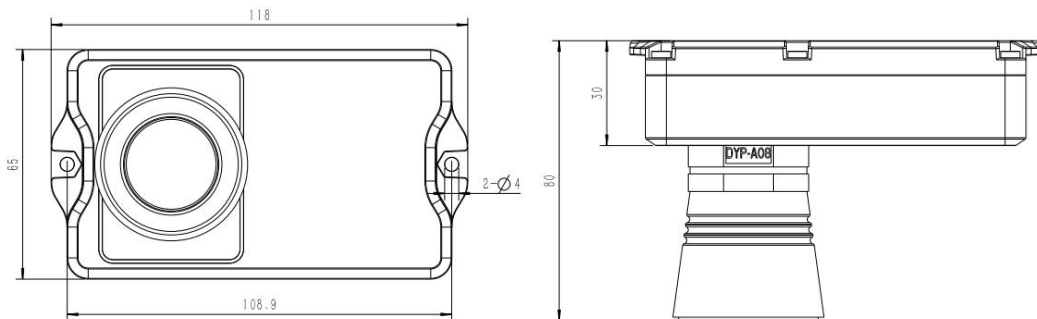


If any of the above items is missing or damaged, please contact your sales representative.

## 2.2 Hardware Overview



## 2.3 Dimensions (mm)



## 2.4 Power Button

EM400-UDL can be switched on/off via NFC. Besides, users can use power button to switch on/off and reset the device manually.

| Function            | Action  | LED Indication                                     |
|---------------------|---|--|
| Switch On           | Press and hold the button for more than 3 seconds.  | Off → On   |
| Switch Off          | Press and hold the button for more than 3 seconds.  | On → Off   |
| Reset               | Press and hold the button for more than 10 seconds. | Quickly Blinks                                     |
| Check On/Off Status | Quickly press the power button.                     | Light On: Device is on<br>Light Off: Device is off |

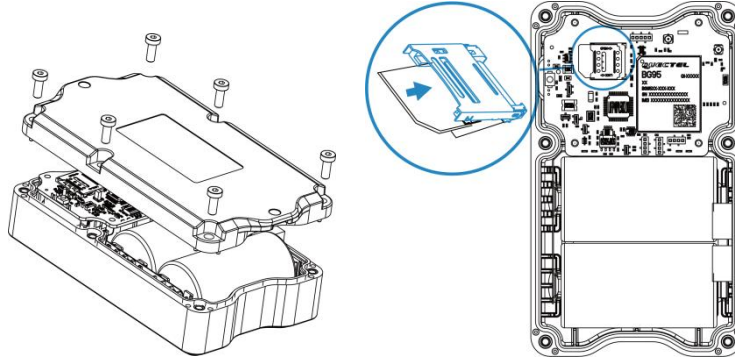
## 3. SIM Installation (NB Version Only)

Release the screws and back cover, insert the SIM card (3FF), then replace the back cover to the device and fix the screws.

### Note:

- 1) PSM (Power Saving Mode) is required for the SIM card.
- 2) The device does not support hot plugging (also called hot swapping), please reboot the device after inserting the SIM card.

- 3) When a new SIM card is inserted to the device for the first time, it will take about 2 minutes to register to network; next time the registration time will be shorten to 30s.
- 4) When the device does not send data, the device will go to sleep mode and the network status will be unregistered.



## 4. Operation Guide


### 4.1 NFC Configuration

EM400-UDL can be configured via NFC.

1. Download and install “Milesight ToolBox” App from Google Play or App Store.
2. Enable NFC on the smartphone and open “Milesight ToolBox” App.
3. Attach the smartphone with NFC area to the device to read the basic information.



4. Basic information and settings of devices will be shown on ToolBox if it's recognized successfully. You can switch on/off, read and write the device by tapping the button on the Apps. In order to protect the security of devices, password validation is required when configuring via unused phone. Default password is **123456**.

| Status           | Setting   | Maintenance |
|------------------|---|-------------|
| SN               | 6329C42903640033  |             |
| Model            | EM400-UDL-470M  |             |
| PN               | C050  |             |
| Device EUI       | 24E124329C429036  |             |
| Firmware Version | V1.1-a4   |             |
| Hardware Version | V1.0  |             |
| Device Status    | ON  |             |


**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.
- 3) EM400-UDL can also be configured by dedicated NFC reader provided by Milesight IoT.

## 4.2 Basic Settings

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

Reporting Interval  10  min

Tilt & Distance Switch 

Change Password

| Parameters             | Description  |
|------------------------|--|
| Reporting Interval     | Reporting interval of transmitting data to server.<br><b>LoRaWAN® Version:</b> 10 minutes as default, range: 1~1080 minutes;<br><b>NB Version:</b> 30 minutes as default, range: 1~1440 minutes. |
| Tilt & Distance Switch | When detecting that the offset angle is greater than 20 degrees, turn off the distance sensor.   |
| Change Password        | Change the password for ToolBox App or software to access this device.   |
| NB Version Only        |  |
| Cumulative Numbers     | Store this number of periodic packets to report together.  |

|                            |  |
|----------------------------|--|
| Positioning Settings       | Enable GNSS positioning. When the device is on motion status, it will only upload positioning data instead of distance data. |
| The duration of Motion     | When device is detected to move beyond this duration, it will upload a GNSS data packet.                                     |
| The duration of stationary | When device is detected to stop moving beyond this duration, it will upload a GNSS data packet.                              |
| Motion Report Interval/Min | The interval to report GNSS data during the motion.  |

## 4.3 Communication Settings

### 4.3.1 LoRaWAN Settings (LoRaWAN® Version Only)

Go to **Device > Setting > LoRaWAN Settings** of ToolBox App to configure join type, App EUI, App Key and other information. You can also keep all settings by default.

Device EUI

\* APP EUI

\* Application Port  85

Join Type

\* Application Key

LoRaWAN Version

Work Mode

RX2 Data Rate

RX2 Frequency

Confirmed Mode [i](#)

Rejoin Mode

Set the number of detection signals sent [i](#)

ADR Mode [i](#)

Spreading Factor [i](#)

TXPower

| Parameters              | Description  |
|-------------------------|--|
| Device EUI              | Unique ID of the device which can also be found on the label.                          |
| App EUI                 | Default App EUI is 24E124C0002A0001.   |
| Application Port        | The port used for sending and receiving data, default port is 85.                      |
| Join Type               | OTAA and ABP mode are available.   |
| Application Key         | Appkey for OTAA mode, default is 5572404C696E6B4C6F52613230313823.                     |
| Device Address          | DevAddr for ABP mode, default is the 5 <sup>th</sup> to 12 <sup>th</sup> digits of SN. |
| Network Session Key     | Nwkskey for ABP mode, default is 5572404C696E6B4C6F52613230313823.                     |
| Application Session Key | Appskey for ABP mode, default is 5572404C696E6B4C6F52613230313823.                     |
| LoRaWAN Version         | V1.0.2, 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   |
| 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   |

|                |   |
|----------------|---|
| Spread Factor  | If ADR is disabled, the device will send data via this spread factor.   |
| Confirmed Mode | If the device does not receive ACK packet from network server, it will resend data once.  |
| Rejoin Mode    | 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.<br>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.    |
| Set the number of packets sent | When rejoin mode is enabled, set the number of LinkCheckReq packets sent.<br><b>Note:</b> the actual sending number is <b>Set the number of packets sent + 1</b> . |
| ADR Mode                       | Allow network server to adjust datarate of the device.   |
| Tx Power                       | Transmit power of device.  |

**Note:**

- 1) Please contact sales for device EUI list if there are many units.
- 2) Please contact sales if you need random App keys before purchase.
- 3) Select OTAA mode if you use Milesight IoT cloud to manage devices.
- 4) Only OTAA mode supports rejoin mode.

**4.3.2 Application Mode Settings (NB Version Only)**

Go to **Device > Setting > Application Mode Settings** of ToolBox App to configure the application mode and server information.

Application Mode

MQTT

Broker Address

112.48.19.183

Port

18226

Client ID

6748D11290120003

User Credentials

TLS

| Parameters         | Description   |
|--------------------|---|
| Application Mode   | Select from AWS, TCP, UDP, and MQTT.                        |
| <b>AWS</b>         |   |
| Server Address     | Fill in the AWS server domain name which the data sends to. |
| CA File            | Import the CA.crt file.                                     |
| Client Certificate | Import the client certificate.                              |

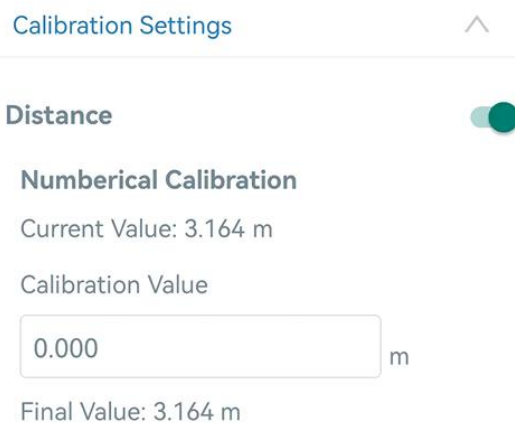
|                         |  |
|-------------------------|--|
| Client Key              | Import the client key.   |
| <b>TCP/UDP</b>          |  |
| Server Address          | Fill in the TCP/UDP server address (IP/domain name).   |
| Server Port             | Fill in the TCP/UDP server port. Range: 1-65535.   |
| <b>MQTT</b>             |  |
| Broker Address          | Fill in MQTT broker address to receive data.   |
| Port                    | Fill in MQTT broker port to receive data.  |
| Client ID               | Client ID is the unique identity of the client to the server, it must be unique when all clients are connected to the same server. |
| <b>User Credentials</b> |  |
| Enable                  | Enable user credentials.   |
| Username                | The username used for connecting to MQTT broker.   |
| Password                | The password used for connecting to MQTT broker.   |
| <b>TLS</b>              |  |
| Enable                  | Enable the TLS encryption in MQTT communication.   |
| Protocol                | It's fixed as TLS v1.2.  |
| CA File                 | Import the CA.crt file.  |
| Client Certificate      | Import the client certificate.   |
| Client Key              | Import the client key.   |

## 4.4 Advanced Settings

### 4.4.1 Calibration Settings

Go to **Device > Settings > Calibration Settings** to enable calibration. EM400-UDL supports two calibration types.

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



- **Measure Outlier Calibration:** users can define either outlier range or value. When the device distance value exceeds the outlier range (or range) comparing to last value, the device will measure the distance again.

**Measure Outlier Calibration** (i)

Maximum Range: 5 m

Outlier Range / % (i)

Outlier Value / m (i)

#### 4.4.2 Threshold Settings

Go to **Device > Setting > Threshold Settings** to enable the threshold settings and input the distance threshold. EM400-UDL will detect whether the distance reaches the threshold according to collecting interval. If threshold is triggered, it uploads the current data once instantly.

**Distance**

Over / m

Below / m

Collecting Interval  10  min

Threshold Dismiss Report (i)

| Parameters               | Description   |
|--------------------------|---|
| Collecting Interval      | Collecting interval of ultrasonic sensor to detect distance. Range: 1~1080min   |
| Threshold Dismiss Report | When the collected value changes from outside the threshold to within the threshold, a threshold release packet will be reported. |

## 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:**

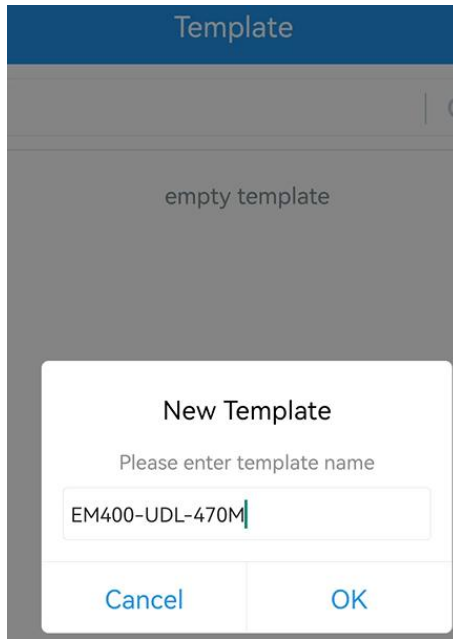
- 1) Operation on ToolBox is not supported during a firmware upgrade.
- 2) Only Android version ToolBox supports the upgrade feature.

| Status                                | Setting          | Maintenance |
|---------------------------------------|------------------|-------------|
| SN                                    | 6329C42903640033 |             |
| Model                                 | EM400-UDL-470M   |             |
| Firmware Version                      | V1.1-a4          |             |
| Hardware Version                      | V1.0             |             |
| Manual Upgrade                        |                  |             |
| <input type="button" value="Browse"/> |                  |             |

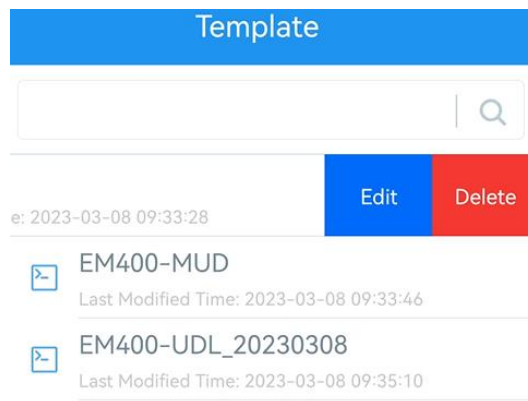
### 4.5.2 Backup

EM400-UDL support 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

Please select one of following methods to reset device:

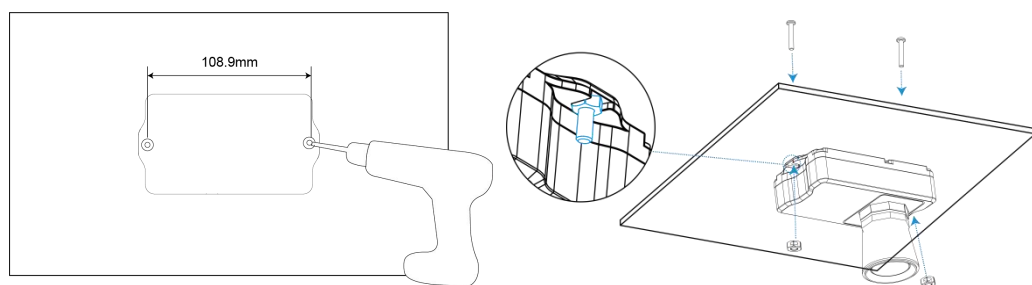
**Via Hardware:** Hold on power button (internal) for more than 10s.

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

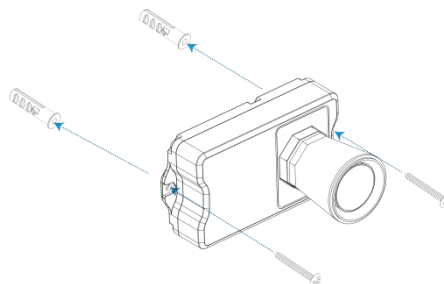
| Status                  | Setting          | Maintenance |
|-------------------------|------------------|-------------|
| SN                      | 6329C42903640033 |             |
| Model                   | EM400-UDL-470M   |             |
| Firmware Version        | V1.1-a4          |             |
| Hardware Version        | V1.0             |             |
| Manual Upgrade          |                  |             |
| <a href="#">Browse</a>  |                  |             |
| Restore Factory Default |                  |             |
| <a href="#">Reset</a>   |                  |             |

## 5. Installation

1. Drill two holes on the container cover according to the location of device mounting holes.
2. Put the device under container cover and align the holes in order to perfectly screw the bolts into the holes from the other side of the cover.



Besides, the device can also be fixed by two M4 mounting screws and wall plugs.



**Installation Note:**

- In order to provide the best data transmission, please ensure the device is deployed within the signal range of the LoRaWAN® gateway or base station and keep it away from metal objects and obstacles.
- The device must be placed in a horizontal position above the detected object so that it has a clear path to the object.
- The device should be installed at least 30cm away from the side-wall without obstructions blocking the ultrasonic signal. If the device needs to be installed on the side wall, please ensure the ultrasonic horn is away from the side wall.
- Do not install the ultrasonic sensor above the influent stream to ensure the measured surface rather than the incoming stream.

## 6. Communication Protocol

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

### 6.1 LoRaWAN® Version

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    | ... |

#### 6.1.1 Uplink Data

| Channel | Type                  | Description  |
|---------|-----------------------|--|
| ff      | 01(Protocol Version)  | 01=>V1   |
|         | 09 (Hardware Version) | 01 40 => V1.4  |
|         | 0a (Software Version) | 01 14 => V1.14   |
|         | 0b (Power On)         | Device is on   |
|         | 0f (Device Type)      | 00: Class A, 01: Class B, 02: Class C  |
|         | 16 (Device SN)        | 16 digits  |
| 01      | 75(Battery Level)     | UINT8, Unit: %   |
| 03      | 67 (Temperature)      | INT16, Unit: °C  |
| 04      | 82 (Distance)         | INT16, Unit: mm  |
| 05      | 00 (Device Position)  | 00: Normal (horizontal offset angle < 20°)<br>01: Tilt (horizontal offset angle ≥ 20°)   |
| 83      | 67(Temperature)       | Temperature (2 Bytes) + Alarm Status(1 Byte)<br>Temperature: unit -- °C<br>Alarm Status: |

|    |              |   |
|----|--------------|---|
|    |              | 00 -Alarm dismiss<br>01 -Alarm  |
| 84 | 82(Distance) | Distance (2 Bytes) + Alarm Status (1 Byte)<br>Distance: unit -- mm<br>Alarm Status:<br>00 -Alarm dismiss<br>01 -Alarm |

**Examples:**

1. Device information: report once whenever join the network.

| ff0bff ff0101 ff166329c42903640033 ff090100 ff0a0101 ff0f00 |                          |                      |         |                          |                 |
|---|--------------------------|----------------------|---------|--------------------------|-----------------|
| Channel   | Type                     | Value                | Channel | Type                     | Value           |
| ff  | 0b<br>(Power On)         | ff<br>(Reserved)     | ff      | 01<br>(Protocol Version) | 01 (V1)         |
| Channel   | Type                     | Value                | Channel | Type                     | Value           |
| ff  | 16<br>(Device SN)        | 6329c42903<br>640033 | ff      | 09<br>(Hardware version) | 0100<br>(V1.0)  |
| Channel   | Type                     | Value                | Channel | Type                     | Value           |
| ff  | 0a<br>(Software version) | 0101<br>(V1.1)       | ff      | 0f<br>(Device Type)      | 00<br>(Class A) |

2. Periodic uplink: report according to reporting interval (10 mins by default).

| 017564 0367f800 04820101 050001 |                  |  |         |                         |   |
|---------------------------------|------------------|--|---------|-------------------------|---|
| Channel                         | Type             | Value                                  | Channel | Type                    | Value                                     |
| 01                              | 75<br>(Battery)  | 64 => 100%                             | 03      | 67<br>(Temperature)     | f8 00 => 00 f8<br>= 248 * 0.1<br>=24.8 °C |
| Channel                         | Type             | Value                                  | Channel | Type                    | Value                                     |
| 04                              | 82<br>(Distance) | 01 01 =><br>01 01<br>=257mm<br>=0.257m | 05      | 00<br>(Device Position) | 01=Tilt                                   |

3. Distance Threshold: report when distance reaches the threshold or returns back to normal value.

| 8482330701 |                  |  |
|------------|------------------|--|
| Channel    | Type             | Value  |
| 84         | 82<br>(Distance) | Distance: 33 07 =>07 33 = 1843mm = 1.843m<br>Alarm Status: 01= Alarm |

4. Temperature Threshold: report when the abrupt change of temperature is greater than 5 °C.

| 8367220101 |                     |   |
|------------|---------------------|---|
| Channel    | Type                | Value   |
| 83         | 67<br>(Temperature) | Temperature: 22 01 => 01 22 = 290 * 0.1 = 29°C<br>Alarm Status: 01= Alarm |

### 6.1.2 Downlink Commands

EM400-UDL supports downlink commands to configure the device. Application port is 85 by default.

| Channel | Type                            | Description  |
|---------|---------------------------------|--|
| ff      | 10 (Reboot)                     | ff (Reserved)  |
|         | 03 (Set Reporting Interval)     | 2 Bytes, unit: s   |
|         | 3e (Set Tilt & Distance Switch) | 00 = Disable; 01 = Enable  |
|         | 06 (Set Threshold Alarm)        | 9 Bytes,<br>CTRL(1B)+Min(2B)+Max(2B)+00000000(4B)<br><br>CTRL:<br>Bit2~Bit0:<br>000-disable<br>001-below<br>010-above<br>011-within<br>100-below or above<br>Bit5~Bit3=001<br>Bit6=0<br>Bit7:<br>0 - disable threshold dismiss report<br>1 - enable threshold dismiss report |

#### Example:

1. Set reporting interval as 20 minutes.

| ff03b004 |                             |                                     |
|----------|-----------------------------|-------------------------------------|
| Channel  | Type                        | Value                               |
| ff       | 03 (Set Reporting Interval) | b0 04 => 04 b0 = 1200s = 20 minutes |

2. Reboot the device.

| ff10ff |  |  |
|--------|--|--|
|--------|--|--|

| Channel | Type        | Value         |
|---------|-------------|---------------|
| ff      | 10 (Reboot) | ff (Reserved) |

3. Enable "Tilt & Distance Switch" feature.

| ff3e01  |                                 |             |
|---------|---------------------------------|-------------|
| Channel | Type                            | Value       |
| ff      | 3e (Set Tilt & Distance Switch) | 01 = Enable |

4. When the distance is below 1 m or above 3 m, the sensor will trigger threshold alarm.

| ff06 8c e803 b80b 0000 0000 |                          |   |
|-----------------------------|--------------------------|---|
| Channel                     | Type                     | Value   |
| ff                          | 06 (Set Threshold Alarm) | CTRL: 8c=10 001 100<br>100=below or above<br>10=enable threshold dismiss report<br>Min: e8 03=> 03 e8 =1000mm =1m<br>Max: b80b => 0b b8 =3000mm =3m |

## 6.2 NB Version

### 6.2.1 AWS/MQTT Topics

When the device is connected to AWS/MQTT server, the bi-directional communication uses different topics.

| Topic                       | Content   |
|-----------------------------|---|
| em/[SN]/status              | Receive periodic reports, threshold alarms, etc.  |
| em/[SN]/cmd/update          | Send downlink commands  |
| em/[SN]/cmd/update/accepted | Receive success ACK of downlink commands<br><b>Note:</b> users need to send downlink command to enable ACK feature first. |

### 6.2.2 Uplink Data

All data are based on following format (HEX):

| Start    | ID       | Packet Length | FLAG     | Frame Counter | Protocol Version | Software Version | Hardware Version |
|----------|----------|---------------|----------|---------------|------------------|------------------|------------------|
| 02       | 0001     | 2 Bytes       | 00       | 0000          | 01               | 4 Bytes          | 4 Bytes          |
| SN       | IMEI     | IMSI          | ICCID    | Signal        | Data Length      | Data1            | ...              |
| 16 Bytes | 15 Bytes | 15 Bytes      | 20 Bytes | 1 Byte        | 2 Bytes          | N Bytes          | ...              |

## Example:

| Type             | Content  |
|------------------|--|
| Start            | 02   |
| ID               | 0001   |
| Packet Length    | 00 5f=95 bytes   |
| FLAG             | 00   |
| Frame Counter    | 0000   |
| Protocol Version | 01=V1  |
| Software Version | 30 31 30 31 => 0101=V1.1   |
| Hardware Version | 30 31 30 30 => 0100=V1.0   |
| SN               | 36 37 34 38 44 31 31 32 39 30 31 32 30 30 30<br>33=>6748d11290120003                   |
| IMEI             | 38 36 38 35 30 38 30 36 31 39 32 34 35 31 33<br>=>868508061924513                      |
| IMSI             | 34 36 30 30 38 33 38 38 33 38 30 36 36 38 36 =><br>460083883806686                     |
| ICCID            | 38 39 38 36 30 34 62 38 31 30 32 32 63 30 34 35 36 36<br>38 36 => 898604b81022c0456686 |
| Network Signal   | 10=>16 asu   |
| Data Length      | 0e=>14 Bytes   |
| Data             | See details below  |

Data part is based on Channel+Type+Data, the Data field should follow little-endian:

| Channel | Type                 | Description  |
|---------|----------------------|--|
| 01      | 75(Battery Level)    | UINT8, Unit: %   |
| 03      | 67 (Temperature)     | INT16, Unit: °C  |
| 04      | 82 (Distance)        | INT16, Unit: mm  |
| 05      | 00 (Device Position) | 00: Normal (horizontal offset angle < 20°)<br>01: Tilt (horizontal offset angle ≥ 20°)   |
| 06      | 88 (Location)        | Byte 1-4: latitude*1000000<br>Byte 5-8: longitude*1000000<br>Byte 9: motion status,<br>20=unknown, 21=start moving, 22=in motion,<br>23=stop moving<br><b>Note:</b> If the device fails to get GNSS data,<br>the latitude or longitude will show FFFFFFFF. |

|    |                 |  |
|----|-----------------|--|
| 83 | 67(Temperature) | Temperature (2 Bytes) + Alarm Status(1 Byte)<br>Temperature: unit -- °C<br>Alarm Status:<br>00 -Alarm dismiss<br>01 -Alarm |
| 84 | 82(Distance)    | Distance (2 Bytes) + Alarm Status (1 Byte)<br>Distance: unit -- mm<br>Alarm Status:<br>00 -Alarm dismiss<br>01 -Alarm      |

**Examples:**

1. Periodic uplink: report according to reporting interval\*cumulative numbers (30 mins\*12 by default) when the device is stationary.

| 017564 0367f800 04820101 050000 |                  |  |         |                         |   |
|---------------------------------|------------------|--|---------|-------------------------|---|
| Channel                         | Type             | Value                                  | Channel | Type                    | Value                                     |
| 01                              | 75<br>(Battery)  | 64 => 100%                             | 03      | 67<br>(Temperature)     | f8 00 => 00 f8<br>= 248 * 0.1<br>=24.8 °C |
| Channel                         | Type             | Value                                  | Channel | Type                    | Value                                     |
| 04                              | 82<br>(Distance) | 01 01 =><br>01 01<br>=257mm<br>=0.257m | 05      | 00<br>(Device Position) | 00=Normal                                 |

2. GNSS uplink: report when positioning setting is enabled and the device is in motion.

| 050001 068873c177019cff080722 |                         |         |         |                  |   |
|-------------------------------|-------------------------|---------|---------|------------------|---|
| Channel                       | Type                    | Value   | Channel | Type             | Value   |
| 05                            | 00<br>(Device Position) | 01=Tilt | 06      | 88(Locati<br>on) | Latitude: 73c17701=>01 77 c1<br>73=24625523/1000000=24.62<br>5523<br>Longitude: 9cff0807=>07 08 ff<br>9c=118030236/1000000=118.<br>030236<br>22=in motion |

3. Distance Threshold: report when distance reaches the threshold or returns back to normal value. If the threshold triggering time is close to periodic report time, it will send with periodic uplink.

| 8482330701 |                  |  |
|------------|------------------|--|
| Channel    | Type             | Value  |
| 84         | 82<br>(Distance) | Distance: 33 07 =>07 33 = 1843mm = 1.843m<br>01= Alarm |

4. Temperature Threshold: report once when the abrupt change of temperature is greater than 5 °C.

| 8367220101 0688FFFFFFFFFFFFFFFF20 |                     |   |         |              |  |
|-----------------------------------|---------------------|---|---------|--------------|--|
| Channel                           | Type                | Value   | Channel | Type         | Value  |
| 83                                | 67<br>(Temperature) | Temperature: 22 01<br>=>01 22 = 290 * 0.1<br>= 29 °C<br>01= Alarm | 06      | 88(Location) | Latitude/longitude<br>: FFFFFFFF<br>20=unknown |

### 6.2.3 Downlink Commands

EM400-UDL supports downlink commands to configure the device. **Note that it can only receive downlink commands within the 10s after sending uplink packets.**

| Channel | Type                                   | Description  |
|---------|--|--|
| ff      | 10 (Reboot)                            | ff (Reserved)  |
|         | 03 (Reporting Interval)                | 4 Bytes, unit: s   |
|         | 3e (Tilt & Distance Switch)            | 00 = Disable; 01 = Enable  |
|         | a0 (Position Setting)                  | 00 = Disable; 01 = Enable  |
|         | 58 (Duration of Motion and Stationary) | 5 Bytes,<br>Byte 1: duration of motion, unit: s<br>Byte 2-5: duration of stationary, unit: s |
|         | 8e (Motion Report Interval)            | 5 Bytes,<br>Byte 1: 00 = Disable; 01 = Enable<br>Byte 2-5: report interval, unit: s          |
|         | 9e (Cumulative Numbers)                | 2 Bytes,<br>Byte 1: 00 = Disable; 01 = Enable<br>Byte 2: Cumulative numbers                  |
|         | 9f (ACK of Downlink Command)           | 00 = Disable; 01 = Enable  |
|         | 06 (Set Threshold Alarm)               | 9 Bytes,<br>CTRL(1B)+Min(2B)+Max(2B)+00000000 (4 B)<br>CTRL:                                 |

|  |  |  |
|--|--|--|
|  |  | Bit2~Bit0:<br>000-disable<br>001-below<br>010-above<br>011-within<br>100-below or above<br>Bit5~Bit3:<br>001-Standard Mode<br>010-Bin Mode<br>Bit6=0<br>Bit7:<br>0 - disable threshold dismiss report<br>1 - enable threshold dismiss report |
|--|--|--|

**Example:**

1. Set reporting interval as 20 minutes.

| ff03b0040000 |                             |   |
|--------------|-----------------------------|---|
| Channel      | Type                        | Value   |
| ff           | 03 (Set Reporting Interval) | b0 04 00 00 => 00 00 04 b0 = 1200s = 20 minutes |

2. Reboot the device.

| ff10ff  |             |               |
|---------|-------------|---------------|
| Channel | Type        | Value         |
| ff      | 10 (Reboot) | ff (Reserved) |

3. When the distance is below 1 m or above 3 m, the sensor will trigger threshold alarm.

| ff06 8c e803 b80b 0000 0000 |                          |   |
|-----------------------------|--------------------------|---|
| Channel                     | Type                     | Value   |
| ff                          | 06 (Set Threshold Alarm) | CTRL: 8c=10 001 100<br>100=below or above<br>10=enable threshold dismiss report<br>Min: e8 03=> 03 e8 =1000mm =1m<br>Max: b80b => 0b b8 =3000mm =3m |

4. Set duration of motion to 50s and duration of stationary to 180s.

| ff5832b4000000 |                           |                            |
|----------------|---------------------------|----------------------------|
| Channel        | Type                      | Value                      |
| ff             | 58(Duration of Motion and | Duration of motion: 32=50s |

|  |             |   |
|--|-------------|---|
|  | Stationary) | Duration of stationary: b4 00 00 00=00<br>00 00 b4=180s |
|--|-------------|---|

**-END-**