ToF Laser Distance Sensor

## Featuring LoRaWAN®

EM400-TLD

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 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.
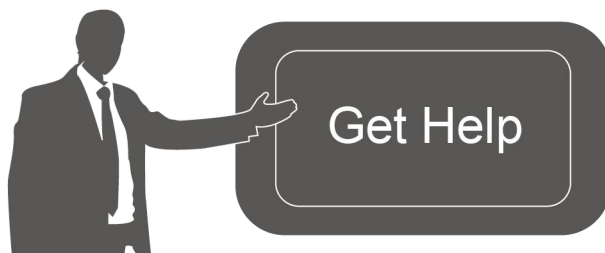
Declaration of Conformity

EM400-TLD is in conformity with the essential requirements and other relevant provisions of the CE, FCC, and RoHS.
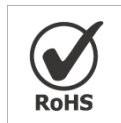
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For assistance, please contact
Milesight technical support:
Email: iot.support@milesight.com
Support Portal: support.milesight-iot.com
Tel: 86-592-5085280
Fax: 86-592-5023065
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Revision History

Date	Doc Version	Description
February 23, 2023	V 1.0	Initial version

Contents

1. Product Introduction

1.1 Overview

EM400-TLD is a LoRaWAN® distance sensor based on ToF (time of flight), which is mainly used for detecting the fill level and position status. With an appropriate FOV with the maximum field angle of 27°, it has almost no blind spot when installed on small-sized waste bins or containers. The embedded temperature sensor enables it to monitor whether the containers are burning for security reasons.

With IP67 waterproof rating and internal damp-proof coating, it is suitable for outdoor applications. Besides, EM400-TLD is equipped with 3-axis accelerometer to detect the status of container lid. Compatible with Milesight LoRaWAN® gateway and IoT Cloud solution, users can know the containers' status and fill level in real-time and manage effectively and remotely.

1.2 Features

- 2-350 cm wide detection range with extremely short blind zone
- Easy to install, especially suitable for small-size waste bins or containers
- Equipped with NTC temperature sensor for the detection and alarm of trash 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
- Ultra-wide-distance wireless transmission up to line of sight of 15km
- Equipped with NFC for one touch configuration, support car emulation mode
- Function well with standard LoRaWAN® gateways and network servers
- Compatible with Milesight IoT Cloud

2. Hardware Introduction

2.1 Packing List
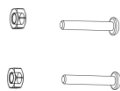
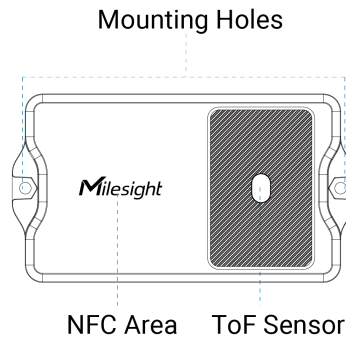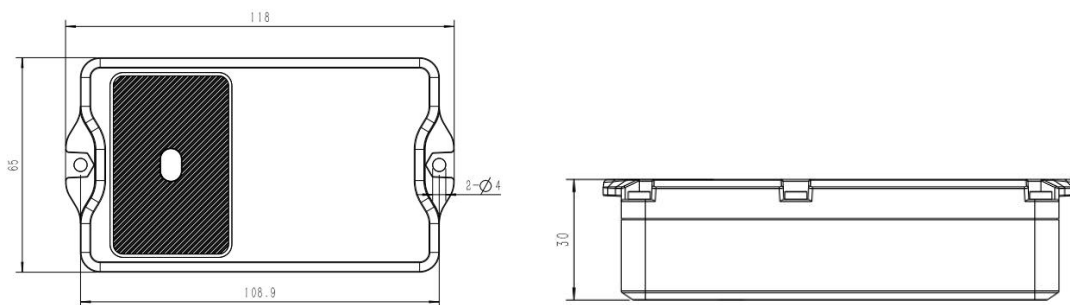| 1 × EM400-TLD Device	2 × Mounting Kits	1 × Mirror Cleaning Cloth	1 × Warranty Card	1 × Quick Guide

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

2.2 Hardware Overview

Mounting Holes

NFC Area   ToF Sensor

2.3 Dimensions (mm)

2.4 Power Button

EM400-TLD 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
		Light Off: Device is off

3. Operation Guide

3.1 NFC Configuration

EM400-TLD 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.
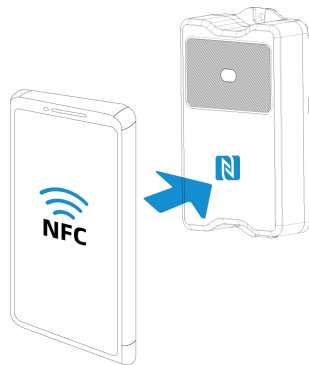
4. Basic information and settings of devices will be shown on ToolBox if it's recognized successfully. You can switch on/off, read and write the device by tapping the button on the App. In order to protect the security of devices, password validation is required when configuring via unused phone. Default password is **123456**.

Status	Setting	Maintenance
SN		6329C42503920003
Model		EM400-TLD-470M
Device EUI		24E124329C425039
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-TLD can also be configured by dedicated NFC reader provided by Milesight IoT or you can configure it via TTL interface inside the device.

3.2 LoRaWAN Settings

LoRaWAN settings is used for configuring the transmission parameters in LoRaWAN® network.

Basic 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.

Device EUI

24E124329C425039

* APP EUI

24e124c0002a0001

* Application Port 　－　85　＋

Join Type

OTAA ▼

* Application Key

****

LoRaWAN Version

V1.0.3 ▼

Work Mode

Class A ▼

RX2 Data Rate

DR0 (SF12, 125 kHz) ▼

RX2 Frequency

505300000

Confirmed Mode ⓘ   ⬤

Rejoin Mode   ⬤

Set the number of detection signals sent ⓘ

32

ADR Mode ⓘ   ⬤

Spreading Factor ⓘ

SF10-DR2 ▼

TXPower

TXPower0-19.15 dBm ▼

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 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, 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
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 ≤ 30 mins: the device will send a specific number of LinkCheckReq MAC packets to the network server every 30 mins to validate connectivity; if there is no response, the device will re-join the network. Reporting interval > 30 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.
ADR Mode	Allow network server to adjust data rate 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.

LoRaWAN Frequency Settings:

Go to **Setting > LoRaWAN Settings** to select supported frequency and select channels to send uplinks. Make sure the channels match the LoRaWAN® gateway.

If frequency is one of CN470/AU915/US915, you can enter the index of the channel that you want to enable in the input box, making them separated by commas.

Examples:

1, 40: Enabling Channel 1 and Channel 40

1-40: Enabling Channel 1 to Channel 40

1-40, 60: Enabling Channel 1 to Channel 40 and Channel 60

All: Enabling all channels

Null: Indicates that all channels are disabled

3.3 Basic Settings

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

Parameters	Description
Device Mode	Select from "Standard Mode" or "Bin Mode".
Reporting Interval	Reporting interval of transmitting data to network server. Standard Mode: 10 minutes as default; Bin mode: 20 minutes as default.
Installation Height	Enable or disable the installation height of the device when in Bin Mode. **Note:** 1. It is suggested to enable this feature if the bin is located under strong light and there are bags inside the garbage bin. 2. If the collected value is above the installation height twice, the sensor will report the installation height.
Value of the Installation Height	Set the installation height between device and the bottom of waste bin. Range: 0.02 - 3.5m.
Tilt & Distance Switch	When detecting that the offset angle is greater than 20 degrees, turn off the distance measurement.
Change Password	Change the password for ToolBox App or software to read/write this device.

3.4 Threshold Settings

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

Parameters	Description
Collecting Interval	Collecting interval of ToF sensor to detect distance. The default value for standard mode is 10 minutes, for bin mode is 20 minutes.
Threshold Dismiss Report	When the collected value changes from outside the threshold to within the threshold, a threshold dismiss packet will be reported.

3.5 Maintenance

3.5.1 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.
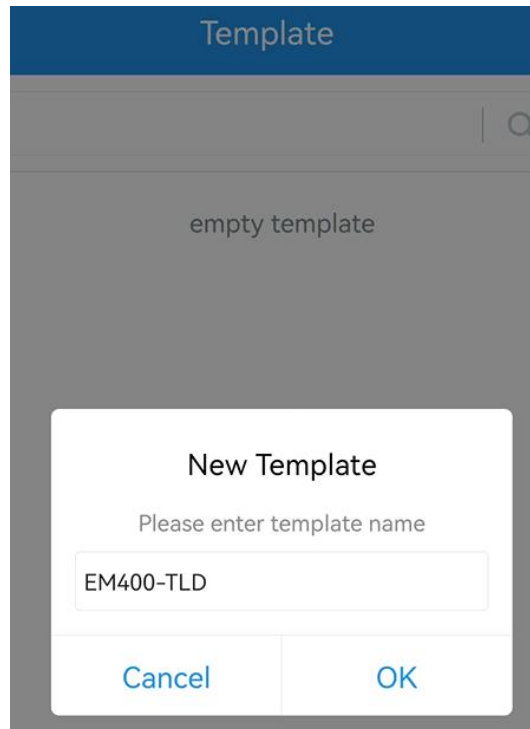
Note:

1) Operation on ToolBox is not supported during a firmware upgrade.

2) Only Android version ToolBox supports the upgrade feature.

3.5.2 Backup

EM400-TLD 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. 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.
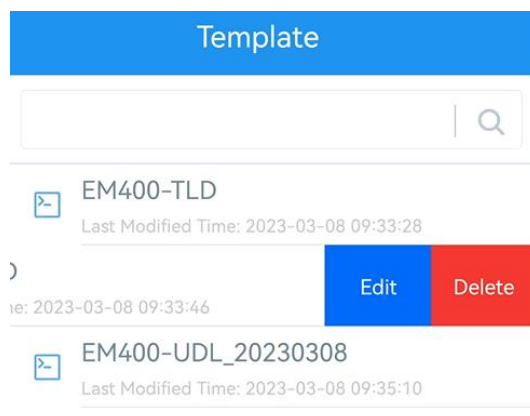
3.5.3 Reset to Factory Default

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.

4. 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.
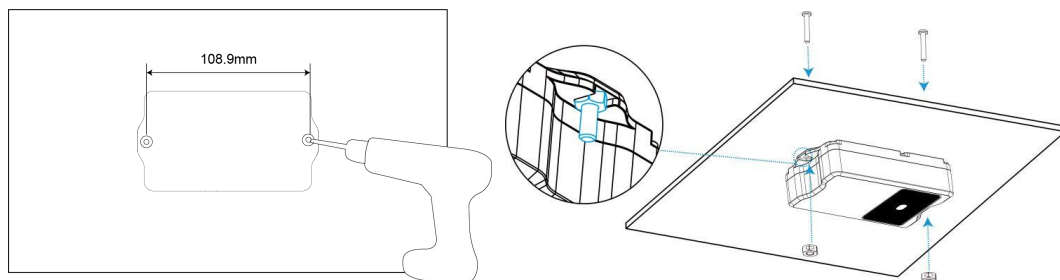
Besides, the device can also be fixed by two M4 mounting screws and wall plugs.
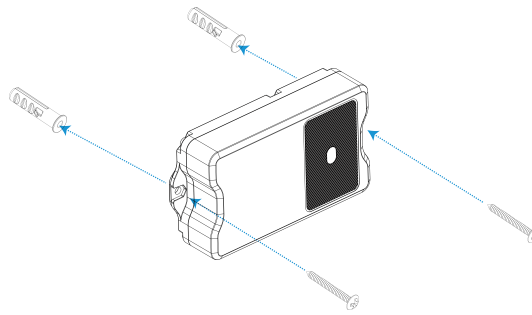
Installation Note:

● In order to provide the best data transmission, please ensure the device is within the signal range of the LoRaWAN® gateway and keep it away from metal objects and obstacles.

● Avoid strong light, like direct sunlight or IR LED, in the detection area.

● Do not install the device close to glass or mirror.

● After installation and adjustment, please remove the protective film.

● Do no touch the lens of sensor directly to avoid leaving the fingerprint on it.

● The detecting performance will be affected if there's dust on the lens. Please use the mirror cleaning cloth to clean the lens if needed.

● The device must be placed in a horizontal position on the top of the object so that it has a clear path to the object.

● When using waste bin mode, place the device in the center of waste bin and here are some recommended sizes of waste bins: when the height is 40cm, the minimum radius should be 10cm; when the height is 80cm, the minimum radius should be 19cm.

5. Device Payload

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.

5.1 Basic Information
EM400-TLD reports basic information of sensor whenever it joins the network.

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

Example:

ff0bff ff0101 ff166329c42503920003 ff090100 ff0a0101 ff0f00					
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	16 (Device SN)	6329c42503 920003	ff	09 (Hardware version)	0100 (V1.0)
Channel	**Type**	**Value**	**Channel**	**Type**	**Value**
ff	0a (Software version)	0101 (V1.1)	ff	0f (Device Type)	00 (Class A)

5.2 Sensor Data

EM400-TLD reports sensor data according to reporting interval (10 mins or 20 mins by default).

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°) 01: Tilt (horizontal offset angle ≥ 20°)

Example:

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

Threshold Packet:

When collected distance exceeds threshold, EM400-TLD will report a distance alarm packet;

besides, it will also report a alarm dismiss packet if distance returns back to normal value. When the abrupt change of temperature is greater than 5 °C, it will report a temperature threshold packet.

Channel	Type	Description
84	82 (Distance)	3 Bytes, Distance (2 Bytes) + Alarm Status (1 Byte) Distance: unit -- mm Alarm Status: 00 -Alarm dismiss 01 -Alarm
83	67 (Temperature)	3 Bytes, Temperature (2 Bytes) + Alarm Status(1 Byte) Temperature: unit -- °C Alarm Status: 00 -Alarm dismiss 01 -Alarm

Example:

1. Distance Threshold

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

2. Temperature Threshold

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

5.3 Downlink Commands

EM400-TLD 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
	13 (Set Installation Height)	00 = Disable; 01 = Enable

71 (Set Device Mode)	00 = Standard Mode; 01 = Bin Mode
3e (Set Tilt & Distance Switch)	00 = Disable; 01 = Enable
56 (Set ToF Distance Sensor)	00 = Disable; 01 = Enable
06 (Set Threshold Alarm)	9 Bytes, CTRL(1B)+Min(2B)+Max(2B)+00000000 (4 B) CTRL: Bit2~Bit0: 000-disable 001-below 010-above 011-within 100-below or above Bit5~Bit3: 001-Standard Mode 010-Bin Mode Bit6=0 Bit7: 0 - disable threshold dismiss report 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. Set the device as standard mode.

ff7100		
Channel	Type	Value
ff	71 (Set Device Mode)	00 = Standard Mode

4. When the distance is below 3mm or above 20mm, the sensor will send threshold alarm.

ff06 8c 0300 1400 00000000		
Channel	Type	Value
ff	06 (Set Threshold Alarm)	CTRL: 8c=10 001 100 100=below or above 001=standard mode 10=enable threshold dismiss report Min: 03 00=> 00 03 = 3mm Max: 1400 => 00 14 = 20mm

-END-