



# LoRaWAN Temperature & Humidity Sensor

## MS-LBS-TH-X1

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USER GUIDE

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# Chapter 1. Preface

## Copyright Statement

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Macnman reserves the right to change this guide and the specifications without prior notice. The latest specifications and user documentation for all Macnman products are available on our official website [www.macnman.com](http://www.macnman.com).

## Safety Instruction

These instructions are intended to ensure that users can use the product correctly and avoid danger or loss of property. Macnman will not be responsible for any loss or damage resulting from not following the instructions of this guide.

### CAUTION:

Injury or equipment damage may be caused if any of these cautions are neglected.

- The device is not intended to be used as a reference instrument. Macnman will not be responsible for any damage which may result from inaccurate readings.
- The device must not be disassembled or modified in any way. The battery cannot be replaced by the user.
- Do not place the device close to naked flames or other heat sources.
- Do not use the device where the temperature is below or above its operating range.
- The device contains a 3.6 V Li-SOCl<sub>2</sub> battery. Never recharge, short-circuit, crush, open or heat the device or its battery.
- The device must never be subjected to strong shocks or impacts.
- The AppKey protects the device's LoRaWAN traffic. Keep it private and do not put it in shared documents or screenshots.

## Revision History

| Release Date       | Version | Revision Content                                                           |
|--------------------|---------|----------------------------------------------------------------------------|
| September 30, 2026 | V1.0    | First release, for hardware V2.0.0, firmware V1.0.0 and Maya app V3.3.4+20 |

## Chapter 2. Product Introduction

### Overview

The MacSync MS-LBS-TH-X1 is a compact, battery-powered LoRaWAN sensor that measures air temperature and relative humidity with a Sensirion SHT40 sensor and reports the readings over a LoRaWAN network. It works with any standard LoRaWAN gateway and network server, and runs for years on one 19 Ah lithium cell.

The device is set up with the Macnman Maya app, which connects to it over Bluetooth Low Energy. Through the app, users set the reporting interval, alarm thresholds and batch sampling, check the radio link on the spot, view live readings and update the firmware. Most settings can also be changed remotely from the network server.

The MS-LBS-TH-X1 is widely used for cold storage and warehousing, smart buildings, server rooms, greenhouses and environmental monitoring.

### Features

- Sensirion SHT40 digital temperature and humidity sensor, factory calibrated
- Standard LoRaWAN 1.0.3, Class A, over-the-air activation (OTAA) - compliant with standard LoRaWAN gateways and network servers
- Two region bands: IN865 (default) and EU868
- Built-in 3.6 V, 19 Ah Li-SOCl<sub>2</sub> battery: around 8 years at a 10-minute reporting interval (SF7, Chapter 7)
- Rugged IP65 enclosure for indoor and outdoor use
- Two independent threshold triggers; each sends one confirmed ALARM when the value leaves its range and one CLEAR when it returns
- Batch sampling: 2 to 12 readings sent together in one message
- Quick configuration with the Macnman Maya app over Bluetooth, and remote configuration by downlink command
- Safe firmware updates over Bluetooth: the new firmware is used only after it has arrived complete and been checked
- Supports major LoRaWAN network servers (LNS): private LNS, ChirpStack, MQTT, Orbiwise, Netmore and on-premise industrial IoT deployments
- Ready-made decoder and encoder (codec) files on GitHub (Chapter 8)

### Product Limitations

The device works from -30 °C to +80 °C, but two of its functions have a limit at low temperature:

| Function             | Works down to | Below this temperature                                                                                                                                                    |
|----------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bluetooth (Maya app) | -10 °C        | The Maya app cannot find or connect to the device: no settings, Ping, Device data or firmware update over Bluetooth. The device keeps measuring and sending over LoRaWAN. |
| LoRaWAN              | -30 °C        | The device cannot join the network or send its readings.                                                                                                                  |



**Note:**

For cold rooms and freezers, finish the setup with the Maya app and check Ping before the device gets colder than -10 °C. After that, change settings by downlink command (Chapter 8), or bring the device to a warmer place.

## Chapter 3. Hardware Introduction

### Packing List

| Item                                | Quantity |
|-------------------------------------|----------|
| MS-LBS-TH-X1 sensor, battery fitted | 1        |
| Mounting clip                       | 1        |
| Mounting screws                     | 1 set    |
| User manual                         | 1        |
| Warranty card                       | 1        |
| IP68 cable extender *               | Optional |


**Note:**

If any of the above items is missing or damaged, please contact your sales representative.  
Items marked \* are optional accessories and may have to be purchased separately.

### Hardware Overview

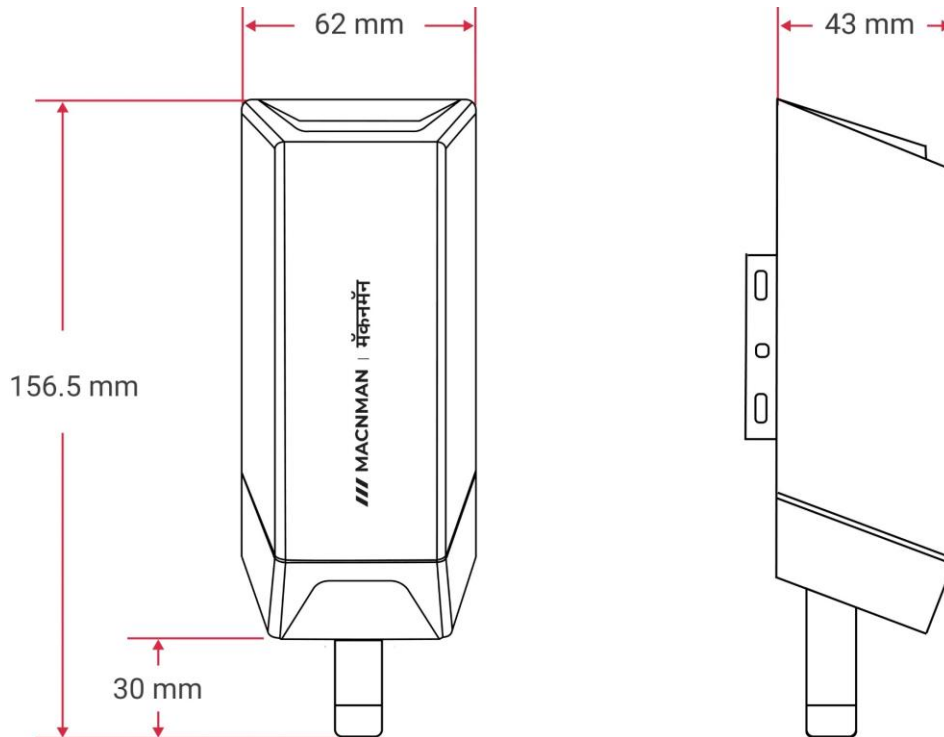
The MS-LBS-TH-X1 has two parts:

- **Enclosure** - IP65, glass-filled nylon, matte white. It holds the battery, the LoRaWAN radio with an internal antenna, the Bluetooth module and one three-colour LED indicator.
- **Sensor probe** - **30 mm long**, at the bottom of the enclosure; holds the Sensirion SHT40 temperature and humidity sensor.

The device has no user-accessible connector: everything is set up from the Maya app over Bluetooth.



## Dimensions (mm)



| Dimension     | Value                                                     |
|---------------|-----------------------------------------------------------|
| Height        | 156.5 mm overall: 126.5 mm enclosure + 30 mm sensor probe |
| Width x Depth | 62 mm x 43 mm                                             |
| Weight        | About 175 g (with battery)                                |

## LED Indicator

The device has one three-colour LED. The main processor drives its red and green colours; the Bluetooth module drives its blue colour. In normal operation, with no phone connected, the LED stays off to save battery.

| Function           | LED Indicator                              | Meaning                                                                                          |
|--------------------|--------------------------------------------|--------------------------------------------------------------------------------------------------|
| Power on / restart | Red: two long blinks (0.8 s on, 0.3 s off) | The device has just started: first start-up, reboot, firmware update or factory reset            |
| Network joined     | Green: five quick flashes within about 1 s | The network accepted the join request                                                            |
| App connected      | Blue: on                                   | The Maya app is connected over Bluetooth                                                         |
| App disconnected   | Blue: off                                  | No Bluetooth connection                                                                          |
| Firmware transfer  | Blue: blinks about twice a second          | A firmware update is being received from the app; goes back to solid blue when the transfer ends |



### Note:

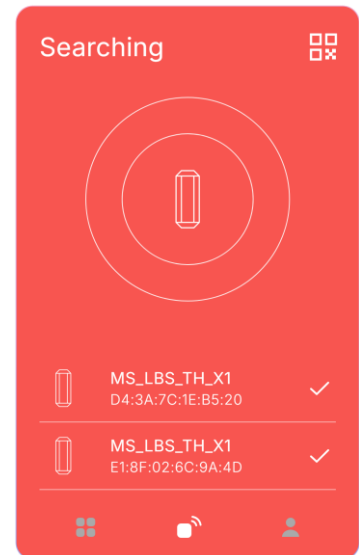
The device has no power button: it runs all the time. To restart it, tap Reboot in the Maya app (Chapter 5).

## Chapter 4. Quick Start

This chapter describes the steps to quickly put the device into operation. For more advanced settings, please refer to Chapter 5, Operation Guide.

1. Install the **Macman Maya** app on your Android smartphone (the Maya app is available for Android only) and switch on Bluetooth.
2. Open the Maya app. The **Searching** screen lists the devices nearby, each with its Bluetooth name - **MS\_LBS\_TH\_X1** from the factory - and its Bluetooth address. Tap your device to connect.

If several units are nearby, tap the QR icon at the top right and scan the label on the unit in your hand.



3. Under **Advanced > LoRaWAN Settings**, check the **Frequency** (region band, IN865 by default) and open **Keys & identity**. We recommend regenerating the JoinEUI and AppKey for each unit (Chapter 5), then copy the **DevEUI**, **JoinEUI** and **AppKey**.
4. On your LoRaWAN network server, add the device with OTAA activation, LoRaWAN 1.0.3, Class A, on the same band as the device and your gateway, and enter the three values. Install the MacSync LBS-TH-X1 codec (Chapter 8).
5. Keep the other settings at their defaults, or change them as required: the reporting interval (Heartbeat), triggers and sampling (Chapter 5).
6. Tap **Reboot** under Troubleshooting. The red LED blinks twice, the device joins the network - the green LED flashes five times - and it sends its start-up messages. The device uses newly generated keys only after this restart.
7. Stand at the mounting position and tap **Ping** to test the radio link (Chapter 5), then close the app connection.



### Note:

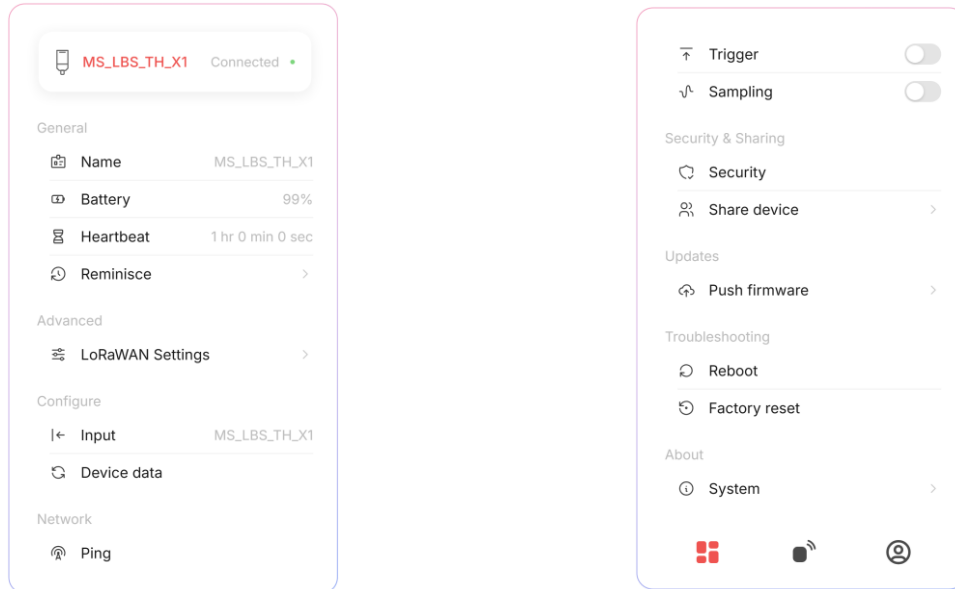
The device stays awake while the app is connected and uses far more power than while it sleeps. Disconnect the app as soon as the settings are done.

A device on the wrong band looks dead to the network although the app still connects to it. Check the band before assuming a coverage problem.

## Chapter 5. Operation Guide

### The Device Screen

The device is set up from the Macnman Maya app. After connecting, the device screen shows the settings in groups:

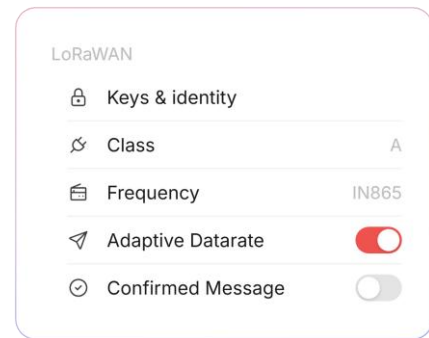


| Group              | Settings                            | Description                                                                             |
|--------------------|-------------------------------------|-----------------------------------------------------------------------------------------|
| General            | Name, Battery, Heartbeat, Reminisce | Device name, battery level and reporting interval. Reminisce is not used on this model. |
| Advanced           | LoRaWAN Settings                    | Keys and identity, class, region band, adaptive data rate, confirmed messages           |
| Configure          | Input, Device data                  | Input shows the built-in sensor, MS_LBS_TH_X1. Device data shows the live readings.     |
| Network            | Ping, Trigger, Sampling             | Radio link test, threshold alarms and batch sampling                                    |
| Security & Sharing | Security, Share device              | Still under implementation - not covered in this guide                                  |
| Updates            | Push firmware                       | Firmware update over Bluetooth                                                          |
| Troubleshooting    | Reboot, Factory reset               | Restart, or return to factory settings                                                  |
| About              | System                              | Hardware and software versions, Bluetooth address                                       |

## LoRaWAN Settings

The LoRaWAN settings are under **Advanced > LoRaWAN Settings**. On a new unit they are already set for India (IN865) with adaptive data rate on and unconfirmed heartbeats - check them rather than change them.

Changing the band, the adaptive data rate or the data rate restarts the device; it rejoins the network automatically.



| Parameter          | Description                                                                                                                                                                                                                                                               |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Device EUI         | Unique ID of the device, fixed to its hardware. Shown in Keys & identity and in the QR code on the label.                                                                                                                                                                 |
| Join EUI (App EUI) | Join identity. Every unit leaves the factory with the same default value; regenerate it per unit in Keys & identity.                                                                                                                                                      |
| Application Key    | AppKey for OTAA. Same factory default in every unit; regenerate it per unit in Keys & identity. Tap QR to show DevEUI, JoinEUI and AppKey as a QR code for the network server app.                                                                                        |
| LoRaWAN Version    | V1.0.3                                                                                                                                                                                                                                                                    |
| Work Mode          | Fixed as Class A.                                                                                                                                                                                                                                                         |
| Join Type          | OTAA                                                                                                                                                                                                                                                                      |
| Frequency          | IN865 (default) or EU868. One band per device, set in the app only; the device restarts when it is changed.                                                                                                                                                               |
| Adaptive Datarate  | On (default): the network server chooses the data rate. Off: the device uses the fixed data rate below. A change takes effect after the device restarts.                                                                                                                  |
| Data Rate          | Used when ADR is off. DR0 (SF12, longest range, factory setting) to DR5 (SF7, shortest range, lowest battery use). Takes effect after the device restarts.                                                                                                                |
| Confirmed Message  | Off (default): heartbeat readings are sent unconfirmed. On: the network must acknowledge every heartbeat; the device retries a limited number of times, so a reading can still be lost. The start-up information, alarms, sampling batches and Ping are always confirmed. |
| Join Retries       | If the join is not accepted, the device makes 12 attempts about 12 seconds apart (2 to 3 minutes in all), then pauses for 24 hours before trying again. Reboot the device to retry at once. Once joined, the device does not rejoin by itself.                            |
| Application Port   | Each message type has its own FPort: uplinks 2, 3, 4, 5 and 16 to 21; downlinks 16 to 21 (Chapter 8).                                                                                                                                                                     |

### Note:

Every unit leaves the factory with the same default JoinEUI and AppKey. For security, regenerate them per unit before deployment.

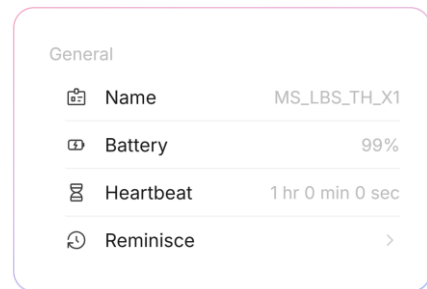
After regenerating the keys, register the new JoinEUI and AppKey on the network server, then reboot the device: it uses the new keys from the next restart.

A factory reset restores the default JoinEUI and AppKey.

## General Setting

General settings include the basic parameters of the device.

- Under **General**, tap **Name** to rename the device, or **Heartbeat** to change the reporting interval; choose hours, minutes and seconds and tap **Okay**.



| Parameter                      | Description                                                                                                                                                                                                                                                                                                  |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Name                           | Bluetooth name used by the Maya app, e.g. Warehouse_B: 4 to 22 characters. Default MS_LBS_TH_X1. After saving, the Bluetooth module restarts and the app disconnects; reconnect under the new name. A factory reset does not change the name. The network server always identifies the device by its DevEUI. |
| Battery                        | Estimated remaining battery, in percent (Chapter 7). Information only.                                                                                                                                                                                                                                       |
| Heartbeat (Reporting Interval) | How often the device measures and sends a reading. Range: 1 minute to 23 h 59 min. Default: 60 minutes. Takes effect at once: the next reading comes one full interval later.                                                                                                                                |
| Reminisce                      | Not used on this model: readings are not stored on the device. A reading the network does not receive is not sent again.                                                                                                                                                                                     |

## Time Synchronization

Once after every join, the device asks the network server for the date and time with the LoRaWAN DeviceTimeReq command. The network server must support device time synchronization (LoRaWAN 1.0.3). The time is sent in every message as Unix time (UTC). It is not synchronized again until the next join.



### Note:

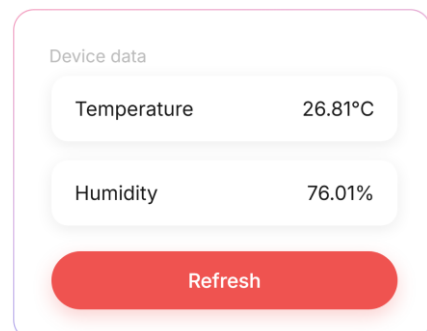
Until the network server answers, the time field carries the device's own clock: close to 1970 after the first start-up, or the last network time after a reboot. Treat times before 2020 as not synchronized and use the network server's receive time instead.

## Device Data

Device data shows the temperature and humidity the sensor is measuring now - use it to check the sensor during installation.

- Under **Configure**, tap **Device data**.
- The app shows the temperature in °C and the relative humidity in %, with two decimals.
- Tap **Refresh** for a new reading at any time.

Nothing is sent to the network and the reporting schedule is not affected. **Error** means the sensor could not be read: tap Refresh again, and contact Macnman support if it continues.



## Network Test (Ping)

Ping tests the whole path from the device to the network server: the device takes a reading, sends it as a confirmed message on FPort 2 and waits for the acknowledgement.

1. Stand at the mounting position. Under **Network**, tap **Ping**.
2. The Send Uplink window shows the result within a few seconds.
3. Tap **Send again** to repeat, for example at another spot.

The 'Send Uplink' window displays the following data:

| Send Uplink   |     |
|---------------|-----|
| Uplink status | ✓   |
| RSSI          | ●   |
| Downlink      | 002 |
| SNR           | ●   |

At the bottom, there is a red button labeled 'Send again'.

| Result        | Description                                                                                             |
|---------------|---------------------------------------------------------------------------------------------------------|
| Uplink status | Green tick: the network received and acknowledged the reading. Red cross: no acknowledgement came back. |
| RSSI          | Signal strength of the network's reply at the device. Green is a usable link; red is weak.              |
| SNR           | Signal quality of the reply.                                                                            |
| Downlink      | The network's downlink frame counter for the current session; it restarts from 0 after every restart.   |



### Note:

Each Ping is a real transmission and uses about as much battery as a heartbeat.

A red cross with RSSI and SNR blank means the network did not answer from that spot: check the join, the band, the gateway and the distance, then try again.

Ping is also the quickest way to make the device collect a waiting downlink command.

## Threshold Setting (Trigger)

A trigger watches temperature or humidity and sends an alarm as soon as the value leaves the range you set. The device has two independent triggers.

1. Under **Network**, tap **Trigger**.
2. Choose **Trigger 1** or **Trigger 2** and the **Parameter**: Temperature or Humidity.
3. Enter the **Minimum Threshold** and **Maximum Threshold** - the normal range - and the **Trigger Time** (check interval).
4. Tap **Set**. The trigger is saved and switched on; Sampling is switched off.

The 'Set Trigger' window shows the following configuration:

| Set Trigger       |               |
|-------------------|---------------|
| Trigger           | Trigger 1 ▼   |
| Parameter         | Temperature ▼ |
| Minimum Threshold | -30.0         |
| Maximum Threshold | 80.0          |
| Trigger Time      | 0m 30s        |

At the bottom, there is a large red button labeled 'Set'.

| Parameter                   | Description                                                                                                 |
|-----------------------------|-------------------------------------------------------------------------------------------------------------|
| Trigger                     | Trigger 1 or Trigger 2. Factory setting: both off; Trigger 1 on Temperature, Trigger 2 on Humidity.         |
| Parameter                   | Temperature or Humidity.                                                                                    |
| Minimum / Maximum Threshold | Temperature -30.00 to 80.00 °C, humidity 0.00 to 100.00 %RH, two decimals. Factory setting: the full range. |
| Trigger Time                | How often the value is checked: 5 seconds to 24 hours. Factory setting: 30 seconds.                         |

How a trigger works:

- At every Trigger Time the device reads the sensor with the radio off. If the value is inside the range, nothing is sent.
- If the value is outside, the device reads it twice more. Only if all three readings are outside does it send an **ALARM** (confirmed, FPort 4).
- While the value stays outside, nothing more is sent. When it comes back inside, the device sends one **CLEAR**.
- If the value keeps moving just above and just below a limit, the device sends an ALARM each time it goes out and a CLEAR each time it comes back. To avoid many messages, set the limits a little away from the normal value.
- The heartbeat carries on while triggers are on. The **Trigger** switch under Network turns Trigger 1 on with its saved settings, or both triggers off; switch Trigger 2 on with Set Trigger.



**Note:**

Short Trigger Times wake the device often and shorten the battery life: checks every 5 seconds cut it to about a third.

## Sampling Setting

Sampling takes several readings with the radio off and sends them together in one message - detailed data at low power.

1. Under **Network**, tap **Sampling**.
2. **Select type**: Temperature, Humidity or Both.
3. **No of samples**: 2 to 12. **Sampling Window (Sec)**: the time between two readings.
4. Tap **Set**. Sampling is switched on; both triggers are switched off and the heartbeat pauses.

| Parameter       | Description                                                                                                                            |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Select type     | Temperature, Humidity or Both. Factory setting: Both.                                                                                  |
| No of samples   | 2 to 12 readings per message. Factory setting: 2.                                                                                      |
| Sampling Window | Time between two readings: 5 to 3,540 seconds. Factory setting: 60 seconds. One message is sent every No of samples x Sampling Window. |

**Note:**

The batch is sent confirmed on FPort 3, oldest reading first, with the time of sending. At SF10 to SF12 a message may carry at most 51 bytes: with Both, use 10 samples or fewer.

The Sampling switch under Network turns sampling on or off. When sampling is switched off, the heartbeat resumes; the triggers stay off until switched on again.

Do not change the heartbeat while Sampling is on, or reboot the device afterwards.

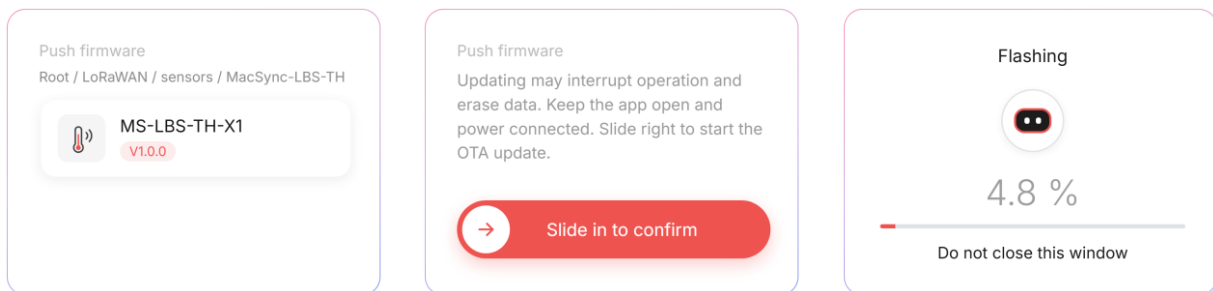
A sample the sensor could not read is sent as 0.00 (Chapter 8).

## Maintenance

### Upgrade

New firmware is installed from the Maya app over Bluetooth. The device keeps running its current firmware until the new one has arrived complete and been checked.

1. Connect to the device and note its Software version under **About > System**.
2. Under **Updates**, tap **Push firmware** and select the firmware image for this product (LoRaWAN > sensors > MacSync-LBS-TH). The device checks that the image is complete and undamaged, not which product it is for - always select the image for MS-LBS-TH-X1.
3. Slide to confirm. Keep the phone next to the device with the app open until the transfer finishes - about 2 minutes.
4. The device checks the firmware, restarts with it and rejoins the network. Connect again and check the Software version.

**Note:**

Firmware cannot be sent over LoRaWAN - a downlink is far too small. Updates are done on site, over Bluetooth. During the transfer the device does not send heartbeats or check triggers.

### Reboot

Under **Troubleshooting**, tap **Reboot**. The device restarts at once - no slide to confirm is needed. It rejoins the network and sends its start-up messages. All settings, the keys and the battery level are kept; the LoRaWAN frame counters start again from 0. If the device could not join the network, it waits 24 hours before it tries again. A reboot makes it try again right away.

## Reset to Factory Default

Under **Troubleshooting**, tap **Factory reset** and slide to confirm. The device restores the factory settings below and restarts. If the keys had been regenerated, update the registration on the network server with the factory JoinEUI and AppKey.

| Setting           | Factory Value                                                       |
|-------------------|---------------------------------------------------------------------|
| Heartbeat         | 60 minutes                                                          |
| Frequency         | IN865                                                               |
| Adaptive Datarate | On (data rate DR0 when off)                                         |
| Confirmed Message | Off                                                                 |
| Keys              | Factory JoinEUI and AppKey                                          |
| Trigger 1         | Off - Temperature, -30.00 to 80.00 °C, checked every 30 s           |
| Trigger 2         | Off - Humidity, 0.00 to 100.00 %RH, checked every 30 s              |
| Sampling          | Off - Both, 2 samples (the Sampling Window keeps its current value) |



### Note:

A factory reset does not change the Bluetooth name. The device keeps the name it had before the reset; to use the factory name again, set it under Name (General Setting).

After a factory reset the battery level shows 100 %, even if the battery is not full. The real battery level does not change (Chapter 7).

The firmware version and the DevEUI never change with a reset.

## Chapter 6. Installation

### Installation Location

- Keep the device away from metal objects, metal cabinets and large obstacles between the device and the gateway.
- Mount the device as high as practical, with the sensor probe at the bottom, as shown in Chapter 3.
- The device works indoors and outdoors. For correct readings, do not mount it in direct sunlight or near a heater, an air-conditioner outlet or a door: they heat or cool the air around the device, so it shows the wrong temperature and humidity.
- Before fixing the device, use **Ping** at the mounting position to check the radio link (Chapter 5).

Do not install the device in the places below. They block or disturb the radio signal, so the device may not join the network or may lose messages.

| Avoid                                                                                   | Why                                                                                                              | Do this instead                                                                       |
|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Inside a metal box, metal cabinet or metal panel                                        | Metal blocks the radio signal. A closed box also gives wrong readings, because room air cannot reach the sensor. | Mount the device outside the box, in free air.                                        |
| Near AC mains cables, power lines or electrical panels (distribution boards, MCB boxes) | Mains cables and panels make electrical noise that disturbs the radio.                                           | Keep the device at least 1 m away from them.                                          |
| Near motors, pumps, compressors, inverters (VFD), transformers or welding machines      | They make strong electrical noise, and their heat changes the readings.                                          | Keep the device at least 1 m away from them.                                          |
| Flat against a large metal surface (metal wall, door or cabinet side)                   | Metal right behind the device weakens the signal.                                                                | Mount it on a non-metal wall. On a metal pole, turn the device towards the gateway.   |
| Underground, in a basement, pit or tank chamber                                         | Soil, concrete and water block the radio signal.                                                                 | Mount it above ground. If there is no other place, check with Ping first.             |
| Behind thick concrete walls, steel structures or large water tanks                      | Concrete, steel and water weaken the signal a lot.                                                               | Mount it near a window or an outer wall that faces the gateway.                       |
| Right next to another antenna (gateway, Wi-Fi router, mobile modem)                     | A strong transmitter close by can overload the radio.                                                            | Keep the device at least 1 m away from other antennas, including the gateway antenna. |
| Covered with metal tape, foil, metallic paint or a metal cover                          | It blocks the signal like a metal box.                                                                           | Do not paint or cover the device.                                                     |



#### Note:

After installation, tap Ping again at the final position. If Ping fails or the signal is weak, move the device or install a gateway closer to it.

## Wall Mounting



1. Stick the white reference tape from the box on the wall where the device will go. Its two marked holes are the drilling template.
2. Drill the two holes at the marks on the tape.
3. Screw the mounting clip to the wall with the mounting screws supplied.
4. Slide the device down onto the clip until it clicks and locks in place.
5. Optional: for extra security, put a screw through the extra screw holes on the other side of the device.

## Pole Mounting

1. Remove the mounting clip from the device.
2. Put metal or plastic zip ties through the mounting holes of the clip.
3. Hold the device, with the clip and the zip ties, against the pole at the height you want.
4. Wrap the zip ties around the pole and pull them tight until the device is held firmly. Plastic and stainless-steel zip ties can both be used.



**Note:**

Mount the device upright with the sensor probe pointing down. The enclosure is IP65; the operating range is  $-30^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$ .

## Chapter 7. Battery Information

The device runs on one non-rechargeable 3.6 V, 19 Ah Li-SOCl<sub>2</sub> cell. The battery level is shown in the Maya app and sent in every message.

| Item         | Description                                                                                                                     |
|--------------|---------------------------------------------------------------------------------------------------------------------------------|
| Battery type | ER34615: 3.6 V, 19,000 mAh Li-SOCl <sub>2</sub> (lithium thionyl chloride), D size                                              |
| Battery life | Around 8 years (SF7), around 7 years (SF10) and around 4.5 years (SF12) in IN865 and EU868, at a 10-minute heartbeat and 25 °C. |

**Note:**

The battery is fitted at the factory and cannot be replaced by the user.

The battery level is an estimate: the device counts the energy it has used rather than measuring the cell.

A factory reset sets the battery level back to 100 % (Chapter 5) even though the battery is partly used, so the level shown is then higher than the real level. A reboot keeps the battery level.

At the end of its life, dispose of the device according to local regulations for lithium batteries.

## Chapter 8. Uplink and Downlink

### Overview

Each kind of message has its own LoRaWAN FPort. All multi-byte fields are big-endian (most significant byte first). Temperature, humidity and thresholds are signed 16-bit values x100 (0.01 resolution); the time is Unix time in seconds, UTC.

| FPort   | Direction | Message                                                                 | Length                                                    |
|---------|-----------|-------------------------------------------------------------------------|-----------------------------------------------------------|
| 2       | Uplink    | Sensor reading: every heartbeat, once after start-up, and at every Ping | 10 bytes                                                  |
| 3       | Uplink    | Sampling batch                                                          | 7 + 2 x n bytes (one parameter) or 7 + 4 x n bytes (both) |
| 4       | Uplink    | Trigger ALARM / CLEAR                                                   | 14 bytes                                                  |
| 5       | Uplink    | Start-up information, once after every join                             | 10 bytes                                                  |
| 16 - 21 | Uplink    | Setting reply: the device's answer to a downlink command                | 2 - 10 bytes                                              |
| 16 - 21 | Downlink  | Setting commands                                                        | 1 - 9 bytes                                               |

The decoder and encoder files, including a stand-alone encoder, are in the MacSync-LBS-TH-X1 folder on GitHub:

[https://github.com/MacnMan/MacnMan\\_LoRaWAN\\_Decoders/tree/main/LoRaWAN-Sensors/MacSync-LBS-TH-X1](https://github.com/MacnMan/MacnMan_LoRaWAN_Decoders/tree/main/LoRaWAN-Sensors/MacSync-LBS-TH-X1)

### Uplink Data

#### Start-up Information (FPort 5)

Sent once after every join, as a confirmed message.

| Byte  | Field            | Description                                             |
|-------|------------------|---------------------------------------------------------|
| 0 - 2 | Firmware version | 3 x uint8: main, sub1, sub2. Example: 01 00 00 = V1.0.0 |
| 3 - 5 | Hardware version | 3 x uint8. Example: 02 00 00 = V2.0.0                   |
| 6 - 9 | Time             | uint32, Unix seconds, UTC (see note)                    |

| 01 00 00 02 00 00 00 00 00 0C |                  |                                          |
|-------------------------------|------------------|------------------------------------------|
| Bytes                         | Field            | Value                                    |
| 01 00 00                      | Firmware version | V1.0.0                                   |
| 02 00 00                      | Hardware version | V2.0.0                                   |
| 00 00 00 0C                   | Time             | 12 s - the clock is not synchronized yet |

 **Note:**

The device asks the network server for the time with this first message. After the first start-up, its time field therefore shows only the time since start-up (1970 dates); after a reboot it continues the last network time. The following messages carry UTC once the network server has answered.

### Sensor Reading (FPort 2)

Sent at every heartbeat, once straight after the start-up information, and at every Ping. Heartbeats are unconfirmed by default (Confirmed Message setting); Ping is always confirmed.

| Byte  | Field       | Description                                                                                 |
|-------|-------------|---------------------------------------------------------------------------------------------|
| 0     | Error flag  | uint8: 0 = reading OK, 1 = sensor read failed (temperature and humidity are then sent as 0) |
| 1 - 2 | Temperature | int16 x100, unit: °C                                                                        |
| 3 - 4 | Humidity    | int16 x100, unit: %RH. Near condensation a value slightly outside 0 to 100 can appear.      |
| 5     | Battery     | uint8, unit: % (estimated remaining battery)                                                |
| 6 - 9 | Time        | uint32, Unix seconds, UTC                                                                   |

| 00 0A 00 17 89 62 6A BC DD A0 |             |                                      |
|-------------------------------|-------------|--------------------------------------|
| Bytes                         | Field       | Value                                |
| 00                            | Error flag  | Reading OK                           |
| 0A 00                         | Temperature | 0x0A00 = 2560 => 25.60 °C            |
| 17 89                         | Humidity    | 0x1789 = 6025 => 60.25 %RH           |
| 62                            | Battery     | 0x62 = 98 %                          |
| 6A BC DD A0                   | Time        | 1790762400 = 2026-09-30 10:00:00 UTC |

### Trigger Report (FPort 4)

Sent as a confirmed message when a trigger raises an ALARM or a CLEAR (Chapter 5).

| Byte    | Field             | Description                                              |
|---------|-------------------|----------------------------------------------------------|
| 0       | Trigger           | uint8: 1 or 2                                            |
| 1       | Parameter         | uint8: 0 = temperature, 1 = humidity                     |
| 2       | Event             | uint8: 1 = ALARM, 0 = CLEAR                              |
| 3 - 4   | Value             | int16 x100: the reading that caused the event, °C or %RH |
| 5 - 6   | Minimum threshold | int16 x100                                               |
| 7 - 8   | Maximum threshold | int16 x100                                               |
| 9       | Battery           | uint8, unit: %                                           |
| 10 - 13 | Time              | uint32, Unix seconds, UTC                                |

| 01 00 01 10 9A 03 E8 0F A0 5A 6A BC DD A0 |                   |                           |
|-------------------------------------------|-------------------|---------------------------|
| Bytes                                     | Field             | Value                     |
| 01                                        | Trigger           | Trigger 1                 |
| 00                                        | Parameter         | Temperature               |
| 01                                        | Event             | ALARM                     |
| 10 9A                                     | Value             | 0x109A = 4250 => 42.50 °C |
| 03 E8                                     | Minimum threshold | 0x03E8 = 1000 => 10.00 °C |
| 0F A0                                     | Maximum threshold | 0x0FA0 = 4000 => 40.00 °C |
| 5A                                        | Battery           | 0x5A = 90 %               |
| 6A BC DD A0                               | Time              | 2026-09-30 10:00:00 UTC   |

### Sampling Batch (FPort 3)

Sent as a confirmed message after the last reading of each batch. The samples are listed oldest first; with Both, each sample is a temperature followed by a humidity value.

| Byte   | Field     | Description                                                           |
|--------|-----------|-----------------------------------------------------------------------|
| 0      | Count     | uint8: number of samples n, 2 to 12                                   |
| 1      | Parameter | uint8: 0 = temperature, 1 = humidity, 2 = both                        |
| 2 ...  | Samples   | int16 x100 per value: n values (one parameter) or n x 2 values (both) |
| next 1 | Battery   | uint8, unit: %                                                        |
| last 4 | Time      | uint32, Unix seconds, UTC: the time the batch was sent                |

| 06 02 07 DC 16 EE 07 EF 17 18 08 01 17 43 08 14 17 6E 08 27 17 99 08 39 17 C4 61 6A BC DD A0 |           |                              |
|----------------------------------------------------------------------------------------------|-----------|------------------------------|
| Bytes                                                                                        | Field     | Value                        |
| 06                                                                                           | Count     | 6 samples                    |
| 02                                                                                           | Parameter | Both                         |
| 07 DC 16 EE                                                                                  | Sample 1  | 20.12 °C, 58.70 %RH (oldest) |
| 07 EF 17 18                                                                                  | Sample 2  | 20.31 °C, 59.12 %RH          |
| 08 01 17 43                                                                                  | Sample 3  | 20.49 °C, 59.55 %RH          |
| 08 14 17 6E                                                                                  | Sample 4  | 20.68 °C, 59.98 %RH          |
| 08 27 17 99                                                                                  | Sample 5  | 20.87 °C, 60.41 %RH          |
| 08 39 17 C4                                                                                  | Sample 6  | 21.05 °C, 60.84 %RH (newest) |
| 61                                                                                           | Battery   | 97 %                         |
| 6A BC DD A0                                                                                  | Time      | 2026-09-30 10:00:00 UTC      |

**Note:**

Sample  $k$  of  $n$  was taken  $(n - k) \times$  Sampling Window before the batch time; the codec does not add a time to each sample.

A sample the sensor could not read is sent as 0x0000 (0.00) without an error flag.

At SF10 to SF12 a message may carry at most 51 bytes: with Both, use 10 samples or fewer. A larger batch is not sent at those data rates.

**Setting Reply (FPort 16 - 21)**

Five seconds after it has applied a downlink command, the device sends an unconfirmed reply on the same FPort. The reply carries the setting now stored - not the value that was sent - followed by the battery level.

| FPort | Content                                                                                         | Example                               |
|-------|-------------------------------------------------------------------------------------------------|---------------------------------------|
| 16    | Reporting interval (uint32, s), battery                                                         | 00 00 02 58 62 = 600 s, 98 %          |
| 17    | ADR (00 off, 01 on), battery                                                                    | 01 62 = ADR on, 98 %                  |
| 18    | Confirmed heartbeat (00 / 01), battery                                                          | 01 62 = confirmed, 98 %               |
| 19    | ADR, SF (7 - 12), confirmed (00 / 01), battery                                                  | 00 09 01 62 = ADR off, SF9, confirmed |
| 20    | Trigger, parameter, min (int16 x100), max (int16 x100), check time (uint16, s), enable, battery | 01 00 03 E8 0F A0 00 3C 01 62         |
| 21    | Parameter, count, enable, battery                                                               | 02 06 01 62 = both, 6 samples, on     |

**Note:**

Compare the reply with the command you sent. On FPort 16 a value outside its range is ignored; on FPorts 17 to 21 it is limited to the range. The reply shows what is really stored. Thresholds can come back 0.01 lower than sent: compare them with a tolerance of 0.01.

No reply is sent if the payload is too short or the trigger number is not 1 or 2. If several commands arrive within 5 seconds, all are applied but only the last one gets a reply - queue one command per uplink.

**Downlink Command**

The device accepts configuration commands on FPorts 16 to 21. As a Class A device it can receive only in the two short windows after each of its own uplinks, so a queued command is delivered after the next heartbeat. Tap **Ping** in the Maya app to deliver it at once. Send one command at a time and wait for its reply.

| FPort | Setting                   | Byte | Description                                                                                                                                                                                                               |
|-------|---------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16    | Reporting interval        | 4    | uint32, unit: s, range 60 - 86399. A value out of range is ignored.                                                                                                                                                       |
| 17    | ADR                       | 1    | 00 = off, 01 = on. The device restarts about 9 s later and rejoins.                                                                                                                                                       |
| 18    | Confirmed heartbeat       | 1    | 00 = unconfirmed, 01 = confirmed. With ADR on, the data rate also returns to the stored data rate (factory SF12) until the network adjusts it again.                                                                      |
| 19    | ADR, data rate, confirmed | 3    | Byte 1: ADR (00 / 01). Byte 2: spreading factor 7 - 12, used when ADR is off. Byte 3: confirmed (00 / 01). The device restarts about 9 s later.                                                                           |
| 20    | Trigger                   | 9    | Byte 1: trigger (01 / 02). Byte 2: parameter (00 temperature, 01 humidity). Bytes 3 - 4: minimum, int16 x100. Bytes 5 - 6: maximum, int16 x100. Bytes 7 - 8: check time, uint16, s (5 - 65535). Byte 9: enable (00 / 01). |
| 21    | Sampling                  | 3    | Byte 1: parameter (00 temperature, 01 humidity, 02 both). Byte 2: count, 2 - 12. Byte 3: enable (00 / 01). The Sampling Window can be set only in the app.                                                                |

**Note:**

Thresholds are limited to the operating range: temperature -30.00 to 80.00 °C, humidity 0.00 to 100.00 %RH. Switching a trigger on switches sampling off; switching sampling on switches both triggers off and pauses the heartbeat.

The spreading factor in FPort 19 sets the data rate as  $DR = 12 - SF$ .

The region band cannot be changed by downlink - only in the app.

**Example 1.** Set the reporting interval to 10 minutes (FPort 16):

| 00 00 02 58 |                    |                            |
|-------------|--------------------|----------------------------|
| Bytes       | Field              | Value                      |
| 00 00 02 58 | Reporting interval | 0x258 = 600 s = 10 minutes |

**Example 2.** ADR off, SF9, confirmed heartbeats (FPort 19):

| 00 09 01 |                     |           |
|----------|---------------------|-----------|
| Bytes    | Field               | Value     |
| 00       | ADR                 | Off       |
| 09       | Spreading factor    | SF9 (DR3) |
| 01       | Confirmed heartbeat | On        |

**Example 3.** Trigger 1 on temperature, alarm outside 10.00 to 40.00 °C, checked every 60 s (FPort 20):

| 01 00 03 E8 0F A0 00 3C 01 |                   |                  |
|----------------------------|-------------------|------------------|
| Bytes                      | Field             | Value            |
| 01                         | Trigger           | Trigger 1        |
| 00                         | Parameter         | Temperature      |
| 03 E8                      | Minimum threshold | 1000 => 10.00 °C |
| 0F A0                      | Maximum threshold | 4000 => 40.00 °C |
| 00 3C                      | Check time        | 60 s             |
| 01                         | Enable            | On               |

Negative thresholds use two's complement: -10.00 °C = -1000 = FC 18. For example 02 00 FC 18 0D AC 03 84 01 sets trigger 2 on temperature, -10.00 to 35.00 °C, checked every 900 s.

**Example 4.** Sample both parameters, 6 samples per batch (FPort 21):

| 02 06 01 |           |           |
|----------|-----------|-----------|
| Bytes    | Field     | Value     |
| 02       | Parameter | Both      |
| 06       | Count     | 6 samples |
| 01       | Enable    | On        |

With the Macnman encoder installed on the network server, the same commands can be sent as JSON, with the FPort also given in the JSON:

| FPort | JSON for the encoder                                                                            |
|-------|-------------------------------------------------------------------------------------------------|
| 16    | { "port": 16, "interval": 600 }                                                                 |
| 17    | { "port": 17, "adr": 1 }                                                                        |
| 18    | { "port": 18, "msgtype": 1 }                                                                    |
| 19    | { "port": 19, "adr": 0, "sf": 9, "msgtype": 1 }                                                 |
| 20    | { "port": 20, "trig": 1, "param": 0, "min": 10.00, "max": 40.00, "checktime": 60, "enable": 1 } |
| 21    | { "port": 21, "param": 2, "count": 6, "enable": 1 }                                             |

## Chapter 9. Services

Macnman provides customers with timely and comprehensive technical support. End users can contact their local dealer for technical support; distributors and resellers can contact Macnman directly.

| Item              | Contact                                                                                                                                                                                               |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Technical support | <a href="mailto:support@macnman.com">support@macnman.com</a>                                                                                                                                          |
| Website           | <a href="http://www.macnman.com">www.macnman.com</a>                                                                                                                                                  |
| Codec downloads   | <a href="https://github.com/MacnMan/MacnMan_LoRaWAN_Decoders/tree/main/LoRaWAN-Sensors/MacSync-LBS-TH-X1">github.com/MacnMan/MacnMan_LoRaWAN_Decoders/tree/main/LoRaWAN-Sensors/MacSync-LBS-TH-X1</a> |

When you contact support, please have ready the DevEUI, the BLE MAC ID (Bluetooth address) and the hardware and software versions (both under About > System), the network server you use and its region band, and a description of what you saw - the LED, the Ping result and the device page on the network server.

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