OY1110

LoRaWAN Temperature and humidity sensor

User manual

Version 1.0

January 2019

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1 Disclaimer

This document represents information on products at the time of publication and is subject to change without prior notice due to product improvements or other reasons. Talkpool makes no warranties based on the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and product descriptions at any time without notice. Talkpool reserves all rights to this document and the information contained herein.

1.1 Technical support

Please visit www.talkpool.io for additional information, or contact IoT.support@talkpool.com

1.2 EU Declaration of conformity

EC DECLARATION OF CONFORMITY

certify that the design and manufacturing of this product
WIRELESS TEMPERATURE SENSOR /
FUNK-TEMPERATURSENSOR /
TRÅDLÖS TEMPERATUR SENSOR /
TRÅDØS TEMPERATUR SENSOR /
DRAADLOZE TEMPERATUURSENSOR
OY1110 EU868
conforms to the following directives and standards
The Radio Equipment Directive (2014/53/EU),
EN 300 220-1 V2.4.1, EN 300220-2 V2.4.1,
EN 301 489-1 V1.9.2, EN 301 489-3 V1.6.1,
EN 60950-1:2006+A11+A1+A12+A2
RoHS Directive 2011/65/EU
This product was CE marked in year -18

2018-12-01
Managing Director **Stefan Lindgren**

2 Warnings

The following safety precautions must be observed during all phases of the operation, usage, service or repair of this Talkpool product.

- Read the product manual.
- Do not modify the product.
- The product should not be exposed to extreme heat or open flame.
- The device must not be exposed to harsh chemical agents or solvents.
- The labelling of the product may not be changed, removed or made unrecognizable.

3 Environmental

This symbol on the product or on its packaging indicates that this product must not be disposed of with your other household waste. Instead, it is your responsibility to dispose of your waste by taking it to a collection point designated for the recycling of electrical and electronic appliances. Separate collection and recycling of your waste at the time of disposal will contribute to conserving natural resources and guarantee recycling that respects the environment and human health. For further information concerning your nearest recycling center, please contact your nearest local authority/town hall offices, your household waste collection company or the shop where you bought the product.

4 Product Description

Figure 1: OY1110 Temperature and humidity sensor

The OY1110 LoRaWAN Temperature and humidity sensor is designed to measure temperature and humidity in indoor environments. The sensor is intended for climate control, energy optimization, and damage preventions in attics and basements. It is optimized for reliable and secure measurements with more than 10 years life length.

The standard measurement and reporting interval is 15 minutes, other reporting intervals can be configured over the air.

5 Installation and activation

The sensor consists of a bottom piece, to be mounted on the wall, and a top piece with the active parts.

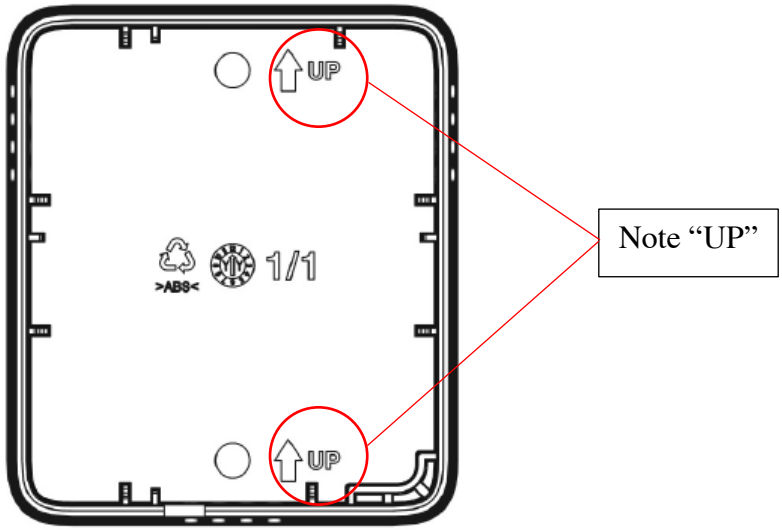


Figure 2: Mounting information

The bottom piece is mounted on the wall with the “UP” arrow upwards. It can be mounted either with screws or adhesive tape.

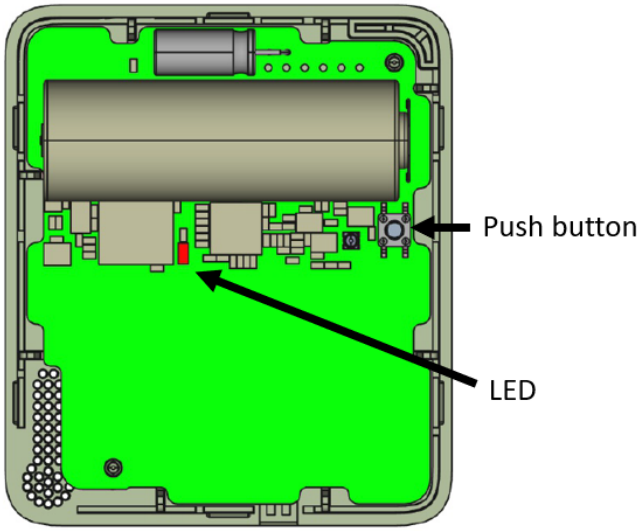


Figure 3: Push button and LED

The top piece contains all active components. The unit is shipped in sleep mode, i.e. with all functions, including radio, deactivated. The sensor is activated by pressing the push button for 3 seconds until the red LED makes two short flashes, make sure to not hold longer than 5 seconds. When the device has successfully joined the LoRaWAN network there will be a long (2s) flash.

5.1 LoRaWAN Configuration

Configuration on the network server is done with

AppEUI: 70-B3-D5-D7-2F-F8-16-00 (a.k.a. JoinEUI)

It is possible to order a batch of devices configured with a customer unique AppEUI from the Talkpool OUI range.

The device is configured with device unique DevEUI and AppKey

The device is default configured for OTA provisioning. Contact the Talkpool team for ABP configuration. The device follows the LoRaWAN standard related Join configuration parameters, such as RX1 and RX2 windows, RX2 downlink frequency etc.

The default setting is ADR enabled.

5.2 Sensor states and state check

The sensor has four states: Initial, Joining, Configure and Operational state.

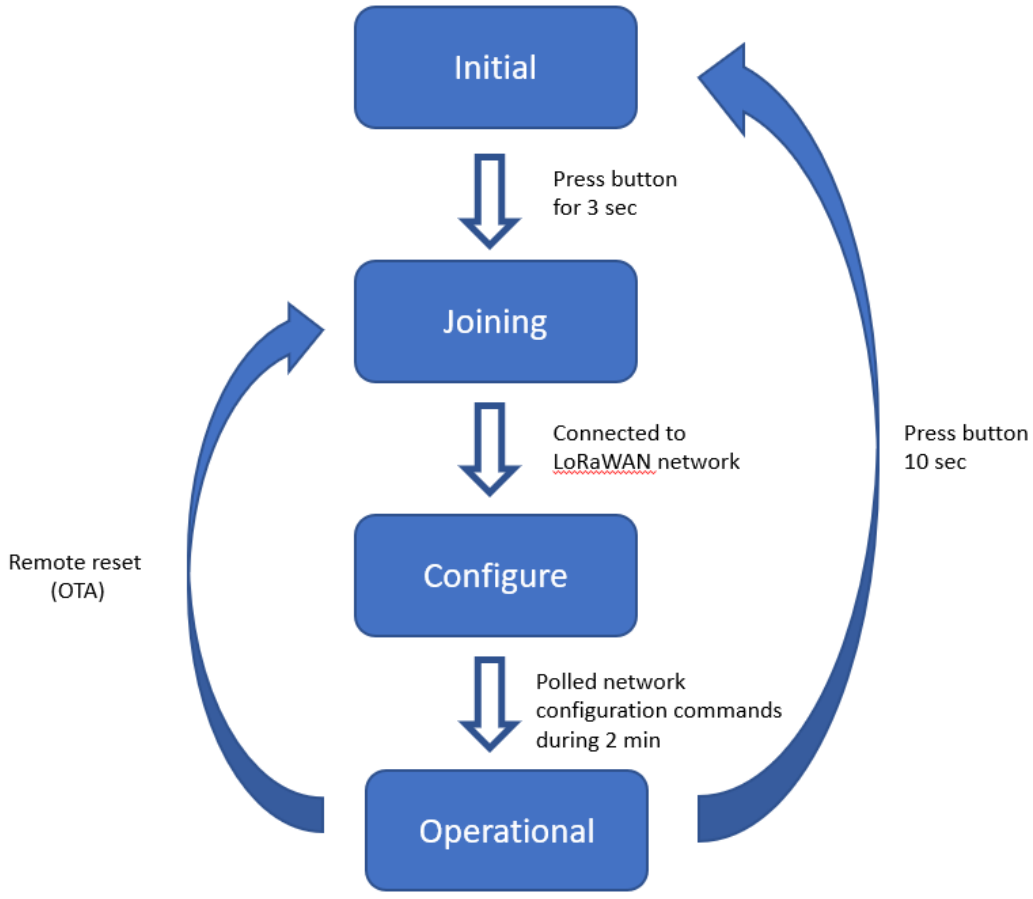


Figure 4: Device states

To check the device state, press the button and hold it pressed until the red LED starts flashing after 0.5s.

State	Description	LED response
Initial	Low power state during transport. Radio not active.	1 short flash (0.5 sec)
Joining	Trying to join a LoRaWAN network. The device will remain in this state until successfully joined a LoRaWAN network	2 short flash (0.5 sec)
Configure	Enables quick over-the-air configuration, by polling server after configuration commands during 2 minutes. This is done by sending uplink status command (0x20).	1 long flash (2 sec)
Operational	Joined to a LoRaWAN network, measures temperature and humidity periodically, and sends measurement reports toward a LoRAWAN network.	1 long flash (2 sec)

5.2.1 Re-join functionality

The device supervises its connectivity to the network, by monitoring that periodic downlink messages are received.

The device tries to re-join the network if it has not heard anything from the network for 288 uplinks (3 days @ 15-minute message interval). The device requests and normally gets a downlink ever 64th uplink due to the ADRAckReq functionality.

6 Specification

Accuracy and range

Temperature accuracy	± 0,2 °C (conditions 0 °C to +50 °C)
Temperature range	-20 °C to +60 °C
Humidity accuracy	± 2% (conditions 10-90% RH)
Humidity range	0% to 100% non-condensing

Accuracy of ± 0,1 °C and ± 1,5% humidity available upon request

Connectivity

Network	LoRaWAN
Frequency bands	868 MHz
Provisioning	Over the air & personalization

Security

Algorithms	AES-128
Hardware	Cryptographic co-processor
Features	Secure boot
	Secure firmware upgrade

Hardware based ultra-secure key storage

Battery life

Battery life length	10 years (at 5-minute intervals, SF7)
Primary cell	Lithium-thionyl 3.6V
Capacity	3.6 Ah

Size & Weight

Size	65 x 75 x 28 mm
Weight	75g

Configuration

Measurement intervals	1 minute – 1 week*
Transmission intervals	1 minute – 12 weeks*

*Default 15 minutes, configurable over the air

Unique App EUI available upon request

Enclosure

IP30

Certifications

RoHS compliant

CE

LoRaWAN

7 Product life length

The OY1110 LoRaWAN Temperature and Humidity sensor is design for 10+ years of maintenance-free operation. The product has high quality, high capacity batteries which support 15 min interval transmission at SF10 for 10 years. The product has soldered battery to prevent problems with corrosion and oxidation on the battery terminals, which is a common problem for batteries in field.

The protocol support also over the air adjustable measurement interval, and grouping function, which enables flexible usage to optimize the product for fine time resolution or extended life length.

8 Security

The OY1110 is based on the Talkpool LoRaWAN platform, with state-of-art security solution. The device has secure boot, to ensuring the firmware integrity, prevents malware injection and modification. The encrypted firmware prevents from any backwards engineering to engineer attack vectors.

The security keys are generated and stored in an ultra-secure cryptographic co-processor and cannot be extracted from the device.

The device is locked down in full security state, to keep the integrity and privacy of the customer data.

9 Protocol

The protocol consists of different types of data

- LoRaWAN v.1.0.4 standard commands
- Unsolicited uplink status commands during configure state
- Periodic measurement reports
- Downlink commands and queries
- Uplink query response

Note 0x denotation means hexadecimal encoded.

9.1 LoRaWAN standard commands

All standard LoRaWAN v 1.0.4 are supported. Please refer to the LoRaWAN standard for the protocol definition.

9.2 Unsolicited uplink status commands

The sensor polls the server for configuration parameters the during the **Configure** state. This is done by sending unsolicited uplink status report (0x20). This is gives quick feedback to the installer that the installation has been successful and enables downlink configuration commands to be sent. After approximately 2 minutes the device changes to **Operational** state.

Port: **Port 1**

Payload 0x01 20 00

0x01: Data type

0x20: Status command

0x00: Normal startup

The expected behavior is 0x01 20 00. If not contact Talkpool support.

9.3 Periodic measurement reports

The sensors transmit periodic unsolicited measurement reports, either from a single measurement or grouping several measurements to one transmission to conserve energy.

9.3.1 Periodic single measurement report

The default configuration is that temperature and humidity is measured and transmitted every 15th minute and transmitted. The data is compressed to conserve energy and minimizing interference.

Port: **Port 2**

Payload: Measurement value (see **chap 9.3.3)**

Size: 3 Bytes

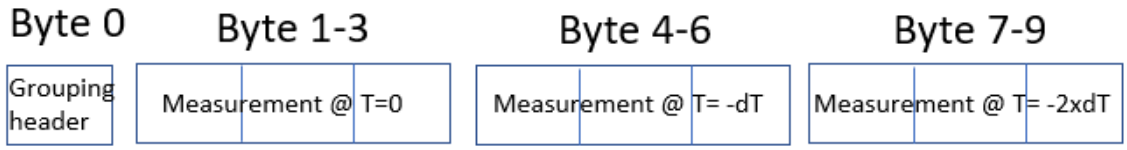
9.3.2 Periodic grouped measurement report

To optimize the time granularity or extend the battery life length, several measurements can be grouped into a single transmission.

Port: **Port 3**

Payload: Grouping header, Measurement value (T=0), Measurement value (T=-dT), Measurement value (T=-2 x dT), ….

Size: 1 Byte (Grouping header) + n x 3 Byte (Measurement value) where n = number of grouped measurements



The latest measurement performed right before the transmission is sent first in the report. To decode the number of measurements in a grouped measurement report the payload length must be used. The time between the measurements (dT) are described in the Grouping header. The data format is further explained in chapter 9.3.3 Measurement value and chapter 9.3.4 Grouping header.

9.3.3 Measurement value

The measurement value for each measurement is sent as two unsigned 12-bit values coded in three bytes.

Byte 0: Temperature, bit 11 – bit 4

Byte 1: Relative humidity, bit 11 – bit4

Byte 2:

bit 7-4: Temperature, bit 3 – bit 0

bit 3-0: Relative humidity, bit 3 – bit 0

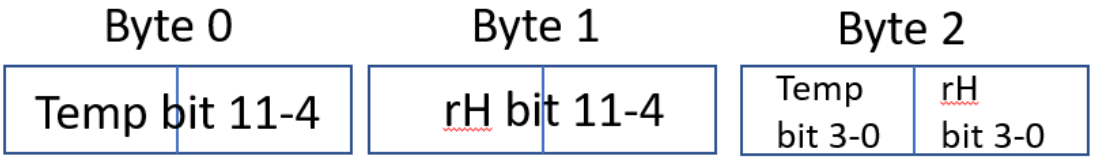


Figure 5: Measurment value encoding

9.3.3.1 Temperature conversion

The temperature measurement is transmitted using an unsigned 12-bit value. The scaling is 1/10 °C and the offset is 80 °C, which means the received value should be subtracted by 800 and then divided with 10 to get it in °C.

See example in 9.3.5

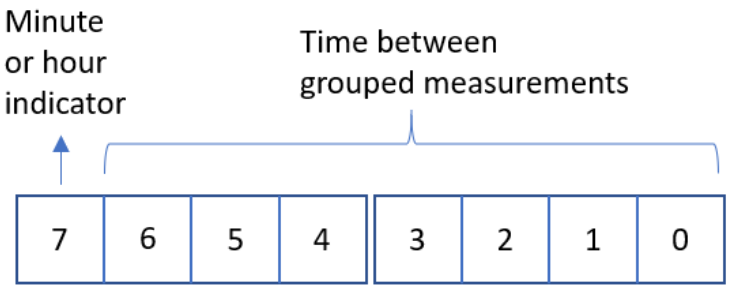
9.3.3.2 *Relative humidity conversion*

The relative humidity (rH) measurement is transmitted using an unsigned 12-bit value. The scaling is 1/10 % rH and the offset is 25 % rH, which means the received value should be subtracted by 250 and then divided with 10 to get it in % rH.

See example in 9.3.5

9.3.4 Grouping header

A periodic grouped measurement report starts with a grouping header, with information of time between the measurements, dT. The dT is coded using an 8-bit unsigned value. If bit7 (the most significant bit) is cleared (=0) the other 7 bits (bit0-bit6) indicates the number of minutes between two measurements. If bit7 (the most significant bit) is set (=1) the other 7 bits (bit0-bit6) indicates the number of hours between two measurements.



9.3.5 Example: Single measurement report

Data with single measurement when TxGroupsSiz = 1 sent on LoRaWAN port 2

3E 44 1d

3E1: 993 => 19.3 gradC

44D: 1101 => 85.1 % Rh

9.3.6 Example: Grouped measurement report

Data with multiple measurements when TxGroupsSize = 3 and MeasurementInterval = 15 sent on LoRaWAN port 3

0F 2E 3C CD 33 38 D2 39 31 F5

Total length = 10 bytes. Header = 1 bytes, each measurement = 3 bytes. Then number of measurements is (10-1)/3=3, i.e. 3 measurements

0F: Delta time. bit7 = 0 => minutes

bit6-0 = 0F => 15 minutes

2EC: 748 => -5.2 °C now

3CD: 973 => 72.3 % Rh now

33D: 829 => 2.9 °C 15 minutes ago

382: 898 => 64.8 % Rh 15 minutes ago

39F: 927 => 12.7 °C 30 minutes ago

315: 789 => 53.9 % Rh 30 minutes ago

9.4 Downlink commands and queries

To control the sensor application, in-band commands and queries can be sent from the server application. Contact your LoRaWAN network provider for in-band application API.

All downlink application communication is done on LoRaWAN **port 1.**

Downlink command network => device				
Field	Bytes	Value	Description	Note
Type	1	xx	0x01: Set 0x02: Query 0x03: Action	
Index	1	xx	Command Index	
Data			As defined for Command Index only applicable for set-commands	

9.5 Commands

Port	Index	Description	Uplink Datatype response	Encoding	Valid range	Access	Unsolicited	Description	Note
1	0x03	FW build hash	6 x Uint8			Query	No	Unique number that identifies the firmware version	
1	0x05	Device reset				Action	No	Reset of device	
1	0x06	CPU voltage	Uint8	25mV/ LSB	0-3.6V	Query	No	Read CPU voltage. Max/min ranges depend on battery chemistry.	
1	0x0A	CPU temperature	Uint16 Big endian	50C - 0.01C / LSB	-50- +125 C	Query	No	Temperature from CPU sensor with 50 °C offset. Approximately 5 °C accuracy.	
1	0x20	Status	Uint8	Bitfield		Query	Yes	For Talkpool support troubleshooting	Cleared through reset
1	0x23	Measurement interval	Uint16 Big endian	Minutes	1-10080	Query Set	No	Measurement interval in minutes	Setting measurement interval resets the measurement timer.
1	0x24	Tx group size	Uint8	-	1-12	Query Set	No	Number of measurements to group in each transmission.	
2	-	Data	[Uint12, Uint12]	(°C + 80)*10 (% Rh +25)*10	0 – 3800 0 - 1500	-	Yes	Current temperature and humidity. Sent if TxGroupSize = 1	See Ch 6.3
3	-	Grouped data	Uint8, TxGroupSize * [Uint12, Uint12]	min / hours (°C + 80)*10 (% Rh +25)*10	1 min – 126 h 0 – 3800 0 - 1500	-	Yes	Groups of temperature and humidity measurements. Sent if TxGroupSize >1. Current measurement is sent first.	See Ch 6.3

9.5.1 Measurement interval

The measurements are done periodically. The interval time is controlled by the configuration parameter Measurement Interval. The default setting is 15 minutes.
The measurement interval can be set between 1 and 10080 minutes (~1 week).
It is also possible to order a batch of OY1110 with a different default setting.

Example

Set measurement interval to 5 minutes:	Port 1: 01230005
Set measurement interval to 15 minutes:	Port 1: 0123000F

Note: For larger intervals than 2 hours, only full hours are supported. Maximal interval is 168 hours, i.e. 7 days.

9.5.2 TX group size

Several measurements can be grouped into a group measurement report to save battery. The TX group command defines how many measurements that should be included in each measurement report. The default setting is that every measurement as sent in a measurement report, i.e. TX group size = 1.

Example:

Group three measurements in one measurement report:	Port 1: 012403
Group one measurements in one measurement report:	Port 1: 012401

Note: Only full hours are supported for measurement intervals longer than 2 hours. The maximum interval is 168 hours, i.e. 7 days.

9.5.3 Reset device

The device can be remotely reset and forced into **Joining** state. All settings are back to factory default.

Example: Remote device reset:	Port 1: 0305

9.6 Uplink query response

When communication on LoRaWAN port 1 the following header is used:

Uplink command device => network				
Field	Bytes	Value	Description	Note
Type	1	xx	0x01: Data 0x02: Command NACK	
Index	1	xx	Command Index	
Data			As defined for Command Index (only for Type: Data)	

9.6.1 Uplink status report

The uplink status report is sent unsolicited during **Configure** state and queried in **Operational** state.

Example: Port 1: 01 20 00

01: Data type

20: Status command

00: Normal startup

For non-zero data, an error has occurred. Provide the error code in contacts with Talkpool support.