



OY1700

LoRaWAN Air quality (PM) sensor

User manual

Version 0.1

September 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 CO2 SENSOR /
FUNK-CO2 SENSOR /
TRÅDLÖS CO2 SENSOR /
TRÅDØS CO2 SENSOR /
DRAADLOZE CO2 SENSOR

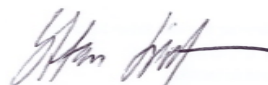
OY1210 EU868

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 V2.1.1,
EN 60950-1:2006+A11+A1+A12+A2
EN 62479:2010

RoHS Directive 2011/65/EU

This product was CE marked in year -19



2019-09-10

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

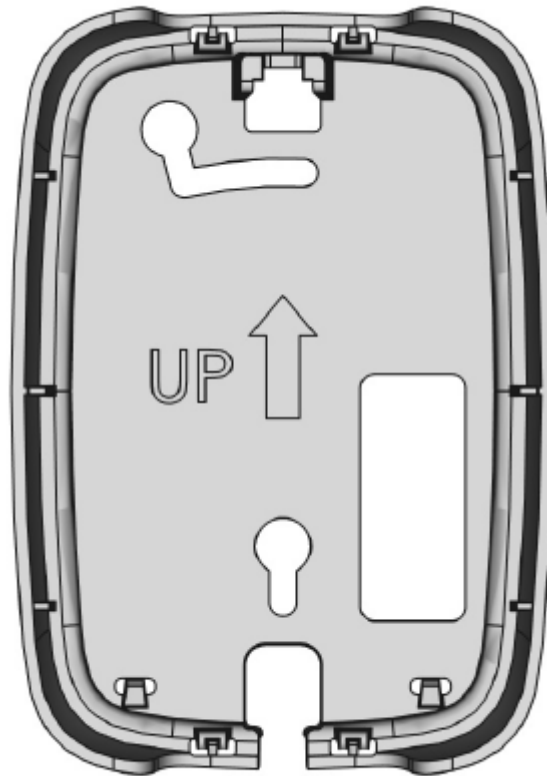


The OY1700 LoRaWAN Air quality (PM) sensor is designed to measure PM10, PM2.5, PM1.0, temperature and humidity in indoor environments. The sensor is intended for indoor climate control and monitoring indoor air quality. It is optimized for reliable and secure operations.

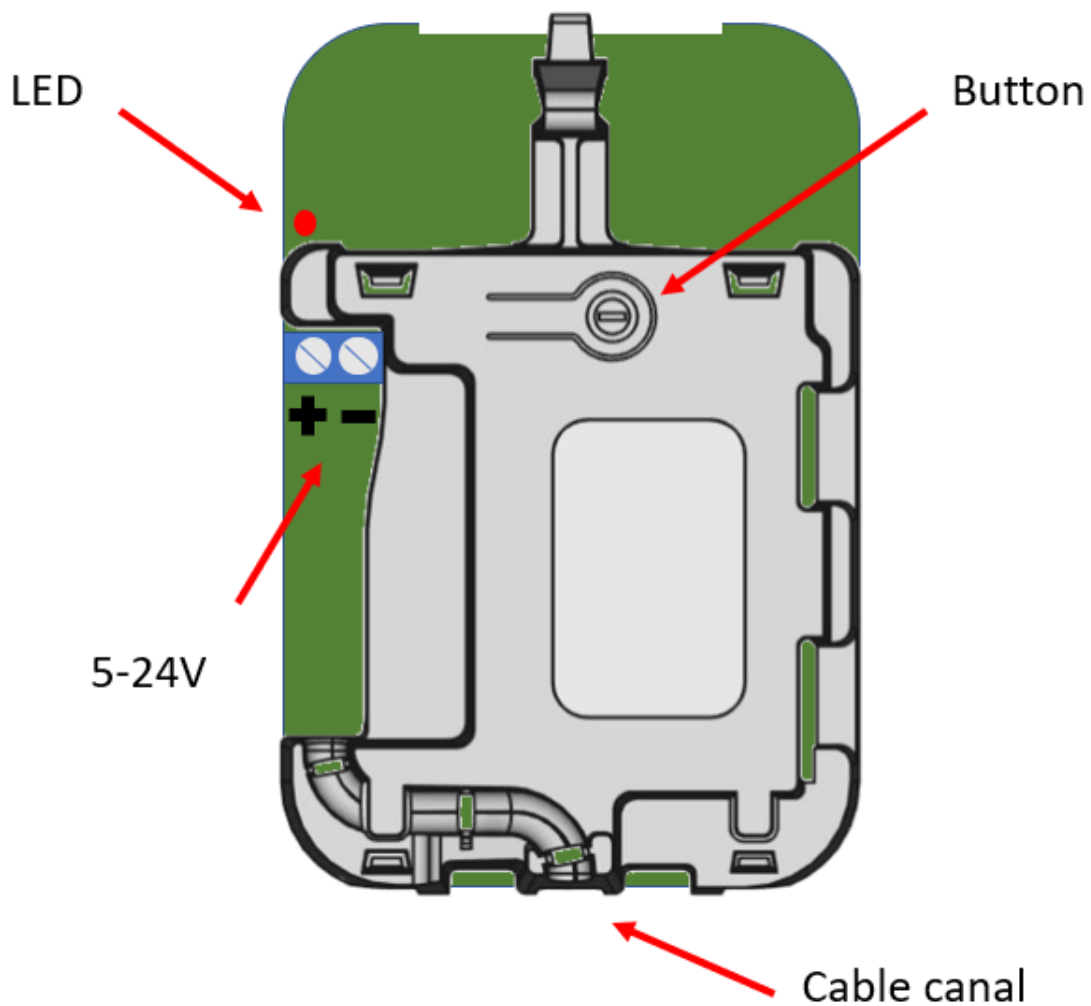
The standard measurement and reporting interval are every 20 minutes, other reporting intervals can be configured over the air.

5 Installation and activation

The sensor consists of a bottom piece, the electronic board and the top cover. Remove the top cover by pressing it upwards and outwards. The electronics are removed by releasing the plastic latch on the top.



The bottom piece is mounted on the wall with the “UP” arrow upwards. It can be mounted either with screws or adhesive tape both included in the package. The hole pattern matches standard junction box.



Configure the device in the LoRaWAN server, according to chapter 5.1, and power the device with 5-24 VDC power, e.g. USB charger or 24 VDC. The cable can be routed through the cable canal or through the electronic board for junction box mount. The sensor starts and flashes 8 times during the boot-up sequence and starts the join sequence to the LoRaWAN network

When the device has successfully joined the LoRaWAN network there will be a 2-second long flash.

Attach the electronic board to the bottom piece and attach the plastic cover.

5.1 LoRaWAN Configuration

Configuration on the network server is done with

AppEUI: 70-B3-D5-D7-2F-F8-17-00 (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 DevEUI is printed on device box and the AppKey is distributed by the sales team. 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.

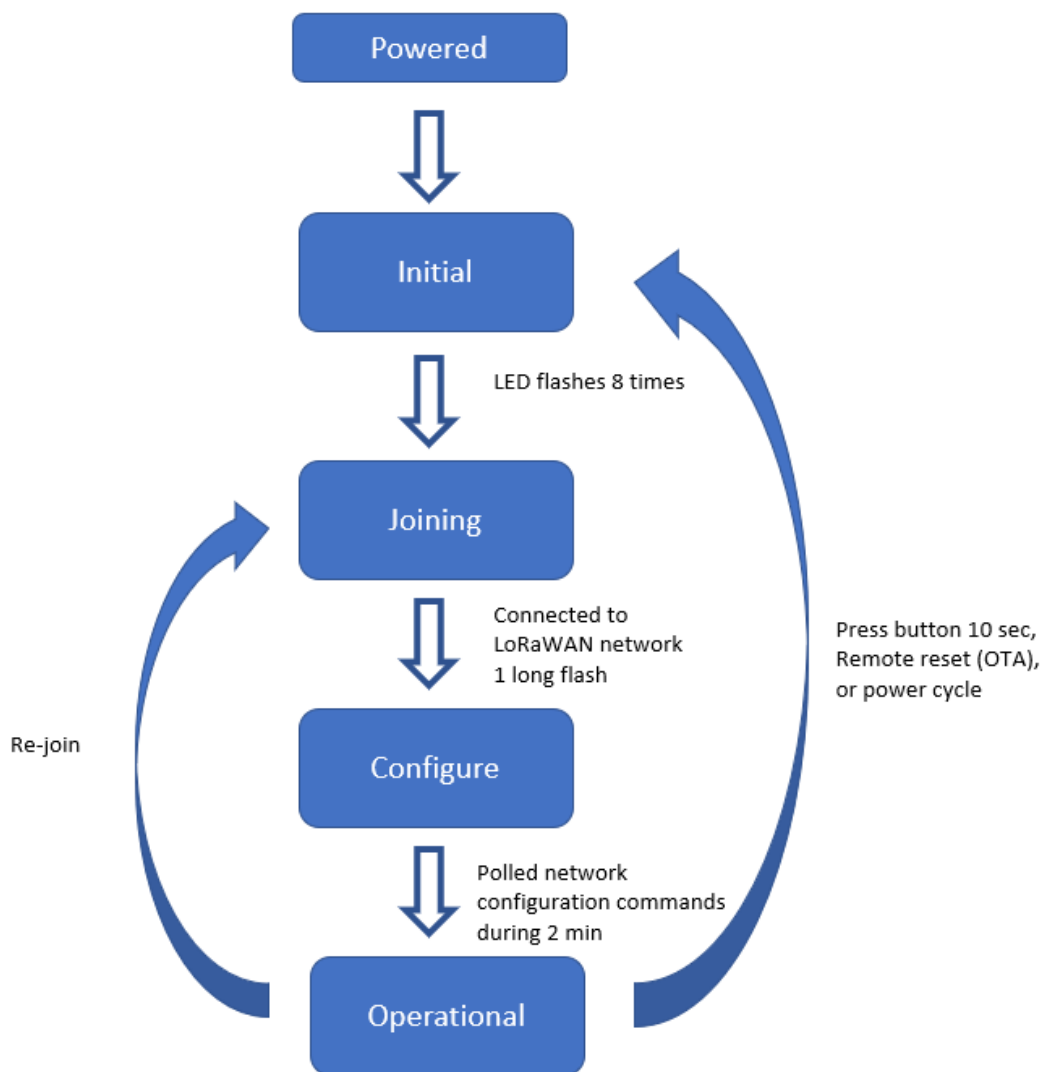


Figure 1 Device states

When the unit is initially powered, it flashes 8 times with the LED, and tries to join the LoRaWAN network. A successful join is indicated with a 2 sec long flash.

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 after initial boot. 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 for 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

Operating principle

Laser scattering Yes

Accuracy and range

Temperature accuracy $\pm 0,2$ °C (conditions 0 °C to +50 °C)

Temperature range -20 °C to +60 °C

Humidity accuracy $\pm 2\%$ (conditions 10-90% RH)

Humidity range 0% to 100% non-condensing

Particulate matters ranges PM_{1.0}, PM_{2.5}, PM₁₀

Connectivity

Network LoRaWAN

Frequency bands 868 MHz

Provisioning Over the air & personalization

Size

Size 111 x 77 x 26 mm

Weight 75g

Security

Algorithms AES-128

Hardware Cryptographic co-processor

Features Secure boot

Secure firmware upgrade

Hardware based ultra secure key storage

Power

DC power 5-24 V

AC power Via USB charger (not included)

Configuration

Measurement intervals 15 minutes, configurable over the air

Transmission intervals 15 minutes, configurable over the air

Unique App EUI available upon request

Enclosure

IP30

Certifications (To be done)

RoHS compliant

CE

LoRaWAN

7 Security

The device has the following security features:

- Cryptographical coprocessor for ultra-secure hardware based key storage
- Secure boot
- Encrypted FW
- Message encryption (AES-128 bit)
- Message integrity (MIC AES-128 bit)
- No port access to device.

8 Protocol

The protocol consists of different types of data

- LoRaWAN v.1.0.2 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.

8.1 LoRaWAN standard commands

All standard LoRaWAN v 1.0.2 are supported. Please refer to the LoRaWAN standard for the protocol definition.

8.2 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 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. See chapter 6.5 for details of the Status report.

Port: **Port 1**

Payload 0x01 20 00

0x01: Data type

0x20: Status command

0x00: bit0 =0 => Normal startup
 bit1 =0 => No boot problem
 bit2-7 reserved

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

8.3 Periodic measurement reports

8.3.1 Periodic measurement report

The default configuration is that particles, temperature and humidity are measured and transmitted every 15th minute. The data is packed into minimal number of bytes to minimizing interference.

Port: **Port 2**

Payload: Measurement value (see **chap 8.3.2**)

Size: 5 Bytes

8.3.2 Measurement value

The measurement value for each measurement

Byte 0: Temperature, bit 11 – bit 4

Byte 1: Relative humidity, bit 11 – bit4

Byte 2:

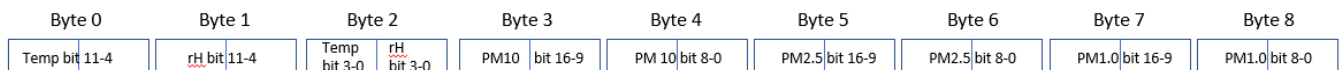
bit 7-4: Temperature, bit 3 – bit 0

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

Byte 3-4: PM10 sent as an unsigned 16-bit integer

Byte 5-6: PM2.5 sent as an unsigned 16-bit integer

Byte 7-8: PM1.0 sent as an unsigned 16-bit integer



8.3.2.1 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.

8.3.2.2 *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.

8.3.2.3 *Particulate Matter (PM) conversion*

The Particulate Matter of different sizes PM10, PM2.5 and PM1.0 are measurement in parts-per-million (ppm – 1×10^{-6}), is transmitted using an un-signed 16 bit integer.

8.3.3 *Example: Measurement report*

Measurement data is sent on LoRaWAN port 2

3e 44 1d 02 1b 01 34 01 12

(3e1)_{HEX}: (993)_{DEC} => $993/10 - 80^{\circ}\text{C}$ => 19.3 gradC

(44d)_{HEX}: (1101)_{DEC} => $1101/10 - 25\%$ => 85.1 % RH

(021b)_{HEX}: (539)_{DEC} => 539 ppm PM10

(0134)_{HEX}: (308)_{DEC} => 308 ppm PM2.5

(0112)_{HEX}: (274)_{DEC} => 274 ppm PM1.0

8.4 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	

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	Should be 0, otherwise contact support with error code information.	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.
2	-	Data	[Uint12, Uint12, Uint16, Uint16, Uint16]	(°C + 80)*10 (% RH +25)*10 (ppm PM10) (ppm PM2.5) (ppm PM1.0)	0 – 3800 0 – 1500 0 – 65535 0 – 65535 0 - 65535	-	Yes	Current temperature, humidity, PM10, PM2.5 and PM1.0.	See Ch 9.3

8.4.1 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 65534 minutes (~1.5 months).

It is also possible to order a batch of OY1700 with a different default setting.

Example

Set measurement interval to 5 minutes: Port 1: 01230005

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

8.4.2 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

8.5 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)	

Example:

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 support.