

OY1211 LoRaWAN[®] CO2 meter US915

Product manual

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OY1211 LoRaWAN® CO2 meter US915

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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. Nordic Propeye 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. Nordic Propeye reserves all rights to this document and the information contained herein.

1.1 Technical support

Please visit www.nordicpropeye.com for additional information, or contact support@propeye.se

1.2 FCC compliance statement



FCC ID: 2A6VH-OY1211
IC ID: 28553-OY1211

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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2 Warnings

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

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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.

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4 Product Description



The OY1211 LoRaWAN CO2 meter is designed to measure carbon dioxide, temperature and humidity in indoor environments. The sensor is intended for indoor climate control, air quality monitoring and energy optimizations. It is optimized for reliable and secure measurements with more than 5-10 years life length on batteries dependent on radio conditions.

The standard measurement interval is every minute and standard reporting interval is every 25 measurements (resulting in a measurement report transmitted every 25 minutes). The fast measurement interval makes it possible to insert additional transmissions when large changes in the CO2 level are detected, resulting in low reporting latency. By default, CO2 level changes larger than +/-100ppm from the last transmitted measurement report causes an additional measurement report over the LoRa uplink channel. If the absolute CO2 level is below a certain threshold, by default 750ppm, these additional reporting events are however omitted. All these parameters can be adjusted using LoRa downlink commands if needed.

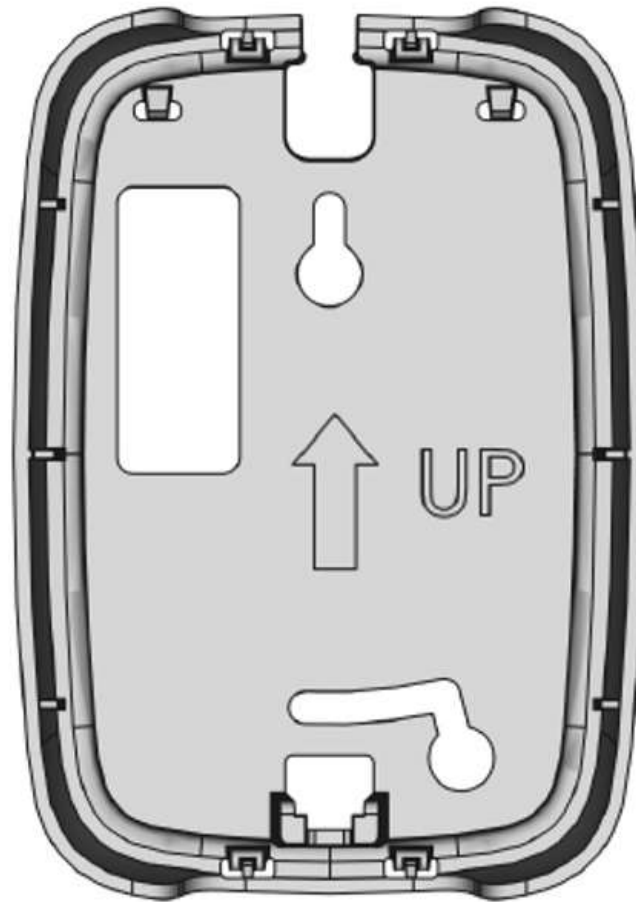
5 Advanced settings

The device has advanced setting options, such as configuration of automatic background calibration (ABC) functionality, target calibration, and sub-sample settings. Those settings are impacting the power and accuracy performance of the device and therefore not part of standard usage, nor this manual. Contact support@propeye.se for detailed information.

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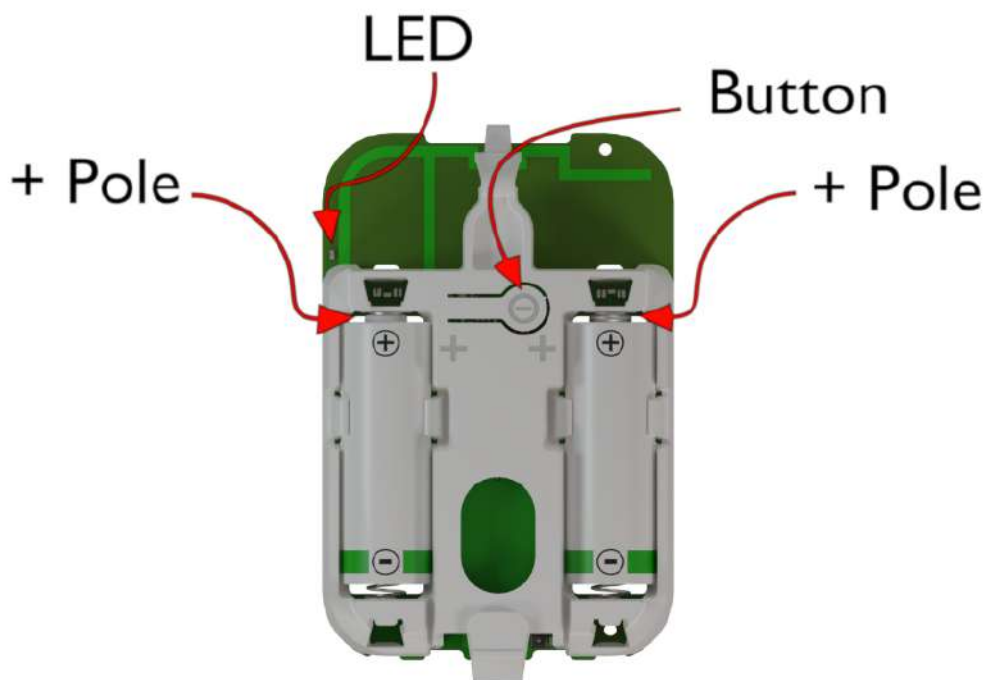
6 Installation and activation

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.

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Configure the device in the LoRaWAN server, according to chapter 6.1, and insert the batteries. The sensor starts and flashes 2 + 6 times during the boot-up sequence. The sensor is activated by pressing the push button for 3 seconds until the red LED makes two short flashes. 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.

6.1 LoRaWAN Configuration

Configuration on the network server is done with AppEUI: 70-B3-D5-D7-2F-F8-18-00 (a.k.a. JoinEUI)

It is possible to order a batch of devices configured with a customer unique AppEUI from the Nordic Propeye 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 Nordic Propeye 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.

If you are not experienced of LoRaWAN, contact support@propeye.se to get started.

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6.2 Sensor states and state check

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

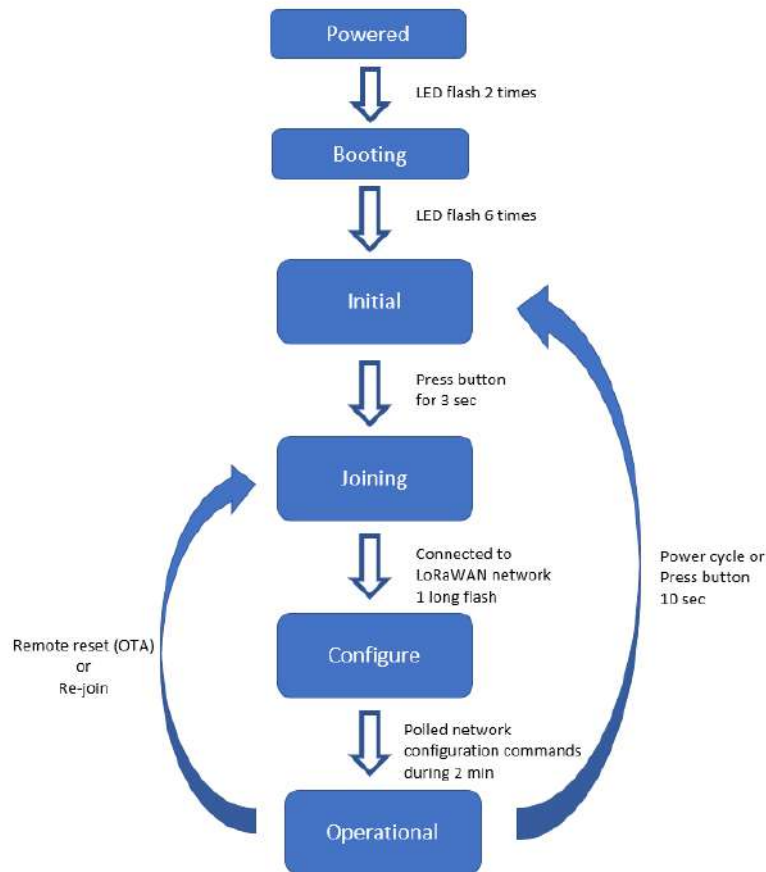


Figure 1 Device states

When the unit is initially powered, it flashes 2 times with the LED, after a few seconds the unit enters initial state automatically. This is indicated by flashing 6 times.

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)

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6.2.1 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 (5 days @ 25-minute message interval). The device requests and normally gets a downlink ever 64th uplink due to the ADRAckReq functionality.

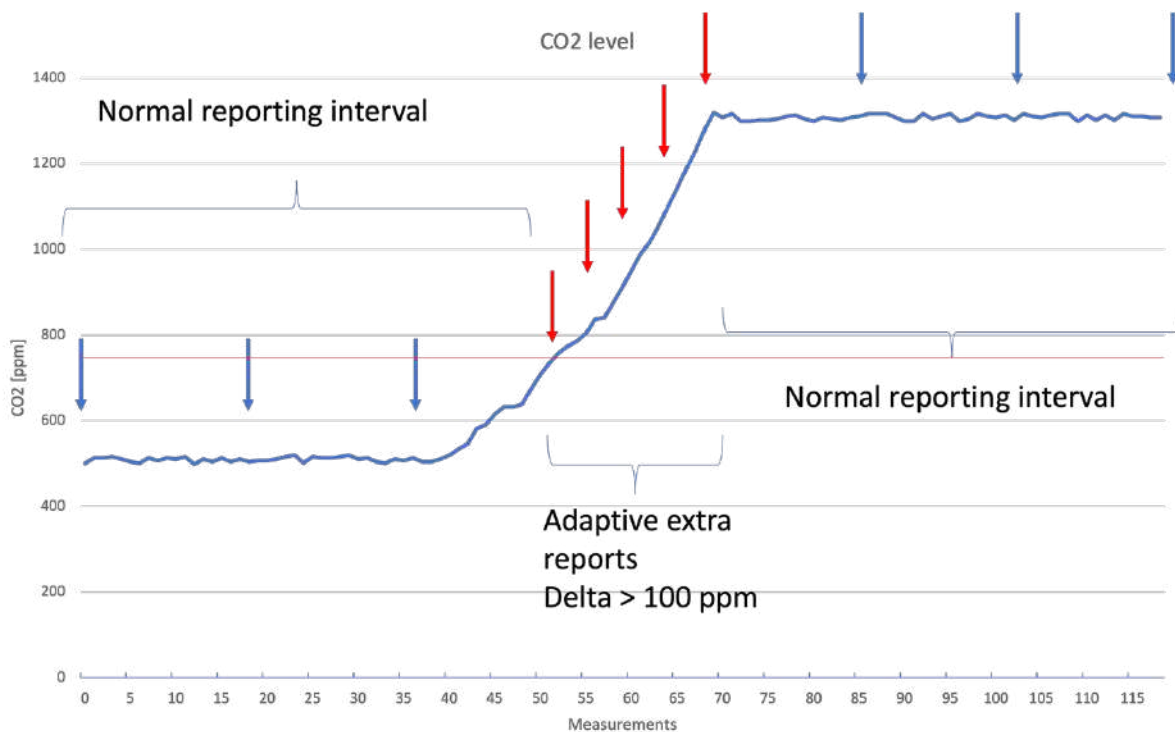
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6.3 Measurement and reporting interval

The measurement interval and reporting interval can be set with downlink commands. The default setting is a measurement interval of 60 sec. The default reporting interval is every 25th measurement interval.

The device sends extra reports when above a configurable CO2 level, default setting 750 ppm and larger difference than 100 ppm from last report.

The reporting interval counting is reset after an extra measurement report.



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7 Specification

Operating principle

Non-dispersive infrared (NDIR) Yes
Sample method Diffusion

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
Measurement range CO₂ 400 – 5000 ppm
Accuracy CO₂ ± 30 ppm $\pm 3\%$ of reading

Connectivity

Network LoRaWAN
Frequency bands 915 MHz
Provisioning Over the air & personalization

Size

Size 111 x 77 x 26 mm
Weight 136g

Security

Algorithms AES-128
Hardware Cryptographic co-processor
Features Secure boot
Secure firmware upgrade
Hardware based ultra-secure key storage

Battery

Battery type 2x Lithium-thionyl 3.6V (replaceable)
Total capacity 3.6Ah

Configuration

Measurement intervals 1 minute, configurable over the air
Transmission intervals 25 minutes, configurable over the air
Threshold for adaptive reporting >750 ppm, configurable over the air
Step threshold for adaptive report 100 ppm, configurable over the air
Unique App EUI available upon request

Enclosure

IP30

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Certifications

RoHS compliant

FCC

IC

LoRaWAN

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8 Battery life

Storage

More than one year without limiting the product life length

Operational

Battery life length >5 years (at 25-minute intervals, SF12) + 1 year storage

9 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.

10 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.

10.1 LoRaWAN standard commands

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

10.2 Unsolicited uplink status commands

The sensor polls the server for configuration parameters 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

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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: Normal startup

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

10.3 Periodic measurement reports

The sensors transmit periodic unsolicited measurement reports or adaptive reports due to changes in CO2 level.

10.3.1 Periodic measurement report

The default configuration is that temperature, humidity and CO2 level are transmitted every 25th minute. The data is packed into a minimal number of bytes to conserve energy and to minimize interference.

Port: **Port 2**

Payload: Measurement value (see **chap 9.3.2**)

Size: 5 Bytes

10.3.2 Measurement value

The measurement value for each measurement

Byte 0: Temperature, bit 11 – bit 4

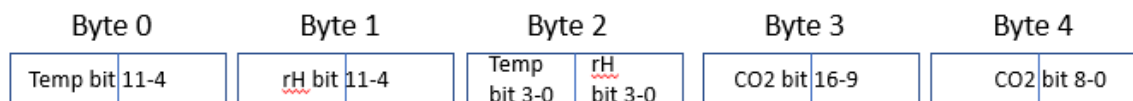
Byte 1: Relative humidity, bit 11 – bit 4

Byte 2:

bit 7-4: Temperature, bit 3 – bit 0

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

Byte 3-4: CO2 sent as an unsigned 16-bit integer



10.3.2.1 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.

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10.3.2.2 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.

10.3.2.3 Carbon dioxide (CO₂) conversion

The carbon dioxide (CO₂) measurement is in parts-per-million (ppm – 1×10^{-6}). The CO₂ data is averaged over a measurement period. The data is transmitted using an un-signed 16-bit integer. The value 0xFFFF indicates an error in the CO₂ reading and should be displayed as an alarm or error code in the application, not as a measurement value.

10.3.3 Example: Single measurement report

Data sent on LoRaWAN port 2 : 3e 44 1d 02 1b

(3e1)_{HEX}: (993)_{DEC} => 993/10 -80°C => 19.3 gradC

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

(021b)_{HEX}: (539)_{DEC} => 539 ppm CO₂

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10.4 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	

10.5 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	Should be 0, otherwise contact support with error code information.	Cleared through reset
1	0x30	Measurement interval	Uint16 Big endian	Seconds	15-7200	Query Set	No	Measurement interval in seconds controlling how often sensors data is acquired. Default 60 seconds	Setting measurement interval resets the measurement timer.
1	0x31	Measurement cycles per reporting event	Uint16 Big endian	Number of measurement cycles	1-2000	Query Set	No	Maximum number of measurement cycles before transmitting sensor data over LoRa uplink. Default 25 cycles	
1	0x32	CO2 concentration variation threshold	Uint16 Big endian	PPM	0-65535	Query Set	No	Maximum CO2 concentration change from last LoRa uplink reporting event before inserting an additional reporting event. Default 100ppm	Set to 0 ppm to disable all additional reporting events based on CO2 level.
1	0x33	CO2 concentration absolute threshold	Uint16 Big endian	PPM	0-65535	Query Set	No	Minimum absolute CO2 concentration level under which all additional reporting event are omitted. Default 750ppm	
1	0x34	Internal CO2 sensor status bits	Uint32 Big endian	CO2 sensor status	1-2000	Query	No	Query only, for internal use	
1	0x35	ABC period	Uint16 Big endian	Hours	1 - 65534	Query Set	No	Period for ABC cycle. Default is 180 hours.	“ 0” disables ABC functionality
2	-	Data	[Uint12, Uint12, Uint16]	(°C + 80)*10 (% RH +25)*10 (ppm CO ²)	0 – 3800 0 – 1500 0 - 65535	-	Yes	Current temperature, humidity and CO2 level.	See Ch 9.3

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10.5.1 Reset device

The device can be reset by three methods, long press on button, removal of battery (note the device will be running for approximately 24 hours even without batteries), or forced into **Joining** state by OTA commands.

Example: Remote device reset:

Port 1: 0305

10.6 Uplink query response

Uplink messages are sent on port 1 with the following heading:

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.