nano sensorics

LoRaWAN

OPERATION AND INSTALLATION MANUAL

CO2, temperature and humidity measuring sensor - CARBONLESS

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General information

The CARBONLESS is advanced technology sensor measures the magnitude of the CO2, temperature, humidity and used indoors. The data transmitted from the sensor is based on Class A LoRaWAN® wireless network. CARBONLESS is powered with two batteries and able to operate up to 10 years depending on the configuration. The CARBONLESS sensor is easily configured and connected to the LoRaWAN® wireless network. CARBONLESS has automatic self-calibration based on integrated advanced intelligent (AI) computational algorithm and Automatic Baseline Correction (ABC) technology.

The main technical characteristics and benefits of CARBONLESS sensor:

- Compatible with LoRaWAN® specification 1.0.3;
- Measures CO2;
- Measures temperature;
- Measures humidity;
- Measurements at regular intervals with integrated advanced intelligent (AI) computational algorithms;
- Indoor use;
- Easy to use and deploy;
- Powered by batteries;
- Data transmission up to 10 km;
- Battery life is up to 10 years depending on settings and environmental conditions.

Applications

- Indoor environment measuring;
- Smart buildings;
- Government buildings;
- Public buildings;
- Banks;
- Industrial facilities;

Product features

- LoRaWAN communication;
- Computational AI algorithm;
- Indoor CO2 sensor;
- Indoor temperature sensor;
- Indoor humidity sensor;
- Configuration over the air;
- Robust enclosure;
- Auto self-calibration;

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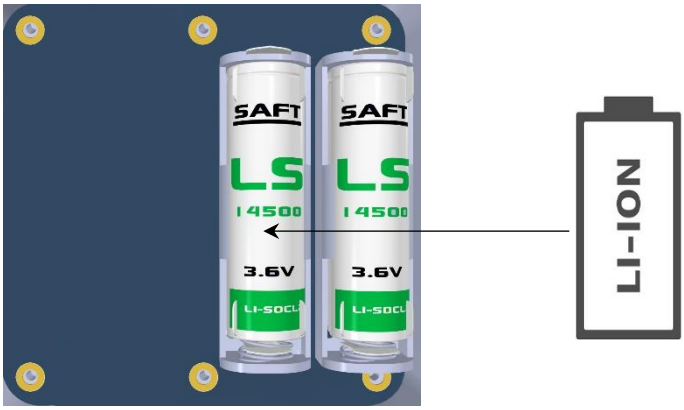
Markings

One the back side of the senor there will be label indicating sensor name, serial number, production date and QR code.

Installation and MAINTENANCE

- Use a screwdriver to open the back cover as showed in the picture:

- Use the lithium batteries type AA 3.6V (2 units) to install in the CARBONLESS sensor as showed in the picture:



- Close the back cover as showed in the picture.
- Screw with two appropriate screws to the wall as showed in the picture.

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Push button and LED indicator description:

- Once batteries are installed or reset button will be pushed in the sensor, it will automatically attempt to connect to the LoRaWAN network and the LED indicator will start to be blinking / flashing for 15 seconds.
- In case of the successful connection to the LoRaWAN network LED indicator will stay on for 3 seconds and LED indicator will stop flashing and go dark. This means sensor successfully connected to the LoRaWAN network.
- If the sensor will not connect on the initial try, it will attempt to connect to the LoRaWAN network after 10 seconds, then after 60 seconds, then after 10 minutes, then after 1 hour, then after 24 hours till successful connection to the LoRaWAN network.
- The sensor will restart by pressing the button on the sensor and it will attempt instantly to connect the LoRaWAN network.

The CARBONLESS sensor has to be installed reliably and with appropriate screws. The sensor must not be placed near any air vents windows, door openings where the constant fresh air flow is possible. The sensor is not suitable to be installed for the outdoor locations. The sensor cannot be stored at dusty or dirty areas with excess operation and storage temperature. The sensor is not washable, paintable. The open holes of the case must not be blocked, glued with any material. Do not throw the battery into a fire to prevent the battery from exploding. Damaged batteries may also explode. All of the above suggestions apply equally to your device, battery and accessories.

The CARBONLESS sensor is maintenance free except replacement of the batteries.

Calibration

Factory calibrates the CARBONLESS sensor when it is produced. The CARBONLESS sensor is maintenance-free in normal indoor environments due to the Nanosensorics integrated intelligent computational algorithms (AI) and Automatic Baseline Correction (ABC) technology. Normal environment is where there is no constant round the clock occupancy or constant high levels of CO2.

If there is a need for manual calibration, these instructions must be followed: After installing the batteries in the sensor, bring the device outside in the fresh air for 10 minutes. The CO2 sensor will then use the CO2 levels from fresh air to compare with the CO2 levels indoors to give accurate values.

Nanosensorics (AI) and (ABC) intelligent algorithms constantly tracking of the sensor's lowest reading value over a predetermined time interval, and slowly corrects for any long-term drift detected as compared to the expected fresh air value of 400 ppm of CO2.

In normal indoor environment, the CO2 level drops to nearly outside air some time during a week. By sampling the values for a period of 7 days and then comparing the lowest value with the 400 point, the CARBONLESS sensor is able to understand if it needs to adjust the zero point. This algorithm takes advantage of the fact that the CO2 level stabilizes in buildings when unoccupied.

If a space is constantly occupied and there are no periods when CO2 levels drop to background levels, then the ABC algorithm will not work. This is the case for closed confined spaces or spaces without any ventilation where CO2 levels may always be high. For these instances, the ABC function must be turned off. When ABC is not operating, the sensor should be calibrated manually every two or three years.

Regulations

UAB "Nano sensorics" is the company which develops and produce highly innovative sensors with integrated intelligent computational algorithms (AI) enabling extremely low power data transmission. Declaration of conformity Hereby, UAB „Nano sensorics" declares that CARBONLESS complies with the essential requirements and other relevant provisions of Directive CEM 2014/30/UE, BT 2014/35/UE, RED 2014/53/UE, CE, RoHS

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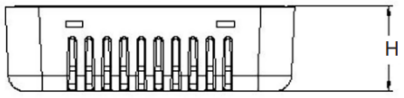
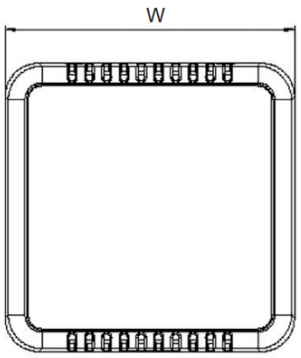
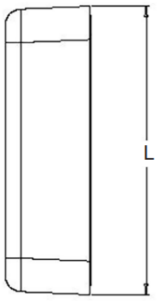
Sensor dimensions:



H: 25,5 mm
W: 86 mm
L: 86 mm



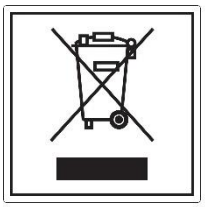


Important safety information

Read this manual before attempting to install the device. UAB „ Nano sensorics" will not accept responsibility for any damage or injury resulting from not following the instructions in this manual.

- The sensor is for indoor use;
- Do not disassemble, crush, puncture, short internal circuits;
- Remove batteries if the sensor is not used, discharged battery has to be removed from the battery sensor, in this case left batteries might leak and damage the sensor;
- Keep the battery or device dry and away from water or any liquid as it may cause a short circuit;
- Replace batteries only with the same or equivalent type recommended by the manufacturer;
- Discard used batteries according to the manufacturer's instructions;
- Do not bend, deform, shred, microwave, paint the sensors, or other hardware;
- Do not insert external material into any opening on the sensors;
- Disassembling or puncturing the battery (whether integrated or removable) can cause an explosion or fire;
- Do not dry the sensors or battery with an external heat source such as a microwave oven or hairdryer;
- Observe proper precautions when handling batteries. Batteries may leak or explode if improperly handled;
- The sensor is not applied as a metrological, commercial accounting purposes and UAB „Nano sensorics" will not be held liable for any damage which may result from inaccurate readings;
- Do not use any detergent or alcohol to clean the device;
- Clean gently with softly moisture cloth.

Waste disposal



The sensor disposed according to the Waste Electrical and Electronic Equipment Directive, (WEEE Directive) 2012/19/EU. The sensor and its individual parts has to be disposed according to local laws and regulations your product should be disposed of separately from household waste and industrial waste. When this product reaches its end of life, you have to bring the sensor, its components to the collection point designated by local authorities in order to protect the environment and to reduce waste through recycling. The battery must be disposed of separately.

Sensor technical details

Sensing characteristics	
Temperature	-10 to 70 °C
Temperature Accuracy	Max '+/-0.4°C@ -10°C—70°C
Humidity	0 to 100 % RH (non-condensing)
Humidity Accuracy	"+/-4%RH @20°C, >80% "+/-7%RH @20°C
CO2 Measurement range	400 – 5000 ppm, extended range 10,000 ppm
CO2 Accuracy	±30 ppm ±3% of reading, (extended range ±10% of reading)
Mechanical specification	
Weight	80 g without battery
Dimensions	86 x 86 x 25,5 mm

Enclosure	Plastic ABS UL94-V0	
Storage Temperature	-10 to 70 °C	
Sensor Power Supply		
Battery Type and voltage	2x3.6 V AA Lithium Battery ER14505 AA lithium batteries (3.6V2400mAh/section)	
Expected Battery Life	<10 years (Depending on configurations and environment)	
Sensor logging Function		
Sampling Interval	Configurable via downlink configuration, NFC configuration is optional	
Data Upload Interval	Configurable via downlink configuration, NFC configuration is optional	
Radio / Wireless specification		
Wireless Technology	LoRaWAN® 1.0.3	
Wireless Security	LoRaWAN® End-to-End encryption (AES)	
LoRaWAN Device Type	Class A End-device	
Supported LoRaWAN® features	OTAA, ABP, ADR, Adaptive Channel Setup	
Supported LoRaWAN® regions	EU863 – 870 Optional: US902 – 928, EU863 – 870, AU915 – 928, EU433, RU864, IN865	
Link Budget	137 dB (SF7) to 151 dB (SF12)	
TX Power	14dBm±1dBm (Region specific)	
Rx Sensitivity	132 dBm (LoRa, Spreading Factor=12, Bit Rate=293bps) -118 dBm (FSK, Frequency deviation=5kHz, Bit Rate=1.2kbps)	
Communication range	10 km (line-of-sight, actual transmission distance depends on the environment)	
Data sizes		
Measurement	Data size	Elaboration
Temperature	2	MSB byte -128 to +128 C, LSB byte, value after decimal point 0 to 100
Humidity	1	One byte integer value (0 to 100%)
Battery	2	MSB byte represent Volts before decimal point , LSB byte represents two digits after decimal point expressed as unsigned 2 byte value, first byte – integer Volts, second byte – Volts (two digits after decimal point)
CO2	2	0 - 65535 BIN (Actual value 400 – 5000 ppm)

Downlink messages

The downlink data messages must be sent via port No. 3 in the specific format. Minimal data size is 3 bytes.

Header	**Payload length**	**Payload**	
Settings ID	**Settings data**		
0xBA	1 byte	1 byte	0-n bytes

The downlink data messages are as follows:

Setting ID	**Setting Length**	**Comment**
0x1A	2 bytes	Set sensors measurement time (Tx) period in seconds. Minimum value is limited to 30 s. Minimum value is 65536 s (1092 min / 18.2
0x1B	1 byte	LED control: • 0x00 – green LED OFF • 0x01 – green LED ON • 0x02 – green LED toggle for 5 s
0x1C	0 byte	Reset device

The examples of the downlink single messages:

- BA031A0384 – set measurement time to 15 minutes (900 s);
- BA021B01 – green LED ON.
- BA011C – Reset device.

It is recommended to send downlink data messages each by each after setting actual operational validation. When downlink message is sent for the setting of the Tx, the new Tx setting is deployed after time interval which is equal to the previous Tx value plus 30 s. The forced new Tx setting deployment can be performed after resetting the sensor in order to shorten new Tx deployment time duration.

In case if downlink message is sent to the sensor working on “ABP” mode, the Tx change will take effect only after the time interval equal to the previous Tx value.

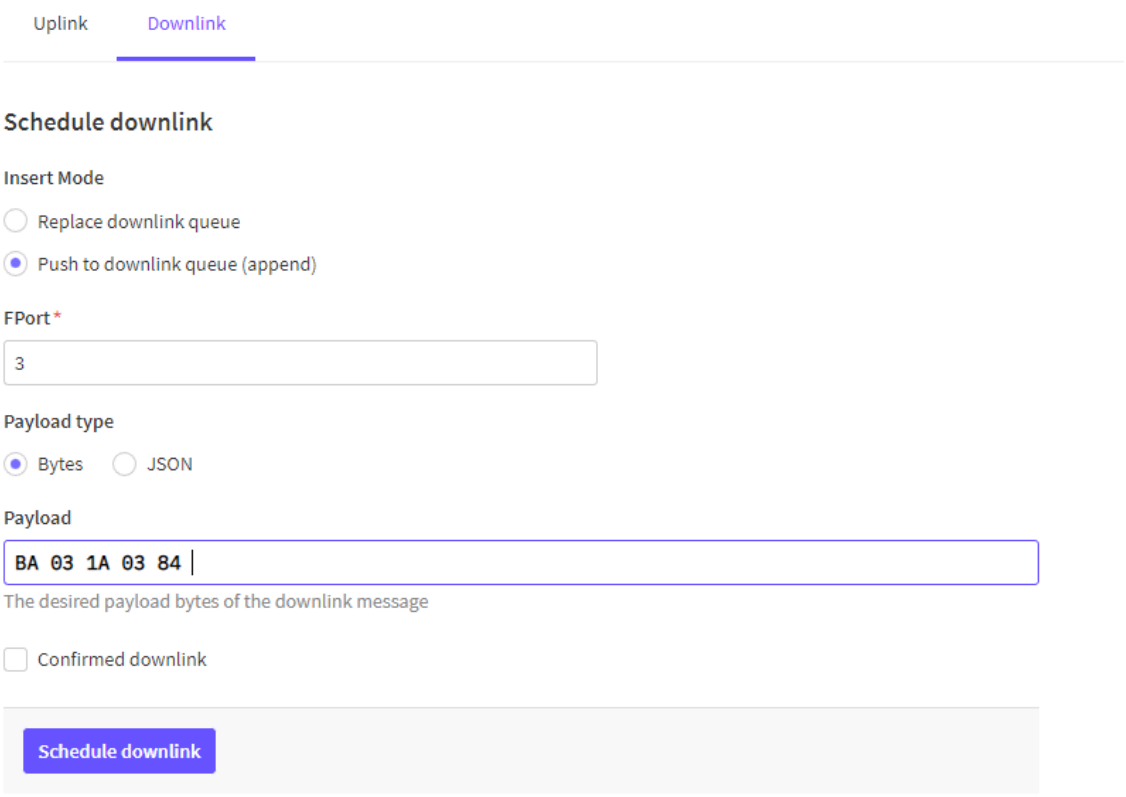
The multiple settings can be sent through the downlink single message. The sum of the bytes has to be indicated without counting of the header.

Header	**Total Payloads length**	**Payload 1**		**…**	**Payload n**		
Setting ID	**Settings data**	**Setting ID n**		**Settings data n**			
0xBA	1 byte	1 byte		0-n bytes	…	1 byte	0-n bytes

Multiple commands:

* BA051A03841B02 – Set measurement time to 15min and toggle green LED for 5s

The example to send the downlink message through the “Things Of The Network”:



Transportation and Storage

Packed sensors may be transported in any type of covered vehicle. Equipment should be anchored reliably to avoid shock and possibility to shift inside vehicle. Sensors should be protected against mechanical damage and shock. No aggressive chemical substances should be stored together because of corrosion hazard.

Warranty

Manufacturer gives warranty that sensor parameters will meet the technical requirements, listed in the “Sensor technical details” paragraph of this document, if transportation, installation, storage and operation conditions will be followed. Warranty period is 1 year from manufacturing date, with additional possibility to extend it for additional charge. Warranty apply, when device is used as intended and if there was no tampering done with the device or other external damage done to the device from outside sources.