



User Guide | COMFORT SERENITY MQTT | NB-IoT / LTE- Cat-M1

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PRODUCT INFORMATION AND REGULATORY INFORMATION



This User Guide applies to the following product:

COMFORT SERENITY

Reference : ARF8394AB

APP Version: V1.2

INFORMATIONS DOCUMENT	
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DOCUMENTATION GUIDE

PREAMBLE

DISCLAIMER

TECHNICAL SUPPORT

RECOMMENDATIONS

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[https://s3-us-west-2.amazonaws.com/secure.notion-static.com/a5b889ac-1b0b-4619-9da2-b5558a5a6caf/EU_declaration_of_conformity_\(COMFORT_Serenity_ARF8394A\).pdf](https://s3-us-west-2.amazonaws.com/secure.notion-static.com/a5b889ac-1b0b-4619-9da2-b5558a5a6caf/EU_declaration_of_conformity_(COMFORT_Serenity_ARF8394A).pdf)

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Block Diagram

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1. PRODUCT OVERVIEW

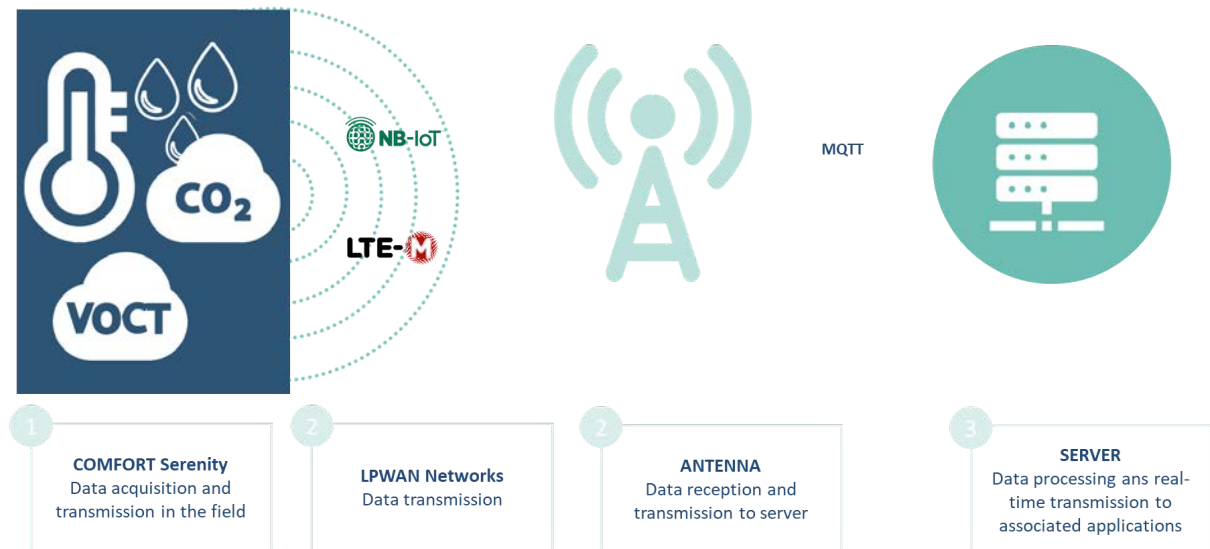
1.1. General description

The Adeunis COMFORT Serenity is a ready-to-use IoT sensor that meets the needs of users for indoor monitoring of **temperature**, **ambient humidity**, **carbon dioxide** (CO₂) concentration, and relative changes in **volatile organic compounds** (VOCs) levels. This product is also equipped with an NFC interface, which allows for quick and easy configuration with a smartphone.

Thermal comfort and indoor air quality data are transmitted via a cellular IoT network (**NB-IoT** or **LTE-Cat-M1**) to a MQTT broker. No additional equipment (gateway, router, etc.) is required for data transmission.

The product operates autonomously and intermittently. It measures temperature, humidity, CO₂, and VOC data from the onboard sensors in "sleep" mode (PSM) and stores the data in its local memory. It then wakes up at preconfigured intervals to transmit the stored data using the MQTT protocol.

The product is powered by a replaceable battery pack and has been designed to work for up to 9 years without maintenance (device configuration : 1 sampling every 60 mins, 1 transmission every 60 mins, LEDs enabled).



1.2. Features

- **4-in-1 Sensor:** Temperature, humidity, CO₂ concentration, relative changes in VOC levels
- **User Notification:** Product equipped with a visual indicator (LED) on the casing
- **Global Cellular Compatibility:** LTE-Cat-M1 and NB-IoT
- **Simplified Application Configuration:** via the NFC IoT Configurator application
- **Data Transmission Modes:** Periodic and/or event-based (threshold exceeded and/or threshold fallen below)
- **Error/Fault Management:** Configuration error, low battery
- **Data Timestamping:** UTC timestamp, remote synchronization via the network
- **Battery-Powered Autonomous Product:** Powered by a replaceable internal dual-battery pack designed to operate for multiple years without replacement (refer to the autonomy table). The product can also be powered by an external power supply (not provided with the product).
- **Autonomy Optimization:** Data logging and blackout (deactivation of data transmission for a given period)
- **Made in France:** Product designed and manufactured in France



NOTE

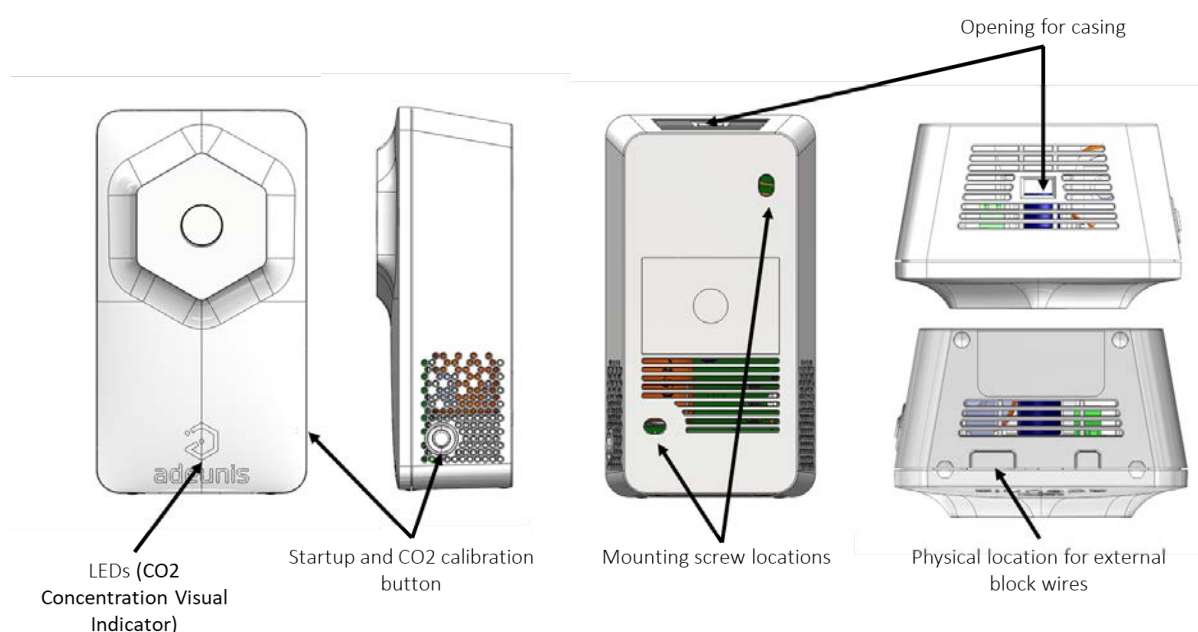
To address different use cases, the COMFORT Serenity product also supports the LwM2M communication protocol.

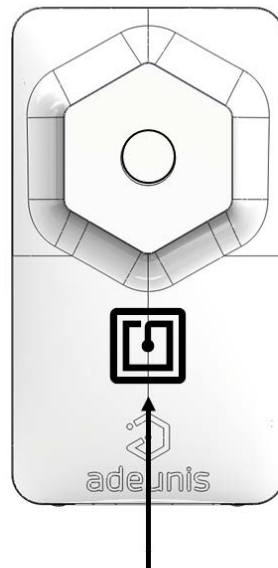
To use the product with the LwM2M protocol, refer to the dedicated User Guide.

1.3. Package contents

The product is delivered in a cardboard packaging containing the following components: Front face, back face, electronic board, and ER18505H-2 dual battery pack.

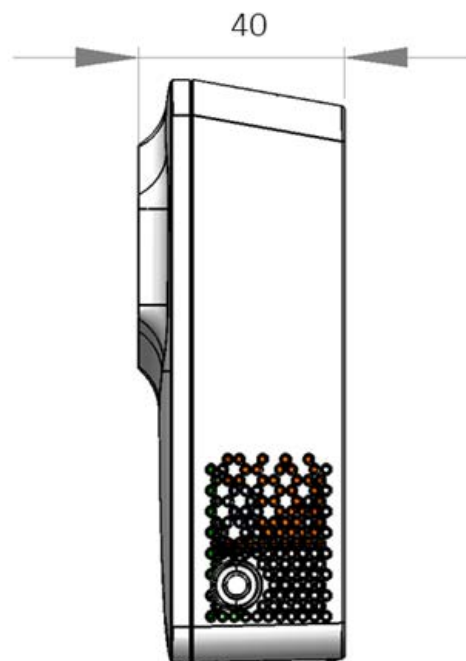
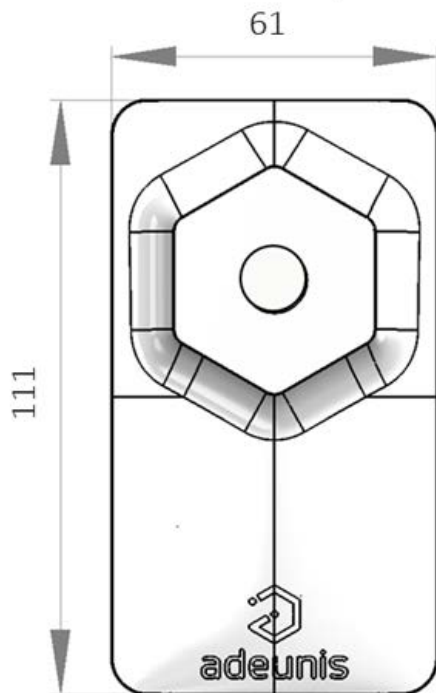
1.4. Casing presentation





NFC antenna
positionning

1.5. Dimensions



Values in millimeters

1.6. Push button

Function	Action
Product Startup	Long button press (> 5 seconds) when the product is in PARK mode (i.e., turned off)
Manual CO2 Sensor Calibration	Long button press (> 5 seconds) when the product is in PRODUCTION mode (i.e., powered on) This function can be disabled
Displaying the Visual Indicator for the Last Measured CO2 Concentration Level	Short button press (< 5 seconds) when the product is in PRODUCTION mode (i.e., powered on)

1.7. LEDs indicator

PRODUCT STATUS	RED LED status	ORANGE LED status	GREEN LED status
Product in PARK mode (i.e., turned off)	OFF	OFF	OFF
Product startup	OFF	OFF	Flashing 5 cycles 100 ms ON / 100 ms OFF
Product startup failure	ON for 15 sec	OFF	OFF
Network attachment process in progress	Flashing 50 ms ON / 1 sec OFF OFF	OFF	Flashing 50 ms ON / 1 sec OFF (after RED LED)
Successful network attachment	OFF	OFF	ON for 5 sec
Network attachment failure	O for 5 sec	OFF	OFF
SIM not detected at product startup	Flashing 1 sec ON / 500 ms OFF for 30 sec	OFF	OFF
CO2 sensor calibration in progress	Flashing 100 ms ON/ 5 sec OFF for 10 min	Flashing 100 ms ON/ 5 sec OFF for 10 min	Flashing 100 ms ON/ 5 sec OFF for 10 min

PRODUCT STATUS	RED LED status	ORANGE LED status	GREEN LED status
CO2 sensor calibration completed	Flashing 5 cycles 100 ms ON / 900 ms OFF	Flashing 5 cycles 100 ms ON / 900 ms OFF	Flashing 5 cycles 100 ms ON / 900 ms OFF
CO2 concentration visual indicator (default configuration)	Flashing 5 cycles 100 ms ON / 900 ms OFF every 1 min	Flashing 5 cycles 100 ms ON / 900 ms OFF every 1 min	Flashing 5 cycles 100 ms ON / 900 ms OFF every 10 min
CO2 concentration visual indicator (custom configuration)	The number of cycles and the interval between 2 cycles can be customized using the NFC IoT Configurator application	The number of cycles and the interval between 2 cycles can be customized using the NFC IoT Configurator application	The number of cycles and the interval between 2 cycles can be customized using the NFC IoT Configurator application
Display of the visual indicator corresponding to the last measured CO2 concentration level	ON/OFF based on CO2 concentration	ON/OFF based on CO2 concentration	ON/OFF based on CO2 concentration
Temporary emission suspension (blackout period)	OFF	OFF	OFF
Low battery level	Flashing 500 ms ON / 500 ms OFF every 1 min	OFF	OFF



NOTE

Users have the option to adjust the power of the LEDs to optimize the product's battery life.

Four operating modes are available:

- LEDs **OFF**
- LEDs **FULL**: All three LEDs operate at 100% power.
- LEDs **ECO**: LEDs operate at 50% power.
- LEDs **ECO+**: LEDs operate at 30% power.

By default, the product is configured with the LEDs operating at 100% power. Changing the LED operating mode is possible via NFC.

Changing the LED operating mode via NFC using the NFC IoT Configurator application:

Go to the "LED" section in the "CONFIGURATION" menu of the sensor => Select the desired LED operating mode => Apply the new configuration to the product via NFC.

1.8. Power supply

1.8.1 Power source

The COMFORT Serenity can be powered by a double-pack of FANSO Li-SOCI2 ER18505H-2 batteries or by an external power supply connected to a 2-pin terminal block (external power supply not provided).

- When both batteries and external power supply are used simultaneously, the external power supply takes priority.
- When the external power supply is used, the product operates with the same cycle as when powered by the double-pack batteries (PSM mode).

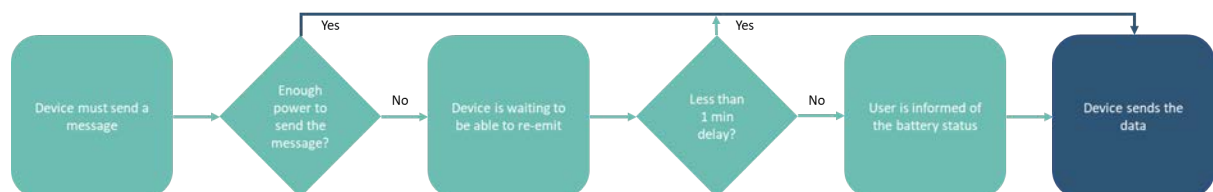
The certified external power supply recommended by Adeunis for use with the product is **GS05E-USB - Wall Mount AC Adapters 5W 5V 1A W/Euro Plug WallMount USB Output from Mean Well**.

If another external power supply model is selected to work with the product, it must strictly adhere to the electrical specifications mentioned above and comply with the standards EN/IEC 62368-1 and EN 61000-3-2, EN 61000-4-2, EN 61000-4-4, EN 61000-4-5. The user must independently verify the compatibility of this power supply with the product.

1.8.2 Low Battery Management

1.8.2.1 Detection mode

When the product detects that the battery is not capable of delivering the required energy for transmission (due to extreme temperatures or end of battery life), it waits until it is capable of transmitting. If it detects that the delay exceeds 1 minute, it notifies the user that the battery level is low.

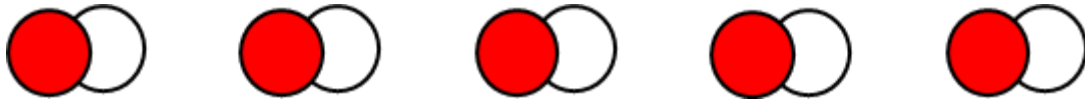


1.8.2.2 User information

The user can be informed of the product's battery status locally through the NFC IoT Configurator application or the LED display.

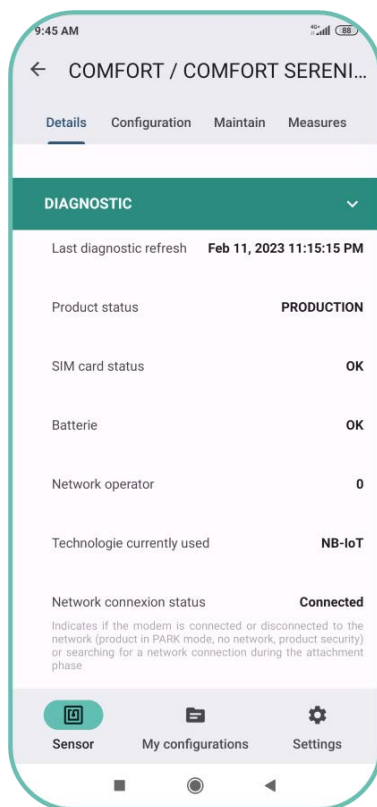
The low battery indication automatically changes when the battery is replaced or when temperature conditions are favorable for proper battery operation.

User Information through visual indication on the product's LEDs:



The red LED flashes every 60 seconds for 500 ms if the product's battery level is low.

User Information through the NFC IoT Configurator application:



Go to the "DIAGNOSTIC" section of the sensor to check the battery status as "OK" or "LOW"

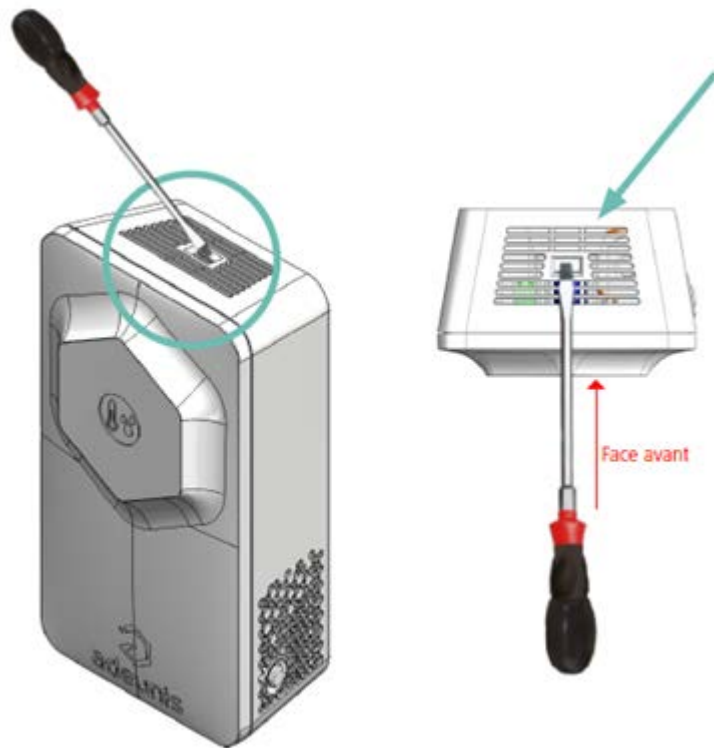
1.8.3 Changing the double battery pack

When the low battery indicator is activated, it is possible to change the internal battery pack of the enclosure.

It is important to use the same battery reference, namely ER18505-2.

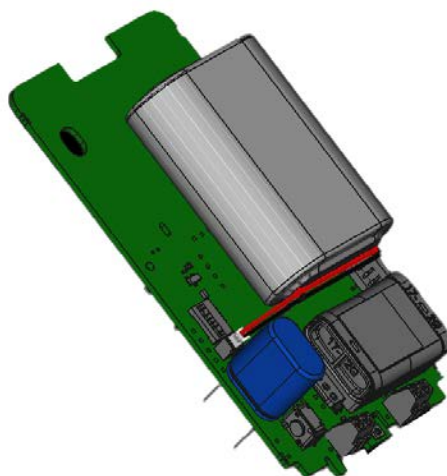
PROCEDURE FOR CHANGING THE DOUBLE BATTERY PACK:

1. Insert a flathead screwdriver tilted towards the front of the enclosure into the opening at the top and press. The enclosure will open in two and the front panel will detach.

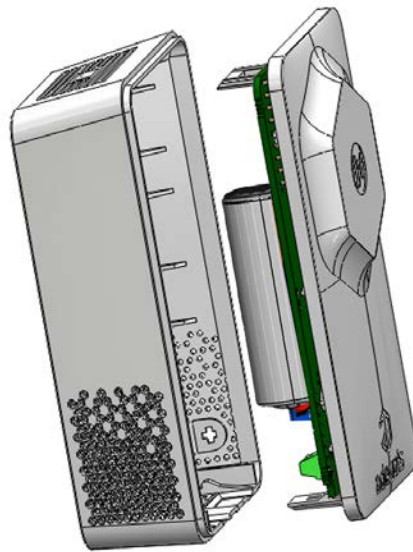


CAUTION: Press gently to avoid damaging the enclosure

2. Remove the current battery and replace it with the new one, making sure to observe the polarity indicated on the electronic board and the battery model.



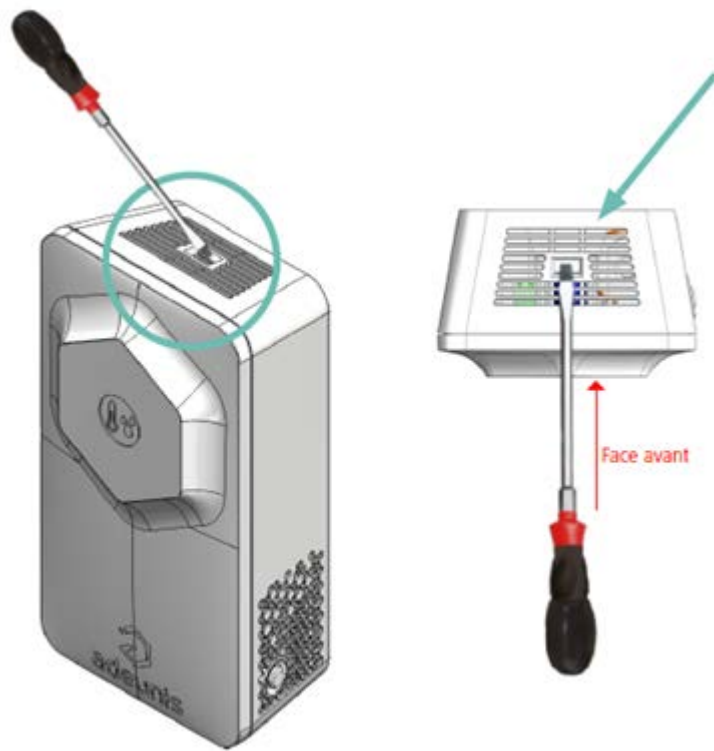
3. To close the enclosure, insert the bottom of the front panel first and snap the top of the enclosure



After this battery replacement procedure, the product will automatically resume its "normal" operation and clear the low battery indicators (status and LED).

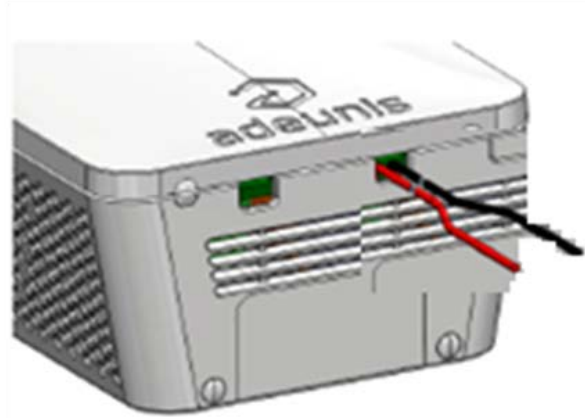
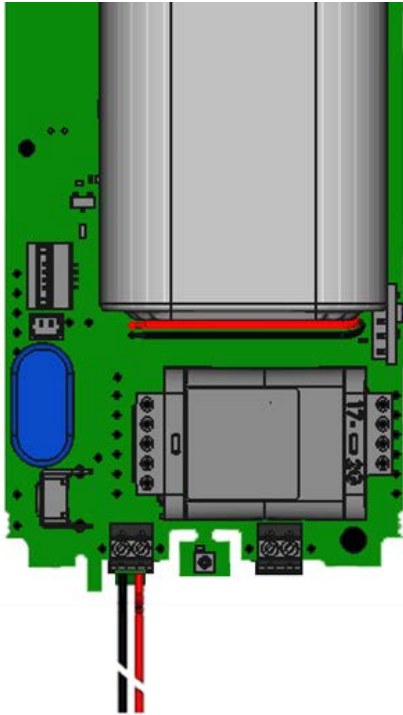
1.8.4 Connecting the external power supply

1. Insert a flathead screwdriver tilted towards the front of the enclosure into the opening at the top and press. The enclosure will open in two and the front panel will detach

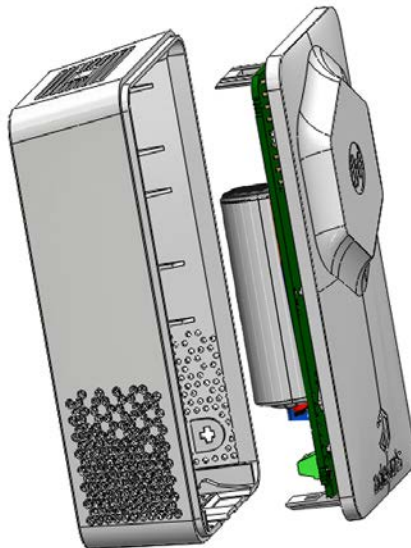


CAUTION: Press gently to avoid damaging the enclosure

2. Connect the external power supply using the dedicated connector.



3. To close the enclosure, insert the bottom of the front panel first and snap the top of the enclosure



2. TECHNICAL SPECIFICATIONS

2.1 General characteristics

Mechanical characteristics	
Dimensions	111 x 61 x 40 mm
Weight	146 g
Enclosure	IP20
Mounting system	Wall-mounted or freestanding

Electrical characteristics	
Batter power	Battery type: Replaceable Double Pack-Pile FANSO Li-SOCl ₂ - ER18505H-2 Nominal voltage: 3.6 V Maximum current: 70 mA Capacity: 8200 mAh
External power supply (not included)	Input range: 4.2 V to 6.0 V Maximum current: 6700 mA

Operating conditions	
Recommended operating range	+0°C to +50°C when powered by a double pack-pile +0°C to +40°C when powered by an external power supply
Operating temperature range	10°C to +70°C

2.2 Connectivity

2.2.1 Compatible networks and protocols

Connectivity	
SIM Card	Nano SIM 4FF Class C (1.8 V)
Cellular Standard	3GPP LTE Version 13
Cellular IoT Networks	NB-IoT, LTE-Cat-M1
Data Transfer Protocol	MQTT, LwM2M (refer to the dedicated User Guide to use the product with LwM2M protocol)

2.2.1 Data Consumption Estimation

This section presents data consumption estimates for the COMFORT Serenity based on the chosen communication mode and the frequency of data scanning and transmission.



NOTE 1

Product/server communications such as keep alive, time synchronization, server registration are not considered in the data consumption estimates below.

NOTE 2

Data consumption is equivalent regardless of the technology (NB-IoT or LTE-Cat-M1) used by the product to connect to the cellular network.

Product/Server Communication Mode	Data Sent per Transmission	Monthly Data Consumption for Transmission Every 10 Minutes	Monthly Data Consumption for Transmission Every Hour
MQTT with data history	6 values of: - Temperature - Humidity - CO2 - VOC	34900 ko	5817 ko Default configuration of the product

2.3 RF specifications

RF specifications	NB-IoT	LTE-Cat-M1
Frequency Bands	B1, B2, B3, B4, B5, B8, B12, B13, B17, B19, B20, B25, B26, B28, B66	B1, B2, B3, B4, B5, B8, B12, B13, B18, B19, B20, B25, B26, B28, B66
Max Transmit Power	+23 dBm	+23 dBm
Tx Bandwidth	200 kHz	1.4 Mhz
Theoretical Data Rate	65 Kbps (UL) 30 kbps (DL)	375 kbps (UL) 300 kbps (DL)
Sensitivity	> -108 dBm -113 dBm typ.	> -103 dBm -107 dBm typ.

RF specifications	NB-IoT	LTE-Cat-M1
Power Consumption Reduction Feature	PSM	PSM

2.4 Updates

Application configuration	Configuration via NFC using the Adeunis NFC IoT Configurator mobile application on Android or remotely
Firmware update	Not supported

2.5 Integrated sensor specifications

Specifications		Value
Temperature	Technology	CMOSens
	Recommended Operating Range	-0°C / +65°C
	Accuracy	± 0.2°C typ. ± 1°C max.
	Typical Resolution	0.01°C
Humidity	Technology	CMOSens
	Recommended Operating Range	10% / 90% HR
	Accuracy	± 2% HR typ. ± 4.5% HR max.
	Typical Resolution	0.01 % HR
CO2	Technology	NDIR (Non-Dispersive Infrared)
	Operating Conditions	0°C / +50°C 0% / 85% HR
	Measurement Range	Up to 5,000 ppm; extended range up to 10,000 ppm
	Accuracy	± 30 ppm +3% of the reading within the range up to 5,000 ppm
	Resolution	1 ppm
VOC (optional)	Technology	MOX
	Operating Conditions	-10°C / +50°C 0% / 90% HR

Specifications		Value
	VOC Index Scale	1 to 500 points
	Measurement Range	0 to 1,000 ppm ethanol in clean air
	Detection Limit	0.05 ppm ethanol or < 10% of the set concentration value (whichever is greater)
	Sensor-to-Sensor Dispersion	< ± 15 index points or < $\pm 15\%$ of the measured value (whichever is greater)

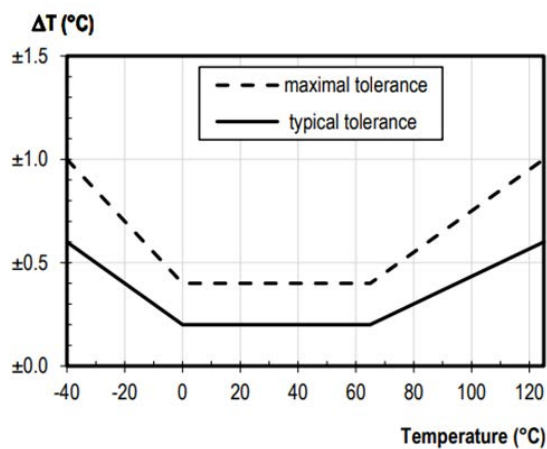


Figure 1 : Temperature measurement accuracy

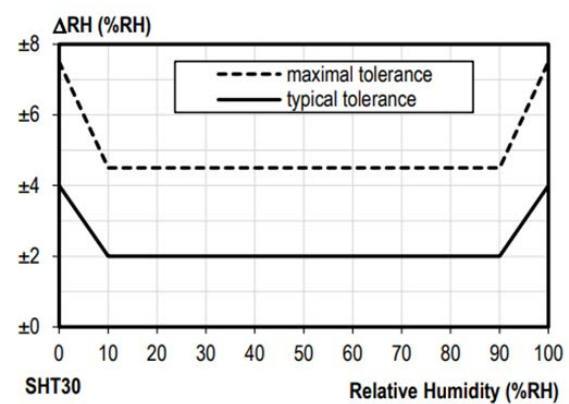


Figure 2 : Relative humidity tolerance at 25°C

3. PRODUCT AUTONOMY

This chapter presents estimates of the autonomy of COMFORT Serenity based on the selected network type, data transmission periodicity, LED activation, and network quality.

To ensure proper product functioning and autonomy, Adeunis strongly recommends:

- Selecting an operator that supports PSM mode on its own network. Note that in the case of a roaming connection, Adeunis recommends verifying that PSM

mode is also guaranteed on other operator networks. For more information on PSM mode, please refer to the dedicated section

- Selecting the technology (NB-IoT or LTE-Cat-M1) that the product will use to connect to the cellular network
- Limiting the number of frequency bands used by the product to connect to the cellular network (for example, in France, only band 20 is used by operators)
- Optimizing the use of the product's LEDs (power and frequency of illumination)

3.1. Estimated battery life with an NB-IoT network connection

The table below has been estimated based on a product connected to an NB-IoT network with PSM (Power Saving Mode) support. Please note that the product's battery life may vary depending on the selected operator.

Activated VOC Sensor, LEDs On

Sampling Frequency	Transmission Interval	Good Network Autonomy (years)	Poor Network Autonomy (years)
Every 10 minutes	Every 10 minutes	2.1	< 1
Every 10 minutes	Every hour (historization)	6.5	< 1
Every hour (default product configuration)	Every hour (default product configuration)	6.7	< 1
Every hour	Every 6 hours (historization)	10.5	2.9

Disabled VOC sensor, LEDs On

Sampling Frequency	Transmission Interval	Good Network Autonomy (years)	Poor Network Autonomy (years)
--------------------	-----------------------	-------------------------------	-------------------------------

Sampling Frequency	Transmission Interval	Good Network Autonomy (years)	Poor Network Autonomy (years)
Every 10 minutes	Every 10 minutes	2.3	< 1
Every 10 minutes	Every hour (historization)	9.8	< 1
Every hour (default product configuration)	Every hour (default product configuration)	10.3	< 1
Every hour	Every 6 hours (historization)	> 15	3.5



NOTE 1 - Evaluation Conditions

The autonomy values below are estimates made under certain usage and environmental conditions (maximum product storage of 1 year before use, calculations performed at an indoor temperature of 25°C).

They do not represent any commitment on the part of Adeunis.

The battery life depends on numerous non-predictive network parameters, including:

- The quality of the signal emitted by the antenna
- The transmission power required by the product to send a message

NOTE 2 - Autonomy Optimization by Disabling LEDs

The above autonomy estimates are provided for a product configuration with enabled LEDs:

- The Green LED lights up every 10 minutes (70% of the time)
- The Orange LED lights up every 1 minute (20% of the time)
- The Red LED lights up every 1 minute (10% of the time).

Disabling the LEDs can result in a gain of 7% to 20% in autonomy.

NOTE 3 - Optimizing Battery Life by Enabling a Blackout Period

Configuring a blackout period for the main functions allows for optimizing the product's autonomy by 10% to 20%.

3.2. Estimated battery life with an LTE-Cat-M1 network connection

The table below has been estimated based on a product connected to an LTE-Cat-M1 network with PSM (Power Saving Mode) support. Please note that the product's battery life may vary depending on the selected operator.

Activated VOC Sensor, LEDs On

Sampling Frequency	Transmission Interval	Good Network Autonomy (years)	Poor Network Autonomy (years)
Every 10 minutes	Every 10 minutes	2.8	< 1
Every 10 minutes	Every hour (historization)	7.5	3.5
Every hour (default product configuration)	Every hour (default product configuration)	7.8	3.6
Every hour	Every 6 hours (historization)	10.9	8

Disabled VOC sensor, LEDs On

Sampling Frequency	Transmission Interval	Good Network Autonomy (years)	Poor Network Autonomy (years)
Every 10 minutes	Every 10 minutes	3.3	< 1
Every 10 minutes	Every hour (historization)	12.4	4.5
Every hour (default product configuration)	Every hour (default product configuration)	13.1	4.6
Every hour	Every 6 hours (historization)	> 15	> 15



NOTE 1 - Evaluation Conditions

The autonomy values below are estimates made under certain usage and environmental conditions (maximum product storage of 1 year before use, calculations performed at an indoor temperature of 25°C).

They do not represent any commitment on the part of Adeunis.

The battery life depends on numerous non-predictive network parameters, including:

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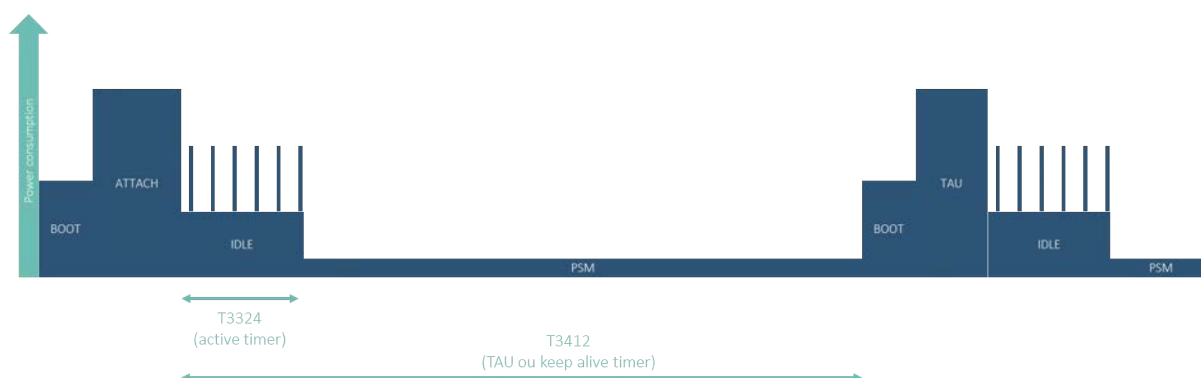
3.3. PSM mode support

The COMFORT Serenity product supports the PSM (Power Saving Mode).

The main advantage of PSM mode is that it allows the product to operate for extended periods with reduced power consumption.

- The product periodically enters a prolonged inactive phase during which it is disconnected from the network. During these periods, the sensor does not receive signals from the network and does not send data. This significantly saves battery power as the product does not need to maintain a continuous connection to the cellular network.

- When the product needs to send data, it exits PSM mode and temporarily rejoins the network. It establishes a connection with the base station and transmits the collected data.
- Once the data is transmitted, the product returns to a low-power consumption state.



The user can configure the following PSM parameters via the **NFC IoT Configurator application**:

- The period during which the product is reachable by the network to receive downlink data (T3324)
- The deep sleep period during which the product remains attached to the network but is unreachable (T3412)



Go to the "CONFIGURATION" menu of the sensor => Select the "NETWORK" section => Configure the "T3412 Multiplier," "T3412 Value," "T3324 Multiplier" and "T3324 Value" parameters => Apply the new configuration to the product via NFC.

Please note that while the product indicates the desired reachability period and the PSM period to the network, these trigger values (T3324 and T3412) can be modified by the network during the attachment procedure or when updating its location (TAU).

At any time, the user can check the trigger values (T3324 and T3412) on the **NFC IoT Configurator application**.



Go to the "DETAILS" menu of the sensor => Select the "DIAGNOSTIC" section => Monitor the "T3412" and "T3324" parameter values



NOTE

If the T3324 value displayed on the application is -1, it means that the network to which the product is connected does not allow access to PSM mode.

4. PRODUCT SETUP

4.1 NFC IoT Configurator App

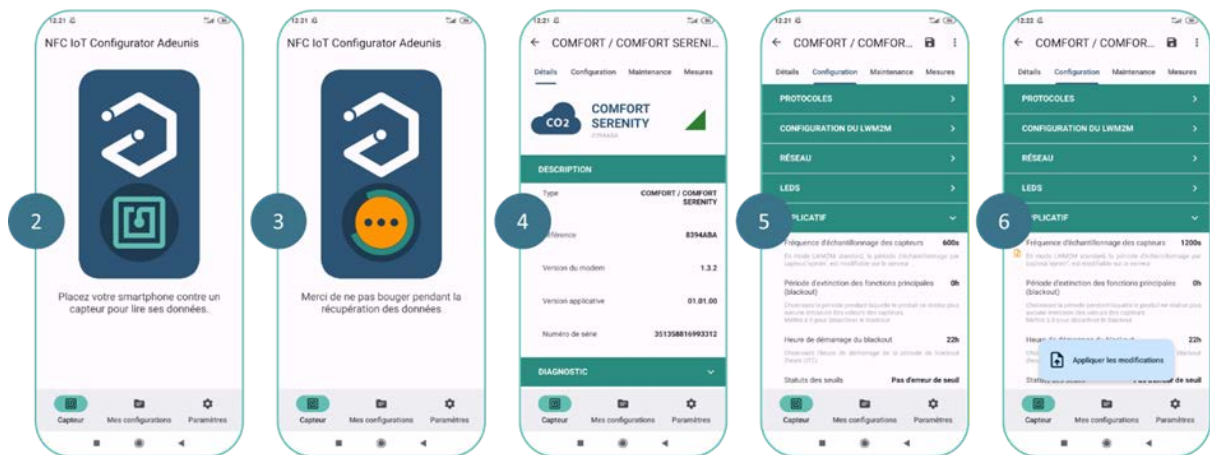
NFC IoT Configurator is an Android application for mobile/tablet that allows configuring the network, server, and application parameters of the COMFORT Serenity product through an NFC interface.



1. Download the application for free from the Play Store

<https://play.google.com/store/apps/details?id=com.adeunis.nfcconfigurator>

2. Enable NFC on your smartphone and launch the NFC IoT Configurator application
3. Place your smartphone against the product. The Android application recognizes the product and reads the information it contains
4. The product's current information and configuration are automatically displayed on the NFC IoT Configurator application
5. Modify the product's configuration quickly and intuitively if necessary, using the various drop-down menus in the application
6. Apply the new configuration to the product by pressing the "Apply Changes" button on the NFC IoT Configurator application



The application also allows saving, exporting, and importing an application configuration for quick duplication onto other products.



NOTE 1

The use of the NFC antenna has an impact on the product's battery life. To preserve battery autonomy, it is preferable to only bring the smartphone close to the NFC antenna of the COMFORT Serenity product when performing a read/write operation. Once the read/write operation is complete, remember to move the smartphone away from the NFC antenna of the product.

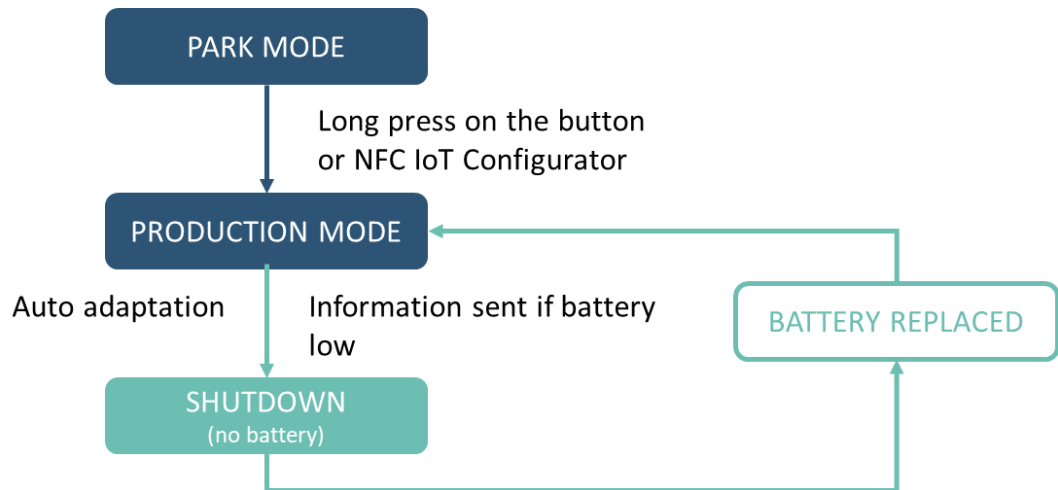
NOTE 2

The sensor is protected against unauthorized external access by an NFC security key consisting of 8 alphanumeric characters. Therefore, only authorized individuals can modify the sensor's configuration through this interface.

The NFC security key of the sensor can be changed by the user after the initial connection. If the security key of a sensor is changed, the new key must also be entered in the application settings to allow it to continue communicating with the sensor.

4.2 Product operating modes

The product has 2 operating modes



4.2.1 PARK Mode

The product is delivered in PARK mode, where it is in standby mode, and its consumption is minimal.

The NFC interface of the product remains active to allow the user to read and modify the product's configuration through the **NFC IoT Configurator application**.

4.2.2 PRODUCTION Mode

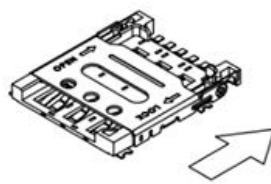
This mode allows the product to function in its final use.

The NFC interface of the product is active to allow the user to read and modify the product's configuration through the **NFC IoT Configurator application** at any time.

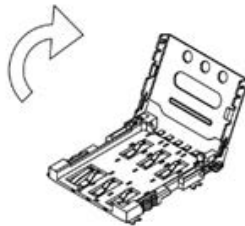
4.3 SIM Card Installation

SIM CARD INSTALLATION PROCEDURE:

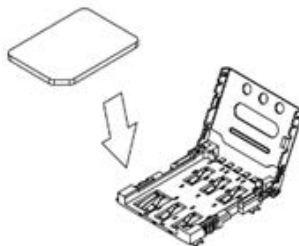
1. Verify that the product is in PARK mode using the NFC IoT Configurator application
2. Open the casing
3. Detach the electronic card from the front face of the casing
4. Carefully slide the metal cover from the "LOCK" position to the "OPEN" position



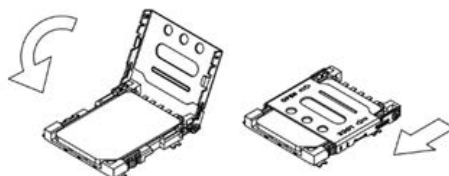
5. Open the metal cover to allow for the insertion of the Nano SIM card



6. Place the Nano SIM card against the contacts, with the chip facing down



7. Close the metal cover and slide it to the "LOCK" position



8. Place the electronic card back into the front face of the casing
3. Close the casing

CAUTION

Make sure the product is in PARK mode when inserting or removing a SIM card. Inserting or removing the SIM card with the product powered on can damage it.



NOTE

Configuring a PIN code is not supported in the COMFORT Serenity product.

4.4 Using the "Quick Start" Function

The **NFC IoT Configurator** app offers users a "Quick Start" function for the COMFORT Serenity product, allowing them to configure the server URI, network connection preferences, and initiate an automatic startup of the product (transition from PARC mode to PRODUCTION mode) with just 3 clicks.

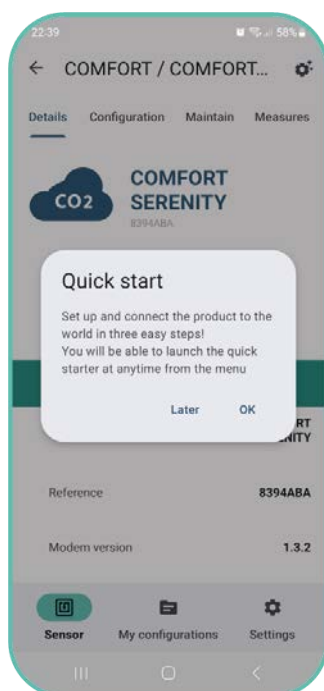
Once in PRODUCTION mode, the COMFORT Serenity product will communicate with the MQTT broker, following its default application configuration:

Application parameters	Default configuration
Sensor Sampling Frequency	3600 sec
Transmission Frequency	3600 sec
Temporary Emission Suspension (blackout)	Disabled
Alarm Mode for High and/or Low Threshold Detection for Temperature, Humidity, CO2, and VOC	Disabled
Automatic CO2 Sensor Calibration	Enabled
Manual CO2 Sensor Calibration	Enabled

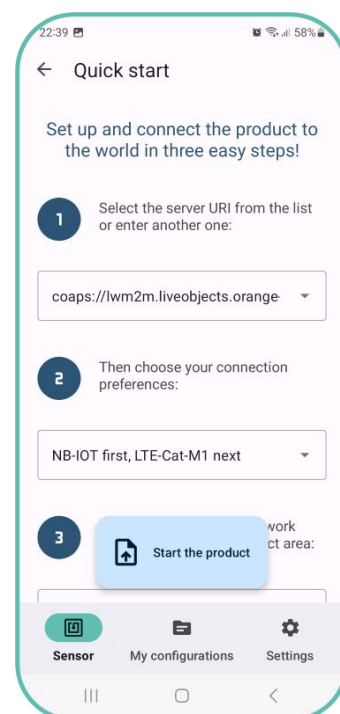
Application parameters	Default configuration
VOC Sensor	Enabled
LEDs Operating Mode	Enabled - 100%
Visual CO2 Concentration Indicator	Enabled 5 blinks
LED Activation Thresholds based on CO2 Concentration	1300 ppm for RED LED 1000 ppm for ORANGE LED
CO2 Concentration Indicator Viewing Frequency	10 min for GREEN LED 1 min for ORANGE LED 1 min for RED LED

CAUTION

Ensure that the COMFORT Serenity product contains a Nano SIM card before using the "Quick Start" function. If the product fails to detect a SIM card during startup, the red LED will blink for 30 seconds, and the product will automatically return to PARC mode.



The Quick Start function is automatically offered to the user during the initial connection of the product to the NFC IoT Configurator app.





Subsequently, the user will be able to access the Quick Start function of the NFC IoT Configurator app from the secondary menu in the "DETAILS" section of the sensor.

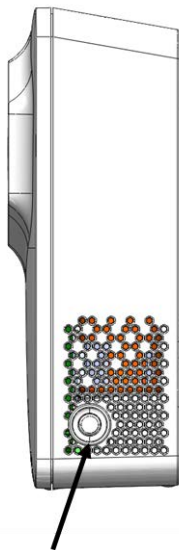
4.5 Other product startup modes

In order to use the other startup modes of the product, the user must have previously configured the server and network parameters of the product using the NFC IoT Configurator application.

Refer to the following sections of this User Guide:

- [Section 5.1 "Server-related parameter configuration"](#)
- [Section 5.2 "Cellular network-related parameter configuration"](#)

4.5.1 Product startup via push button



Start-up button

The startup via push button is performed by pressing and holding the side button of the product for more than 5 seconds.

The green LED will light up to indicate the detection of the button press.



4.5.2 Startup of the product via NFC IoT Configurator app



Go to the "CONFIGURATION" menu of the sensor => Select the "PRODUCT ACTIVATION" section => Enable "PRODUCTION" mode => Apply the new configuration to the product via NFC.

The green LED then flashes rapidly during the mode change phase (rapid blinking of 5 cycles with 100 ms ON / 100 ms OFF).



In case of a faulty product, the red LED will light up for 15 seconds, and then the product will reboot.

Once the product is configured in PRODUCTION mode, it will immediately attempt to attach to the network in order to take measurements and communicate them to a server.

4.6 Network attachment

4.6.1 Startup Network Attachment and Configuration

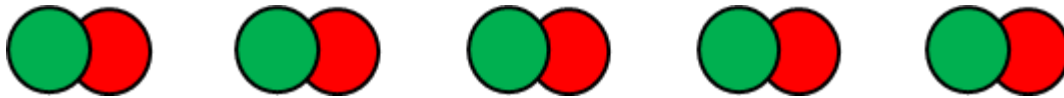
The product performs a network attachment phase at startup (when transitioning to PRODUCTION mode).

4.6.1.1 Automatic Network Attachment

If a single-operator Nano SIM card is inserted into the product, it will automatically attach to the network.

If a multi-operator or multi-technology Nano SIM card is inserted into the product, it will automatically search and select the best operator or technology at product startup (based on the list of operators supported by the SIM card).

During the network attachment process, the green and red LEDs will alternately blink for 50 ms every second.



If the network attachment fails, the red LED will stay on for 5 seconds. By default, the product will attempt 2 network attachments every 12 hours. This mechanism helps to preserve the product's battery life in case of a poor network connection. These 2 parameters (number of network attachment attempts and waiting time between two network attachment attempts) can be configured via the **NFC IoT Configurator app**.

As long as the product has not been attached to the network at least once, for each failed attachment attempt, the red LED will stay on for 5 seconds.

4.6.1.2 Manual Network Attachment

Once the network attachment is successful, the user can choose to manually attach to a specific operator via the **NFC IoT Configurator app**.



Go to the "CONFIGURATION" menu of the sensor => Select the "NETWORK" section => Configure the "Network Selection" parameter to manual mode => Specify the MCC-MNC code corresponding to the network to which the product should connect in manual mode using the "Network to Use in Manual Mode" parameter => Apply the new configuration to the product via NFC.

It is also possible to select the technology used by the product to connect to the network (NB-IoT or LTE-Cat-M1) using the "Connection Preference" parameter.

Once the operator is selected, the product will automatically restart and operate on that operator, even after subsequent power cycles.

ATTENTION

If the manually selected network is not accessible (not supported by the SIM card or no network coverage), then the product will not be attached to any network.

4.6.2 Monitoring Network Attachment Status

At any time, the user can check the network connection status on the **NFC IoT Configurator app**.



Go to the "DETAILS" menu of the sensor => Select the "DIAGNOSTIC" section => Monitor the network attachment status using the "Network Connection Status" parameter..

Network attachment status	Description
Connected	Product in PARK mode or no network at the installation location
Disconnected (timeout)	Network attachment time exceeds the configured timeout in the product (default 120 seconds)
Searching	Product searching for a network connection
Connected	Product connected to the network

4.7 Network Quality Verification

Adeunis recommends that the installer check the network coverage level before installing the product in its final location.

4.7.1 Verification via NFC IoT Configurator app



Go to the "DETAILS" menu of the sensor => Select the "DIAGNOSTIC" section => View the values of RSRQ, SNR, RSRP, Transmission Power parameters.

Two icons, visible at the top of the "DIAGNOSTIC" section, also make it easy to monitor two key parameters to assess the proper functioning of the product:

- The quality of the signal emitted by the antenna.
- The transmission power required by the product to send a message.

Once the product is installed and connected to the network, it automatically performs a network quality diagnosis (RSRQ, RSRP, Tx Power) every time it wakes up from sleep mode.

The installer/user can check this network quality information at any time using the NFC IoT Configurator application or the MQTT broker. They can potentially relocate the product to an area with better network quality.

4.8 Specific Case of Starting without a Nano SIM

It is possible to use the COMFORT Serenity product in "disconnected" mode, meaning without inserting a Nano SIM card. By activating this mode, the product will not connect to a cellular network and will not transmit its data to a remote server. Comfort and air quality data will only be accessible locally through the LED indicator and/or the NFC IoT Configurator app.



Features accessible in "disconnected" mode

- Configuration via the NFC IoT Configurator application
- Visual indicator on the product for CO2 concentration
- Manual calibration of the CO2 sensor through button press or via the "MAINTENANCE" menu of the NFC IoT Configurator application
- Measurement of temperature, humidity, CO2 concentration, and volatile organic compounds (VOCs)
- Visualization of these 4 data through the NFC IoT Configurator app



Activating the Nano SIM-less operating mode via the NFC IoT Configurator application

Go to the "CONFIGURATION" menu of the sensor => Select the "PRODUCT ACTIVATION" section => Enable "PRODUCT WITHOUT SIM" mode => Apply the new configuration to the product via NFC.

5. PRODUCT CONFIGURATION

5.1 Configuration of Server-Related Parameters

The following table lists the parameters to configure on the product to connect to a MQTT broker.

Parameters	Description	Configuration
User Name	User name used to connect to the MQTT broker The user name is configured by the user	-

Parameters	Description	Configuration
Password	Password used to connect to the MQTT broker The password is obtained from the MQTT broker provider	-
MQTT client ID	ID used to uniquely identify the product (MQTT client) when connecting to the MQTT broker	urn :IMEI :xxxxxx
MQTT Server Certificate	Used to authenticate the product with the MQTT broker (requires downloading a .pem file) This certificate is obtained from the MQTT broker provider	-
MQTT Broker URL	URL of the MQTT broker that the product needs to communicate with	-
MQTT Broker Port	Port used for the connection	-
Publication Topic	Topic to be used for publishing the product's data	-



To configure the MQTT broker via the NFC IoT Configurator application, go to the "CONFIGURATION" menu => Then select the "MQTT CONFIGURATION" section => Modify the connection parameters => Apply the new configuration to the product via NFC.

Once the connection parameters to the MQTT broker are configured in the product, it is ready to be registered on a server.

5.2 Configuration of Cellular Network Parameters

The COMFORT Serenity product needs to be connected to a network in order to transmit its data to a MQTT broker.

The following table lists all the network parameters of the COMFORT Serenity product and their default values.

Parameters	Description	Default Configuration
Network Selection	Automatic or manual selection of the cellular network used by the product to connect during startup	Automatic
Connection Preference	Technology used by the product to connect to the network	NB-IoT followed by LTE-Cat-M1
Frequency Bands	Frequency bands used by the product to connect to the network The default configured bands are the European bands. It is possible to limit the bands to reduce the product's attachment time. For example, in France, only band 20 is used by operators	1,3,8,20,28
Maximum Network Attachment Duration	Maximum duration for the modem to attach to the network If this time is exceeded without successful attachment, the attachment is interrupted	120 seconds
Number of Network Attachment Attempts	Number of consecutive network attachment attempts	2
Delay between 2 Network Attachment Attempts	Delay between 2 consecutive network attachment attempt	12 hours
APN	pecifies the Access Point Name that determines the product's connection settings to the internet (network and operator)	-

Parameters	Description	Default Configuration
T3412 Value	Timer defining the period for periodic Transmission Area Update (TAU) signal emission to the network When the T3412 timer expires, the product exits a deep sleep state with no radio activity (PSM cycle) The value of T3412 will be multiplied by its multiplier to obtain the Keep-alive duration	1
T3412 Multiplier	Multiplier for the T3412 timer	6 hours
T3324 Value	Timer indicating the period during which the sensor remains reachable by the network after a transmission When the T3324 timer expires, the product enters PSM mode but remains registered on the network The value of the T3324 timer will be multiplied by its multiplier to obtain the Active-time duration	5
T3324 Multiplier	Multiplier for the T3324 timer	2 seconds



If desired, the user can modify the default cellular network connection parameters in the product using the NFC IoT Configurator application:

Go to the "CONFIGURATION" menu of the sensor => Select the "NETWORK" section => Configure the product => Apply the new configuration to the product via NFC.

5.3 Configuration of Application Parameters

5.3.1 Configuration of the sampling period

The sampling interval determines how often the COMFORT Serenity product will retrieve the values of temperature, humidity, CO2 concentration, and relative change in VOC level inside a building.

- The default sampling interval is set to 60 minutes.
- The user can choose any sampling interval between 60 and 604,800 seconds, which is equivalent to 7 days.
- The minimum interval between two sampling events is 1 minute.
- The sampling granularity is set to the minute, rounded down to the nearest lower value (e.g., 90 seconds = 1 minute).



Configuration of the sampling interval via the NFC IoT Configurator app:

Go to the sensor's "CONFIGURATION" menu => Select the "APPLICATION" section => Configure the Sensor Sampling Frequency parameter => Apply the new configuration to the product using NFC.

5.3.2 Configuration of the transmission mode

The COMFORT Serenity product allows for the measurement of temperature, humidity, CO2, and VOC levels in a room, and sending the information using 3 transmission modes.

Concrete use cases and examples of associated configurations are provided in the ANNEXES of the User Guide.

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Transmission Mode	Definition	Concrete Use Case
Periodic Emission	Periodic emission involves retrieving the values of TEMP+HUM+CO2+VOC according to the configured sampling interval, saving them, and regularly sending them for analysis over time	ANNEX 3
Threshold-based Emission	Threshold-based emission involves regularly retrieving the values of TEMP+HUM+CO2+VOC according to the configured sampling interval and sending a notification only if a threshold is exceeded. A new notification is sent when the values return to normal	ANNEX 4
Periodic Emission and Threshold-based Emission	A combination of both modes allows for regularly retrieving the values of TEMP+HUM+CO2+VOC according to the configured sampling interval, saving them, and sending them regularly for long-term analysis. To be immediately alerted in case of threshold exceedance, a notification is sent as soon as a threshold is surpassed. This notification includes the last measured value of the sensor that exceeded the threshold, along with the values of all other onboard sensors. A new notification is sent upon returning to normal conditions.	ANNEX 5

5.3.3 Threshold configuration

The user can configure conditional operating rules of the type "if a condition is met, trigger an action" independently for temperature, humidity, CO2, and VOC data.

These rules can be used to limit the number of transmissions made by the COMFORT Serenity product and increase its lifespan.

The available conditions are:

- Above threshold - if the measured value is above the threshold, the product will trigger a transmission of that value.
- Below threshold - if the measured value is below the threshold, the product will trigger a transmission of that value.

The following table lists all the threshold configuration parameters for the COMFORT Serenity product and their default values.

Parameters	Description	Default Configuration
High temperature threshold detection	Temperature threshold beyond which the product will trigger a transmission of the sensor measurement	0°C
Low temperature threshold detection	Temperature threshold below which the product will trigger a transmission of the sensor measurement	0°C
Temperature hysteresis	Hysteresis value for the high and low thresholds	0°C
Alarm mode activation	When the alarm mode is activated, the product triggers a transmission of the temperature sensor measurement when a threshold is reached and when it returns to normal	Disabled
High humidity threshold detection	Humidity threshold beyond which the product will trigger a transmission of the sensor measurement	0%

Parameters	Description	Default Configuration
Low humidity threshold detection	Humidity threshold below which the product will trigger a transmission of the sensor measurement	0%
Humidity hysteresis	Hysteresis value for the high and low thresholds	0%
Alarm mode activation	When the alarm mode is activated, the product triggers a transmission of the humidity sensor measurement when a threshold is reached and when it returns to normal	Disabled
High CO2 concentration threshold detection	CO2 concentration threshold beyond which the product will trigger a transmission of the sensor measurement	0ppm
CO2 concentration hysteresis	Hysteresis value for the high threshold	0ppm
Alarm mode activation	When the alarm mode is activated, the product triggers a transmission of the CO2 sensor measurement when a threshold is reached and when it returns to normal	Disabled
High VOC threshold detection	VOC threshold beyond which the product will trigger a transmission of the sensor measurement	0
VOC hysteresis	Hysteresis value for the high threshold	0
Alarm mode activation	When the alarm mode is activated, the product triggers a transmission of the VOC sensor measurement when a threshold is reached and when it returns to normal	Disabled



To configure thresholds using the NFC IoT configurator App, go to the « CONFIGURATION » menu => Then select the « APPLICATION» subsection => Configure the different threshold values => Apply the new configuration to the product via NFC

Examples of threshold configurations are provided in ANNEXES 4 and 5

5.3.4 Configuration of VOC sensor activation/deactivation

The VOC sensor can be activated or deactivated by the user. Once the VOC sensor is activated/deactivated, the product will automatically restart.



Configuring the VOC sensor via the NFC IoT Configurator app:
Go to the "CONFIGURATION" menu of the sensor => Then select the "APPLICATION" section => Select the "VOC" subsection => Configure the "VOC sensor activation" parameter => Apply the new configuration to the product via NFC

5.3.5 Configuration of a blackout period

The COMFORT Serenity product allows the user to define a period during which the product will not send any notifications.

This allows for optimizing the product's autonomy, saving message sending and data processing costs during a period when no analysis is required (e.g., during the night).

During this blackout period, the sensor:

- Continues to measure temperature, relative humidity, CO2 concentration, and VOC.
- Continues to send protocol messages (such as Keep alive).
- Takes this period into account for automatic calibration of the CO2 sensor.
- Disables the LEDs corresponding to the CO2 level.
- Disables the periodic transmission of temperature, relative humidity, CO2 concentration, and VOC values.
- Does not allow manual calibration of the CO2 sensor.

The following table lists the parameters to be configured on the product to define a blackout period.

Parameters	Description	Default Configuration
Main Functions Blackout Period	Period during which the product does not emit any sensor values.	Disabled
Blackout Start Time	Start time of the blackout period.	10 PM



To configure a blackout period via the NFC IoT Configurator application, go to the "CONFIGURATION" menu => Select the "APPLICATION" section => Choose the "General" subsection => Configure the "Blackout Period of the main functions" and "Blackout Start Time" => Apply the new configuration to the product via NFC.

5.4 Factory Reset

The COMFORT Serenity product can be restored to its default settings using the **NFC IoT Configurator application**.



To restore factory settings via the NFC IoT Configurator application, go to the secondary menu at the top of the "CONFIGURATION" menu => Select the action "Restore Default Configuration" => Apply the new configuration to the product via NFC.

5.5 Data Timestamping

Each measurement value (temperature, relative humidity, CO2 concentration, and VOC) reported by the COMFORT Serenity product is automatically associated with a UTC timestamp.

The clock is synchronized remotely via the network.

The timestamp is provided in the EPOCH format.

6. INSTALLATION

6.1. Product Mounting

Recommended positioning for use in office and home environments:

- Mount on a wall at a height of 1.5 meters from the floor, in an unobstructed area and not exceeding 2 meters.
- Place on a furniture piece at 1 meter from the floor.

The product should be installed using 2 CBLZ 2.2 x 19mm screws and 2 SX4 anchors. Use these products or equivalent ones to secure your product to a flat surface.



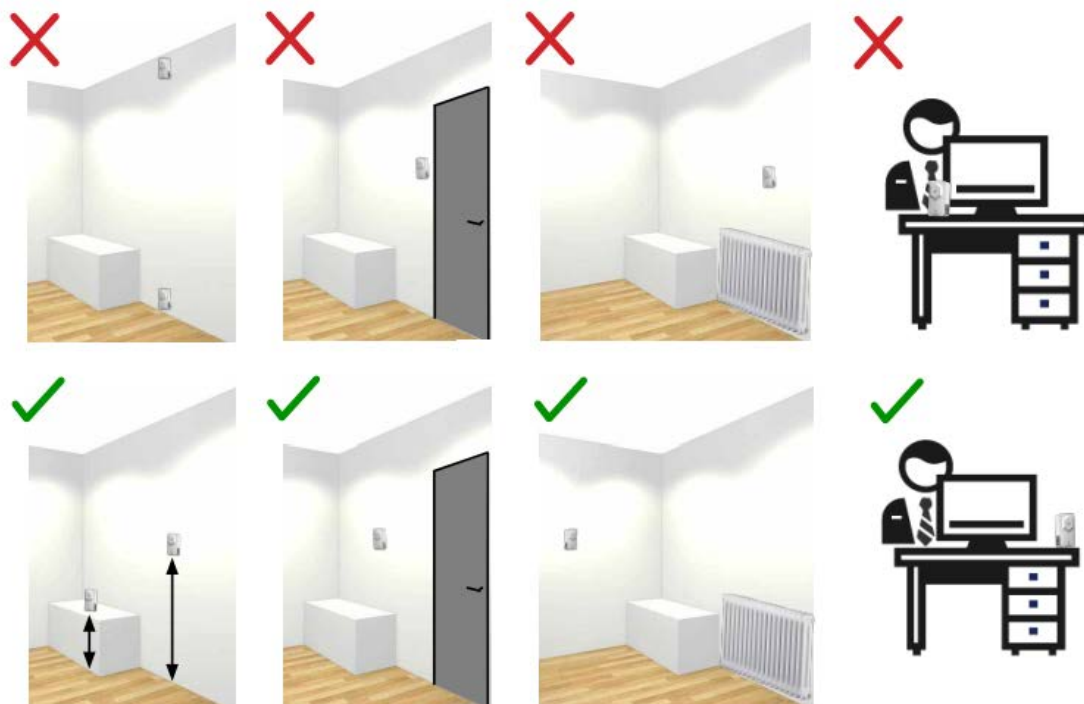
6.2. Product Installation Recommendations

To obtain accurate air quality measurements, we recommend following the instructions below:

- Do not use the sensor for outdoor purposes.
- Avoid positioning the sensor directly facing the sun or near a heat source, cold source, ventilation, or in an airflow.
- Maintain a minimum distance of one meter from doors or windows.
- When installed on furniture, avoid placing it in direct proximity to an individual.
- Do not install the sensor too close to the ground, less than 30 cm.
- Do not install the sensor in a dusty or poorly maintained area (garage, basement, workshop, etc.).
- Do not install the sensor in areas with regularly exceeding 95% relative humidity (bathrooms, changing rooms, spas, laundry rooms, etc.).
- Do not install the sensor in an area where it can be damaged or torn.

CAUTION

The top face of the product (allowing access to the enclosure) should be accessible with a screwdriver. Do not position it against a ceiling or under an object, as this may prevent opening the enclosure.



7. DOCUMENT HISTORY

Version	Content
V1.1.0	Creation

ANNEX 1: MQTT PROTOCOL

The COMFORT Serenity product can be configured to use one of the following two protocols to exchange data with an IoT platform: MQTT or LwM2M.



Adeunis recommends the use of the LwM2M protocol as it is the ONLY protocol that minimizes the consumption of the COMFORT Serenity product and ensures remote operational management.

Description of the MQTT Protocol

MQTT (Message Queuing Telemetry Transport) is an open-source, simple, and standardized client/server messaging protocol based on a Publish/Subscribe architecture.

Publication Topic for COMFORT Serenity Product

The user needs to configure the publication topic to be used for publishing the data of the COMFORT Serenity product.

Any application wishing to communicate with the product must subscribe to this publication topic.

The name of the publication topic can be modified by the user via the NFC IoT Configurator application.

Security

To authenticate with an MQTT broker, the COMFORT Serenity product uses a server CA certificate.

This authentication mode requires switching the product to PARC mode and downloading a .pem file via the NFC IoT Configurator application.

Adeunis recommends importing 2 certificates into the product as certificates cannot be updated remotely.

The COMFORT Serenity product does not support advanced security modes (X509 client certificate). Therefore, the product is not compatible with AWS and Azure servers.

Quality of Service (QoS)

Three levels of Quality of Service (QoS) determine how the MQTT protocol handles message transmission (client-to-broker publish messages and broker-to-subscriber messages). Subscribed clients can specify the maximum QoS level they wish to receive.

The COMFORT Serenity product supports QoS level 1.

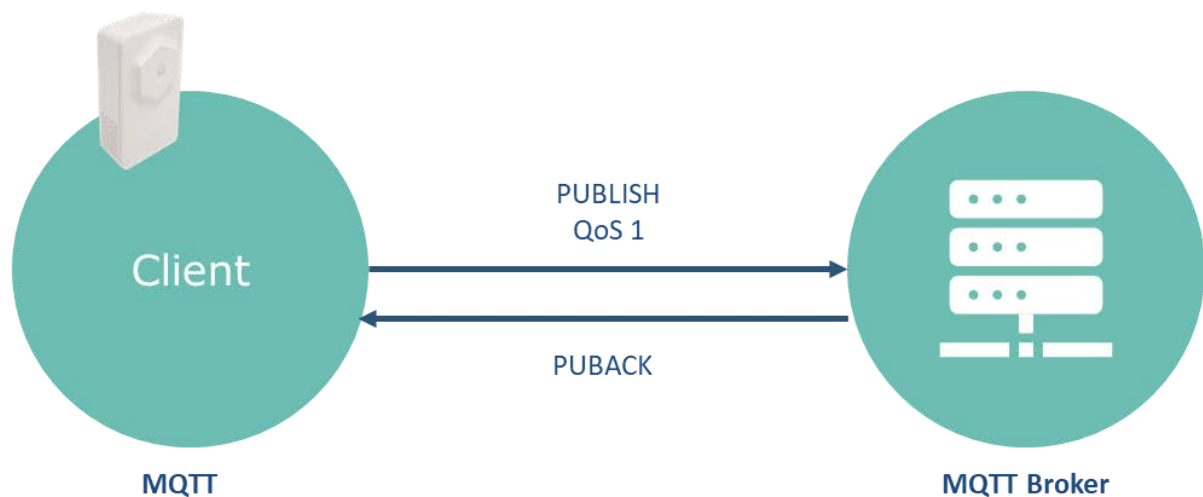
- **QoS 1 "At least once"**

This level ensures that the message sent by the COMFORT Serenity product (PUBLISH) will be received at least once. The sender retains the message until it receives an acknowledgment (PUBACK).

After a certain period, if no acknowledgment with the corresponding message identifier is received, the sender resends the message. The message can be sent multiple times until a confirmation is received.

Furthermore, when the recipient receives a QoS level 1 message, it can process it immediately before sending an acknowledgment. For example, when the broker receives a message, it sends that message to all subscribers and then acknowledges the message to the recipient.

Therefore, a message can be sent and received multiple times. This duplicate will contain a DUP flag that will not be processed by the receiver. The receiver will send an acknowledgment without considering the DUP flag.



ANNEX 2: DATA FORMAT OF THE COMFORT SERENITY PRODUCT

Messages from the COMFORT Serenity NB-IoT & LTE-Cat-M1 product are based on the JSON data exchange format.

The JSON data of the COMFORT Serenity product contains the following information:

- Product serial number
- Battery status
- Timestamped values measured by the CO2 sensor
- Timestamped values measured by the temperature sensor
- Timestamped values measured by the humidity sensor

```
{
  "id": "635b803df00d2573fd0cc6e4",
  "streamId": "urn:io:msid:imei:351358816993411",
  "timestamp": "2022-10-28T07:09:49.269Z",
  "value": {
    "sn": "351358816993411",
    "lowbat": false,
    "temp": [
      {
        "value": 20.800363693237305,
        "time": 1666940711
      },
      {
        "value": 21.184099197387695,
        "time": 1666940771
      },
      {
        "value": 21.23415542602539,
        "time": 1666940831
      }
    ],
    "hum": [
      {
        "value": 56.7696533203125,
        "time": 1666940711
      },
      {
        "value": 56.3363037109375,
        "time": 1666940771
      },
      {
        "value": 56.0189288984375,
        "time": 1666940831
      }
    ],
    "cov": [
      {
        "value": 103,
        "time": 1666940711
      },
      {
        "value": 108,
        "time": 1666940771
      },
      {
        "value": 116,
        "time": 1666940831
      }
    ],
    "co2": [
      {
        "value": 136,
        "time": 1666940711
      },
      {
        "value": 143,
        "time": 1666940771
      },
      {
        "value": 149,
        "time": 1666940831
      }
    ],
    "txInfo": {
      "cwr": 7,
      "rsrp": -43,
      "rsrq": -9,
      "txPower": 8,
      "nbReboot": 26
    }
  },
  "tags": {},
  "extra": {},
  "metadata": {
    "source": "urn:io:msid:imei:351358816993411",
    "group": {
      "id": "root",
      "path": "/"
    },
    "connector": "mqtt",
    "network": {
      "mqtt": {
        "clientId": "urn:imei:351358816993411"
      }
    }
  },
  "created": "2022-10-28T07:09:49.275Z"
}
```

- Timestamped values measured by the VOC sensor (if enabled)
- Network performance data (if enabled)

If the measurement values contain data arrays, the first element corresponds to the first measurement taken.

The timestamp is of EPOCH UTC type.

ANNEX 3: PERIODIC TRANSMISSION

The product allows for periodically retrieving temperature, humidity, CO2 level, and relative change in volatile organic compounds (VOCT) and sending this information to a MQTT broker.

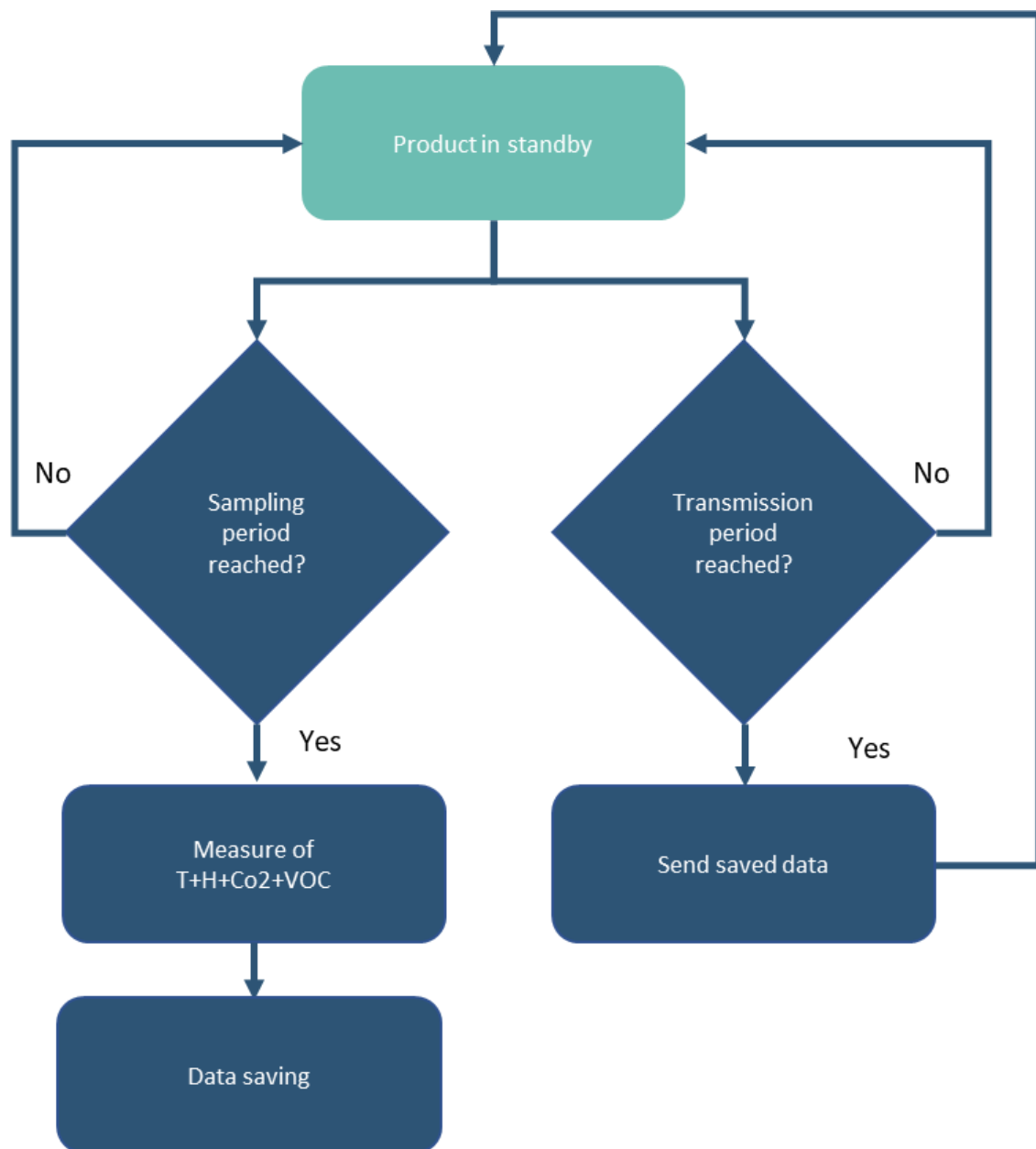
With the history mechanism, if the sensor sampling frequency is higher than the transmission frequency, the product will store all measured values in local memory to be transmitted later in a single message at the end of the transmission period.



Maximum number of samples per message : 144

Block Diagram

The periodic transmission is performed according to the following block diagram



The table below lists the parameters to configure to use this transmission mode:

Parameters	Description	Default Configuration
Transmission Frequency	Data transmission frequency	3600 seconds
Sensor Sampling Frequency	Common scanning frequency for sensors	3600

These parameters can be configured via the NFC IoT configurator app.

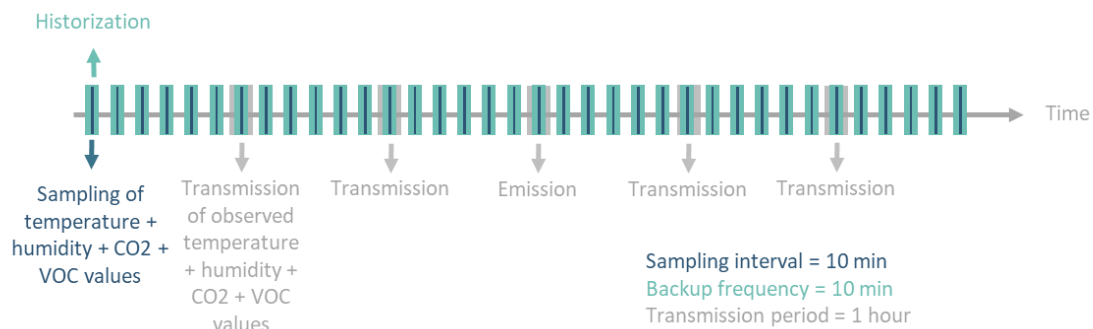


For a transmission without history, it is sufficient to configure the transmission frequency to be equal to the sensor sampling frequency.

Example

The product retrieves temperature, humidity, CO2 concentration, and relative change in volatile organic compounds every 10 minutes and saves the information.

The product performs 6 saves and transmits them once per hour. These values will be considered in calculating the minimum and maximum values measured by each sensor.



Configuration of Application Parameters to Use

Parameters	Unit	Value	Description
Transmission Frequency	Seconds	3600	1 transmission per hour T+H+CO2+VOC
Sensor Sampling Frequency	Seconds	600	1 sample every 10 minutes T+H+CO2+VOC



Configuration via the NFC IoT Configurator App

Go to the "CONFIGURATION" menu of the sensor

=> Go to the "APPLICATION" section => Configure the sensor sampling frequency to 600 seconds => Configure the transmission period to 3600 seconds

=> Apply the new configuration to the product via NFC

ANNEX 4: THRESHOLD EXCEEDING TRANSMISSION

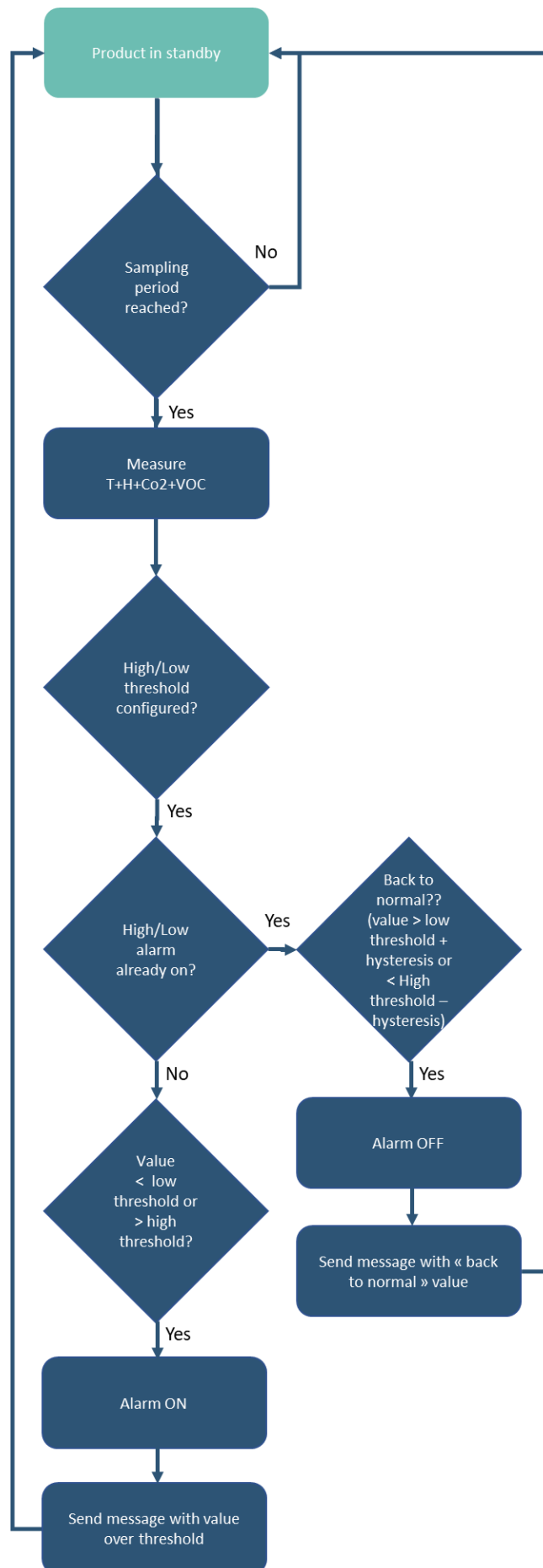
The product allows for periodic measurement of temperature, humidity, CO2 level, and relative change in volatile organic compounds (VOC) level.

If the product detects a threshold exceeding (both high and low for temperature and humidity, only high threshold exceeding for CO2 and VOC), it sends a message to the MQTT broker to alert the user. A new message is sent when the values return to normal.

Only the value exceeding the threshold is transmitted to the MQTT broker.

Block Diagram

The transmission on threshold exceeding is performed according to the following block diagram



The table below lists the parameters to configure for using this transmission mode:

Parameters	Description	Default Configuration
Transmission Frequency	Frequency of data transmission	3600 seconds
Sensor Sampling Frequency	Sampling frequency of Temperature + Humidity + CO2 + VOC values	3600 seconds
High Threshold Detection	Threshold beyond which the product will trigger a transmission of the sensor measurement	-
Low Threshold Detection	Threshold below which the product will trigger a transmission of the sensor measurement	-
Hysteresis	Hysteresis value for high and low thresholds	-
Threshold Status	Identifies an error in the configuration of different thresholds	-

These parameters can be configured via the NFC IoT Configurator app.

Example

The product measures temperature, humidity, CO2 concentration, and relative change in volatile organic compounds every 10 minutes.

Alarms are configured for the product to notify the MQTT broker:

- If the temperature exceeds 25°C. This alarm will be disabled if the temperature falls below 24°C.
- If the temperature goes below 19°C. This alarm will be disabled if the temperature rises above 20°C.
- If the CO2 concentration exceeds 1300 ppm. The CO2 alarm will be disabled if the concentration falls below 1270 ppm.

There are no alarms for humidity and VOC.

Configuration of Applicable Parameters to Use

Parameters	Unit	Value	Description
Transmission Frequency	Seconds	0	No periodic transmission of T+H+CO2+VOC values
Sensor Sampling Frequency	Seconds	600	1 measurement every 10 minutes for T+H+CO2+VOC
CO2 Alarm Activation	-	Enabled	CO2 concentration alarm activated
CO2 High Threshold Detection	ppm	1300	High threshold to trigger the alarm is 1300 ppm
Hysteresis	ppm	30	Hysteresis value is 30 ppm
Temperature Alarm Activation	-	Enabled	Temperature alarm activated
Temperature High Threshold Detection	°C	25	High threshold to trigger the alarm is 25°C
Temperature Low Threshold Detection	°C	19	Low threshold to trigger the alarm is 19°C
Hysteresis	°C	1	Hysteresis value is 1°C
Humidity Alarm Activation	-	Disabled	Humidity alarm disabled
VOC Alarm Activation	-	Disabled	VOC alarm disabled



Configuration via the NFC IoT Configurator App

Go to the "APPLICATION" section => Configure the sensor sampling frequency to 600 seconds => Configure the transmission period to 0 seconds.

=> Go to the "TEMPERATURE" section => Enable the high and low threshold alarm mode => Configure the high threshold detection to 25°C, the low threshold detection to 19°C, and the hysteresis to 1°C.

=> Go to the "CO2" section => Enable the alarm mode => Configure the high threshold detection to 1300 ppm and the hysteresis to 30 ppm => Go to the "APPLICATION" section => Check the threshold status.

=> Apply the new configuration to the product using NFC.

ANNEX 5: PERIODIC AND THRESHOLD EXCEEDANCE TRANSMISSION

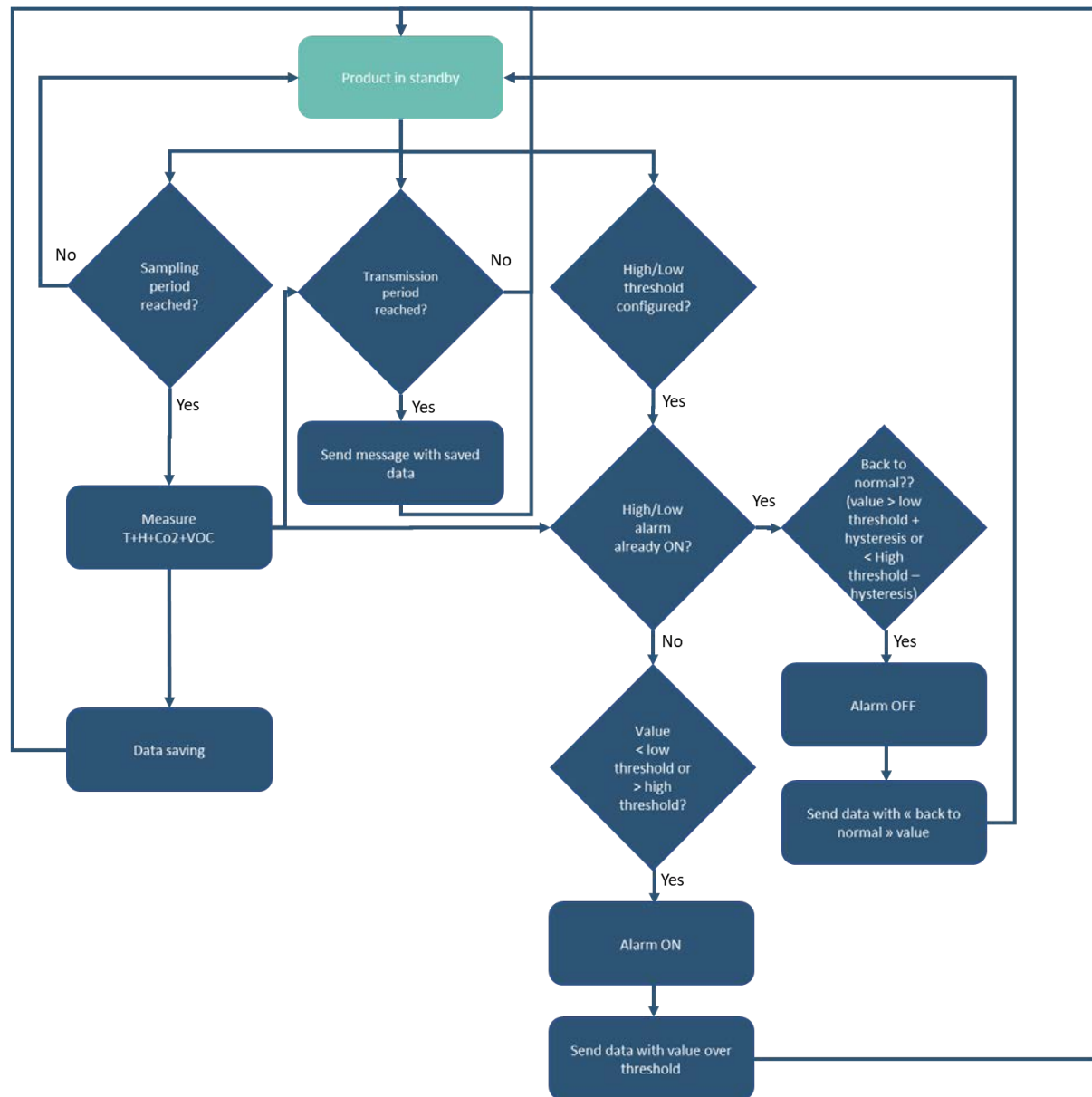
The product allows for periodic measurement of temperature, humidity, CO2 level, and relative change in volatile organic compounds (VOC), and sends this information to a MQTT broker at regular intervals.

With the history mechanism, if the sensor sampling frequency is higher than the transmission frequency, the product will store all measured values in local memory to transmit them in a single message at the end of the transmission period.

If the product detects a threshold exceedance (both high and low for temperature and humidity, only high threshold for CO2 and VOC), it sends a message to the broker to alert the user. A new notification is sent when the values return to normal. Only the exceeded value is transmitted to the broker.

Block diagram

Periodic and Threshold Exceedance Transmission are implemented according to the following diagram:



The table below lists the parameters to configure for using this transmission mode:

Parameters	Description	Default Configuration
Transmission Frequency	Frequency of data transmission	3600 seconds
Sensor Sampling Frequency	Start time of the blackout period	3600 seconds

Parameters	Description	Default Configuration
High Threshold Detection	Threshold beyond which the product will trigger a sensor measurement transmission	-
Low Threshold Detection	Threshold below which the product will trigger a sensor measurement transmission	-
Hysteresis	Hysteresis value for high and low thresholds	-
Threshold Status	Identifies an error in the configuration of different thresholds	-

For non-historical transmission, simply configure the transmission frequency to be equal to the sensor sampling frequency.



The content of a message related to periodic transmission and a message related to threshold exceedance is identical.

When an alarm occurs at time t , all the stored data is sent. An alarm message is therefore a "regular" message sent before the end of the transmission period.

After sending an alarm message, the periodic transmission timer is reset, meaning that the next periodic transmission will be sent at " $t + \text{transmission period}$ ".

These parameters can be configured using the NFC IoT Configurator app.

Example

The product measures temperature, humidity, CO2 concentration, and relative change in volatile organic compounds synchronously every 30 minutes and saves the information. The product performs 8 backups and transmits them every 4 hours.

The 8 measured values from each of the 4 sensors over 4 hours are included in the unique message sent by the product every 4 hours.

The product triggers an alarm if the temperature exceeds 24°C. This alarm will be disabled if the temperature drops below 22°C. The product also triggers an alarm if the CO2 concentration exceeds 1300 ppm. The CO2 alarm will be disabled if the concentration drops below 1270 ppm.

There are no alarms for relative humidity and VOC.

Configuration of Application Parameters to Use

Parameters	Unit	Value	Description
Transmission Frequency	Seconds	14400	1 transmission every 4 hours (T+H+CO2+VOC)
Sensor Sampling Frequency	Seconds	1800	1 measurement every 30 minutes (T+H+CO2+VOC)
CO2 Alarm Mode Activation	-	Enabled	CO2 concentration alarm activated
CO2 High Threshold Detection	ppm	1300	High threshold to trigger the CO2 alarm is 1300 ppm
Hysteresis	ppm	30	Hysteresis value is 30 ppm
Temperature Alarm Mode Activation	-	Enabled	Temperature alarm activated
Temperature High Threshold Detection	°C	24	High threshold to trigger the temperature alarm is 24°C
Hysteresis	°C	2	Hysteresis value is 2°C
Humidity Alarm Mode Activation	-	Disabled	Humidity alarm disabled
VOC Alarm Mode Activation	-	Disabled	VOC alarm disabled



Configuration via the NFC IoT Configurator App

Go to the "CONFIGURATION" menu of the sensor.

=> Go to the "APPLICATIVE" section => Configure the sensor sampling frequency to 1800 seconds => Configure the transmission period to 14400 seconds.

=> Go to the "TEMPERATURE" section => Enable the high threshold alarm mode => Set the high threshold detection to 24°C and the hysteresis to 2°C.

=> Go to the "CO2" section => Enable the alarm mode => Set the high threshold detection to 1300 ppm and the hysteresis to 30 ppm.

=> Go to the "APPLICATIVE" section => Verify the threshold status.

=> Apply the new configuration to the product via NFC.

ANNEX 6: CONFIGURING A BLACKOUT PERIOD

The COMFORT Serenity product allows the user to define a period during which the product will no longer perform periodic transmissions.

The table below lists the parameters to configure in order to define a blackout period:

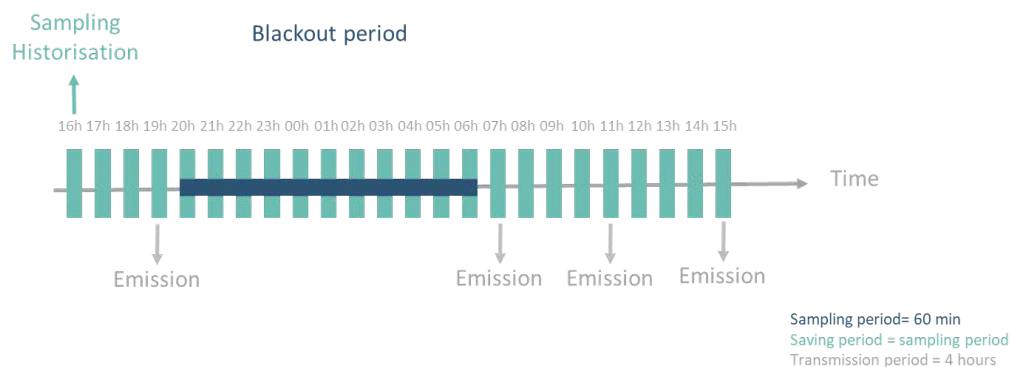
Parameters	Description	Default Configuration
Main Functions Blackout Period	Period during which the product does not perform any sensor value transmissions	Disabled
Blackout Start Time	Start time of the blackout period	22:00 (10:00 PM)

These parameters can be configured using the NFC IoT Configurator app.

Example

The product measures temperature, humidity, CO2 concentration, and VOCT index every 60 minutes (3600 seconds) and stores the information.

The product performs 4 backups and transmits them every 4 hours. The blackout is activated at 20:00 (8:00 PM) for a period of 10 hours (until 6:00 AM).



With the blackout mechanism, the product sends its last message to the server at 19:05 (7:05 PM) with the measured values at 16:00 (4:00 PM), 17:00 (5:00 PM), 18:00 (6:00 PM), and 19:00 (7:00 PM). At 20:00 (8:00 PM), the product enters the blackout period. It does not communicate until the end of the period and resumes communication at 07:05 (7:05 AM).

Configuration of Applicative Parameters to Use

meters	Unit	Value	Description
Transmission Frequency	Seconds	14400	1 transmission every 4 hours (T+H+CO2+VOC)
Sensor Sampling Frequency	Seconds	3600	1 measurement every hour (T+H+CO2+VOC)
Main Functions Blackout Period	Hours	10	The product does not perform any sensor value transmissions for 10 hours

meters	Unit	Value	Description
Blackout Start Time	Hours	20	The blackout period will start at 20:00 (8:00 PM)



Configuration via the NFC IoT Configurator application: Go to the "CONFIGURATION" menu => Select the "APPLICATION" section => Configure the "Blackout Period of the main functions" to 10 hours and the "Blackout Start Time" to 20:00 (8:00 PM) => Apply the new configuration to the product via NFC.

ANNEX 9: CO2 SENSOR USAGE

CO2 Sensor Maintenance

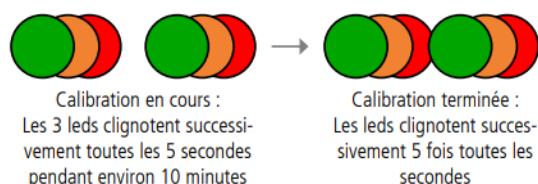
The COMFORT Serenity sensor requires no maintenance if the following calibration criteria are met:

- Automatic calibration is enabled and the area is regularly ventilated.

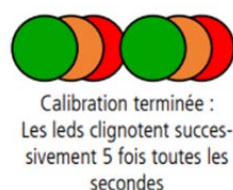
OR

- Manual calibration is performed at least every 6 months with "fresh" air, which is equivalent to 400 ppm (outdoors, sheltered from wind and sunlight, or in a ventilated room for a minimum of 20 consecutive minutes).

During calibration, the green, orange, and red LEDs will blink successively for 100 ms every 5 seconds for approximately 10 minutes.



Once calibration is complete, the 3 LEDs will blink successively for 100 ms every 1 second for 5 cycles.



Automatic Calibration of the CO2 Sensor

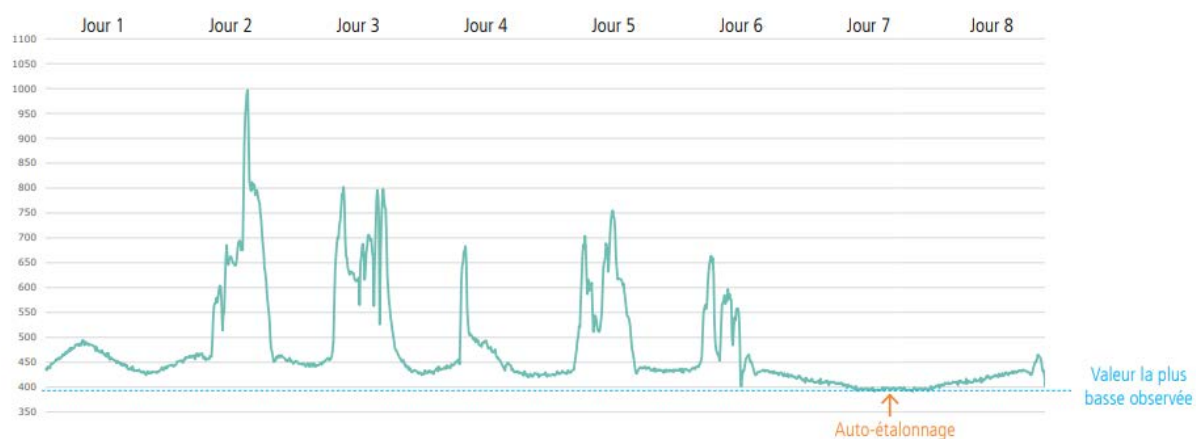


Automatic calibration is enabled by default in the sensor and is performed continuously and cyclically over a 180-hour window without any user intervention.

The 180-hour period is intended to allow the sensor to be exposed to "fresh" air at least once or multiple times. This means obtaining CO2 measurements during low occupancy of the observed area or during a period of low emissions or high ventilation of the room. The sensor can compare the lowest observed values during this period with the reference value and calibrate the sensor if necessary.

To avoid potential calibration of the sensor with an erroneous low value (due to significant drift or an unintended signal variation), the embedded automatic calibration algorithm has limits that prevent it from modifying the reference value if the deviation is too large. In this context, the self-calibration cycle may be slightly extended.

Example of a meeting room:



This calibration must be disabled if the building's usage does not regularly provide minimum values close to "fresh" air, which is 400 ppm by default. This is the case, in particular, for buildings used 24/7. In this situation, the user must use manual calibration.

Automatic calibration is not disabled if a period of main functions shutdown is activated.

If necessary, this calibration period can be customized via the NFC IoT Configurator app to better adapt to the building's usage.



To configure automatic calibration via the NFC IoT Configurator application, go to the "CONFIGURATION" menu => Select the "CO2" section => Modify the default configured 180-hour window => Apply the new configuration to the product via NFC.

Manual Calibration

Manual calibration allows the user to calibrate the sensor whenever desired.

There are two options to do this:

Trigger manual calibration via button press

Trigger manual calibration via the NFC IoT configurator application



Open the windows 10 to 20 minutes before the calibration and during the calibration



Prohibit people to enter the room during calibration



Wait 10 minutes before entering the room

CAUTION

Once calibration is initiated, it cannot be canceled.

NOTE

Manual calibration cannot be performed during a blackout period when the functions are disabled.

Manual Calibration via Button Press

To initiate manual calibration using the side button, press and hold the side button for at least 5 seconds.



Manual calibration via button press can be disabled by configuring it through the NFC IoT Configurator application.

Go to the "CO2" section in the "CONFIGURATION" menu of the sensor => Choose the "Disabled" option for the "Activation of calibration via button press" parameter => Apply the new configuration to the product via NFC.

Manual Calibration via NFC IoT Configurator App



Go to the "MAINTENANCE" menu of the sensor => Perform CO2 sensor calibration by clicking on the "CO2 sensor calibration" parameter => Apply the new configuration to the product via NFC.

The user can initiate manual calibration using either the sensor's default reference value (400 ppm) or a configurable value set through the NFC IoT Configurator app.

Manual and Scheduled CO2 Sensor Calibration

This manual calibration allows the user to schedule a sensor calibration at the most appropriate time based on the building usage (e.g., during the night).

The user can initiate manual and scheduled calibration using either the sensor's default reference value (400 ppm) or a configurable value set through the NFC IoT Configurator app.



Manual and scheduled calibration is not supported in PRODUCTION WITHOUT SIM mode.

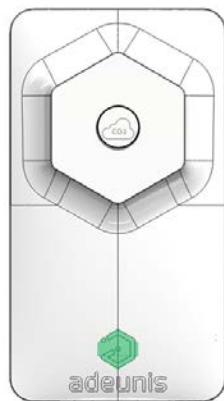


To configure calibration via the NFC IoT Configurator application, go to the "CO2" section in the "CONFIGURATION" menu of the sensor => Set the calibration start date and time using the "CO2 Calibration Start Date" parameter => Apply the new configuration to the product via NFC.

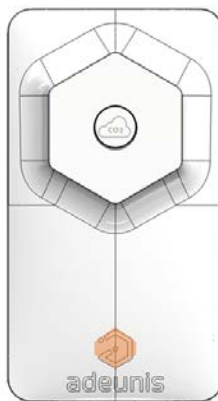
CO2 Concentration Visual Indicator

By default, a visual indicator is enabled in the sensor to allow users in the area to be aware of the CO2 concentration and take appropriate action.

The default thresholds considered are those specified in the Departmental Health Regulation (RSDT):



Green
IAQ OK
Threshold < 1000 ppm



Orange
Ventilation advised
Threshold between 1000 and 1300 ppm



Red
Ventilation is mandatory
Threshold > 1300 ppm

This visual indicator can be fully configured or disabled through the NFC IoT Configurator app.

Displaying the Last CO2 Concentration Level

The user can display the visual indicator corresponding to the last measured CO2 concentration level by pressing the side button for less than 5 seconds.

Timing

To preserve the sensor's battery life while maintaining responsiveness for users, a timer has been programmed for each measured CO2 concentration state.

Initially, the LED blinks immediately after the measurement is taken (configured by the user). Then, if the LED indicator status remains unchanged, the LED blinks cyclically according to the following default configuration:

- Green: every 10 minutes
- Orange: every minute
- Red: every minute

The number of LED blinks and the frequency of each LED's visualization can be configured by the user through the NFC IoT Configurator app.



To configure the visual indicator via the NFC IoT Configurator application, go to the "CONFIGURATION" menu => Select the "LEDS" section => Modify the "CO2 Concentration Visual Indicator" parameter to change the number of LED blinks => Then modify the three parameters "CO2 concentration indicator visualization frequency" => Apply the new configuration to the product via NFC.

Disabling the Visual Indicator

The visual indicator for CO2 concentration can be disabled via the **NFC IoT Configurator app**.



NOTE

If a blackout period is activated in the sensor, the LEDs are disabled during that period.

ICONE Index

Confinement Indicator based on CO2 Concentration

The ICONE index is an indicator created to assess the level of confinement in schools. It can also be applied to other buildings.

Based on the CO2 concentration, it considers both the frequency and intensity of confinement situations.

Derived from measurements taken every 10 minutes, this index offers 3 concentration classes:

- Class 0: concentrations between 0 and 1000 ppm
- Class 1: concentrations between 1000 and 1700 ppm
- Class 2: concentrations above 1700 ppm

The formula for this index is: $N = 8.3 \log(1+f_1+3 f_2)$, where f_i represents the proportions of CO2 values in each of the three classes ($f_0+f_1+f_2=1$).

The resulting index varies between 0 (no confinement) and 5 (extreme confinement).

The classes mentioned above are the default configurations in the product. The ICONE index automatically adjusts based on the "orange" and "red" thresholds set by the user.

-> THE GOAL IS TO MAINTAIN A LOW (1) OR ZERO (0) LEVEL OF CONFINEMENT <—

The ICONE index is calculated by the product once every 24 hours using the different measurements taken by the embedded CO2 sensor.

If a blackout period is activated in the product, the calculation of the ICONE index does not consider that period. The analysis is only performed during the active period.



CAUTION

If the CO2 scanning frequency configured in the product is greater than 1 hour, the ICONE index calculation will be less accurate and more pessimistic than the actual situation.

ANNEX 10: USE OF THE VOC SENSOR

Detection Method

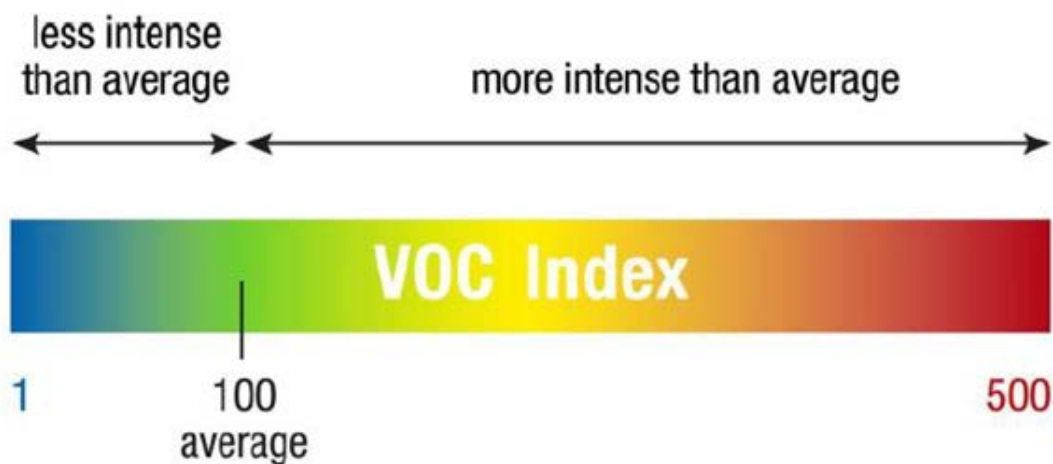
The COMFORT Serenity product incorporates an MOX gas sensor that is sensitive to a wide range of VOCs typically found in buildings. This VOC sensor requires no maintenance.

The product monitors the VOC level and reports it as an index. This detection method does not distinguish between different volatile compounds measured in a room but provides information about relative changes.

Interpretation of the VOC Index

To inform the end user about the intensity of a VOC event, the algorithm embedded in the sensor maps all VOC events to a VOC index scale ranging from 1 to 500 VOC

index points.



The product informs the user about the extent to which indoor air quality has deteriorated or improved compared to the average VOC environment of the onboard sensor, regardless of the actual VOC level in the room:

- VOC Index 100 corresponds to the average gas composition indoors over the past 7 days.
- Values between 100 and 500 represent VOC events (more intense compared to the historical average).
- Values between 1 and 100 represent events of clean air or low VOC content (less intense compared to the historical average).

Algorithm Configuration

In accordance with the recommendations of the MOX sensor supplier, Adeunis has adapted the VOC algorithm to match its behavior with the use case of "indoor air quality":

- Application of a 30-minute moving average on the VOC index values. This ensures that short-term events on the minute scale are less significant than the long-term trend on the daily scale.
- Use of a 7-day sliding window for the learning period.

Parameter	Value
VOC Index	100
Learning Sliding Window	7 days
Initial Standard Deviation	50

NOTE

Temperature and humidity can greatly influence the VOC level in a room. This can explain significant variations in the index even in a room without human activity.

Starting the VOC Sensor

Start and initialize the sensor in a "normal" environment where a typical VOC event occurs. The initialization and rapid learning phase take approximately 90 minutes. Any measurement taken before this 90-minute period will not be reliable and should be ignored by the user.

Afterward, the VOC sensor is ready to operate normally.