SENSIRION
connected solutions

# Nubo Sphere
# User Manual

User Manual for

***Nubo Sphere***
***Sensor Node (LTE MOx) & Wind Meter***
*Continuous Methane Leakage Monitoring System*

Revision 0.2 from June 1, 2022

**IMPORTANT Safety Information**

Throughout the manual, you will find caution and warning statements that require you to take cautionary measures when working with the device to avoid damage to the device or injury. Please read the manual carefully and follow the procedures of operation as prescribed.

**Caution**

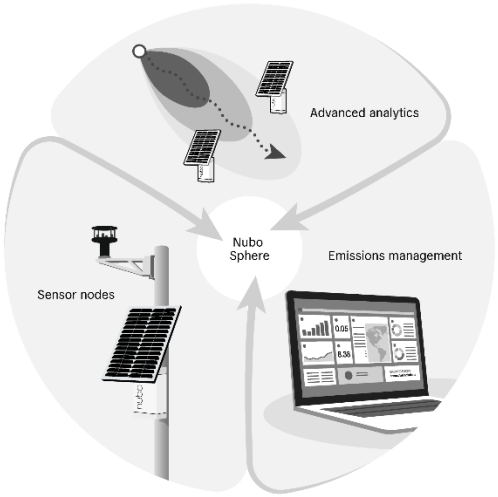
Caution means that incorrect use might break the device. Failure to follow the procedures explained and prescribed in this manual might result in irreversible damage to the device.

**Warning**

Warning means that unsafe use of the device can result in injury or cause damage to the device or its surroundings. Follow the procedures prescribed.

# Contents

# 1 Introduction




The Nubo Sphere methane ($CH_4$) emission monitoring system based on the rugged and reliable Nubo sensor node is an end-to-end solution for real-time detection, localization and quantification of methane emissions. Relying on Sensirion's market-leading environmental and air quality sensing know-how paired with our expertise in high-volume scaling solutions, the Nubo Sphere system offers high performance at low total cost of ownership. The robust system design enables the acquisition of reliable and highly accurate data at any time. It is rapidly deployed and easy to use, and the two sensor cartridges ensure low maintenance expenses and provide a future-proof, sustainable setup.

Nubo Sphere changes the state of the art in methane emissions monitoring. Detecting, locating and quantifying fugitive methane emissions have never been easier. The deployment of consistent ground-based methane data logging enables emission detection much earlier than was previously possible through human detection, ensuring fast, accurate and cost-saving damage control through rapid incident response actions for increased safety and reduced financial losses.

The forward-thinking system design with two exchangeable sensor cartridges allows easy maintenance and sustainable upgrades to the latest sensor technology. In cases of customer-specific sensing needs or changing regulatory requirements, parameters can be added in a very flexible manner and on an as-needed basis without the need to exchange the entire system.

# 2 System description

## 2.1 System operation overview

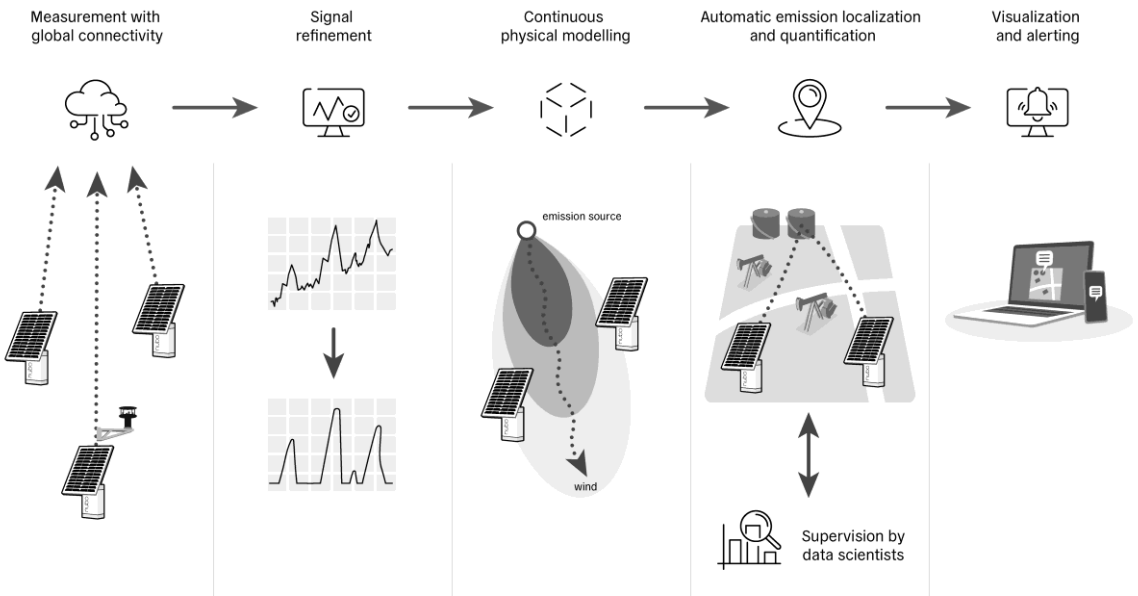
The Nubo Sphere monitoring system consists of multiple Nubo sensor nodes, a cloud-based data analytics system and a user- and mobile-friendly web interface. The node has two slots for sensing cartridges. The cartridges can be easily exchanged for maintenance or upgrading. At the current stage, a methane ($CH_4$) sensing cartridge based on metal-oxide (MOx) technology is available. In the future, we plan to offer improved cartridges for faster and more precise methane emission detection. The currently unused second cartridge slot could be used to extend the parameter space once other cartridges become available.

Because of the solar panel, the low-power electronics and the state-of-the-art lithium-ion batteries, the nodes operate fully autonomously even under the most adverse conditions and without the need to deploy electric power cables. The compact size ensures easy deployment wherever needed. At least one of the nodes is equipped with a wind meter in addition to the methane sensor to enable measurement of the local wind speed and direction at any time.

The nodes transmit the data constantly to the cloud platform via LTE-M or 2G (GPRS). Every node has its own connectivity to ensure maximum redundancy, simple and rapid setup and flexibility. At the cloud level, the signals are refined to exclude artifacts and ensure maximal data fidelity. The algorithms have been developed on the basis of Sensirion's extensive know-how with the employed sensor technologies and their application in the field.

Our advanced analytics system continuously applies algorithms based on physical modelling to the refined data to detect any emission as early as possible. The models allow for automatic and reliable localization and quantification of most leaks. The models and their output are continuously improved and supervised by our dedicated team of data scientists to improve accuracy and avoid false positives.

The status of all your sites can be easily monitored on the intuitive dashboard in any web browser or smartphone. Sites where action is most urgently required can be easily identified, and their status can be tracked during the repair process. The best mitigation action can be easily determined on the basis of the intuitive data visualization of the location and size of any emission event. If critical emission events are detected, you will receive notifications to enable your team to react rapidly.



## 2.2 Nubo Sphere system components and accessories

Each Nubo Sphere sensor node package contains:

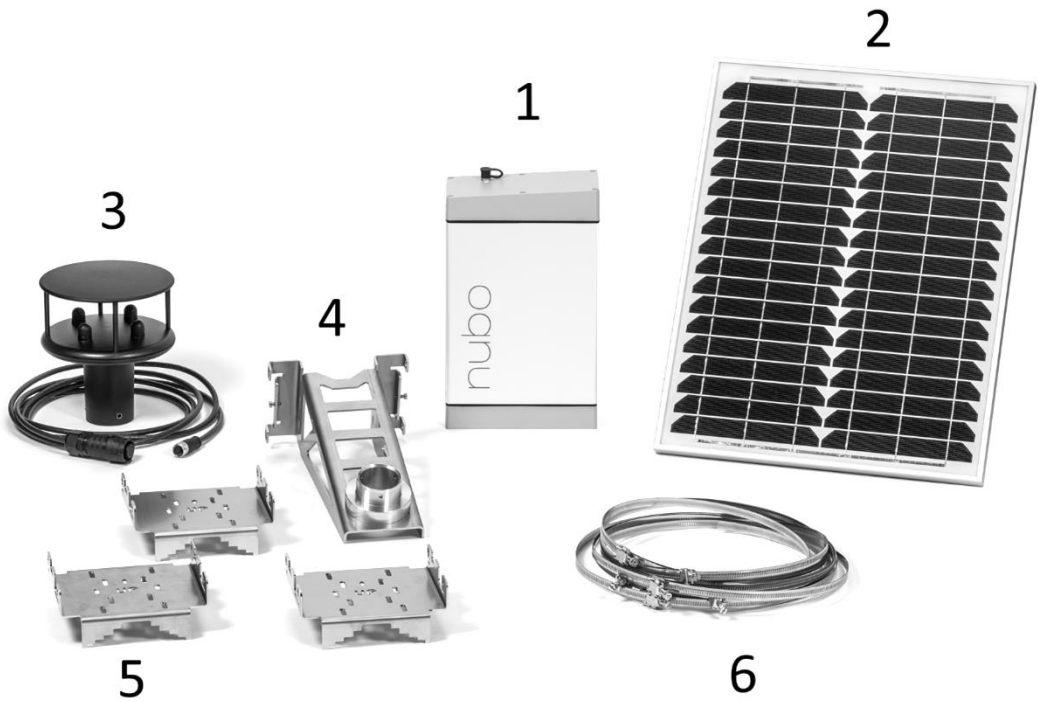
- 1 sensor node that includes a preinstalled methane sensing cartridge (1)
- 1 solar panel with mount and cable (2)
- 2 pole mounts (5)
- 4 band ties for the pole mounts (6)

Each Nubo Sphere wind meter package contains:

- 1 wind meter, including cable (3)
- 1 wind meter mounting adapter (4)
- 1 pole mount (5)
- 2 band ties for the pole mount (6)

For a typical installation, multiple sensor nodes (4 to 12 depending on conditions and goals for a 150 x 150 $m^2$ (500 x 500 $ft.^2$) site) and at least one wind meter are required. The exact numbers depend on the specifics of the installation site (e.g. the size), the installed equipment and the performance requirements. For additional details, please contact our support team or your point of sales. Our experts can help you determine the optimum number of devices for your project.

Package contents of one Nubo Sphere sensor node and one Nubo Sphere wind meter:



# 3 Handling & mounting instructions

## 3.1 General safety instructions

**Warning**

- Do not open the device. Do not modify the device in any way, including, but not limited to, exchanging the included antenna, replacing the included modem and modifying the power supply or circuit board.
- Nubo sensor nodes are to be operated only with compatible sensor cartridges provided by Sensirion Connected Solutions AG. Do not modify the cartridge and/or install components not supplied by Sensirion Connected Solutions AG or components not explicitly marketed to be used with Nubo sensor nodes.
- The device is to be installed in a clean and dry environment. Do not install in rainy conditions.
- The device is to be operated with the supplied powering options only. Do not attach any other power supplies. Do not use the supplied powering options for any purpose other than powering the device.
- The device contains a lithium-ion battery. Do not store or operate the device or battery in temperature conditions outside the specified range. Do not crush the device or its battery. Do not dispose of the device or battery into fire or a hot oven. Do not expose the device or the battery to extremely low air pressures. Do not replace the battery with any other type.

**Caution**

- The device is to be installed with the sensor cartridges facing toward the ground. Do not install and/or operate the system in any other orientation.
- The system is designed to be water resistant to rain or spray. It is not designed to be waterproof when immersed. Do not immerse the device in water.

## 3.2 Installation instructions

The device comes pre-assembled with an MOx-based methane sensor cartridge and a blind cover to seal the second slot. No further configurations or steps are needed to prepare the Nubo sensor nodes. They can be deployed directly in the field, as described below. A video tutorial showing the installation steps is available on our website.

### 3.2.1 Node placement

For the entire system to operate correctly, it is important to ensure that the Nubo Sphere sensor nodes are placed at the correct positions on your site. Please check with your point of sales before installation to determine exactly where the Nubo Sphere units and the wind meter should be placed.

All elements of the system must not be placed within hazardous zones. Nubo Sphere sensor nodes should be placed approximately 20 to 60 m (66 to 197 ft.) downwind of potential emission sources.

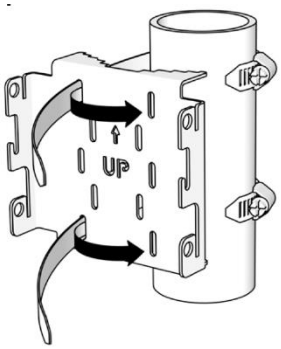
The units can be installed either on new poles or on existing infrastructure. In the latter case, ensure that no other equipment that might influence the wind patterns is in close proximity to the units, especially the devices equipped with a wind meter. In any case, ensure that the pole is fixed properly and cannot be moved or rotated by wind or other external influences.

To avoid insufficient charging of the internal batteries, please also ensure that the solar panels are not shaded by buildings or trees at any time of the day.

**Warning**

The Nubo Sphere sensor nodes are not rated for operation in hazardous zones. It is in your responsibility to verify whether installation of the device is permissible by local laws and/or the owner of the infrastructure.

### 3.2.2 Installing pole mounts




All physical components of the Nubo Sphere system can be easily installed on a pole using the supplied pole-mount adapter. The Nubo sensor node, the solar panel and the wind meter all use the same pole-mount adapter (compare (5) in section 2.2). You can use any commercially available pole with a diameter between 50 and 300 mm (1.95–12 in.). The pole should have a height of approximately 2–3 m (6.5–10 ft.) and be manufactured of a suitable material that can support the system weight (compare specifications in section **Error! Reference source not found.**) and expected wind forces.

Always use two band ties to fix a pole mount to the pole. Use the slits on the mount that fit best the actual pole diameter. Always tighten the band ties well. After tightening the band ties, carefully shorten protruding parts of the band ties using a strong wire cutter. Please be careful; the cut surfaces can have sharp edges. Wear protective gloves and smooth out the edge with a file.

**Warning**

- Using the pole-mount adapters may result in scratch marks or abrasion on the chosen pole. By installing and using this mounting kit, you accept that Sensirion Connected Solutions AG is not liable for any damage resulting from the installation and use of the pole-mount adapters.
- Plastic zip ties might age and/or break because of environmental influences. Only use metal bands or similarly reliable mounting bands.
- Cut surfaces can have sharp edges. Always wear gloves and safety glasses when cutting metal band ties and use a file to smoothen the edges.

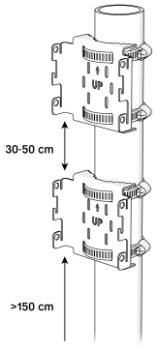
There are two installation variants, depending on the actual location. All sensor nodes are installed in conjunction with a solar panel. The necessary components are included in the Nubo Sphere sensor node package. In most situations, one node per site is equipped with an additional wind meter, which requires a Nubo Sphere wind meter package.

Two pole mounts are usually required: one for the sensor and one for the solar panel. Alternatively, a third pole mount is needed if a wind meter is to be connected to the node.

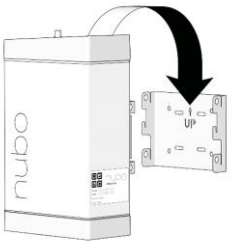
### 3.2.3 Node without wind meter

1. Fix two mounting plates to the pole with 30–50 cm (12–20 in.) distance between the plates. The lower plate should have at least 1.5 m (5 ft.) of clearance from the ground.

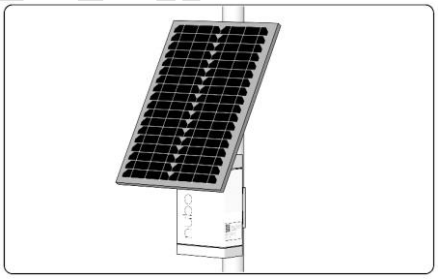
   All plates should face the orientation of the sun at noon. The plates should face south in the Northern Hemisphere and north in the Southern Hemisphere.



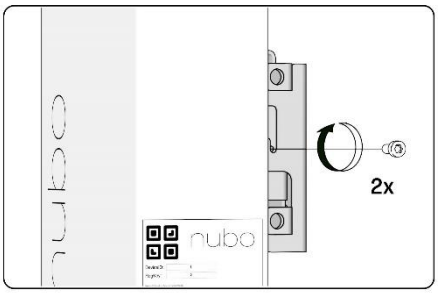

2. Once the mounting plates are installed, you can simply attach the sensor node and the solar panel by sliding the corresponding backplate into the mounting plate.



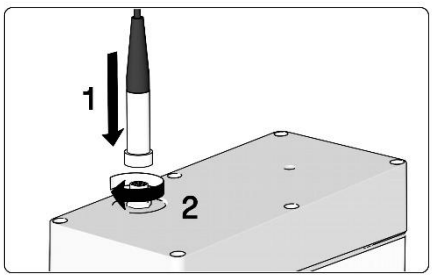

3. Mount the sensor node to the lower plate and the solar panel to the upper plate.



4. For ease of installation, the mounts are designed so that the node and the accessories remain in place without the screws being tightened. However, it is important to tighten both screws on each side of every mount to ensure safe and secure fixation of the system under all weather conditions. Do not overtighten the screws.

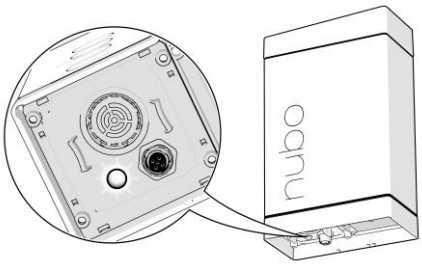



5. Connect the solar panel to the cable power plug of the sensor node. Connecting the cable turns the device on automatically. Always tighten the union nut to ensure proper protection from water ingress.



6. Once powered, the device will power up automatically, perform a self-test and then establish communication with the cloud. During this time, the LED will blink yellow.

   Once the device is working correctly, the LED will turn solid green for as long as 1 min. Afterwards, it will turn off to save power. If any error occurs, the LED will flash red.



**Warning**

- It is in your responsibility to verify whether installation of the device is permissible by local laws and/or by the owner of the infrastructure.
- It is the responsibility of the person installing the device to ensure secure and safe installation. Sensirion Connected Solutions AG cannot be held liable for damages and/or injuries due to improper placement or installation.
- Do not install and/or operate the device or any accessories without tightening the lateral mounting screws. Always check that the device and accessories cannot be removed. Failing to do so may result in injury and/or damage to the device.

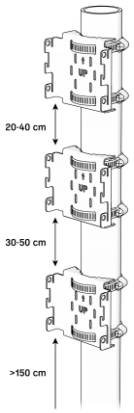
**Caution**

Do not install the power connector without tightening the union nut.

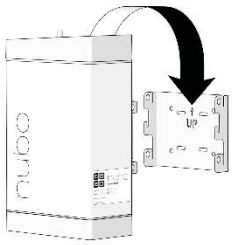
### 3.2.4 Node with wind meter

1. Fix three mounting plates to the pole with 30–50 cm (12–20 in.) distance between the two lower plates and 20–40 cm (8–16 in.) distance between the upper two plates. The lowest plate should have at least 1.5 m (5 ft.) clearance from the ground.

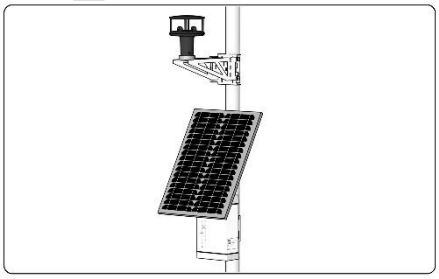
   All plates should face the orientation of the sun at noon. The plates should face south in the Northern Hemisphere and north in the Southern Hemisphere.



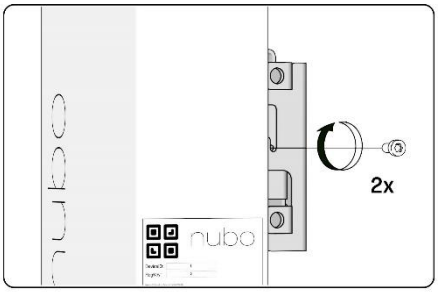

2. Once the mounting plates are installed, you can simply attach the sensor node and the solar panel by sliding the corresponding backplate into the mounting plate.



3. Mount the sensor node to the bottom plate, the solar panel to the middle plate and the wind meter arm to the upper plate.

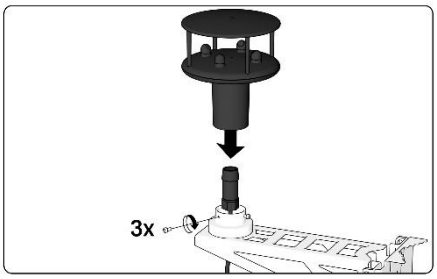


4. For ease of installation, the mounts are designed so that the node and the accessories remain in place without the screws being tightened. However, it is important to tighten the screws on the side to ensure safe and secure fixation of the system under all weather conditions. Do not overtighten the screws.

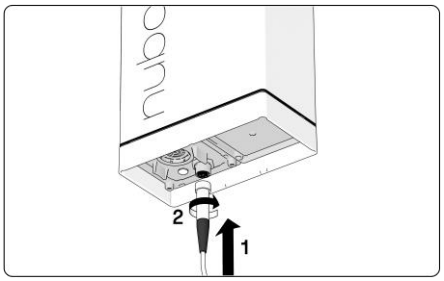



5. Connect the wind meter cable to the wind meter. Ensure that you hear a "click," then thread the cable through the hole at the wind meter mount.

   Place the wind meter on the adapter and orient it approximately (the red mark on the wind meter should point toward another sensor node installed on the site). Fix the wind meter with the two supplied screws.

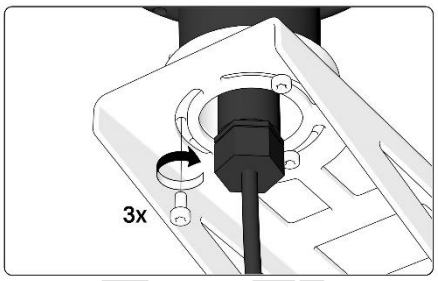


6. Connect the other end of the wind meter cable to the connector on the cartridge at the bottom of the Nubo Sphere sensor node.



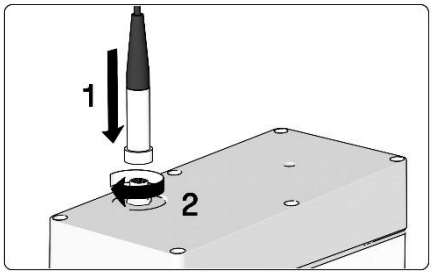

7. Finely align the wind meter (for correct alignment, the arrow and the red mark on the wind meter must point exactly toward another sensor node on the site). Secure its orientation by tightening the three screws on the bottom of the mounting adapter.

   Please either directly enter the ID of the unit in the web application or note it for later configuration.



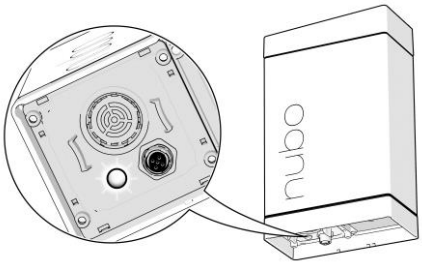

8. Connect the solar panel to the cable power plug of the sensor node.

   Always tighten the union nut to ensure proper protection from water ingress.




8. Connecting the cable turns the device on automatically, resulting in the device emitting a sound sequence. It will then perform a self-test and establish communication with the cloud. During this time, the LED will blink orange.

   Once the device is correctly working, the LED will turn solid green for as long as 1 min. Afterwards, it turns off to save power. If any error occurs, the LED will flash red.



**Warning**

- It is in your responsibility to verify whether installation of the device is permissible by local laws and/or the owner of the infrastructure.
- It is the responsibility of the person installing the device to ensure secure and safe installation. Sensirion Connected Solutions AG cannot be held liable for damages and/or injuries due to improper placement or installation.
- Do not install and/or operate the device or any accessories without tightening the lateral mounting screws. Always check that the device and accessories cannot be removed. Failing to do so may result in injury and/or damage to the device.

**Caution**

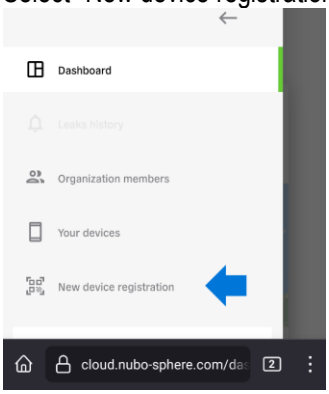
Do not install the power connector without tightening the union nut.

### 3.3 Registering device to cloud

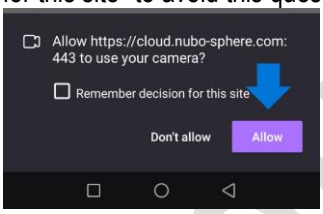
After hardware installation, please register the device to the cloud. For the complete solution to work properly, you must register all installed devices. You will have received an invitation to create an account by your admin or sales contact. All necessary steps are plainly explained within the web application. You can either register your devices using a computer with a normal web browser, or you can use your smartphone to register devices directly in the field.

To register a device in the field with a smartphone, simply

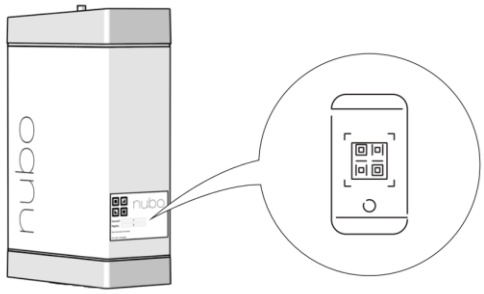
1. Go to https://cloud.nubo-sphere.com
2. Login in using your personal credentials
3. Select "New device registration" from the menu




4. In case your smartphone asks you, please allow use of your camera; you can select "Remember decision for this site" to avoid this question next time




5. Verify or change to which site and which organization the device should be registered
6. Scan the QR code located on the label of the device:




7. Click on "Register Nubo"

   If you cannot scan the device, you can alternatively enter the "Device ID" and the "Registration Key" manually by clicking on "Register Nubo Manually."

### 3.4 Before leaving the site

Note the installation height above the ground and the orientation of the wind meter, either on the cloud or on paper to add afterwards.

Before leaving the site, ensure that all the devices are visible on the cloud and green and that connected wind meters are also shown.

## 4 Maintenance

### 4.1 General

The device requires minimal maintenance. The currently provided MOx sensor technology does, however, have a limited lifetime. When required to exchange the cartridge with a new factory calibrated spare, please follow the steps below. Otherwise, the system does not require regular maintenance.

### 4.2 Cartridge replacement

Turn off the device before removing any cartridge. Ensure that the cable of the power source at the device side is disconnected.

Using a Torx T7 screwdriver, unscrew the four screws securing the cartridge; then remove the cartridge in a clean and dry space by pulling on the small plastic handles on the cartridge. While removing the cartridge, ensure that the internal contacts of the device remain clean and dry. Loosen all four cartridge screws before attempting to remove the cartridge. Afterwards, grab the external parts of the cartridge and pull the cartridge in the direction opposite the direction of installation.

Insert the replacement cartridge into the now-empty slot. Insert the cartridge until you hear and feel it snap into place. Fix the cartridge inside the device by tightening the integrated screws. These screws are intended to prevent unwanted removal of the cartridge and to secure it in place.

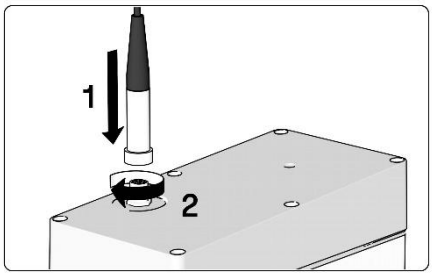
Note: New cartridges do not require any extra calibration or configuration. The device and/or system will configure the new cartridge automatically.

| Caution |
| --- |
| • Always use the supplied blind cover to protect unused cartridge slots from environmental influences.<br>• Always disconnect the device from its power source before removing or installing a cartridge to avoid damage to the device. It is important to disconnect the cable from the device to power down the device correctly.<br>• It is not necessary to tighten the screws of the cartridge strongly. Only tighten the screws by hand and without excessive force to avoid wearing of the threads.<br>• When removing the cartridge, only pull on the plastic parts. Never pull on the connector as doing so might adversely influence the water ingress protection. |

# 5 General handling

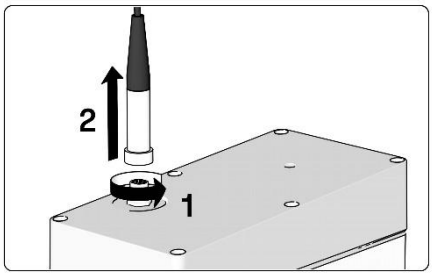
## 5.1 Powering up the device

The power connector of the device functions as an on/off switch. To power up the device, simply connect the power cord from your power source. Please always tighten the union nut to ensure proper protection from water ingress.

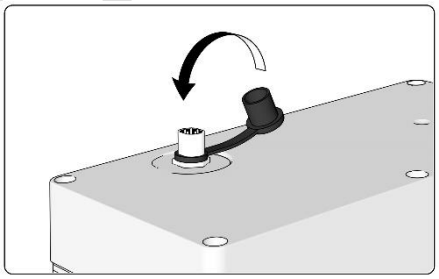



## 5.2 Depowering the device

To power down the device, unscrew the nut and unplug the cable at the device side.



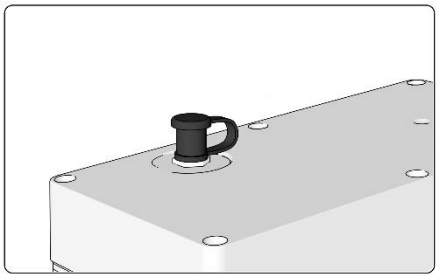

Unplugging the cable will turn off the device and disconnect the battery for transport. After the device has been depowered, be certain to correctly install the protective cap to protect the pin's connector and avoid corrosion or dirt build-up.



## 5.3 Storage

The system operates whenever a power plug is connected. Please always disconnect the cable of the power source from the device as described in section 5.2 when storing it. This procedure ensures that the system is turned off, avoiding deep discharge of the battery. Only store the device when you are confident that the battery was well charged.

When storing the device, please always ensure that the protective cap is securely placed on the power connector to protect the pins and avoid corrosion.



| Warning |
| --- |
| The device contains batteries. Store the device within the specified temperature range: **−20 to 60°C**. Store in a noncondensing environment.<br>When the device is stored for an extended period, be certain to reconnect it to an external power source every **6 months** to prevent battery damage |

| Caution |
| --- |
| Always place the protective cap on the power socket of the device whenever no plug is connected to avoid corrosion of the contacts. |

### 5.4 Shipment

Note that the device includes a large buffer battery and will continue to run unless the device-side connector of the power cord is disconnected. Before transporting or shipping the device, powering down the device as described in section 5.2 is critical. The device contains batteries; please ensure correct handling and labelling when shipping the device.

| Warning |
| --- |
| • The device contains batteries. Store the device within the specified temperature range: **−20 to 60°C**. Store in a noncondensing environment.<br>• When the device stored for an extended period, be certain to reconnect it to an external power source every **6 months** to prevent battery damage<br>• Do not ship if damage to the battery is suspected. Ensure that the box is properly labelled to comply with international law. |

# 6 Conformity information

## 6.1 European conformity information

Hereby, Sensirion Connected Solutions AG declares that this radio equipment is compliant with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at https://cloud.nubo-sphere.com/docs/eu-doc.

## 6.2 FCC notice

**Warning**

Do not open the device. Do not modify the device in any way, including, but not limited to, exchanging the included antenna, replacing the included modem and modifying the power supply or circuit board.

Contains FCC IDs: XMR201707BG96

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio-frequency energy and, if not installed and used in accordance with the instructions, can cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to attempt to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna;
- Increase the separation between the equipment and receiver;
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected;
- Consult the dealer or an experienced radio/TV technician for assistance.

### 6.3 Frequency band(s) and maximum radio-frequency power transmitted

This product includes the following features and characteristics:

- BDS
  - Operating frequency range: 1559–1610 MHz
- GLONASS receiver
  - Operating frequency range: 1559–1610 MHz
- GPS receiver
  - Operating frequency range: 1559–1610 MHz
- GSM 900
  - Operating frequency range: 880–915, 925–960 MHz
  - Maximum output power: 33 dBm rated
- GSM 1800
  - Operating frequency range: 1710–1785, 1805–1880 MHz
  - Maximum output power: 30 dBm rated
- LTE FDD Band 1
  - Operating frequency range: 1920–1980, 2110–2170 MHz
  - Maximum output power: 23 dBm rated
- LTE FDD Band 3
  - Operating frequency range: 1710–1785, 1805–1880 MHz
  - Maximum output power: 23 dBm rated
- LTE FDD Band 8
  - Operating frequency range: 880–915, 925–960 MHz
  - Maximum output power: 23 dBm rated
- LTE FDD Band 20
  - Operating frequency range: 832–862, 791–821 MHz
  - Maximum output power: 23 dBm rated
- LTE FDD Band 28
  - Operating frequency range: 758–803, 703–748 MHz
  - Maximum output power: 23 dBm rated

# 7 Important legal notices

## Warning, Personal Injury

**Do not use this product as safety or emergency stop devices or in any other application where failure of the product could result in personal injury. Do not use this product for applications other than its intended and authorized use. Before installing, handling, using or servicing this product, please consult the manual and data sheet. Failure to comply with these instructions could result in death or serious injury.**

If the Buyer purchases or uses SENSIRION CONNECTED SOLUTIONS (SCS) products for any unintended or unauthorized application, the Buyer shall defend, indemnify and hold harmless SENSIRION and its officers, employees, subsidiaries, affiliates and distributors against all claims, costs, damages, expenses and reasonable attorney fees arising from, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if SCS is allegedly negligent with respect to the design or the manufacture of the product.

## Warranty

SENSIRION warrants solely to the original Buyer of this product for a period of 12 months (one year) from the date of delivery that this product shall be of the quality, material and workmanship defined in SCS' published specifications of the product. Within such period, if proven to be defective, SCS shall repair and/or replace this product, at SENSIRION's discretion, free of charge to the Buyer, provided that

- notice in writing describing the defects is given to SCS within fourteen (14) days after their appearance;
- such defects are found, to SCS' reasonable satisfaction, to have arisen from SCS' faulty design, material or workmanship;
- the defective product is returned to SCS' factory at the Buyer's expense; and
- the warranty period for any repaired or replaced product is limited to the unexpired portion of the original period.

This warranty does not apply to any equipment that has not been installed and used within the specifications recommended by SCS for the intended and proper use of the equipment. SCS' warranty does not cover defects caused by faulty maintenance, incorrect installation or faulty repair by the Buyer or by alterations carried out without SCS' consent in writing. SCS' warranty does not cover normal wear and tear or deterioration. EXCEPT FOR THE WARRANTIES EXPRESSLY SET FORTH HEREIN, SCS MAKES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THE PRODUCT. ANY AND ALL WARRANTIES, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, PERMANENT AVAILABILITY OF THE CLOUD SERVICE, OR COMPLETE AND ACCURATE DATA TRACKING, ARE EXPRESSLY EXCLUDED AND DECLINED.

SENSIRION is only liable for defects of this product arising under the conditions of operation provided for in the data sheet and of proper use of the goods. SENSIRION explicitly disclaims all warranties, express or implied, for any period during which the goods are operated or stored not in accordance with the technical specifications.

SENSIRION does not assume any liability arising out of any application or use of any product and specifically disclaims any and all liability, including, without limitation, consequential or incidental damages.

SENSIRION reserves the right, without further notice, (i) to change the product specifications and/or the information in this document, (ii) to improve the reliability, functions and design of this product and (iii) to modify the cloud service.

# 8 Revision history

| Date | Revision | Page(s) | Changes |
|---|---|---|---|
| TBD | 1.0 | All | Initial release |

# 9 Contact

## Headquarters and subsidiaries

## Sensirion Connected Solutions

**Sensirion Connected Solutions AG**
Laubisrütistr. 50
CH-8712 Stäfa ZH
Switzerland
phone: +41 44 306 40 00
fax: +41 44 306 40 30
info@sensirion.com
sensirion-connected.com

**Sensirion Connected Solutions Inc., USA**
Sensirion Connected Solutions Inc.
11 East Adams Suite 220
Chicago, IL 60603
phone: +1 312 690 5858
info@sensirion.com
sensirion-connected.com

**AiSight GmbH**
Gertraudenstrasse 10-12
10178 Berlin
Germany
phone: +49 30 403 633 99
info@aisight.de
aisight.de