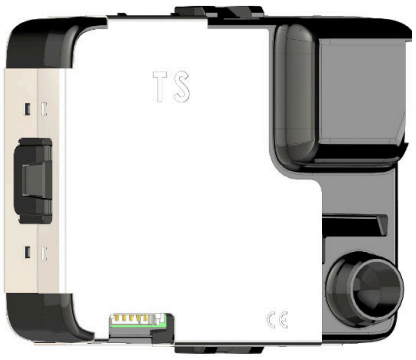
NextPM Mechanical tips

Reference : NPM_11122023_INT_XX

Author : V. BARTOLOMEI

Version : 1.0

Last update : 2024/02/16



SUMMARY

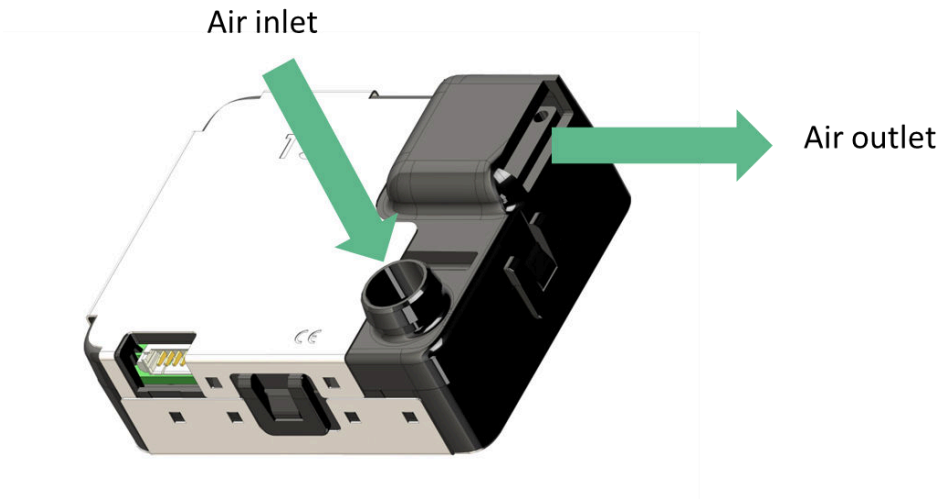
1. Introduction

This document has been written in order to support our customer to optimize the integration of the NextPM Sensor in their device and obtain the best and most accurate results for PM monitoring. The mechanical settings and the guidelines for integration of the NextPM will be approached in the following part of the document to guarantee the best performance for the sensor. This guideline is a tips summary of more than 20 years experience in the air quality monitoring domain.

2. Mechanical settings

2.1 Air path in the sensor

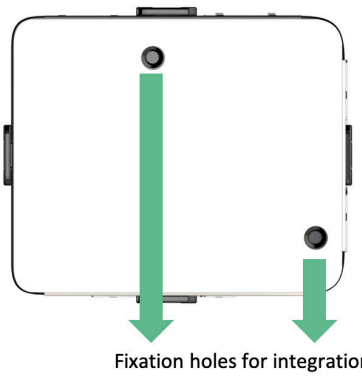
The NextPM Sensor presents a 6 pins Molex connector to ensure power supply and to communicate with the sensor. Once the power supply is provided to the sensor, the sensor turns on automatically, the fan starts and the airflow path operates. The air inlet is facing the front of the sensor, while the outlet is rejecting the air by the side of the sensor to limit PM recycling effects.

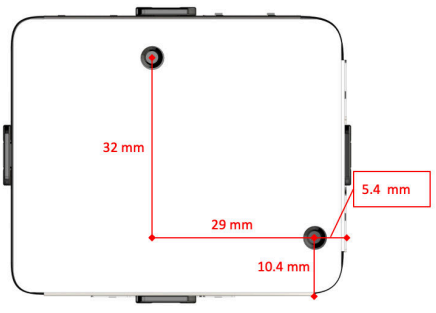


2.2 Fixation

You can fix the NextPM sensor thanks to the two holes in the back of the sensor. The holes are made to receive a self turret screw M2.5 and are 5 mm deep.

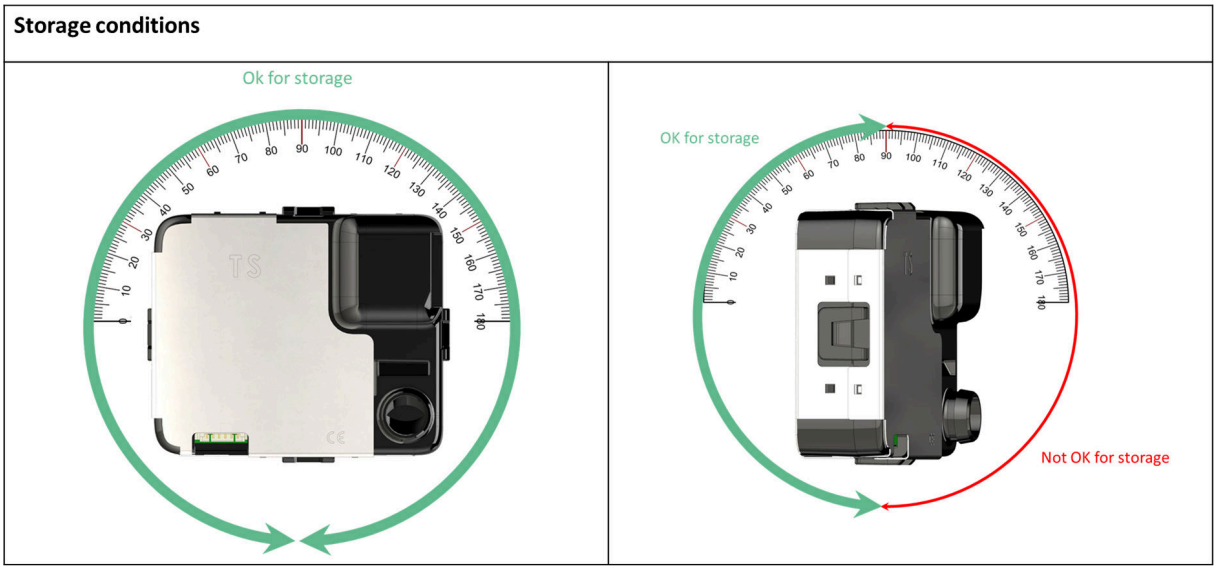
Fixation



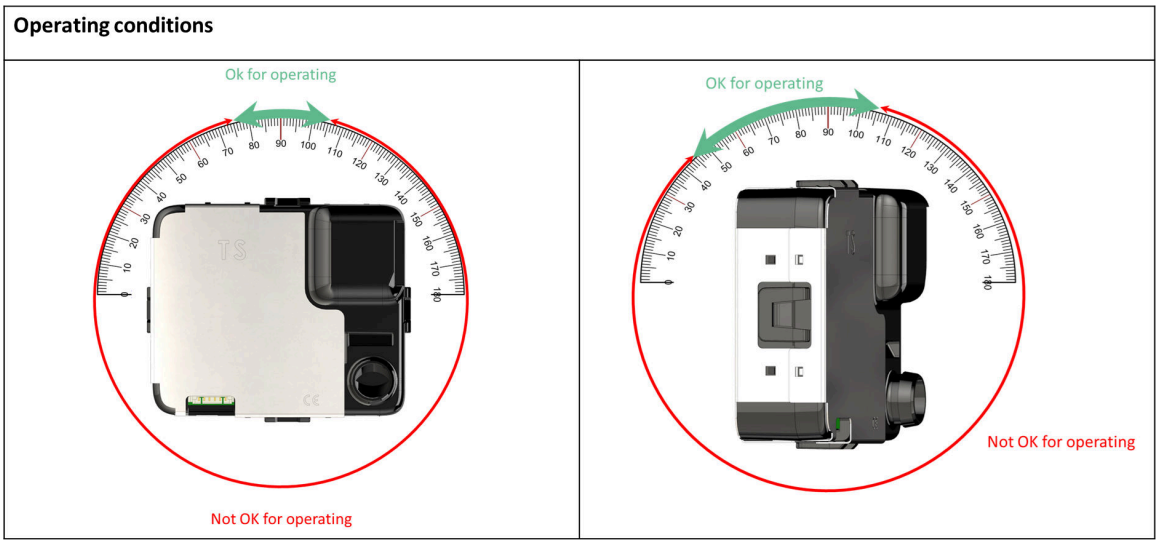


3. General NextPM integration

3.1 Positions for storage



3.2 Positions to operate



Why this recommendations for operating conditions:

- The NextPM inlet is an aeraulic filter that stops particles larger than 10µm from entering the sensor. If the sensor is upside down, then the aeraulic filter will not be able to block those big particles and the lifetime of the sensor will be affected due to clogging.

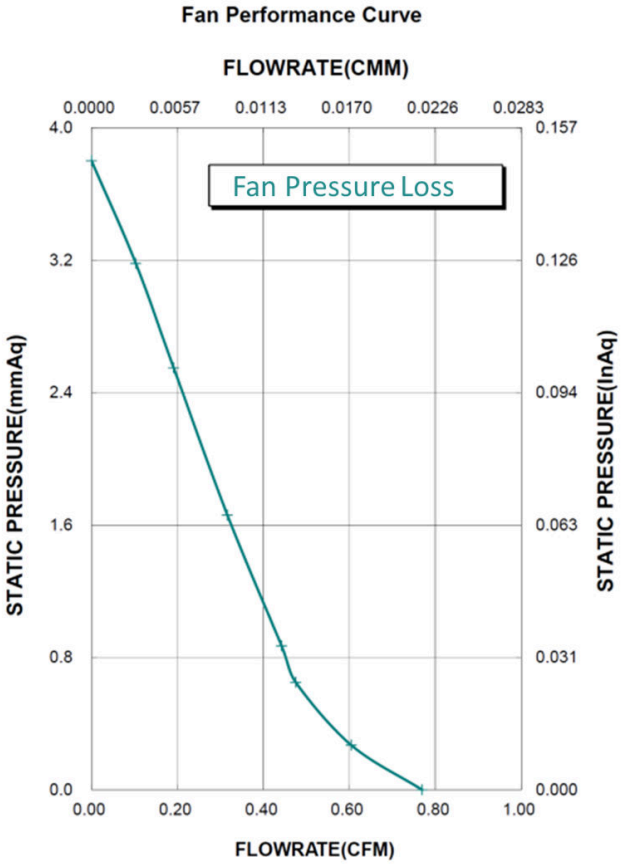
- The fan is a critical part if not correctly set in the sensor. Inside the fan, a small amount of oil allows the rotation without friction. If the NextPM (and consequently the fan) is not correctly placed, the oil can leak and it results with stretching in the fan, an increased power

consumption to compensate for the frictions, until the failure of the fan. That will strongly affect the lifetime of the sensor.

3.3 Pressure lost and Deported Inlet

Pressure Loss

The sensor uses an active airflow to sample the particles. In order to keep his accuracy, we advise you to put the inlet directly to the air you want to monitor. Be aware that the fan allowing the flow inside the sensor is sensitive to pressure loss, it does not allow a differential pressure between the inlet and outlet more than 0.3 mbar. As the fluidic path already generates a 0.15 mbar pressure loss, the remaining possible pressure loss is 0.15 mbar due to additional features, for instance a deported inlet of the NextPM.

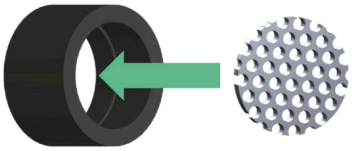


Deported Inlet

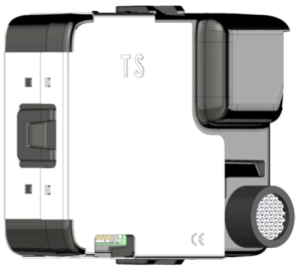
If the integration is difficult, you can add a duct made with antistatic materials and with an internal diameter of 8 to 10 mm (depending on the rigidity of the material). The maximum length of the duct must not exceed 100 cm to avoid particle losses in the tube, and approximative measurements. Avoid sharp angles in the tubing as much as possible to prevent particle losses and approximation in measurements.

3.4 Inlet protection

The NextPM sensor is not an IPXX device. The sensor must be protected from direct water droplets such as rain or cleaning tools.



To extend the lifetime of the device, we recommend placing a metallic grid at the inlet of the NextPM to avoid insects or dust getting in the sensor. A cap including the grid can also be provided by Tera Sensor to correctly set the grid at the NextPM inlet (please contact support@groupe-tera.com for further details).



3.5 Sensor integration

The NextPM main purpose is to monitor the particulate matter. Different types of environments or applications are possible for the sensor. For example,

The NextPM is designed for outdoor PM monitoring, but can also be used for indoor uses. If you plan to use the sensor outdoors, an integration to a casing is needed to maintain the performance of the NextPM sensor (not waterproof). There are principal cases:

- Open casings
- HVAC Sealed casing

3.5.1 Open casings:

- The louver system

The casing with louver is a good option for outdoor air PM monitoring. It allows a good ventilation of the air inside the casing to be sure that the pollution is the same inside the casing and outside. It prevents the NextPM sensor from rain, and does not expose the sensor to direct sunlight. Moreover, the inlet and outlet are at the same pressure.
A cap including the grid can also be provided to set correctly the grid at the NextPM inlet and avoid large dust particles or small insects to get in the sensor.
We recommend keeping at least 4 centimeters distance between the NextPM inlet and outlet from the louver walls.

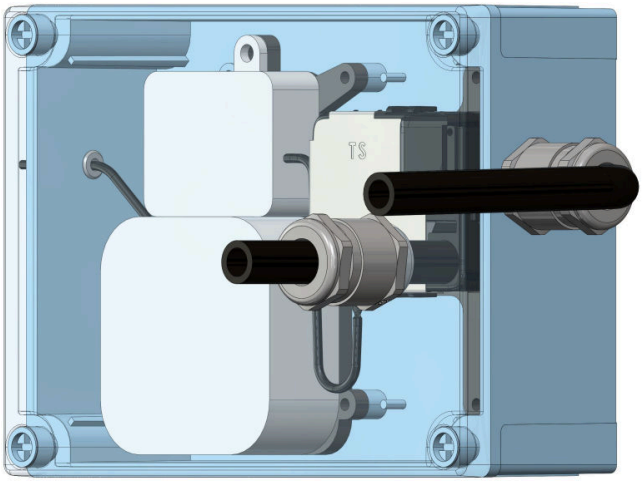
- The bottom open systems

A bottom open system is also possible for the NextPM integration. The larger the opening, the better the sensor will operate.

A gap between the sensor and the wall of at least 2 cm is recommended to avoid obstruction of the inlet and outlet of the sensor.

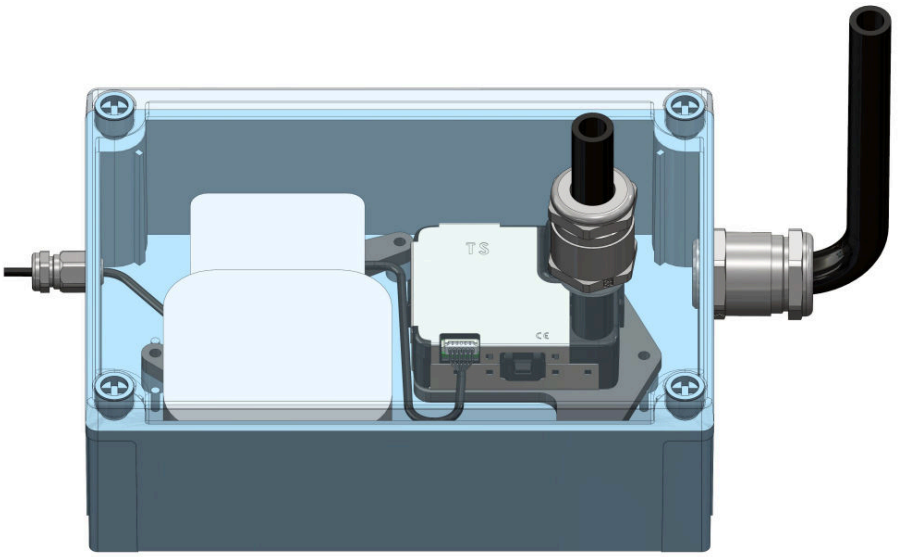
Those two cases presented above are not the only ones possible and will depend on every integrator regarding the new or existing product to integrate the NextPM. If doubts are present about the integration of the sensor, please feel free to contact us at support@groupe-tera.com in order to discuss and provide the best solutions for a good integration.

3.5.2 Sealed casing:



This casing is more dedicated to sampling particles for dedicated environments, such as HVAC systems directly in ventilation tubings. The Inlet tubing must be antistatic to avoid particle losses.

The outlet connection must be connected to the same location of the inlet to avoid pressure losses that could not be tolerated by the NextPM.



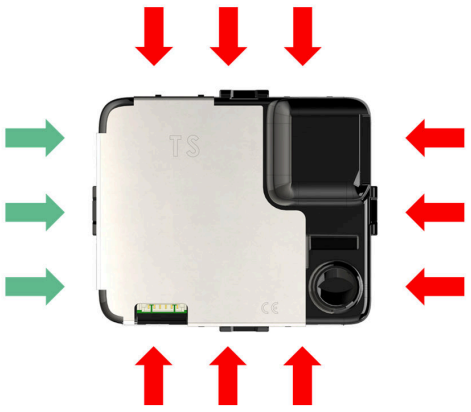
3.5.3 HVAC:

The NextPM has been developed first to be integrated in cars where it could be exposed to different air velocities. Therefore, we studied what will be the behavior of the sensor if we change the direction and the speed of air. The results could be used in every use case where the air speed is not still.

The first conclusion of the study is that the sensor has better performances if it is not integrated in an additional standard casing. The second one is that the air direction has more impact than the air speed itself.

Therefore, when you integrate the NextPM sensor to monitor the air quality into a HVAC system, please respect the following placement of NextPM sensor into the airflow:

Be aware that it is not recommended to place the inlet of the NextPM in an opposite direction with the airflow of the HVAC system.

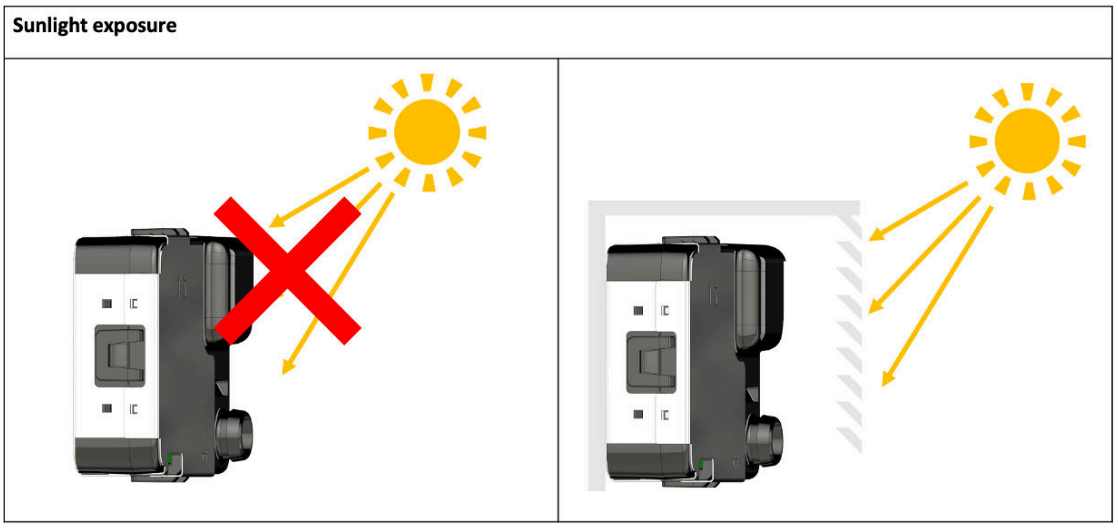
HVAC Integration	
	

If you can't place the sensor into the airflow directly, the main concern you have to mind is that the inlet and the outlet of the NextPM must be set at the same pressure. The sealed casing presented in the general integration tips can be used.

3.6 Light exposure:

Direct light exposure can modify the sensor performance. For example the temperature measurements can be affected by the heating process due to direct sunlight exposure. Moreover, if the sensor is directly exposed to light the PM measurements can be affected due to light entering the sensor by the outlet. This will generate measurement artifacts due to the light beam arriving at the photodetectors. This is why it is always recommended to turn the sensor to the North direction in the case of outdoor uses.

The following picture presents how to integrate the NextPM sensor into a casing dedicated to outdoor measurements, preventing the sensor from light exposure, and also environmental parameters.



4. Sequential measurement for Autonomous Device

The NextPM sensor is a good option for autonomous products, but there are conditions to respect in order to obtain the best results possible.

The NextPM sensor is equipped with a sleep mode to reduce power consumption, or it is also possible to add a power switch to turn the sensor completely off (depending on the maximum power consumption possible).

After an off/sleep period, the sensor is turned back on, it is needed to wait 15 seconds before the sensor is fully operational (mainly for the fluidic path to become stable after the fan restart) . It is also recommended to wait an additional 20 seconds minimum (1 minute is better) before collecting the data from the 1 minute average command for PM1, PM2.5 and PM10.

In this case the results obtained will be reliable and can be compared with other instruments if needed.

Table resuming the example cited above:

	Cycle description		
Cycle Steps	NextPM off / sleep mode	NextPM on (measuring PM)	
Description	Sensor not measuring	Warm up period (NextPM on but not measuring yet)	Data collection (1 minute average channel)
Timeline	As long as needed	15 sec.	20-60 sec. later

Special cases:

In specific environmental conditions, the sensor recovering from the sleep mode will take more time, for instance for very low temperatures below 0°C.

Another classical scenario is if relative humidity is elevated (above 70%), then the heater function will need more than 1 minute to be fully operational.

In those particular cases, it is recommended to directly reach the Tera Sensor Support team at support@groupe-tera.com to give a complete description of the configuration in order to have the optimized cycles for the NextPM sensor.

5. Electrical integrity

As the EMC shield of the sensor is connected to its ground, the integrator should avoid a mechanical contact to the system earth / ground, by using a non conductive material or an electrical insulation.

This will avoid any unwanted current path flow in case of power supply isolation fault, which would damage the sensor.

6. Contact

If you need any further information, feel free to contact us:

Sales: sales@groupe-tera.com

Support: support@groupe-tera.com

 https://www.linkedin.com/company/tera-sensor

 www.tera-sensor.com