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NEXT-PM User Guide



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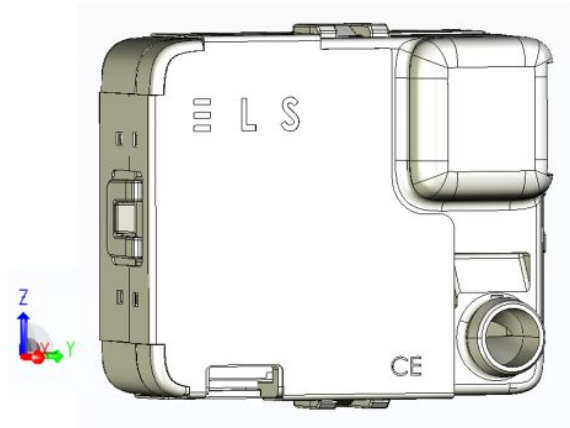
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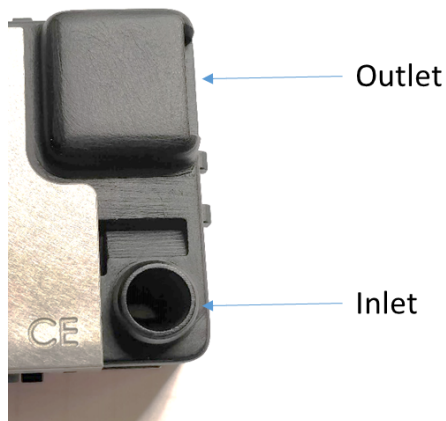
How to integrate the Next-PM Sensor ?

To be fully functional, the Next-PM must be integrated in order to be in a vertical way with the inlet down and the outlet up.

Plane	Angle tolerance's
XOZ	+/- 45°
YOZ	+/- 30°



You can set the Next-PM sensor in another device thanks to the two holes in the back of the sensor. The holes are made to receive self turret screw M2.5 and are 5 mm deep.



The sensor use an active airflow to sample the particles. In order to keep his accuracy, we advice you to put the inlet directly to the air you want to monitor. If the integration is difficult, you can add a duct made with antistatic materials and with an internal diameter of 8 to 9 mm. The maximum length of the duct must be 100 cm.

Moreover, the inlet and the outlet need to be at a similar pressure and not obstructed.



The connector is a 6 PIN one. You can use an ADAM TECH 125CH-B-06 reference to connect with or an equivalent like a MOLEX 51021-0600 reference.

How to communicate with the Next-PM Sensor ?

Simplified serial port communication

PIN connector assignment

1. GND
2. +5V
3. Tx (output)
4. Rx (input)
5. CS
6. GND

The serial communication is available thanks to PIN 3 and 4.



Serial port configuration

The serial port must be configured following these parameters :

- Speed : 115200 bauds,
- 8 bits,
- 1bit parity : even,
- 1 bit stop.

The Next-PM reply to a request in more than 350 ms.

The Next-PM must be power supplied with + 5 VDC.

The signal amplitude is +3.3V.

Warning 1 : to connect Next-PM to a PC, prior, you must use a FTDI cable. One example of FTDI that could be used is : TTL-232R-3V3

Warning 2 : do not connect Next-PM sensor directly on the RS232 port of a PC.

Send a command

The Next-PM information's reading can be realized through the command frame : Address Command Checksum

To write information, use the command frame : Address Command DATA Checksum

The address is freezed at 0x81.

Below, the command possibilities :

Cmd_Id	Description	Example
0x11	Concentrations reading's averaged over 10 seconds and updated every 1 second	0x81 0x11 0x6E
0x12	Concentrations reading's averaged over 60 seconds and updated every 10 seconds	0x81 0x12 0x6D
0x13	Concentrations reading's averaged over 900 seconds and updated every 60 seconds	0x81 0x13 0x6C
0x14	Temperature and humidity readings	0x81 0x14 0x6B
0x15	Power on or sleep mode	0x81 0x15 0x6A (note 1)
0x16	Sensor state's readings	0x81 0x16 0x69
0x17	Firmware version readings	0x81 0x17 0x68
0x21	Wrote the fan speed	0x81 0x21 0x23 0x3B (35%) 0x81 0x21 0x42 0x1C (66%) 0x81 0x21 0x55 0x09 (85%) 0x81 0x21 0x00 0x5E (note 2)

Note 1 : Each 0x15 command frame send, the Next-PM change its functional state alternately. To know its state before to send the command frame, you can send 0x16 command frame : if the 0 bit of the code state is 1, the Next-PM is in sleep mode.

Note 2 : The minimum fan speed is set to 10%. Below this value, the new speed value is not saved and the sensor will use its previously speed value and the sensor answers by the current speed.

The checksum is calculated in order that the sum of all the frame bytes is equal to a multiple of 256 (0x100).

Exemple :

$$0x81 + 0x16 + 0x69 = 0x100$$

$$0x81 + 0x21 + 0x55 + 0x09 = 0x100$$

Thus :

$$\text{Checksum} = 0x100 - \text{MOD}((\text{sum of the other bytes}), 256).$$

There is only one writing command, the 0x21, it allows to set the fan's speed. This setting is saved in EEPROM. The value to write is coded with one byte and correspond speed ratio of the actual fan speed over the maximum fan speed in percentage. The command frame is denied if the sensor is in sleep mode, in that case it returns the commande frame 0x16 with the state code.

Next-PM responses

The Next-PM reply to a command frame by a frame that always begins by its address (0x81) following by the command frame asked and ending by a checksum.

The datas sent are function of the command frame :

Command frame 0x11, 0x12 and 0x13

address	Cnd id	State (1 byte)	PM1 pcs/ mL (2 bytes)	PM2.5 pcs/ mL (2 bytes)	PM10 pcs/ mL (2 bytes)	PM1 µg/m ³ (2 bytes)	PM2.5 µg/m ³ (2 bytes)	PM10 µg/m ³ (2 bytes)	Check sum
0x81	0x11	0x00	0x022B	0x06F4	0x06F4	0x0A82	0x1FC6	0x1FC6	0xF7
0x81	0x12	0x00	0x022B	0x06F4	0x06F4	0x0A82	0x1FC6	0x1FC6	0xF6
0x81	0x13	0x00	0x022B	0x06F4	0x06F4	0x0A82	0x1FC6	0x1FC6	0xF5
0x81	0x16	0x04							0x65

The particulate matter concentration in pcs/mL and µg/m³ are coded with 2 bytes (16 bits).

Exemple :

The response 0x81 0x12 0x00 0x32 0xE7 0x32 0xF5 0x32 0xF8 0x00 0x6A 0x00 0x72 0x00 0x85 0xA2

Signifies that the results are averaged over 1 minute. No error occurred during the measurement and the state code is 0.

In this example, the measured concentrations are :

	2 bytes datas	Coef	Results
PM1 pcs/mL	0x32E7	1	13031
PM 2.5 pcs/mL	0x32F5	1	13045
PM10 pcs/mL	0x32F8	1	13048
PM1 $\mu\text{g}/\text{m}^3$	0x006A	0.1	10.6
PM2.5 $\mu\text{g}/\text{m}^3$	0x0072	0.1	11.4
PM10 $\mu\text{g}/\text{m}^3$	0x0085	0.1	13.3

The concentrations are calculated from the 2 bytes read data and multiplied by a coefficient (Coef).

The state code must always be read, it highlights the functional state of the Next-PM and allows to know the validity of the sent values.

The checksum can be checked, the sum of all the frame bytes is equal to a multiple of 256 (0x100), here :

$0x81 + 0x12 + 0x00 + 0x32 + 0xE7 + 0x32 + 0xF5 + 0x32 + 0xF8 + 0x00 + 0x6A + 0x00 + 0x72 + 0x00 + 0x85 + 0xA2 = 0x600$ is a multiple of 0x100, le checksum is OK.

State code

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Laser Error	Memory Error	Fan Error	T/RH Error	Heat Error	Not Ready	Degraded State	Sleep State

The bit 0 is set to 1 when the sensor is set to sleep state : the laser, the fan and the heat are switch off. The only command frame still possible is 0x16 (Read the Next-PM State), the Next-PM will respond to any other command frame as if it is the 0x16 command frame.

The bit 1 is set to 1 each time a minor error is detected, the sensor part in error is set to 1 in the state code, the Next-PM can still send datas but with less accuracy.

The minor errors are the following :

- Heat Error, the relative humidity stay above 60% during more than 10 minutes,
- T/RH Error, the sensor reading are out of specification,
- Fan Error, the fan speed is out of range but the fan is still working.

- Memory Error, the sensor can't access its memory, some internal smart functions will not be available.

The sensor will be set to Default State if the fan or the laser are broken. If the sensor is in the Default State, the degraded state flag is set to 0, the default part is indicated by its flag set to 1 and the bit 0 indicates that the sensor is in sleep state.

If the sensor replies by a 0x16 command frame, it means that the Next-PM has no data to send neither because the sensor has just been switch on nor because the sensor is in the Default State or Sleep State.

Command frame 0x14

address	Command id	State (1 byte)	Temperature (2 bytes)	Humidity (2 bytes)	Checksum
0x81	0x14	0x00	0x0B40	0x13E7	0x26
0x81	0x16	0x76			0xF3

The temperature and relative humidity are sent with 2 bytes, you need to divide by 100 the obtained value in order to have the real value. Note that the temperature and relative humidity are not the environmental ones but the ones within the sensor, they could only be used for a debug diagnosis.

Exemple : the Next-PM reply : 0x0B40, thus 2880 for a 28.80 °C temperature and 0x13E7, thus 5095 for a 50.95% relative humidity.

If the sensor reply by a 0x16 command frame, it means that the Next-PM has no data to send, neither because the Next-PM has just been switch on, nor because the Next-PM is in the T/RH Error State or Sleep State.

Command frame 0x15

address	Command id	State (1 byte)	Checksum
0x81	0x15	0x01	0x69
0x81	0x16	0x01	0x68

When the command frame 0x15 is sent to set the sensor in sleep mode, the Next-PM replies with a state code with the flag SLEEP set to 1 and stop to work.

During the SLEEP mode, if the sensor receives a new 0x15 command frame, then the Next-PM will be switch on and will send the first PM datas after 15 seconds.

During the SLEEP mode, the Next-PM reply to all the other command frame by sending 0x16 command frame with the state code.

If the Next-PM is in the Default State, the 0x15 command frame allowed to try to switch on the Next-PM.

Beware to not confound SLEEP Mode and STOP Mode. The SLEEP Mode is obtained thanks to the command frame 0x15 and switch off the charges : laser, fan and heat. The STOP Mode is obtained thanks to set the entrance high state CS (Connector PIN5), all the charges are also switch off and the μ controller is set to low energy mode.

Command frame 0x16

address	Command id	State (1 byte)	Checksum
0x81	0x16	0x33	0x36

The 0x16 command frame send the State code. It's the default response when there is no data to transmit or when the asked command frame can't be done (for example, when the sensor is in SLEEP mode).

Command frame 0x17

address	Command id	State (1 byte)	Firmware Version (2 bytes)	Checksum
0x81	0x17	0x00	0x0034	0x34
0x81	0x16	0x01		0x68

The Next-PM will send the firmware version. In the above example, the firmware version is 0x0034. If the Next-PM is in the SLEEP mode, it will only reply its state code.

Command frame 0x21

address	Command id	State (1 byte)	Fan Speed (1 byte)	Checksum
0x81	0x21	0x00	0x42	0x1C
0x81	0x16	0x01		0x68

When a 0x21 command frame is sent, the sensor replies using the actual value.

The minimum fan speed is set to 10%. Below this value, the new speed value is not saved and the sensor will use its previous speed value. Note that if you send a NULL value, the Next-PM will send you its memory last value.

If the command frame is sent when the sensor is in SLEEP mode, then the Next-PM will reply with the 0x16 command frame to indicate that the command will not be used.

In the above example, the fan speed is set to 66% (0x42).