

# OEM Laser scattering SENSORS for aerosol or micro-Dust concentration Measurements



The new Qbit-OEM2 Dust-sensor represents a sensible improvement from the previous generation of particle sensors. It is more compact, and has a simpler handling. It is provided with a standard USB interface and it is powered from this cable ( 5 V, 100 mA). It thus presents only a mini-USB female plug and the air inlet/outlet connections. The overall sensor box dimensions are (100 mm x 100 mm x 90 mm). The box contains the laser-scattering optical cell and the electronic board performing the measure elaboration and making it available in ASCII format through the Universal Serial Bus (USB). It can thus be easily interfaced to most digital devices , such as PC's, laptop, tablet or smartphones.

A series of options can be available on request, such as battery operation, integration with environmental parameters measures (such as Temperature, Pressure and Relative Humidity) Control of external devices (such as electro-valves for automatic calibration cycles).



## **SENSOR SPECIFICATIONS :**

DETECTABLE Dust particles:

***PM1 - PM10 depending on the mounted filters impactors or cyclone-selectors.***

Typical detectable dust concentrations (for cyclone selection, 2l/min air flow, 30 sec integration).	PM 2.5	2 ( $\mu\text{g}/\text{m}^3$ )
	PM 10	1 ( $\mu\text{g}/\text{m}^3$ )
Measuring range	1- 10000 ( $\mu\text{g}/\text{m}^3$ )	
Minimum response time	1 (sec)	(1)
Gas flow	Up to 6 l/min	(2)
Power Supply	USB , 5V external, 3.7V LiIon Battery	
digital I/O	USB	(3)

(1) the sensor measurement time can be set by the user as detailed in the FW operation manual in the following paragraphs. Please note: a faster response time means a lower detector precision.

(2) Sensor parameters are factory set for a flow rate around 2 l/m. FW enables the user to scale the measured concentration given a different operation mode.

(3) Standard Baud-rate 9600 (it can be differently set on customer demand).

[ Baud rate: 9600, Data bits: 8, Parity: none, Stop bits: 1, Device control: no]



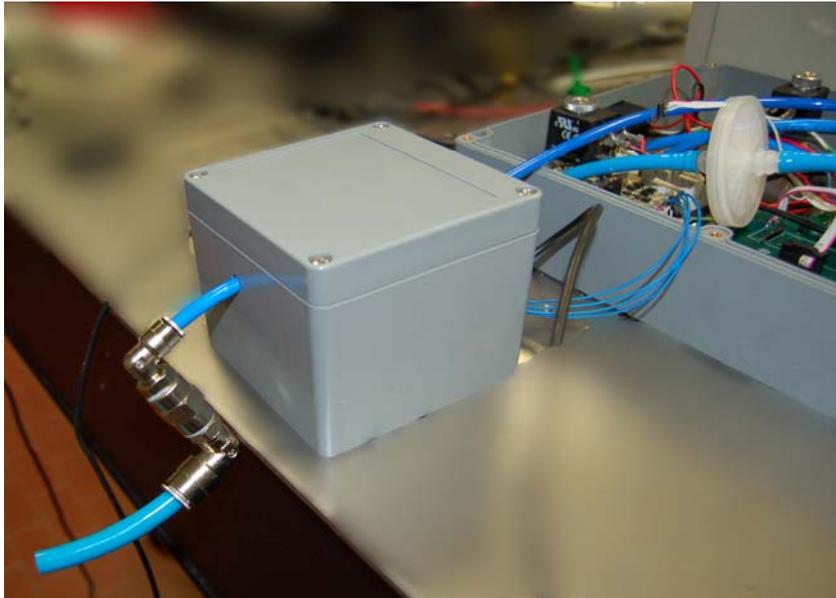
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## WARM-UP:

- Precise measures are reached after a 10 minutes warm-up time.

For precision measurements the sensor should be inserted in a system automatically performing zero-level calibrations making use of a suitable zero-pass filter. As evidenced in the following picture:



A service box is available from Qbit s.r.l. , to automatically perform this task.



## **SENSOR LAYOUT:**



The 10 x 10 x 9 cm ABS protection BOX contains the Laser-scattering cell and the electronics devoted to the processing of the optical signal.



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## Firmware (FW) command list:

(FW: Rel 1.11 - 09/12/2014)

[commands must be followed by a carriage-return line-feed: <CR> <LF>]

INPUT	COMMAND DESCRIPTION	SENSOR OUTPUT
<b>M</b>	<b>Sensor Model:</b>	Sensor answers with its type and serial number. (e.g. <b>Mod. P-00XX</b> for Particulate measuring sensor s/n 00XX)
<b>r</b>	<b>Reset processor:</b> carries out diagnostics and sets parameters to factory values.	Sensor answers <b>rok</b> in case of positive diagnostics. It may alternatively send an error code: <b>E00</b> if the detector signal optimization and diagnostics was not completed (ended with a time-out) <b>E02</b> if the Laser source is not properly working and an error code <b>E03</b> if the Optical receiver is not properly working.
<b>c</b>	<b>Calibration:</b> carries out a manual zero setting (to be done in clean air ). Sensor answers after the interval <i>Tmeas</i> selected in the “timing” command.	Sensor answers <b>coK</b> at the end of the calibration procedure.  When the detector answers with a warning message <b>W03</b> (or <b>W04</b> ), the measuring range will be reduced to 90% (80%) due to source and detector aging. (resolution results reduced correspondingly). Measurements can be done anyway.
<b>h</b>	<b>High res. Measurement:</b> PM measure command.  Sensor answers after the interval <i>Tmeas</i> selected in the “timing” command.	Sensor answers with an ASCII string corresponding to the measured concentration in $\mu\text{g}/\text{m}^3$ (e.g. <b>771</b> meaning $771 \mu\text{g}/\text{m}^3$ )  Scaling refers to typical operation (2.2 l/min and PM2.5 cyclone filter). If different operation parameters are used a comparison with a reference instruments may be necessary and data may be corrected using the “ <b>scale</b> ” command.
<b>start</b>	<b>Starts a continuous cycle of measurements:</b> With this procedure the sensor performs a cycle of continuous measurements. Output will appear as reported at the end of this list.	Sensors answers “ <b>startok</b> ” and starts the cycle. Sensor will output “ <b>c..</b> ” at the beginning of a calibration cycle and “ <b>coK</b> ” at the end of it) (during this execution the sensor answers <u>only</u> to a “ <b>stop</b> ” command and only at the end of the measure already initiated).
<b>stop</b>	<b>Stops the continuous cycle of measurements.</b> Cycle started with a “ <b>start</b> ”.	Please Note : the cycle will not be stopped until the last initiated measurements has ended. During this time the sensor will not answer to any further command.
<b>timing</b>	<b>Sets Measurement time and Calibration Interval</b>	<b>Tcal</b> is the interval (in minutes) between successive calibrations. <b>Tmeas</b> is the integration time (in seconds) of each measurement.  The sensor answers to the command with: “ <b>Tcal=10</b> ” (the user may accept this setting with a <CR><LF> or change it with a new value followed by <CR><LF>) Then the sensor will write: “ <b>Tmeas=30</b> ” (the user may act as stated above)



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<b>scale</b>	<b>Enables scaling of the output</b>	Here gain <b>g1</b> and offset <b>off1</b> of the <b>PM</b> measurement may be changed. (with the same input operation of the “timing” Command) <b>g2,g3,g4</b> and <b>off2,off3,off4</b> are used for Temperature, Pressure and Relative Humidity in sensors equipped with this option. <b>NEG_ON</b> variable enables (if set to 1) or disables (if set to 0) the occurrence of negative values. When <b>NEG_ON=0</b> , the sensor converts to zero all the negative values.
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Example of sensor output with the start/stop Cycle:

```

*****
startok
c..cok
27
25
23
23
23
22
22
256
55
493
1063
138
39
31
28
26
23
33
46
25
c..cok
23
26
22
22
22
22
22
22
23
22
23
22
.....
24
stopok
*****

```



Example of sensor output with the start/stop Cycle (and the optional measurement of T,P and rH):

\*\*\*\*\*

startok

c..cok

PM: 5 | T: 22.86 | P: 100021.50 | rH: 56.34  
PM: 5 | T: 22.98 | P: 100020.25 | rH: 56.08  
PM: 10 | T: 23.08 | P: 100026.75 | rH: 55.84  
PM: 268 | T: 23.21 | P: 100028.75 | rH: 55.58  
PM: 295 | T: 23.31 | P: 100036.25 | rH: 55.23  
PM: 193 | T: 23.41 | P: 100041.50 | rH: 54.94  
PM: 75 | T: 23.49 | P: 100049.75 | rH: 54.71  
PM: 80 | T: 23.58 | P: 100048.00 | rH: 54.53  
PM: 79 | T: 23.67 | P: 100053.00 | rH: 54.24  
PM: 54 | T: 23.74 | P: 100054.50 | rH: 54.00  
PM: 60 | T: 23.81 | P: 100062.00 | rH: 53.83  
PM: 37 | T: 23.89 | P: 100045.50 | rH: 53.71  
PM: 26 | T: 23.95 | P: 100048.25 | rH: 53.57  
PM: 24 | T: 24.03 | P: 100045.75 | rH: 53.48  
PM: 28 | T: 24.09 | P: 100048.75 | rH: 53.30  
PM: 18 | T: 24.15 | P: 100053.50 | rH: 53.19  
PM: 16 | T: 24.21 | P: 100056.75 | rH: 53.21  
PM: 13 | T: 24.26 | P: 100056.75 | rH: 53.07  
PM: 15 | T: 24.33 | P: 100063.75 | rH: 52.92  
PM: 17 | T: 24.39 | P: 100062.25 | rH: 52.80

c..cok

PM: 18 | T: 24.56 | P: 100068.75 | rH: 52.42  
PM: 19 | T: 24.65 | P: 100074.75 | rH: 52.27  
PM: 22 | T: 24.72 | P: 100066.25 | rH: 52.13  
PM: 15 | T: 24.80 | P: 100069.00 | rH: 51.95  
PM: 20 | T: 24.87 | P: 100078.25 | rH: 51.75  
PM: 27 | T: 24.94 | P: 100080.25 | rH: 51.62  
PM: 157 | T: 25.04 | P: 100077.75 | rH: 51.39  
PM: 172 | T: 25.05 | P: 100087.75 | rH: 51.30  
PM: 101 | T: 25.06 | P: 100090.75 | rH: 51.21  
PM: 118 | T: 25.06 | P: 100095.50 | rH: 51.12  
PM: 104 | T: 25.20 | P: 100092.00 | rH: 51.10  
PM: 67 | T: 25.26 | P: 100090.00 | rH: 50.94  
PM: 75 | T: 25.32 | P: 100091.25 | rH: 50.82  
PM: 71 | T: 25.37 | P: 100092.00 | rH: 50.65  
PM: 65 | T: 25.42 | P: 100092.50 | rH: 50.52  
PM: 63 | T: 25.48 | P: 100100.25 | rH: 50.31

stopok

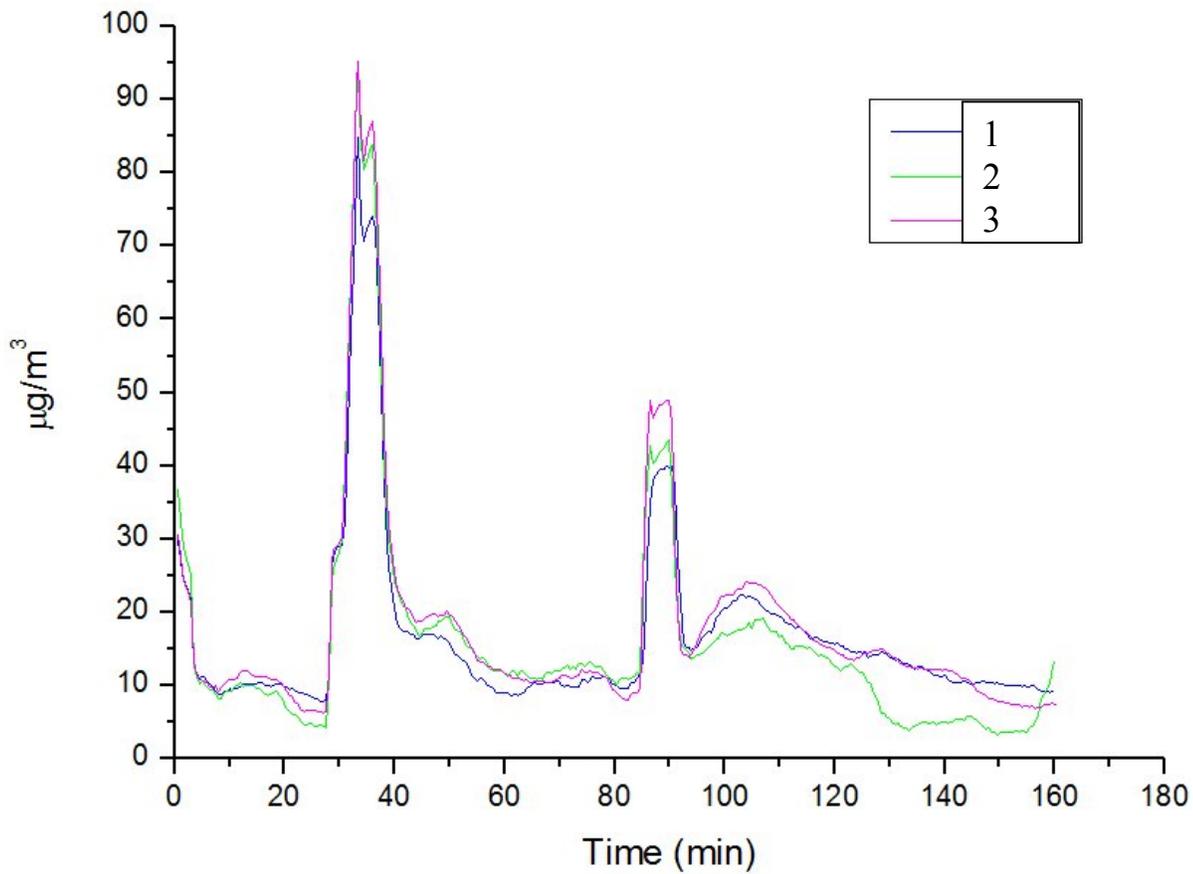
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Comparison of measurements performed with three QBit sensors settled close to each other and thus subject to the similar dust flows artificially produced during the test time. (integration time 5 minutes).

