

Particulate Matter



Where is it found?

Particles, commonly referred to as PM (particulate matter), are emitted from a wide range of anthropogenic sources. The most significant are road transport, non-combustion processes, industrial combustion plants and processes, commercial and residential activities as well as power plants. Natural sources are less important, including volcanoes and sandstorms.

Why is it harmful?

PM may be seen as one of the most critical of all pollutants. Particulate matter is the generic term to classify air pollutants comprising of suspended particles in the air. The size, surface, number and composition of particles play an important role in human health effects. The upper respiratory tract is affected by PM_{10} , $PM_{2.5}$ affect the lower respiratory tract, while PM_1 and ultrafine particles ($<0.1 \mu m$ diameter) can reach the lung alveoli and the bloodstream, respectively.

Particles can cause premature mortality in patients suffering from lung or heart disease, provoke heart attacks, aggravate asthma, reduce lung functionality, and irritate in airways.

PM sensor

The particle sensor consists of sensors based on laser scattering technology. To cover different applications, two particle sensors are available:

- **Type A** (specific for Kunak AIR Pro stations): an OPC (Optical Particle Counter) capable of measuring particles from $0.3 \mu m$ up to $40 \mu m$ thanks to 24 bin channels. The PM_1 , $PM_{2.5}$, PM_4 , PM_{10} , Total Suspended Particles (TSP) and Total Particle Counter (TPC) are calculated assuming a particle density profile. Field co-location studies have shown similar field performance as equivalence instruments based on the same technology, even in monitoring coarse particles (Certified Product for Indicative Ambient Particulate Monitors).
- **Type B** (specific for Kunak AIR Lite stations): sensor with a range of measurement from $0.3 \mu m$ up to $10 \mu m$. The sensor monitors accurately PM_1 and $PM_{2.5}$ concentration, while the expected error for PM_{10} is higher in presence of coarse particles (see technical specifications in p. 25).



The effect of humidity is perfectly corrected in both sensors with the embedded algorithm achieving high accuracy at any environmental conditions except under foggy days or condensation, where the data is automatically invalidated by the software Kunak Cloud to prevent data noise.

Besides, the remote Kunak calibration tool allows you to adjust the correction factor to the specific location where the device is installed. Additionally, particle size distributions are available in Kunak Cloud.

* See notes on page 24



Technical specifications

CSA MC230418/00



Type A (only for Kunak AIR Pro)

Type	Optical particle counter		
Unit of measurement	$\mu\text{g}/\text{m}^3$	Limit of Detection (LOD) ⁽⁷⁾	0.5 $\mu\text{g}/\text{m}^3$ (PM1) 0.5 $\mu\text{g}/\text{m}^3$ (PM2.5) 0.5 $\mu\text{g}/\text{m}^3$ (PM4) 1 $\mu\text{g}/\text{m}^3$ (PM10) 1 $\mu\text{g}/\text{m}^3$ (TSP)
Measurement range ⁽¹⁾	0 - 1,000 $\mu\text{g}/\text{m}^3$ (PM1) 0 - 2,000 $\mu\text{g}/\text{m}^3$ (PM2.5) 0 - 2,000 $\mu\text{g}/\text{m}^3$ (PM4) 0 - 10,000 $\mu\text{g}/\text{m}^3$ (PM10) 0 - 15,000 $\mu\text{g}/\text{m}^3$ (TSP) 0 - 8,000 counts/cm ³ (TPC)	Typical accuracy (MAE) ⁽¹⁰⁾	$\pm 2 \mu\text{g}/\text{m}^3$ (PM1) $\pm 3 \mu\text{g}/\text{m}^3$ (PM2.5) $\pm 3 \mu\text{g}/\text{m}^3$ (PM4) $\pm 4 \mu\text{g}/\text{m}^3$ (PM10) $\pm 6 \mu\text{g}/\text{m}^3$ (TSP)
Resolution ⁽²⁾	1 $\mu\text{g}/\text{m}^3$ 1 count/cm ³ (TPC)	Typical precision R ² ⁽¹⁰⁾	> 0.9 (PM1) > 0.8 (PM2.5) > 0.8 (PM4) > 0.7 (PM10) > 0.7 (TSP) > 0.8 (TPC)
Operating temperature range ⁽³⁾	-20 to 50 °C -40 to 50 °C with heater**	Typical slope ⁽¹⁰⁾	0.85 - 1.18
Operating RH range ⁽⁴⁾	0 to 99 %RH	Typical intercept (a) ⁽¹⁰⁾	-1.8 $\mu\text{g}/\text{m}^3 \leq a \leq +1.8 \mu\text{g}/\text{m}^3$ (PM1) -2 $\mu\text{g}/\text{m}^3 \leq a \leq +2 \mu\text{g}/\text{m}^3$ (PM2.5) -2 $\mu\text{g}/\text{m}^3 \leq a \leq +2 \mu\text{g}/\text{m}^3$ (PM4) -3 $\mu\text{g}/\text{m}^3 \leq a \leq +3 \mu\text{g}/\text{m}^3$ (PM10) -4 $\mu\text{g}/\text{m}^3 \leq a \leq +4 \mu\text{g}/\text{m}^3$ (TSP)
Recommended RH range ⁽⁴⁾	0 to 95 %RH	DQO - Typical U (exp) ⁽¹¹⁾	< 50% (PM1 - PM10) < 35% (PM2.5)
Operating life ⁽⁵⁾	> 24 months	Typical intra-model variability ⁽¹²⁾	< 2 $\mu\text{g}/\text{m}^3$
Repeatability ⁽⁸⁾	2 $\mu\text{g}/\text{m}^3$ (PM1) 3 $\mu\text{g}/\text{m}^3$ (PM2.5) 3 $\mu\text{g}/\text{m}^3$ (PM4) 5 $\mu\text{g}/\text{m}^3$ (PM10) 6 $\mu\text{g}/\text{m}^3$ (TSP)		
Response time ⁽⁹⁾	< 10 sec		

** More information on this version on request

Type B (only for Kunak AIR Lite)

Type	Optical particle counter		
Unit of measurement	$\mu\text{g}/\text{m}^3$	Limit of Detection (LOD) ⁽⁷⁾	0.5 $\mu\text{g}/\text{m}^3$ (PM1) 0.5 $\mu\text{g}/\text{m}^3$ (PM2.5) 0.5 $\mu\text{g}/\text{m}^3$ (PM10)
Measurement range ⁽¹⁾	0 - 1,000 $\mu\text{g}/\text{m}^3$	Typical accuracy (MAE) ⁽¹⁰⁾	$\pm 3 \mu\text{g}/\text{m}^3$ (PM1) $\pm 3 \mu\text{g}/\text{m}^3$ (PM2.5) $\pm 6 \mu\text{g}/\text{m}^3$ (PM10) *
Resolution ⁽²⁾	1 $\mu\text{g}/\text{m}^3$	Typical precision R ² ⁽¹⁰⁾	> 0.85 (PM1) > 0.8 (PM2.5) > 0.5 (PM10) *
Operating temperature range ⁽⁵⁾	-10 to 60 °C	Typical slope ⁽¹⁰⁾	0.80-1.25 (PM1) 0.83-1.20 (PM2.5) 0.75-1.35 (PM10) *
Operating RH range ⁽⁴⁾	0 to 99 %RH	Typical intercept (a) ⁽¹⁰⁾	-2 $\mu\text{g}/\text{m}^3 \leq a \leq +2 \mu\text{g}/\text{m}^3$ (PM1) -3 $\mu\text{g}/\text{m}^3 \leq a \leq +3 \mu\text{g}/\text{m}^3$ (PM2.5) -9 $\mu\text{g}/\text{m}^3 \leq a \leq +9 \mu\text{g}/\text{m}^3$ (PM10) *
Operating life ⁽⁵⁾	> 24 months	DQO - Typical U (exp) ⁽¹¹⁾	< 50% (PM1) < 35% (PM2.5) < 75% (PM10) *
Repeatability ⁽⁸⁾	3 $\mu\text{g}/\text{m}^3$ (PM1) 3 $\mu\text{g}/\text{m}^3$ (PM2.5) 6 $\mu\text{g}/\text{m}^3$ (PM10)	Typical intra-model variability ⁽¹²⁾	< 2 $\mu\text{g}/\text{m}^3$
Response time ⁽⁹⁾	< 10 sec		

* See notes on page 25