BMV080

Ultra-mini Particulate Matter Sensor

BOSCH

BMV080 Ultra-mini Particulate Matter Sensor

Technical Specification Statement

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Notes	Data and descriptions in this document are subject to change without notice. Product photos and pictures are for illustration purposes only and may differ from the real product appearance. The technical details and legal disclaimer of the respective product datasheet apply.

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1   Glossary

PM2.5	Mass concentration of particulate matter with a diameter smaller or equal to 2.5 µm
PM1	Mass concentration of particulate matter with a diameter smaller or equal to 1.0 µm
PM10	Mass concentration of particulate matter with a diameter smaller or equal to 10.0 µm
ΔA	Deviation from accuracy
$\varepsilon(t)$	Precision
S2S	Sensor-to-sensor variation

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2   BMV080 standard test conditions

Evaluation of precision, accuracy, and sensor-to-sensor (S2S) variation for any optical PM2.5 requires a defined environ-ment regarding temperature, relative humidity, and type and density distribution of particles. As BMV080 uses prevalent airflow, a defined range of velocities at which both calibration and evaluation take place is also needed.

Table 1: Standard test conditions

Parameter	Value	Unit
Ambient temperature	25 ± 2	° C
Relative ambient humidity	50 ± 10	% rH
Relative particle velocity	0.1 - 1.5	m/s
Relative particle flow	Laminar, plane parallel	–
Reference instrument	Aerosol particle size spectrometer LAP 322	–
Particle source	Arizona Road Dust (ARD) Ultrafine A1, ISO 12103-1	–
Integration time	10	s
Vibration suppression	Disabled	–
Measurement algorithm	High precision	–

3 Precision

Precision $\varepsilon(t)$ for BMV080 is defined by the variation of measurement values around the long-term average (greater or equal to 120 seconds) for constant environmental conditions.

$\overline{PM2.5}$ is the average PM2.5 value as measured by BMV080 over a time period of at least 120 seconds at constant environmental conditions, and $PM2.5(t)$ is the momentary PM2.5 value reported, the momentary precision is defined as:

$$\varepsilon(t) = \frac{\overline{PM2.5} - PM2.5(t)}{\overline{PM2.5}} \cdot 100 \ [\%]$$

for relative values and

$$\varepsilon(t) = \overline{PM2.5} - PM2.5(t) \ [\mu g/m^3]$$

for absolute units.

For default settings, the value $PM2.5(t)$ is reported once per second but this time interval can be customized (see API documentation).

Collecting $\varepsilon(t)$ for a long period of time allows to calculate the expected distribution of precision values, which, for BMV080 will stay within the following limits:

Table 2: Precision value range

PM2.5 range[1]	3 σ precision
0 - 100	10 µg/m³
101 - 1000	10 %

Figure 1: Precision observed during test equipment measurements after individual calibration; 254 individual sensors from 3 production runs.

[1]Standard test conditions and standard distribution (Arizona Road Dust).
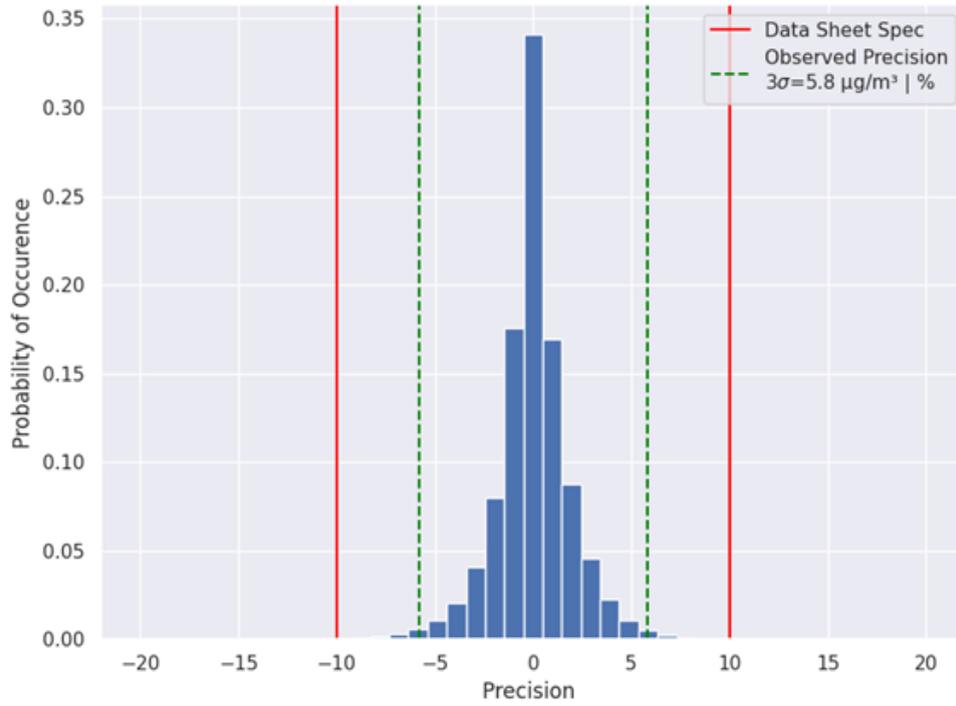
Figure 2: Precision observed for incense stick pollution in ranges from 0 to 200 µg/m³; 1309 individual sensors in 57 measurements.

The images displayed in this chapter show sample distributions, obtained by using a limited number of sample devices. Actual results may vary based on system integration, operating and environmental conditions, and particle distribution.

4 Deviation from accuracy

Deviation from accuracy ΔA is given in relation to the specific reference instrument and standard test conditions as specified in Table 1.

$\overline{PM2.5}_{BMV080}$, and $\overline{PM2.5}_{LAP}$ are the average PM2.5 values reported by BMV080 and LAP322, respectively, over a period with stable conditions of at least 120 seconds. The deviation from accuracy, ΔA, is then given by:

$$\Delta A = \left(\frac{\overline{PM2.5}_{BMV080}}{\overline{PM2.5}_{LAP}} - 1 \right) \cdot 100 \ [\%]$$

for relative values and

$$\Delta A = \overline{PM2.5}_{BMV080} - \overline{PM2.5}_{LAP} \ [\mu g/m^3]$$

for absolute units.

Table 3: Accuracy value range

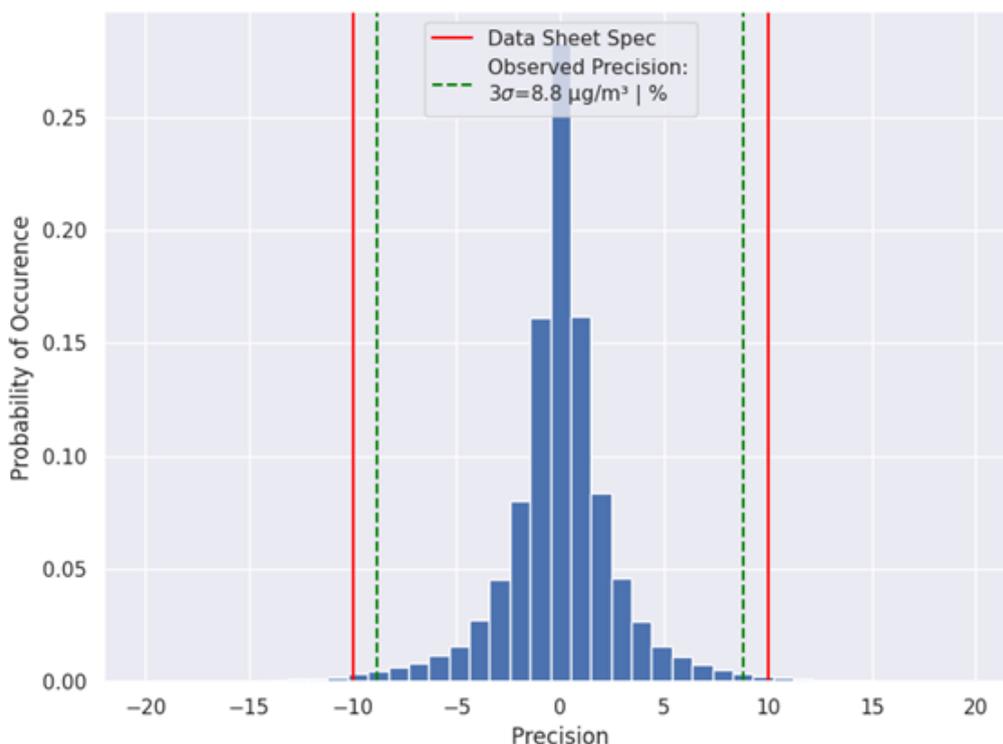| PM2.5 range[2]	Target 3 σ deviation from accuracy
0 - 100	10 µg/m³
101 - 1000	10 %
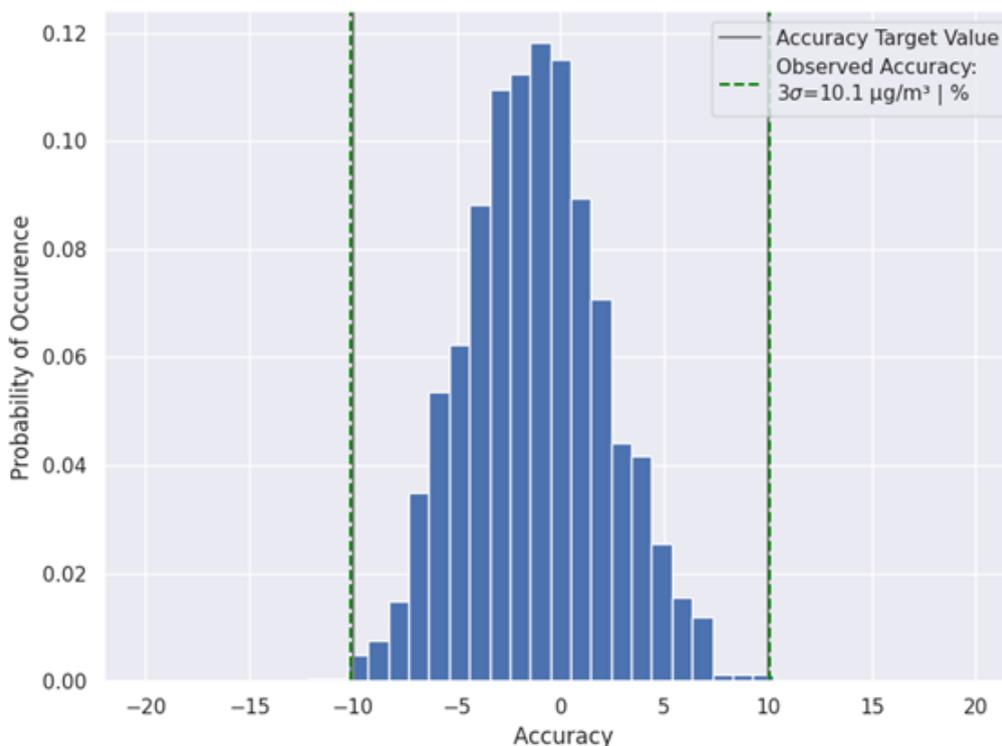
Figure 3: Deviation from accuracy observed during test equipment measurements after individual calibration; 254 individual sensors from 3 production runs.

The image displayed in this chapter shows a sample distribution, obtained by using a limited number of sample devices. Actual results may vary based on system integration, operating and environmental conditions, and particle distribution.

²Standard test conditions and standard distribution (Arizona Road Dust).

5 Sensor-to-sensor-(S2S)-variation

For unknown particle size distributions and conditions other than the standard test conditions, accuracy is not defined, but a very similar measure can be found in the sensor-to-sensor-(S2S)-variation. The main difference to accuracy is that the averaged value of PM2.5 given by a reference instrument is replaced by the average PM2.5 reported by all of the BMV080 sensors in the same experiment, $\overline{PM2.5}_{BMV080}$, giving:

$$\triangle S2S = \left(\frac{\overline{PM2.5}_{BMV080}}{\overline{\overline{PM2.5}}_{BMV080}} - 1 \right) \cdot 100 \ [\%]$$

for relative values and

$$\triangle S2S = \overline{PM2.5}_{BMV080} - \overline{\overline{PM2.5}}_{BMV080} \ [\text{µg/m}^3]$$

for absolute units.

The averages are again to be taken over a time period of 120 seconds – due to frequent fast variation in underlying PM2.5 values under realistic conditions (see Figure 4).
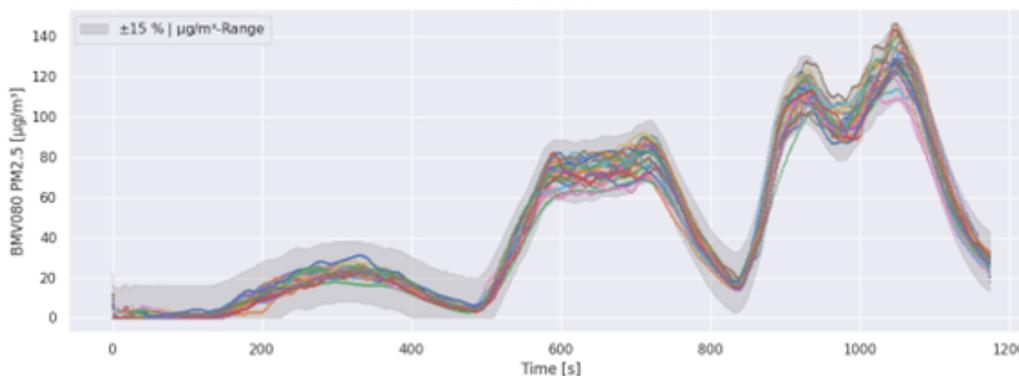
Figure 4: Typical PM2.5 time series for 26 co-located sensors in incense stick field experiments.

For Arizona Road Dust, the expected limits of S2S in standard conditions are identical listed in the previous chapter; i.e.

Table 4: Sensor to sensor variation range for ARD

PM2.5 range	Target 3 σ S2S
0 - 100	10 µg/m³
101 - 1000	10 %

For different particle size distributions, however, these limits will be higher. Generally, the following range can be expected:

Table 5: Sensor to sensor variation range

PM2.5 range	Target 3 σ S2S
0 - 100	15 µg/m³
101 - 1000	15 %

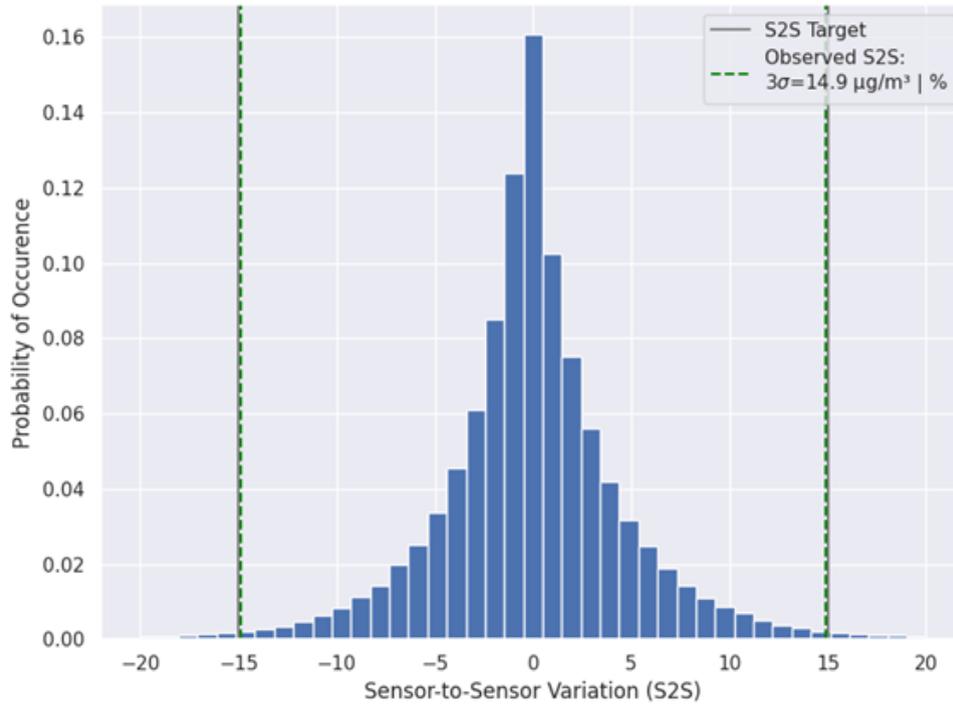Figure 5: Sensor-to-sensor variation observed for incense stick pollution in ranges from 0 to 200 μg/m³; 1309 individual sensors in 57 measurements.

The images displayed in this chapter show sample distributions, obtained by using a limited number of sample devices. Actual results may vary based on system integration, operating and environmental conditions, and particle distribution.

6   Temperature changes

There is **no** impact of external temperature changes on precision. Deviation from accuracy and S2S, might show some influence of external temperature.

All sensors are calibrated for an external temperature of 25 °C (corresponding to a sensor temperature in continuous mode of about 50 °C).

Measurement at temperatures other than the standard test conditions lead to a slight temperature-dependent broadening of both expected deviation from accuracy and S2S as shown in the table below:

Table 6: Temperature dependence of accuracy and sensor to sensor variation

PM2.5 range[3]	Expected variance addition 3 σ values of accuracy and S2S
0 - 100	0.5 µg/m³/K
101 - 1000	0.5 %/K

As an example, if the sensor is tested at in an environment with a temperature of 35 °C, the expected deviation from accuracy and S2S variation will change to the values given in the table below.

Table 7: Expected deviation from accuracy and S2S for 35 °C

PM2.5 range[3]	Expected 3 σ values for $\triangle A$	Expected 3 σ values for S2S
0 - 100	11.2 µg/m³	15.8 µg/m³
101 - 1000	11.2 %	15.8 %

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[3]For uniform particle distributions of uniform particle type.

7 PM1 and PM10 estimation

The ARD distribution is associated with a specific ratio of PM1 to PM2.5 and PM2.5 to PM10 as listed in the table below.

Table 8: PM ratios for ARD distribution

Ratio	Value
PM1/PM2.5	0.46
PM2.5/PM10	0.73

For other particle size distributions, these ratios will generally be different which is reflected in the PM1 and PM10 numbers reported by BMV080.

8   Number concentration estimation

The number concentrations reported by BMV080 are calculated and based on Arizona Road Dust; thus, the number of particles will reflect the value that would be valid for the currently observed PM2.5 assuming the Arizona Road Dust particle size distribution.

9 Legal disclaimer

9.1 Engineering samples

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10   Document history and modifications

Table 9: Document history

Rev. No.	Chapter	Description of modification/changes	Date
1.0	all	Initial release.	March 2025
1.1	all	Editorial changes.	December 2025
	4	Formula for deviation from accuracy (absolute units) added.	
	5	Formula for sensor-to-sensor variation (absolute units) added.	