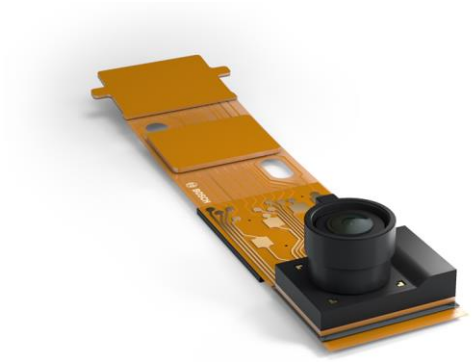
# BMV080

Particulate matter sensor

# 1 General description

The BMV080 is a revolutionary innovation in the field of optical Particulate Matter (PM)*[1] sensing for air quality measurement.

The BMV080 is the world's smallest PM sensor, >450 times smaller in volume compared to any alternative sensor in the market, and is completely fanless based on an engineering breakthrough – a game changer. The BMV080 measures PM2.5 mass concentration directly in free space, in real-time, in complete silence (noiseless) and maintenance free as there is no fan-induced dust build-up. The dimensions of the BMV080 sensing element measure a mere 4.2 x 3.5 x 3 mm³ (W x L x H) which is assembled on a flex PCB for integration.



The novel measurement principle based on fanless design & minimized form factor facilitate integration into ultra-compact Internet of Things (IoT) devices such as air quality monitors, smart thermostats, smart air purifiers, and wearables to monitor local PM concentration in real-time to provide actionable data.

**BMV080 TARGET APPLICATIONS**

- Air quality monitors
- Smart thermostats
- Smart air purifiers
- HVAC & air ventilation systems
- Wearables
- Ultra-compact IoT devices (e.g., smart speakers, smart switch, etc)

*[1] *Particulate Matter - PM - also referred to as "fine dust," is a common proxy indicator for air pollution. The BMV080 measures PM2.5 mass concentration which refers to atmospheric particulates or fine dust having diameter of 2.5µm and lower.*

# 2 Sensor features

### Novel custom designed optics

- Provides accurate PM2.5 measurements, allowing IoT devices to provide reliable, actionable information to consumers

### Entirely new integrations for ultra-compact IoT devices

- New integration possibilities in extremely compact and slim IoT devices for industrial design flexibility

### Innovative fanless design

- Zero dust build-up means a lifetime of zero maintenance, high accuracy measurement
- Measures in complete silence (noiseless) causing no disturbance to consumers
- Enables waterproof design

# 3 Preliminary technical specifications

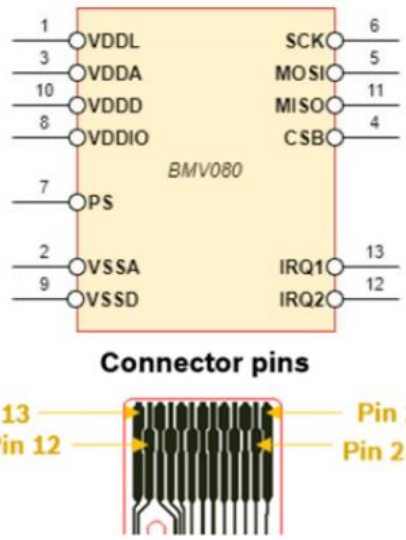
| BMV080 preliminary technical data*[2] | |
|---|---|
| Sensor dimension (WxHxL) | 4.2 mm x 3 mm x 3.5 mm<br>excluding flex PCB connector |
| Supply voltage | 1.8 – 3.3 V |
| Laser class | Class 1<br>according to IEC 60825-1 |
| Start-up time | 1.2 sec |
| Mass concentration resolution | 1 µg/m³ |
| Mass concentration range | 0 – 1000 µg/m³ |
| Minimum detectable size | 0.5 µm |
| Accuracy | ±10 µg/m³<br>For mass concn range:<br>0 – 100 µg/m³<br><br>±10 % of measured value<br>For mass concn range:<br>101 – 1000 µg/m³ |
| Maximum output data rate | 1 Hz<br>Lower rates possible with duty cycling |
| Communication interface | SPI<br>I2C (coming soon) |
| Sleep current | <30 µA |
| Operating temperature | -10 – 40° C |
| Storage temperature | -40 – 85° C |

*[2] *Data and descriptions are subject to change without notice*



Doc.-Number: BST-BMV080-FL000-00 / Version_1.0_102022

## Pin configuration




| Pin | Name | Description |
|---|---|---|
| 1 | VDDL | The laser supply voltage is 3.3V. This supply voltage is applied to the laser driver. This supply pin should be decoupled from VSSA by >1µF |
| 3 | VDDA | The ADC supply voltage is 2.5V to 3.3V. This supply voltage is applied to the ADC capturing photodiode current. This supply pin should be decoupled from VSSA by >1µF |
| 10 | VDDD | The digital supply voltage is 2.5V to 3.3V. This supply voltage is applied to the digital core. This supply pin should be decoupled from VSSD by >1µF |
| 8 | VDDIO | The Interface power supply is 1.8V to 3.3V. This supply voltage is applied to the I/O interface of the digital core. This pin is typically connected to the same supply of the host interface (e.g., application processor, microcontroller, or FPGA) |
| 7 | PS | Protocol select pin to configure the type serial interface, SPI or I2C. Logic input. The SPI protocol is selected if this pin is tied to a logic low (VSSD). If this pin is tied to a logic high (VDDIO), the I2C protocol is selected. If this pin is not connected (not recommended), the I2C protocol is selected. The pin state is latched during power-up by the digital core. |
| 2 | VSSA | Analog ground. This pin is the ground reference for all analog domains, namely VDDL and VDDA. Tying VDDA and VDDD as close as possible to the BMV080 pin header is recommended. |
| 9 | VSSD | Digital ground. This pin is the ground reference for all digital domains, namely VDDD and VDDIO. Tying VDDA and VDDD as close as possible to the BMV080 pin header is recommended. |
| 6 | SCK | Serial clock. Digital input. This pin functions as serial input for both serial interface protocols (SPI and I2C). |
| 5 | MOSI | This pin functions as Master Out Slave In (MOSI) in SPI mode. In I2C mode, this pin functions as a Serial Data line (SDA) |
| 11 | MISO | This pin functions as Master In Slave Out (MISO) in SPI mode. In I2C mode, this pin functions as I2C Address Bit 0 (IAB0). IAB0 allows adjusting the I2C Address Bit 0 of the slave by applying a logic low (VSSD) or logic high (VDDIO) |
| 4 | CSB | In SPI mode, this pin functions as not Slave Select (nSS). In I2C mode, this pin functions as I2C Address Bit 1 (IAB1). IAB1 allows adjusting the I2C Address Bit 1 of the slave by applying a logic low (VSSD) or logic high (VDDIO) |
| 12 | IRQ2 | Interrupt line 2. Digital out. According to the interrupt configuration of the digital core, this pin reports the corresponding condition. Active low |
| 13 | IRQ1 | Interrupt line 1. Digital out. According to the interrupt configuration of the digital core, this pin reports the corresponding condition. Active low5. |

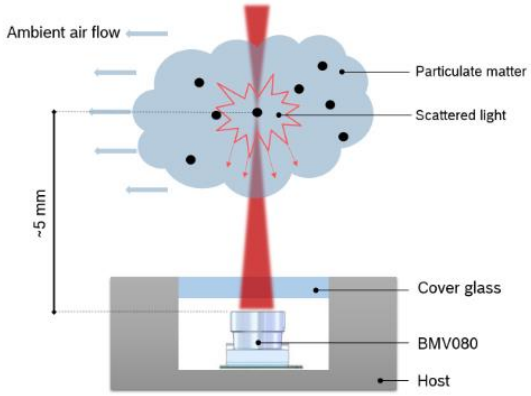
The BMV080 packaging consists of:

- Customer designed lens
- LGA package
- Flex PCB

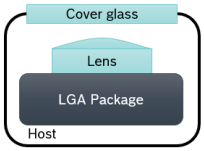
The sensor flex-PCB connection to the host is a ZiF (zero insertion force) connector.

# 4 Sensor operation

- The BMV080 sensor works based on laser-based opto-electronic technology to measure PM concentration in free space (illustration below)
- The natural ambient airflow in the proximity of the sensor is utilized in the measurement
- An algorithm derives PM mass concentration out of the measured parameters (particle counts, relative particle velocities, etc)

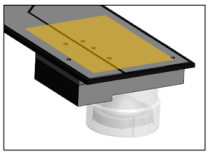



# 5 System integration



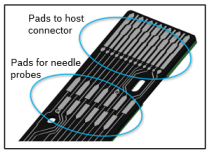

**Optical**

Simple integration behind an optical window



**Thermal**

Cooling shield for thermal dissipation




**Mechanical & Electrical**

Flex cable compatible with ZIF connector

**Communication & Software**

SPI interfaces

SDK (supporting common embedded platforms, e.g., ARM Cortex M4F)

**Headquarters**
**Bosch Sensortec GmbH**

Gerhard-Kindler-Strasse 9
72770 Reutlingen · Germany
Telephone +49 7121 3535 900
Fax +49 7121 3535 909

**www.bosch-sensortec.com**