BMV080
Ultra-mini Particulate Matter Sensor

BMV080 Ultra-mini Particulate Matter Sensor – Integration Guideline

Document revision	1.5
Document release date	Dec 2025
Document number	BST-BMV080-AN000-05
Sales part number	0273.017.054-1NV
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 data sheet apply.

Table of Contents

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

List of figures

List of tables

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

1 Purpose of this document

The goal of this *BMV080 integration guideline* application note is to provide guidance and best practices to product designers, engineers, and manufacturers on how to effectively integrate BMV080 sensor in your application or product.

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

2 BMV080 Unboxing and Handling – Best Practices

2.1 Unboxing

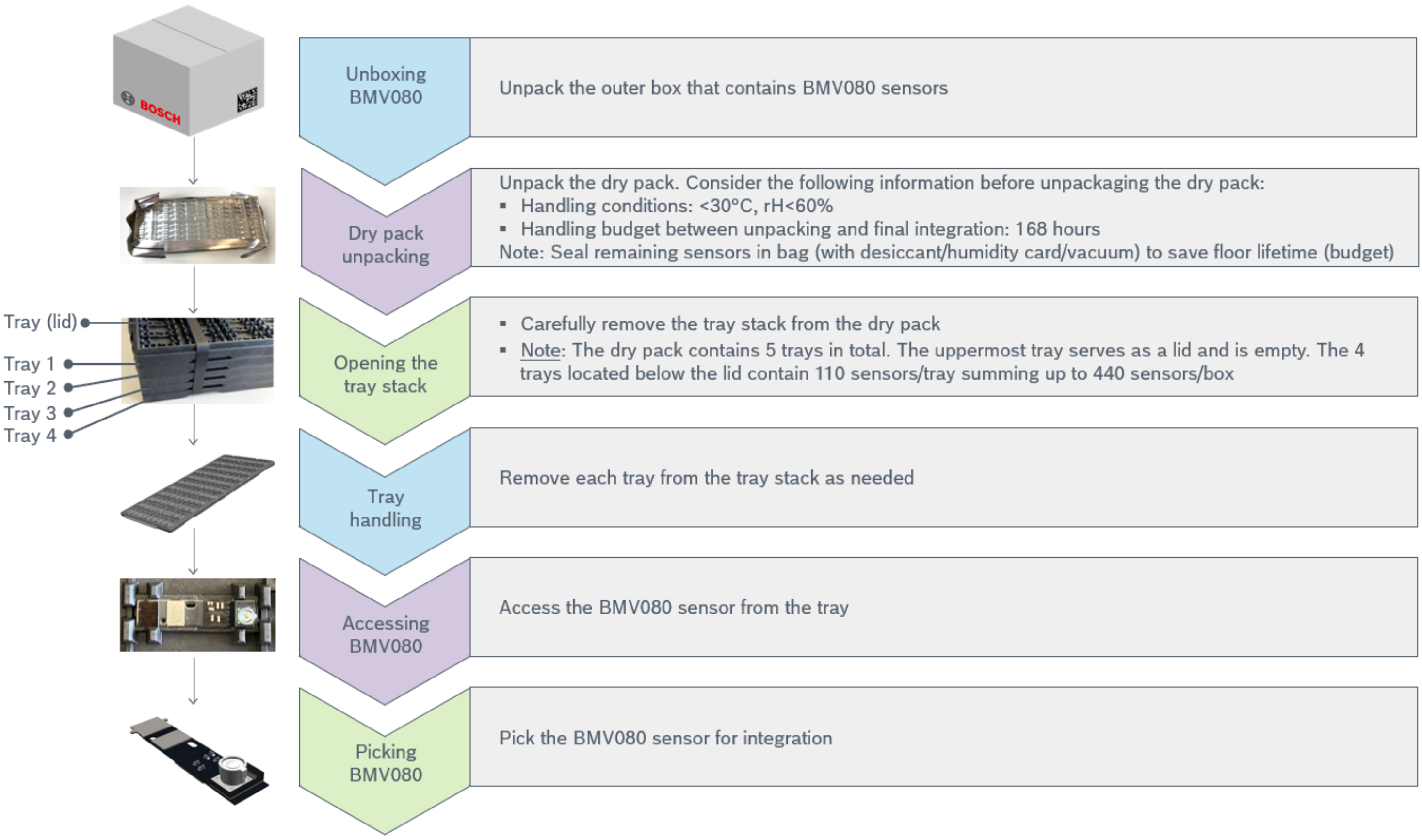


Figure 1: BMV080 unboxing

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

2.2 Handling

Pick up the sensor from the stiffener 1 area using vacuum picking or suitable plastic tweezers.

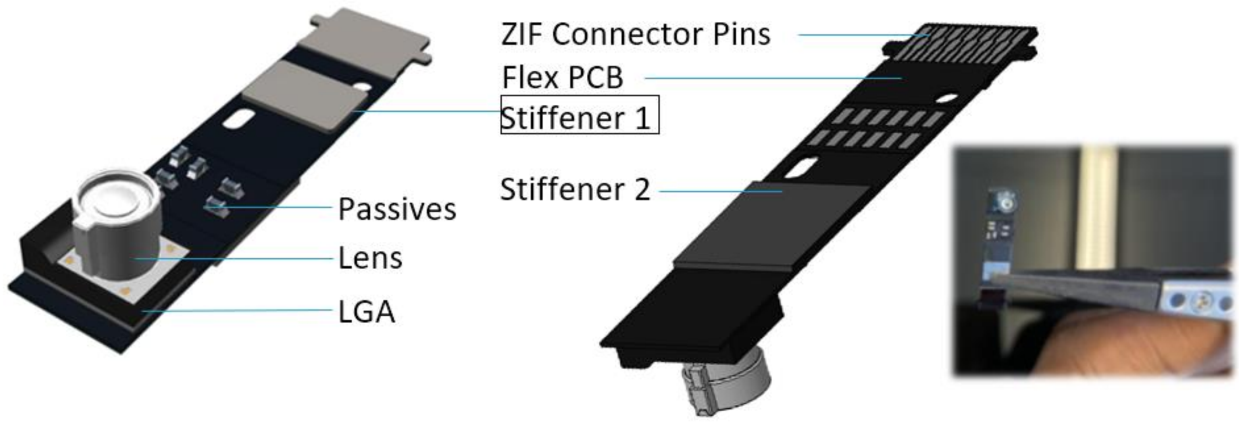


Figure 2: Location of the stiffener on the BMV080

Important: During assembly process, do not touch the passives, lens or connector.

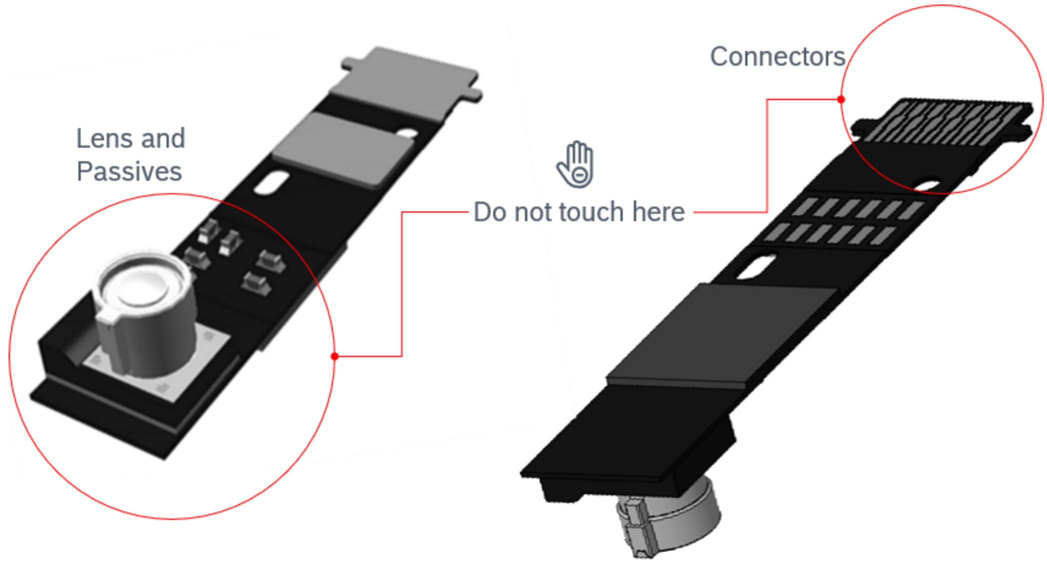


Figure 3: "No touch areas" of the BMV080 during assembly

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3 BMV080 Integration – Best Practices

3.1 Mechanical integration best practices

- The sensor can be mounted directly on the host PCB working simultaneously as a mechanical fixation and thermal connection, as shown in Figure 4 using a mechanical cage system
- Different options can be used to affix the mechanical cage system to the host PCB, such as screws or glue
- Ensure enough clearance between the sensor lens and the optical over as per recommendations in section 3.5

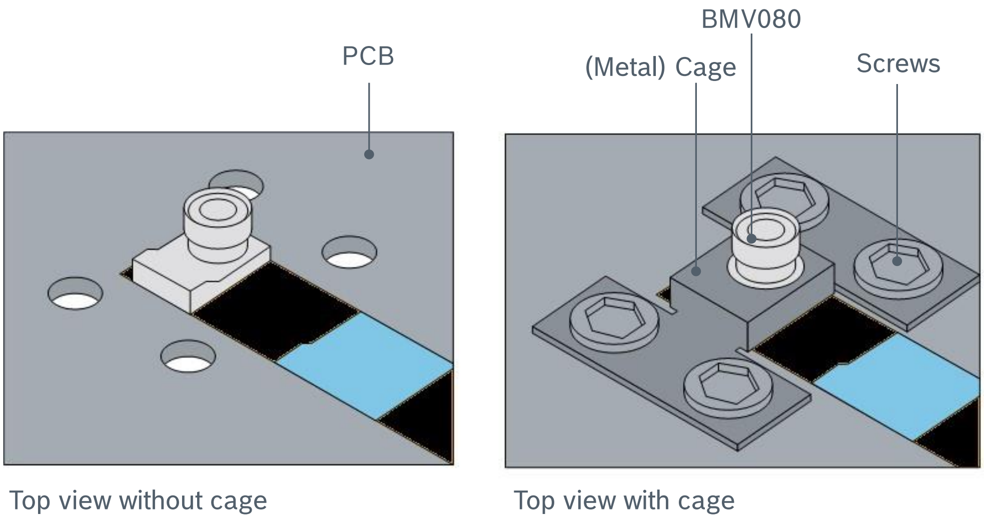


Figure 4: Mounting example

3.2 Bending of Flex PCB

Bending of the Flex-PCB is only allowed in the bending area highlighted with red rectangle shown in Figure 5 with maximum bending angle of 90◦ in clockwise direction and 180◦ in counterclockwise direction. Minimum bending radius is 0.5 mm, as shown in Figure 6 .

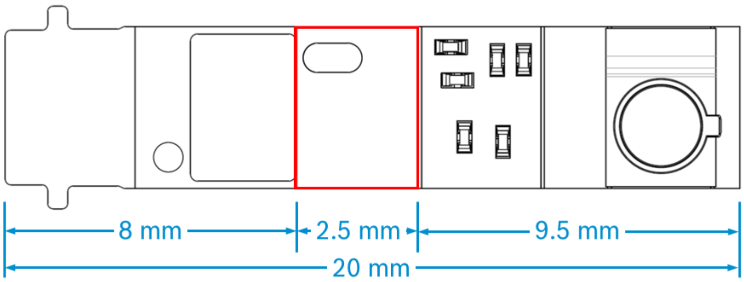


Figure 5 BMV080 flex PCB footprint for bending

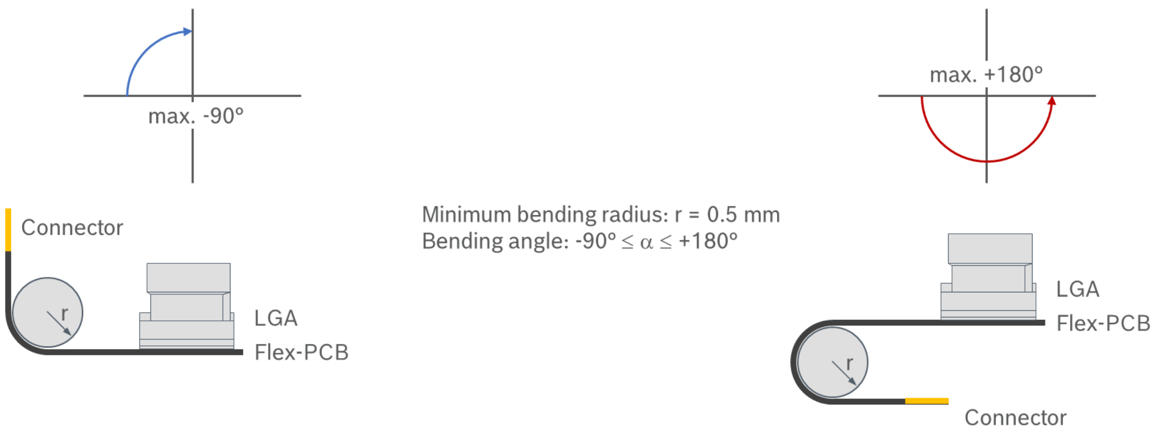


Figure 6 Maximum bending angles and minimum bending radius

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.3 Obstruction notifier and recommendations to avoid obstruction

- BMV080 is an optical sensor with unique capability of measuring particulate matter in free space
- To ensure particulate matter measurement, it is essential for the BMV080 to have a clear field of view
- Objects in front of the sensor (i.e., reflections caused by objects in the optical path) can influence the functionality as BMV080 detects these events as *obstructions*
- Occasional obstruction (e.g., waving hands) is filtered out in the software and does not influence the sensor
- However, static obstruction (e.g., fixed object in *obstruction sensitive range* (see Figure 7) will influence sensor functionality. When the BMV080 detects a static obstruction, the PM output is not available, and an *obstruction flag* is returned. Therefore, static obstructions caused by the integration into the host should be avoided
- The optical properties and geometry of object(s) in the BMV080's optical path determine the size of the obstruction-sensitive range
  - For a white, highly reflective surface perpendicular to the laser beams emitted by the BMV080, this distance is ~350 mm from the host surface
  - This distance reduces for less reflective objects (e.g., skin)
- Installing the BMV080 too close to adjacent walls, ceilings, or other items (e.g., cupboards) can block its field of view, or cause the sensor to pick up reflections or shadows impacting the sensor's performance
- Therefore, installing the BMV080 at a sufficient distance from such obstructive surfaces is necessary depending on the intended use-case (e.g., wall-mounted device, table-top device) to minimize these effects which is the focus of the following sub-sections

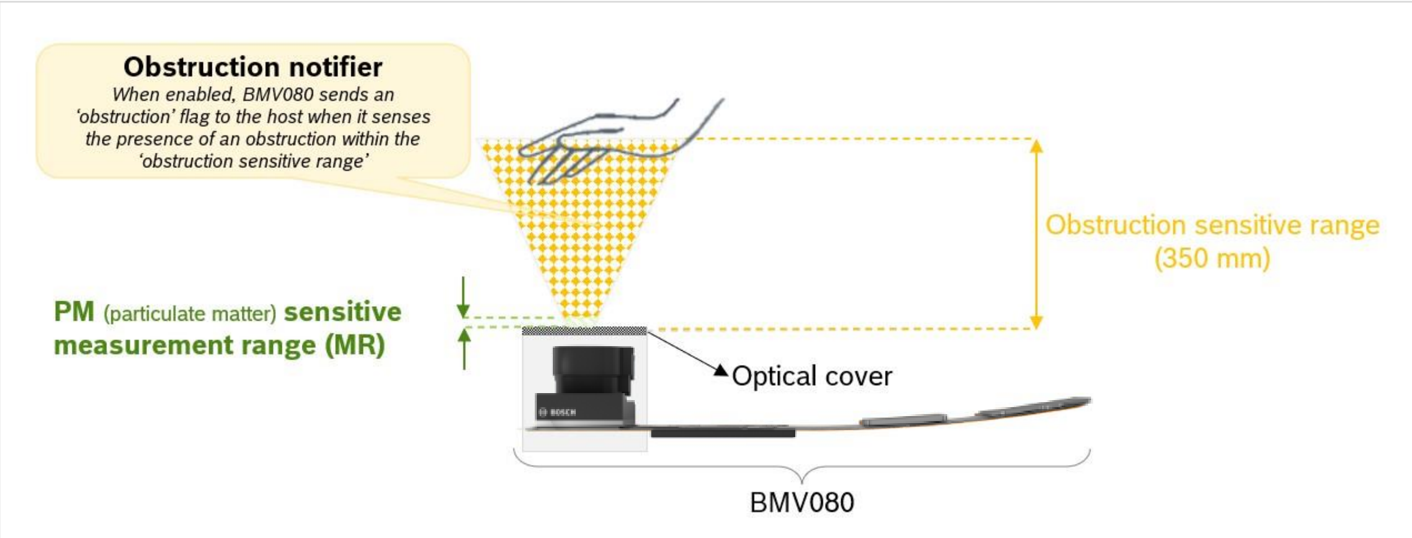


Figure 7: Typical obstruction sensitive range of BMV080

Obstruction notifier	Obstruction sensitive range (d1)
Enabled (default)	0 to 350 mm

Table 1: Typical obstruction sensitive range of BMV080

Important: For robust measurement, it is recommended to have *obstruction notifier* enabled which is the default setting.

Disabling *obstruction notifier* is generally possible via software and is intended primarily for evaluation purpose (e.g., in a lab). Permanently disabling *obstruction notifier* should be used with caution, as it can lead to a performance impact in PM measurement. It must be independently evaluated and qualified based on specific application or use-case.

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.3.1 Application-specific obstruction ranges

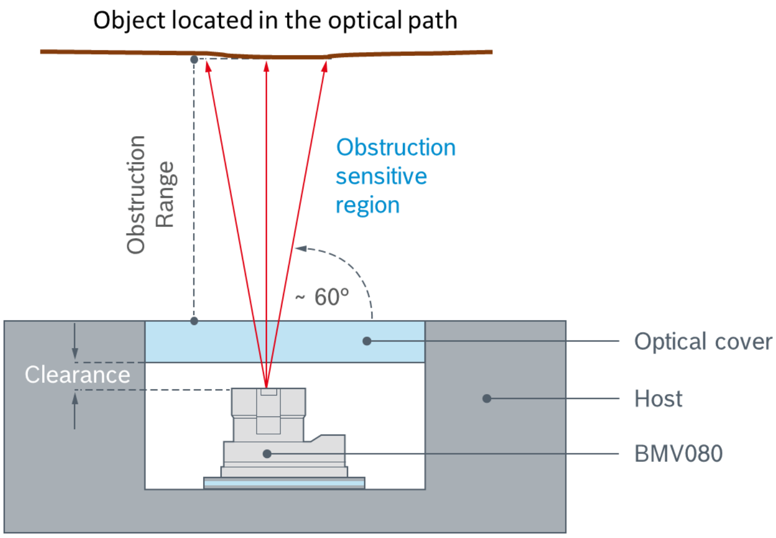
The obstruction sensitive range depends on the reflectivity and geometry of objects located in the optical path. For robust operation across a wide range of use cases, the default obstruction notifier is specified for highly reflective surfaces up to 350 mm (axial). This default configuration shall be used unless an application-specific validation has been performed.

Host integrators may reduce the obstruction detection range after completing a dedicated qualification in the final system environment. Table 1 and Figure 8 provide indicative obstruction ranges derived from internal evaluation for typical surface categories and provided for reference purposes only.

Surface type / finish	**Example qualified range[1] (depending on reflectivity and angle)**
High reflectivity (e.g., white paper, white painted surface)	~350 mm
Medium reflectivity (e.g., cardboard, uncoated plastic)	~ 150 – 260 mm
Low reflectivity (e.g., matte black surface)	~ 30 – 60 mm (≈ 30 mm for very low-reflectance surfaces)

Table 2: Application-specific obstruction ranges

Figure 8: Application-specific obstruction ranges



[1] The ranges in the qualified column are indicative results observed during internal integration evaluation. Final limits depend on the optical cover, housing geometry and surface properties and shall be verified depending on the intended use cases and applications.

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.3.2 Wall-mounted device

- It is important to take care that the surrounding surfaces don't obstruct the field of view of the BMV080
- The distances the BMV080 must be kept from potential obstructions which are measured from the BMV080 axis to the surrounding surfaces
- Sensor location in the host system: place the BMV080 minimum 17 mm (T>17mm) away from sharp edges to avoid turbulent air flows that could affect the sensor performance, see Figure 9.

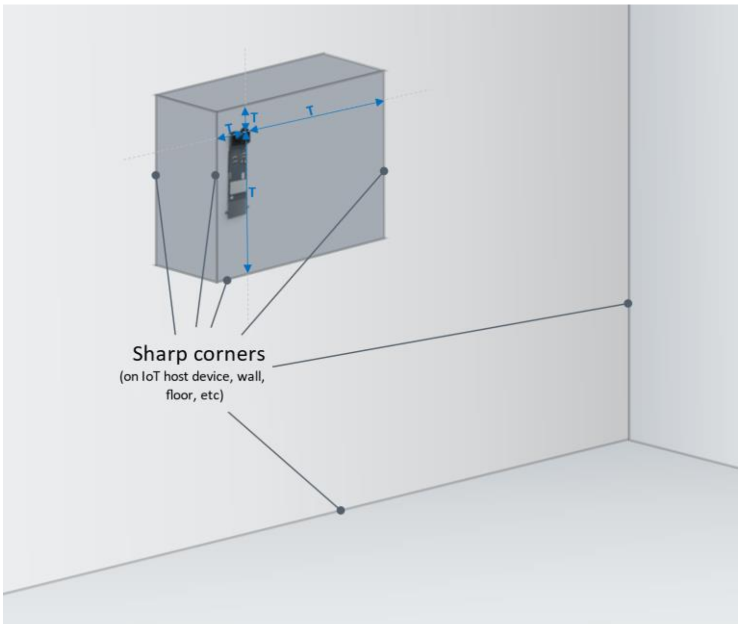


Figure 9: Placement of BMV080 away from sharp edges

3.3.2.1 Case 1: Wall-mounted device with the BMV080 facing front

- For the case below, follow distances in Table 3 to ensure an unobstructed measurement with the BMV080

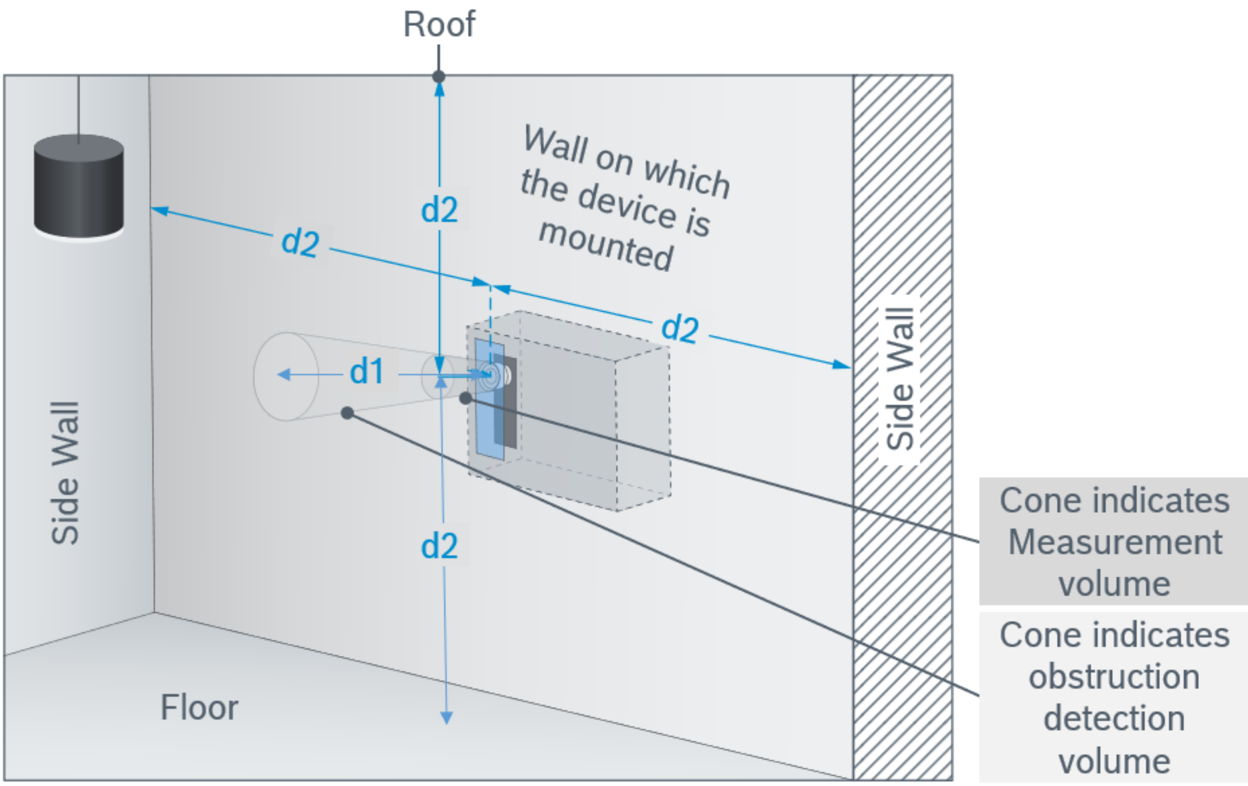


Figure 10: BMV080 (facing front) on host device

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

Obstruction notifier	**Obstruction sensitive range** axial-direction **(d1)**	**Obstruction sensitive range** radial-direction **(d2)**
Enabled (default)	0 – 350 mm	0 – 210 mm

Table 3: Relevant obstruction sensitive ranges with BMV080 (facing front) on host device

3.3.2.2 Case 2: Wall-mounted device with BMV080 facing left or right

- For the case below, follow distances in Table 4 to ensure an unobstructed measurement with the BMV080

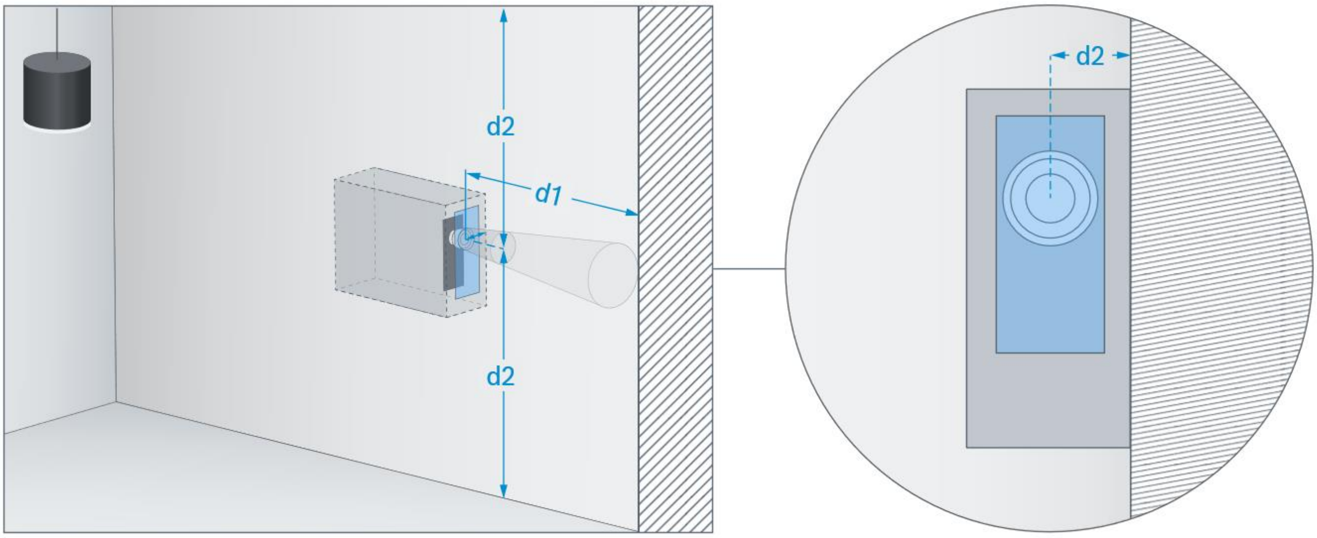


Figure 11: BMV080 (facing left or right) on host device

Obstruction notifier	**Obstruction sensitive range** axial-direction **(d1)**	**Obstruction sensitive range** radial-direction **(d2)**
Enabled (default)	0 – 350 mm	0 – 210 mm

Table 4: Relevant obstruction sensitive ranges with BMV080 (facing left or right) on host device

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

Note

- If BMV080 needs to be mounted closer to the mounting surface (e.g., wall), BMV080 must be tilted away from the surface as depicted in Figure 12 and Figure 13

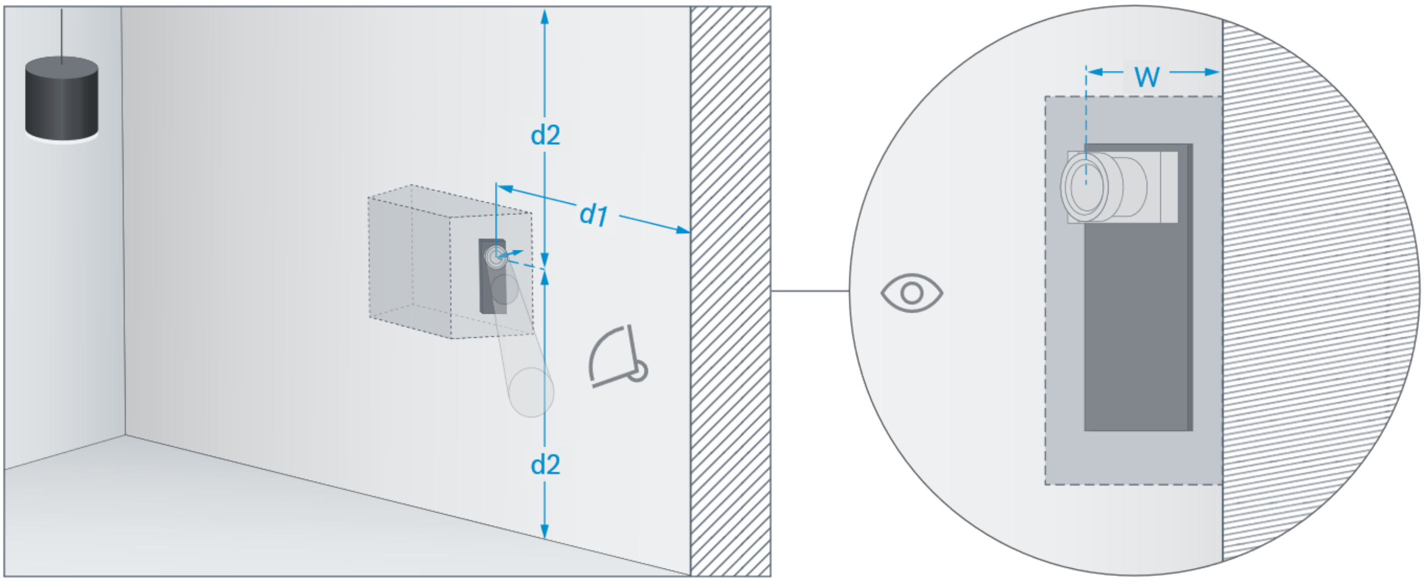


Figure 12: BMV080 (facing left or right) when mounted closer to the wall on host device

- Please refer to the recommended distance 'W' in Table 5 to ensure an unobstructed measurement with BMV080

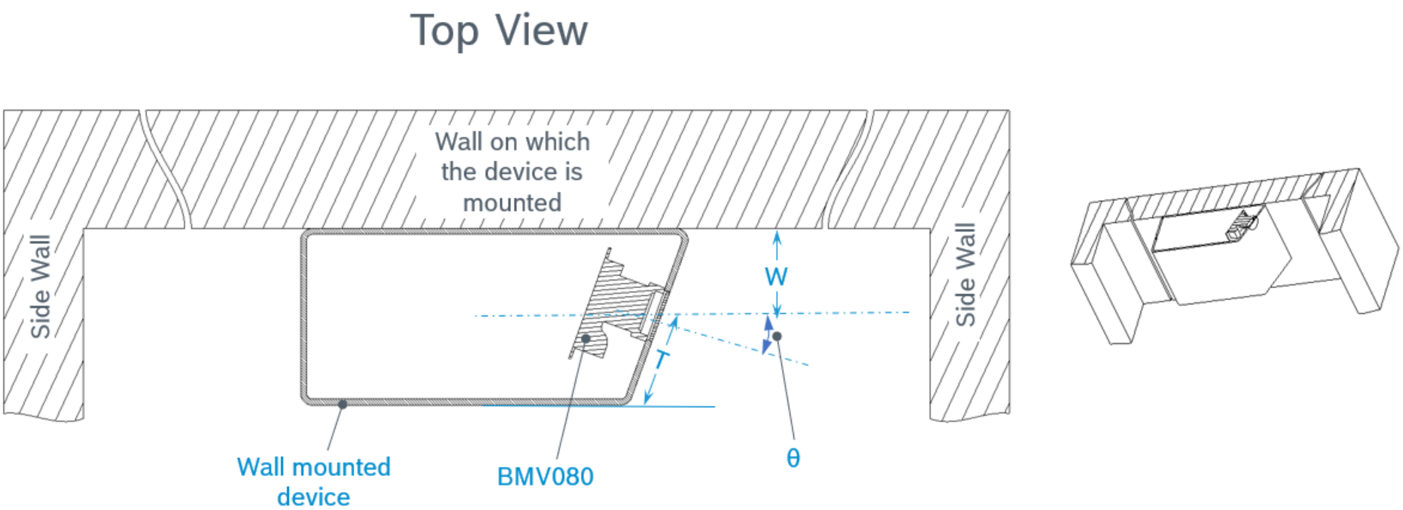


Figure 13: Schematic of BMV080 (facing left or right) when mounted closer to the wall on host device

Obstruction notifier	W
Enabled (default)	func = 420 * Sin (30 - θ) mm *If [func] > 10 mm, then consider W = func* *Else If [func] ≤ 10 mm, then consider W ≥ 10 mm*

Table 5: BMV080 distance to the mounting surface when placed down closer to the surface

W: Distance between 'lens top center' to the surface (e.g., wall) on which the device is mounted
θ: Angle (in degrees) between the 'lens axis' and the surface (e.g., wall) on which the device is mounted
T: A minimum of 17 mm must be available to reduce turbulent air flow near the measurement range

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

- It is recommended to ensure laminar air flow conditions to get best BMV080 sensing performance by following the guideline as per Figure 14

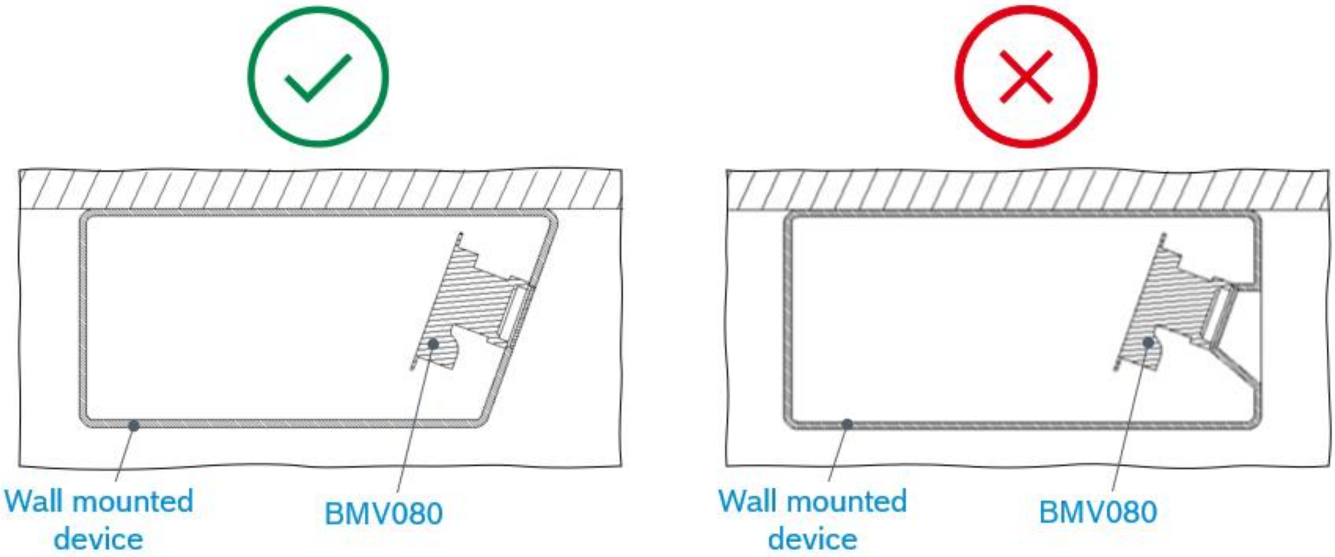


Figure 14: Schematic of BMV080 (facing left or right) when mounted closer to wall on host to ensure laminar airflow

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.3.2.3 Case 3: Wall-mounted device with BMV080 facing down

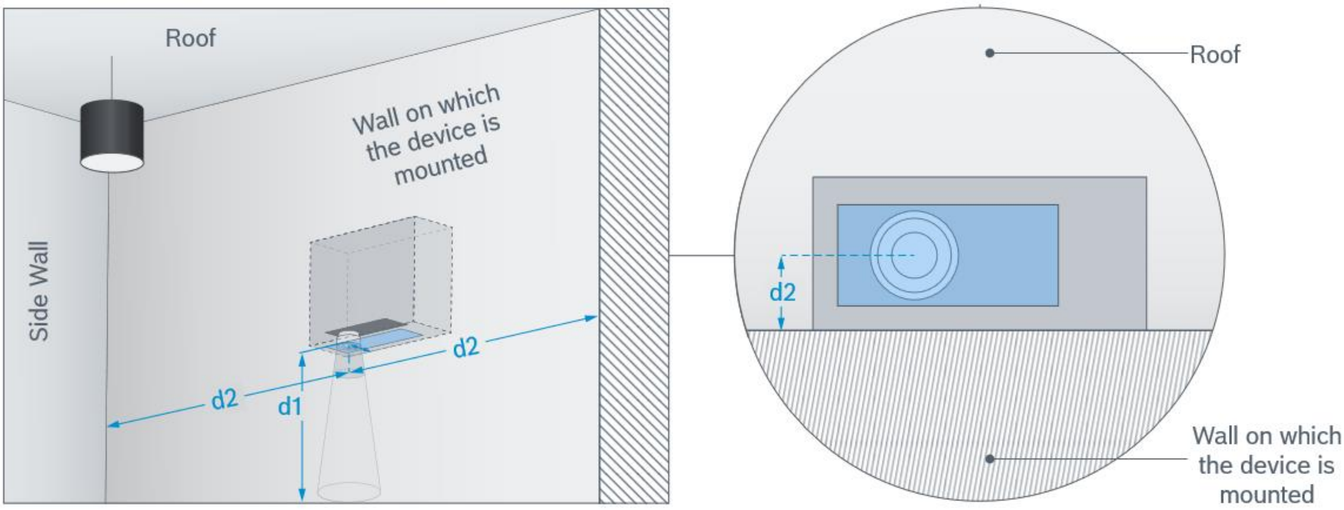


Figure 15: BMV080 (facing down) on host device

Obstruction notifier	Obstruction sensitive range axial-direction **(d1)**	Obstruction sensitive range radial-direction **(d2)**
Enabled (default)	0 – 350 mm	0 – 210 mm

Table 6: Relevant obstruction sensitive ranges with BMV080 (facing down) on host device

Note

- If the BMV080 needs to be mounted closer to the mounting surface (e.g., wall), the sensor must be tilted away from the surface as depicted in Figure 16 and Figure 17

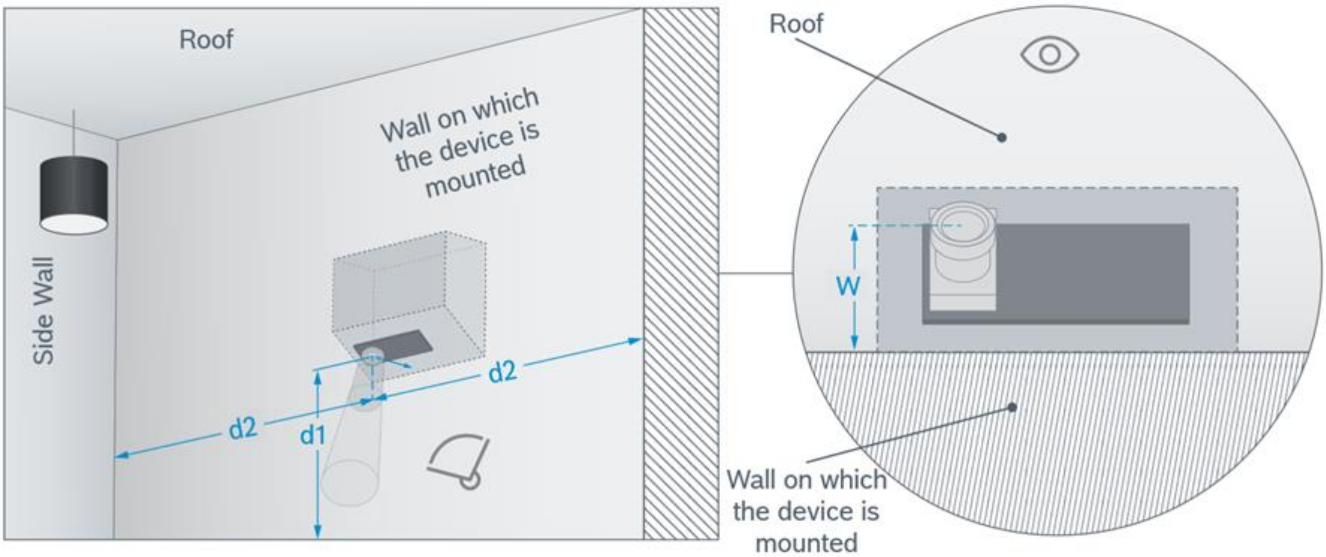


Figure 16: BMV080 (facing down) when mounted closer to the wall on host device

- Please refer to the recommended distance 'W' provided in Table 7 to ensure unobstructed measurement

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

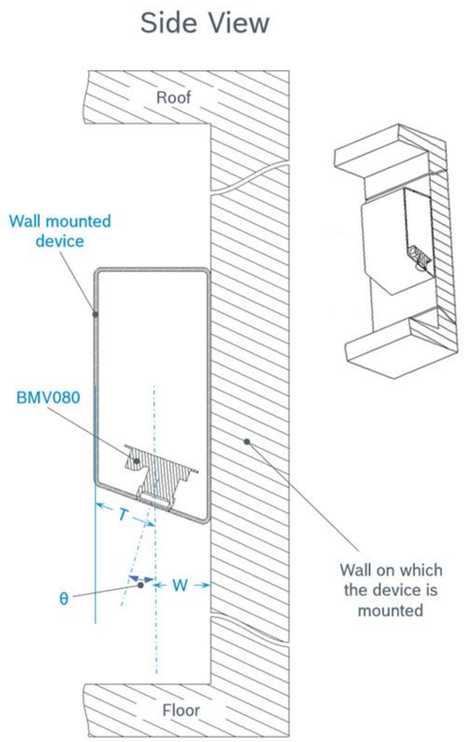


Figure 17: Schematic of BMV080 (facing down) when mounted closer to the wall on host device

Obstruction notifier	W
Enabled (default)	func = 420 * Sin (30 - θ) mm *If [func] > 10 mm, then consider W = func* *Else If [func] ≤ 10 mm, then consider W ≥ 10 mm*

Table 7: BMV080 distance to the mounting surface when placed down closer to the surface

W: Distance between the lens top center to the surface (e.g., wall) on which the device is mounted
θ: Angle (°) between the lens axis and the surface (e.g., wall) on which the device is mounted
T: A minimum of 17 mm must be available to reduce the turbulent flow near the measurement range

- It is recommended to ensure laminar air flow conditions to get best BMV080 sensing performance by following the guideline as per Figure 18

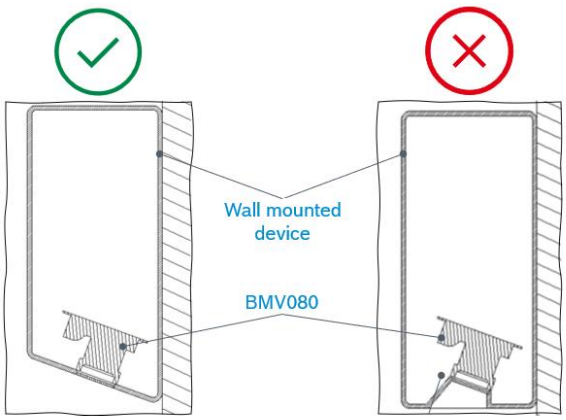


Figure 18: Schematic of BMV080 (facing down) when mounted closer to wall on host to ensure laminar airflow

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.3.3 Table-top device

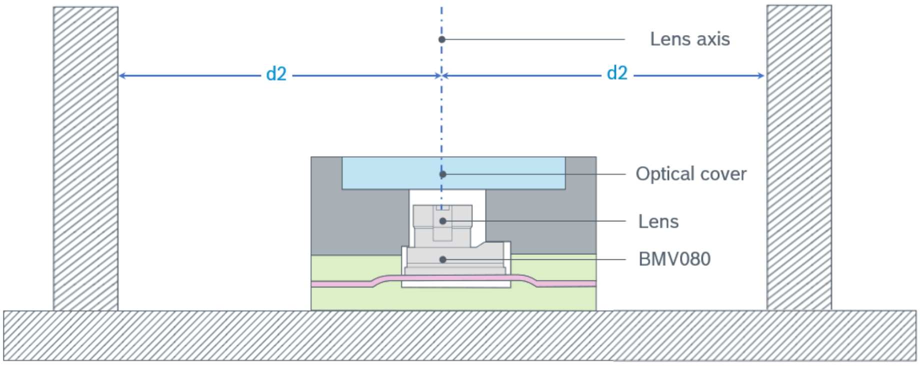


Figure 19: BMV080 (facing up in table top device) on host device

- For the case below, follow recommended distances below which ensures an unobstructed measurement

Obstruction notifier	**Obstruction sensitive range** radial-direction **(d2)**
Enabled (default)	0 – 210 mm

Table 8: Relevant obstruction sensitive range with BMV080 (facing up in table top device) on host device

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.4 Thermal integration best practices

- The thermal integration design must consider the ambient temperature range of the intended use-case to ensure BMV080's operating temperature range is not exceeded
- If the BMV080 is operated outside the operating temperature range, the sensing performance is not guaranteed and the operating lifetime is impacted negatively
- To avoid this, a thermal management system is recommended to dissipate heat generated by the BMV080

3.4.1 Typical thermal integration setup and recommended design considerations

- Figure 20 shows a typical thermal integration setup where the *lower surface of the BMV080 flex PCB* (referred to as the BMV080Node) is attached to a cooling element (e.g., a heat sink) via a thermal contact (in this case, a thermal tape) and the heat sink itself is attached to the host

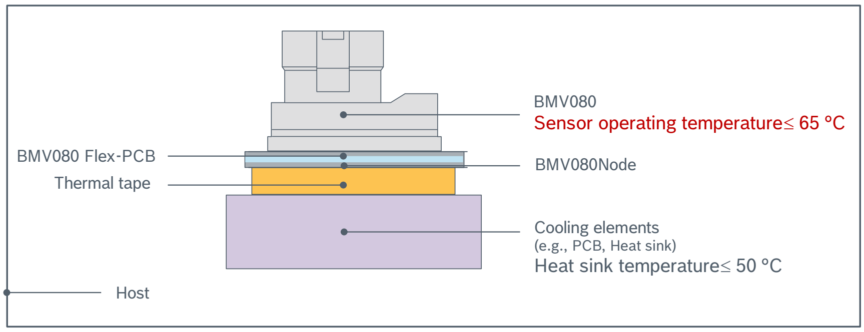


Figure 20: Typical thermal integration setup

- **Thermal contact**
  - It is important that the thermal contact between BMV080Node (lower surface of flex PCB) and the attached cooling element (e.g., heat sink) remains intact as a break in this contact can increase sensor temperature above the allowed range
  - Below are some thermal contact examples for consideration:
    - Würth Elektronik WE-TTT
    - Fischer Elektronik, WLFT 412 (Material: 10169226)
    - Thermattach T412
    - Copper foil conductive adhesive on both sides
- **Measurement mode**
  - Measurement mode with the longest *on-time* must be considered for the thermal integration design
- When designing thermal interface from BMV080 flex PCB to the host, parameters in Table 9 must be considered

Parameter	Value
Maximum sensor operating temperature	65°C
Maximum heat sink temperature	50°C
Maximum power (continuous measurement) (Pmax)	181.9[2] mW

Table 9: Parameters to be considered for thermal integration

Example of thermal integration setup considering the above parameters:

Given that the sensor internal temperature increases by ~15K (vs. heat sink temperature) due to power dissipation in the sensor in continuous measurement mode with the 3.6.1.2 Power Optimized Configuration

- An assumption of host internal temperature increase of ~5K (e.g., due to heat source from microcontrollers, etc) would lead to an ambient temperature range between -5°C – 45° C
- An assumption of host internal temperature increase of ~10K (e.g., due to heat source from microcontrollers, etc) would lead to an ambient temperature range between -10°C – 40° C

[2] Power consumption estimation is based on electrical integration of the BMV080 using Power Optimized Configuration as per 3.6.1.2

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

- **Heat sink**
  - While connecting heat sink to lower surface of flex PCB, ensure no gap between heat sink and LGA as shown in Figure 21
  - The heat sink shall cover complete LGA area on the lower side of the BMV080 as shown in Figure 22
  - How a proper thermal connection shall look is depicted in Figure 23

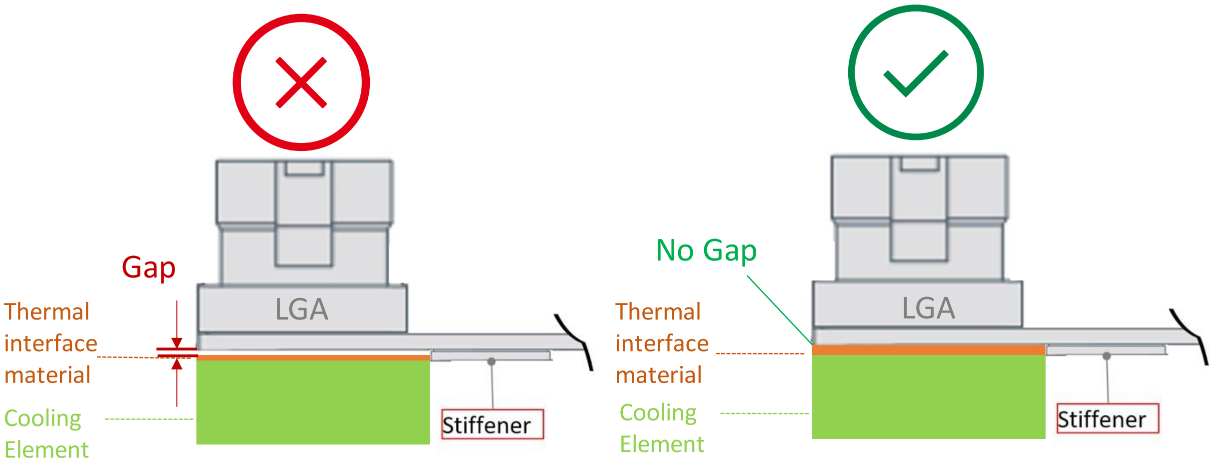


Figure 21: Recommendation to integrate BMV080 to the heat sink without gap

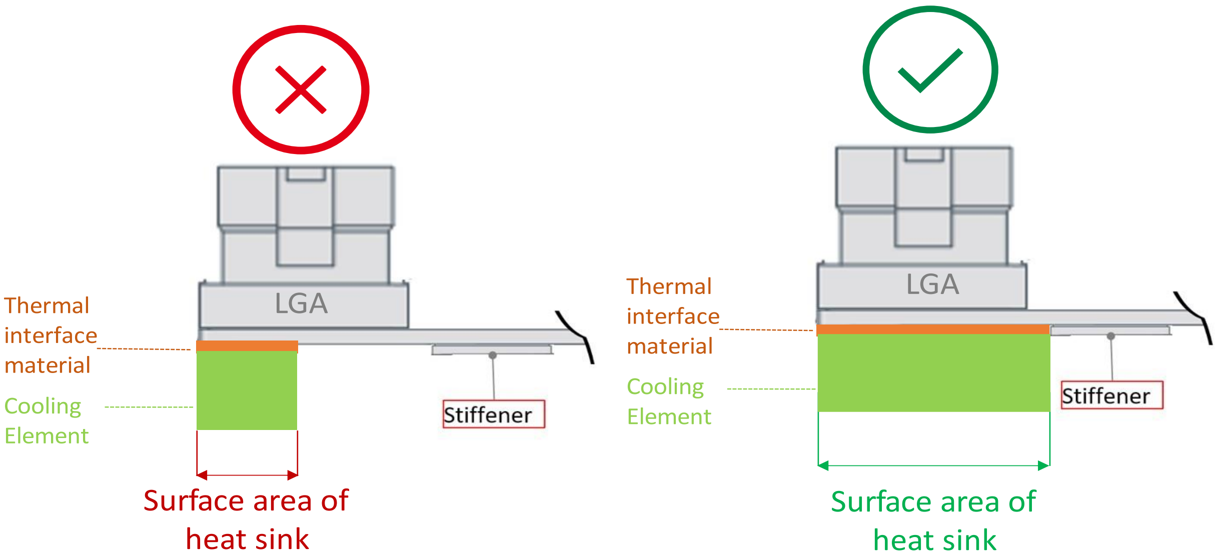


Figure 22: Recommendation to integrate heat sink covering the complete LGA area on lower side of BMV080

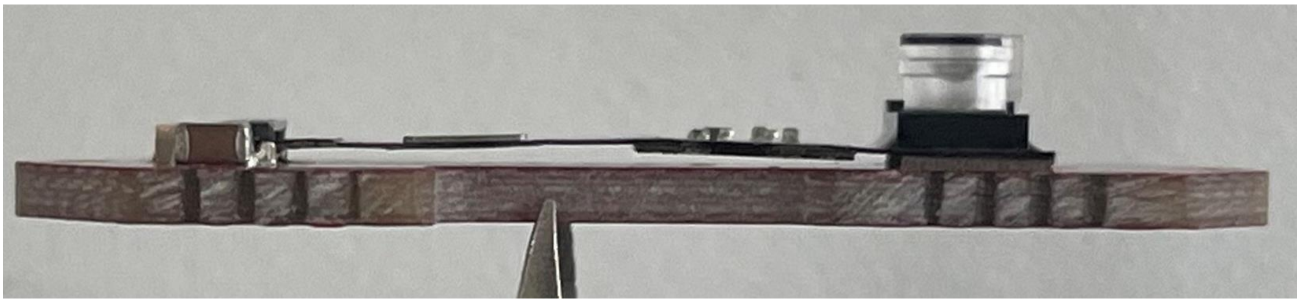


Figure 23: Depiction of proper thermal connection

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.5 Optical integration best practices

In the host system, the BMV080 must be integrated behind an optical cover to protect the *lens* from contamination (dust, fingerprints) and mechanical damage. This section provides recommendations on the opto-mechanical properties to be considered for the optical cover.

3.5.1 Mechanical properties of optical cover

The following mechanical properties must be followed:

- **Optical cover thickness (d) and clearance (σ) between the lens and optical cover**
  - The sensitive measurement range is approx. between 5 – 10 mm above the lens surface and must be above the optical cover i.e., outside the host in free space
- **Optical window width (Φ)**
  - The optical cover has to be wide enough to transmit the laser beams
- **Maximum tilt angle (α) between the optical cover and the BMV080**
  - The lens surface and the optical cover must be almost parallel to avoid distorting the optical signal.
  - Figure 24 and Table 10 show the mechanical requirements of the optical interface

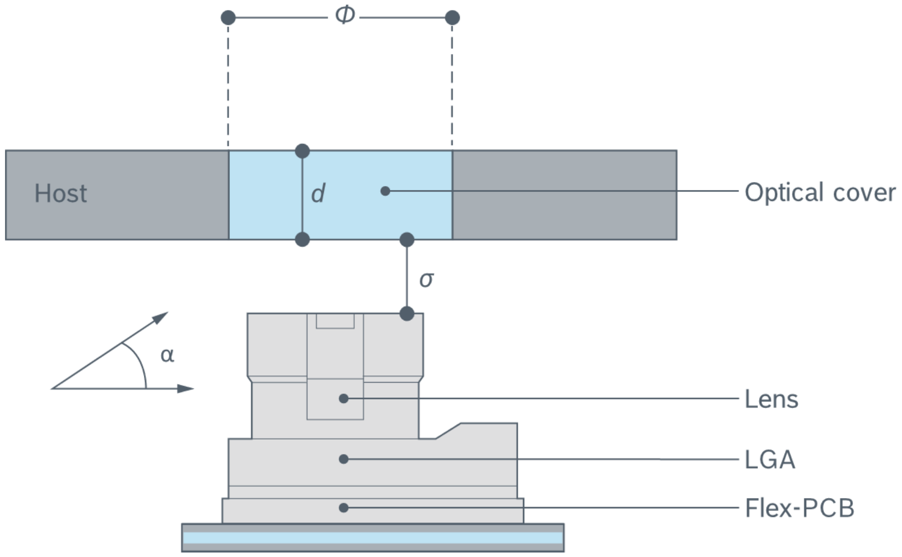


Figure 24: Optical interface

Parameter	Symbol	Value	Unit
Optical cover thickness	d	0.3 ≤ d ≤ 0.8	mm
Optical window width	Φ	≥ 1.4	mm
Tilt angle	α	≤ 4	°
Clearance between the top of the BMV080 lens and the bottom of the optical cover	σ	0.35 ± 0.1	mm

Table 10: Mechanical properties of optical interface

- Scratches and damage on the optical cover can affect the sensor performance
- A hard material like glass is recommended (e.g., Corning® Gorilla® Glass 6)
- The optical cover must be kept free from fingerprints, dust, and other impurities and contaminations

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.5.2 Optical properties of optical cover

It is strongly recommended to consider an optical cover which has the following optical properties:

- **Refractive index:** This parameter influences the laser beam shape, and ,therefore, needs to be specified to avoid affecting sensor performance
- **Transmissivity:** The cover glass must allow the transmission of the laser beams. A transmissivity below specifications will decrease the optical signal intensity, thus affecting the sensor performance

Parameter	Typical value
Refractive index	1.45 – 1.77 for λ = 850 nm
Transmissivity	≥90% for an angle of incidence of 30°, P-polarization, λ = 850 nm

Table 11: Optical power properties

- **Optical surface roughness:** It is recommended to have max 5 nm RMS for ideal sensor performance, although surface roughness up to 10 nm RMS should also be feasible with robust integration of optical cover to minimize 'vibrations' during sensor operation
- **Polarization:** Optical cover shall be non-polarizing
- **Scratch-Dig:** It is recommended to have 40/20 for ideal sensor performance. However, a scratch-dig up to 60/40 (with degradation of optical cover over its lifetime) may also be acceptable, but with minor impact to sensor performance (sensor to sensor variation)

3.5.2.1 Flat optical cover (glass material)

Please consider the properties for flat optical cover listed under Table 10 and under Table 11.

3.5.2.2 Curved optical cover (glass material)

In addition to the properties listed under Table 10 and under Table 11, please consider the following properties for curved optical covers.

- **Radius of curvature:** A minimum recommended radius of curvature of 100 mm is recommended

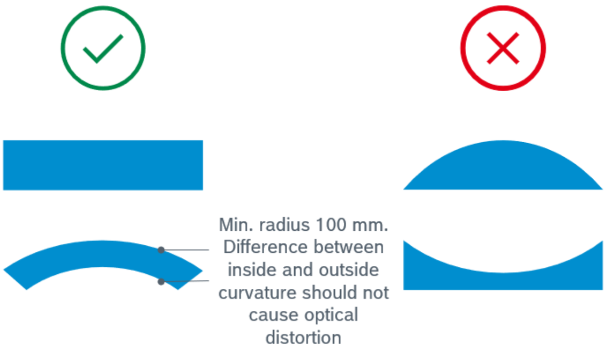


Figure 25: Recommended optical cover glass geometry

3.5.2.3 Optical cover (plastic material)

Plastic based optical covers are technically feasible provided the following considerations are taken care of:

- The plastic based optical cover shall have a transmission >90%
- Additionally, plastic based optical covers if chosen shall:
    - be non-polarizing, non-yellowing and scratch resistant
    - have refractive index 'similar' to glass
    - have stress birefringence ≤10 milli-lambda
- Ink based plastic optical covers (similar to inked glass) are technical feasible as long as:
    - Plastic based optical cover after inking ideally results in transmissivity >90%

Hint: It is important to consider the type of ink being used (e.g., some organic inks contain polymers that lead to polarization which shall be avoided)

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.5.2.4 Optical Materials Examples

The third-party optical materials listed below are provided as non-binding recommendations to support material selection. Each must be independently assessed and qualified by the host to ensure suitability for the intended application or use case. Examples include:

- Glass, Transparent (visible spectrum): e.g., Schott BOROFLOAT® 33
- Glass, Tinted (visible spectrum): e.g., Schott RG 695, RG715
- Plastic, Transparent (visible spectrum): e.g., Clarex - Precision Sheet, Non-Glare Sheet, Hard Coat Sheet
- Plastic, Tinted (visible spectrum): e.g., Clarex NIR- 70N, NIR-75N

Final integration decisions should be guided by application-specific requirements and supported by appropriate validation efforts.

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.6 Electrical integration best practices

3.6.1 Voltage domains

- The BMV080 has four power domains with different voltages they can operate at and Table 12 summarizes the main limits of the power domains

Voltage domain	Supported voltage range limits	Supply voltage requirements	Absolute maximum rating
VDDIO	1.2 – 3.3 V	±5%	3.6V
VDDL	3.3 – 3.3 V	±5%, max ripple 100 mV_{pp}	3.6V
VDDA	2.5 – 3.3 V	±5%, max ripple 100 mV_{pp}	3.6V
VDDD	2.5 – 3.3 V	±5%	3.6V

Table 12: Main limits of the power domains

- The following subsection show connection diagrams of how to connect the BMV080 to a host system electrically
- Common acronyms used in every connection diagram are *voltage battery* (VBAT) and *power management integrated circuit* (PMIC)

3.6.1.1 Single supply rail

- Figure 26 illustrates the simplest connection possible where all four power domains of the BMV080, i.e., VDDL, VDDA, VDDD, and VDDIO, are powered by the same rail (3.3V)
- The power consumption of BMV080 is highest since VDDA and VDDD are supplied at the highest voltage possible

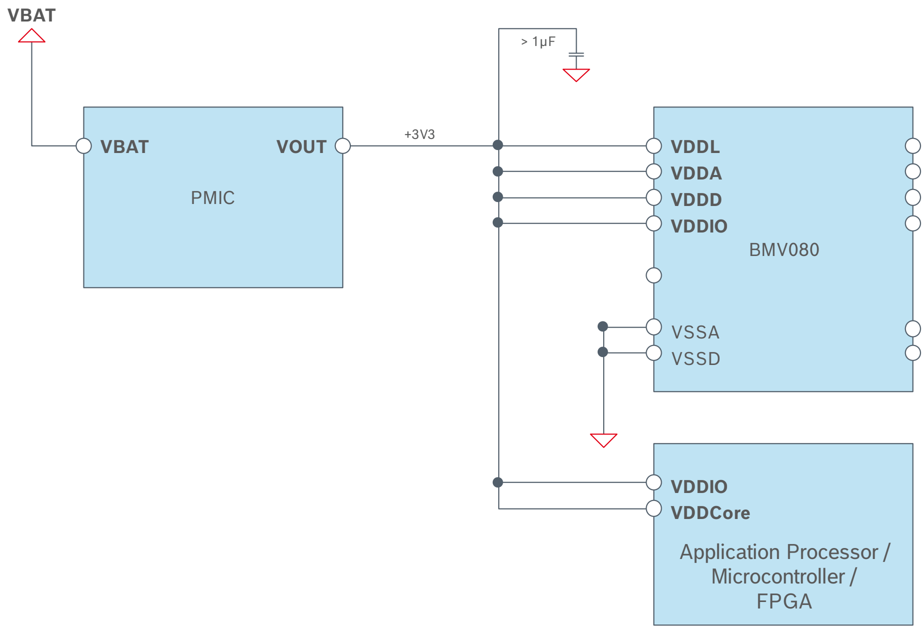


Figure 26: Power-supply configuration with a single supply rail

Advantages and Disadvantages of a Single Supply Rail	
Pros	▪ Simple power supply setup (one voltage) ▪ Power-up sequence not needed if VDDD and VDDIO are connected to the same power rail
Cons	▪ Higher power consumption compared to multi-supply rail (as current remains the same) which: ○ ...requires better thermal management technique ○ ...can result in increased temperature; decreasing BMV080 lifetime ▪ Leads to VDDIO and VDDD having higher ripple (±5%, max ripple 100 mV_{pp})

Table 13: Advantages and things to consider when deciding on single supply rail

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.6.1.2 Multi-supply rail (Power Optimized Configuration)

Figure 27 shows a connection diagram targeting lowest power consumption for each BMV080 power domain, while keeping maximum speed on SPI interface. Therefore, each power domain is supplied at its lowest allowed voltage:

- VDDL is supplied at 3.3V
- VDDA and VDDD are supplied at 2.5V
- VDDIO is supplied by a second PMIC supplying the host (e.g., Application Processor, Microcontroller, or FPGA)

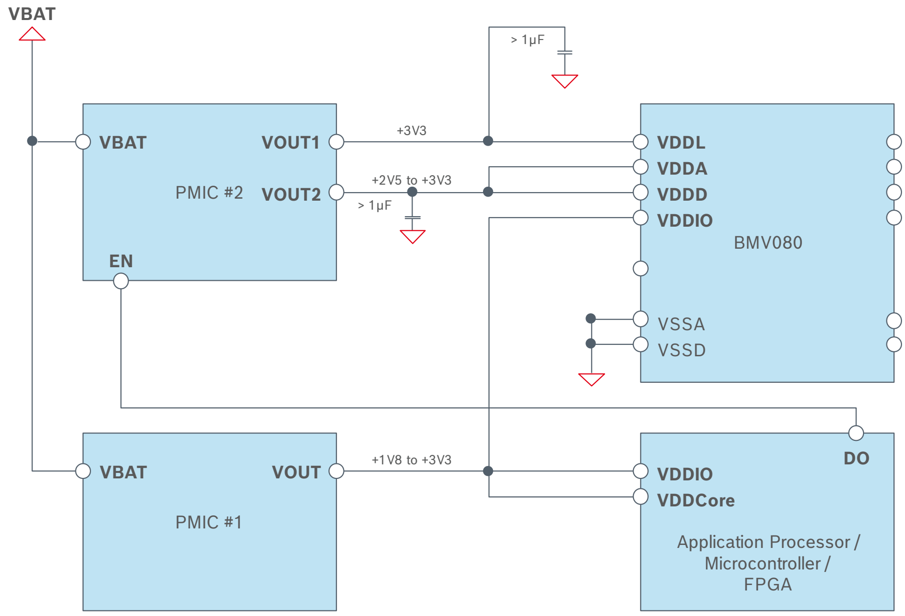


Figure 27: Power-supply configuration with the lowest voltage level

- Since VDDD and VDDIO do not share the same power rail, a power-up sequence has to be implemented to ensure the latching of the correct information during start-up (see Figure 28)
- For this purpose, it is possible to use a dedicated PMIC (PMIC #2) controlled by the host
- The sequence is as follows:
  - PMIC #1 supplies the host and also provides VDDIO to BMV080; the host boots up
  - After the required period, a digital output (DO) of the host is used to enable the PMIC #2
  - PMIC #2 supplies the remaining domains of BMV080, i.e., VDDL, VDDA, and VDDD
- Whenever BMV080 is not actively measuring, further energy consumption can be saved by powering off BMV080 instead of putting it into sleep mode. This can be done by disabling PMIC #2 through an enable command generated by the host application processor/microcontroller/FPGA

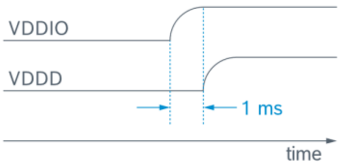


Figure 28: Power-up sequence diagram

Pros and cons of multi-supply rail (power optimized config)	
Pros	▪ Power consumption lower (by approx. 20%) than single-suppy ▪ Lower power consumption leads to lower temperature and longer lifetime
Cons	▪ Separate circuits need to be considered for different voltages ▪ Power-up sequence has to be implemented (VDDIO 1 ms before VDDD, see Figure 28)

Table 14: Advantages and things to consider when deciding on multi supply rail

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.6.2 Polarity of Voltage domains

For optimal functionality of the BMV080, it is highly recommended to use the correct polarities for all voltage domains (VDDL, VDDA, VDDD, VDDIO) as shown in the Figure 29. Reversing the polarity can cause permanent damage to the sensor and should be avoided.

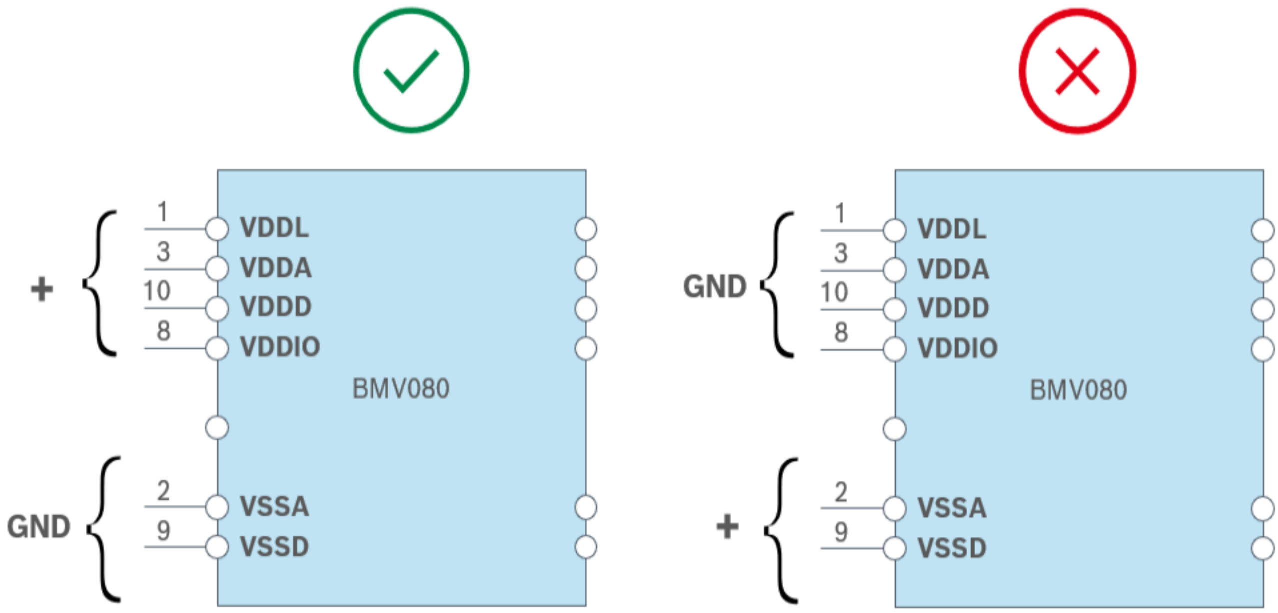


Figure 29: Polarity of Voltage domains - Best Practice

3.6.3 Power consumption

- BMV080 estimates particulate matter mass concentration based on internally measuring relative particle velocity

Measurement mode	**Duty cycling period**	**Power consumption (mW)** [3]
Duty cycling mode	5 min 1 measurement every 5 min	6.2
	10 min 1 measurement every 10 min	3.1
	60 min 1 measurement every 60 min	0.6
Continuous mode 1 measurement every 1 sec	Not applicable	181.9

Table 15: Estimated power consumption

[3] Power consumption estimation is based on electrical integration of the BMV080 using Power Optimized Configuration as per 3.6.1.2.

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

When choosing the right voltage domains and measurement mode for your application, consider the following points:

- The BMV080 measures near the surface (see Figure 30) of the lens

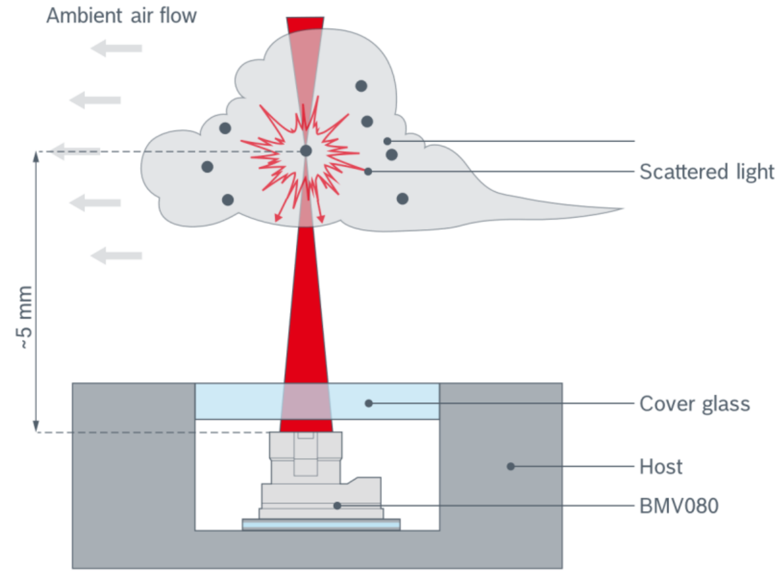


Figure 30: BMV080 measurement distance

- The bulk particle velocity away from the measuring distance of the BMV080 can be significantly higher
- The BMV080 has four power domains, listed in Table 16.
- The passive components specific to the four BMV080 power domains are included on the flex-PCB

Power domain	**Electrical specification**		**Power supply rejection ration**	**Absolute max. rating**	**Current consumption**	
	Min	**Max**			**Sleep mode**	**Measurement mode**
VDDIO[4]	1.2 V - 5%	3.3V + 5%	Ensure dynamically the listed min. and max. supply values	3.6 V	<3 µA	0.8 mA
VDDD	2.5 V - 5%	3.3V + 5%	Ensure dynamically the listed min. and max. supply values	3.6 V	<15 µA	21.6 mA
VDDL	3.3 V ± 5%		100 mV VPP at any frequency	3.6 V	<3 µA	18.29 mA
VDDA	2.5 V - 5%	3.3 V + 5%	100 mV VPP at any frequency	3.6 V	<3 µA	27.0 mA

Table 16: Power domain specifications and current consumption

[4] Reduced SPI speed for VDDIO < 1.8 V

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.6.4 Flex PCB connector

The connector on BMV080's flex PCB is compatible with the following ZIF connectors (to be used by host system):

- Molex 503566-1302
- KYOCERA AVX, Series 6844, Part number: 046844713002846+
- Greenconn, Part number CFTD104-1302A001C2AD

3.6.5 Pinout configuration and function

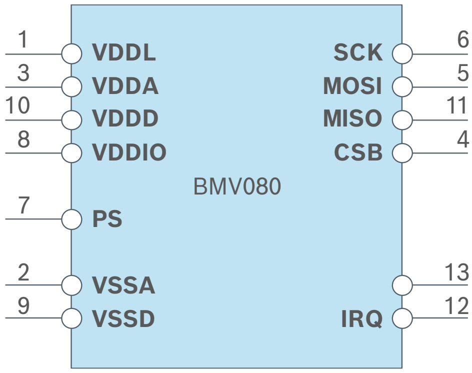


Figure 31: BMV080 pin schematic

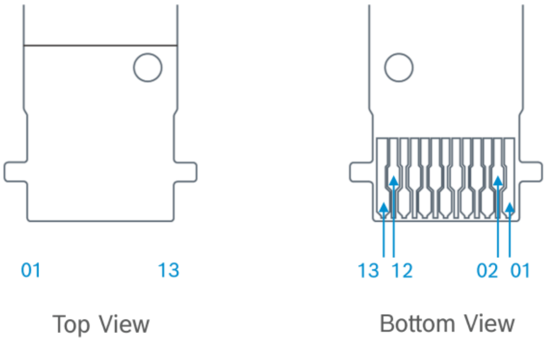


Figure 32: Flex PCB showing the connector pin numbering

- The protocol select (PS) pin is a logic input to configure the type serial interface, SPI, or I^2C
- Figure 33 shows how the PS pin can be connected to select SPI or the I^2C protocol
  - SPI protocol is selected when this pin is tied to a logic low (VSSD)
  - I^2C protocol is selected when this pin is is tied to a logic high (VDDIO)
  - If this pin is not connected (not recommended), I^2C protocol is selected
- The pin state is latched during power-up by BMV080's internal digital core

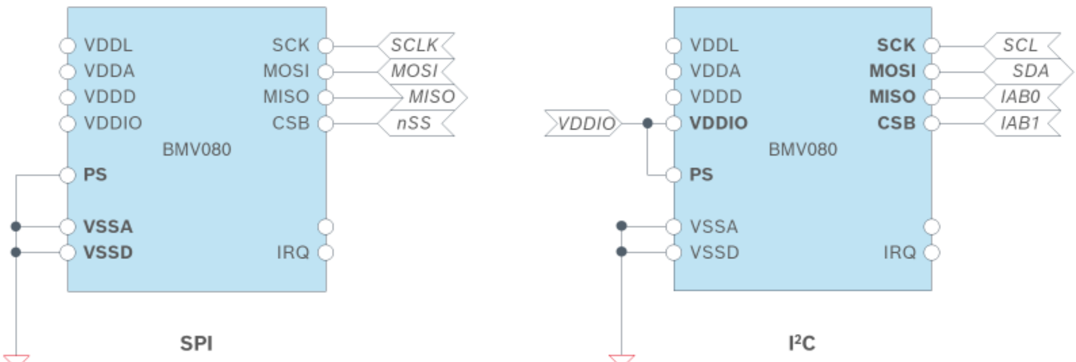


Figure 33: Configurations to select communication interface (SPI / I^2C)

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

Label	**Pin No.**	**Type** [5]	**Description**
VDDL	1	P	Laser supply voltage The laser supply voltage is 3.3V and the supply pin should be decoupled from VSSA by >1µF
VDDA	3	P	ADC supply voltage The ADC supply voltage is 2.5V– 3.3V which should be decoupled from VSSA by >1µF
VDDD	10	P	Digital supply voltage The digital supply voltage is 2.5V to 3.3V which should be decoupled from VSSD by >1µF
VDDIO	8	P	Interface power supply The interface power supply is from 1.2V (min) to 3.3V (max), with 1.8 V being the typical value. This pin is typically connected to the same supply of the host interface (e.g., application processor, microcontroller, or FPGA)
PS	7	DI	Protocol select. Logic input This pin is used to to configure the type of serial interface, SPI or I²C. • 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 **Note** • 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
VSSA	2	GND	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
VSSD	9	GND	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
SCK	6	DI	Serial clock. Digital input. This pin functions as serial input for both serial interface protocols (SPI and I²C)
MOSI	5	DI/DO	SPI: This pin functions as Master Out Slave In (MOSI) I²C: This pin functions as a Serial Data line (SDA)
MISO	11	DI/DO	SPI: This pin functions as Master In Slave Out (MISO) I²C: 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)
CSB	4	DI	SPI: This pin functions as not Slave Select (nSS) I²C: 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)
IRQ	12	DO	Interrupt line. Digital out. Active low. Internal pull-up is enabled by default for IRQ pin.
Do not connect	13	DO	Keep pin floating. Do not connect to ground or apply voltage.

Table 17: BMV080 pin description

3.6.6 SCK Line Filtering Recommendation

In environments where significant electrical noise is present—either within the host device or during operation—it is recommended to implement an appropriate filter on the SCK line (Pin 6) to ensure optimal performance of the BMV080 sensor. The specific filter design and component values (e.g., resistors, capacitors) should be determined based on the electrical characteristics of the host system. To maximize effectiveness, the passive components should be placed as close as possible to the SCK pin on the PCB layout.

3.6.7 Cleanliness of Host PCB

It is recommended to clean the host PCB before assembling the BMV080. Residual contaminants such as solder flux may outgas or migrate over time, potentially contaminating the sensor and affecting long-term performance.

[5] P = power supply, DI = digital in, DO = digital out, GND = ground

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.7 Environmental protection best practices

3.7.1 Ingress protection (IP)

- Ensure protection against dust particles covering the lens during assembly and the lifetime of the host device
    - The BMV080 itself has an IPX0 rating, meaning it has no intrinsic protection against water or chemicals
- The design of the host device must incorporate water protection and prevent condensation on the surface of the BMV080. If the condensation is outside of the optical cover, it is recommended to use a microfiber cloth to clean the optical cover to avoid potential scratches on the optical cover surface

3.7.2 Proximity to heat sources

Heat sources affecting BMV080 to operate outside its operating temperature range (>65°C) (see section 3.4) negatively impacts its lifetime.

3.7.2.1 Internal heat sources

To minimize impact from internal heat sources on the BMV080, follow these recommendations:

- Keep BMV080 away from heat sources that could cause it to operate outside its recommended temperature range
    - Heat sources can include radiators or other hot electronic components
    - The distance at which the BMV080 shall be kept from such heat sources depends on various factors, including nature of the heat source, ambient temperature, and the airflow around the host device
- Install BMV080 at a sufficient distance from heat sources to avoid direct exposure to high temperatures

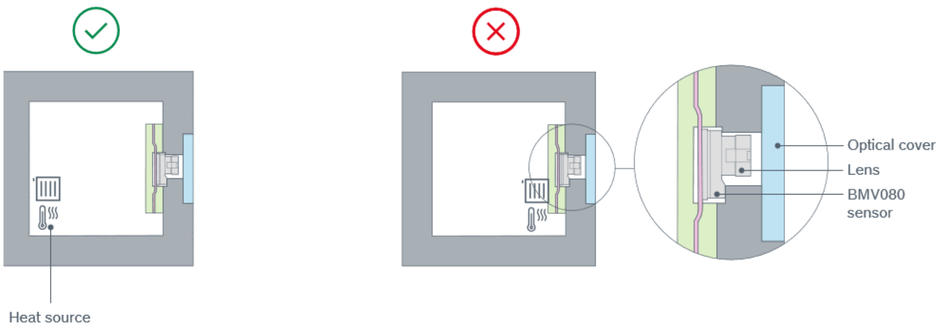


Figure 34: Positioning BMV080 in proximity to internal heat sources

3.7.2.2 Proximity to external heat sources

To minimize impact of external heat sources on the BMV080, follow these recommendations:

- Direct exposure to external heat sources can lead BMV080 to heat over recommended temperature range It is recommended to manage temperature and airflow around BMV080 using heat sinks

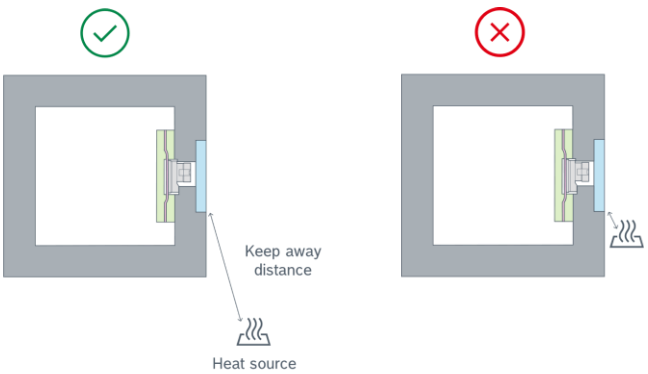


Figure 35: Positioning of the BMV080 in proximity to external heat sources

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.7.3 Proximity to humidity

When exposed to high humidity levels, the BMV080 optical cover can become coated with moisture, interfering with the way particles in the air scatter light, which in turn has an impact on measurement precision.

To minimize impact of humidity on the BMV080, follow these recommendations:

- Take steps to manage condensation around or on the BMV080 and cover glass
- Monitor the humidity levels around the BMV080 during operation and remove any moisture that may accumulate on the optcal cover
- Wipe the optical cover with a dry microfiber cloth to avoid potential scratches on the optical cover surface

3.7.4 Maintenance and Service

Due to its unique measurement principle, the BMV080 particulate matter sensor does not comprise an air inlet or any moving or rotating parts (like e.g. a fan), i.e. the sensor is designed to be maintenance free. Therefore, there is no need for the user to perform regular maintenance or service tasks.

However, it is possible that dust, fingerprints or other contamination accumulates on the outer surface of the cover glass of the host system. This might lead to a slight impact on the sensor performance. Hence, it can be beneficial to clean the cover glass surface using a wiping tissue from time to time. A suitable tissue shall be used to avoid scratches on the cover glass.

3.7.5 Storage Conditions

Table 17 outlines the storage conditions for the BMV080 to ensure its specified lifetime and performance.

Packing status	Storage conditions			Remark
	Temperature (°C)	Humidity rH (%)	Max Storage Time	
BMV080 drypack sealed (as delivered)	-40 to +70	not relevant	2 years	Regular storage
BMV080 drypack opened under air	+20 to +30	<60 (Air)	1 week	Handling before integration
	Equivalent to MSL3			
BMV080 integrated[6] and not operated	+10 - +40	<60 (non-condensing)	18 months	Handling after integration
BMV080 drypack opened in N_2 cabinet	+20 to +30	<30 (N_2)	6 months	N_2 flow rate: >3L/min

Table 18: Storage Conditions for BMV080

[6] Built into the final product following the guidelines in this document

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.8 Software integration best practices

The BMV080 Software Development Kit (SDK) provides the BMV080 sensor driver (as static libraries) along with examples for selected supported hardware platforms to demonstrate the usage of the BMV080 API and to simplify software integration into the user application.

The BMV080 sensor driver serves as the interface between the sensor hardware and the user application running on the host system. The complete sensor driver is provided by Bosch Sensortec to run on the host microcontroller / processor.

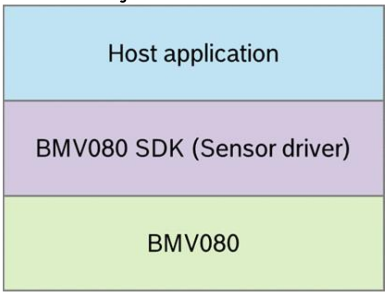


Figure 36: The sensor driver is the communication channel between the BMV080 and the user application

The sensor driver provides high-level, feature-oriented Application Programming Interfaces (APIs), hiding the peripheral complexity from the user application developers. It includes a complete set of ready-to-use APIs in order to simplify the development of user applications. These functions can be easily used to develop an application for specific use cases.

3.8.1 Contents of the BMV080 SDK

The main contents of the SDK archive are shown in Figure 37 and include the sensor driver (API), API examples, and application tools.

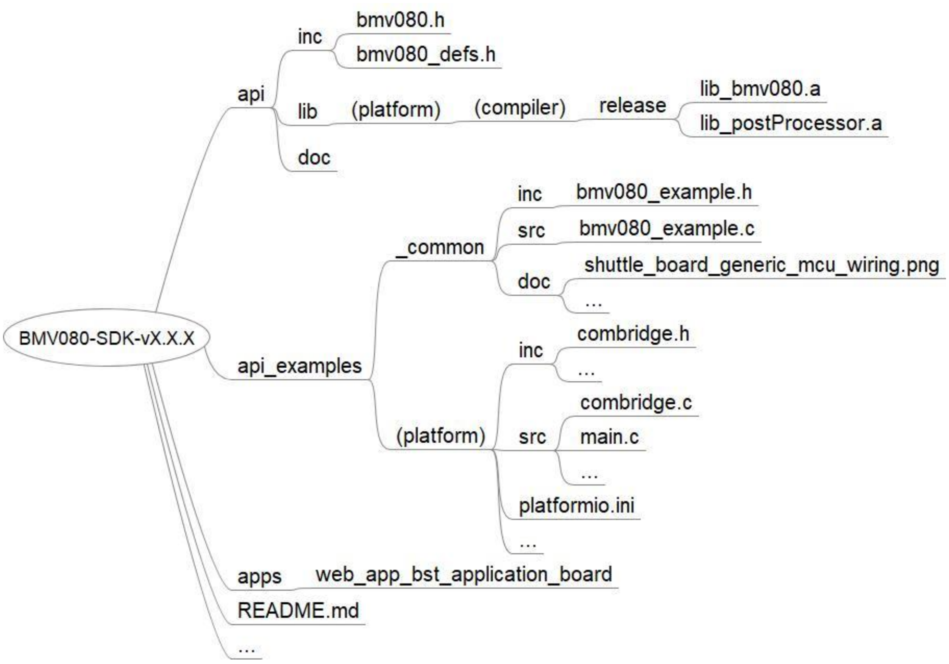


Figure 38: SDK package file structure

3.8.1.1 Sensor driver (API)

In the “/api/inc/” folder, the definitions of API interfaces and data types can be found in the header files(“bmv080.h”, “bmv080_defs.h”).

The "api/lib/" folder contains static libraries (“lib_bmv080.a”, “lib_postProcessor.a”) for different platforms and build environments.

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

3.8.1.2 API examples

The files under "api_example/_common/" provide examples of API usage, including how to initialize and configure the BMV080, as well as how to obtain output from the BMV080.

The "/api_examples/(platform)/" directory contains code examples specific to each supported hardware platform. The "combridge.c" file mainly includes the implementation of communication (SPI/I2C) read and write functions, as well as functions for system time and hardware interrupt handling.

Note: The compilation options for the hardware platform can be found in "platformio.ini".

3.8.1.3 Application tools

The "/apps/web_app_bst_application_board/" provides a visualization tool for the BMV080. For more information, please refer to Web App Quick Guide (BST-BMV080-QG002).

3.8.2 Steps to Integrate the SDK into System

3.8.2.1 Check requirement

Before integrating the SDK, it is necessary to confirm that the hardware platform and software build environment are compatible with the static libraries provided by the SDK.

- Platform and compiler

The supported platforms and build environments for the latest version of the SDK can be found in the Supported Platform document.

- Memory

It is also necessary to confirm that the memory is sufficent, especially RAM(.data + .bss) and ROM(.text + .data), to run the SDK drivers.
Memory requiremnts for different supported platforms can also be found in the Supported Platform document.

3.8.2.2 Copy library and head file

Once the integration environment meets the SDK requirements, the static libraries ("lib_bmv080.a", "lib_postProcessor.a") corresponding to the platform, along with the header ("bmv080.h", "bmv080_defs.h") files can be copied to the software project.

3.8.2.3 Port API example

- Copy or Port example code

Copy the "bmv080_eample.c(.h)" usage example code into your software project. The progress can also be modified according to actual application requirements.

- Implement Callback function

Refer to the "combridge.c" code and to Chapter 5.2.1.4 of BMV080 datasheet (BST-BMV080-DS000) to implement the callback functions for your platform.

Then, refer to the "main.c" , call the entry function ("bmv080") of the example code after completing platform initialization.

3.8.2.4 Compile and download the program

Compile the software project using the compilation options specified in "platformio.ini" of the example code, and then download the program.

3.8.2.5 Confirm the output

The default output of the bmv080 example can be found in Section 3.1 "Common Example Output Structure" of the "README.md".

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

4 Legal Disclaimer

4.1 Engineering samples

Engineering Samples are marked with an asterisk (*), (E) or (e). Samples may vary from the valid technical specifications of the product series contained in this data sheet. They are therefore not intended or fit for resale to third parties or for use in end products. Their sole purpose is internal client testing. The testing of an engineering sample may in no way replace the testing of a product series. Bosch Sensortec assumes no liability for the use of engineering samples. The Purchaser shall indemnify Bosch Sensortec from all claims arising from the use of engineering samples.

4.2 Product use

Bosch Sensortec products are developed for the consumer goods industry. They may only be used within the parameters of this product data sheet. They are not fit for use in life-sustaining or safety-critical systems. Safety-critical systems are those for which a malfunction is expected to lead to bodily harm, death or severe property damage. In addition, they shall not be used directly or indirectly for military purposes (including but not limited to nuclear, chemical or biological proliferation of weapons or development of missile technology), nuclear power, deep sea or air or space applications (including but not limited to satellite technology) or supercomputers. If customers would like to use Bosch Sensortec products in supercomputers, customers are obligated to get written permissions from Bosch Sensortec.

Bosch Sensortec products are released on the basis of the legal and normative requirements relevant to the Bosch Sensortec product for use in the following geographical target market: BE, BG, DK, DE, EE, FI, FR, GR, IE, IT, HR, LV, LT, LU, MT, NL, AT, PL, PT, RO, SE, SK, SI, ES, CZ, HU, CY, US, CN, JP, KR, TW. If you need further information or have further requirements, please contact your local sales contact.

The resale and/or use of Bosch Sensortec products are at the purchaser's own risk and his own responsibility. The examination of fitness for the intended use is the sole responsibility of the purchaser.

The purchaser shall indemnify Bosch Sensortec from all third party claims arising from any product use not covered by the parameters of this product data sheet or not approved by Bosch Sensortec and reimburse Bosch Sensortec for all costs in connection with such claims.

The purchaser accepts the responsibility to monitor the market for the purchased products, particularly with regard to product safety, and to inform Bosch Sensortec without delay of all safety-critical incidents.

4.3 Application examples and hints

With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Bosch Sensortec hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights or copyrights of any third party. The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. They are provided for illustrative purposes only and no evaluation regarding infringement of intellectual property rights or copyrights or regarding functionality, performance or error has been made.

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

5 Document history and modification

Rev. No	Chapter	Description of modification/changes	Date
1.0	all	Initial release	August 2024
1.1	3.4.1	Thermal Contact modified Heat Sink modified	December 2024
1.2	3.4.1 3.6.2 3.7.5	Footnote added on Table 9 Polarity of Voltage domains added Storage Conditions added	February 2025
1.3	3.4.1 3.4.2 3.6.1 3.6.1 3.6.3 3.6.6 3.6.7 3.7.5 4	Thermal contact examples added / modified "Alternative thermal integration" Added Table 17 Modifie Figure 26 , Figure 27 Modified Text corrected SCK Line Filtering Recommendation added Cleanliness of Host PCB added Table 18 Update on storage conditions Legal Disclaimer added	May 2025
1.4	3.2 3.5.1 3.5.2	Bending of Flex PCB Added Table 10: Clearance relaxed to 0.35 ± 0.1mm Optical Materials Examples added	August 2025
1.5	3.3.1 3.4.2 3.8	"Application-specific obstruction ranges" Section Added "Alternative thermal integration" Section Removed "Software integration best practices " Section Added	December 2025

© Bosch Sensortec GmbH 2025 | All rights reserved, also regarding any disposal, exploitation, reproduction, editing, distribution, as well as in the event of applications for industrial property rights

Bosch Sensortec GmbH
Gerhard-Kindler-Straße 9
72770 Reutlingen / Germany

contact@bosch-sensortec.com
www.bosch-sensortec.com

Modifications reserved
Document number: BST-BMV080-AN000-05