BMP3xy – Digital Pressure Sensors

Handling, Soldering and Mounting Instruction

BMP3xy HSMI

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Technical reference codes	Valid for all BMP3xy
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.

Purpose of this document

This document describes the conditions and parameters to be applied when handling, soldering and mounting the BMP3xy to a PCB.

Important:

- In order to avoid any damages of the BMP3xy and resultant loss of warranty please strictly keep with the instructions described within this document.
- It is also strongly recommended to study the BMP3xy data sheet prior to handling the BMP3xy sensor device.
- In case you have any questions, please do not hesitate to contact your nearest Bosch Sensortec representative for further advice.

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1 Package outline dimensions

Please refer to the latest version of the corresponding product datasheet or preliminary datasheet.

2 Device Marking

Please refer to the latest version of the corresponding product datasheet or preliminary datasheet.

3 Moisture sensitivity level (MSL)

3.1 MSL and device storage

The BMP3xy is classified as MSL 1 (moisture sensitivity level) according to IPC/JEDEC standards J-STD-020E and J-STD-033D.

The device can be soldered Pb-free with a peak temperature of 260°C for 20 to 40 sec. The minimum height of the solder after reflow shall be at least 50µm. This is required for a good mechanical decoupling between sensor device and the printed circuit board (PCB).

Note: When designing the solder paste silk print opening window, avoid excess solder paste to allow good reflow.

To ensure good solder-ability, the devices shall be stored at room temperature (20°C).

The soldering process can lead to an offset shift. The physical origin of this shift is not material aging but mechanical hysteresis frozen in by the soldering temperature cycle. Thus the shift is reversible.

Manual unsoldering can lead to further offset shift, especially if the soldering temperature and / or soldering time is above the given values of 260°C and 40 sec.
Avoid contact of the device with liquids.

3.2 Multiple reflow soldering cycles

The BMP3xy can withstand in total up to 3 reflow soldering cycles.

This could be a situation where a PCB is mounted with devices from both sides (i.e. 2 reflow cycles necessary) and where in the next step an additional re-work cycle could be required (1 reflow).

Multiple reflow cycles will not add up in multiple offset shifts. The device is in the same condition after every solder reflow cycle.

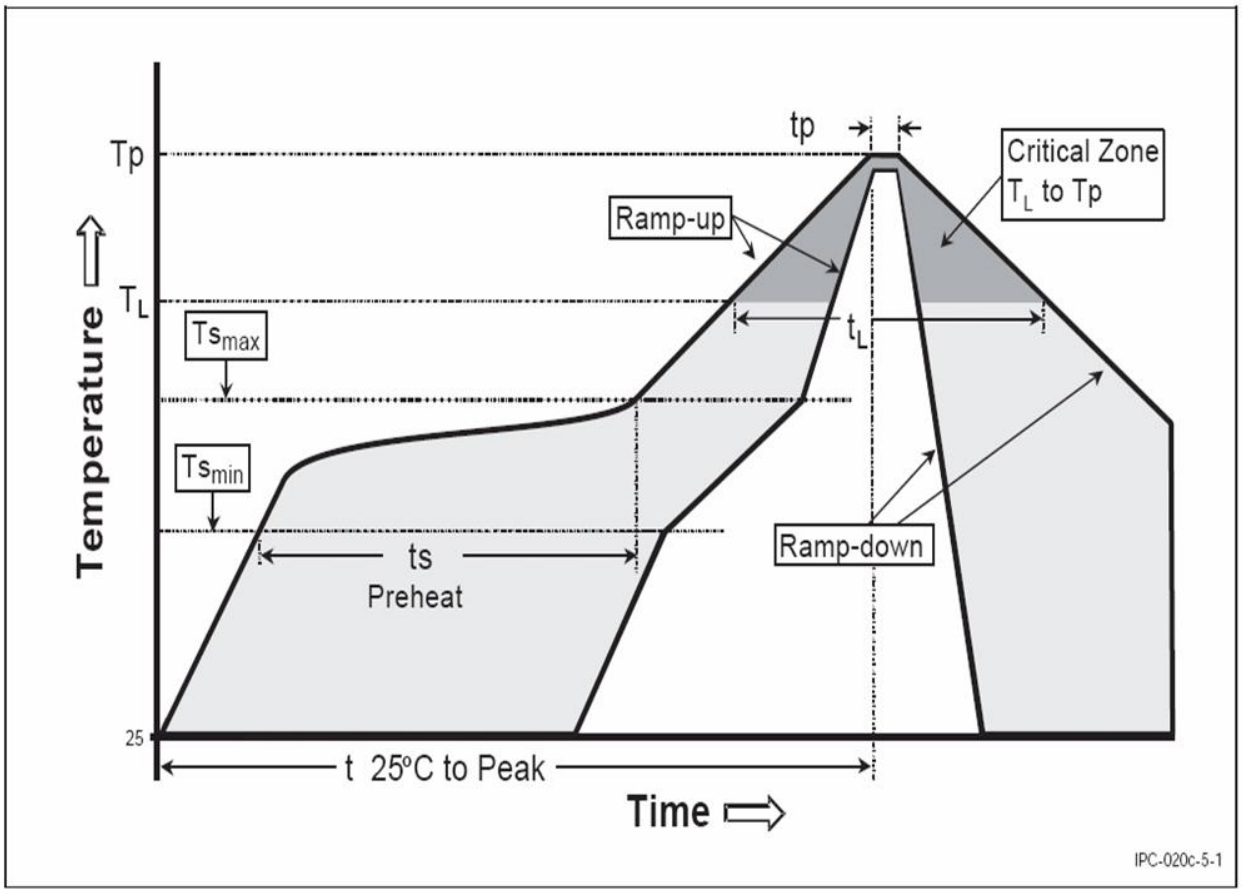
3.3 Classification reflow profile

The following figure describes the recommended reflow soldering process.

Vapor phase soldering has to be avoided.

Profile Feature		Pb-Free Assembly
Average Ramp-Up Rate (Ts_{max} to Tp)		3° C/second max.
Preheat – Temperature Min (Ts_{min}) – Temperature Max (Ts_{max}) – Time (ts_{min} to ts_{max})		150 °C 200 °C 60-180 seconds
Time maintained above: – Temperature (T_L) – Time (t_L)		217 °C 60-150 seconds
Peak/Classification Temperature (Tp)		260 °C
Time within 5 °C of actual Peak Temperature (tp)		20-40 seconds
Ramp-Down Rate		6 °C/second max.
Time 25 °C to Peak Temperature		8 minutes max.

Note 1: All temperatures refer to topside of the package, measured on the package body surface.



4 Environmental Safety

4.1 RoHS

The BMP3xy sensor meets the requirements of the EC restriction of hazardous substances (RoHS) directive, see also: Directive 2011/95/EC of the European Parliament and of the Council of 8 September 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

4.2 Halogen content

The BMP3xy is halogen-free. For more details on the analysis results please contact your Bosch Sensortec representative.

5 Internal package structure

Within the scope of Bosch Sensortec's ambition to improve its products and secure the mass product supply, Bosch Sensortec qualifies additional sources (e.g. 2nd source) for the LGA package of the BMP3xy.

While Bosch Sensortec took care that all of the technical packages parameters are described above are 100% identical for all sources, there can be differences in the chemical content and the internal structural between the different package sources.

However, as secured by the extensive product qualification process of Bosch Sensortec, this has no impact to the usage or to the quality of the BMP3xy product.

6 Handling of reels

6.1 Storage

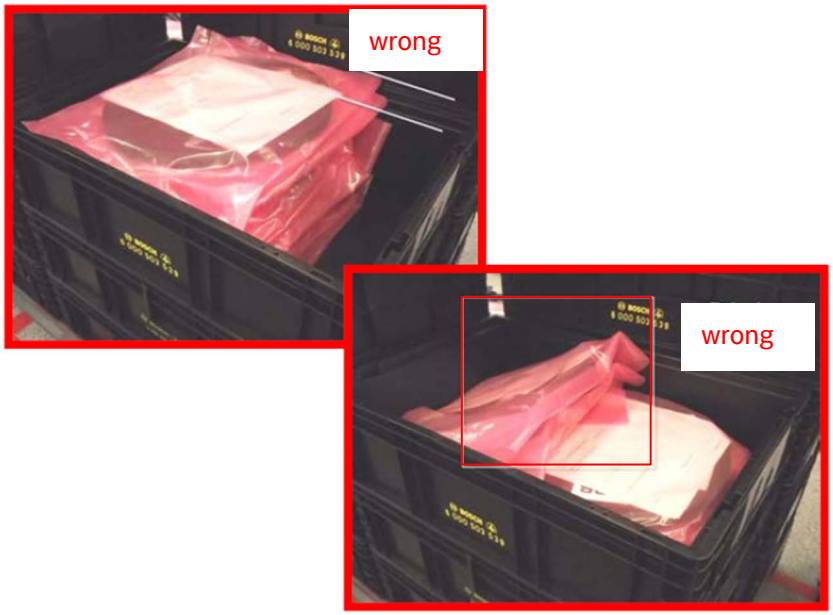
Once the reels are removed from the pizza box, they should always be stacked in vertical condition.

6.2 Introduction into production

Reel trailers must not be removed. Removal of the trailer could cause deformation of the reel during de-reeling and consequently tilted parts

Reels must be stored vertically as shown in the image below.

When reels are to be stored horizontally, then they must be ordered in a stack with max. 4 reels pro stack (see images below).



7 Mounting recommendations

MEMS sensors in general are high-precision measurement devices which consist of electronic as well as mechanical silicon structures. Bosch Sensortec MEMS sensor devices are designed for precision, efficiency and mechanical robustness.

However, in order to achieve best possible results for your design, the following recommendations should be taken into consideration when mounting a pressure sensor on a printed-circuit board (PCB).

7.1 Recommendation details

- Please avoid rear side handling of the BMP3xy sensor, otherwise the device can be destroyed
- It is generally recommended to keep a reasonable distance between the sensor mounting location on the PCB and the critical points described in the following examples. The exact value for a “reasonable distance” depends on many customer specific variables and must therefore be determined case by case
- It is not recommended to place the sensor directly under or next to push-button contacts as this can result in mechanical stress
- It is not recommended to place the sensor close to the edge of the PCB
- It is not recommended to place the sensor in direct vicinity of extremely hot spots (e.g. a µController) as this can result in heating-up the sensor
- Do not mount the sensor too close to a PCB anchor point, where the PCB is attached to a shelf (or similar) as this could also result in mechanical stress
- Please avoid total or partial coverage of the sensor by any kind of (epoxy) resin, as this can possibly result in mechanical stress and could clog the hole in the sensor’s top lid
- The clearance above the metal lid of the BMP3xy shall be 0.1mm at minimum
- For the device housing appropriate venting needs to be provided in case the ambient pressure shall be measured
- When operating the sensor inside a water resistant device (e.g. IPX5 or higher rated), special care must be taken, if a fast response to changes in ambient air pressure is needed (see details below)
- The sensor has to be protected against all kinds of liquids, during processing (e.g. solder flux, cleaning agents) and during operation, strong air blasts from an air-pistol (not oil-free air) are also forbidden. Applying liquids, cleaning agents or solder flux to the sensor may cause to drift of the reading or complete malfunction of the sensor. Low viscose coatings or potting materials can enter the sensor hole, get onto the MEMS sensor chip and damage the sensor element.

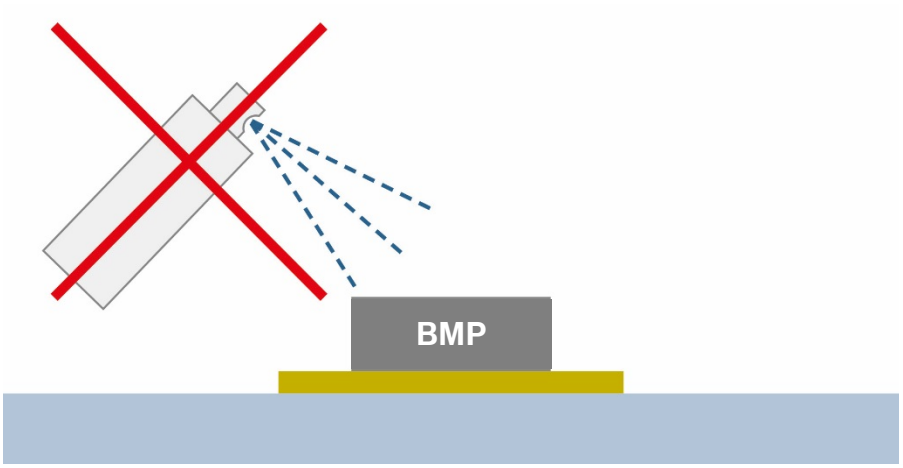


Figure 1: Do not apply spray to the BMP without port protection

- It is recommended to cover the hole of the device with a protective cover during processing to avoid contamination of the MEMS sensors with all kind of liquids, dust, e.g. kapton tape during assembly, e.g. cleaning, soldering. No board wash is applied once the sensor is assembled to the PCB w/o protection of the sensor hole

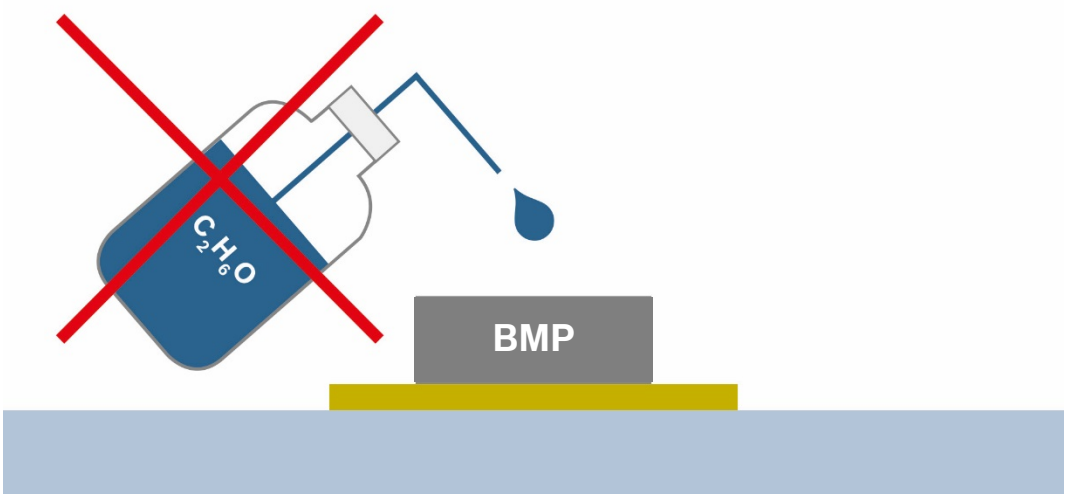


Figure 2: Do not apply liquids to the BMP without port protection

- The BMP3xy sensor is sensitive to light, which can influence the accuracy of the measurement. Therefore, the hole in the top lid shall not be exposed to direct light during operation

- The BMP3xy shall not be placed close to fast heating parts. In case of temperature changes > 3.0°C/sec during operation. It is recommended to follow Bosch Sensortec application note “Correction of errors induced by fast temperature changes”. Please contact your Bosch Sensortec representative for details

- During handling of the BMP3xy, especially in case parts are handled manually, make sure that no objects, like for example tweezers tips or other sharp objects do get inside of the vent hole of the sensor. This could damage the device

- At any point if an operator or piece of equipment needs to come into direct contact with BMP3xy; no sharp edges on grippers, tweezers, or other handling equipment should be used. Sharp point objects or tools could go into the sensor's snout and damage the transducer. The gripper of the tweezers should not consist of hard material, i.e. metal or ceramics, in order to avoid scratching of the sensor. The following figure illustrates an example of "good" and "not good" (NG) handling tools for BMP3xy.

- The tweezers on the bottom have a blunt tip and cannot go into the BMP3xy snout by design. This makes it very unlikely that the tweezer will go into the sensor's snout and damage the transducer. Another interim solution to reduce the likelihood of damaging BMP3xy while handling, is to keep the tweezer covers on (this is only meant to be for a short period of time). The tweezers on the top are an example of improper or "no good" (NG) tweezers due to the sharp tips. This makes it very easy for the tweezers to enter the snout and damage the transducer.

- Ultrasonic welding: ultrasonic welding can induce damage in the pressure sensor. Customer – in case of using this process in his manufacturing line – has to secure the parameter of the process for each project individually to protect the pressure sensor

- Vapor phase soldering: connecting BMP3xy on the PCB through vapor phase soldering might cause deposits on the diaphragm which can distort the electrical signal

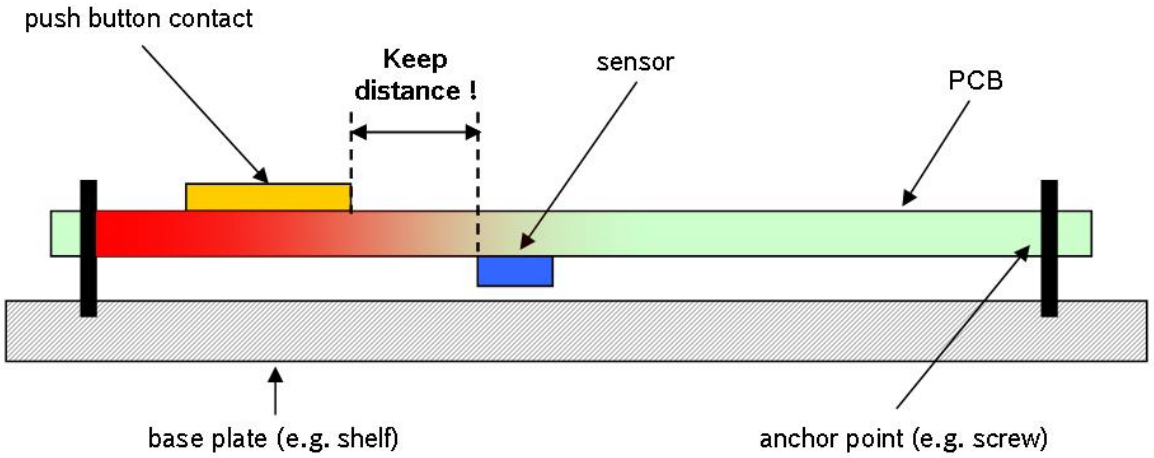
In case you have any questions with regard to the mounting of the sensor on your PCB, do not hesitate to contact us.

The scenarios described below – given as examples – may lead to a bending of the PCB, which as a consequence, might influence the performance of a sensor mounted on the PCB.

Please note that this possible behavior is not limited to Bosch Sensortec devices, but may as well occur with 3rd party MEMS devices in a similar manner.

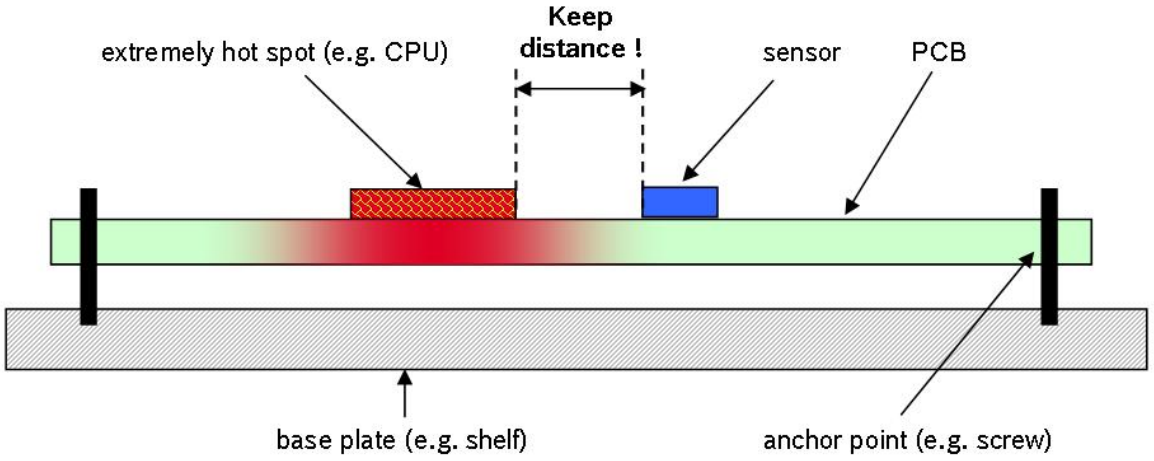
7.1.1 Push-button contacts

Keep a reasonable distance to push-button contacts, when placing the sensor device. Do not position the sensor directly beneath a push-button contact.



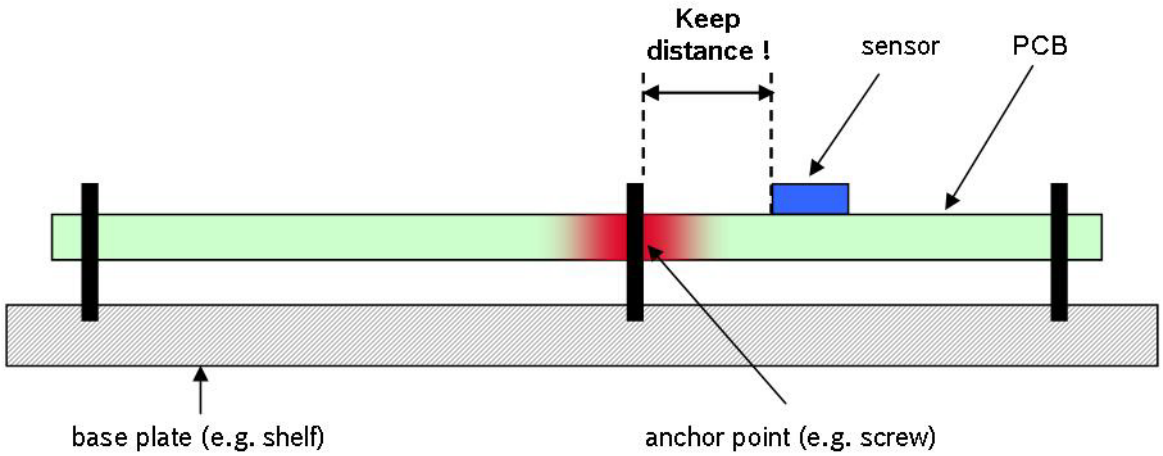
7.1.2 Hot-spots on the PCB

Keep a reasonable distance from any hot spots, when placing the sensor device. Hot spots can be for example other integrated circuits with high power consumption.



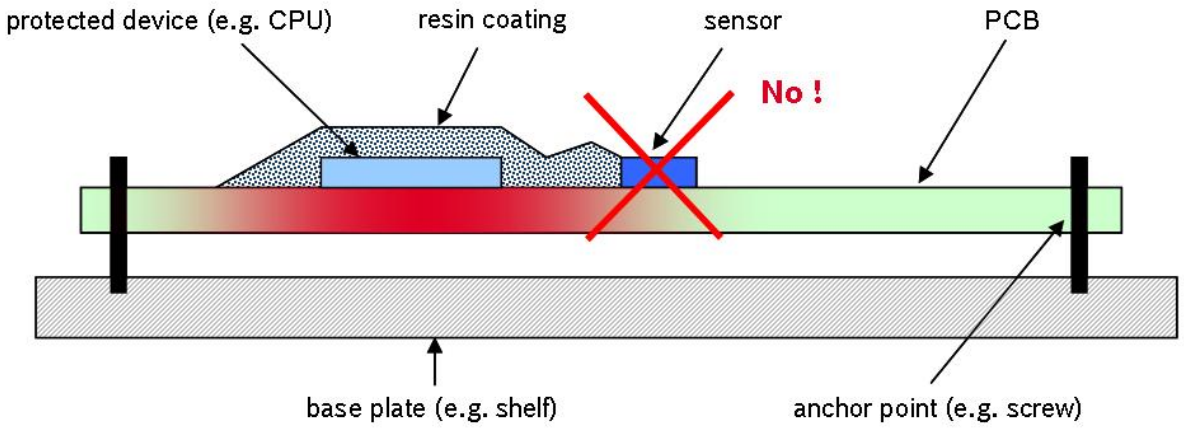
7.1.3 PCB anchor points

Please keep a reasonable distance from any anchor points, where the PCB is fixed at a base plate (e.g. like a shelf or similar), when placing the sensor device.



7.1.4 Resin coatings

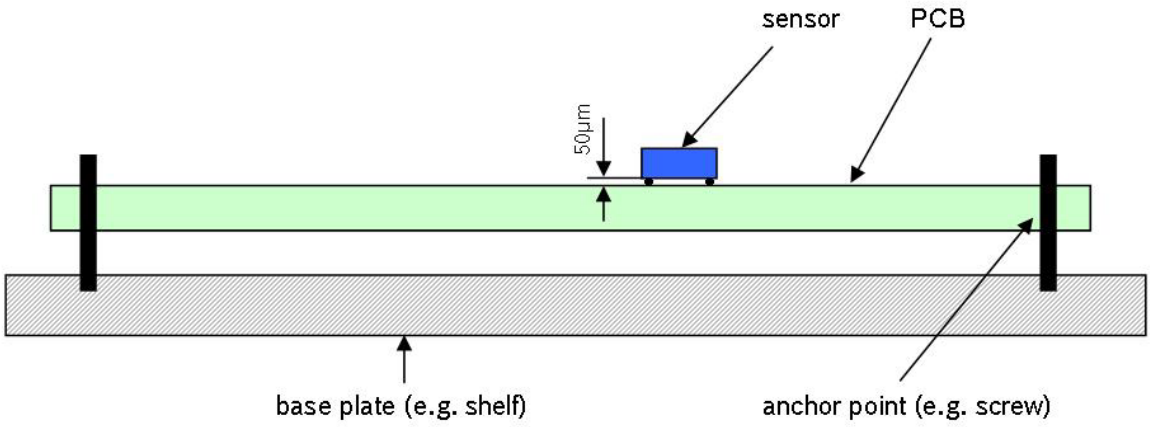
Please avoid total and partial covering of the BMP3xy sensor with any protective material like for example epoxy resin.



As shown in the above figure, please take care that the sensor is not covered and not in contact with any (epoxy) resign material leading to an un-symmetric stress distribution over the sensor package.

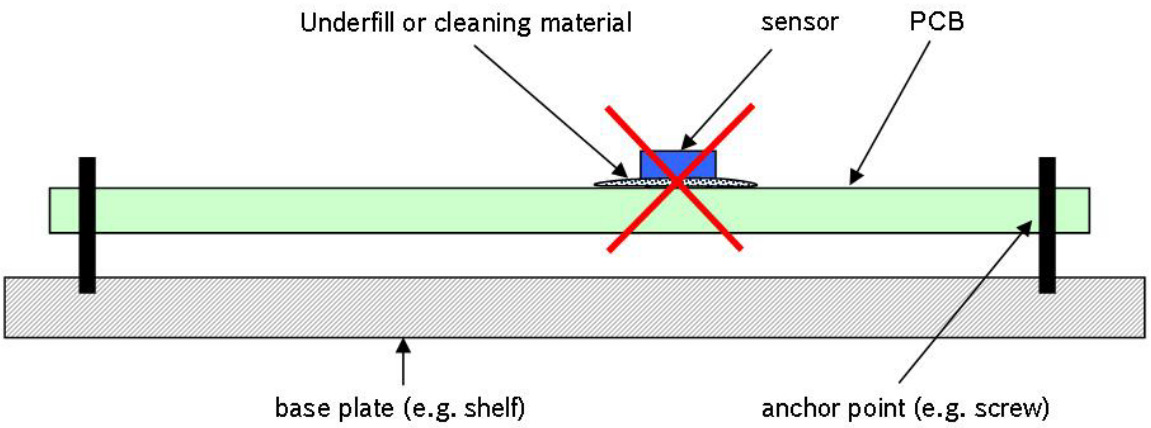
7.1.5 Minimum distance between sensor and PCB

The distance between the sensor and the PCB after the soldering process must be at least 50µm.



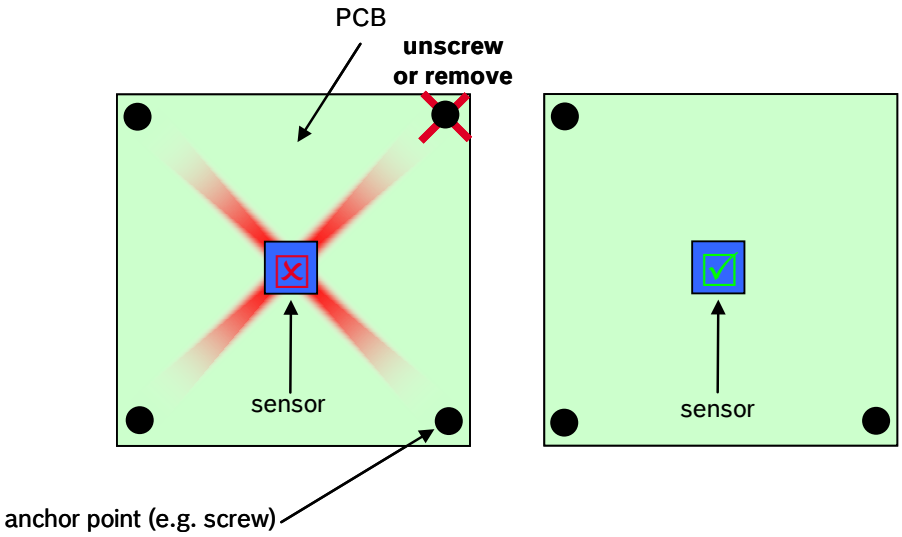
7.1.6 Underfill and cleaning materials

Please avoid all kinds of foreign materials under the sensor, e.g. underfill and cleaning materials.



7.1.7 Redundant PCB anchor points

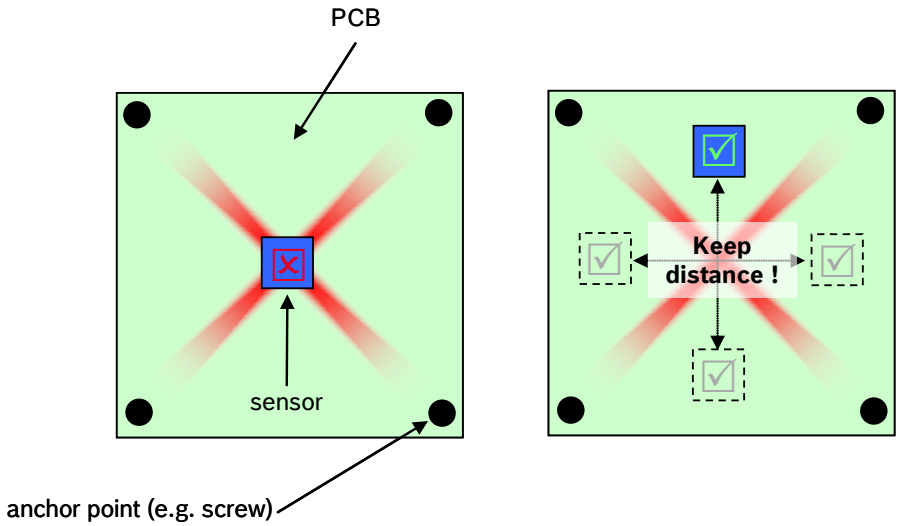
It is recommended to unscrew or remove any redundant PCB anchor points. In theory, an ideal flat plane is determined by 3 anchor points, exclusively. Any further anchor point will over-determine the ideal flat plane criteria. If these redundant anchor points are out of plane position (which means not 100% exact in plane position) the ideal flat criteria is infringed, resulting in mechanical stress.



7.1.8 Mechanical stress maximum on the PCB

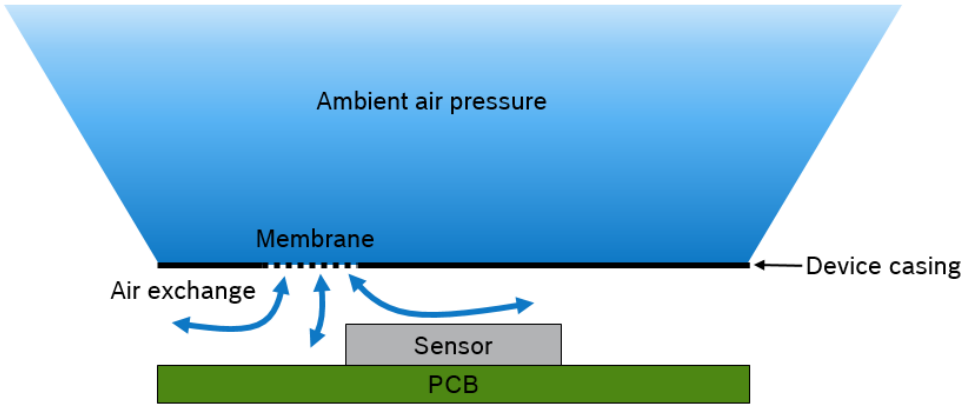
It is recommended to keep a reasonable distance from any mechanical stress maximum, when placing the sensor device. Mechanical stress can be induced for example by redundant anchor points, as described in 9.1.7.

The below given example will show a stress maximum in the center of the diagonal crossover of the 4 anchor points. It is good manufacturing praxis to always avoid or reduce the mechanical stress by optimizing the PCB design first, then to place the sensor in an appropriate low stress area.

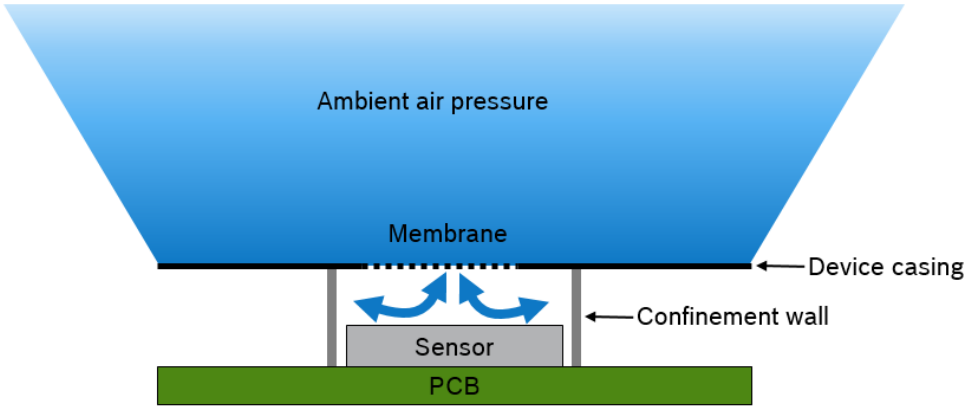


7.1.9 Integration into water resistant devices

When operating the sensor inside a water resistant device (e.g. IPX5 or higher rated), special care must be taken, if a fast response to changes in ambient air pressure is needed.



Typical non-optimized placement of sensor inside a water resistant device.



Visualization of potential optimizations: Dead volume reduction with confinement walls and larger port hole

Typically, in a water resistant device the port for ambient air pressure exchange is protected by a porous membrane (e.g. ePTFE), which prevents the intrusion of water into the device (see figure above). However, this also means that the air exchange might be reduced depending on the water proofness of the membrane and its airflow breathability, leading to a slower response of the pressure sensor to changes in ambient air pressure.

The following measures can be taken to mitigate this effect (see figure above):

1. Reduction of dead volume to reduce to amount of air needed to reach pressure equilibrium
2. Increase of port aperture
3. Careful choice of membrane to optimize trade-off between airflow and water protection

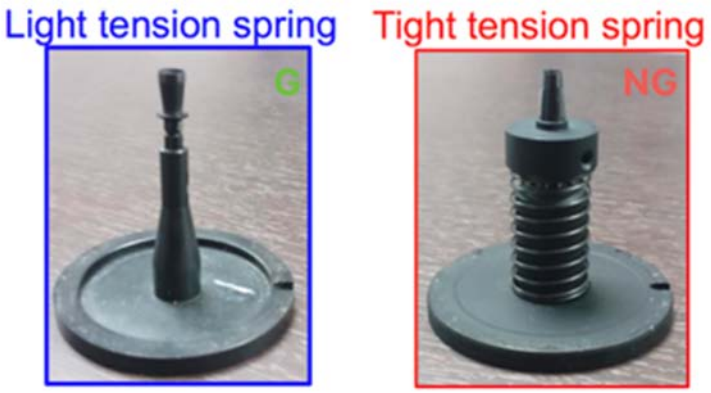
Please note that while the device is exposed to water, accurate pressure readings cannot be guaranteed.

7.2 Automatic handling

- When picking up the component from the Tape and Reel carrier, we recommend that you place the pick-up tool at a vertical-height distance from the sensor.
- When picking up the component from the Tape and Reel carrier, it is recommended that you place the pick-up tool at a vertical-height distance from the sensor.
- Use vacuum pressure at approximately -80kPa (with unit) as indicated in the picker vacuum gauges. Optimal conditions may depend on picker design.
- Similarly, set vertical-height distance during placement on the board to zero to avoid overdrive beyond the limit of the PCB.
- Avoid rear side handling of the sensor, otherwise the device can be destroyed.

The following table reflects the recommended settings for pick and place equipment when handling BMP3xy:

Parameter	Best Practice
Nozzle	Use a low stress pick and place nozzle (refer to Figure below)
Collet Material	A rubber collet should be used
Picking up module	The pick and place tool should focus its vacuum to the shoulders of the package and not on the gel; the vacuum pressure acting on the gel should be minimized
Pickup speed	Minimize z-axis acceleration. Excessive z-axis force (F=ma) can cause the transducer membrane to crack and fail.
Transfer speed	A low velocity transfer speed is recommended
Pick-up force	Do not apply more than 5N
Place speed	Minimize z-axis acceleration. Excessive z-axis force (F=ma) can cause the transducer membrane to crack and fail.



8 Legal Disclaimer

8.1 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.

8.2 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 space applications (including but not limited to satellite technology).

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.

8.3 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.

9 Document history and modification

Rev. No	Chapter	Description of modification/changes	Date
1.0	all	Initial release	May 2017
1.1	all	Changed validity from BMP380 to BMP3xy	14. Apr 2018
1.2		Added comments about using tape and applying all kind of liquids	10. Dec 2018
1.3	7.1	Deleted link to ANP015 Added recommendation for usage of tweezers	14. May 2019
	7.2	Modified automatic handling recommendation	
1.4	All	New document layout Replacement of product name from BMP380 to BMP3xy	31. Oct 2019
	1, 2	Reference to datasheet	
	5	Deletion of redundant chapter	
	8	Update of Legal Disclaimer	
	3.1	Updated JEDEC and ROHS	
1.5	all	Changed validity from BMP3xy to BMP3xy	23. Apr 2020

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