Data sheet bluSensor® Pro
Package - Particulate Matter Sensor (BSP03PM)

- Long-term stable sensors
- Integrated sensors (optical PM sensor)
- Particulate matter particle size 1.0 µg/m3 (PM 1.0)
- Particulate matter particle size 2.5 µg/m3 (PM 2.5)
- Particulate matter particle size 4.0 µg/m3 (PM 4.0)
- Particulate matter particle size 10.0 µg/m3 (PM 10.0)
- 0 to 100 µg/m3:   +/-10 µg/m3
  100 to 1'000 µg/m3:   +/- 10%
- Advanced particle size binning
- Superior accuracy in mass-concentration sensing
- Data memory for 3 months (optionally extendable)

- Open interface for integration into external systems
- Robust housing with translucent RGB
- 2.4 GHz Bluetooth low energy
- bluSensor® AIR App

Product summary

The bluSensor® air quality model with particulate matter is specifically designed to analyse indoor air and support proper ventilation. The particulate matter sensor is a technological breakthrough in optical fine dust sensors. Its measurement principle is based on laser scattering and uses bluSensor® innovative pollution resistance technology. This technology, together with high-quality and durable components, enables precise measurements from the first start-up and over the entire lifetime of more than ten years. In addition, the advanced algorithms provide superior precision for different PM types and higher resolution particle size binning, opening up new possibilities for detecting different types of environmental dust and other particles. The integrated sensor is MCERTS certified. The bluSensor® technology provides unique long-term stability at a competitive price. The bluSensor® can be used as a stand-alone device without an app as well as with an app or can be quickly integrated into existing systems thanks to its open interfaces. As soon as power is supplied to the device, it immediately measures various fine dust values and flashes in different colours when limit values are exceeded. With this new fine dust sen-

sor, bluSensor® is expanding its range of environmental sensor solutions and opening up new dimensions for air quality monitoring applications. PM2.5 refers to the category of fine dust with particle sizes from 0.3 to 2.5 micrometres. For the human body, fine dust is one of the most dangerous pollutants. Due to their small size, the particles can penetrate deep into the lungs, where they can cause lung diseases such as bronchitis or asthma over a longer period of time, as well as contribute to cardiovascular diseases. With the help of this bluSensor® technology, you can easily and innovatively measure particulate matter levels that can prevent long-term health damage from air pollution. This sensor solution from bluSensor® offers the best possible and stable monitoring of air quality. Using the bluSensor® app, predefined limit values and alarms can be individually configured via a Bluetooth connection and detailed values of the device can be queried. Once Wi-Fi is activated on the device, it can also be remotely interrogated, configured and waded (e.g. software updates). This IoT-enabled device was developed in compliance with the highest and most modern security standards and is protected from hacker access by a 3-stage security system.

Advantages of the bluSensor®-technology

- Proper ventilation made easy
- Best price - performance ratio
- Wide range of applications

- Complies with the funding conditions of Salzburg
- Regional product
- 100% Made in Austria

Data sheet bluSensor® Pro
Modell - Particulate Matter Sensor (BSP03PM)

- Can be operated with user-friendly bluSensor® AIR app
- Can also be used without app (device flashes in different colors when limit values are exceeded)
- Translucent housing for integrated, multi-color warning light (RGB)
- Power supply by 12/24V DC plug-in power supply unit (continuous operation) or intergrated terminal strip
- Use of long-term stable and calibrated sensors
- Dual radio (Bluetooth and Wi-Fi)
- Robust housing for wall mounting
- Dimension 86 x 86 x 25.5 mm

Model BSP03PM	Functions
Bluetooth 4.2 (coming soon 5.0)	x
Wi-Fi 2.4 GHz	x
Integrated red warning light	x
Power supply	power supply unit or 12-24 V rail
Integrated Sensors	
Particulate Matter (PM) 1.0 µg/m3	x
Particulate matter (PM) 2.5 µg/m3	x
Particulate matter (PM) 4.0 µg/m3	x
Particulate matter (PM) 10.0 µg/m3	x
Data memory on the device	
2 Megabyte (MB)	optional
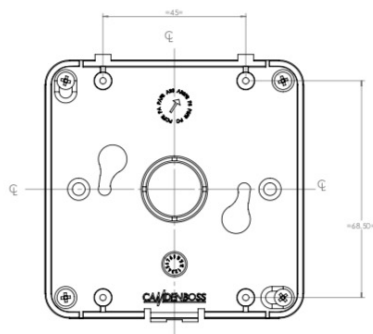
Especially for buildings:
- Wall mounting with a variety of sensors
- Possibility of cable grommet at the back for cables for:
  - Rail for 12-24 volt power supply on the printed circuit board
  - Potential-free outputs on the printed circuit board for external controls e.g. zone valves (optional)
- Wi-Fi data transmission with MQTT interface for Modbus TCP/IP connection (see gateway)
- Also suitable for mounting on flush-mounted boxes

Data sheet bluSensor® Integrated Sensor Technology

Particualte Matter (PM)	
PM 1.0	PM 2.5
PM 4.0	PM 10.0

Recommended storage conditions

Important !

Please store properly and do not let it condense !

The temperature should be in the range of -30°C - 60°C and 20% - 80% relative humidity. It is recommended to put the sensors into operation within 1 year from the date of delivery.
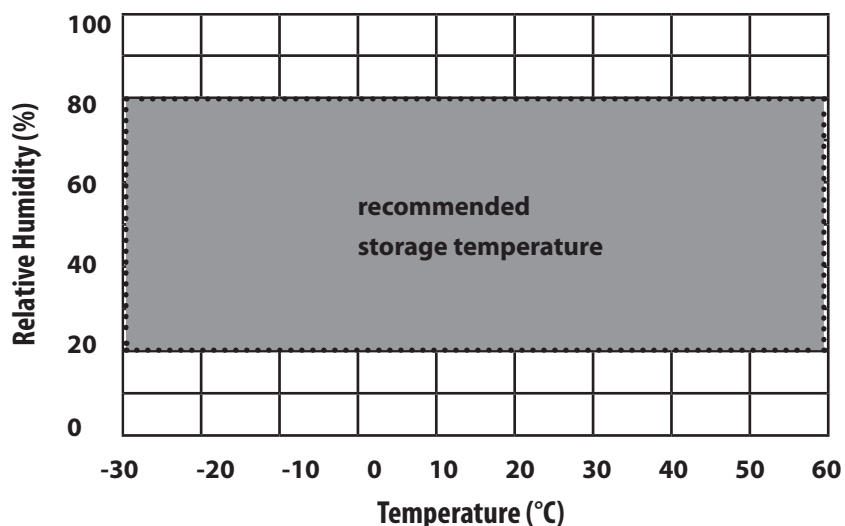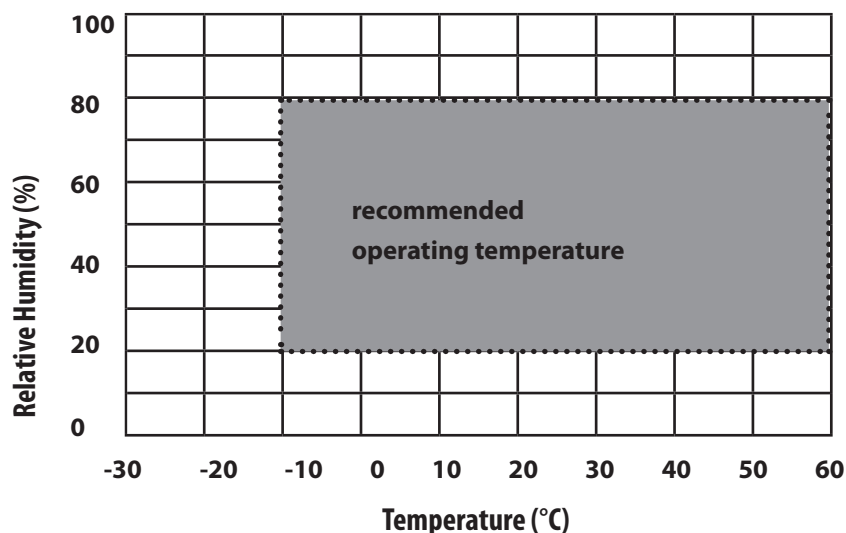

Figure Recommended humidity and temperature for sensor storage.

Recommended operating conditions

The sensor shows best performance when operated within recommended normal temperature and humidity range of 10 to 40 °C and 20 to 80 % RH, respectively

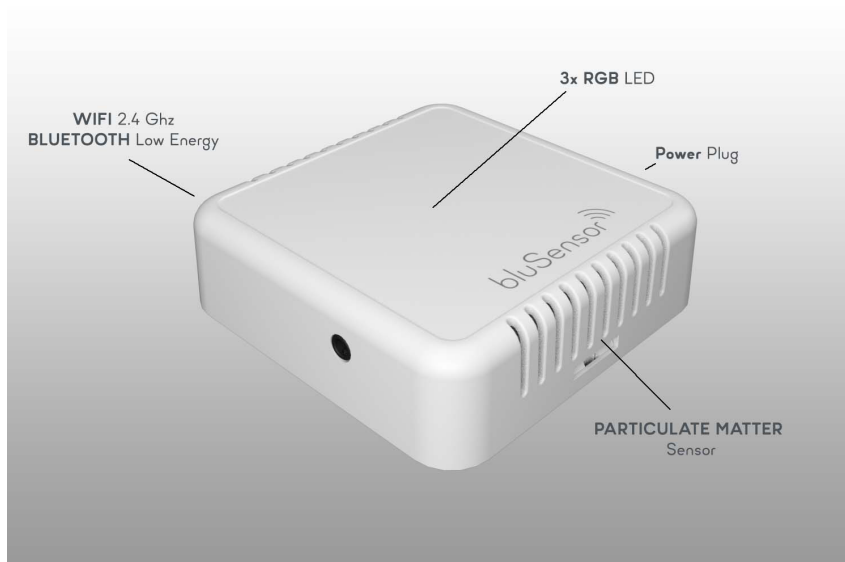**Figure** Recommended humidity and temperature for sensor operation.

Particualte Matter (PM)	
PM 1.0	PM 2.5
PM 4.0	PM 10.0

Optimal position

To achieve the most accurate measurement results, the environment in which the sensor is positioned must also be taken into consideration. Please note that in one room the air quality can differ. Next to the window is the freshest air, while in corners or niches it is much worse. Position the sensor where you spend the most time. Please also take into consideration that when you ventilate in places that are not easily accessible, the fresh air will be distributed later. The optimum height is usually about 1.5 m (59 inches).

Warning lights

You can define limit values for all integrated sensors. If these are exceeded or undershot, up to three warning light starts to flash. If no warning light is illuminated, either no limit values have been exceeded or no alarms (on the device) have been activated.

Data sheet bluSensor® Integrated Sensor Technology

Particualte Matter (PM)	
PM 1.0	PM 2.5
PM 4.0	PM 10.0

Warning light

You can define limit values for particulate matter 1.0 / 2.5 / 4.0 / 10.0. If these are exceeded or undershot, a warning light starts to flash. If no warning light is illuminated, either no limit values have been exceeded or no alarms have been activated on the device. The alarm is switched off at the factory and must be activated with the bluSensor® app..

Colour chart:

Colors can be customized upon customer request. By means of the color you can recognize which limit value has been exceeded. In this case please contact our support at: support@blusensor. The factory setting for the limit value definition is as follows:

too bad air
preset limit values
> 66 PM 1.0 or PM 2.5
> 156 PM 4.0 or PM 10.0

Display in App	PM 1.0	PM 2.5	PM 4.0	PM 10.0
Excellent	0 - 12 μm	0 - 12 μm	0 - 25 μm	0 - 25 μm
Good	13 - 35 μm	13 - 35 μm	26 - 55 μm	26 - 55 μm
Moderate	36 - 65 μm	36 - 65 μm	56 - 155 μm	56 - 155 μm
Poor	66 - 150 μm	66 - 150 μm	156 - 354	156 - 354 μm
Ungesund	> 150 μm	> 150 μm	> 354 μm	> 354 μm

The preset limit values can be changed at any time in the bluSensor® app.

No warning light

= no limit value exceeded !

(or no alarms activated on the device)

Data sheet bluSensor® Integrated Sensor Technology

Particualte Matter (PM)	
PM 1.0	PM 2.5
PM 4.0	PM 10.0

Ventilate extensively !

Good for you and good for the sensor !

Value ranges, resolution and time response

The maximum possible range is 1'000. The resolution is always 1 and does not depend on the value range.

Parameter	Condition	Value	Units
Mass concentration range	-	0 to 1'000	µg/m3
Mass concentration size range	PM 1.0	0.3 to 1.0	µm
	PM 2.5	0.3 to 2.5	µm
	PM 4.0	0.3 to 4.0	µm
	PM 10.0	0.3 to 10.0	µm
Number concentration range		0 to 3'000	#/cm3
Number concentration size range[1]	PM 0.5	0.3 to 0.5	µm
	PM 1.0	0.3 to 1.0	µm
	PM 2.5	0.3 to 2.5	µm
	PM 4.0	0.3 to 4.0	µm
	PM 10.0	0.3 to 10.0	µm
Sampling rate	-	1 +/ 0.04	sec
Typical start-up time[2]			
number concentration	200 - 3000 #/cm3	8	sec
number concentration	100 - 200 #/cm3	16	sec
number concentration	50 - 100 #/cm3	30	sec
Lifetime[3]	24 h/day operation	>10	years
Acoustic emission level	0.2 m	max. 25	dB(A)

Table Particulate matter sensor specifications. Default conditions of 25±2 °C, 50±10% relative humi-dity. 'max.' means 'maximum', 'typ.' means 'typical', '% m.v.' means '% of measured value'.

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1 PM4 and PM10 output values are calculated based on distribution profile of all measured particles.

2 Time after starting Measurement-Mode, until a stable measurement is obtained.

3 Lifetime is based on mean-time-to-failure (MTTF) calculation. Lifetime might vary depending on different operating conditions.

No calibration needed.

The user does not have to calibrate his device himself.

Data sheet bluSensor® Integrated Sensor Technology

Particualte Matter (PM)	
PM 1.0	PM 2.5
PM 4.0	PM 10.0

- **Gas measurement performance of the integrated sensor technology:**

   Particulate matter sensor:
   Particulate matter particle size 1.0 µg/m3 (PM 1.0)
   Particulate matter particle size 2.5 µg/m3 (PM 2.5)
   Particulate matter particle size 4.0 µg/m3 (PM 4.0)
   Particulate matter particle size 10.0 µg/m3 (PM 10.0)
   0 to 100 µg/m3:   +/-10 µg/m3
   100 to 1'000 µg/m3:   +/- 10%
   Advanced particle size binning
   Superior accuracy in mass-concentration sensing

The specifications listed apply to the individual components integrated by us and may deviate minimally in our finished housing variants.

Gas measurement performance of the integrated sensors (Particulate matter sensor)

We only integrate electronic components that meet our quality criteria. The air quality sensors we integrate are used from suppliers who perform their tests based various test methods. In the following section, we will discuss the measurement accuracy of the integrated sensor technology.

Parameter	Condition	Value	Units
Mass concentration precision[1] for PM 1.0 and PM 2.5[2]	0 to 100 µg/m3	+/- 10	µg/m3
	100 to 1'000 µg/m3	+/- 10	% m.v.
Mass concentration precision[1] for PM 4.0 and PM 10.0[3]	0 to 100 µg/m3	+/- 25	µg/m3
	100 to 1'000 µg/m3	+/- 25	% m.v.
Maximum long-term mass concentration precision limit drift	0 to 100 µg/m3	+/- 1.25	µg/m3 / year
	100 to 1'000 µg/m3	+/- 1.25	% m.v. / year
Number concentration precision[1] for PM 0.5 and PM 1.0 and PM 2.5	0 to 1000 #/cm3	+/- 100	#/cm3
	1000 to 3'000 #/cm3	+/- 10	% m.v.
Number concentration precision[1] for PM 4.0 and PM 10.0[3]	0 to 1000 #/cm3	+/- 250	#/cm3
	1000 #/cm3 to 3'000 #/cm3	+/- 25	% m.v.

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1 Also referred to as "between-parts variation" or "device-to-device variation".

2 Verification Aerosol for PM2.5 is a 3% atomized KCl solution. Deviation to reference instrument is verified in end-tests for every sensor after calibration.

3 PM4 and PM10 output values are calculated based on distribution profile of all measured particles.

Particualte Matter (PM)	
PM 1.0	PM 2.5
PM 4.0	PM 10.0

Parameter	Condition	Value	Units
Maximum long-term number concentration precision limit drift	0 to 1000 #/cm3	+/- 12.5	#/cm3 / year
	1000 #/cm3 to 3'000 #/cm3	+/- 1.25	% m.v. / year
Sensor output characteristics			
PM 2.5 mass concentration	Calibrated to TSI DustTrak™ DRX 8533 Ambient Mode		
PM 2.5 number concentration	Calibrated to TSI OPS 3330		
Acoustic emission level	0.2 m	max. 25	dB(A)
Long term acoustic emission level drift	0.2 m	max. +/- 0.5	dB(A)
Additional T-dependent mass and number concentration precision limit drift	temperature difference to 25°C	typ. +/- 0.5	% m.v. / °C
Laser wavelength (DIN EN 60825-1 Class 1)		typ. 660	nm

Table Specifications of the particle sensor. Standard conditions: 25±2 °C, 50±10% relative humidity. max." means „maximum", „typ." means „typical", „% m.v." means „% of measured value".

Time specifications

For the use of the sensor you have to consider certain time factors. These can be found in the table below.

Parameter	Value
Switch-on time until ready for operation	10 seconds
Active Bluetooth connection	1 Hz (update rate)
Passive Bluetooth connection	10 secunds
Wi-Fi connection	10 minutes (default update rate)
Alarms (soon available)	1x immediately in the event of a limit being exceeded
	1x as soon as normal range is reached again

Table Time specifications / general and for integrated sensor technology

Absolute minimum and maximum values

Loads exceeding the values shown in the table below may cause permanent damage to the device. These are load values for electrical components. The function of the device under these conditions cannot be guaranteed. Exposing the device to maximum values over a longer period of time may affect the reliability of your device.

Parameter	Value
Supply voltage for models with battery	3 V
Supply voltage for models with USB	5 V
Supply voltage for models with power supply unit	12-24 V
Supply voltage for models with terminal strip	12-24 V
Temperature range storage	according to integrated sensor specifications
Temperature range operation	according to integrated sensor specifications
Humidity range	according to integrated sensor specifications

Table Absolute minimum and maximum values.

Handling instructions

Humidity, temperature and air quality sensors are highly accurate environmental sensors. Please follow the guidelines below carefully to ensure that you benefit from the excellent performance of the sensor.

Exposure to chemicals

The sensor must **not come into close contact with volatile chemicals** such as solvents or other organic compounds. In particular, high concentrations and long exposure must be avoided. Ketene, acetone, ethanol, isopropyl alcohol, toluene, etc. are known to cause moisture measurement drift - irreversible in most cases. Please note that such chemicals are integral components of epoxies, glues, adhesives, etc. and outgas during baking and curing. These chemicals are also added as plasticizers in plastics used for packaging materials and outgas for some time.

Acids and bases can irreversibly attack the sensor and must be avoided: HCl, H2SO4, HNO3, NH3 etc. Ozone in high concentration or H2O2 also have the same effect and should be avoided. Please note that the above examples are not a complete list of pollutants.

The sensor must **not come into contact with cleaning agents** or strong air blasts from an air gun (non-oil-free air). Exposure of the sensor to cleaning agents may cause drift of the measured value or complete failure of the sensor.

Ensure **good ventilation (fresh air supply)** to avoid high concentrations of volatile chemicals (solvents, e.g. ethanol, isopropanol, methanol, acetone, cleaning solutions, detergents...).

Important !

Protect your Sensor !

Use and installation

Do not apply mechanical force to any part of the sensor during mounting and operation. Prevent dust or particles from entering the sensor opening (sensor performance may be affected). For use in corrosive environments - such as condensation or corrosive gases - it may be necessary to protect the electronics of the sensor with a passivation. Please contact the support for this (support@blusensor.com). Such a passivation can be achieved by a conformal coating, by applying special agents to the sensor or by integrating a membrane in the housing.

Packing

We recommend storing the devices in metallic, antistatically shielded ESD bags. In particular, it is recommended not to reseal the ESD bags with adhesive or adhesive tapes after opening. Sensors must not be packed in outgassing plastics that could cause contamination of the sensor. In addition to antistatically shielded metal ESD bags, paper or cardboard-based packaging, thermoformed plastic trays (PE, PET, PP) can also be considered. Do not use polyethylene anti-static bags (light blue, pink or rose); be very careful with bubble wrap and foam. Pay attention to stickers that are inside the packaging. Sticker size should be kept to a minimum, and the sticky side must adhere completely to a surface. Note that many packaging materials may have additives (plasticizers) that can have an environmentally harmful effect on the sensor. As a general rule, if a material gives off a strong odor, do not use it. Even materials listed for recommended use may have additives. For high safety, device housings and shipping packages must be qualified.

Such a qualification test may involve exposing the device in the shipping package to a temperature ≥65°C for at least 168 hours. (If shipping or storage conditions are expected to be harsh, the qualification test conditions must be adjusted for the packaging material.) The sensor reading must then show no changed deviation from a reference compared to the same measurements before exposure.

Do not use polyethylene antistatic bags (light blue, pink or rose colored). Do not use adhesive tapes in the packaging.

Ordering information

When ordering the air quality sensor, use the product names listed in the table. For current product information and distributors, visit www.blusensor.com .

bluSensor Mini		quantity	EAN-number
Model Beacon	(BSP01BE)		
Model Humidity and Temperature Data Logger	(BSP01AIR)		0742832891417
Model Humidity and Temperature Monitoring	(BSP02AIR)		0742832891431
Model Air Quality Sensor Smart Home	(BSP02AIQ)		0742832891424
Model Usage Counter	(BSP02COUNT)		
Model Motion	(BSP02MOTION)		
bluSensor Pro		**quantity**	**EAN-number**
Model Air quality - VOCs (volatile organic compounds)	(BSP03AIX)		0742832891448
Model Air quality - CO2 and VOCs (volatile organic compounds)	(BSP03AIXC)		0742832891455
Model Air quality - Particulate Matter Sensor	(BSP03PM)		0742832891462
Model Temperature Monitoring	(BSP03TEM)		
Model Relay control	(BSP03RELAY)		

Revision History

Datum	Version	Page	Changes
February 2021	1.0	-	-
May 2021	2.0	all	Particulate matter sensor
November 2021	3.0	all	VOC and CO2 sensor

Warning, personal injury

Do not use this product as a safety or emergency stop switch or in any other application where failure of the product could result in injury. Do not use this product for applications other than those for which it is intended and approved. Before installing, handling, using or servicing this product, please read the data sheet and application instructions. Failure to follow these instructions could result in death or serious injury.

If purchaser purchases or uses bluSensor® products for an unintended or unauthorized use, purchaser shall indemnify and hold harmless ALMENDO and its officers, employees, subsidiaries, affiliates and distributors from and against all claims, costs, damages and expenses, and reasonable attorneys' fees, arising directly or indirectly from any claim of personal injury or death in connection with such unintended or unauthorized use, even if ALMENDO is alleged to be negligent in the design or manufacture of the product.

ESD precautions
The device is sensitive to electrostatic discharge (ESD). To avoid ESD-induced damage and/or impairment, take the usual and legally prescribed ESD precautions when handling this product.

Warranty
ALMENDO warrants exclusively to the original purchaser of this product, for a period of 24 months (two years) from the date of delivery, that this product will be of the quality, materials and workmanship defined in ALMENDO's published specifications for the product. Within this period, if this product is found to be defective, ALMENDO will, at its option, repair and/or replace this product at no charge to the purchaser, provided that:
- the defects are reported and described in writing to ALMENDO within fourteen (14) days after their occurrence;
- such defects are found to be due to defects in design, materials or workmanship on the part of ALMENDO;
- the defective product is returned to ALMENDO at the Purchaser's expense;

The warranty period for any repaired or replaced product is limited to the unexpired portion of the original warranty period. This warranty does not apply to equipment that has not been installed and used within ALMENDO's recommended specifications for the intended and proper use of the equipment. EXCEPT AS EXPRESSLY STATED HEREIN, ALMENDO MAKES NO WARRANTIES, EXPRESS OR IMPLIED, WITH RESPECT TO THE PRODUCT. ANY WARRANTIES, INCLUDING WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY DISCLAIMED AND DISCLAIMED. ALMENDO shall only be liable for defects in this product that occur under the operating conditions provided in the data sheet and when the product is used properly. ALMENDO expressly disclaims all warranties, express or implied, for any period during which the goods are not operated or stored in accordance with the technical specifications. ALMENDO assumes no liability arising out of the application or use of the products or circuits and expressly disclaims all liability, including without limitation for consequential or incidental damages. All operating parameters, including without limitation recommended parameters, must be validated for each customer application by the customer's technical experts. Recommended parameters can and will vary in different applications.
ALMENDO reserves the right, without further notice, to (i) change the product specifications and/or the information in this document, improve the reliability, features and design of this product.

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