BME280
Integrated Environmental Unit

Bosch Sensortec

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General Description

The BME280 is an integrated environmental sensor developed specifically for mobile applications where size and low power consumption are key design constraints. The unit combines individual high linearity, and high accuracy sensors for pressure, humidity and temperature in an 8-pin metal-lid 2.5 x 2.5 x 0.93 mm³ LGA package. The BME280 designed for low current consumption (3.6 µA @1Hz), long term stability, and high EMC robustness. The humidity sensor features an extremely fast response time which supports performance requirements for emerging applications such as: context awareness, and high accuracy over a wide temperature range.

The pressure sensor is an absolute barometric pressure sensor which features exceptionally high accuracy and resolution at very low noise.

The integrated temperature sensor has been optimized for very low noise and high resolution. It is primarily used for temperature compensation of the pressure and humidity sensors, and can also be used for estimating ambient temperature.

The BME280 supports a full suite of operating modes which provides the flexibility to optimize the device for power consumption, resolution, and filter performance.

Technical data	BME280 (prelim.)
Package dimensions	8-Pin LGA with metal 2.5 x 2.5 x 0.93 mm³
Operation range (full accuracy)	Pressure: 300...1100 hPa Temperature: -40...+85 °C
Supply voltage V_{DDIO} Supply voltage V_{DD}	1.2 ... 3.6 V 1.71 ... 3.6 V
Interface	I²C and SPI
Average current consumption (typ.) (1Hz data refresh rate)	1.8 µA @ 1 Hz (H, T) 2.8 µA @ 1 Hz (P, T) 3.6 µA @ 1 Hz (H, P, T) T=temperature
Average current consumption in sleep mode	0.1 µA
Humidity sensor Response time ($\tau_{63\%}$) Accuracy tolerance Hysteresis	1s ±3 % relative humidity ≤2 % relative humidity
Pressure sensor RMS Noise Sensitivity Error Temperature coefficient offset	0.2 Pa (equiv. to 1.7 cm) ±0.25 % (equiv. to 1 m at 400 m height change) ±11.5 Pa/K (equiv. to ±12.6 cm at 1°C temperature change
RoHS compliant, halogen-free, MSL1	

BME280 Target Applications

▶ Context awareness, e.g. skin detection, room change detection
▶ Fitness monitoring/well-being
  – Warning regarding dryness or high temperatures
  – Measurement of volume and air flow
▶ Home automation control
  – Control heating, ventilation, air conditioning (HVAC)
▶ Internet of things
▶ GPS enhancement (e.g. time-to-first-fix improvement, dead reckoning, slope detection)
▶ Indoor navigation (change of floor detection, elevator detection)
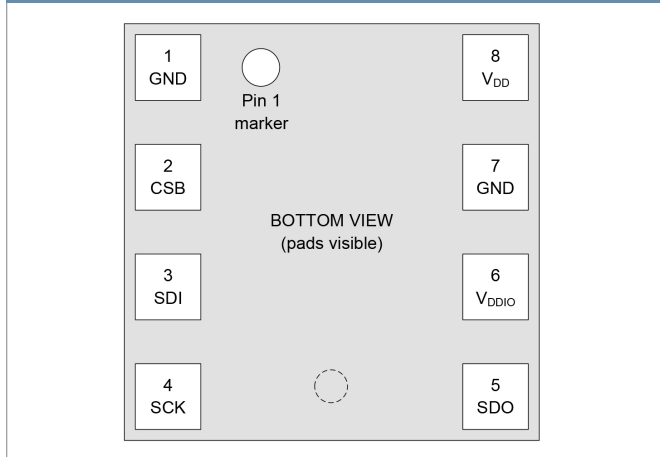▶ Outdoor navigation, leisure and sports applications

▶ Weather forecast
▶ Vertical velocity indication (rise/sink speed)

Technology and Specification

Emerging applications such as indoor navigation, home automation control, personalized weather stations, and innovative sport and fitness tools require a pressure sensor with high relative accuracy and a low TCO, in combination with fast response, high accuracy of relative humidity and ambient temperature measurements.

Pin configuration and dimensions (bottom view, pads visible)

1 GND		8 V$_{DD}$
	Pin 1 marker	
2 CSB		7 GND
	BOTTOM VIEW (pads visible)	
3 SDI		6 V$_{DDIO}$
4 SCK		5 SDO

To simplify the design-in phase, default settings optimized for several example use-cases such as weather monitoring, elevator/stair case detection, drop detection or indoor-navigation are provided.

Pin No.	Name	Function
1	GND	Ground
2	CSB	Chip select
3	SDI	Serial data input
4	SCK	Serial clock input
5	SDO	Serial data output
6	V$_{DDIO}$	Digital/Interface supply
7	GND	Ground
8	V$_{DD}$	Analog supply

The BME280 is perfectly suitable for such applications as the device features excellent relative accuracy of ±0.12 hPa (equivalent to ±1 m difference in altitude), and an offset temperature coefficient (TCO) of only 1.5 Pa/K (equivalent to 12.6cm/K).

Sensor Operation

The BME280 supports I^{2}C and SPI (3-wire/4-wire) digital, serial interfaces.

The sensor can be operated in three power modes: Sleep mode, normal mode and the forced mode. In normal mode the sensor automatically cycles between a measurement and a standby period. This mode is recommended when using BME280 built-in IIR filter when short-term disturbances (e.g. blowing into the sensor) need to be filtered. In forced mode, the sensor performs a single measurement on request and returns to sleep mode afterwards. This mode is recommended for applications that require a low sampling rate or host-based synchronization.

In order to tailor data rate, noise, response time and current consumption to the needs of the user, a variety of oversampling modes, filter modes and data rates can be selected. In combination with several short term disturbance filter settings, the sensor can be programmed in a very flexible way in order to adapt to application and power management requirements.

Software

The Altitude Content Provider ACP2.0 software is available as a software package for the BME280 which calculates the altitude with best possible accuracy. The ACP2.0 uses the sea level pressure to calculate the altitude, compensating for the non-sphericallicity of the earth by geoid correction, and compares its altitude with current altitude given by the GPS module, if available.

System Compatibility

The BME280 has been designed for best possible fit into modern mobile consumer electronics devices. Besides the ultra-small footprint and very low power consumption, the BME280 has very wide ranges for V$_{DD}$ and V$_{DDIO}$ supply voltages

Bosch is the world market leader in MEMS sensors. The BME280 from Bosch Sensortec combines extensive experience with reliability for consumer applications. Bosch Sensortec is a subsidiary of Bosch that focuses on micromechanical components for the non-automotive markets.

Data & Specification subject to change without notice   Doc.-Number: BST-BME280-FL000-00 / Version_1.1_062015