

BHV250

Small, low-power Vital Sensor Hub with integrated Acceleration Sensor

Bosch Sensortec



BOSCH
Invented for life

General Description

The BHV250 is a small, low-power Sensor Hub with an integrated MEMS sensor specifically designed to enable heart rate and motion evaluation in fitness and wellbeing applications with enhanced user experience. The device integrates a 14-bit acceleration sensor with the new Bosch Sensortec Fuser Core. The device fuses photoplethysmography (PPG) signals with the onboard inertial MEMS sensor signals for robust, motion compensated heart rate measurement. The Fuser Core powers Firstbeat's field-proven vital analytics algorithms, translating the fused heartbeat data into rich, user-friendly personal insights. The BHV250 is specifically designed for sensor based always-on applications in wearable devices such as smartwatches, fitness wristbands, earphones, smart shoes and textiles.

BHV250 target applications

- ▶ Heart rate sensing and Vital Analytics
- ▶ Activity recognition, including pedestrian dead-reckoning and step-counting
- ▶ Full Android compliant sensor fusion, including gesture detection for motion based user interfaces

BHV160 target devices

- ▶ Smartwatches and smart glasses
- ▶ Wearable devices such as fitness wristbands, earphones, smart shoes and textiles

Sensor features

The BHV250 provides an ideal all-in-one-solution for sensor based always-on sensor applications such as fitness level and training effect analysis, sleep quality and body stress, tracking of physical activity and calorie consumption based on Firstbeat's powerful vital analytics algorithms. Additionally, with the integration of the powerful Bosch Sensortec BSX Sensor Fusion library, the BHV250 enables always-on sensor features like activity and gesture recognition. By significantly offloading the main application processor from these tasks the BHV250 maximizes system operational battery time.

Technical data	BHV250 (preliminary)
Package dimensions	2.2 × 2.2 × 0.95 mm ³
Temperature range	-40...+85 °C
Supply voltage V _{DD}	1.71...3.6 V
Supply voltage V _{DDIO}	1.6...3.3 V
Typ. current consumption	
▶ eCompass @100 Hz ODR ¹	630 µA
▶ Hub+Acc. @100 Hz ODR	430 µA
▶ Hub+PPG @1 Hz ODR ²	788 µA
▶ Step detector ³	70 / 210 µA
▶ Suspend mode	14 µA
Sensor Fusion Performance	
▶ Static accuracy ^{1,4} (Head., Pitch, Roll)	7, 2, 2 degrees
▶ Dynamic accuracy ^{1,4} (Head., Pitch, Roll)	15, 7, 7 degrees
▶ Heart Rate ⁵	<2 bpm
▶ Calorie consumption	<7%
▶ Step counting error	<5% ⁶
▶ Activity recognition accuracy	Precision: 85...97% ⁷ Recall: 83...95% ⁷
Implemented Sensor Types ⁸ (with integrated accel. only)	Accelerometer, Step counter, Step detector, Significant motion, Tilt detector, Pickup gesture, Wake up gesture, Glance gesture (Activity recognition)
(with attached PPG frontend)	Heart Rate Heart Rate Variability

¹ Heading accuracy: 2 (static), 7 (dynamic) degrees with attached Gyro

² Motion compensation active; 8mA LED on current

³ Still / in motion

⁴ With additional magnetometer

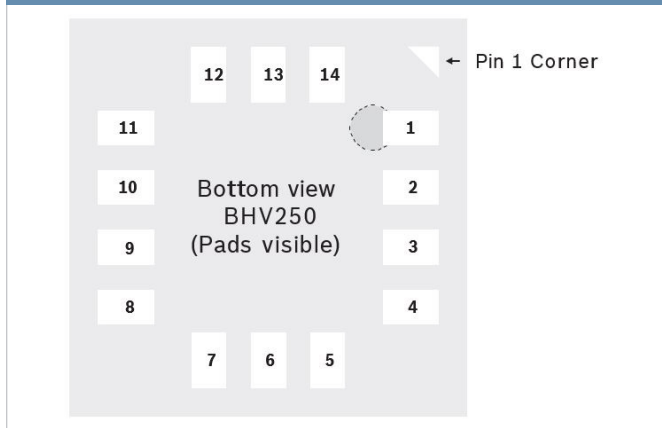
⁵ Measured at rest

⁶ False positives <9 counts within 5 min while driving

⁷ Dependent on activity

⁸ Full Android Lollipop stack is supported by connecting additional sensors to the BHV250

Pin configuration (bottom view)



In conjunction with the available interrupt lines and the high speed I²C interface, which can transfer up to 3.4 MBit/s, the BHV250 optimizes data transmission to the host CPU, making further positive contribution for an optimized system power consumption.

The integrated Fuser Core is a 32-bit floating-point microcontroller that is optimized to execute sensor fusion and activity recognition algorithms with ultra-low power consumption. It uses significantly less power than standard microcontrollers. The BHV250 implements the full Android Lollipop sensor stack and can be updated with new software features to support future requirements.

The internal RAM memory can be used for feature extension and/or data buffering in a very flexible way, giving a high degree of flexibility to the system designer.

The BHV250 is available in a 2.2 x 2.2 x 0.95 mm³ LGA package, simplifying the integration of the sensor hub into miniaturized PCBs, reducing the bill of materials, and saving valuable PCB space compared to solutions based on standard microcontrollers.

The device is compatible with a wide range of available PPG chipsets, giving customers the flexibility to support different configurations and opening a wide space for architectural decisions.

Pin	Name	Description
1	INT	Host interrupt
2	SCK	I ² C serial clock (Host interface)
3	ASCK	I ² C Master serial clock, for connecting to external sensors
4	ASDA	I ² C master serial data, for connecting to external sensors
5	VREG	Regulator filter capacitor connection
6	GPIO1	Application specific I/O pin
7	RESV1	Do not connect pin (reserved)
8	GPIO2	Application specific I/O pin
9	GND	Analog power supply ground
10	SA_GPIO7	Select I ² C address (I ² C Slave Address LSB) / Application specific I/O pin
11	GNDIO	Digital I/O power supply ground
12	VDD	Analog power supply voltage (1.71V ... 3.6V)
13	VDDIO	Digital I/O power supply voltage (1.6 ... 3.3 V)
14	SDA	I ² C serial clock (Host interface)

**Headquarters
Bosch Sensortec GmbH**

Gerhard-Kindler-Strasse 9
72770 Reutlingen · Germany
Telephone +49 7121 3535 900
Fax +49 7121 3535 909
contact@bosch-sensortec.com
www.bosch-sensortec.com