BOSCH

BHA250
Low-power Smart Hub: MEMS Sensors + µC

GENERAL DESCRIPTION

The BHA250 is a small, low-power smart-hub with an integrated three axis accelerometer plus a programmable microcontroller. Containing pre-installed software and specific algorithms for activity recognition, it is specifically designed to enable always-on motion sensing. It perfectly matches the requirements of smartphones, wearables or any other application which demands highly accurate, real-time motion data at a very low power consumption level. The device integrates our millionfold proven 14 bit acceleration sensor with a MCU – the new Bosch Sensortec Fuser core. It is bringing you the full Android sensor stack inside your devices – even without having an Android OS or an Android environment. Combining this with the built-in computing power and the highly configurable on-board memory the BHA250 offers a low power solution for motion sensing and data processing.
Software included! Programmable! Extendable!

BHA250 TARGET APPLICATIONS

▶ Activity recognition of standing, walking, running, biking or in vehicle

▶ Step-counting, Indoor navigation and PDR

▶ HMI interfaces incl. gesture detection of motion, tilt, pickup, wake up, glance or other gestures for wearables

▶ Augmented reality and immersive gaming
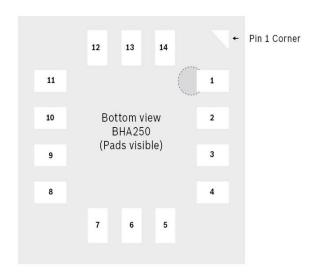
▶ Tilt-compensated eCompass and orientation

BHA250 TARGET DEVICES

▶ Mobile phones and tablets

▶ Wearables such as smart watches, wrist- or neck bands

▶ Smart-sports and smart-fitness devices

▶ Head mounted displays, AR/VR controllers

▶ Smart-TV remotes

TECHNICAL SPECIFICATIONS

BHA250 Technical data	
Package dimensions	2.2 x 2.2 x 0.95 mm³
Temperature range	-40 °C ...+85 °C
Supply voltage (V_{DDIO})	1.2 V ... 3.6 V
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Typ. current consumption	
– eCompass @100Hz ODR1	630 µA
– Hub+Acc @100 Hz ODR	430 µA
– Activity recognition	200 µA
– Significant motion	100 µA
– Step detector	100 µA
– Suspend mode	11 µA
Sensor Fusion Performance	
– Static accuracy[1] (Head., Pitch, Roll)	7, 2, 2 Degrees
– Dynamic accuracy[1] (Head., Pitch, Roll)	15, 7, 7 Degrees
– Calibration time[2]	<2 seconds
– Orientation stabilization time [1,3]	0.2 seconds
– Step counting error	<5 %[5]
– Activity recognition accuracy	Precision: 85 ... 97 %[6] Recall: 83 ... 95 %[6]
Implemented Sensor Types[4] with integrated Accel only	Accelerometer, Step counter, Step detector, Significant motion, Tilt detector, Pickup gesture, Wake up gesture, Glance gesture, Activity recognition of standing, running, biking, in vehicle
Implemented Sensor Types[4] with attached magnetometer	Gravity, Linear acceleration, Geomagnetic field, Magnetic field uncalibrated, Orientation vector, Rotation vector, Geomagnetic rotation vector

[1] With attached Magnetometer

[2] Determined by magnetometer calibration time

[3] Time from dynamic to static accuracy

[4] Full Android sensor stack is supported by connecting additional sensors to the BHA250

[5] False positives <9 counts within 5 minutes while driving

[6] Dependent on activity

Pin configuration (top view)

TECHNICAL SPECIFICATIONS

Pin	Name	Description
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1	INT	Host interrupt
2	SCK	I^2C serial clock (Host interface)
3	ASCK	I^2C Master serial clock, for connecting to external sensors
4	ASDA	I^2C 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^2C address (I^2C Slave Address LSB) / Application specific I/O pin
11	G_{NDIO}	Digital I/O power supply ground
12	V_{DD}	Analog power supply voltage (1.71 ... 3.6 V)
13	V_{DDIO}	SCK for SPI serial clock SCL for I^2C serial clock
14	SDA	I^2C serial clock (Host interface)

SENSOR FEATURES

The BHA250 provides an ideal all-in-one-solution for always-on sensor applications such as fitness tracking, step counting, indoor navigation and gesture recognition. The integration of the powerful Bosch Sensortec BSX Sensor Fusion library – i.e. software- and motion based algorithms, running on the built-in Fuser core – significantly offloads sensor- and data processing from the main application processor to the low power companion device BHA250. With the dual FIFO buffer for Wake-Up and Non-Wake- Up events, and the support of Android's latest batching feature, system designers can ensure the main application processor is not woken up just to process sensor data.

In conjunction with the available interrupt lines and the high speed I2C interface, which can transfer up to 3.4 MBit/s, the BHA250 additionally reduces system power consumption. The integrated Fuser core is a 32-bit floating-point MCU that is optimized to execute sensor fusion and activity-recognition algorithms with ultra-low power consumption. It uses significantly less power than standard MCUs. The result is always-on motion sensing without any compromise.

The BHA250 implements the full Android sensor stack. Although an Android OS or any other Android environment is not required. The pre-installed software of the device can be updated with optimized and extended features. Even upgrades with totally new features are possible to support future requirements. All by simple firmware updates. In a very flexible way the internal RAM can be used to run the built-in features, to extend them, to place own or third-party code inside and/or to use it for FIFO data buffering. The BSX sensor fusion library, integrated into the ROM, provides a rock-solid solution with the lowest effort and fastest time-to-market. Altogether giving speed plus a high degree of flexibility to the system designer.

The BHA250 is available in a 2.2 x 2.2 x 0.95 mm^3 LGA package, simplifying the integration of the sensor hub into miniaturized PCBs, reducing the bill of material, and saving valuable PCB space compared to solutions based on standard microcontrollers.