BOSCH

BHI160B
Low-power Smart Sensor (IMU + µC)

GENERAL DESCRIPTION

The BHI160B is a small, low-power smart-hub with an integrated three axis gyroscope plus 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 smart phones, wearables or any other application which demands highly accurate, real-time motion data at very low power consumption.

The device integrates our best-in-class 6-axis IMU (BMI160) with an 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 BHI160B offers you a low power solution for motion sensing and data processing. Software included! Programmable! Extendable!

BHI160B TARGET APPLICATIONS

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

▶ Step-counting, indoor navigation, PDR

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

▶ Augmented reality, immersive gaming, and tilt compensated eCompass

▶ Full 9DoF data fusion for highly accurate 3D orientation, quaternions, Euler angles, etc.
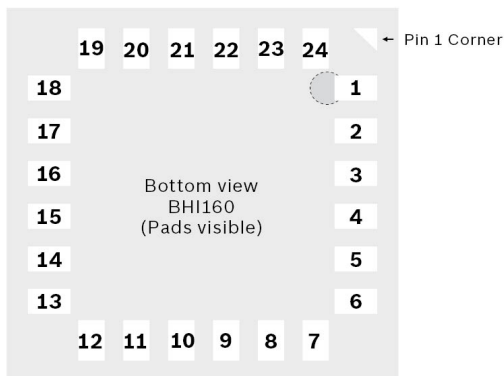
BHI160B TARGET DEVICES

▶ Mobile phones and tablets

▶ Wearables such as smart watches, wrist- or neckbands

▶ Smart-sports and smart-fitness devices

▶ Head mounted displays, AR/VR controllers

▶ Smart-TV remotes

[1]With attached Magnetometer

[2]Full Android sensor stack is supported by connecting additional sensors to the BHI160B

[3]False positives <9 counts within 5 min while driving

[4]Dependent on activity

TECHNICAL SPECIFICATIONS

BHI160B Technical data	
Package dimensions	3.0 x 3.0 x 0.95 mm³
Temperature range	-40 ... +85 °C
Supply voltage V_{DDIO}	1.6 ... 3.3 V
Supply voltage V_{DD}	1.71 ... 3.6 V
Typ. current consumption	
– Full 9DoF Fusion @100 Hz ODR[1]	1.6 mA
– Hub + IMU @100 Hz ODR	1.2 mA
– Hub + Gyro @100 Hz ODR	1 mA
– Hub + Acc. @100 Hz ODR	310 µA
– Activity recognition	150 µA
– Significant motion	128 µA
– Step detector	131 µA
– Suspend mode	11 µA
Sensor Fusion Performance	
– Static accuracy (Head., Pitch, Roll)	2, 2, 2, Degrees
– Dynamic accuracy (Head., Pitch, Roll)	7, 2, 2, Degrees
– Calibration time[1]	<1 second
– Orientation stabilization time	0.2 seconds
– Step counting error	<5 %[3]
– Activity recognition accuracy	Precision: 85 ... 97 %[4] Recall: 83 ... 95 %[4]
Implemented Sensor Types[2] with integrated IMU only	Accelerometer, Gravity, Linear acceleration, Gyroscope, Gyroscope uncalibrated, Game rotation vector, 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[2] with attached magnetometer	Geomagnetic field, Magnetic field uncalibrated, Orientation vector, Rotation vector, Geomagnetic rotation vector

Pin configuration (top view)

SENSOR FEATURES

The BHI160B 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 BHI160B. 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 BHI160B 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 BHI160B 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.

Pin		
Pin	Name	Description
1	NC	Not connected
2	RESV1	Do not connect pin
3	GPIO1	Application specific I/O pin
4	RESV2	Do not connect pin
5	RESV3	Do not connect pin
6	NC	Not connected
7	ASCK	I²C master serial clock, for connection of external sensors
8	V_{DDIO}	Digital I/O power supply
9	SA_GPIO7	Select I²C adress (I²C slave address LSB) / application specific I/O pin
10	VREG	Regulator filter capacitor connection
11	GPIO2	Application specific I/O pin
12	INT	Host interrupt
13	VDD	Analog power supply voltage (1.71 ... 3.6 V)
14	NC	Not connected
15	NC	Not connected
16	NC	Not connected
17	NC	Not connected
18	GND	Analog power supply ground
19	NC	Not connected
20	GND_{IO}	Digital I/O power supply
21	ASDA	I²C master serial data, for connection of external sensors
22	RESV4	Reserved
23	SCK	I²C serial clock (Host interface)
24	SDA	I²C serial data (Host interface)

TECHNICAL SPECIFICATIONS

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 BHI160B is available in a 3.0 x 3.0 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.

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