BMI160

Small, low power inertial measurement unit

GENERAL DESCRIPTION

The BMI160 is a small, low power, low noise 16 bit inertial measurement unit designed for use in mobile applications like augmented reality or indoor navigation which require highly accurate, real-time sensor data. In full operation mode, with both the accelerometer and gyroscope enabled, the current consumption is typically 950 µA, enabling always-on applications in battery driven devices. It is available in a compact 14-pin 2.5 x 3.0 x 0.8 mm³ LGA package.

BMI160 TARGET APPLICATIONS

- Augmented reality and immersive gaming
- 3D-scanning and indoor mapping
- Indoor navigation, pedestrian dead-reckoning, step-counting
- 6- and 9-axis sensor fusion, air mouse applications
- Optical image stabilization

BMI160 TARGET DEVICES

- Mobile phones and tablets
- Wearable devices such as smart watches, head mounted displays, sports and fitness devices
- Game controllers and smart remote controls
- Toys, e. g. quatrocopters

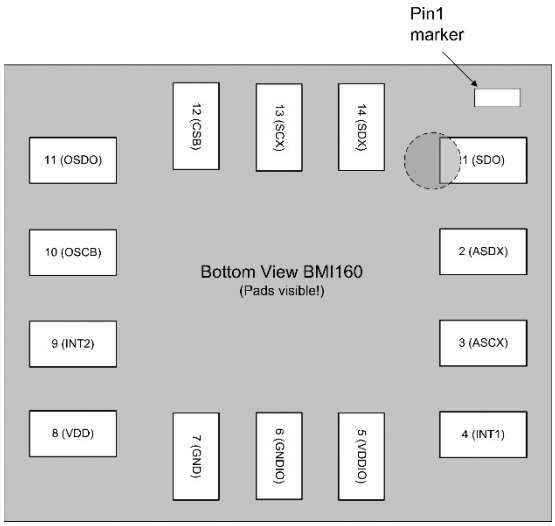
SENSOR FEATURES

Due to the built-in hardware synchronization of the inertial sensor data and its ability to synchronize data from external devices such as geomagnetic sensors, the BMI160 is ideally suited for augmented reality, immersive gaming and navigation applications, which require highly accurate, low power and low latency 9-axis sensor data fusion. The BMI160 provides high precision sensor data together with a 39 µs resolution time stamp generated by a real-time clock.

The BMI160 features a configurable on-chip interrupt engine which provides motion-based gesture recognition and context awareness as always-on background functions. Examples of interrupts that can be issued in a power efficient manner without using software algorithms are: any- or no-motion detection, tap/double tap sensing, orientation detection, free-fall or shock events.

TECHNICAL SPECIFICATIONS

BMI160 (preliminary) Technical data	
Package dimensions	2.5 x 3.0 x 0.8 mm³
Temperature range	-40...+85 °C
Supply voltage V_{DDIO}	1.2 ... 3.6 V
Supply voltage V_{DD}	1.71 ... 3.6 V
Typ. current consumption – Gyro. @full operation – Gyro. + Acc. @full oper. – Gyro. @fast start-up – Acc. @full operation – Suspend mode – Significant motion – Step detector	 850 µA 925 µA 500 µA 180 µA 3 µA 200 µA 200 µA
Sensitivity (typ.) Acc.	±2g: 16384 LSB/g ±4g: 8192 LSB/g ±8g: 4096 LSB/g ±16g: 2048 LSB/g
Sensitivity (typ.) Gyro.	±125 °/s: 262.4 LSB/°/s ±250 °/s: 131.2 LSB/°/s ±500 °/s: 65.6 LSB/°/s ±1000 °/s: 32.8 LSB/°/s ±2000 °/s: 16.4 LSB/°/s
TCS (typ.)	(A): ±0.03 %/K (G): ±0.02 %/K
Nonlinearity (typ.)	(A): 0.5 %FS (G): 0.1 %FS
Offset (typ.)	(A): ±40 mg (G): ± 3 °/s
TCO (typ.)	(A): ±1.0 mg/K (G): 0.05 °/s/K
Noise density (typ.)	(A): 180 µg/√Hz (G): 0.007 °/s/√Hz
FIFO size	1024 byte
OS support/compatibility	Android ≤4.4 Windows ≤8.1



Pin configuration (top view)

TECHNICAL SPECIFICATIONS

Pin

Pin	Name	Description
1	SDO	Serial data output in SPI Address select in I²C mode
2	ASDx	Magnetometer interface
3	ASCx	Magnetometer interface
4	INT1	Interrupt pin 1
5	V_{DDIO}	Digital I/O supply voltage (1.2 ... 3.6 V)
6	GND_{IO}	Ground for I/O
7	GND	Ground for digital & analog
8	VDD	Power supply analog & digital domain (1.62 V – 3.6 V)
9	INT2	Interrupt pin 2
10	OCSB	Secondary SPI interface
11	OSDO	Secondary SPI interface
12	CSB	Chip select for SPI mode
13	SCx	SCK for SPI serial clock SCL for I²C serial clock
14	SDx	SDA serial data I/O in I²C SDI serial data input in SPI 4W SDA serial data I/O in SPI 3W

The smart built-in power management unit (PMU) can be configured, for example, to further lower the power consumption by automatically sending the gyroscope into fast start-up mode and waking it again based on the any-motion interrupt of the accelerometer. By allowing the host to sleep longer, the PMU significantly contributes to power saving on system level.

The integrated 1024 byte FIFO buffer supports low power applications and prevents data loss in non-real-time systems. The intelligent FIFO architecture allows dynamic reallocation of FIFO space for accelerometer, gyroscope and external sensors, respectively. For a 6-DoF application at 25 Hz ODR, this is sufficient for approximately three seconds of data capture. In a typical 9-DoF application – including the geomagnetic sensor – this is sufficient for approximately two seconds.

SYSTEM COMPATIBILITY

With its footprint of 2.5 x 3.0 mm² and a package height of only 0.8 mm, BMI160 can easily be designed into devices with miniaturized PCBs.

The accelerometer and the gyroscope of BMI160 both have a 16 bit digital resolution. The product offers a wide V_{DD} voltage range from 1.71 V to 3.6 V and a V_{DDIO} range from 1.2 V to 3.6 V, allowing the BMI160 to be powered conveniently at 1.8 V for both V_{DD} and V_{DDIO}.

In mobile phone applications, the BMI160 fulfills the requirements of most standard operating systems. The device is Android 4.4 (Kitkat) and Windows 8.1 compliant. Significant motion and step detector interrupts have been implemented in a power-friendly manner and consume less than 200 µA each.

Further Bosch Sensortec sensors, e.g. geomagnetic (BMM series) or pressure sensors (BMP series) can be connected as slaves via a secondary I²C interface. In this configuration, the BMI160 controls the data acquisition of the external sensor and the data of all sensors is made available by the built-in FIFO.

Besides the flexible primary interface (I²C or SPI) used to connect to the host, BMI160 provides an additional high speed interface. This secondary SPI interface supports OIS (optical image stabilization) applications in conjunction with camera modules or advanced gaming use cases.

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