

BMI055

6-axis inertial sensor

Bosch Sensortec



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General description

The BMI055 is a very small, 6 axis inertial sensor, consisting of: A digital, triaxial 12bit acceleration sensor and a digital, triaxial 16bit, $\pm 2000^\circ/\text{s}$ gyroscope. The BMI055 allows very low-noise measurement of angular rates and accelerations in 3 perpendicular axes and thus senses tilt, motion, shock and vibration in mobile phones, handhelds, computer peripherals, man-machine interfaces, remote and game controllers.

BMI055 target applications

- ▶ Activity monitoring, step-counting
- ▶ Navigation
- ▶ Vibration measurement, also for active damping
- ▶ Six-dimensional tracking of trajectories
- ▶ Flat detection, tap sensing, menu scrolling
- ▶ Tilt compensation for electronic compass
- ▶ Advanced power management for mobile devices
- ▶ Shock and free-fall detection
- ▶ Image stabilization

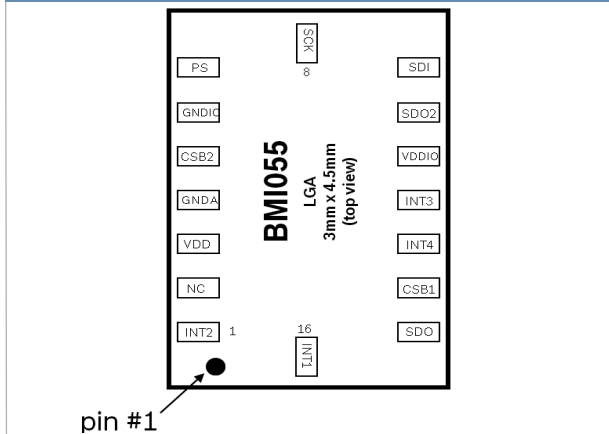
Sensor features

With its ultra-small footprint of only 3 mm x 4.5 mm the BMI055 is unique in the class of low-noise inertial measurement units. On top, the BMI055 integrates a multitude of features that facilitate its use especially in the area of motion detection applications, such as device orientation measurement, gaming, HMI and menu browser control.

Featuring a full operation current consumption of < 5.15mA the BMI055 is ideally suited for battery powered devices like mobile phones, remote controllers, and gaming devices. In low-power mode current consumption can be significantly reduced: the accelerometer can be operated with low current consumption at less than 10 μA in order to wake-up the gyroscope only when necessary. The BMI055 is highly configurable in order to give the designer full flexibility when integrating the sensor into his system.

BMI055	Technical data
Digital resolution	Accelerometer (A): 12 bit Gyroscope (G): 16bit
Resolution	(A): 0.98mg (G): 0.004 $^\circ/\text{s}$
Measurement ranges (programmable)	(A): $\pm 2\text{ g}$, $\pm 4\text{ g}$, $\pm 8\text{ g}$, $\pm 16\text{ g}$ (G): $\pm 125^\circ/\text{s}$, $\pm 250^\circ/\text{s}$, $\pm 500^\circ/\text{s}$, $\pm 1000^\circ/\text{s}$, $2000^\circ/\text{s}$
Sensitivity (calibrated)	(A): $\pm 2\text{ g}$ 1024 LSB/g $\pm 4\text{ g}$ 512 LSB/g $\pm 8\text{ g}$ 256 LSB/g $\pm 16\text{ g}$ 128 LSB/g (G): $\pm 125^\circ/\text{s}$ 262.4 LSB/ $^\circ/\text{s}$ $\pm 250^\circ/\text{s}$: 131.2 LSB/ $^\circ/\text{s}$ $\pm 500^\circ/\text{s}$: 65.6 LSB/ $^\circ/\text{s}$ $\pm 1000^\circ/\text{s}$: 32.8 LSB/ $^\circ/\text{s}$ $\pm 2000^\circ/\text{s}$: 16.4 LSB/ $^\circ/\text{s}$
Zero-point offset	(A): $\pm 70\text{mg}$, (G): $\pm 1^\circ/\text{s}$
Noise density (typ.)	(A): 150 $\mu\text{g}/\sqrt{\text{Hz}}$ (G): 0.014 $^\circ/\text{s}/\sqrt{\text{Hz}}$
Bandwidths (progr.)	1000Hz ... 8Hz
Digital inputs/outputs	SPI, I ² C, 4x digital interrupts
Supply voltage (V_{DD})	2.4 ... 3.6 V
I/O supply voltage (V_{DDIO})	1.2 ... 3.6 V
Temperature range	-40 ... +85 $^\circ\text{C}$
Current consumption	
▶ Full operation	5.15 mA
▶ Accelerometer wake-up mode	< 10 μA
FIFO data buffer	(A) 32 samples depth / (G) 100 samples (each axis)
LGA package	3 x 4.5 x 0.95mm ³
Shock resistance	10,000 g x 200 μs

Pin configuration (top view)



Pin no.	Signal
1	INT2 (Accelerometer)
2	NC
3	V _{DD}
4	GNDA
5	CSB2 (Gyroscope)
6	GND _{IO}
7	PS
8	SCx
9	SDx
10	SDO2 (Gyroscope)
11	V _{DDIO}
12	INT3 (Gyroscope)
13	INT4 (Gyroscope)
14	CSB1 (Accelerometer)
15	SDO1 (Accelerometer)
16	INT1 (Accelerometer)

Depending on the programmable settings the integrated interrupt engine of the BMI055 signals the occurrence of certain events via the sensors' interrupt pins. The corresponding registers of the BMI055 can easily be set and read-out via the digital interfaces, i.e. I²C and SPI (3-wire/4-wire).

Sensor parameters, like measurement ranges or low-pass filter settings and all interrupt engine settings can also be easily programmed via the digital interfaces.

Integrated interrupt engine

One of the key elements of the BMI055 is the enhanced intelligent interrupt engine that gives the designer full control. Various motion detection scenarios can

be identified by the BMI055 and signaled to the system via interrupt pins. The interrupt sources can be freely mapped to the interrupt pins. Following motion detection use case scenarios are supported by the BMI055 interrupt engine:

Accelerometer interrupts

- ▶ Data-ready (e.g. for processor synchronization)
- ▶ Any-motion detection (e.g. for wake-up)
- ▶ No-motion detection (e.g. for power saving)
- ▶ Tap sensing (e.g. for tap-sensitive UI control)
- ▶ Orientation change recognition (e.g. for portrait/landscape & face-up/face-down switching)
- ▶ Flat detection (e.g. for position sensing)
- ▶ Low-g / high-g detection (e.g. for shock and free-fall detection)

Gyroscope interrupts

- ▶ Self-wake-up/auto-wake-up
- ▶ Auto sleep: after a predefined duration of no activity, switch to sleep mode and activate self-wake-up/auto-wake-up; durations: 5s/10s/15s/20s/30s/60s

Interrupt parameters (e.g. switching angles and hysteresis settings for orientation change) can be configured and thus perfectly support the integration of the BMI055 into the user's system environment.

- ▶ The interrupt outputs are configurable as active-high or active-low
- ▶ The interrupt source is selectable from filtered or unfiltered data

System compatibility

The BMI055 has been designed for best possible fit into modern mobile consumer electronics devices. Besides the ultra-small footprint and very low power consumption, the BMI055 has very wide ranges for V_{DD} and V_{DDIO} supply voltages. The BMI055 also includes a FIFO buffer with 32 samples depth for each axis for the accelerometer and a FIFO buffer with 100 samples depth for each axis of the gyroscope. An integrated self-test feature facilitates overall system reliability.

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