

# BMA355

## Digital, triaxial acceleration sensor

Bosch Sensortec



**BOSCH**  
Invented for life

### General Description

The BMA355 is an advanced, ultra-small, triaxial, low-g acceleration sensor with digital interfaces in a wafer level chip scale package (WLCSP), aiming for highly integrated low-power consumer electronics applications. Featuring 12 bit digital resolution, the BMA355 allows very low-noise measurement of accelerations in 3 perpendicular axes and thus senses tilt, motion, shock and vibration in smartphones, tablets, computer peripherals, human-machine interfaces, augmented reality devices, ubiquitous sensor networks, hearing aids and game controllers.

### BMA355 target applications

- ▶ Display profile switching (portrait/landscape, face-up/face-down switching)
- ▶ Flat detection
- ▶ Tap/double tap sensing
- ▶ Gaming
- ▶ Advanced power management for mobile devices
- ▶ Shock and free-fall detection
- ▶ Step-counting
- ▶ Tilt compensation for electronic compass

### Sensor features

The innovative wafer level chip scale package with a footprint of only  $1.2 \times 1.5 \text{ mm}^2$  and a height of 0.8 mm provides highest design flexibility to developers of highly integrated mobile devices.

It is unique in the class of digital acceleration sensors. Featuring a full operation current consumption of only  $130 \mu\text{A}$  the BMA355 is ideally suited for mobile consumer electronic devices. In low-power mode operation the current consumption can be even further reduced by more than one order of magnitude.

The BMA355 is highly configurable in order to give the designer full flexibility when integrating the sensor into the system.

BMA355	Tech. Data (prelim.)
Digital resolution	12 bit
Resolution (in $\pm 2\text{g}$ range)	0.98 mg
Measurement ranges (programmable)	$\pm 2\text{g}$ , $\pm 4\text{g}$ , $\pm 8\text{g}$ , $\pm 16\text{g}$
Sensitivity (calibrated)	$\pm 2\text{g}$ : 1024 LSB/g $\pm 4\text{g}$ : 512 LSB/g $\pm 8\text{g}$ : 256 LSB/g $\pm 16\text{g}$ : 128 LSB/g
Zero-g offset (typ., over life-time)	$\pm 60\text{mg}$
Noise density (typ.)	$150 \mu\text{g}/\sqrt{\text{Hz}}$
Bandwidths (programmable)	1000 Hz ... 8 Hz
Digital inputs/outputs	SPI & I <sup>2</sup> C, 2x digital interrupt pins
Supply voltage ( $V_{\text{DD}}$ )	1.62 ... 3.6 V
I/O supply voltage ( $V_{\text{DDIO}}$ )	1.2 ... 3.6 V
Temperature range	-40 ... +85°C
Current consumption	
▶ full operation	$130 \mu\text{A}$ (@2 kHz data rate)
▶ low-power mode	$6.5 \mu\text{A}$ (@40 Hz data rate)
FIFO data buffer	32 sample depth (for each axis)
Package	WLCSP (10 sold. balls) $1.2 \times 1.5 \times 0.8 \text{ mm}^3$ 0.4 mm ball pitch
Shock resistance	10,000 g x 200 $\mu\text{s}$

### Sensor operation

The BMA355 supports two modes of operation:

1) Standard data polling mode: Acceleration data is directly read-out via the sensor's digital interface and computed by a system  $\mu\text{Controller}$ , application processor or a baseband processor.

2) Interrupt engine mode: Acceleration data is computed already within the BMA355 by the integrated, programmable interrupt engine.

Depending on the programmable settings the integrated interrupt engine of the BMA355 signals the occurrence of certain events via the sensors' two interrupt pins. The corresponding registers of the BMA355 can easily be set and read-out via the digital sensor interface.

The BMA355 features I2C and SPI (3-wire/4-wire) digital, serial interfaces. Sensor parameters, like g-ranges or low-pass filter settings, and also all interrupt engine settings can be easily programmed via the digital interfaces.

### Integrated interrupt engine

One of the key elements of the BMA355 is the enhanced intelligent interrupt engine that gives the hard and software designer full control. Various motion detection scenarios can be identified by the BMA355 and signaled to the system via two interrupt pins. The interrupt sources can be freely mapped to either of the two interrupt pins. The following motion detection use case scenarios are supported by the BMA355 interrupt engine:

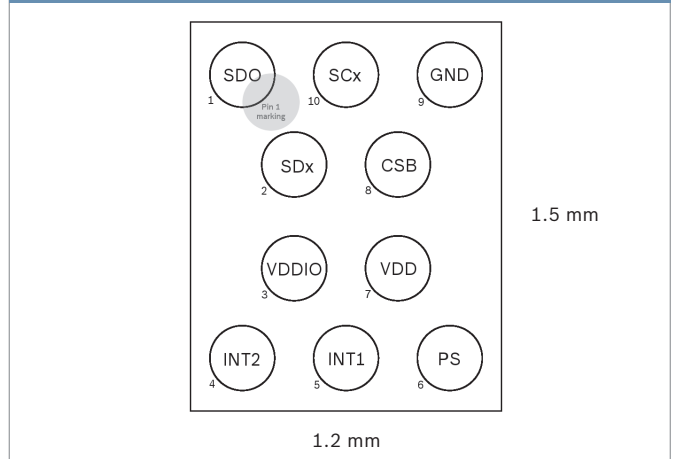
- ▶ Data-ready (e.g. for processor synchronization)
- ▶ Any-motion (slope) detection (e.g. for wake-up)
- ▶ Tap sensing (e.g. for tap-sensitive UI control)
- ▶ Orientation change recognition (e.g. for portrait/landscape switching)
- ▶ Flat detection (e.g. for position sensitive switching)
- ▶ Low-g /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

Interrupt parameters (e.g. switching angles and hysteresis settings for orientation change) can be configured by the designer and thus perfectly support the integration of the BMA355 into the user's system environment.

### System compatibility

The BMA355 has been designed for best possible fit into modern mobile consumer electronics devices. Besides the wafer level chip scale package with ultra-small footprint and lowest power consumption, the BMA355 has very wide ranges for VDD and VDDIO supply voltages. The BMA355 also includes a FIFO buffer with 32 samples depth for each acceleration axis. An integrated self-test feature facilitates overall system reliability.

Pin configuration (top view)



Pin	Name	Description
1	SDO	SPI: serial data output in SPI 4-wire mode I <sup>2</sup> C: I <sup>2</sup> C address select
2	SDx	SPI: SDI serial data input in SPI 4-wire mode SPI: SDA serial data I/O in SPI 3-wire mode I <sup>2</sup> C: SDA serial data line
3	V <sub>DDIO</sub>	Voltage supply for I/Os
4	INT2	Interrupt output #2
5	INT1	Interrupt output #1
6	PS	Protocol select: SPI: GND I <sup>2</sup> C: V <sub>DDIO</sub>
7	V <sub>DD</sub>	Voltage supply
8	CSB	Chip select for SPI
9	GND	Ground
10	SCx	SCK: SPI clock SCL: I <sup>2</sup> C clock

#### Headquarters Bosch Sensortec GmbH

Gerhard-Kindler-Strasse 8  
72770 Reutlingen · Germany  
Telephone +49 7121 3535 900  
Fax +49 7121 3535 909  
contact@bosch-sensortec.com  
[www.bosch-sensortec.com](http://www.bosch-sensortec.com)