

# BMA222

## Digital, triaxial acceleration sensor

Bosch Sensortec



### General description

The BMA222 is an advanced, ultra-small, triaxial, low-g acceleration sensor with digital interfaces, aiming for low-power consumer electronics applications.

The BMA222 allows measurement of accelerations in 3 perpendicular axes and thus senses tilt, motion, shock and vibration in cellular phones, handhelds, computer peripherals, man-machine interfaces, virtual reality features and game controllers.

### BMA222 target applications

- ▶ Display profile switching (portrait/landscape, face-up/face-down switching)
- ▶ Flat detection
- ▶ Tap sensing function
- ▶ Menu scrolling
- ▶ Gaming
- ▶ Advanced power management for mobile devices
- ▶ Shock and free-fall detection
- ▶ Step-counting

### Sensor features

With its size of only 2 mm x 2 mm the BMA222 represents a new generation of digital acceleration sensors. The BMA222 integrates a multitude of features that facilitate its use especially in the area of motion detection applications, such as device orientation detection, gaming, HMI and menu browser control. Featuring a full operation current consumption of only 139  $\mu$ A the BMA222 is ideally suited for mobile consumer electronic devices. In low-power mode operation the current consumption can be even further reduced by almost one order of magnitude.

The BMA222 is highly configurable in order to give the designer full flexibility when integrating the sensor into his system.

### Sensor operation

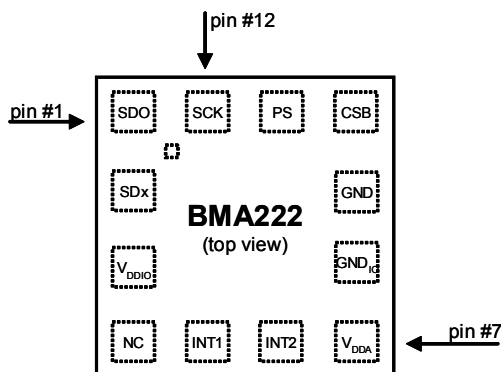
The BMA222 supports two modes of operation:

1) Streaming data mode: Acceleration data is directly read-out via the sensor's digital interface and computed by a system  $\mu$ Controller, application processor or a base-band processor.

2) Interrupt engine mode: Acceleration data is computed already within the BMA222 by the integrated, programmable interrupt engine. Depending on the programmable settings the integrated interrupt engine of the BMA222 signals the occurrence of certain events via the sensors' two interrupt pins. The corresponding registers of the BMA222 can easily be set and read-out via the digital sensor interface.

| BMA222                               | Technical data   |
|--------------------------------------|--|
| Digital resolution                   | 8 bit  |
| Resolution<br>(in $\pm 2g$ range)    | 15.6 mg  |
| Measurement ranges<br>(programmable) | $\pm 2g$ , $\pm 4g$ , $\pm 8g$ , $\pm 16g$   |
| Sensitivity<br>(calibrated)          | $\pm 2g$ : 64 LSB/g<br>$\pm 4g$ : 32 LSB/g<br>$\pm 8g$ : 16 LSB/g<br>$\pm 16g$ : 8 LSB/g |
| Zero-g offset<br>(over life-time)    | $\pm 100$ mg   |
| Bandwidths<br>(programmable)         | 1000 Hz ... 8 Hz   |
| Digital inputs/outputs               | SPI & I <sup>2</sup> C,<br>2x interrupt pins   |
| Supply voltage ( $V_{DD}$ )          | 1.62 ... 3.6 V   |
| I/O supply voltage ( $V_{DDIO}$ )    | 1.2 ... 3.6 V  |
| Temperature range                    | -40 ... +85°C  |
| Current consumption                  |  |
| ▶ full operation                     | 139 $\mu$ A (@2 kHz data rate)   |
| ▶ low-power mode                     | 7 $\mu$ A (@40 Hz data rate)<br>1 $\mu$ A (@1 Hz data rate)                              |
| LGA package                          | 2 x 2 x 0.95 mm <sup>3</sup>   |
| Shock resistance                     | 10.000 g x 200 $\mu$ s   |

Pin configuration (top view)



| Pin No. | Name              | Function  |
|---------|-------------------|---|
| 1       | SDO               | SPI serial data output  |
| 2       | SDA, SDI, SDO     | I <sup>2</sup> C/SPI serial data input/output                 |
| 3       | V <sub>DDIO</sub> | I/O supply voltage  |
| 4       | N.C.              | Not connected   |
| 5       | INT1              | Interrupt output #1   |
| 6       | INT2              | Interrupt output #2   |
| 7       | V <sub>DD</sub>   | Supply voltage  |
| 8       | GND <sub>IO</sub> | Ground I/O  |
| 9       | GND               | Ground  |
| 10      | CSB               | SPI chip select   |
| 11      | PS                | Protocol select pin (0=SPI, 1=I <sup>2</sup> C)               |
| 12      | SCK               | SCL (I <sup>2</sup> C serial clock)<br>SCK (SPI serial clock) |

The BMA222 features I<sup>2</sup>C 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 BMA222 is the enhanced intelligent interrupt engine that gives the hard- and software designer full control. Various motion detection scenarios can be identified by the BMA222 and signaled to the system via two interrupt pins. The interrupt sources can be freely mapped to either of the two interrupt pins.

Following motion detection use case scenarios are

supported by the BMA222 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 & face-up/face-down switching)
- ▶ Flat detection (e.g. for position sensitive switching)
- ▶ Low-g / high-g detection (e.g. for shock and free-fall detection)

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 BMA222 into the user's system environment.

### System compatibility

The BMA222 has been designed for best possible fit into modern mobile consumer electronics devices. Besides the ultra-small footprint and lowest power consumption, the BMA222 has very wide ranges for V<sub>DD</sub> and V<sub>DDIO</sub> supply voltages. An integrated self-test feature facilitates overall system reliability.

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