BMA456 with hearable feature set

Intelligent, triaxial accelerometer

GENERAL DESCRIPTION

The BMA456 is an ultra-small, triaxial, low-g and high-performance accelerometer with digital interfaces, aiming for low-power hearable applications. Featuring 16-bit digital resolution and several smart features, the BMA456 allows low-noise measurement of acceleration in three perpendicular axes and thus senses single/double/triple tap and enables plug 'n' play step counting especially optimized for hearable devices. In addition, BMA456 enables in-ear/out-of-ear detection.

The superior temperature behaviour of BMA456 facilitates accurate measurements over changing temperatures. Thanks to the low height of only 0.65 mm, manufacturers can flexibly place the sensor and minimize the design of the hearable devices.

BMA456 TARGET APPLICATIONS

- Step counting optimized for hearable devices
- Low-power and intuitive user interaction by tap/double tap/triple tap
- Power management for hearables: motion/no-motion detection
- Activity recognition and activity tracking
- In-ear/out-of-ear recognition

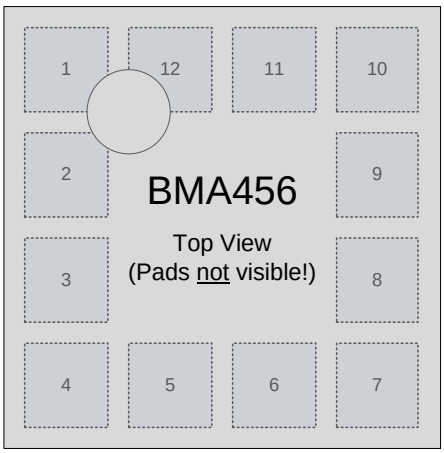
SENSOR FEATURES

BMA456 is the industry's only accelerometer with new and optimized features for hearable devices and headphones integrated in one sensor. The BMA456 integrates a multitude of features like triple tap, step counting and activity recognition that that facilitate the usage and enhance the user experience of hearable devices. The plug'n' play step counter and activity recognition feature is optimized for hearable positions.

In the low-power mode the power consumption is reduced to 14 µA for standard use cases. The integrated motion/no-motion detection automatically switches the sensor to the ultra-low power mode with a power consumption of only 6 µA. Motion automatically triggers a wake-up function. This fulfills the power consumption requirements for hearable devices. In addition, a high-performance measurement mode with low pass filters is available to make the BMA456 robust to vibrations and aliasing. The default parameter set of the BMA456 features is highly configurable in order to give the designer full flexibility when integrating the sensor into the system.

TECHNICAL SPECIFICATIONS

BMA456 technical data	
Digital resolution	16-bit
Resolution (in ±2g range)	0.06 mg
Measurement ranges (programmable)	±2 g; ±4 g; ±8 g; ±16 g
Sensitivity (calibrated)	±2 g: 16384 LSB/g ±4 g: 8192 LSB/g ±8 g: 4096 LSB/g ±16 g: 2048 LSB/g
Zero-g offset (typ., over life-time)	±20 mg
TCO	0.35 mg/K
Noise density (typ.)	120 µg/√Hz
Output data rate (programmable)	1600 Hz ... 1.5 Hz
Digital inputs/outputs	SPI & I^2C, 2x digital interrupt pins
Supply voltage (V_{DD})	1.62 ... 3.6 V
I/0 supply voltage (V_{DDIO})	1.2 ... 3.6 V
Temperature range	-40 ... +85 °C
Current consumption – high performance – low-power mode	 150 µA 14 µA (@ 50 Hz data rate)
Shock resistance	10,000 g x 200 µs
LGA package	2 x 2 x 0.65 mm^3



Pin configuration (top view)

TECHNICAL SPECIFICATIONS

Pin		
Pin	Name	Description
1	SDO	SPI: serial data out I²C: I²C address select
2	SDx	Serial data I/O
3	V_{DDIO}	Power supply
4	ASDA	Serial data I/O – Secondary interface
5	INT1	Interrupt pin
6	INT2	Interrupt pin
7	V_{DD}	Power supply
8	GND_{IO}	Ground
9	GND	Ground
10	CSB	Chip select for SPI
11	ASCL	Digital clock (in) – Secondary Interface
12	SCx	Digital clock (in)

SENSOR OPERATION

The BMA456 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 microcontroller, application processor or a baseband processor.
2. Smart plug 'n' play features:
   Acceleration data is computed within the BMA456. The sensor's embedded intelligence triggers an interrupt at certain selectable events which can be mapped to the selectable interrupt pins. In addition to the electrical interrupt, the sensor stores the status of the events and the counted steps in the register map and reads them out.

Smart feature set for hearables:

- Motion/no-motion detection (self-wake-up)
- Tap, double tap and triple tap
- Step detector and step counter
- Activity recognition: standing still, walking running

Feature parameters can be configured by the designer and thus perfectly support the adoption to the required use case and system design, releasing the full potential to improve the performance of respective hearable device.

SYSTEM COMPATIBILITY

The BMA456 has been designed for best possible fit into modern hearable devices. In addition to the very low height and lowest power consumption, the BMA456 offers very wide ranges for V_{DD} and V_{DDIO} supply voltages. The BMA456 features I²C and SPI (3-wire/4-wire) digital, serial interfaces. The availability of a separate I²C interface enables the connection of an external magnetometer (BMM150 recommended). This reduces the complexity of sensor data fusion while improving its precision. BMA456 is designed for plug 'n' play functionality and ease-of-use in hearable devices with demanding performance requirements.

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