

BMA456

Intelligent, triaxial acceleration sensor

GENERAL DESCRIPTION

The BMA456 is an ultra-small, triaxial, low-g high performance acceleration sensor with digital interfaces, aiming for low-power and demanding consumer electronics applications. Featuring 16 bit digital resolution and embedded intelligence, the BMA456 allows low-noise measurement of accelerations in 3 perpendicular axes and thus senses wrist tilt, tab/double tab and enables plug 'n' play step counting especially in wearable devices. The superior temperature behaviour of BMA456 facilitates accurate measurements over changing temperature. The reduced height of only 0.65 mm is beneficial for wearable devices.

requirements for always-on applications and wearable devices. The BMA456 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 $\pm 2g$ range)	0.06 mg	
Measurement ranges (programmable)	$\pm 2 g$; $\pm 4 g$; $\pm 8 g$; $\pm 16 g$	
Sensitivity (calibrated)	$\pm 2 g$: 16384 LSB/g	
	$\pm 4 g$: 8192 LSB/g	
	$\pm 8 g$: 4096 LSB/g	
	$\pm 16 g$: 2048 LSB/g	
Zero-g offset (typ., over life-time)	± 20 mg	
Noise density (typ.)	120 $\mu g/\sqrt{Hz}$	
Output data rate (programmable)	1600 Hz ... 1.5 Hz	
Digital inputs/outputs	SPI & I ² C, 2x digital 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	150 μA
	– low-power mode	13 μA (@ 50 Hz data rate)
Large FIFO data buffer	1 kb	
LGA package	2 x 2 x 0.65 mm ³	
Shock resistance	10,000 g x 200 μs	

BMA456 TARGET APPLICATIONS

- ▶ Step counting in wearable devices
- ▶ Wake up display on wrist tilt
- ▶ Low power user interaction by tab/double tab
- ▶ Advanced gesture recognition
- ▶ Activity recognition/tracking
- ▶ Advanced power management for mobile devices
- ▶ Tilt compensation for electronic compass
- ▶ Spirit leveling / Virtual horizon

SENSOR FEATURES

With its embedded intelligence BMA456 is unique in the class of consumer grade accelerometers for wearable devices, wrist bands and toys and gadgets. The embedded intelligence enables low current step-counting at 25 μA . On top, the BMA456 integrates a multitude of other features (e.g. wrist tilt, tab/double tab etc.) that facilitate its use especially in wearable devices. The plug'n' play step counter is optimized for wrist band usage and can be used in other wearable positions as well. Featuring a high performance measurement mode with low pass filters and a current consumption of only 150 μA the BMA456 is robust to vibrations and aliasing. In low-power mode operation the current consumption can be even further reduced by more than one order of magnitude. This fulfills the current consumption



Pin configuration (top view)

TECHNICAL SPECIFICATIONS

Pin	Name	Description
1	SDO	SPI: serial data out I ² C: I ² C 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 μ Controller, application processor or a baseband processor. An integrated FIFO with 1 kB of size can be used optionally to reduce overall system current consumption.

2) Plug 'n' play intelligence operation: Acceleration data is computed already within the BMA456. The embedded intelligence of the sensor can trigger an interrupt at certain selectable events which can be mapped to the selectable interrupt pins. In addition to the electrical interrupt, the status of the events and the counted steps are stored in the register map and can be read out easily.

Embedded intelligence:

- ▶ Step detector / Step counting
- ▶ Activity recognition: still, walking running
- ▶ Tilt on wrist detection
- ▶ Tap/double tap

Feature parameters can be configured by the designer and thus perfectly support the adoption to the required use case and system design.

SYSTEM COMPATIBILITY

The BMA456 has been designed for best possible fit into modern mobile consumer electronics and IoT devices. Besides the very low height and lowest power consumption, the BMA456 has 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) and the synchronization of the acceleration and the magnetometer data in the FIFO of the BMA456. This reduces the complexity of sensor data fusion and improves its precision as well. BMA456 is designed for plug 'n' play functionality and ease-of-use in various system designs with demanding performance requirements.

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