BMA400

Ultra-low power, triaxial accelerometer

GENERAL DESCRIPTION

The BMA400 is the first real ultra-low power acceleration sensor without compromises on performance. Featuring 12-bit digital resolution, continuous measurement and a defined selectable bandwidth combined with ultra-low power the BMA400 allows low-noise measurement of accelerations in three perpendicular axes, thus senses tilt, orientation tab/double tab, and enables plug 'n' play step counting with activity recognition especially in wearable devices, which need a long lasting battery lifetime. The continuous measurement principle of the device makes it the perfect sensor for smart home applications like sensor nodes of climate controls and security systems, thus the BMA400 avoids false alarms by unintentional vibrations from the environment.

BMA400 TARGET APPLICATIONS

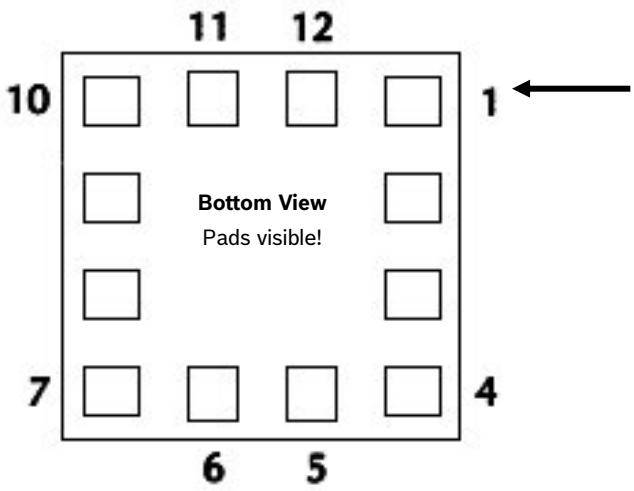
- Activity tracking in wearable devices
- Smart home applications
- Power management
- Tilt measurement
- Industrial applications (e.g. predictive maintenance, package tracking etc.)

SENSOR FEATURES

With its embedded features the BMA400 is unique in the class of ultra-low current accelerometers for wearable devices, smart home and Internet of Things. The embedded step counter and activity recognition enables low current step-counting and activity tracking at only 4 µA overall current consumption. The plug'n' play step counter is optimized for wrist band usage and can be used in other wearable positions as well. On top, the BMA400 integrates a multitude of other features (e.g. activity changed, orientation, tab/double tab etc.) that facilitate its use especially in wearable devices and increase battery life significantly. Featuring continuous measurement and low pass filters in all power/noise configurations down to 3.2 µA the BMA400 is robust to vibrations and aliasing. In an additional ultra-low power mode the current consumption can be even further reduced down to 800 nA. This mode offers a self wake-up function to switch the sensor into any normal mode configuration when precise measurement is required. In addition an auto ultra-low power feature is available to switch the sensor into its lowest current consumption configuration, when simple motion monitoring is needed. The BMA400 is highly configurable in terms of current consumption and noise performance in order to give the designer full flexibility when integrating the sensor into an always on low power system. The integrated features enable the device to be used as main part of a power management system.

BMA400 Technical data	
Measurement range	±2g, ±4g, ±8g, ±16g
Digital resolution	12 bit
Output Data Rate (ODR)	12.5 Hz to 800Hz
Low path filter bandwidth	Selectable 0.48xODR or 0.24xODR
Current consumption (independent from ODR → continuous measurement)	Max. Performance: 14 µA Typical use-case: < 8µA Low power use-case: < 4 µA
Noise density	Max. performance: < 220 µg/√Hz Typical use case: < 320 µg/√Hz Low power: < 600 µg/√Hz
Ultra low power / Self-wake-up mode	800nA @ 25Hz ODR
Embedded Features	- Step Counter (< 4 µA overall) - Activity Recognition (walking, running, standing still) - Activity Changed - Orientation - Tab/Double Tab (< 8 µA overall) - General Interrupt 1 and 2 (programmable via thresholds, timer, logical AND/OR operations) - 1 kByte FIFO
Offset	50 mg
TCO	1 mg/K
Interface	SPI & I²C & 2 Interrupt pins
Supply Voltage	1.72 V up to 3.6 V
Package	12 pin LGA 2x2x0.95m³

TECHNICAL SPECIFICATIONS



Pin configuration

Pin	Name	Description
1	SDO	Serial data output in SPI Address select in I²C mode
2	SDX	SDA serial data I/O in I²C SDI serial data input in SPI 4W SDA serial data I/O in SPI 3W
3	VDDIO	Digital I/O supply voltage (1.2V … 3.6V)
4	NC	Do not connect
5	INT1	Interrupt output 1 (default)
6	INT2	Interrupt output 2 (default)
7	VDD	Power supply for analog & digital domain (1.72V … 3.6V)
8	GNDIO	Ground for I/O
9	GND	Ground for digital & analog
10	CSB	Chip select for SPI mode
11	NC	Do not connect
12	SCX	SCK for SPI serial clock SCL for I²C serial clock

SENSOR OPERATION

1) Standard data polling mode: Acceleration data is directly read-out via the sensor's digital interface and computed by a system µController or an application processor. Down to 3.2 µA the acceleration data on the interface is always continuously measured and has a defined selectable bandwidth. An integrated FIFO with 1 kB of size as well as Auto wake-up and Auto ultra-low power can be used optionally to reduce the overall system current consumption.

2) Plug 'n' play embedded functionality. Acceleration data is computed already within the BMA400. The embedded features 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 features:

- Step detector / Step counting
- Activity recognition: still, walking running
- Activity changed (detects change of unspecific periodic activities)
- Orientation
- Tab/double tap
- General Interrupt 1 und 2 → Programmable by threshold, timing, axes and logical AND/OR functionality.

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 BMA400 has been designed for best possible fit into modern wearable and IoT devices which are either non-chargable or chargable devices with a long battery lifetime. Besides the lowest current consumption and superior performance, the BMA400 has very wide ranges for V_{DD} and V_{DDIO} supply voltages. The performance and the current consumption are stable over the whole voltage supply range. The BMA400 features I²C and SPI (3-wire/4-wire) digital, serial interfaces. The availability of data timestamping enables the synchronization of the acceleration data with other sensors connected to the same µController or application processor. This reduces the complexity of sensor data fusion and improves its precision as well. BMA400 is designed for plug 'n' play functionality and ease-of-use in various system designs which require ultra-low current consumption on sensor and system level.

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