BMA140
Analog, triaxal acceleration sensor

Bosch Sensortec

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General description

The BMA140 is an analog, triaxial low-g acceleration sensor for consumer market applications, available in a super-flat land-grid array (LGA) package with a very small footprint of 3mm x 3mm and a height of merely 0.9mm. It allows measurements of static as well as dynamic accelerations. Due to its three perpendicular axes it gives the absolute orientation in a gravity field and enables free-fall detection.
The BMA140 is a two-chip arrangement, which combines an application-specific integrated circuit (ASIC) with a three-channel silicon accelerometer, to form a true micro electro mechanical system (MEMS).

Key features BMA140
▶ Triaxial, analog low-g sensor with three parallel outputs
▶ ±4g range
▶ Ultra low power consumption
▶ Power-saving stand-by mode
▶ Fast wake-up time
▶ Very wide power supply range
▶ Additional multiplexed serial analog output
▶ Internal filtering capability
▶ On-chip gain and offset compensation
▶ Self-test capability
▶ Super-flat, small footprint LGA package
▶ RoHS compliant

This concept and the advanced micromachining technology have proven their robustness and reliability in more than 150 million Bosch MEMS sensors per year. The modular ASIC design provides the flexibility to react quickly to customer needs for additional sensor functionality in the future.

The BMA140 provides three parallel analog output signals in a ±4g acceleration range. In addition to the parallel X, Y and Z output signals there is the option to multiplex any axis to a single supplementary output pin in a freely customized manner.

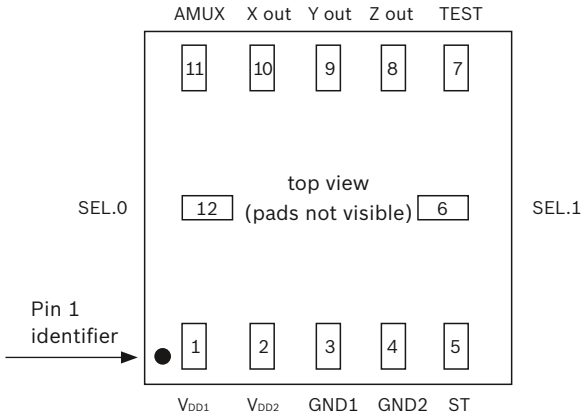
Leveraging its ultra-low power consumption and its wake-up feature the BMA140 senses tilt, motion, shock and vibration in advanced gaming console applications and all kind of mobile, personal communication and entertainment devices.

BMA140 applications based on low-g sensing

- ▶ Gaming
- ▶ Virtual reality
- ▶ Sports- and life-style wear
- ▶ Handhelds
- ▶ Healthcare
- ▶ Cell phones
- ▶ Navigation
- ▶ Electronic compass compensation

Technical data	BMA140
Sensitive axes	x/y/z
Measurement range	±4g
Package	LGA, 3 mm x 3 mm x 0.9 mm
Sensitivity (factory trimmed)	V_{DD}/10 [V/g]
Non-linearity	±0.5 % FS (typ.)
Cross axis sensitivity	0.2 % (typ.)
Zero-g offset (factory trimmed)	±150 mg (max.)
Zero-g offset temperature drift	±1 mg/K (typ.)
RMS-noise	220 µg/√Hz
Bandwidth (1st order LP filtering)	1.5 kHz
Supply voltage	1.8 ... 3.5 V
Current consumption	200 µA (typ., normal mode)
Idle current	0.9 µA (max.,stand-by mode)
Wake-up time	1 msec (typ.)
Temperature range	-40 °C ... +85 °C

Package and pin configuration



Pin No.	Name	Function
1	V_{DD1}	Supply voltage
2	V_{DD2}	Supply voltage
3	GND 1	Ground connection
4	GND 2	Ground connection
5	ST	Self test activation
6	SEL.1	Multiplexer selection
7	TEST	Do not connect
8	AZ	Z acceleration output
9	AY	Y acceleration output
10	AX	X acceleration output
11	AMUX	Multiplex serial output
12	SEL.0	Multiplexer selection

Sensor operation

The BMA140 provides three parallel analog output signals in a ±4g acceleration range. All acceleration signals are permanently available on three independent analog pads through 33kΩ resistors on each pad. For each axis, an independent analog 1.5kHz 1st-order low-pass filter is included to provide preconditioning of the measured acceleration signal.

In combination with the integrated 33kΩ resistors, the corner frequency of this filter can easily be customized by the use of external capacitors. Additional signal preconditioning steps are performed by a digital-to-analog converter for offset and gain correction purposes with a subsequent signal amplification. All output signals are fully ratio-metric.

With an acceleration range of ±4g the BMA140 provides a sensitivity of 300mV/g at 3.0V supply voltage (VDD/10) and 220µg/√Hz as a typical RMS noise level. The typical current consumption is only 200µA in normal operation mode.

In addition to the parallel X, Y and Z output signals there is the option to multiplex any axis to one single supplementary output pin in a freely customized manner, thus requiring only one A/D channel.

Furthermore, the BMA140 can be switched into stand-by mode via supplementary selection pins. In this mode the sensor module features an ultra-low current consumption of only 0.9µA at maximum. The return from stand-by mode to normal mode takes less than 1 millisecond wake up time.

The BMA140 is ready to use due to test and calibration at factory level. All calibration parameters, e.g. for offset and sensitivity, are stored in an internal EEPROM.

The BMA140 also features full self-test capability for all three axes. It provides full testing of the complete signal evaluation path including the MEMS accelerationsensing element and the evaluation ASIC.

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