Exhibit 2153

Ultracompact ±2*g* Dual-Axis Accelerometer

ADXL311

FEATURES

High resolution
Dual-axis accelerometer on a single IC chip
5 mm × 5 mm × 2 mm LCC package
Low power <400 μA (typ)
X-axis and Y-axis aligned to within 0.1° (typ)
BW adjustment with a single capacitor
Single-supply operation
High shock survival

APPLICATIONS

Tilt and motion sensing
Smart hand-held devices
Computer security
Input devices
Pedometers and activity monitors
Game controllers
Toys and entertainment products

GENERAL DESCRIPTION

The ADXL311 is a low power, complete dual-axis accelerometer with signal conditioned voltage outputs, all on a single monolithic IC. The ADXL311 is built using the same proven iMEMS® process used in over 180 million Analog Devices accelerometers shipped to date, with demonstrated 1 FIT reliability (1 failure per 1 billion device operating hours).

The ADXL311 measures acceleration with a full-scale range of ±2 *g*. The ADXL311 can measure both dynamic acceleration (e.g., vibration) and static acceleration (e.g., gravity). The outputs are analog voltages proportional to acceleration.
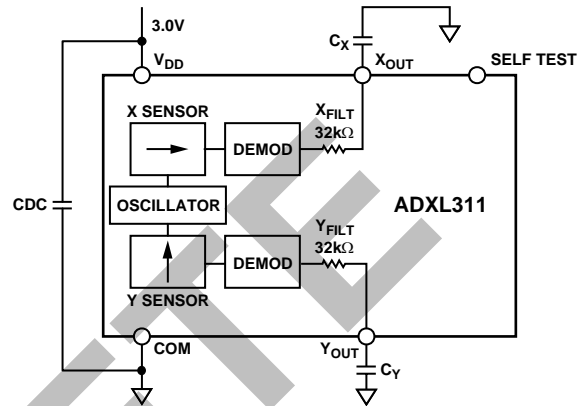
FUNCTIONAL BLOCK DIAGRAM

Figure 1.

The typical noise floor is 300 μ*g*/√Hz, allowing signals below 2 m*g* (0.1° of inclination) to be resolved in tilt sensing applications using narrow bandwidths (10 Hz).

The user selects the bandwidth of the accelerometer using capacitors C_X and C_Y at the X_{OUT} and Y_{OUT} pins. Bandwidths of 1 Hz to 3 kHz can be selected to suit the application.

The ADXL311 is available in a 5 mm × 5 mm × 2 mm, 8-terminal, hermetic LCC package.

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REVISION HISTORY

1/05—Rev. A to Rev. B

7/03—Rev. 0 to Rev. A

Revision 0: Initial Version

SPECIFICATIONS

$T_A = 25°C$, $V_{DD} = 3$ V, acceleration = 0 g, unless otherwise noted.

Table 1.

Parameter	Conditions	Min	Typ	Max	Unit
SENSOR INPUT	Each axis				
Measurement Range			±2		g
Nonlinearity	Best fit straight line		0.2		% of FS
Aligment Error[1]			±1		Degrees
Aligment Error	X sensor to Y sensor		±0.1		Degrees
Cross-Axis Sensitivity[2]			±2		%
SENSITIVITY	Each axis				
Sensitivity at X_{FILT}, Y_{FILT}	$V_{DD} = 3$ V		174		mV/g
Sensitivity Tolerance (part to part)			±15		%
Sensitivity Change due to Temperature[3]	Δ from 25°C		±0.02		%/°C
0 g BIAS LEVEL	Each axis				
0 g Voltage X_{FILT}, Y_{FILT}	$V_{DD} = 3$ V	1.2	1.5	1.8	V
0 g Offset vs. Temperature	Δ from 25°C		±1.0		mg/°C
NOISE PERFORMANCE					
Noise Density	@ 25°C		300		µg/$\sqrt{Hz}$ rms
FREQUENCY RESPONSE					
−3 dB Bandwidth	@ Pin X_{FILT} and Pin Y_{FILT}		3		kHz
Sensor Resonant Frequency			5.5		kHz
FILTER					
R_{FILT} Tolerance	32 kΩ nominal		±15		%
Minimum Capacitance	@ Pin X_{FILT} and Pin Y_{FILT}	1000			pF
SELF TEST					
X_{FILT}, Y_{FILT}	Self Test 0 to Self Test 1		50		mV
POWER SUPPLY					
Operating Voltage Range		2.4		5.25	V
Quiescent Supply Current			0.4	1.0	mA
Turn-On Time[4]			$160 \times C_{FILT} + 4$		ms
TEMPERATURE RANGE					
Operating Range		0		70	°C

[1] Alignment error is specified as the angle between the true and indicated axis of sensitivity.
[2] Cross axis sensitivity is the algebraic sum of the alignment and the inherent sensitivity errors.
[3] Defined as the change from ambient to maximum temperature, or ambient to minimum temperature.
[4] C_{FILT} in µF.

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Acceleration (Any Axis, Unpowered)	3,500 g, 0.5 ms
Acceleration (Any Axis, Powered, V_{DD} = 3 V)	3,500 g, 0.5 ms
V_{DD}	−0.3 V to + 6 V
All Other Pins	−0.3 V to V_{DD} + 0.3 V
Output Short-Circuit Duration, (Any Pin to Common)	Indefinite
Operating Temperature Range	−55°C to +125°C
Storage Temperature	−65°C to +150°C

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 3. Package Characteristics

Package Type	θ_{JA}	θ_{JC}	Device Weight
8-Lead LCC	120°C/W	20°C/W	<1.0 g

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

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