3-Axis, ±2 *g*/±4 *g*/±8 *g*/±16 *g* Digital Accelerometer

Enhanced Product

ADXL345-EP

FEATURES

Ultralow power: as low as 23 µA in measurement mode and 0.1 µA in standby mode at V_S = 2.5 V (typical)
Power consumption scales automatically with bandwidth
User-selectable resolution from 10 to 13 bits
4 m*g*/LSB scale factor in all *g* ranges
32-sample FIFO minimizes host processor load
Single tap, double tap, and free-fall detection
Activity/inactivity monitoring
Supply voltage range: 2.0 V to 3.6 V
I/O voltage range: 1.7 V to V_S
SPI (3- and 4-wire) and I²C digital interfaces
Flexible interrupt modes mappable to either interrupt pin
Measurement ranges selectable via serial command
Bandwidth selectable via serial command
10,000 *g* shock survival
Pb free/RoHS compliant
Small and thin: 3 mm × 5 mm × 1 mm LGA package

ENHANCED PRODUCT FEATURES

Supports defense and aerospace applications (AQEC standard)
Extended industrial temperature range (−55°C to +105°C)
Controlled manufacturing baseline
One assembly/test site
One fabrication site
Enhanced product change notification
Qualification data available on request

APPLICATIONS

Industrial equipment
Aerospace equipment

GENERAL DESCRIPTION

The ADXL345-EP is an extended performance version of the ADXL345, which is a small, thin, ultralow power, 3-axis accelerometer with high resolution (13-bit) measurement at up to ±16 *g*. Digital output data is formatted as 16-bit twos complement and is accessible through either a SPI (3- or 4-wire) or I²C digital interface.

The ADXL345-EP is well suited for extended temperature range industrial and aerospace equipment. It measures the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion or shock. Its high resolution (3.9 m*g*/LSB) enables measurement of inclination changes less than 1.0°.

Several special sensing functions are provided. Activity and inactivity sensing detect the presence or lack of motion by comparing the acceleration on any axis with user-set thresholds. Tap sensing detects single and double taps in any direction. Free-fall sensing detects if the device is falling. These functions can be mapped individually to either of two interrupt output pins. An integrated memory management system with a 32-level first in, first out (FIFO) buffer can be used to store data to minimize host processor activity and lower overall system power consumption.

Low power modes enable intelligent motion-based power management with threshold sensing and active acceleration measurement at extremely low power dissipation.

The ADXL345-EP is supplied in a small, thin, 3 mm × 5 mm × 1 mm, 14-lead, enhanced plastic package.

FUNCTIONAL BLOCK DIAGRAM

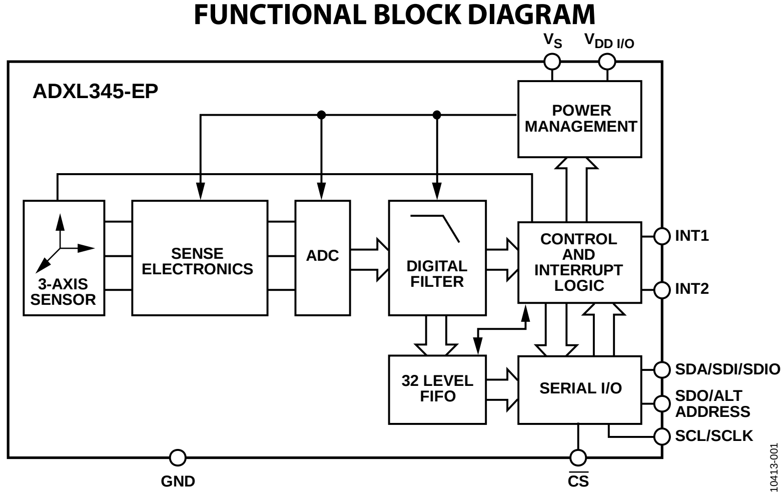

Figure 1.

Rev. B

Document Feedback

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Technical Support
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REVISION HISTORY

4/13—Rev. A to Rev. B

Deleted Package Information Section, Figure 2, and Table 4, Renumbered Sequentially 5

2/13—Rev. 0 to Rev. A

Changes 354 to 345 in Figure 2 5

12/11—Revision 0: Initial Version

RELATED DOCUMENTS

The ADXL345-EP is, by definition, an extended performance variation of the ADXL345 accelerometer. All ADXL345 datasheet descriptions are applicable and not repeated in this document, so users should refer to it for complete functionality and product description. Information and data in this ADXL345-EP subset datasheet supersede those in the standard ADXL345 datasheet.

SPECIFICATIONS

T_A = 25°C, V_S = 2.5 V, $V_{DD\ I/O}$ = 1.8 V, acceleration = 0 *g*, C_S = 10 µF tantalum, $C_{I/O}$ = 0.1 µF, output data rate (ODR) = 800 Hz, unless otherwise noted. All minimum and maximum specifications are guaranteed. Typical specifications are not guaranteed.

Table 1.

Parameter	Test Conditions	Min	Typ[1]	Max	Unit
SENSOR INPUT	Each axis				
Measurement Range	User selectable		±2, ±4, ±8, ±16		*g*
Nonlinearity	Percentage of full scale		±0.5		%
Inter-Axis Alignment Error			±0.1		Degrees
Cross-Axis Sensitivity[2]			±1		%
OUTPUT RESOLUTION	Each axis				
All *g* Ranges	10-bit resolution		10		Bits
±2 *g* Range	Full resolution		10		Bits
±4 *g* Range	Full resolution		11		Bits
±8 *g* Range	Full resolution		12		Bits
±16 *g* Range	Full resolution		13		Bits
SENSITIVITY	Each axis				
Sensitivity at X_{OUT}, Y_{OUT}, Z_{OUT}	All *g*-ranges, full resolution	230	256	282	LSB/*g*
	±2 *g*, 10-bit resolution	230	256	282	LSB/*g*
	±4 *g*, 10-bit resolution	115	128	141	LSB/*g*
	±8 *g*, 10-bit resolution	57	64	71	LSB/*g*
	±16 *g*, 10-bit resolution	29	32	35	LSB/*g*
Sensitivity Deviation from Ideal	All *g*-ranges		±1.0		%
Scale Factor at X_{OUT}, Y_{OUT}, Z_{OUT}	All *g*-ranges, full resolution	3.5	3.9	4.3	m*g*/LSB
	±2 *g*, 10-bit resolution	3.5	3.9	4.3	m*g*/LSB
	±4 *g*, 10-bit resolution	7.1	7.8	8.7	m*g*/LSB
	±8 *g*, 10-bit resolution	14.1	15.6	17.5	m*g*/LSB
	±16 *g*, 10-bit resolution	28.6	31.2	34.5	m*g*/LSB
Sensitivity Change Due to Temperature			±0.01		%/°C
0 *g* OFFSET	Each axis				
0 *g* Output for X_{OUT}, Y_{OUT}		−150	0	+150	m*g*
0 *g* Output for Z_{OUT}		−250	0	+250	m*g*
0 *g* Output Deviation from Ideal, X_{OUT}, Y_{OUT}			±35		m*g*
0 *g* Output Deviation from Ideal, Z_{OUT}			±40		m*g*
0 *g* Offset vs. Temperature for X-, Y-Axes			±0.4		m*g*/°C
0 *g* Offset vs. Temperature for Z-Axis			±1.2		m*g*/°C
NOISE					
X-, Y-Axes	ODR = 100 Hz for ±2 *g*, 10-bit resolution or all *g*-ranges, full resolution		0.75		LSB rms
Z-Axis	ODR = 100 Hz for ±2 *g*, 10-bit resolution or all *g*-ranges, full resolution		1.1		LSB rms
OUTPUT DATA RATE AND BANDWIDTH	User selectable				
Output Data Rate (ODR)[3, 4, 5]		0.1		3200	Hz
SELF-TEST[6]					
Output Change in X-Axis		0.20		2.10	*g*
Output Change in Y-Axis		−2.10		−0.20	*g*
Output Change in Z-Axis		0.30		3.40	*g*
POWER SUPPLY					
Operating Voltage Range (V_S)		2.0	2.5	3.6	V
Interface Voltage Range ($V_{DD\ I/O}$)		1.7	1.8	V_S	V
Supply Current	ODR ≥ 100 Hz		140		µA
	ODR < 10 Hz		23		µA
Standby Mode Leakage Current			0.1		µA
Turn-On and Wake-Up Time[7]	ODR = 3200 Hz		1.4		ms

Parameter	Test Conditions	Min	Typ[1]	Max	Unit
TEMPERATURE					
Operating Temperature Range		−55		+105	°C
WEIGHT					
Device Weight			30		mg

[1] The typical specifications shown are for at least 68% of the population of parts and are based on the worst case of mean ±1 σ, except for 0 *g* output and sensitivity, which represents the target value. For 0 *g* output and sensitivity, the deviation from the ideal describes the worst case of mean ±1 σ.
[2] Cross-axis sensitivity is defined as coupling between any two axes.
[3] Bandwidth is the −3 dB frequency and is defined as half the output data rate, bandwidth = ODR/2.
[4] The output format for the 3200 Hz and 1600 Hz ODRs is different from the output format for the remaining ODRs. This difference is described in the ADXL345 data sheet.
[5] Output data rates below 6.25 Hz exhibit additional offset shift with increased temperature, depending on selected output data rate. Refer to the ADXL345 data sheet for details.
[6] Self-test change is defined as the output (*g*) when the SELF_TEST bit = 1 (in the DATA_FORMAT register, Address 0x31) minus the output (*g*) when the SELF_TEST bit = 0. Due to device filtering, the output reaches its final value after 4 × τ when enabling or disabling self-test, where τ = 1/(data rate). The part must be in normal power operation (LOW_POWER bit = 0 in the BW_RATE register, Address 0x2C) for self-test to operate correctly.
[7] Turn-on and wake-up times are determined by the user-defined bandwidth. At a 100 Hz data rate, the turn-on and wake-up times are each approximately 11.1 ms. For other data rates, the turn-on and wake-up times are each approximately τ + 1.1 in milliseconds, where τ = 1/(data rate).

ABSOLUTE MAXIMUM RATINGS

Table 2.

Parameter	Rating
Acceleration	
Any Axis, Unpowered	10,000 *g*
Any Axis, Powered	10,000 *g*
V_S	−0.3 V to +3.9 V
$V_{DD\ I/O}$	−0.3 V to +3.9 V
Digital Pins	−0.3 V to $V_{DD\ I/O}$ + 0.3 V or 3.9 V, whichever is less
All Other Pins	−0.3 V to +3.9 V
Output Short-Circuit Duration (Any Pin to Ground)	Indefinite
Temperature Range	
Powered	−55°C to +105°C
Storage	−65°C to +150°C

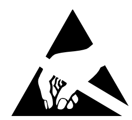
Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute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

THERMAL RESISTANCE

Table 3. Package Characteristics

Package Type	θ_{JA}	θ_{JC}	Device Weight
14-Terminal LGA	150°C/W	85°C/W	30 mg

ESD CAUTION



ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

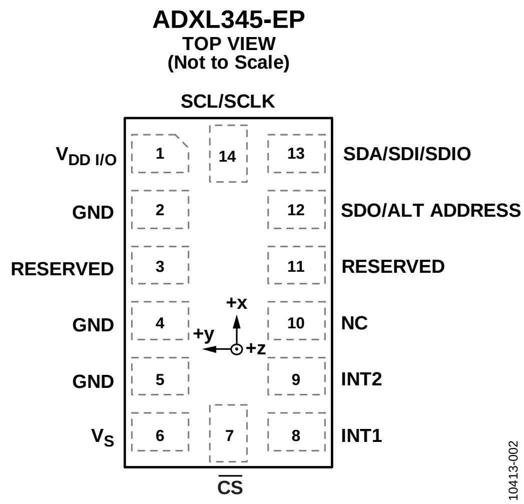


Figure 2. Pin Configuration (Top View)

Table 4. Pin Function Descriptions

Pin No.	Mnemonic	Description
1	$V_{DD\ I/O}$	Digital Interface Supply Voltage.
2	GND	This pin must be connected to ground.
3	RESERVED	Reserved. This pin must be connected to V_S or left open.
4	GND	This pin must be connected to ground.
5	GND	This pin must be connected to ground.
6	V_S	Supply Voltage.
7	$\overline{CS}$	Chip Select.
8	INT1	Interrupt 1 Output.
9	INT2	Interrupt 2 Output.
10	NC	Not Internally Connected.
11	RESERVED	Reserved. This pin must be connected to ground or left open.
12	SDO/ALT ADDRESS	Serial Data Output (SPI 4-Wire)/Alternate I^2C Address Select (I^2C).
13	SDA/SDI/SDIO	Serial Data (I^2C)/Serial Data Input (SPI 4-Wire)/Serial Data Input and Output (SPI 3-Wire).
14	SCL/SCLK	Serial Communications Clock. SCL is the clock for I^2C, and SCLK is the clock for SPI.

TYPICAL PERFORMANCE CHARACTERISTICS

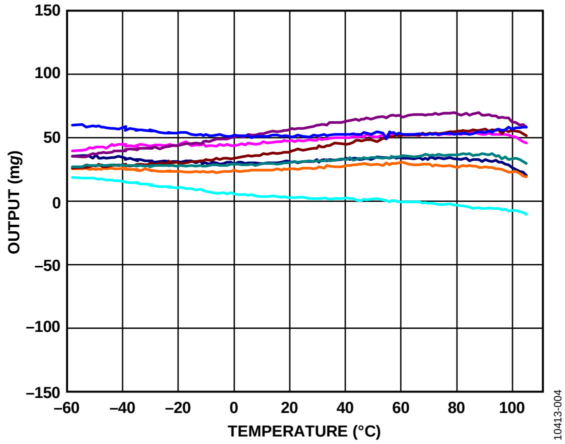


Figure 3. X-Axis Zero g Offset vs. Temperature—Eight Parts in Sockets, V_S = 3.6 V

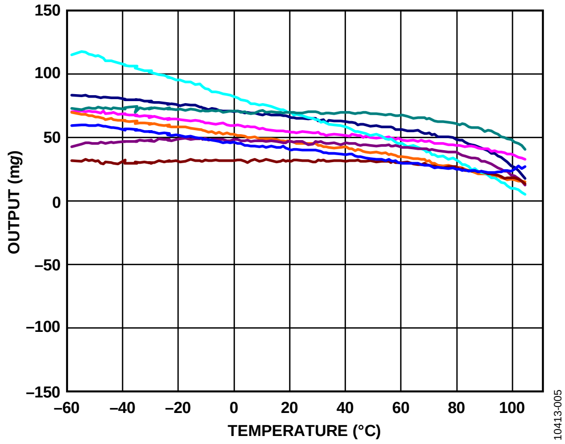


Figure 4. Y-Axis Zero g Offset vs. Temperature—Eight Parts in Sockets, $V_S = V_{DD\ I/O}$ = 3.6 V

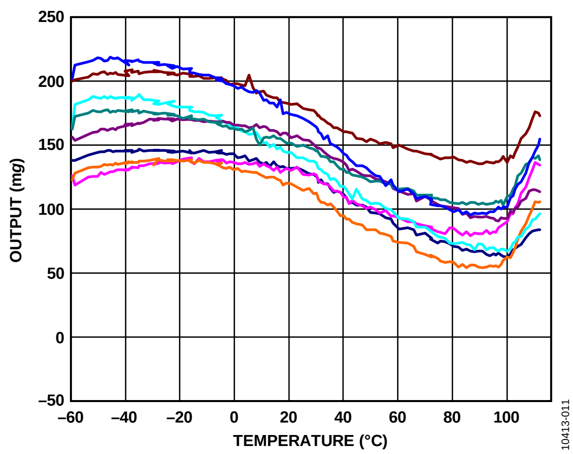


Figure 5. Z-Axis Zero g Offset vs. Temperature—Eight Parts in Sockets, $V_S = V_{DD\ I/O}$ = 3.6 V

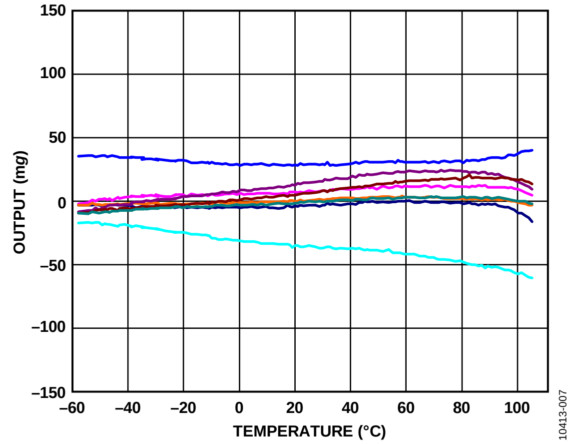


Figure 6. X-Axis Zero g Offset vs. Temperature—Eight Parts in Sockets, V_S = 2.5 V

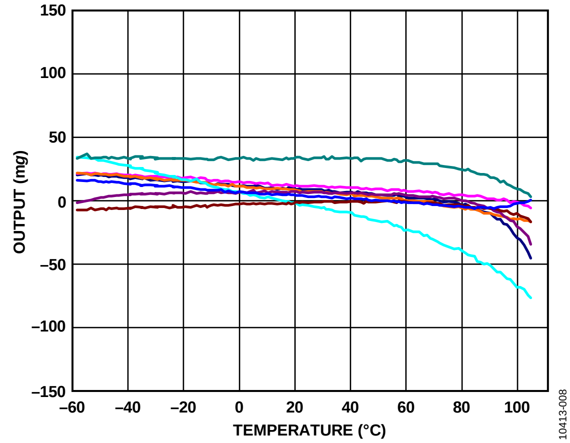


Figure 7. Y-Axis Zero g Offset vs. Temperature—Eight Parts Soldered to PCB, $V_S = V_{DD\ I/O}$ = 2.5 V

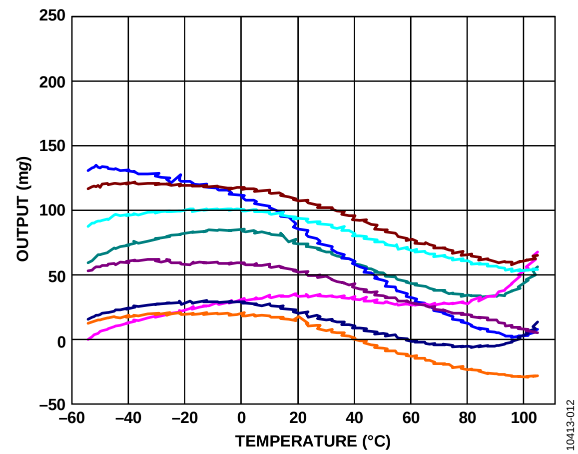


Figure 8. Z-Axis Zero g Offset vs. Temperature—Eight Parts Soldered to PCB, $V_S = V_{DD\ I/O}$ = 2.5 V

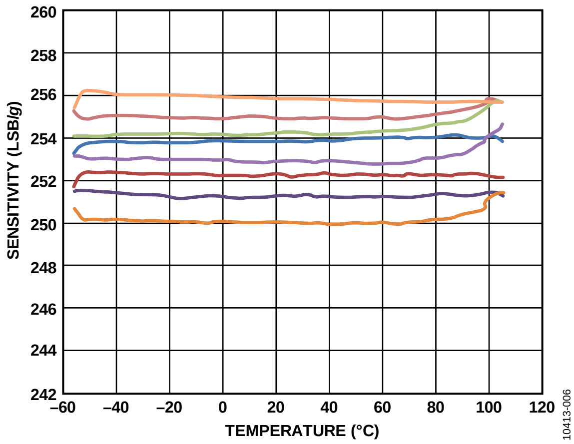


Figure 9. X-Axis Sensitivity vs. Temperature—Eight Parts in Sockets, $V_S = V_{DD I/O} = 2.5$ V

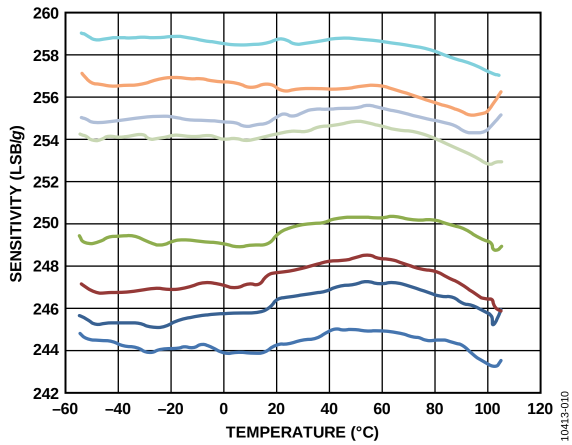


Figure 10. Z-Axis Sensitivity vs. Temperature—Eight Parts in Sockets, $V_S = V_{DD I/O} = 2.5$ V

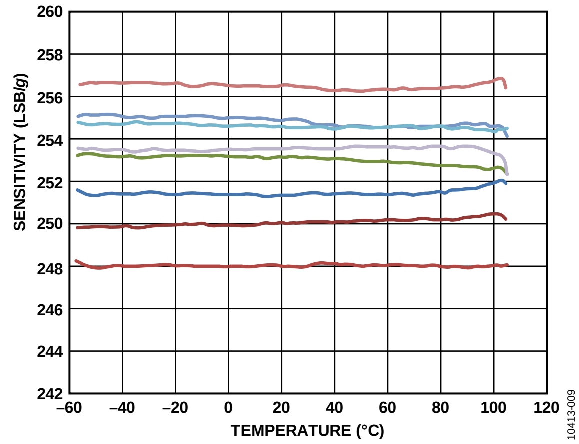


Figure 11. Y-Axis Sensitivity vs. Temperature—Eight Parts in Sockets, $V_S = V_{DD I/O} = 2.5$ V

OUTLINE DIMENSIONS

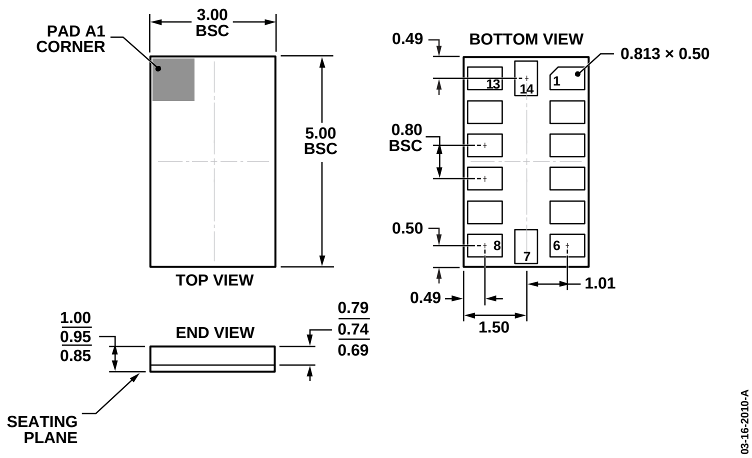


Figure 12. 14-Terminal Land Grid Array [LGA]
(CC-14-1)
Solder Terminations Finish Is Au over Ni
Dimensions shown in millimeters

ORDERING GUIDE

Model[1]	Measurement Range (*g*)	Specified Voltage (V)	Temperature Range	Package Description	Package Option
ADXL345TCCZ-EP	±2, ±4, ±8, ±16	2.5	−55°C to +105°C	14-Terminal Land Grid Array [LGA]	CC-14-1
ADXL345TCCZ-EP-RL7	±2, ±4, ±8, ±16	2.5	−55°C to +105°C	14-Terminal Land Grid Array [LGA]	CC-14-1
ADXL345TCCZ-EP-RL	±2, ±4, ±8, ±16	2.5	−55°C to +105°C	14-Terminal Land Grid Array [LGA]	CC-14-1

[1] Z = RoHS Compliant Part.

NOTES

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NOTES

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