± 2 g Tri-Axis Accelerometer Specifications

PART NUMBER:

KXPB5-2050

Rev. 1

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	APPROVED BY	DATE
PROD. MGR.	S. Miller	03/19/07
TECH. MGR.	K Foust	03/19/07
TEST MGR.	J. Chong	03/19/07
VP ENG.	T. Davis	03/19/07

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	-		Initial release	10/27/06	
07-007	1	3, 5	Revised standby current spec and pin descriptions	3/19/2007	K. Foust

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Product Description

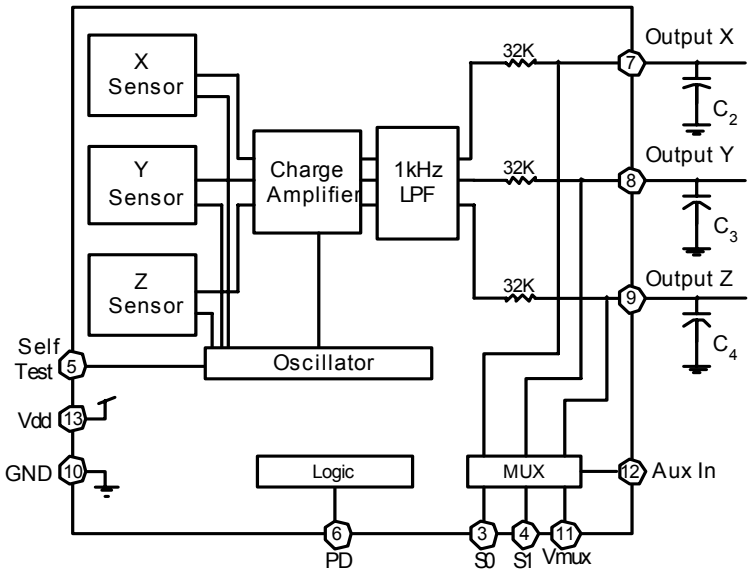
The KXPB5-2050 is a tri-axis, silicon micromachined accelerometer with a full-scale output range of ±2.0g (19.6m/s^2). The sense element is fabricated using Kionix's proprietary plasma micromachining process technology. Acceleration sensing is based on the principle of a differential capacitance arising from acceleration-induced motion of the sense element, which further utilizes common mode cancellation to decrease errors from process variation, temperature, and environmental stress. The sense element is hermetically sealed at the wafer level by bonding a second silicon lid wafer to the device using a glass frit. A separate ASIC device packaged with the sense element provides signal conditioning and self-test. The accelerometer is delivered in a 5 x 3 x 0.9 mm LGA plastic package operating from a 2.5 – 5.25V DC supply.

There are 4 factory programmable modes of operation for the KXPB5. The mode for the KXPB5-2050 is:

Mode 11 – The three outputs (X, Y, Z) are provided on three **analog** output pins. The KXPB5 also features an integrated **4-channel multiplexer** (X, Y, Z, Aux In). The Enable pin must be **low** for normal operation and **high** for power shutdown.

Functional Diagram

Mode 11



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Product Specifications

Table 1. Mechanical

(specifications are for operation at V_{dd} = 3.3 V and T = 25ºC unless stated otherwise)

Parameters	Units	Min	Typical	Max
Operating Temperature Range	ºC	-40	-	85
Zero-g Offset	V	1.559	1.650	1.741
Zero-g Offset Variation from RT over Temp.	mg/ºC		±0.6	
Sensitivity	mV/g	640	660	680
Sensitivity Variation from RT over Temp.	%/ºC		±0.005	
Offset Ratiometric Error (V_{dd} = 3.3V ± 5%)	%		0.3	1.5
Sensitivity Ratiometric Error (V_{dd} = 3.3V ± 5%)	%		0.4	1.5
Non-Linearity	% of FS		0.1	
Cross Axis Sensitivity	%		2.0	
Self Test Output change on Activation	g	2.2 (xy) 0.7 (z)	2.7 (xy) 1.1 (z)	3.2 (xy) 1.6 (z)
Bandwidth (-3dB)[1]	Hz		1000	
Noise Density (on filter pins)	µg / √Hz		175	

Notes:

1. Internal 1 kHz low pass filter. Lower frequencies are user definable with external capacitors.

Table 2. Electrical

(specifications are for operation at V_{dd} = 3.3 V and T = 25ºC unless stated otherwise)

Parameters		Units	Min	Typical	Max
Supply Voltage (V_{dd})	Operating	V	2.5	3.3	5.25
Current Consumption	Operating	mA	0.30	0.50	0.70
	Standby	nA	-	1.2	-
Analog Output Resistance(R_{out})		kΩ	24	32	40
Power Up Time[1]		ms		1	

Notes:

1. Power up time can also be determined by 5 times the RC time constant of the optional user defined low pass filter.

Table 3. Environmental

Parameters		Units	Min	Typical	Max
Supply Voltage (V_{dd})	Absolute Limits	V	-0.3	-	7.0
Operating Temperature Range		ºC	-40	-	85
Storage Temperature Range		ºC	-55	-	150
Mech. Shock (powered and unpowered)		g	-	-	5000 for 0.5ms
ESD	HBM	V	-	-	3000

Caution: ESD Sensitive and Mechanical Shock Sensitive Component, improper handling can cause permanent damage to the device.

The LGA plastic package conforms to European Union Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).

Soldering

Soldering recommendations available upon request or from www.kionix.com.

Application Schematic

Mode 11

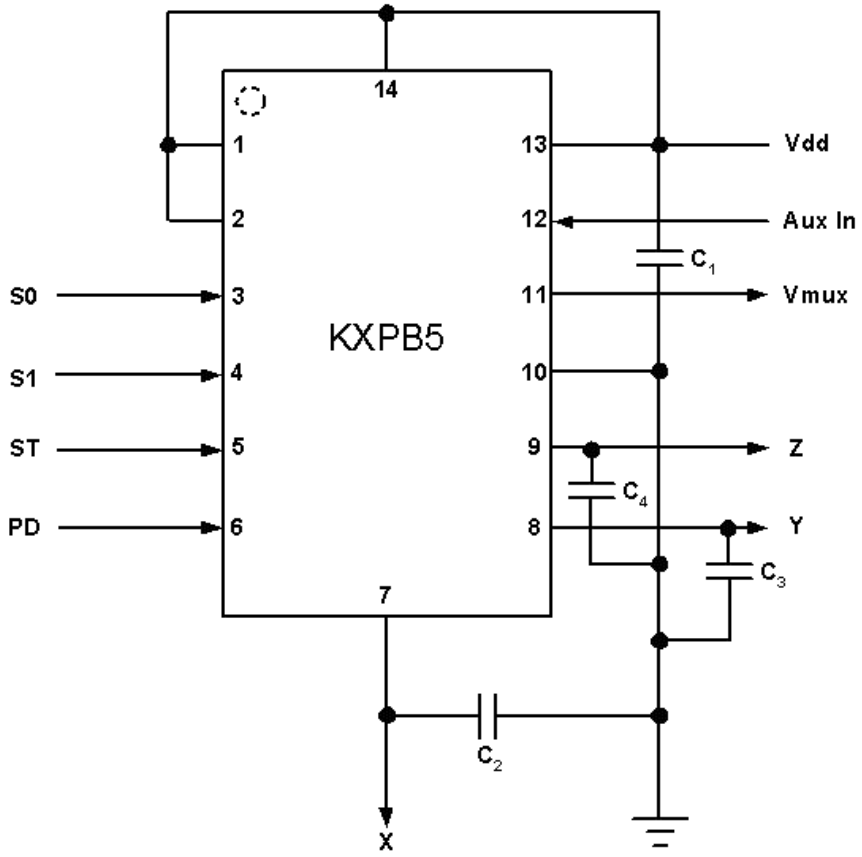

Table 4. KXPB5 Pad Descriptions

Pad	Name	Description
1	Vdd	The power supply input. Decouple this pin to ground with a 0.1uF ceramic capacitor (C_1).
2	NC	Not Connected Internally (can be connected to Vdd)
3	S0	MUX selector 0 (See Output Select Table). Connect to Vdd or Ground if not used.
4	S1	MUX selector 1 (See Output Select Table). Connect to Vdd or Ground if not used.
5	ST	Self Test: **Low** – Normal operation; **High** – Device is in self-test mode
6	PD	Power shutdown: **Low** - Normal operation; **High** - Device is in standby, power down mode
7	X Output	Analog output of the x-channel. Optionally, a capacitor (C_2) placed between this pin and ground will form a low pass filter.
8	Y Output	Analog output of y-channel. Optionally, a capacitor (C_3) placed between this pin and ground will form a low pass filter.
9	Z Output	Analog output of z-channel. Optionally, a capacitor (C_4)placed between this pin and ground will form a low pass filter.
10	GND	Ground
11	Vmux	Multiplexed analog output. Float if the multiplexer is not used.
12	Aux In	Auxiliary input for multiplexer. Connect to Vdd or Ground if not used.
13	Vdd	The power supply input. Decouple this pin to ground with a 0.1uF ceramic capacitor (C_1).
14	Vdd	The power supply input. Decouple this pin to ground with a 0.1uF ceramic capacitor (C_1).

Application Design Equations

The bandwidth is determined by the filter capacitors connected from pins 7, 8 and 9 to ground. The response is single pole. Given a desired bandwidth, f_{BW}, the filter capacitors are determined by:

$$C_2 = C_3 = C_4 = \frac{4.97x10^{-6}}{f_{BW}}$$

USING THE MULTIPLEXED OUTPUT OF THE KXPB5

Multiplexer Data Select

The KXPB5 features an integrated 4-channel multiplexer. This feature reduces system MCU requirements to only 1 ADC and 2 digital I/O's. The KXPB5 uses two select inputs (S0, S1) to control the data flow from Vmux. When a microprocessor toggles the select inputs, the desired output is attained based on the select table. Note that logic 0 is GND and logic 1 is Vdd.

S1	S0	Vmux
0	0	X Output
0	1	Y Output
1	0	Z Output
1	1	Aux. In

Output Select Table

Data Sampling Rate

When operating in its multiplexed mode, the KXPB5 has the ability to achieve very high data sampling rates. Internally, the sensor elements (X, Y, and Z) are sequentially sampled in a "round robin" fashion at a rate of 32KHz per axis. Note that this is a differential capacitance sampling of each sensor element, which stores an analog voltage on the filter cap for each axis. Combine this high sensor element sampling rate with the short 5µS settling time of the integrated multiplexer, and the user can achieve a performance very close to that of the 3 separate analog outputs. This is more than sufficient to eliminate any aliasing in the final application since the KXPB5 will be operating with a typical bandwidth of ~50Hz and a maximum of 1000Hz.

Test Specifications

! *Special Characteristics:*

These characteristics have been identified as being critical to the customer. Every part is tested to verify its conformance to specification prior to shipment.

Table 5. Test Specifications

Parameter		Specification	Test Conditions
Zero-g Offset @ RT		1.650 ± 0.091 V	25ºC, V_{dd} = 3.3V
Sensitivity @ RT		660 ± 20 mV/g	25ºC, V_{dd} = 3.3V
Current Consumption	Operating	0.3 <= I_{dd} <= 0.7 mA	25ºC, V_{dd} = 3.3V

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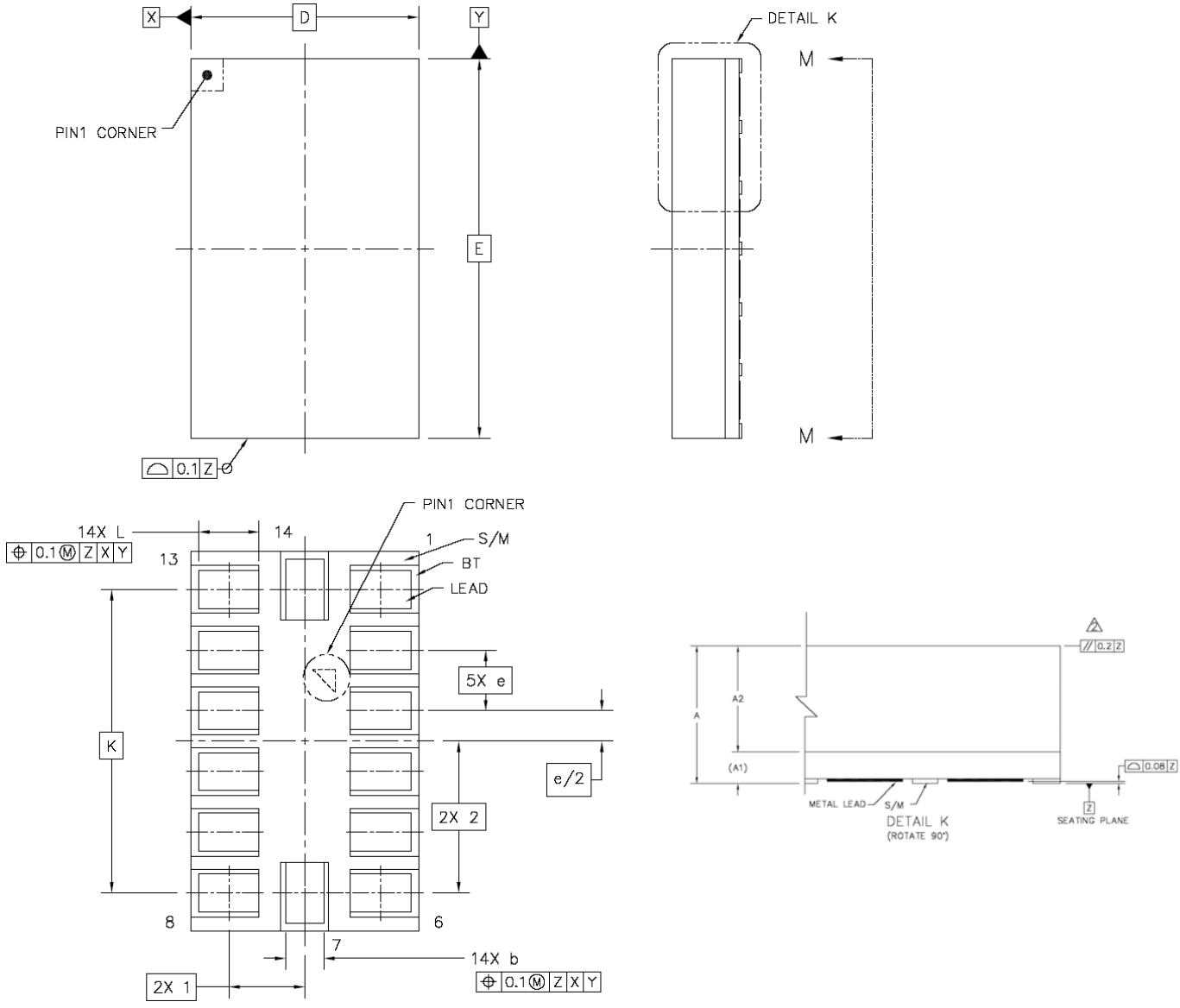
Package Dimensions and Orientation

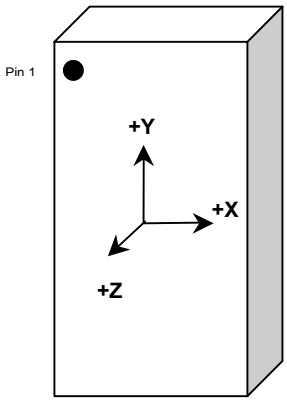
3 x 5 x 0.9 mm LGA



Dimension	mm			inch		
	Min	Nom	Max	Min	Nom	Max
A	---	0.91	1.0	---	0.036	0.039
A1		0.21 REF			0.008 REF	
A2	0.66	0.7	0.74	0.026	0.028	0.029
b	0.45	0.5	0.55	0.018	0.020	0.022
D	2.8	3.0	3.2	0.110	0.118	0.126
E	4.8	5.0	5.2	0.189	0.197	0.205
K	3.9	4.0	4.1	0.153	0.157	0.161
e	0.78	0.8	0.82	0.030	0.031	0.032
L	0.75	0.8	0.85	0.029	0.031	0.033

All dimensions and tolerances conform to ASME Y14.5M-1994

Orientation



When device is accelerated in +X, +Y or +Z direction, the corresponding output will increase.

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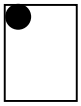
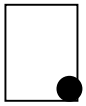
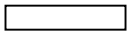
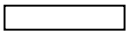
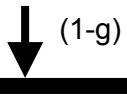
Static X/Y/Z Output Response versus Orientation to Earth's surface (1-g):

Position	1	2	3	4	5	6
Diagram					Top  Bottom	Bottom  Top
X	1.65 V	2.31 V	1.65 V	0.99 V	1.65 V	1.65 V
Y	2.31 V	1.65 V	0.99 V	1.65 V	1.65 V	1.65 V
Z	1.65 V	1.65 V	1.65 V	1.65 V	2.31 V	0.99 V
X-Polarity	**0**	**+**	**0**	**-**	**0**	**0**
Y-Polarity	**+**	**0**	**-**	**0**	**0**	**0**
Z-Polarity	**0**	**0**	**0**	**0**	**+**	**-**



Earth's Surface