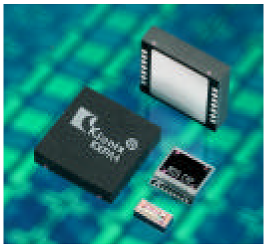
KXPA4 Series Data Sheet

Accelerometers and Inclinometers
Multiplexed Analog Output

KXPA4-1050 — Tri-Axis XYZ, 2.8V
KXPA4-2050 — Tri-Axis XYZ, 3.3V



APPLICATIONS

Drop Detection	***Cell Phones and Handheld PDAs***
Gesture Recognition	***Gaming and Game Controllers***
Inclination and Tilt Sensing	***Universal Remote Controls***
Image Stabilization	***Theft and Accident Alarms***
Sports Diagnostics	***GPS Recognition Assist***
Vibration Analysis	***Hard-drive Protection***
Static or Dynamic Acceleration	***Pedometers***
Inertial Navigation and Ded(uctive) Reckoning	***Computer Peripherals***
	Cameras and Video Equipment

FEATURES

- Ultra-Small Package — 5x5x1.2mm DFN
- Precision Tri-axis Orthogonal Alignment
- Multiplexed Analog Output
- High Shock Survivability
- Excellent Temperature Performance
- Low Noise Density
- Very Low Power Consumption
- Selectable Power Reduction Modes
- User Definable Bandwidth
- Factory Programmable Offset and Sensitivity
- Self-test Function

PROPRIETARY TECHNOLOGY

These high-performance silicon micromachined linear accelerometers and inclinometers consists of a sensor element and an ASIC packaged in a 5x5x1.2mm Dual Flat No-lead (DFN). The sensor element is fabricated from single-crystal silicon with proprietary Deep Reactive Ion Etching (DRIE) processes, and is protected from the environment by a hermetically-sealed silicon cap wafer at the wafer level.

The KXPA4 series is designed to provide a high signal-to-noise ratio with excellent performance over temperature. These sensors can accept supply voltages between 2.7V and 5.25V. Sensitivity is factory programmable allowing customization for applications requiring ±1.5g to ±6.0g ranges. Sensor bandwidth is user-definable.

The sensor element functions on the principle of differential capacitance. Acceleration causes displacement of a silicon structure resulting in a change in capacitance. An ASIC, using a standard CMOS manufacturing process, detects and transforms changes in capacitance into an analog output voltage, which is proportional to acceleration. The analog output is also accessed through an on-board 3 channel multiplexor. The sense element design utilizes common mode cancellation to decrease errors from process variation and environmental stress.

Precision in Motion

Kionix®

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KXPA4 Series Data Sheet

PRODUCT SPECIFICATIONS

PERFORMANCE SPECIFICATIONS [1]				
PARAMETERS	**UNITS**	**KXPA4–1050**	**KXPA4–2050**	**CONDITION**
Range [2]	g	±2.0		Factory programmable
Sensitivity	mV/g	560	660	
0g Offset vs. Temp.	mg	±150 (x and y) ±300 (z)		Over temp range
	°C	-40 to 85 [3]		
Sensitivity vs. Temp	%	±2.0 max		Over temp range
Span	mV	±1120	±1320	
Noise	$mg/\sqrt{Hz}$	175 typical		
Bandwidth [4]	Hz	0 to 3300 max (x and y)		-3dB
		0 to 1700 max (z)		
Output Resistance [5]	Ω	32K typical		
Non-Linearity	% of FS	0.1 typical (0.5 max)		
Ratiometric Error	%	±0.4 typical (±1.5 max)		
Cross-axis Sensitivity	%	±2.0 typical (±3.0 max)		
Power Supply	V	2.8 [1]	3.3 [1]	
	V	-0.3 (min) 7.0 (max)		Absolute min/max
	mA	1.1 typical		
	µA	<10		Shutdown pin connected to GND
	ms	1.6		Power-up time @ 500 Hz [6]

ENVIRONMENTAL SPECIFICATIONS			
PARAMETERS	**UNITS**	**KXPA4 Series**	**CONDITION**
Operating Temperature	°C	-40 to 85 [7]	Powered
Storage Temperature	°C	-55 to 150	Unpowered
Mechanical Shock	g	4600	Powered or unpowered, 0.5 msec halversine
ESD	V	3000	Human body model

Notes

[1] The performance parameters are programmed and tested at 2.8 volts (KXPA4-1050) and 3.3V (KXPA4-2050). However, the device can be factory programmed to accept supply voltages from 2.7 V to 5.25 V. Operation at reduced supply voltages, down to 2.6 V, can be achieved by narrowing the operating temperature range. Performance parameters will change with supply voltage variations.

[2] Custom ranges from 1.5g to 6g available.

[3] Temperature range for specified offset.

[4] Lower bandwidth can be achieved by using the external C_2 , C_3 , and C_4 (see application note on page 3).

[5] 32K Ω resistor connects the output amplifier to the output pin. Resistive loading may reduce sensitivity or cause a shift in offset. Maintaining a load resistance at 3.2M Ω will prevent appreciable changes.

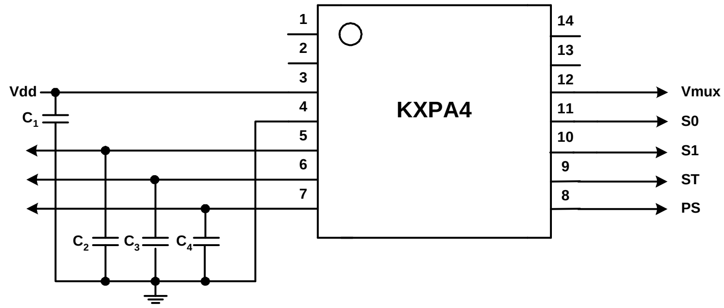
[6] The power-up time will increase or decrease according to bandwidth (5RC).

[7] 0g offset and sensitivity change linearly with temperature.

KXPA4 Series Data Sheet

APPLICATION SCHEMATIC & PIN FUNCTION TABLES

Pin	Tri-Axis Function
1	DNC
2	DNC
3	Vdd
4	GND
5	X Output
6	Z Output
7	Y Output
8	PS
9	Self Test
10	S1
11	S0
12	Vmux
13	DNC
14	DNC



KXPA4 Pin Descriptions

GND – Ground

PS — Power shutdown pin. When the PS pin is connected to GND or left floating, the KXPA4 is shutdown and drawing very little power. When the PS pin is tied to Vdd, the unit is fully functional.

Self Test — The output of a properly functioning part will increase when Vdd is applied to the self-test pin. When NOT in use, this pin must be tied to ground.

SO — MUX select

S1 — MUX select

Vdd – Power supply

Vmux — Multiplexed analog output

X Output – Analog X output

Y Output – Analog Y output

Z Output – Analog Z output

Application Design Equations

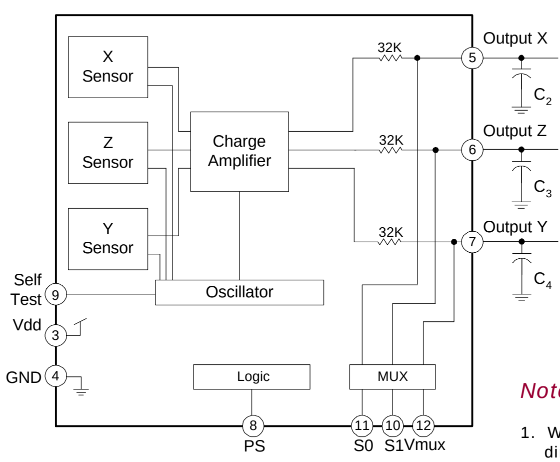
The bandwidth is determined by the filter capacitors connected from pins 3, 4 and 5 to ground. The response is single pole. Given a desired bandwidth, f_{BW}, the filter capacitors are determined by:

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

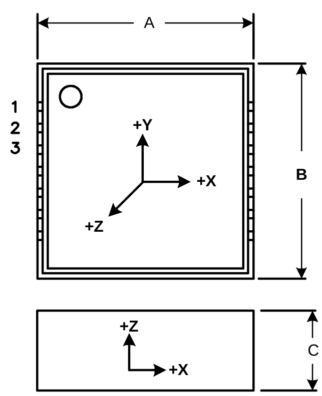
Notes

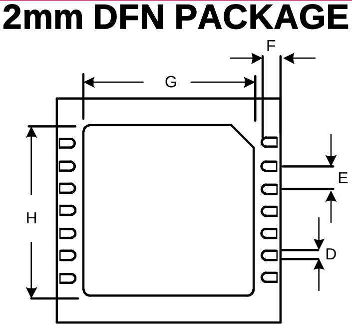
1. Recommend using 0.1 µF for decoupling capacitor C_1.

FUNCTIONAL DIAGRAM



5x5x1.2mm DFN PACKAGE





Dimension	Inches	Millimeters
A	.197	5.00
B	.197	5.00
C	.047	1.20
D	.009	0.23
E	.020	0.50
F	.016	0.40
G	.142	3.60
H	.142	3.60

Notes:

1. When device is accelerated in +X, +Y or +Z direction, the corresponding output will increase.
2. The packaged device weighs .079 grams.

ORDERING GUIDE

Product	Axis(es) of Sensitivity	Range	Sensitivity (mV/g)	Offset (V)	Operating Voltage (V)	Temperature	Package
KXPA4-1050	XYZ	2g	560	1.40	2.8	-40 to +85 °C	5x5x1.2mm DFN
KXPA4-2050	XYZ	2g	660	1.65	3.3	-40 to +85 °C	5x5x1.2mm DFN

CAUTION: ELECTROSTATIC SENSITIVE COMPONENT