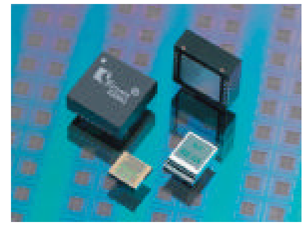
KXM52 Series Data Sheet

Accelerometers and Inclinometers
Analog Output

KXM52-1040 — Dual-Axis XY
KXM52-1050 — Tri-Axis XYZ



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 — 5x5x1.8mm DFN

Precision Tri-axis Orthogonal Alignment

Lead-free Solderability

High Shock Survivability

Excellent Temperature Performance

Very Low Noise Density

Low Power Consumption

Power Shutdown Pin

High-Speed Power-Up

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 5x5x1.8mm 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 KXM52 series is designed to provide a high signal-to-noise ratio with excellent performance over temperature. These sensors can accept supply voltages between 2.5V and 5.5V. Sensitivity is factory programmable allowing customization for applications requiring ±1.0g 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 sense element design utilizes common mode cancellation to decrease errors from process variation and environmental stress.

Precision in Motion

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KXM52 Series Data Sheet

PRODUCT SPECIFICATIONS

PERFORMANCE SPECIFICATIONS [1]			
PARAMETERS	**UNITS**	**KXM52-1040 (xy) KXM52-1050 (xyz)**	**CONDITION**
Range	g	±2.0	Factory programmable
Sensitivity [2]	mV/g	660	@3.3V
0g Offset vs. Temp.	mV	±100	Over temp range
	°C	-40 to 85 [3]	
Sensitivity vs. Temp	%	±2.0 typical (±3.0 max)	Over temp range
Span	mV	±1320	@ 3.3 V
Noise	$mg/\sqrt{Hz}$	35 (x and y) 65 (z) typical	
Bandwidth [4]	Hz	0 to 3000 max (x and y)	-3dB
		0 to 1500 max (z)	
Output Resistance [5]	Ω	32K typical	
Non-Linearity	% of FS	±0.1 typical (±0.5 max)	
Ratiometric Error	%	±1.0 typical (±1.5 max)	
Cross-axis Sensitivity	%	±2.0 typical (±3.0 max)	
Power Supply	V	2.5 to 5.5 [6]	
	V	-0.3 (min) 7.0 (max)	Absolute min/max
	mA	1.5 typical (1.8 max)	Current draw @ 3.3V
	µA	<10	Shutdown pin connected to GND
	ms	1.6	Power-up time @ 500 Hz [6]
ENVIRONMENTAL SPECIFICATIONS			
PARAMETERS	**UNITS**	**KXM52**	**CONDITION**
Operating Temperature	°C	-40 to 125 [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 3.3 volts. However, the device can be powered from 2.5 V to 5.5 V. Performance parameters will change with supply voltage variations.

[2] Custom sensitivities from 1g to 6g available.

[3] Temperature range for specified offset.

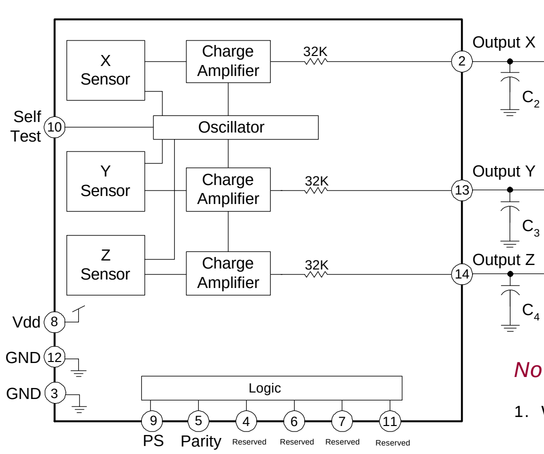
[4] Lower bandwidth can be achieved by using the external C_2 , C_3 , and C_4 (see application note on page 3).

[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.

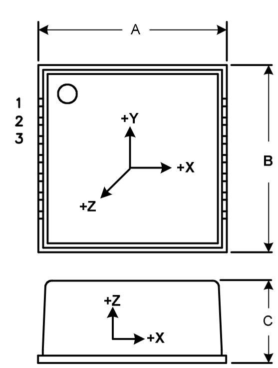
[6] The power-up time will increase or decrease according to bandwidth.

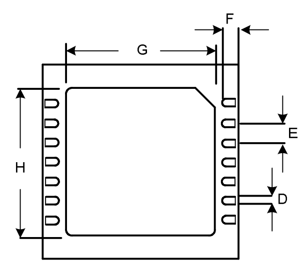
[7] 0g offset and sensitivity change linearly with temperature. Within the extended temperature range of –40°C to 125°C, the maximum 0g offset tolerance is ±167 mV and the maximum sensitivity is ±5%.

FUNCTIONAL DIAGRAM



5x5x1.8mm DFN PACKAGE





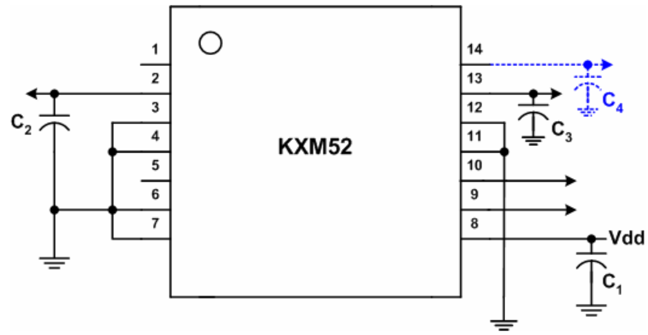
Dimension	Inches	Millimeters
A	.197	5.00
B	.197	5.00
C	.071	1.80
D	.009	0.23
E	.020	0.50
F	.016	0.40
G	.142	3.60
H	.142	3.60

Notes

1. When device is accelerated in +X, +Y or +Z direction, the corresponding output will increase.
2. The packaged device weighs .12 grams.

APPLICATION SCHEMATIC & PIN FUNCTION TABLES

Pin	Dual-Axis Function
1	DNC
2	Output X
3	GND
4	Reserved
5	Parity
6	Reserved
7	Reserved
8	Vdd
9	PS
10	Self Test
11	Reserved
12	GND
13	Output Y
14	DNC



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

Definitions

C_2, C_3, C_4 An external capacitor is used to set the -3dB filter point for each sensor output.

DNC Do not connect.

f_{BW} Sensor bandwidth frequency needed in application (typ. 10Hz to 1500Hz).

Parity Checks EEPROM for parity error.

PS Power shutdown pin. When the PS pin is connected to GND or left floating, the KXM52 is shutdown and drawing very little power. When the PS pin is tied to Vdd, the unit is fully functional.

Reserved For factory use; recommend grounding.

Self Test The output of a properly functioning part will increase when Vdd is applied to the self-test pin (#10).

Application Design Equations

In a typical application, the desired bandwidth will be determined by the fastest signal needing to be measured. Use this equation to calculate C_2, C_3 and C_4 and for the sensor:

$$C_2 = C_3 = C_4 = \frac{1}{2 * p * 32000 * f_{BW}}$$

Notes

1. Recommend using 0.1 µF for decoupling capacitor C_1.
2. Do not connect pin #14 on the dual-axis device.
3. An evaluation board is available upon request.

ORDERING GUIDE

Product	Axis(es) of Sensitivity	Range	Sensitivity (mV/g)	Offset (V)	Operating Voltage (V)	Temperature	Package
KXM52-1040	XY	2g	660	1.65	3.3	-40 to +85 °C	5x5x1.8mm DFN
KXM52-1050*	XYZ	2g	660	1.65	3.3	-40 to +85 °C	5x5x1.8mm DFN

* The KXM52-1050 supercedes the KXM52-L20.

See KXM52 Technical Notes and MEMS Sensor Terminology for extended data and further information.

CAUTION:
ELECTROSTATIC
SENSITIVE
COMPONENT