MX210Q (RATIOMETRIC)

Low Cost, 10*g*, Dual Axis Accelerometer with Analog Outputs

General Description

The MX210Q is a very low cost dual-axis acceleration sensor on a monolithic IC. With no moving parts, the device is extremely reliable and is manufactured on a submicron CMOS process enabling small geometries and small die size, resulting in low overall cost and high functionality. The MX210Q is primarily designed for applications requiring high performance and where overall system cost is a driving factor in component selection. The MX210Q measures acceleration with a full-scale range of up to ±10*g* and produces an Analog signal output. The X,Y accelerometer outputs are scaled proportionately to the VDD, VDA supply voltage with the scale of 44%. Typical noise floor is 750 µg/√Hz rms, allowing signals below 1 .0 milli-*g* to be resolved in 1 Hz bandwidth. Frequency response extends to 40 Hz. The frequency response can be extended to 160 Hz with the implementation of a simple external circuit. See Application Note (AN-00MX-003).

The MX210Q is a dc accelerometer with the capability to measure both ac acceleration, (typical of vibration) or dc accelerations, (such as inertial force or constant, gravity-induced accelerations).

The MX210Q offers a calibrated temperature sensor output with a positive temperature coefficient of 5.0 mV/°C. This device can be temperature compensated easily. The change in sensitivity over the temperature range –40°C to 125°C is predictable and follows the physical gas laws. The following equation can be used to predict the sensitivity at any given temperature: $S_{IN} X (T_{IN})^{2.67} = S_{FIN} X (T_{FIN})^{2.67}$ Temperature in °K See Application Note (AN-00MX-002).

The MX210Q is available in a metal can (TO-100) or an LCC surface mount device; both are hermetically sealed and are operational over the temperature range -40°C to 125°C.

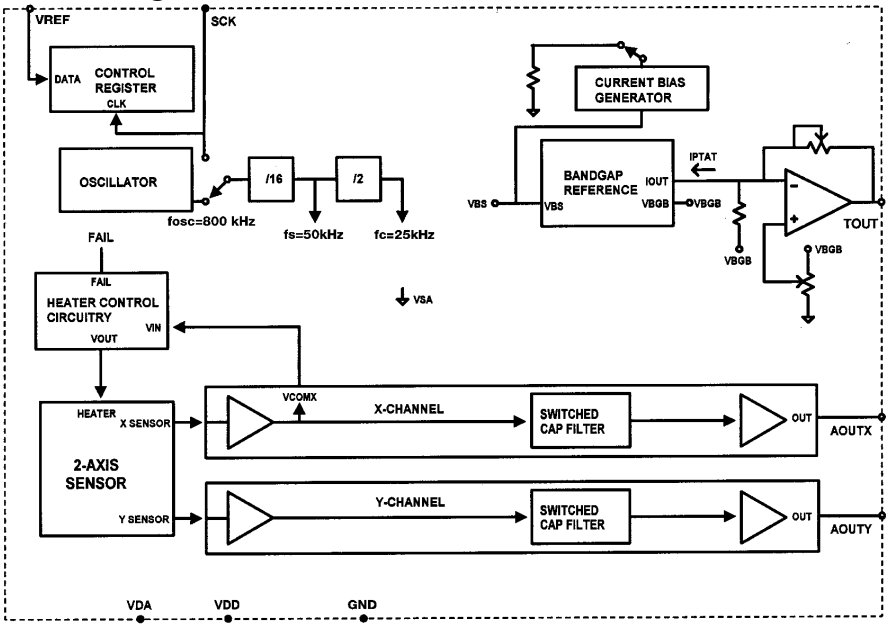
Applications

- **Automotive -** Vehicle Security/Active Suspension/ABS/HED Angle Control
- **Security -** Gas Line/Elevator/Fatigue Sensing
- **Office Automation Equipment -** Computer Peripherals/Disk Drives/PDA's/Mouse Smart Pens/Cell Phones/Printer Head Acceleration Sensor
- **Gaming -** Joystick/RF Interface/Menu Selection
- **White Goods -** Spin Vibration Control

Features

- **Dual axis acceleration outputs**
- **Analog outputs, ratiometric**
- **1.0 *mg* Resolution in 1Hz bandwidth**
- **40 Hz Bandwidth expandable to 160 Hz See Application Note (AN-00MX-003)**
- **Quiescent Supply Voltage: 3.5 mA**
- **0*g* output voltage 2.315V (with 5V supply)**
- **50,000*g* shock survival**
- **2.70V to 5.25V Single Supply**
- **On-chip mixed signal processing**
- **Continuous sensors self test**
- **Temperature sensor output (Tout) 5mV/°K**
- **Packaged in 8 pin LCC SMD or 10 pin TO-100 THRU-HOLE**
- **Hermetically sealed packaging**
- **Reference voltage (V_{REF}) 2.50V**

Block Diagram of MX21XX



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Technical information.
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MX210Q ANALOG Data Sheet N 8/1/01

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MX210Q SPECIFICATIONS
Analog Electrical Characteristics

Measurements @ 25°C Acceleration = 0g unless otherwise noted
V_{DD}, V_{DA} = 5.0V unless otherwise specified

Parameter	Conditions	MEMSIC MX210Q			Units
		Min	Typ	Max	
SENSOR Measurement Range[1] Nonlinearity Alignment Error[2]	Each axis Best Fit Straight Line	 +/- 10.0	 2% +/- 1.0	 +/- 2.5	 g % of FS degrees
SENSITIVITY ANALOG OUTPUTS Sensitivity	Each axis	 45	 50	 55	 mV/g
Temperature Changes[8]	Delta from 25°C per formula $S_{IN} X (T_{IN})^{2.67} = S_{FIN} X (T_{FIN})^{2.67}$				
Cross-Axis Sensitivity[3]	X sensor to Y sensor		+/- 2		%
ZERO g BIAS LEVEL[11] 0g Offset vs. Temperature[4]	Each axis	2.0	2.2 2.0	2.4	V mg/°C
NOISE PERFORMANCE Noise Density[5] in 40 Hz Bandwidth	@ +25°C		750	1000	µg/√Hz rms
FREQUENCY RESPONSE 3 dB Bandwidth 3 dB Bandwidth[7]			 40 160		 Hz Hz
Tout Voltage Temp sensor sensitivity	25°C	1.23	1.25	1.27 5	V mV/°K
V REFERENCE[9]	25°C	2.4	2.5	2.6	V
SELF TEST Voltage Delta at outputs @5V Supply @2.7V Supply	 Continuous, Output rails with failure			 5.0 2.7	 V V
X, Y OUTPUTS[10]	Current drive capabilities, source/sink	-2.5		+2.5	mA
POWER SUPPLY Operating Voltage Range Specified Performance Quiescent Supply Current @ 5V Quiescent Supply Current @ 2.7V Turn-On Time[6]		 2.7	 3.0 4.0 200	 5.25 3.5 4.5 400	 V mA mA ms
TEMPERATURE RANGE Operating Range		-40		125	°C

NOTES

[1]Guarantee by measurements of initial offset and sensitivity.

[2]Alignment error is specified as the angle between the true and indicated axis of sensitivity.

[3]Cross-axis sensitivity is the algebraic sum of the alignment and the inherent sensitivity errors.

[4]Specification refers to the maximum change in parameter from its initial value at 25°C to its worst case value at Tmin to Tmax of the specified temperature range.

[5]Noise density (µg/√Hz rms) is the average noise at any frequency in the bandwidth of the device.

[6]The voltage is required to ramp full scale before making a measurement.

[7]**Note: Frequency compensating circuit will achieve 160 Hz operations. See Application Note (AN-00MX-002) . Application boards available.**

[8]Defined as the output change from ambient to maximum temperature or minimum. For more details refer to Application Note (AN-00MX-002).

[9]For more details refer to Application Note (AN-00MX-001).

[10]Operating at maximum current drive capabilities, shifting of baseline sensitivity may occur.

[11]Ratiometric analog output voltage will be 44.0% of VDD, VDA supply.

All min and max specifications are subject to change without notification.

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ABSOLUTE MAXIMUM RATINGS*

Symbol	Parameter	Rating	Units
VDD	Supply Voltage to Ground Potential	-0.5 to 7.0	Volts
T_{STG}	Storage Temperature	-65 to +150	Deg C
	Acceleration	50,000	g

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

PACKAGE CHARACTERISTICS

Package	ThetaJA	ThetaJC	Device Weight
TO-100	150°C/W	25°C/W	0.04 oz
LCC-8	110°C/W	22°C/W	0.02 oz

ORDERING GUIDE

Model	Package Style
MX210QC	TO-100 Metal Can
MX210QL	LCC-8 SMD *

* LCC parts are shipped in tape and reel packaging.

NOTE

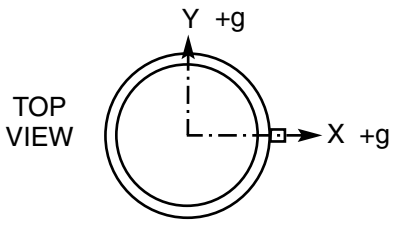
Drops onto hard surfaces can cause shocks of greater than 50,000g and exceed the absolute maximum rating of the device.
Care should be exercised in handling to avoid damage.

CAUTION

ESD (electrostatic discharge) sensitive device.

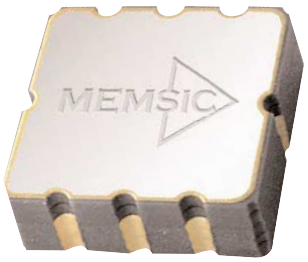
TO-100

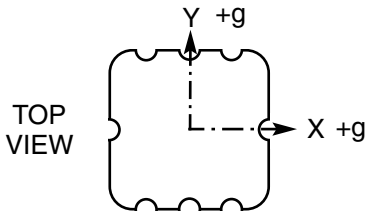




TO-100
Axes of Sensitivity

LCC-8





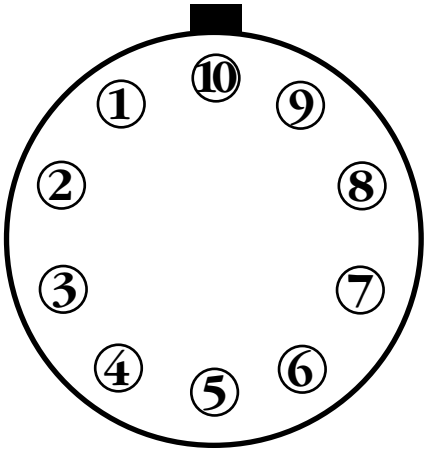
LCC-8
Axes of Sensitivity

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Pin Function Descriptions
TOP-100 and LCC-8

PIN DESCRIPTION: TO-100 Package

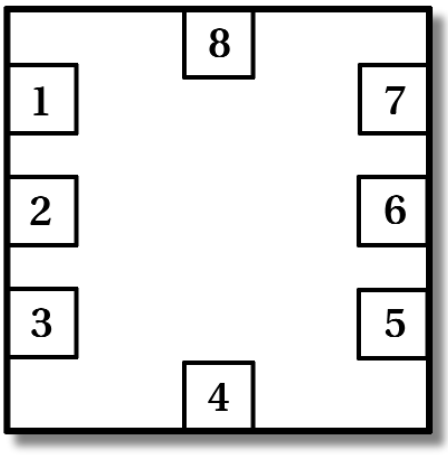
	Pin	Name	Description
	1	VDD	Digital Supply Voltage
	2	TOUT	Temperature
	3	AOUTY	Acceleration Signal
	4	GND	Ground
	5	n/c	no connection
	6	VDA	Analog Supply Voltage
	7	AOUTX	Acceleration Signal
	8	VREF	2.50V Reference Voltage
*	9	SCK	Serial Clock
	10	RBias	no connection



Top View

PIN DESCRIPTION: LCC-8 Package

	Pin	Name	Description
	1	TOUT	Temperature
	2	AOUTY	Acceleration Signal
	3	GND	Ground
	4	VDA	Analog Supply Voltage
	5	AOUTX	Acceleration Signal
	6	VREF	2.50V Reference Voltage
*	7	SCK	Serial Clock
	8	VDD	Digital Supply Voltage



Top View

* Optional external clock factory programmed per customer request

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Pin Definition

VDD - This is the digital power supply input for the MX20XX. The DC voltage should be between 2.70 and 5.25 volts.

VDA - This is the analog power supply input for the MX20XX. VDA should always be connected to VDD.

GND - This is the ground pin for the MX20XX.

AOUTX - This pin is the output of the x-acceleration sensor.

AOUTY - This pin is the output of the y-acceleration sensor.

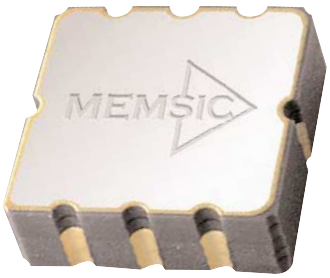
TOUT - This pin is the buffered output of the temperature sensor. The voltage at TOUT is an indication of the die temperature. This voltage can be measured and used to compensate out the temperature dependence of accelerometer sensitivity.

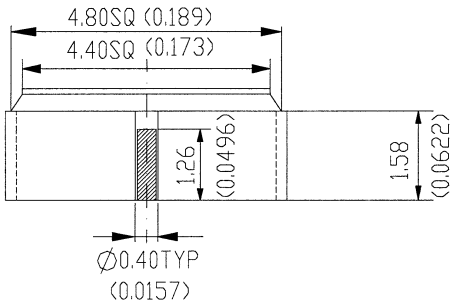
SCK - Standard product is delivered with an Internal Clock option. Ground this pin when operating with the Internal Clock. The External Clock must be ordered special from the factory.

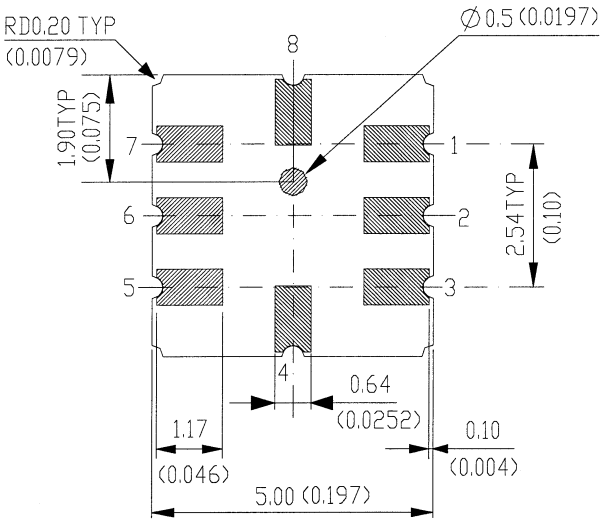
VREF - A reference voltage is output from this pin.

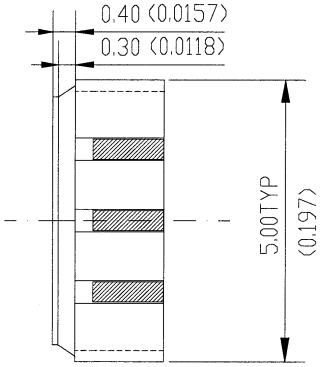
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Package Outline
LCC-8 mm (in)









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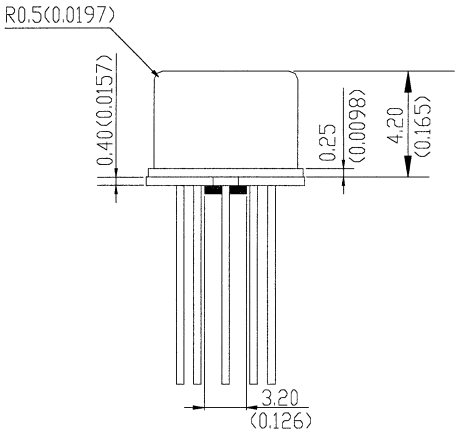
Preliminary technical information.
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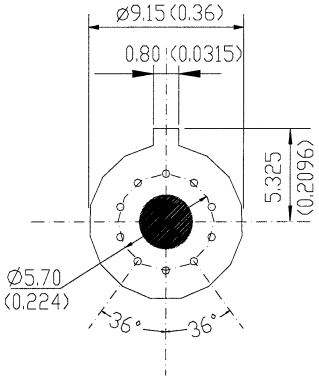
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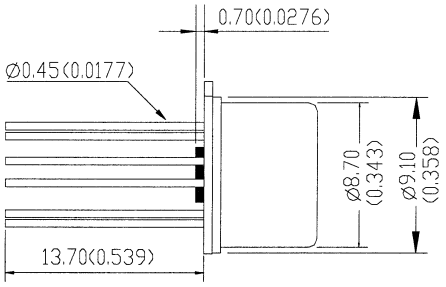
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Package Outline
TO-100 mm (in)









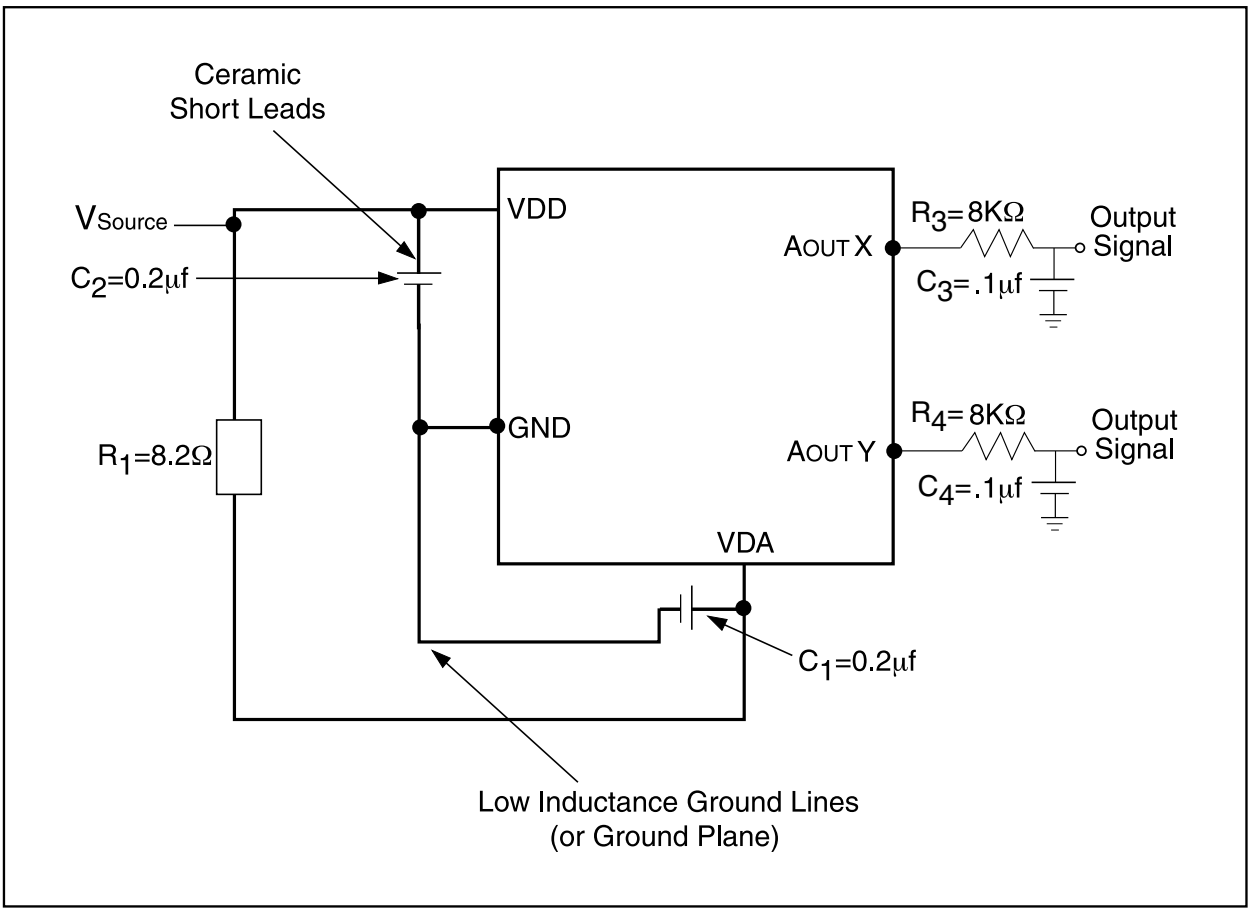
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Printed Circuit Board Layout and Filter Requirements



Layout Notes

1. Use robust low inductance ground wiring
2. Liberal use of ceramic bypass capacitors
3. The capacitors should be located as close as possible to the device supply pins (VDA, VDD).
4. The capacitor lead length should be as short as possible. Surface mount capacitors are preferred.

Filtering Notes

1. Low pass filter – 200Hz, -3db
2. Ceramic capacitors C_3, C_4
3. $f = 1/2\pi RC$
4. Resistor R_3, R_4 – 1/8 Watt, 5% tolerance
5. Reference Application Note # AN-00MX-004

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