MXR7250VW SPECIFICATIONS (Measurements @ 25°C, Acceleration = 0 g unless otherwise noted; $V_{DD} = 5.0V$ unless otherwise specified)

Parameter	Conditions	MXR7250V			Units
		Min	Typ	Max	
SENSOR INPUT	Each Axis				
Measurement Range[1]		±5.0			g
No linearity	Best fit straight line		0.5	1.0	% of FS
Alignment Error[2]			±0.2		degrees
Transverse Sensitivity[3]			±0.5	±1.0	%
SENSITIVITY	Each Axis				
Sensitivity, Analog Outputs at pins Xout and Yout[4]	@5.0V supply	235	250	265	mV/g
Sensitivity Ratiometricity	5V+/-5%		1.0	2.0	%
Change over Temperature	Δ from 25°C –40°C to +95°C	-6		+3	%
ZERO g BIAS LEVEL	Each Axis				
0 g Offset		-0.20	0.00	+0.20	g
0 g Voltage		2.45	2.50	2.55	V
0 g Offset Ratiometricity	5V+/-5%			1.0	%
0 g Offset over Temperature	Δ from 25°C, based on 250mV/g			±80	mg
NOISE PERFORMANCE					
Noise Density, rms	–40°C to +95°C		0.6	1.5	$mg/\sqrt{Hz}$
FREQUENCY RESPONSE					
3dB Bandwidth		24	27	30	Hz
Phase delay	at 5Hz		-18		deg
SELF TEST					
Delta Output changes at Xout, Yout	at 25°C, 0g input	-650	-830	-1000	mV
	at 25°C, 1g input	-700	-850	-1050	mV
	at 25°C, -1g input	-600	-900	-1100	mV
	-40°C~95°C, 0g input	-600		-1100	mV
	-40°C~95°C, 1g input	-500		-1500	mV
	-40°C~95°C, -1g input	-600		-1600	mV
Selftest Input Voltage	High	4.0			V
	Low			1.0	V
Selftest Response Time		20	25	30	mS
Self Test Pin Pull-Down Resistor (Internal)			50		Kohms
Xout and Yout/Zout OUTPUTS					
Normal Output Range (Guaranteed symmetric clipping)		0.5		4.5	V
Current	Source or sink, @ 4.5V-5.25V supply			100	μA
Resistance				100	ohm
Capacitance				100	pF
Turn-On Time	@5.0V Supply		80		mS
POWER SUPPLY					
Operating Voltage Range		4.5	5.0	5.25	V
Supply Current[5]	@ 5.0V RMS	3.2	4.1	5.0	mA
TEMPERATURE RANGE					
Operating Range		-40		+95	°C
PRESSURE RANGE					
Operating Range		40		300	KPa.

[5] Note that the accelerometer has a constant heater power control circuit thereby requiring higher supply current at lower operating voltage.

NOTES

[1] Guaranteed by measurement of initial offset and sensitivity.

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

[3] Transverse sensitivity is the algebraic sum of the alignment and the inherent sensitivity errors.

[4] The device operates over a 4.5V to 5.25V supply range. The output zero g reference voltage scales 50% of the supply voltage. Sensitivity has a linear scale over the supply range of 4.5 to 5.25 volts according to the ratio (Vdd/5.0 volts) x (250mV/g).

recommended to filter with a minimum of 200Hz low pass filter.

ABSOLUTE MAXIMUM RATINGS*

Supply Voltage (V_{DD}, V_{DA}) [1] …………….....-0.5 to +7.0V
Storage Temperature …….....…………-70°C to +150°C
Storage Pressure…………….……….…………1,378 kPa
Acceleration (any axis, Un-powered for 0.5 msec)..50,000 g
Acceleration (any axis, Powered for 0.5 msec)…… .2,000 g
Output Short Circuit Duration, any pin to common…….Indefinite

*Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; the functional operation of the 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.

[1] Exposure for up to 60 minutes to absolute maximum ratings for supply voltages will not affect device reliability.

Pin Description: LCC Package

Pin	Name	Description
1	NC	Do Not Connect
2	Xout	X Channel Output
3	V_{DD}	4.5V to 5.25V
4	ST_{IN}	Selftest
5/J	NC/NC	Do Not Connect
6/M	CLK/CLK	Ground
7/L	COM/COM	Ground
8/K	Yout/Zout	Y Channel Output/Z channel output (XZ sensing)

Ordering Guide

Model	Package Style	Temperature Range
MXR7250VW	LCC RoHS compliant	-40 to 95°C

All parts are shipped in tape and reel packaging.
Caution: ESD (electrostatic discharge) sensitive device.

X=2.25V
Y=2.50V

X=2.50
Y=2.75

TOP VIEW
(Not to Scale)

X=2.50V
Y=2.25V

X=2.50V
Y=2.50V

X=2.75V
Y=2.50V

EARTH'S SURFACE

ESD Compliance:
The MXR7250V sensor is in compliance with the following ESD standards:
Human Body and 2500V per AEC-Q100-002 Rev. E
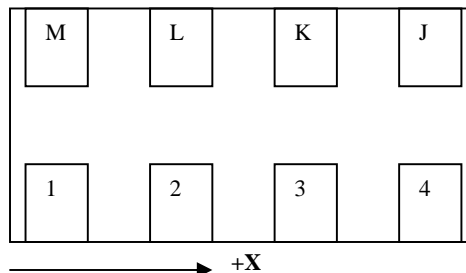Machine Model and 250V per AEC-Q100-003 Rev. E
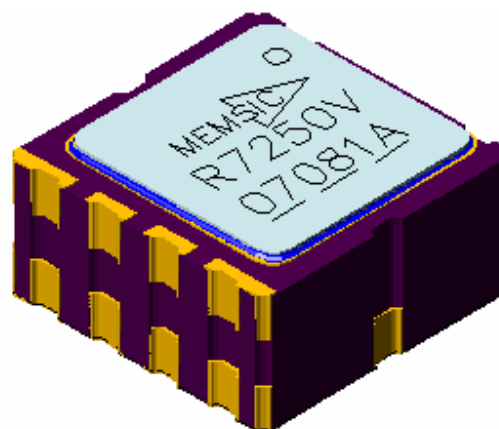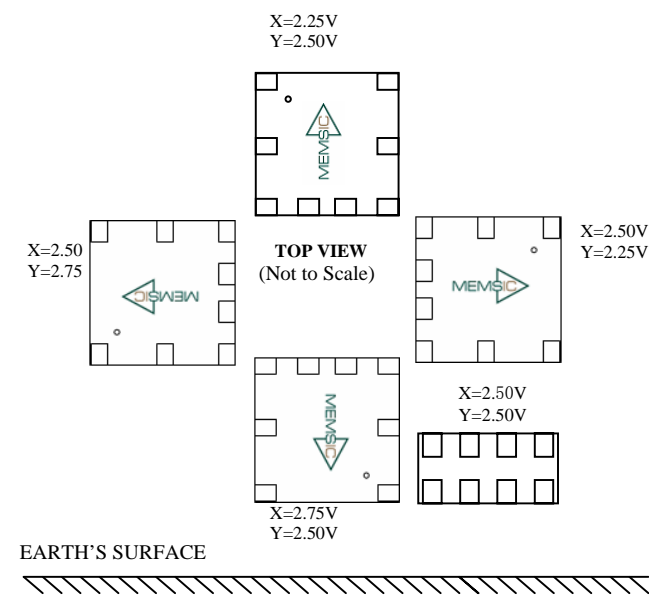
XY Sensing:
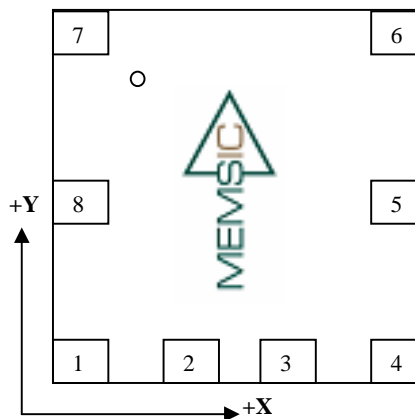
(Top View, do not scale)

Note: Small circle indicates pin seven (7).

XZ Sensing:

(Bottom View, do not scale)

THEORY OF OPERATION

The MEMSIC device is a complete dual-axis acceleration measurement system fabricated on a monolithic CMOS IC process. The device operation is based on heat transfer by natural convection and operates like other accelerometers having a proof mass except it is a gas in the MEMSIC sensor

A single heat source, centered in the silicon chip is suspended across a cavity. Equally spaced aluminum/polysilicon thermopiles (groups of thermocouples) are located equidistantly on all four sides of the heat source (dual axis). Under zero acceleration, a temperature gradient is symmetrical about the heat source, so that the temperature is the same at all four thermopiles, causing them to output the same voltage.

Acceleration in any direction will disturb the temperature profile, due to free convection heat transfer, causing it to be asymmetrical. The temperature, and hence voltage output of the four thermopiles will then be different. The differential voltage at the thermopile outputs is directly proportional to the acceleration. There are two identical acceleration signal paths on the MXR7250VW, one to measure acceleration in the x-axis and one to measure acceleration in the Y-axis. For more details visit the MEMSIC website at www.memsic.com for a picture/graphic description of the free convection heat transfer principle.

PIN DESCRIPTIONS

V_{DD} – Supply voltage input for digital and analog circuits. For proper operation V_{DD} must be between 4.50 and 5.25 volts. Refer to the section on PCB layout and fabrication suggestions for guidance on external parts and connections recommended.

Xout – X-axis acceleration signal output
It is capable of sinking or sourcing up to 100μA. The user should ensure the load impedance is sufficiently high as to not source/sink >100μA. While the sensitivity of this axis has been programmed at the factory to be the same as the sensitivity for the Y-axis, the MXR7250VW can be programmed for non-equal sensitivities on the x- and y-axes.
Contact Memsic's local office for additional information.

Yout /Zout– Y-axis acceleration signal output.
It is capable of sinking or sourcing up to 100μA. The user should ensure the load impedance is sufficiently high as to not source/sink >100μA. While the sensitivity of this axis has been programmed at the factory to be the same as the sensitivity for the X-axis, the MXR7250VW can be programmed for non-equal sensitivities on the X- and Y-axes.
Contact Memsic's local office for additional information.

NC – No connect. These pins can be tied to common if the application does not allow pins to remain unconnected.

COM – This is the ground pin for the MXR7250VW

CLK – This is an optional serial clock input. The standard product is delivered with an internal clock (1000 kHz). However, an external clock between 400 kHz and 1.6 MHz can be used as an option, if the sensor is programmed from the factory to run in external clock mode.
This pin is grounded internally with a 50 Kohm resistor if an external clock is used it should be able to drive this load. But if external clock is not used, in order to minimize noise and ESD this pin should be grounded externally as well.
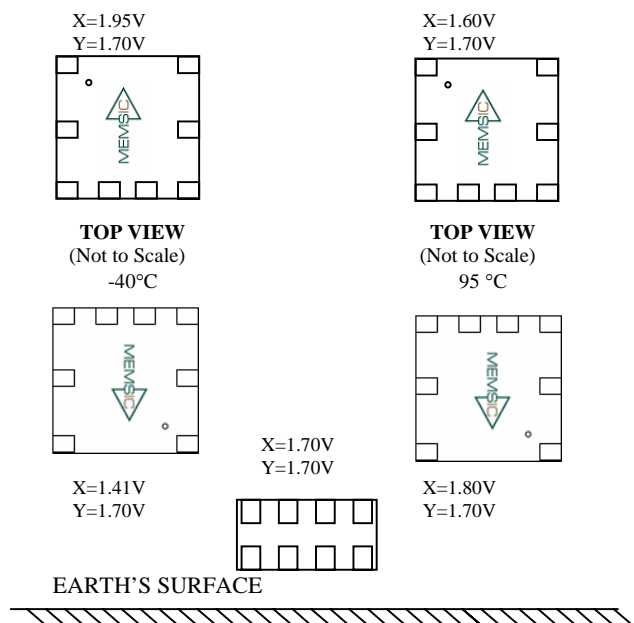
ST_{IN}– Self –Test Input

This pin controls the self-test function of the sensor. Bringing ST_{IN} high will cause a negative deflection around 830mV to the AoutX AoutY from the 0g value.
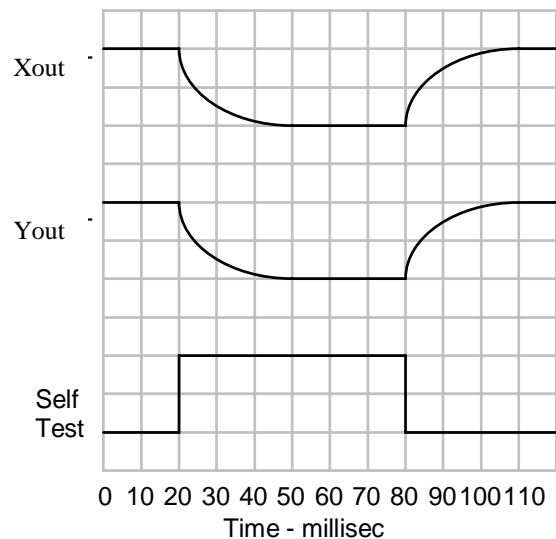
SELF-TEST DESCRIPTION

When Self-test is enabled the sensitivity compensation is turned off (disabled). With the sensitivity compensation disabled, the 1.0g offset voltages will double it's value as compared with the zero g condition. With an exponent of 2.8 in the equation, the sensitivity will be $(298K / 233K)^{2.8}$ = 2.00 times larger

X=1.95V
Y=1.70V

X=1.60V
Y=1.70V

TOP VIEW
(Not to Scale)
-40°C

TOP VIEW
(Not to Scale)
95 °C

X=1.41V
Y=1.70V

X=1.70V
Y=1.70V

X=1.80V
Y=1.70V

EARTH'S SURFACE

Thermal Accelerometer Sensitivity

.

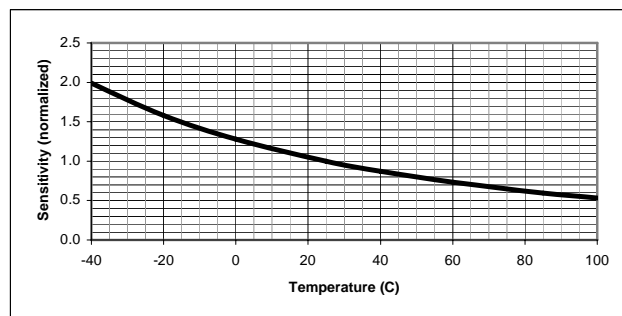
Accelerometer Position Relative to Gravity

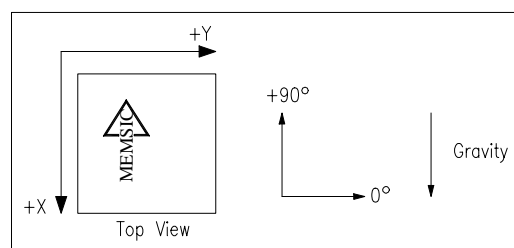The gas law governs the change in sensitivity over temperature.

All thermal accelerometers display the same sensitivity change with temperature. The sensitivity change depends on variations in heat transfer that are governed by the laws of physics. Manufacturing variations do not influence the sensitivity change, so there are no unit-to-unit differences in sensitivity change. The sensitivity change is governed by the following equation (and shown in the following figure in °C):

$$S_i \text{ x } T_i^{2.8} = k \text{ x } S_f \text{ x } T_f^{2.8}$$

where S_i is the sensitivity at any initial temperature T_i, and S_f is the sensitivity at any other final temperature T_f with the temperature values in °C, k is the ratio between uncompensated sensitivity and compensated sensitivity at 25°C.

.

Note1: When the temperature compensation is disabled and self-test is enabled. Self-test follows different gas law from sensitivity temperature dependence. It changes much smaller than sensitivity; this is why the temperature compensation is not done on self-test conditions.

Note2: Initial offset monitoring is a much better and reliable method to ensure sensor integrity, since it is ultra sensitive to sensor structure defect and damage. As long as initial offset is within specification the sensor is functioning correctly.

The sensor structure for the Thermal technology is guaranteed to fall outside the specified initial zero g offset parameters if the sensor is damaged or thermopile is failing. In most cases this will result in the output voltage hitting the rail at 5.0 volts.

PCB LAYOUT AND FABRICATION SUGGESTIONS

Reference figure and the notes below for recommendations on connecting a power source to the MEMSIC device and PCB fabrication.

Notes:
1. $C_1 = 1.0 \mu F$
2. The capacitor should be located as close as possible to the device supply pin V_{DD}, since the internal heater is in PWM (1MHz) control mode, with all V_{DD} on the heater at some portion of the time, by using larger value capacitor can minimize the induced noise on the outputs.
3. The CLK is grounded internally with a 50 kOhm resistor, however, in order to minimize noise and ESD this pin should be grounded externally as well.
4. Robust low inductance ground wiring should be used.
5. Care should be taken (like isolated rings and planes, signal route out perpendicular to the external thermal gradient) to ensure there is "thermal symmetry" on the PCB immediately surrounding the MEMSIC device and that there is no significant heat source nearby. This will minimize any errors in the measurement of acceleration.
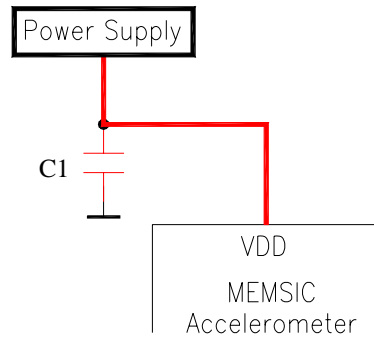
PCB Layout

PACKAGE OUTLINE
Dimensions shown in mm.