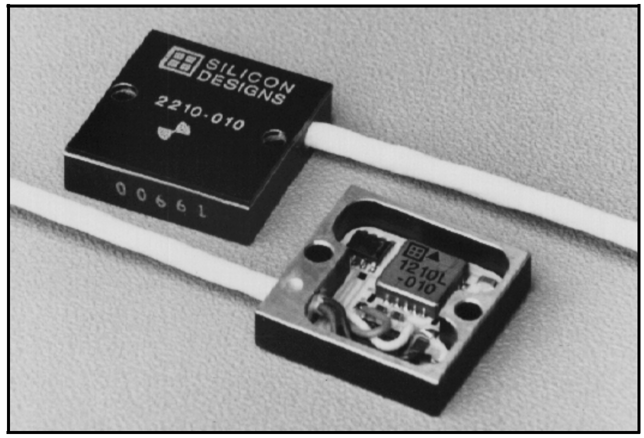
SILICON DESIGNS, INC

Model 2210
ANALOG ACCELEROMETER MODULE

FEATURES

- SENSOR: Hermetic Capacitive
  Micromachined
  Nitrogen Damped
- ±4V Differential Output or
  0.5V to 4.5V Single Ended Output
- Low Power Consumption
- -40 to +85°C Operation
- +9 to +30V DC Power
- Simple Four Wire Connection
- Responds to DC and AC Acceleration
- Non Standard g Ranges Available
- Rugged Anodized Aluminum Module
- No external Reference Voltage Required
- Low Cost
- Serialized for Traceability



ACTUAL SIZE

ORDERING INFORMATION

Full Scale Acceleration	Model Number
± 2 g	2210-002
± 5 g	2210-005
± 10 g	2210-010
± 25 g	2210-025
± 50 g	2210-050
±100 g	2210-100
±200 g	2210-200

DESCRIPTION

The Model 2210 accelerometer module combines an integrated model 1210L accelerometer with high drive, low impedance buffering for measuring acceleration in commercial/industrial environments. It is tailored for zero to medium frequency instrumentation applications. The module contains a miniature, hermetically sealed micromachined capacitive sense element, a custom integrated circuit sense amplifier, and differential output stages. The anodized aluminum case is epoxy sealed and is easily mounted via two #4 screws. On-board regulation is provided to minimize the effects of supply voltage variation. It is relatively insensitive to temperature changes and to gradients. The cable shield is electrically connected to the anodized aluminum package. An optional initial calibration sheet (2210-CAL) and periodic calibration checking are also available.

OPERATION

The Model 2210 accelerometer module produces two analog voltage outputs which vary with acceleration as shown in the graph on the next page. The sensitive axis is perpendicular to the bottom of the package, with positive acceleration defined as a force pushing on the bottom of the package. The signal outputs are fully differential about a common mode voltage of approximately 2.5 volts. The output scale factor is independent from the supply voltage of +9 to +30 volts. At zero acceleration the output differential voltage is nominally 0 volts DC; at ±full scale acceleration the output differential voltage is ±4 volts DC respectively.

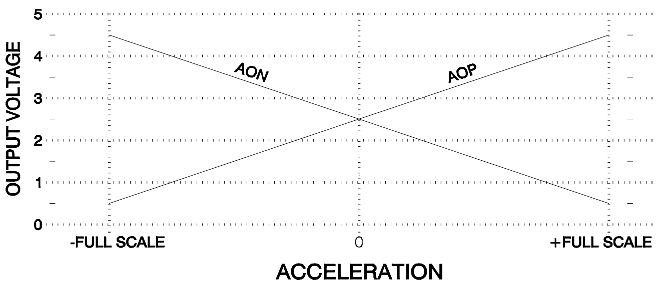
APPLICATIONS

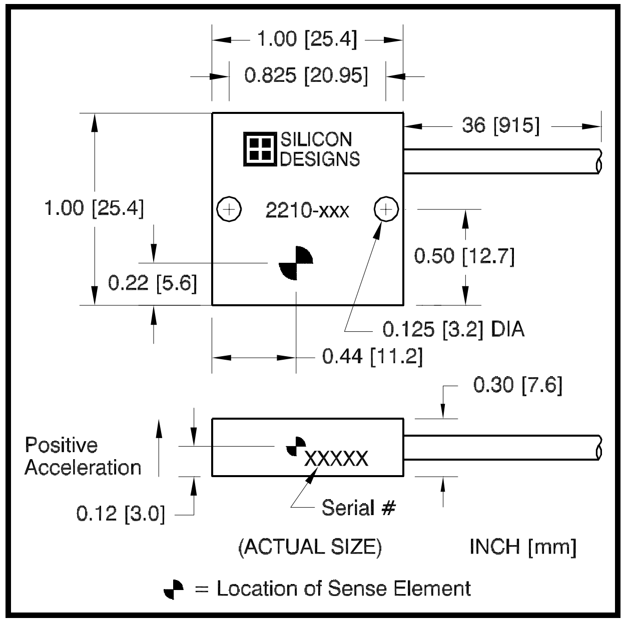
- VIBRATION MONITORING
- VIBRATION ANALYSIS
- MACHINE CONTROL
- MODAL ANALYSIS
- ROBOTICS
- CRASH TESTING
- INSTRUMENTATION

SIGNAL DESCRIPTIONS

Vs and GND (Power): Red and Black wires respectively. Power (+9 to +30 Volts DC) and ground.

AOP and AON (Output): Green and White wires respectively. Analog output voltages proportional to acceleration; AOP voltage increases (AON decreases) with positive acceleration. At zero acceleration both outputs are nominally equal to 2.5 volts. The device experiences positive (+1g) acceleration with its lid facing up in the Earth's gravitational field. Either output can be used individually or the two outputs can be used differentially. (See output response plot below)





PERFORMANCE by Model: Vs=+9 to +30VDC, T_C=25°C.

Model Number	2210-002	2210-005	2210-010	2210-025	2210-050	2210-100	2210-200	Units
Input Range	±2	±5	±10	±25	±50	±100	±200	g
Frequency Response (Nominal, 3 dB)	0 - 300	0 - 400	0 - 600	0 - 1000	0 - 1600	0 - 2000	0 - 2500	Hz
Sensitivity - Differential [1]	2000	800	400	160	80	40	20	mV/g
Max. Mechanical Shock (0.1 ms)	2000							g

Note 1: Single ended sensitivity is half of values shown.

PERFORMANCE - All Models: Unless otherwise specified, Vs=+9 to +30VDC, T_C=25°C, Differential Mode.

Parameter		Min	Typ	Max	Units
Cross Axis Sensitivity			2	3	%
Bias Calibration Error [2]	5g & above		2	3	% of span
	2g		2	4	
Bias Temperature Shift (T_C= -40 to +85°C) [2]	10g & above		50	200	(ppm of span)/°C
	2g & 5g		100	300	
Scale Factor Calibration Error [2, 3]			2	3	%
Scale Factor Temperature Shift (T_C= -40 to +85°C) [2]			+300		ppm/°C
Output Noise (0 - 1.0 kHz)			800		uV (RMS)
Non-Linearity (-90 to +90% of Full Scale) [2, 3]			0.5	1.0	% of span
Power Supply Rejection Ratio		50	>65		dB
Output Impedance			1		Ω
Output Common Mode Voltage			2.45		VDC
Operating Voltage		9		30	VDC
Operating Current [2]			9	12	mA DC
Mass (not including cable)			10		grams
Cable Mass			25		grams/meter

Notes: 2. Tighter tolerances are available on special order.
3. 100g versions and above are tested from -65g to +65g.

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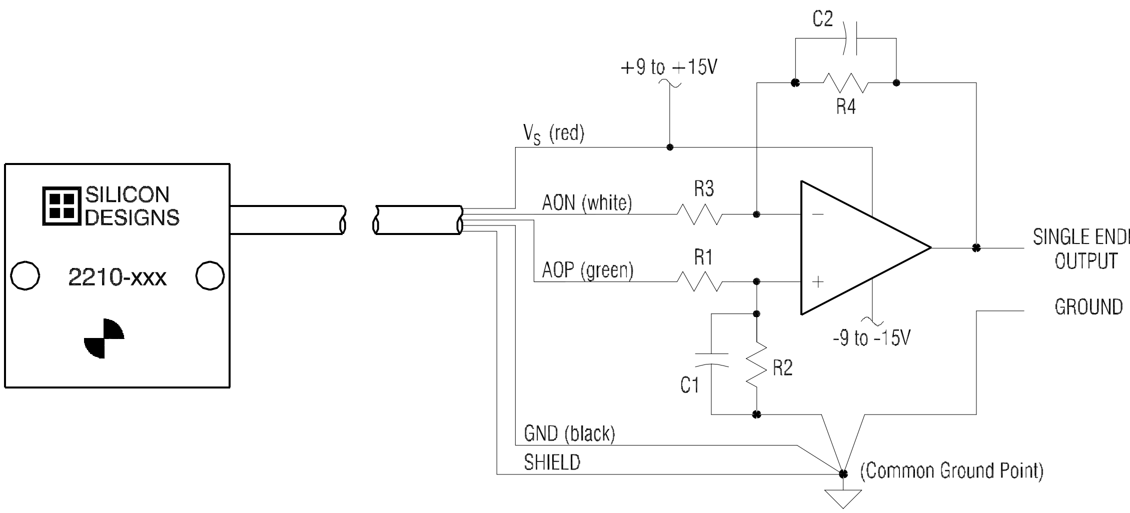
ADDING A SINGLE ENDED OUTPUT TO THE MODEL 2210 DIFFERENTIAL OUTPUT ACCELEROMETER



R1, R2, R3 & R4 = 5kΩ to 50kΩ
R1 = R3 to within 0.1% for good common mode rejection
R2 = R4 to within 0.1% for good common mode rejection
R2 / R1 ratio accurate to within 0.1% for gain control
R4 / R3 ratio accurate to within 0.1% for gain control

To achieve the highest resolution and lowest noise performance from your model 2210 accelerometer module, it should be connected to your voltage measurement instrument in a differential configuration using both the **AOP** and **AON** output signals. If your measurement instrument lacks differential input capability or you desire to use a differential input capable instrument in single ended mode, then the circuit above can be used to preserve the low noise performance of the model 2210 while using a single ended type connection.

This circuit converts the ± 4 Volt differential output of the model 2210 accelerometer, centered at +2.5 Volts, to a single ended output centered about ground (0.0 VDC). It provides the advantage of low common mode noise by preventing the ground current of the model 2210 from causing an error in the voltage reading.

The op-amp should be located as close as possible your voltage monitoring equipment. The majority of the signal path can therefor be differential so any noise will affect the wire run as a common mode signal which will be rejected. The op-amp type is not critical; a µA741 or ¼ of a LM124 can be used. The power supplies need to be ±10V to ±15V to allow for both positive and negative output swing.

The gain of the op-amp is determined by the ratio R2/R1 (where R4=R2 and R3=R1). If R1 through R4 are all the same value, the gain equals 1 and the output swing will be ± 4 Volts single ended with respect to ground. To obtain a ± 5 Volt single ended output, set R2/R1 = R4/R3 = 5/4 = 1.25. The single ended output of the op-amp will be centered at ground if R2 and C1 are tied to ground; using some other fixed voltage for this reference can shift the output. The value of the optional capacitors C1 and C2 (C1=C2) can be selected to roll off the frequency response to the frequency range of interest.

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