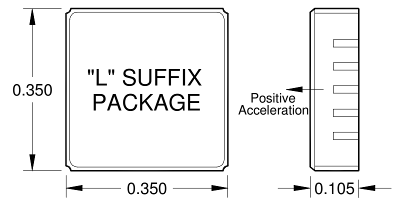
SILICON DESIGNS INC
ADVANCED ACCELEROMETER SOLUTIONS

MODEL 1510 VIBRATION APPLICATION ANALOG SURFACE MOUNT ACCELEROMETER

- Excellent long term stability
- Responds to DC and AC Acceleration
- Differential or Single Ended Output
- ±4V Differential
- 0.5V to 4.5V Single Ended
- +5 VDC, 6 mA power (typical)
- -40 to +85°C operation
- Integrated sensor & amplifier
- Nitrogen damped & hermetically sealed
- Serialized



AVAILABLE G-RANGES

FULL SCALE ACCELERATION	20 PIN LCC
± 5 g	1510L-005
± 10 g	1510L-010
± 25 g	1510L-025
± 50 g	1510L-050
± 100 g	1510L-100

DESCRIPTION

The low cost 1510 is ideally suited for vibration applications. Each miniature, hermetically sealed package combines a micro-machined capacitive sense element and a custom integrated circuit that includes a sense amplifier and differential output stage. It is insensitive to temperature changes and gradients. The 1510 is RoHS compliant.

ZERO (DC) TO MEDIUM FREQUENCY APPLICATIONS

PERFORMANCE

INPUT RANGE	FREQUENCY RESPONSE (MINIMUM, 3 DB)	SENSITIVITY, DIFFERENTIAL	OUTPUT NOISE, DIFFERENTIAL (RMS, TYPICAL)	MAX. MECHANICAL SHOCK (0.1 MS)
g	Hz	mV/g	μg/(root Hz)	g (peak)
±5	0 – 600	800	32	2000
±10	0 – 1000	400	63	5000
±25	0 – 1500	160	158	
±50	0 – 2000	80	316	
±100	0 – 2500	40	632	

By Model: V_{DD}=V_R=5.0 VDC, T_C=25°C.

PERFORMANCE - ALL VERSIONS

All Models: Unless otherwise specified V_{DD}=V_R=5.0 VDC, T_C=25°C, Differential. Span = ±g range = 8000 mV

PARAMETER	MIN	TYP	MAX	UNITS
Cross Axis Sensitivity			3	± %
Bias Calibration Error, differential			1	± % of span
Bias Calibration Error, single ended[3]			0.15	± V
Bias Temperature Shift (T_C= -40 to +85°C)	-200		200	(ppm of span)/°C
Scale Factor Calibration Error[1]			1.5	± %
Scale Factor Temperature Shift (T_C= -40 to +85°C)	-300		300	PPM/°C
Long Term Bias Stability		1000	2000	± PPM of span
Non-Linearity (-90 to +90% of Full Scale) [2]			1.0	± % of span
Output Impedance		90		Ohms
Operating Voltage	4.75	5.0	5.25	volts
Operating Current (I_{DD}+I_{VR})		6	8	mA
Mass: 'L' package		0.62		grams

Note 1: Single ended sensitivity is half of values shown. Note 2: 100g version is tested and specified from -65g to +65g.
Note 3: Voltage difference from +2.5V reference voltage supplied to pin 17

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

MAXIMUM RATINGS *

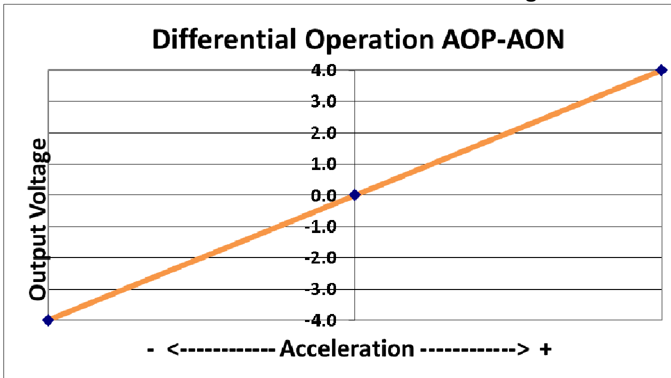
Case Operating Temperature	-40 to +85°C
Storage Temperature	-40 to +120°C
Voltage on V_{DD} to GND	-0.5V to 6.5V
Voltage on Any Pin (except DV) to GND [1]	-0.5V to V_{DD}+0.5V
Voltage on DV to GND (Self-Test)	±15V
Power Dissipation, max	50 mW

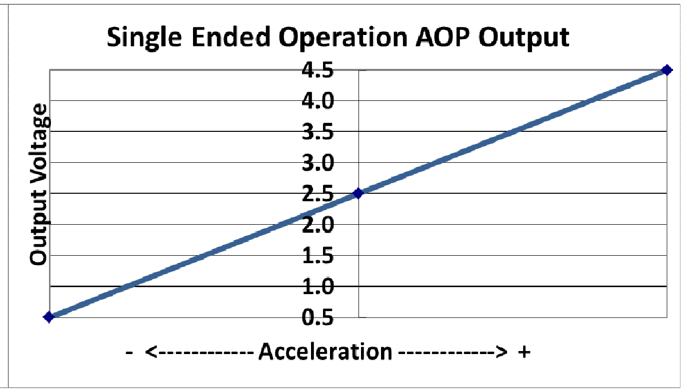
** NOTICE: Stresses greater than those listed above may cause permanent damage to the device. These are maximum stress ratings only. Functional operation of the device at or above these conditions is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability and lifespan.*

OPERATION

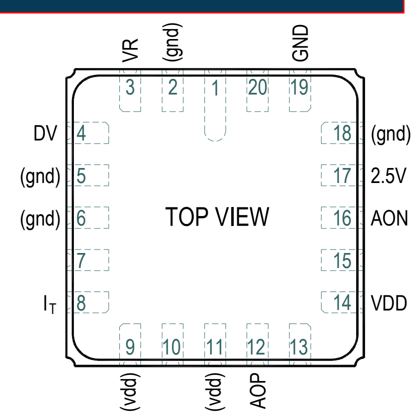
The model 1510 sensitive axis is perpendicular to the bottom of the package, with positive acceleration resulting from a positive force pushing on the bottom of the package. The seismic center is located on a centerline through the dual sense elements and halfway between them. The internal electronics effectively cancel any errors due to rotation. Two reference voltages, +5.0 and +2.5 volts (nominal), are required; scale factor is ratiometric to the +5.0 volt reference voltage relative to GND, and both outputs at zero acceleration are nominally 80 mV below the +2.5 volt input.

The Model 1510 produces a differential +/-4 volts output voltage or single ended mode, 0.5 – 4.5 volts full scale, the value of which varies with acceleration as shown in the figures below.





SIGNAL DESCRIPTIONS



VDD and GND (power): Pins (9,11,14) and (2,5,6,18,19) respectively. Power (+5 Volts DC) and ground.

AOP and AON (output): Pins 12 and 16 respectively. Analog output voltages proportional to acceleration. The AOP voltage increases (AON decreases) with positive acceleration; at zero acceleration both outputs are nominally equal to the +2.5 volt reference. 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 but differential mode is recommended for both lowest noise and highest accuracy operation. Voltages can be measured ratiometrically to VR for good accuracy without requiring a precision reference voltage. In single ended mode the unused -AON signal output PIN 16 must be left unconnected. Connecting this signal output to your shield or to the 0 volt power supply ground plane will potentially cause the sensor to overheat and prematurely fail.

DV (input): Pin 4. Deflection Voltage. Normally left open. A test input that applies an electrostatic force to the sense element, simulating a positive acceleration. The nominal voltage at this pin is ½ VDD. DV voltages higher than required to bring the output to positive full scale may cause device damage.

VR (input): Pin 3. Voltage Reference. Tie directly to VDD for ratiometric measurements or to a +5V reference for better absolute accuracy. A 0.1µF bypass capacitor is recommended at this pin.

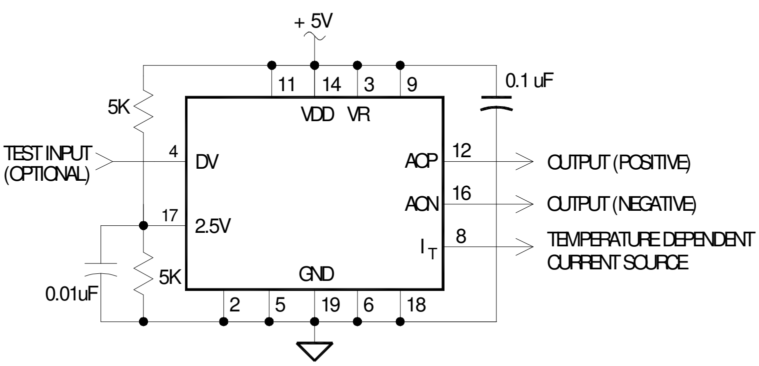
2.5 Volt (input): Pin 17. Voltage Reference. Tie to resistive voltage divider from +5 volts or a +2.5 volt reference voltage.

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

RECOMMENDED CONNECTIONS

DEFLECTION VOLTAGE (DV) TEST INPUT: This test input applies an electrostatic force to the sense element, simulating a positive acceleration. It has a nominal input impedance of 32 kΩ and a nominal open circuit voltage of **½ V_{DD}**. For best accuracy during normal operation, this input should be left unconnected or connected to a voltage source equal to ½ of the **V_{DD}** supply. The change in differential output voltage (**AOP** – **AON**) is proportional to the square of the difference between the voltage applied to the **DV** input (**V_{DV}**) and **½ V_{DD}**. Only positive shifts in the output voltage may be generated by applying voltage to the **DV** input. When voltage is applied to the **DV** input, it should be applied gradually. The application of **DV** voltages greater than required to bring the output to positive full scale may cause device damage. The proportionality constant (***k***) varies for each device and is not characterized.

$$\Delta(AOP - AON) \approx k\left(V_{DV} - \frac{1}{2}V_{DD}\right)^2$$



SIGNAL CONNECTIONS

The 2.5V input (pin 17) may be driven from a resistive divider.

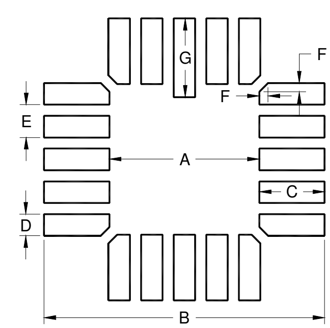
ESD and LATCH-UP CONSIDERATIONS: The model 1510 accelerometer is a CMOS device subject to damage from large electrostatic discharges. Diode protection is provided on the inputs and outputs, and it is not easily damaged, but care should be exercised during handling. However, individuals and tools should be grounded before coming in contact with the device. Although the 1510 is resistant to latch-up, inserting a 1510 into or removing it from a powered socket may cause damage.

SOLDERING RECOMMENDATIONS

RoHS Compliance: The model 1510 does not contain elemental lead and is RoHS compliant.

Pre-Tinning of Accelerometer Leads is Recommended: To prevent gold migration embrittlement of the solder joints, it is best to pre-tin the accelerometer leads.

LCC Solder Contact Plating Information: The plating composition and thickness for the solder pads and castellations on the "L" suffix (LCC) package are 60 to 225 micro-inches thick of gold (Au) over 80 to 350 micro-inches thick of nickel (Ni) over a minimum of 5 micro-inches thick of moly-manganese or tungsten refractory material. The J-Lead package top layer is 100 to 225 microinches thick of 99.7% gold (Au) over 80 to 350 microinches thick of electroplated nickel (Ni).



DIM	Inch	mm
A	.230	5.84
B	.430	10.92
C	.100	2.54
D	.033	0.84
E	.050	1.27
F	.013	0.33
G	.120	3.05

Do not use ultrasonic cleaners.

Ultrasonic cleaning will void the warranty and may break internal wire bonds.

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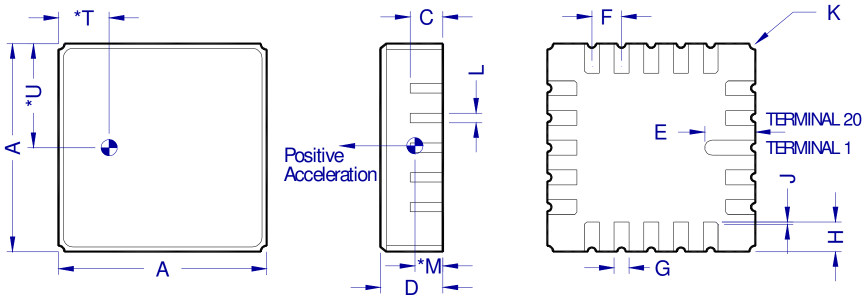
PACKAGE DIMENSIONS

1. *Dimensions "M," "T," and "U" locate sensing element's center of mass.
2. Lid is electrically tied to terminal 19 (GND).
3. Controlling dimension: Inch.
4. Terminals are plated with 60 microinches min gold over 80 microinches min nickel. This plating specification does not apply to the Pin-1 identifier mark on the bottom of the J-lead package version.
5. Package: 90% min alumina (black), lid: solder sealed kovar.

"L" SUFFIX PACKAGE (20 PIN LEADLESS CERAMIC CHIP CARRIER)



Dim	Inches		Millimeters	
	Min	Max	Min	Max
A	0.342	0.358	8.69	9.09
B	0.346	0.378	8.79	9.60
C	0.055 TYP		1.40 TYP	
D	0.095	0.115	2.41	2.92
E	0.085 TYP		2.16 TYP	
F	0.050 BSC		1.27 BSC	
G	0.025 TYP		0.64 TYP	
H	0.050 TYP		1.27 TYP	
J	0.004 x 45°		0.10 x 45°	
K	0.010 R TYP		0.25 R TYP	
L	0.016 TYP		0.41 TYP	
* M	0.048 TYP		1.23 TYP	
N	0.050	0.070	1.27	1.78
P	0.017 TYP		0.43 TYP	
R	0.023 R TYP		0.58 R TYP	
* T	0.085 TYP		2.16 TYP	
* U	0.175 TYP		4.45 TYP	