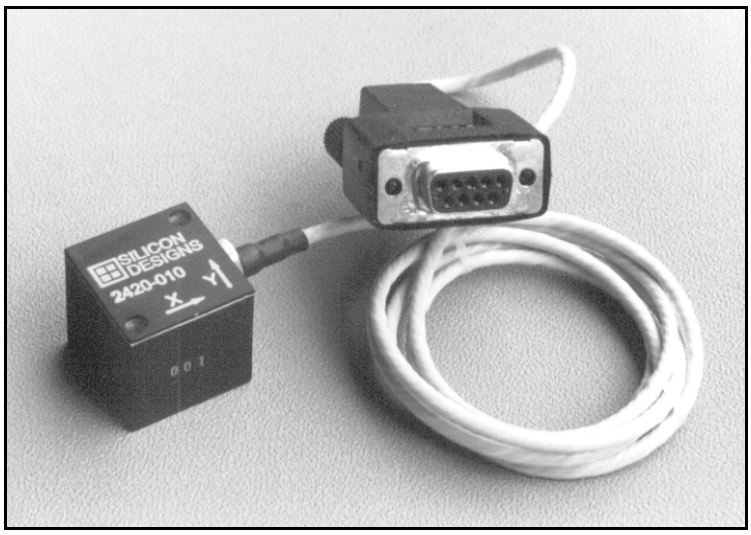
SILICON DESIGNS, INC

Model 2420

TRIAXIAL DIGITAL ACCELEROMETER MODULE

- 3 Axis Acceleration Sensing
- Capacitive Micromachined
- Nitrogen Damped
- Use with model 3320 G-LOGGER™ or Interface to your Microprocessor
- Digital Pulse Density Outputs
- Fully Calibrated
- Low Power Consumption
- -55 to +125°C Operation
- +5 V DC Power
- Serialized for Traceability
- Good EMI Resistance
- Responds to DC & AC Acceleration
- TTL / CMOS Compatible
- Non Standard Ranges Available
- Rugged Anodized Aluminum Module
- D-Sub, 9-Pin (4 signal+2 Power) Connection



DESCRIPTION

The Model 2420 triaxial accelerometer module is meant to be used with the model 3320 ***G-LOGGER***™ Acceleration Acquisition System. The 2420 contains three orthogonally mounted model 1010 accelerometers which feature a micromachined capacitive sense element, a custom integrated circuit sense amplifier and sigma-delta A/D converter. It provides a TTL/CMOS compatible output signal for measuring accelerations in commercial/industrial environments and is tailored for zero to medium frequency instrumentation applications. The anodized aluminum case is epoxy sealed and is easily mounted via two #8 (or M4) screws. It is relatively insensitive to temperature changes and gradients. An optional calibration sheet (2420-CAL) and periodic calibration checking are also available.

ORDERING INFORMATION

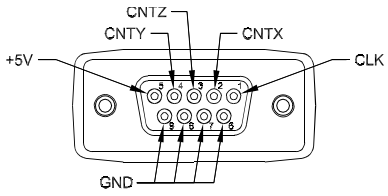
Full Scale Acceleration	Model Number
± 2 g	2420-002
± 5 g	2420-005
± 10 g	2420-010
± 25 g	2420-025
± 50 g	2420-050
± 100 g	2420-100
±200 g	2420-200

OPERATION

The Model 2420 produces three digital pulse train outputs in which the density of pulses (number of pulses per second) is proportional to applied acceleration. It operates from a single +5 volt power supply and a 100kHz to 1MHz, TTL/CMOS compatible, clock. Each of the three outputs are ratiometric to the clock frequency and independent of the power supply voltage. The "Z" axis is perpendicular to the bottom of the package, with positive acceleration defined as a force pushing on the bottom of the package. The "X" and "Y" axis directions are marked on the cover with positive acceleration defined as acceleration in the direction of the axis arrow. External digital line drivers can be used to drive long cables or when used in an electrically noisy environment.

SIGNALS

+5V:	(pin 5)	DC Power	(reddish brown wire)
GND:	(pins 6-9)	Ground	(black wire)
CLK:	(pin 1)	Input reference clock; 100Khz-1MHz	(white wire)
CNTX:	(pin 2)	X-Axis count output	(green wire)
CNTY:	(pin 4)	Y-Axis count output	(light brown wire)
CNTZ:	(pin 3)	Z-Axis count output	(light blue wire)



D-Subminiature Connector (actual size)

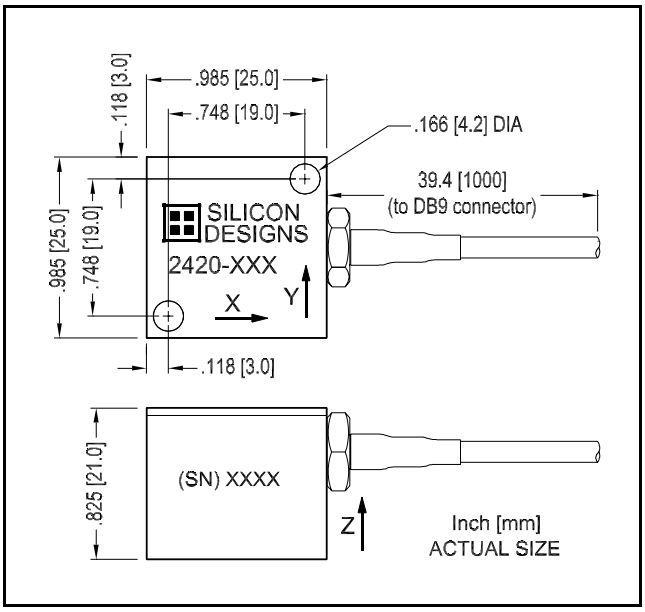
Model 2420 *Triaxial Digital Accelerometer Module*

*ABSOLUTE MAXIMUM RATINGS **

Operating Temperature (Case & Cable) . . . -55 to +125°C
Operating Temperature (Connector) . . . . . -55 to +105°C
Storage Temperature . . . . . -55 to +105°C
Acceleration Over-range . . . . . 2000g for 0.1 ms
Voltage on V_{DD} to GND . . . . . -0.5V to 6.5V
Voltage on Any Pin to GND [1] . . . . . -0.5V to V_{DD}+0.5V
Power Dissipation . . . . . 100 mW

**** NOTICE:** Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are 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.*

ESD CONSIDERATIONS: The model 2420 triaxial accelerometer is a CMOS device subject to damage by large electrostatic discharges. Diode protection is provided on the inputs and outputs but care should be exercised during handling of the connector or cable wire ends (without connector). Individuals and tools should be grounded before coming in contact with the connector pins or cable wire ends (without connector).



PERFORMANCE - By Model: V_{DD}=5.0VDC, T_C=25°C.								
MODEL NUMBER	**2420-002**	**2420-005**	**2420-010**	**2420-025**	**2420-050**	**2420-100**	**2420-200**	**Units**
Input Range	±2	±5	±10	±25	±50	±100	±200	g
Frequency Response (Nominal, 3 dB)	0 - 400	0 - 600	0 - 1000	0 - 1400	0 - 1600	0 - 1800	0 - 2000	Hz
Sensitivity (F_{CLK}=250kHz)	62.5	25.0	12.5	5.00	2.50	1.25	0.625	kHz/g
Maximum Mechanical Shock (0.1 ms)	2000							g

PERFORMANCE - All Models: Unless otherwise specified, V_{DD}=5.0VDC, F_{CLK}=250kHz, T_C=25°C.					
PARAMETER		**Min**	**Typ**	**Max**	**Units**
Cross Axis Sensitivity			2	3	%
Bias Calibration Error [2]	-002		2	4	% of F_{CLK} (span)
	-005 thru -200		1	2	
Bias Temperature Shift (T_C=-55 to +125°C) [2]	-002		150	400	(ppm of F_{CLK})/°C
	-005 thru -200		100	300	
Scale Factor Calibration Error [2, 3]			1	2	%
Scale Factor Temperature Shift (T_C=-55 to +125°C) [2]			+300		ppm/°C
Non-Linearity (-90% to +90% of Full Scale) [3]	-002 thru -100		0.5	1.0	% of span
	-200		0.7	1.5	
Power Supply Rejection Ratio		40			dB
Operating Voltage		4.5	5.0	5.5	V
Operating Current [2]			6.0	9.0	mA
Clock Input Voltage Range (with respect to GND)		-0.5		V_{DD}+0.5	V
Mass (not including cable)			21		grams
Cable Mass			15		grams/meter

Note 1: Voltages on the **CLK** & **CNT** signal wires may exceed 0.5 volt above or below the supply voltage provided the current is limited to 1 mA.
Note 2: Tighter tolerances available on special order.
Note 3: 100g and greater versions are tested from -65g to +65g.

ALTERNATE OUTPUT VERSION AVAILABLE: A custom version may be ordered which provides the **DIR** (direction) output instead of the **CNT** (count) output. For a description of the **DIR** signal, see the model 1010 data sheet.

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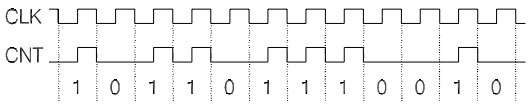
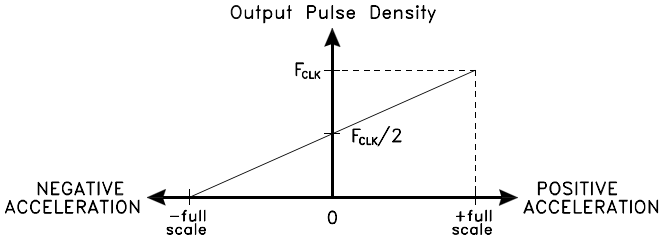
SIGNAL DESCRIPTIONS

CLK (input): Reference clock input. This hysteresis threshold input must be driven by a 50% duty cycle square wave signal. Factory Calibration is performed at 250 kHz but the 2420 will operate at frequencies as low as 100 kHz or as high as 1 MHz.

CNT (output): Pin 10. Count output. A return-to-zero type digital pulse stream whose pulse width is equal to the input CLK logic high time. The CNT pulse rate increases with positive acceleration. The device experiences positive (+1g) acceleration with its lid facing up in the earth's gravitational field. This signal is meant to drive an up-counter directly.





Pulses from the **CNT** output are meant to be accumulated in a hardware counter. Each pulse accumulation or sample, reflects the average acceleration (change in velocity) over that interval. The sample period or "gate time" over which these pulses are accumulated determines both the bandwidth and quantization of the measurement.

$$\text{Quantization (g's)} = \frac{g_{SPAN} \bullet f_{SR}}{f_{CLK}}$$

$$f_{CNT} = f_{CLK}\left(\frac{1}{2} + \frac{g_{FORCE}}{g_{SPAN}}\right)$$

$$g_{FORCE} = g_{SPAN}\left(\frac{f_{CNT}}{f_{CLK}} - \frac{1}{2}\right)$$

Where:

g_{SPAN} = 2 * (full scale acceleration in g's)

f_{SR} = CNT sample rate in Hertz

f_{CLK} = accelerometer clock rate in Hertz

f_{CNT} = CNT pulse rate in pulses / sec

g_{FORCE} = acceleration in gravity units

1 g = 9.807 m / s^2 or 32.175ft / s^2

The first equation above shows that as the sample rate is reduced (i.e. a longer sample period), the quantization becomes finer but bandwidth is reduced. Conversely, as the sample rate is increased, quantization becomes coarser but the bandwidth of the measurement is increased. The second and third equations show how the **CNT** pulse frequency equates to the applied g-force. When using a frequency counter to monitor the **CNT** output pulse rate, a counter with a DC coupled input must be used. The **CNT** output is a return-to-zero signal whose duty cycle varies from zero to fifty percent, from minus full scale to positive full scale acceleration. A frequency counter with an AC coupled input will provide an erroneous reading as the duty cycle varies appreciably from fifty percent.

CABLE LENGTH CONSIDERATIONS

Cable lengths of up to 45 meters (150 feet) can be added to the model 2420's standard 1 meter cable when it is being used with a Model 3320 **G-LOGGER**$_{TM}$. The extension cable must however, be a longer version of the **G-LOGGER**$_{TM}$ 9 conductor flat cable instead of the 2420's round cable to reduce crosstalk between the CNT and CLK signals. 15 meter (50 foot) cable lengths of DB9 male to DB9 female flat extension cable are available on special order.

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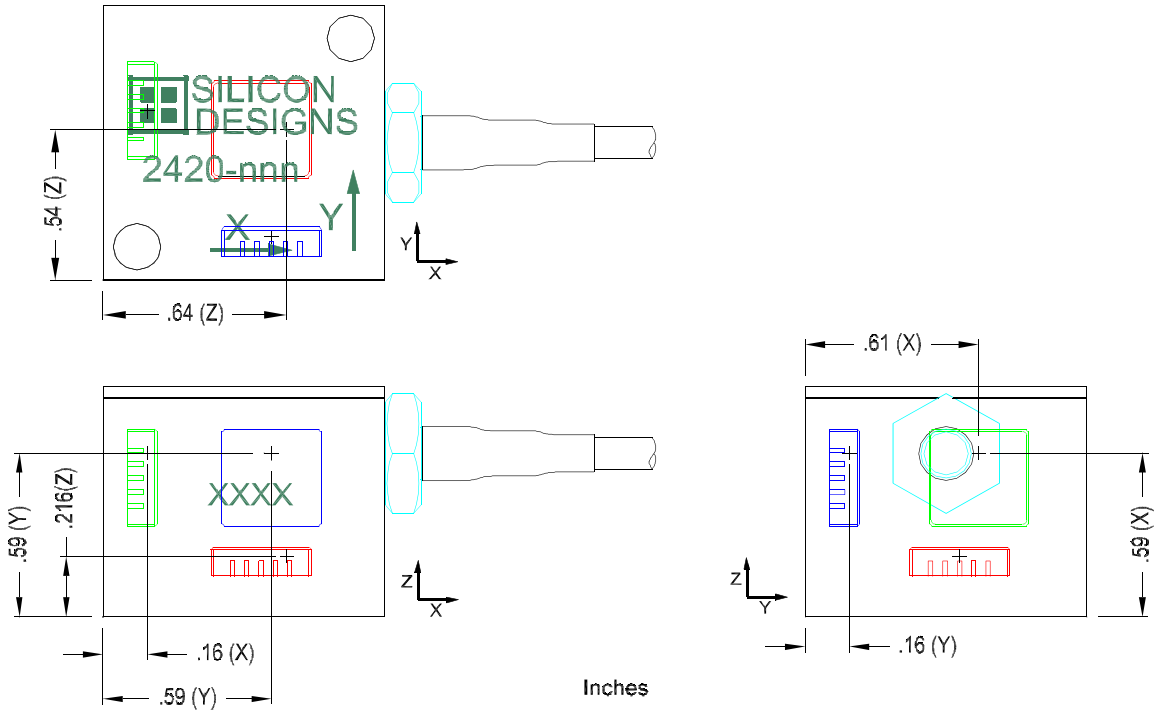
SENSOR LOCATIONS



Inches