



# **Piezo Film Sensors**

## **Technical Manual**

### **Internet Version**

### **Part 11 of 18**

#### **Accelerometers**

#### **Table 6. Accelerometer Family**

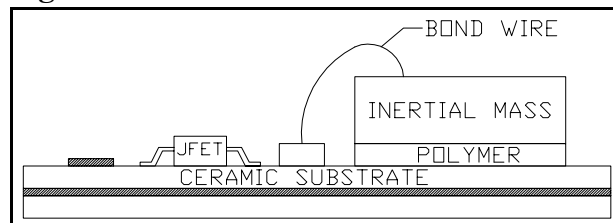
#### **Table 7. Accelerometer Applications**

## ACCELEROMETERS

A logical outgrowth of the many vibration sensor applications of MSI's piezoelectric technology are accelerometers. These accelerometer designs are based on more traditional piezoelectric ceramic, as well as piezoelectric polymer materials. The choice of base materials allows the product to be tailored for specific applications. Table 6 lists the key specifications for the MSI Accelerometer product family.

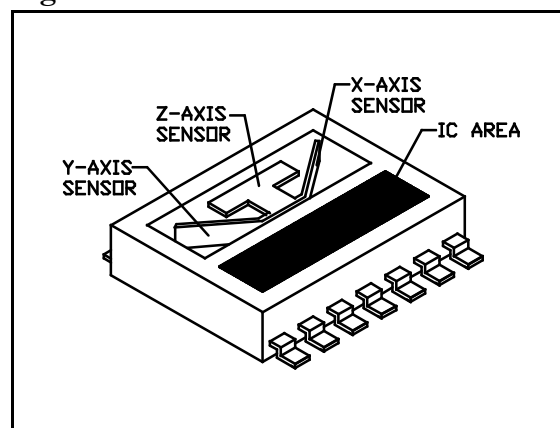
Like more conventional sensors, these accelerometers are configured as either compression-design type or beam-design type. Compression-design accelerometers typically have higher resonant frequencies providing wide useful frequency ranges. Consequently, they also tend to have lower sensitivities. An internal view of MSI's ACH-01-XX compression-design accelerometer is shown in Figure 59.

Figure 59. ACH-01-XX internal view



Beam-design accelerometers, on the other hand, tend to have lower resonant frequencies and useful frequency ranges but higher sensitivities. Beam-design accelerometers also have another very interesting feature: They can be oriented to sense acceleration in multiple-axes with one monolithic sensing element using MSI's patented "Origami" beam technology ("Origami" is the Japanese word for the art of paper folding). An internal view of the ACH-04-08-05 beam-design accelerometer, with its origami sensing element, is shown in Figure 60.

Figure 60. ACH-04-08-05 internal view



To reduce system costs as well as simplify use, all of MSI's accelerometers include some type of integral electronic sensor interface. The ACH-01 family of accelerometers and the ACH-04-08-05 multiple-axis accelerometer both use simple JFET impedance buffers. With these sensors, JFET biasing and signal processing is implemented external to the device. The rest of the ACH-04-08 multiple-axis accelerometer family uses custom ASIC's (Application Specific Integrated Circuit) to provide impedance matching, gain, and signal processing. The system gain, output type (analog or digital), and output axis can be programmed (via on-chip EEPROM) to allow the sensors to be easily configured for a specific application. A SLEEP mode, to minimize power requirements, is also included.

The ACH-01 family of products is typically used in applications which require broad frequency capability, high sensitivity, low noise, and low cost. Such applications include: speaker feedback and control systems, automotive anti-theft systems, acoustic pick-ups, machine-health and pump monitoring systems, and medical body motion monitoring.

The ACH-04-08 product family, because of the products wide capabilities, is used in a very broad range of applications such as computer hard-disk-drive shock sensing, speaker feedback and control systems, appliance fault monitoring, virtual reality systems, automotive systems, medical body motion monitoring, shipment damage and material-handling monitoring systems, GPS systems, vibration switches and earthquake shut-off switches. OEM applications that require acceleration or vibration measurements in more than one axis are perfect for the ACH-04-08.

MSI is constantly developing and upgrading its accelerometer product line. Please contact MSI for further details on these products or on customizing one of our other products.

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**Table 1 Accelerometer Family**

Production Qualified Accelerometers					
		ACH-01-XX	ACH-04-08-01	ACH-04-08-05 / ACH-04-08-05	
Features	Frequency Range	Wide	Basic	Basic	Frequency Operation
	Dynamic Range	Wide	Programmable	Programmable	Simultaneous
	Sensitivity	High	Low	Low	Outputs
	Noise	Low	High	High	
Sensitive Axes	X-Axis	---	---	X	
	Y-Axis	---	X	X	X
	Z-Axis	X	X	---	X
	Angular	---	X (only)	---	
Sensitivity		10 mV/g	10 mV/g 10 mV/rad/s <sup>2</sup>	10 mV/g 10 mV/rad/s <sup>2</sup> (08 only)	10 mV/g
Frequency Range		10 Hz - 10 kHz	10 Hz - 10 kHz		
Dynamic Range		10 (Max)	10 (Max)	10	
Resolution		10 µg/√Hz	1800 µg/√Hz	390 µg/√Hz	200 µg/√Hz
Frequency		10 Hz	10 kHz	10 kHz	
Resolution (Hz/Hz)		30	10	10	
Sensitivity		5%	25%	10%	15%
Linearity		0.1%	0.1%	1%	0.1%
Operating Temperature		-55 °C to +85 °C	-55 °C to +85 °C	-55 °C to +85 °C	-55 °C to +85 °C
Storage Temperature		-55 °C to +85 °C	-55 °C to +85 °C	-55 °C to +105 °C	-55 °C to +85 °C
Shock		100	100	100	
Supply Voltage		3V to 5V	3V to 5V	3V to 5V	
Supply Current		2A Typical	2A Typical	2A Typical	2A Typical
Weight		1 gram	1 gram	1 gram	
Size (mm)		10 x 10	10 x 10	10 x 10	
Mounting		Adhesive PCB		Adhesive PCB	Adhesive PCB

Table 7. Accelerometer Applications

Industry	Application	ACCELEROMETER PRODUCTS				
		Model 4000	Model 4001	Model 4002	Model 4003	Model 4004
Aerospace Electronics	Anti-Tamper	X	X	X	X	
	Surveillance	X				
	Analysis	X	X	X	X	
Automotive	Crashbag			Cylindrical accelerometer information		
	SABbag					
	Anti-theft	X	X	X	X	
	Seat/Ring	X	X			
Computer Peripherals	Shock Sensor			X	X	
	Mouse Sensor					X
	Vibration				X	
Household Appliances	Scale/Balance		X	X	X	
	Shower		X	X	X	
	Washing Machine	X		X		
	Vibration		X	X		
Consumer Electronics	Feedback	X			Cylindrical accelerometer information	
	Pickups	X				
	Security			X	X	X
Industrial	Monitor	X		X	X	
	Monitor	X		X	X	
Instrument Measuring Equipment	Vibration Damping		X			X
	Vibration		X	X		
	Redundancy	X		X	X	
Medical	Monitor		X	X	X	
	Pacemaker			Cylindrical accelerometer information		
Utilities	Earthquake				X	
	Monitoring	X		X	X	
Telecommunications	Systems		X	X		
	Vibration		X	X		
Transportation	Monitoring	X			X	
	Refrigerators	X			X	