FILTERED & THERMALLY STABLE ACCELEROMETERS

PCB PIEZOTRONICS
AN AMPHENOL COMPANY

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FILTERED ACCELEROMETERS

Environments with mechanical shock and with significant high frequency vibration content necessitate specialized accelerometers tailored for these demanding test conditions. Mechanical shock events can excite the high frequency resonance of the piezoelectric crystal, saturating the signal and leading to clipping in the ICP® signal conditioning amplifier. To help alleviate this event, PCB offers low pass filtering in select accelerometers which suppresses the effects of any crystal resonance before it can enter and over range the ICP® signal conditioning amplifier. Another purpose for filtering is to extend the usable high frequency range of the sensor by minimizing crystal resonance, resulting in an extended flat frequency response.

APPLICATIONS WHERE FILTERING MAY BE NEEDED:

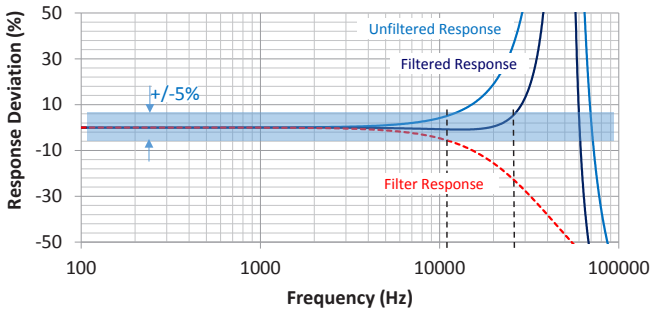
- Powertrain Development
- Climatic Chamber Testing
- Powertrain NVH
- Cylinder head
- Vehicle Systems NVH
  - Under-hood
  - Exhaust Testing
  - Brake Testing
- Component and Systems Performance
- Vehicle Road Load & durability
- Racing
- Flight Testing
- Aerospace applications - High-frequency airframe vibration monitoring
- General purpose applications with potential for signal saturation

FILTER CHARACTERISTICS

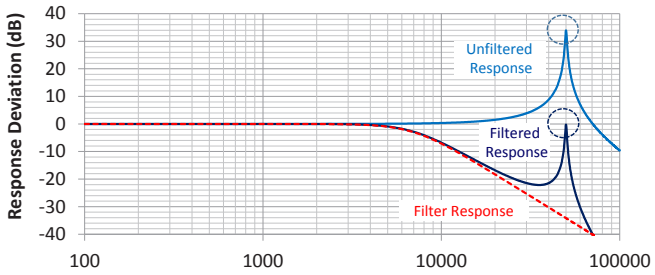
PCB integrates a low pass filter between the sensing crystal and the ICP® amplifier on a select number of accelerometers, avoiding amplifier saturation and extending useful frequency response. These filters are uniquely specified based on the intended application environment and the design of the sensor. Two values are represented on PCB's product specification sheet that define this filter:

- **Electric Filter Roll Off** – the severity of the filter
  - 1st Order (Single Pole or 6 dB / Octave) commonly used to extend useable frequency range
  - 2nd Order (Two Pole or 12 dB / Octave) commonly used to avoid amplifier saturation
- **Electric Filter Corner Frequency** – the frequency at which the signal of interest is attenuated 3 dB

Filtering to Extend Useable Frequency Range



Filtering to Minimize Amplifier Saturation



SPECIFICATIONS

								
Model Number	**356A67**		**356A63**		**356A66**		**356A61**	
Performance	**English**	**SI**	**English**	**SI**	**English**	**SI**	**English**	**SI**
Sensitivity (±10%)	10 mV/g	1.02 mV/(m/s²)	10 mV/g (±15%)	1.02 mV/(m/s²) (±15%)	10 mV/g	1.02 mV/(m/s²)	10 mV/g	1.02 mV/(m/s²)
Measurement Range	±500 g pk	±4900 m/s² pk	±500 g pk	±4905 m/s² pk	±500 g pk	±4900 m/s² pk	±500 g pk	±4905 m/s² pk
Frequency Range (±5%)	0.5 to 3000 Hz		2 to 4000 Hz		2 to 4000 Hz		2 to 4000 Hz	
Temperature Range (Operating)	-65 to 250 °F	-54 to 121 °C	-65 to 250 °F	-54 to 121 °C	-65 to 250 °F	-54 to 121 °C	-65 to 325 °F	-54 to 163 °C
Resonant Frequency	≥ 25 kHz		≥ 55 kHz		≥ 35 kHz		≥ 55 kHz	
Filter Type	Single pole (LP)		Single pole (LP)		Single pole (LP)		Single pole (LP)	
Electrical Filter Corner Frequency	≥ 10 kHz		≥ 15 kHz		≥ 35 kHz		≥ 15 kHz	
Broadband Resolution	0.0005 g rms	0.005 m/s² rms	0.008 g rms	0.08 m/s² rms	0.002 g rms	0.02 m/s² rms	0.008 g rms	0.08 m/s² rms
Non-Linearity	≤ 1 %		≤ 1 %		≤ 1 %		≤ 1 %	
Transverse Sensitivity	≤ 5 %		≤ 5 %		≤ 5 %		≤ 5 %	
Physical								
Weight	0.37 oz	10.5 gm	0.19 oz	5.3 gm	0.32 oz	9.0 gm	0.14 oz	4.0 gm
Size	0.55 in Cube	14 mm Cube	0.40 in Cube	10.2 mm Cube	0.55 in Cube	14 mm Cube	0.4 in Cube	10.2 mm Cube
Electrical Connector	1/4-28 4-Pin		1/4-28 4-Pin		1/4-28 4-Pin		Integral cable terminating to 1/4-28 4-Pin Jack	
Mounting	10-32 Female		5-40 Female		10-32 Female		5-40 Female	
Included Cable	No		No		No		Yes, 034G05	

SPECIFICATIONS

								
Model Number	**350B50**		**352A72**		**353B77**		**320C20**	
Performance	**English**	**SI**	**English**	**SI**	**English**	**SI**	**English**	**SI**
Sensitivity	0.5 mV/g (±30%)	0.05 mV/(m/s²) (±30%)	10 mV/g (±15%)	1.02 mV/(m/s²) (±15%)	2.0 mV/g (±20%)	0.204 mV/(m/s²) (±20%)	10 mV/g (±10%)	1.02 mV/(m/s²) (±10%)
Measurement Range	±10000 g pk	±98000 m/s² pk	±500 g pk	±4900 m/s² pk	±2500 g pk	±24525 m/s² pk	±500 g pk	±4900 m/s² pk
Frequency Range	3 to 10000 Hz (±1%)		0.5 to 4500 Hz (±5%)		0.7 to 20000 Hz (±10%)		1.5 to 10000 Hz (±10%)	
Temperature Range (Operating)	-65 to 250 °F	-54 to 121 °C	-65 to 200 °F	-54 to 93 °C	-65 to 250 °F	-54 to 121 °C	-100 to 325 °F	-73 to 163 °C
Resonant Frequency	≥ 60 kHz		≥ 65 kHz		≥ 70 kHz		≥ 60 kHz	
Filter Type	Two pole (LP)		Single pole (LP)		Single pole (LP)		Single pole (LP)	
Electrical Filter Corner Frequency	≥ 20 kHz		≥ 15 kHz		≥ 30 kHz		≥ 13 kHz	
Broadband Resolution	0.03 g rms	0.29 m/s² rms	0.003 g rms	0.03 m/s² rms	0.05 g rms	0.5 m/s² rms	0.006 g rms	0.06 m/s² rms
Non-Linearity	≤ 2 %		≤ 1 %		≤ 1 %		≤ 1 %	
Transverse Sensitivity	≤ 5 %		≤ 5 %		≤ 5 %		≤ 5 %	
Physical								
Weight	0.3 oz	8.0 gm	0.023 oz	0.64 gm	0.06 oz	1.7 gm	0.23 oz	6.5 gm
Size	0.32 in x 0.72 in x 0.72 in	8.2 mm x 18.3 mm x 18.3 mm	0.41 in x 0.25 in x 0.14 in	10.4 mm x 6.4 mm x 3.6 mm	0.59 in	15.0 mm	0.87 in	22.1 mm
Electrical Connector	Integral cable		Solder pins with attached cable		Solder pins		10-32 Coaxial jack	
Mounting	Through hole		Adhesive		5-40 Male		10-32 Male	
Included Cable	No		No		No		No	

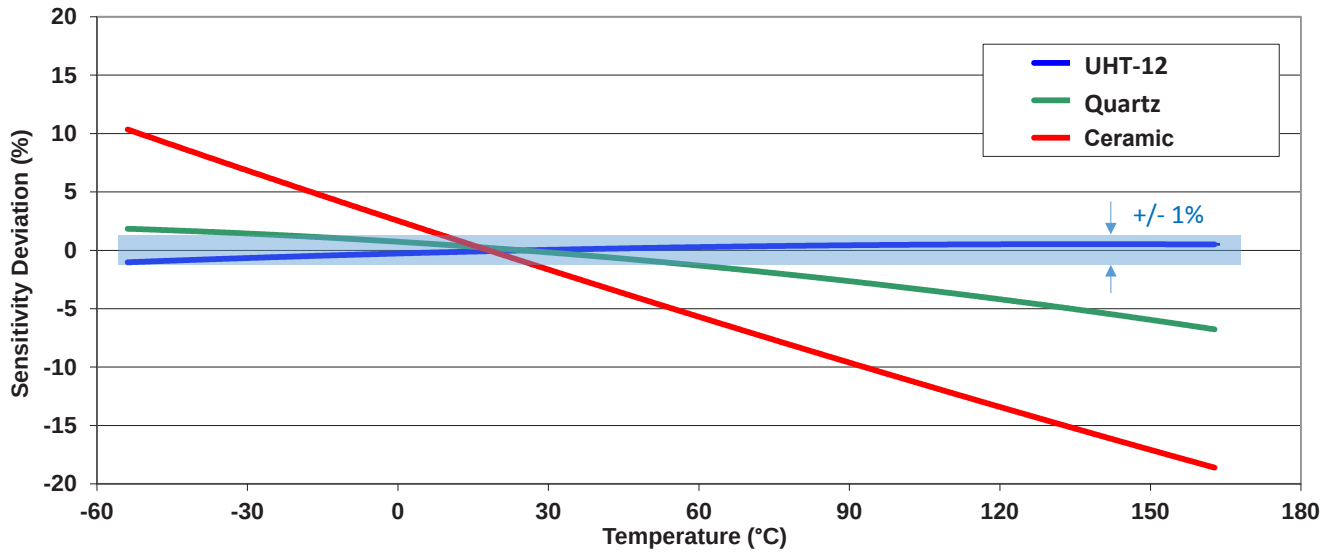
THERMALLY STABLE AND FILTERED ACCELEROMETERS

In 2007, an engine manufacturer approached PCB to develop a new type of ICP® filtered accelerometer with a stable sensitivity over a wide temperature range. Soon after PCB developed a specialized ICP® filtered accelerometer using UHT-12™ crystal technology with extremely stable sensitivity over a wide temperature range, better than quartz or ceramic. In addition to improved accuracy over temperature this new line of accelerometers exhibit low noise, low base strain sensitivity (shear mode construction), and a wide operating frequency range. PCB has expanded these products into a Low Temperature Coefficient (LTC) product line to cover a wide variety of demanding applications. With filtering, temperature coefficients down to 0.005% / °F (0.009% / °C), and operating temperatures to 356 °F (180 °C) this new line of titanium and hermetically sealed accelerometers are ideal for powertrain testing, flight testing, and any other application requiring robust sensing in challenging environments. The LTC series of accelerometers are available in a range sensitivities and mounting configurations (stud, adhesive and thru-hole).

PCB series of LTC Accelerometers offer the following:

- Sensitivity that remains consistent over a wide temperature change
- Single pole filtering
- Titanium housing
- Hermetic sealing
- Wide operating frequency range
- Shear mode configuration, isolated from base strain and transverse measurement errors
- Single axis and triaxial configurations
- Ranges from 50 g to 5000 g
- ICP® technology for ease of use

Typical ICP® Sensor Sensitivity Deviation vs. Temperature
UHT-12 vs. Quartz vs. Ceramic Sensing Elements



Temperature Coefficient of Sensitivity as defined in PCB product specification sheets are calculated by determining the slope of the tangent line at any given point on the Sensitivity Deviation vs. Temperature plot (above). In this manner the Temperature Coefficient of Sensitivity is always equal to or lower than the specification at any given temperature.

PCB offers a portfolio of thermally stable and filtered ICP® accelerometers, both single and triaxial configurations with operating temperatures up to 356 °F (180 °C).

SPECIFICATIONS						
						
Model Number	**320C52**		**320C53**		**339B32**	
Performance	**English**	**SI**	**English**	**SI**	**English**	**SI**
Sensitivity (±10%)	10 mV/g	1.02 mV/(m/s²)	1 mV/g (±20%)	0.102 mV/(m/s²) (±20%)	10 mV/g	1.02 mV/(m/s²)
Measurement Range	±500 g pk	±4905 m/s² pk	±5000 g pk	±49050 m/s² pk	±500 g pk	±4905 m/s² pk
Frequency Range (±5%)	1 to 10000 Hz		1 to 5000 Hz		2 to 10000 Hz	
Temperature Range (Operating)	-100 to 325 °F	-73 to 163 °C	-100 to 325 °F	-73 to 163 °C	-65 to 325 °F	-54 to 163 °C
Temperature Coefficient of Sensitivity	±0.005 %/°F	±0.009 %/°C	±0.005 %/°F	±0.009 %/°C	≤ 0.011 %/°F	≤ 0.020 %/°C
Resonant Frequency	≥ 50 kHz		≥ 50 kHz		≥ 45 kHz	
Filter Type	Single pole (LP)		Single pole (LP)		Single pole (LP)	
Electrical Filter Corner Frequency	> 35 kHz		> 20 kHz		> 14 kHz	
Broadband Resolution	0.004 g rms	0.039 m/s² rms	0.04 g rms	0.39 m/s² rms	0.003 g rms	0.029 m/s² rms
Non-Linearity	≤ 1 %		≤ 1 %		≤ 0.5 %	
Transverse Sensitivity	≤ 5 %		≤ 5 %		≤ 5 %	
TEDS Compliant (Per IEEE 1451.4)	No		No		No	
Physical						
Weight	0.065 oz	1.85 gm	0.065 oz	1.85 gm	0.13 oz	3.6 gm
Size	0.23 in x 0.65 in x 0.38 in	5.8 mm x 16.4 mm x 9.6 mm	0.23 in x 0.65 in x 0.38 in	5.8 mm x 16.4 mm x 9.6 mm	0.28 in x 0.47 in x 0.47 in	7.0 mm x 12.0 mm x 12.0 mm
Electrical Connector	5-44 Coaxial		5-44 Coaxial		8-36 4-Pin	
Mounting	Through Hole		Through Hole		Adhesive	
Included Cable	No		No		Model 339B32 – Yes (034K10) Model 339B32/NC – No	

SPECIFICATIONS

						
Model Number	**339A30 & 339A30/NC**		**339A31 & 339A31/NC**		**339B31 & 339B31/NC**	
Performance	**English**	**SI**	**English**	**SI**	**English**	**SI**
Sensitivity (±10%)	10 mV/g	1.02 mV/(m/s²)	10 mV/g	1.02 mV/(m/s²)	10 mV/g	1.02 mV/(m/s²)
Measurement Range	±500 g pk	±4905 m/s² pk	±500 g pk	±4905 m/s² pk	±500 g pk	±4905 m/s² pk
Frequency Range (±5%)	2 to 8000 Hz		2 to 6000 Hz		2 to 8000 Hz	
Temperature Range (Operating)	-65 to 325 °F	-54 to 163 °C	-65 to 325 °F	-54 to 163 °C	-65 to 356 °F	-54 to 180 °C
Temperature Coefficient of Sensitivity	≤ 0.011 %/°F	≤ 0.020 %/°C	≤ 0.011 %/°F	≤ 0.020 %/°C	≤ 0.012 %/°F	≤ 0.022 %/°C
Resonant Frequency	≥ 25 kHz		≥ 25 kHz		≥ 50 kHz	
Filter Type (single pole)	Single pole (LP)		Single pole (LP)		Single Pole (LP)	
Electrical Filter Corner Frequency	> 14 kHz		> 13 kHz		> 14 kHz	
Broadband Resolution	0.008 g rms	0.078 m/s² rms	0.008 g rms	0.078 m/s² rms	0.008 g rms	0.078 m/s² rms
Non-Linearity	≤ 0.5 %		≤ 0.5 %		≤ 0.5 %	
Transverse Sensitivity	≤ 5 %		≤ 5 %		≤ 5 %	
TEDS Compliant (Per IEEE 1451.4)	No		No		No	
Physical						
Weight	0.14 oz	4 gm	0.14 oz	5.5 gm	0.15 oz	4.2 gm
Size	0.4 in cube	10.2 mm cube	0.55 in x 0.4 in x 0.4 in	14 mm x 10.2 mm x 10.2 mm	0.4 in cube	10.2 mm cube
Electrical Connector	8-36 4-Pin		8-36 4-Pin		1/4-28 4-Pin	
Mounting	Adhesive		5-40 Female		10-32 Female	
Included Cable	Model 339A30 – Yes (034K10) Model 339A30/NC – No		Model 339A31 – Yes (034K10) Model 339A31/NC – No		Model 339B31 – Yes (010S10) Model 339B31/NC – No	

SPECIFICATIONS

				
Model Number	**TLD339A36**		**TLD339A37**	
Performance	**English**	**SI**	**English**	**SI**
Sensitivity (±10%)	10 mV/g	1.0 mV/(m/s²)	100 mV/g	10.2 mV/(m/s²)
Measurement Range	±500 g pk	±4900 m/s² pk	±50 g pk	± 490.5 m/s² pk
Frequency Range (±5%)	2 to 5000 Hz		0.3 to 4000 Hz	
Temperature Range (Operating)	-65 to 325 °F	-54 to 163 °C	-65 to 356 °F	-54 to 180 °C
Temperature Coefficient of Sensitivity	≤ -0.03 %/°F	≤ -0.06 %/°C	≤ 0.011 %/°F	≤ 0.02 %/°C
Resonant Frequency	≥ 35 kHz		≥ 35 kHz	
Filter Type (single pole)	Single pole (LP)		Single pole (LP)	
Electrical Filter Corner Frequency	> 13 kHz		≥ 15 kHz	
Broadband Resolution	0.003 g rms	0.029 m/s² rms	0.002 g rms	0.019 m/s² rms
Non-Linearity	≤ 1 %		≤ 1 %	
Transverse Sensitivity	≤ 5 %		≤ 5 %	
TEDS Compliant (Per IEEE 1451.4)	Yes		Yes	
Physical				
Weight	0.37 oz	10.5 gm	0.37 oz	10.5 gm
Size	0.55 in cube	14.0 mm cube	0.55 in cube	14.0 mm cube
Electrical Connector	1/4-28 4-Pin		1/4-28 4-Pin	
Mounting	5-40 Female		5-40 Female	
Included Cable	No		No	

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