HIGH TEMPERATURE ACCELEROMETERS FOR GAS TURBINES & HELICOPTERS
VIBRATION TESTING IN SEVERE THERMAL ENVIRONMENTS

Vibration testing of aircraft gas turbine engines, industrial turbines, rocket propulsion systems, and exhaust systems requires accelerometers that are designed to withstand very high temperature environments. PCB’s accelerometers for testing and monitoring of turbomachinery are manufactured from tough low mass materials such as titanium and Inconel, and are hermetically sealed.

This brochure contains a sample of our stock and standard high temperature instrumentation, including those that feature our UHT-12™ high temperature crystal for operation to 1400 °F (760 °C). We also offer sensors that are matched precisely to the requirements of engine manufacturers to ensure successful measurement.

VIBRATION TESTING IN SEVERE THERMAL ENVIRONMENTS

- Temperature Range: -100 to +1400 °F (-73 to +760 °C)
- ICP® & Charge Output
- Case and Ground Isolation
- RTCA/DO-160 & MIL STD-810 Qualification Available
- UHT-12™ Crystal

APPLICATIONS

- Test & Monitor Vibration of Gas Turbine Engines
- Turbocharger and Exhaust System Testing
- Engine Balancing
WHAT IS UHT-12™?

PCB® offers specially designed and tested ICP® accelerometers for conducting vibration and shock measurements under demanding environmental conditions of up to 356 °F (180 °C). These sensors combine proven quartz and ceramic shear sensing technology with specialized, built-in microelectronic signal conditioning circuitry to achieve dependable operation in extreme temperatures and through repetitive temperature cycling.

Charge output accelerometers from PCB® use piezo-ceramic sensing elements that output an electrostatic charge signal proportional to the applied acceleration. These sensors can operate at extremely high temperatures (up to 1400 °F/ 760 °C) because they do not contain the built-in signal conditioning electronics that limit the temperature range of ICP® accelerometers.

UHT-12™ technology reduces the effects of temperature variation. Pyroelectricity phenomenon may occur during large temperature fluctuations, generating “spikes” and disrupting behavior of the accelerometer and the test results. Accelerometers made with UHT-12™ technology have an improved data quality.

APPLICATIONS
Vibration testing of automotive exhaust, turbocharger and engine systems requires accelerometers that are designed to withstand very high temperatures.

HIGHLIGHTS
Absence of pyroelectric noise spikes up to 1400 °F (760 °C)
Sensitivity that remains more consistent over a wide temperature change
Shear mode crystals isolated from base strain & transverse measurement errors
Proprietary crystal technology comes sealed in a hermetic package and has proven reliable performance in hundreds of automotive powertrain NVH installations for research and monitoring

PCB® ACCELEROMETERS ARE AVAILABLE TO 1400 °F (760 °C)
ICP® accelerometers available in single and triaxial versions to 356°F/180°C
Charge output accelerometers for testing or continuous monitoring cover temperature ranges to 1400 °F (760 °C)
**PCB® High Temperature Accelerometers are Available to 1400 °F (760 °C)**

ICP® Accelerometers available in single and triaxial versions to 325 °F (163 °C)

Charge output accelerometers for testing or continuous monitoring cover temperature ranges to 1400 °F (760 °C)
**FAN AREA AND COMPONENT TESTING**

**HIGHLIGHTS**
- Robust titanium housings
- Measuring range up to 1000 g
- Frequency from 2 to 10k Hz
- Low weight starting at only 1 gram

**ICP® ACCELEROMETERS TO 356 °F (180 °C)**

The fan area of a turbine engine requires test accelerometers capable of withstanding not only high temperatures but also severe vibration. With small size and low mass, ICP® accelerometers below are recommended for ESS and HALT/HASS testing of engine components.

**ESS MINI QUARTZ SHEAR ICP® ACCELEROMETER**

MODEL 320C15 & 320C18

- Temperature: -100 to +325 °F (-73 to +163 °C)
- Sensitivity: 10 mV/g
- Measuring range: 500 g
- Weight: 1.7 to 2 grams

**TRIAXIAL LIGHTWEIGHT MINIATURE ICP® ACCELEROMETER**

MODEL HT356B01 & HTJ356B01

- Temperature: -65 to +356 °F (-54 to +180 °C)
- Sensitivity: 5 mV/g
- Measuring range: 1000 g
- Weight: 1 gram
- HTJ356B01 is ground isolated

**UHT-12™ ICP® TRIAXIAL ACCELEROMETER**

MODEL 339B32

- Temperature: -65 to +325 °F (-54 to +163 °C)
- Sensitivity: 10 mV/g
- Measuring range: 500 g
- Weight: 3.6 grams
- UHT-12™ sensing technology

**UHT-12™ ICP® TRIAXIAL ACCELEROMETER**

MODEL 339B31

- Sensitivity: (± 10%) 10 mV/g
- Measurement Range: ±500 g pk
- Frequency Range: (±5%) 2 - 8000 Hz
- Temperature Range: (Operating) -65 to +356 °F (-54 to +180 °C)
- Weight: 4.2 grams
COMPRESSOR AREA AND COMPONENT TESTING

CHARGE OUTPUT ACCELEROMETERS TO 900 °F (482 °C)

The compressor area of a turbine engine requires an accelerometer capable of higher temperatures. The charge accelerometers listed below are ideal for the application and feature hermetically sealed titanium housings, smaller size and high frequency range.

HIGHLIGHTS
- Robust housings, hermetically sealed
- Measuring range to 2300 g
- Frequency to 12k Hz
- Miniature models from 2 grams
MINIATURE TRIAXIAL
CHARGE OUTPUT
ACCELEROMETER
MODEL 356A70 & 356A71

- Temperature: -94 to +490 °F
  (-70 to +254 °C)
- Sensitivity: 2.7 to 10 pC/g
- Measuring range: 1500 g
- Weight: 8 grams

MINIATURE RING-STYLE
CHARGE OUTPUT
ACCELEROMETER
MODEL 357B06

- Temperature: -65 to +500 °F
  (-54 to +260 °C)
- Sensitivity: 5 pC/g
- Measuring range: 500 g
- Weight: 2.3 grams

MINIATURE RING-STYLE
CHARGE OUTPUT
ACCELEROMETER
MODEL 357B11

- Temperature: -95 to +500 °F
  (-71 to +260 °C)
- Sensitivity: 3 pC/g
- Measuring range: 2300 g
- Weight: 2 grams

CHARGE OUTPUT TRIAXIAL
ACCELEROMETER
WITH UHT-12™
MODEL EX356A73

- Temperature: -67 to +900 °F
  (-55 to +482 °C)
- Sensitivity: 3.2 pC/g
- Measuring range: ±500 g
- Weight: 150 grams

UHT-12™ HIGH TEMPERATURE
CHARGE OUTPUT
ACCELEROMETER
MODEL 357A63

- Temperature: -65 to +900 °F
  (-54 to +482 °C)
- Sensitivity: 0.53 pC/g
- Measuring range: ±5000 g
- Weight: 8.7 grams

HIGH TEMPERATURE
MINIATURE RING-STYLE
CHARGE OUTPUT
ACCELEROMETER
MODEL 357B69

- Temperature: -65 to +900 °F
  (-54 to +482 °C)
- Sensitivity: 3.5 pC/g
- Measuring range: ±500 g
- Weight: 16.0 grams
MINIATURE CHARGE OUTPUT ACCELEROMETER
ENDEVCO MODEL 7240C

Temperature: -67 to +500 °F
(−55 to +260 °C)
Sensitivity: 3 pC/g
Measuring range: 5000 g pk
Weight: 4.8 grams

MINIATURE CHARGE OUTPUT ACCELEROMETER
ENDEVCO MODEL 2220E

Temperature: -67 to +500 °F
(−55 to +260 °C)
Sensitivity: 3 pC/g
Measuring range: 5000 g pk
Weight: 3.1 grams

MINIATURE CHARGE OUTPUT ACCELEROMETER
ENDEVCO MODEL 2230E

Temperature: -67 to +500 °F
(−55 to +260 °C)
Sensitivity: 2.8 pC/g
Measuring range: 2000 g pk
Weight: 17 grams

CHARGE OUTPUT ACCELEROMETER
ENDEVCO MODEL 2221F

Temperature: -67 to +500 °F
(−55 to +260 °C)
Sensitivity: 10 pC/g
Measuring range: 2000 g pk
Weight: 11 grams

TRIAXIAL CHARGE OUTPUT ACCELEROMETER
ENDEVCO MODEL 2230EM1

Temperature: -67 to +500 °F
(−55 to +260 °C)
Sensitivity: 3 pC/g
Measuring range: 2000 g pk
Weight: 17 grams

CHARGE OUTPUT ACCELEROMETER
ENDEVCO MODEL 7221A

Temperature: -67 to +500 °F
(−55 to +260 °C)
Sensitivity: 10 pC/g
Measuring range: 2000 g pk
Weight: 0.37 grams

CHARGE OUTPUT ACCELEROMETER
ENDEVCO MODEL 7201-10

Temperature: -67 to +500 °F
(−55 to +260 °C)
Sensitivity: 10 pC/g
Measuring range: 2000 g pk
Weight: 18 grams

CHARGE OUTPUT ACCELEROMETER
ENDEVCO MODEL 7703A-50

Temperature: -67 to +550 °F
(−55 to +288 °C)
Sensitivity: 300 pC/g
Measuring range: 2000 g pk
Weight: 25 grams

CHARGE OUTPUT ACCELEROMETER
ENDEVCO MODEL 7704A-50

Temperature: -67 to +550 °F
(−55 to +288 °C)
Sensitivity: 50 pC/g
Measuring range: 2000 g pk
Weight: 0.9 grams

Model 7221A is a small, piezoelectric accelerometer designed specifically for general vibration measurement. The accelerometer offers wide bandwidth and operational temperature range, it is also hermetically sealed for high reliability. Its light weight (10.5 gm) effectively minimizes mass loading effects on small structures. This accelerometer is a self-generating device that requires no external power source for operation.

7221A features Endevco’s Piezite ® type P-8 crystal element, operating in annular shear mode, which exhibits low base strain sensitivity and excellent output stability over time. Signal ground is connected to the outer case of the unit. When used with an isolated mounting screw, it is electrically isolated from ground. The centrally located mounting bolt permits 360° cable orientation, a very desirable feature in many applications. The supplied low-noise coaxial cable is required for error-free operation.

Signal conditioner models 133, 2775B, 2771C, 6634C, Oasis 2000 (4990A-X with 428 and/or 433 cards) are recommended for use with this accelerometer.
COMBUSTOR AND EXHAUST TESTING

CHARGE OUTPUT
ACCELEROMETERS UP TO 1400 °F (760 °C)

Testing the combustor and exhaust of turbine engines requires an ultra-high temperature sensor. The confined space demands accelerometer compactness. These sensors are designed specifically for the testing and development of turbine combustors and exhaust systems and feature integral hardline cables.

HIGHLIGHTS
Compact and electrically isolated
Temperature range to 1400 °F (760 °C)
Insensitive to extreme variations in temperature with UHT-12™ element
**CHARGE OUTPUT ACCELEROMETER WITH UHT-12™**

**MODEL 357A64 & 357M168**

- Sensitivity: 1.15 pC/g
- Measurement Range: ±1000 g
- Signal Type: Single-ended
- Connector: 10-32 jack

**CHARGE OUTPUT ACCELEROMETER WITH UHT-12™**

**SERIES EX357A9X & EX357E9X**

<table>
<thead>
<tr>
<th>Model</th>
<th>Sensitive Axis</th>
<th>Sensitivity</th>
<th>Measurement Range</th>
<th>Connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>EX357A90</td>
<td>Up</td>
<td>5.0 pC/g</td>
<td>±1000 g</td>
<td>10-32 jack</td>
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<td>EX357A91</td>
<td>Right</td>
<td>2.3 pC/g</td>
<td>±1000 g</td>
<td>10-32 jack</td>
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<tr>
<td>EX357A94</td>
<td>Up</td>
<td>3.3 pC/g</td>
<td>±1000 g</td>
<td>7/16-27 2-pin (EX357A9X)</td>
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<tr>
<td>EX357A95</td>
<td>Right</td>
<td>3.3 pC/g</td>
<td>±1000 g</td>
<td>10-32 jack (EX357E9X)</td>
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</tbody>
</table>

Arrows Depict Sensitive Axis
LONG TERM VIBRATION MONITORING AND HUMS

DIFFERENTIAL ACCELEROMETERS FOR TURBINE ENGINE MONITORING

Charge mode accelerometers with high temperature differential output are ideal for monitoring of turbines and HUMS applications on helicopters.

**UHT-12™ HIGH TEMPERATURE ACCELEROMETER**

**SERIES EX600B1X**

- Temperature: -65 to 900 ºF (-54 to 482 ºC)
- Sensitivity: 10 to 100 mV/g
- Measurement Range: ±50 to 500 g
- Hazardous location approvals
- UHT-12™ sensing technology
**HIGH TEMPERATURE CHARGE OUTPUT ACCELEROMETER WITH UHT-12™**

*Model 357A100*

- Temperature: -65 to 900 °F
  (-54 to 482 °C)
- Sensitivity: 5.0 pC/g
- Measuring Range: ±200 g
- UHT-12™ sensing technology

**CHARGE OUTPUT ACCELEROMETER**

*Series 357C7X*

- Temperature: -65 to 900 °F
  (-54 to 482 °C)
- Sensitivity: 10 to 100 pC/g
- Measurement Range: 300 to 1000 g

**HIGH TEMPERATURE CHARGE OUTPUT ACCELEROMETER WITH UHT-12™**

*Model EX611A20*

- Temperature: -165 to 1200 °F
  (-109 to 650 °C)
- Sensitivity: 5.0 pC/g
- Measurement Range: ±200 g
- Featuring shear mode sensing element
- Hazardous location approvals
- UHT-12™ sensing technology

**DIFFERENTIAL CHARGE OUTPUT ACCELEROMETER**

*EnDevco Model 6222S*

- Temperature: -65 to 500 °F
  (-54 to 260 °C)
- Sensitivity: 20 pC/g
- Measuring Range: ±500 g
- Weight: 60 grams
ACCESSORIES

HIGH TEMPERATURE, SINGLE-ENDED, CHARGE OUTPUT SYSTEM CONFIGURATION

RECOMMENDED OUTPUT CABLES
CHARGE CONVERTERS

In-line ICP® charge converters serve to convert high impedance charge mode piezoelectric sensor signals into low impedance voltage signals for input into readout, recording, and analysis instruments. Powered by ICP® sensor signal conditioners, series 422 converters are placed between the sensor and signal conditioner. They can also connect directly to a DAQ system or readout device if the system includes ICP® power.

<table>
<thead>
<tr>
<th>Model</th>
<th>Sensitivity</th>
<th>Input Range</th>
<th>Low Frequency (-5%)</th>
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<tbody>
<tr>
<td>2771CM2-1</td>
<td>1 mV/pC</td>
<td>5000 pC</td>
<td>3 Hz</td>
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<td>422E38</td>
<td>0.1 mV/pC</td>
<td>25000 pC</td>
<td>5 Hz</td>
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<td>422E35</td>
<td>1 mV/pC</td>
<td>2500 pC</td>
<td>5 Hz</td>
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<tr>
<td>422E36</td>
<td>10 mV/pC</td>
<td>250 pC</td>
<td>5 Hz</td>
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<tr>
<td>422E39</td>
<td>1 mV/pC</td>
<td>2500 pC</td>
<td>5 Hz</td>
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</table>
DIFFERENTIAL CHARGE OUTPUT SYSTEM COMPONENTS

**Model GN**
Hardline Accelerometer Mating
Socket Connector 900 °F (482 °C)

**Model 013**
2-Conductor Hardline Cable
1200 °F (650 °C)

**Model GP**
Hardline 7/16-27 2-pin Connector
900 °F (482 °C)

**Model ET**
Softline Accelerometer Mating
Socket Connector 500 °F (260 °C)

**Model 045**
2-Conductor Softline
FEP Cable 500 °F (260 °C)

**Model JD**
2-pin connector mate to 495B10

**Endevco Model 2777A**
Differential Charge Converter