

ENVIRONMENTAL TEST

PCB PIEZOTRONICS
AN AMPHENOL COMPANY

pcb.com/environmental | 1 800 828 8840

ENVIRONMENTAL TEST

Piezoelectric Accelerometers, Piezoresistive, Accelerometers, Shock Sensors, Force Sensors, Pressure Sensors, Microphones, Torque Sensors & Shakers

INTRODUCTION

PCB Piezotronics was founded in 1967 as a manufacturer of piezoelectric quartz sensors, and associated electronics for the measurement of dynamic pressure, force, and acceleration. The unique expertise of the company was the incorporation of microelectronic signal conditioning circuitry within these sensors to make them easier to use and more environmentally compatible. These ICP® sensors gained wide popularity and became the foundation for the company's success.

Subsequent growth and steady investment in facilities, machinery, and equipment permitted a constant broadening of the product offering. Measurement capabilities expanded with the addition of piezoceramic, tourmaline, capacitive, piezoresistive, and metal strain gage sensing technologies. Ensuing products include industrial accelerometers, DC MEMS accelerometers, load cells, torque sensors, microphones, pressure transmitters, and calibration equipment.

The backbone of the company is its mission statement: Total Customer Satisfaction. This mission is not only supported by products that offer great value, but also backed by our industry exclusive Lifetime Warranty Plus. Factory application engineering and a worldwide network of sales offices and representatives are readily available to assist with customer requests.

QUALITY SYSTEM CERTIFICATIONS

PCB® Quality Systems are certified to the requirements of the following International Standards:

AS9100:2016 QMS Certified by DQS, Inc.: Requirements for Aviation, Space and Defense

ISO 9001:2015 QMS Certified by DQS, Inc: Quality Management Systems requirements

ISO17025 and ANSI-Z-540-1: Requirements for Competence of Testing & Calibration Laboratories

EN13980 & Directive 94/9/EC: Quality Systems for Potentially Explosive Atmospheres

These standards strive for process consistency and provide a means for continuous improvement while covering the entire product cycle, which includes contracting, product design control, manufacturing process control and inspection and test. In-house calibration of PCB® sensors is conducted with full traceability to National and International Institutes of Standards and Technology (N.I.S.T., P.T.B). In addition, a complete listing of A2LA accredited calibration services is documented on PCB's "Scope of Calibration" document(s). Assurance of quality system conformity is provided by certifying bodies and through our internal auditing system. In addition, our system remains compliant with obsolete or superseded standards such as: ISO 10012-1 (former MIL-STD-45662A), Guide 25, MIL-Q-9858 and MIL-I-45208. PCB is also compliant to nuclear power plant specification 10CFR50 Appendix B. PCB sensors are capable of testing MIL-STD-810 and MIL-STD-461. If you require compliance to a product or application specific standard (such as RoHS, European CE Marking, or US test requirement MIL-STD-740-2) which was not mentioned, please contact the factory for additional information.

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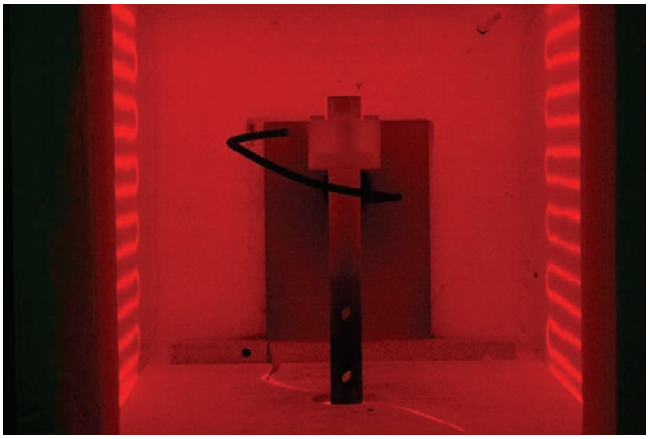
Photo Courtesy of Sun Microsystems Advanced Product Testing Laboratory

HALT/HASS ICP® TEST ACCELEROMETERS

Environmental Stress Screening (ESS) is a general reliability term used to define the practice of exposing primarily electronic products to environmental stresses in an attempt to create failures and expose defects. HALT and HASS represent two types of ESS:

Highly Accelerated Life Testing (HALT) is a design verification process, which exposes a product to very rapid and extreme changes in vibration in temperature in an effort to quick uncover design and assembly flaws.

Highly Accelerated Stress Screening (HASS) is a weeding-out process that involves testing 100 percent of final products in an effort to identify those which may possess a higher probability of early failure.







ESS GENERAL PURPOSE QUARTZ SHEAR ICP® ACCELEROMETER

MODEL 320C03

Sensitivity: 10 mV/g (1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range (±5%): 1 - 6000 Hz



ESS GENERAL PURPOSE QUARTZ SHEAR ICP® ACCELEROMETER

MODEL 320C04

Sensitivity: 10 mV/g (1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range: (±5%): 1 - 6000 Hz



ESS GENERAL PURPOSE QUARTZ SHEAR ICP® ACCELEROMETER

MODEL 320C15

Sensitivity: 10 mV/g (1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range: (±5%): 1 - 10000 Hz



ESS HIGH SENSITIVITY QUARTZ SHEAR ICP® ACCELEROMETER

MODEL 320C20

Sensitivity: 10 mV/g (1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range: (±5%) 2 - 5000 Hz



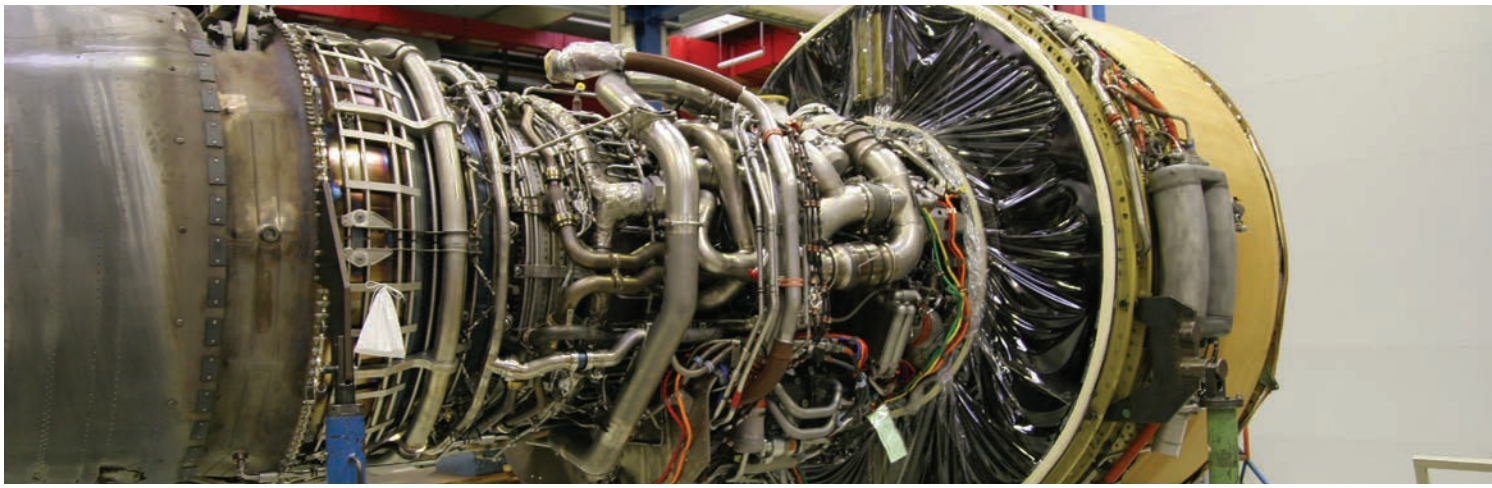
ESS HIGH SENSITIVITY QUARTZ SHEAR ICP® ACCELEROMETER

MODEL 320C33

Sensitivity: 100 mV/g
(10.2 mV/(m/s²))

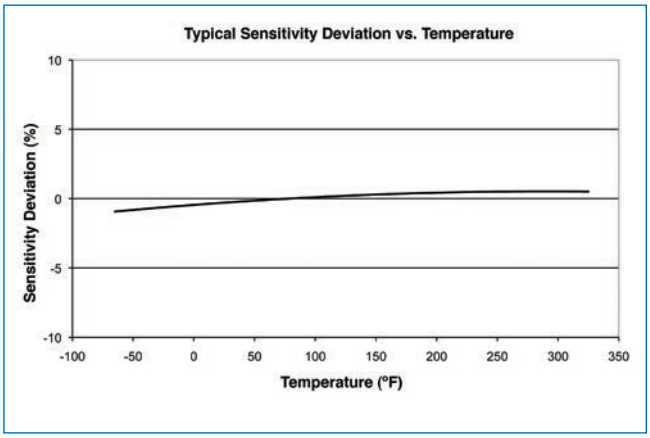
Measurement Range:
±50 g pk (±490 m/s² pk)

Frequency Range: (±5%) 1 - 4000 Hz



HIGH TEMPERATURE ICP® ACCELEROMETERS

PCB® single axis and triaxial ICP® accelerometers are designed with a temperature coefficient as low as 0.005% / °F (0.009% / °C), wide operating temperature range, and good broadband measurement resolution, making them ideal for any vibration measurement requiring tight control of amplitude sensitivity over a wide thermal gradient. To alleviate the effects of high frequency overloads some models have a low pass filter incorporated, ensuring accurate data in the frequency range of interest.





UHT-12™ MINIATURE ICP® ACCELEROMETER

MODEL 320C52

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range: (±5%)
1 - 10000 Hz



UHT-12™ MINIATURE ICP® ACCELEROMETER

MODEL 320C53

Sensitivity: 1 mV/g
(0.102 mV/(m/s²))

Measurement Range:
±5000 g pk (±49050 m/s² pk)

Frequency Range: (±5%)
1 - 5000 Hz



UHT-12™ TRIAXIAL ICP® ACCELEROMETER

MODEL 339A30

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4905 m/s² pk)

Frequency Range: (±5%)
2 - 8000 Hz



UHT-12™ ICP® ACCELEROMETER

MODEL 339A31

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range: (±5%)
2 - 6000 Hz



UHT-12™ TRIAXIAL ICP® ACCELEROMETER

MODEL 339B31

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range:
(±5%) 2 - 8000 Hz
(±10%) 1.5 - 11000 Hz



UHT-12™ LOW-PROFILE ICP® ACCELEROMETER

MODEL 339B32

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range: (±5%)
2 - 10000 Hz



UHT-12™ LOW-PROFILE ICP® ACCELEROMETER

MODEL TLD339A34

Sensitivity: 50 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±100 g pk (±980 m/s² pk)

Frequency Range: (±5%) 2 - 5000 Hz



TRIAXIAL ICP® ACCELEROMETER WITH TEDS

MODEL TLD339A36

Sensitivity: 10 mV/g (1.0 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range: (±5%) 2 - 5000 Hz



UHT-12™ TRIAXIAL ICP® ACCELEROMETER WITH TEDS

MODEL TLD339A37

Sensitivity: 100 mV/g (10.2 mV/(m/s²))

Measurement Range:
±50 g pk (±490.5 m/s² pk)

Frequency Range: (±5%) 0.3 - 4000 Hz



Photo Courtesy of Sun Microsystems Advanced Product Testing Laboratory

FILTERED ICP® ACCELEROMETERS

Impact testing of aerospace components often involves exposing the test specimen to dynamic stimuli, which include high levels of broadband excitation. This testing regiment can cause resonant behavior in brackets or other subassemblies that may be mounted to the component under test. A resonating component can cause vibration energy to be transmitted throughout the test structure, which can potentially corrupt or mask the measurement data of interest. Internal LP filtering is used to eliminate unwanted high magnitude high frequency signals that are above the structural frequency range of interest.







CERAMIC SHEAR ICP® ACCELEROMETER

MODEL 352A60

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4905 m/s² pk)

Frequency Range (±5%):
5 to 60000 Hz



MINIATURE LIGHTWEIGHT ICP® ACCELEROMETER

MODEL 352A72

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range (±5%):
0.5 - 4500 Hz



TRIAXIAL MINIATURE ICP® ACCELEROMETER

MODEL 356A63

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range (±5%):
2 - 4000 Hz



TRIAXIAL CERAMIC SHEAR ICP® ACCELEROMETER

MODEL 356A66

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range (±5%):
2 - 4000 Hz



SINGLE AXIS MINIATURE ICP® ACCELEROMETER

MODEL 353B77

Sensitivity: 2 mV/g
(0.204 mV/(m/s²))

Measurement Range: ±2500 g pk
(±24525 m/s² pk)

Frequency Range: (±5%)
1 - 10000 Hz



HIGH AMPLITUDE ICP® ACCELEROMETER

MODEL 350B50

Sensitivity: 0.5 mV/g
(0.05 mV/(m/s²))

Measurement Range:
±10000 g pk (±98000 m/s² pk)

Frequency Range (±1dB):
3 - 10000 Hz



HIGH AMPLITUDE ICP® SHOCK ACCELEROMETERS

Piezoelectric ICP® accelerometers afford a very high signal output (+/- 5 volts full scale) and the ease of two-wire electrical connectivity. Their inherent ruggedness enables them to be severely over ranged without damage. The addition of internal mechanical isolation minimizes the high frequency stress that would otherwise be encountered by their ceramic sensing elements. This mechanical isolation, coupled with an internal 2-pole electrical filter, built into the ICP® circuitry, tailors the overall accelerometer response to assure data quality to frequencies as high as 10 kHz. Depending on the specific model, accelerations in excess of 50 kg can be successfully measured. These modern designs, with their internal elastomeric isolation materials are verified through calibration to remain dynamically linear and are enabling piezoelectric accelerometers to operate in increasingly severe acceleration environments.







SHOCK ICP® ACCELEROMETER
MODEL 350C23

Sensitivity: 0.5 mV/g
(0.05 mV/(m/s²))

Measurement Range:
±10000 g pk (±98000 m/s² pk)

Frequency Range (±1dB):
0.4 - 10000 Hz



SHOCK ICP® ACCELEROMETER
MODEL 350C24

Sensitivity: 1 mV/g
(0.1 mV/(m/s²))

Measurement Range:
±5000 g pk (±49000 m/s² pk)

Frequency Range (±1dB):
0.4 - 10000 Hz



SHOCK ICP® ACCELEROMETER
MODEL 350B01

Sensitivity: 0.05 mV/g
(0.005 mV/(m/s²))

Measurement Range:
±100000 g pk (±981000 m/s² pk)

Frequency Range (±1dB):
4 - 10000 Hz



SHOCK ICP® ACCELEROMETER
MODEL 350D02

Sensitivity: 0.1 mV/g
(0.01 mV/(m/s²))

Measurement Range:
±50000 g pk (±490000 m/s² pk)

Frequency Range (±1db):
4 - 10000 Hz



TRIAXIAL SHOCK ICP® ACCELEROMETER

MODEL 350B41

Sensitivity: 0.05 mV/g
(0.005 mV/(m/s²))

Measurement Range:
±100000 g pk (±981000 m/s² pk)

Frequency Range (±1dB):
0.4 - 10000 Hz

MODEL 350B42

Sensitivity: 0.1 mV/g
(0.01 mV/(m/s²))

Measurement Range:
±50000 g pk (±490000 m/s² pk)

Frequency Range (±1dB):
0.4 - 10000 Hz

MODEL 350B43

Sensitivity: 0.5 mV/g
(0.05 mV/(m/s²))

Measurement Range:
±10000 g pk (±98000 m/s² pk)

Frequency Range (±1dB):
0.4 - 10000 Hz

MODEL 350B44

Sensitivity: 1 mV/g
(0.1 mV/(m/s²))

Measurement Range:
±5000 g pk (±49000 m/s² pk)

Frequency Range (±1dB):
0.4 - 10000 Hz



MEMS PIEZORESISTIVE SHOCK ACCELEROMETERS

Piezoresistive shock accelerometers, manufactured by MEMS technology, have low power consumption while still providing +/- 200 mV full scale output at acceleration levels greater than 50 kg. The accelerometers are electrically compatible with the same type 4-wire circuit used to condition a strain gauge full bridge and since they have much greater output compared to a strain gauge, the requirement for signal amplification is greatly reduced. They afford a wider operating temperature range when compared to mechanically isolated ICP® accelerometers. Their frequency response, dependent on model, can be uniform from DC (0 Hz) to values as high as 20 kHz. To lessen the severity of response when their resonant frequency is excited, they incorporate squeeze film damping, achieving values of 0.02 to 0.06 of critical. These damping values are much higher than those found in legacy MEMS accelerometers. Since silicon is a brittle material, over range stops are also incorporated to minimize breakage of the sensing element, and then the sensing element is sealed within a hermetic package. At comparable G levels, MEMS technology enables the smallest package size to be attained for individual accelerometers.

APPLICATIONS:

- Metal-to-metal impact & pyroshock
- Data recorders, penetrator & launch tests
- Consumer electronics drop testing
- Sporting goods and impact tool testing
- Blast loading & survivability of structures
- Fuze, safe and arm

HIGHLIGHTS:

- Single axis and triaxial arrangements
- Mechanical over-range stops improves survivability
- Slight damping reduces resonance amplification
- Excellent amplitude linearity
- Low power consumption



2000 G MEMS SHOCK ACCELEROMETER

Sensitivity: 0.2 mV/g
(0.02 mV/(m/s^2))

Measurement Range:
±2000 g pk (±19613 m/s^2 pk)

Frequency Range (±1dB):
0 - 10000 Hz



STUD MOUNT SINGLE AXIS

MODEL 3501B122KG
MODEL 3501B1220KG
MODEL 3501B1260KG

20000 G MEMS SHOCK ACCELEROMETER

Sensitivity: 0.01 mV/g
(0.001 mV/(m/s^2))

Measurement Range:
±20000 g pk (±196100 m/s^2 pk)

Frequency Range (±1dB):
0 - 10000 Hz



SURFACE MOUNT SINGLE AXIS

MODEL 3501A202KG
MODEL 3501A2020KG
MODEL 3501A2060KG

60000 G MEMS SHOCK ACCELEROMETER

Sensitivity: 0.003 mV/g
(0.0003 mV/(m/s^2))

Measurement Range:
±60000 g pk (±588400 m/s^2 pk)

Frequency Range (±1dB):
0 - 20000 Hz



SURFACE MOUNT TRIAXIAL

MODEL 3503C202KG
MODEL 3503C2020KG
MODEL 3503C2060KG



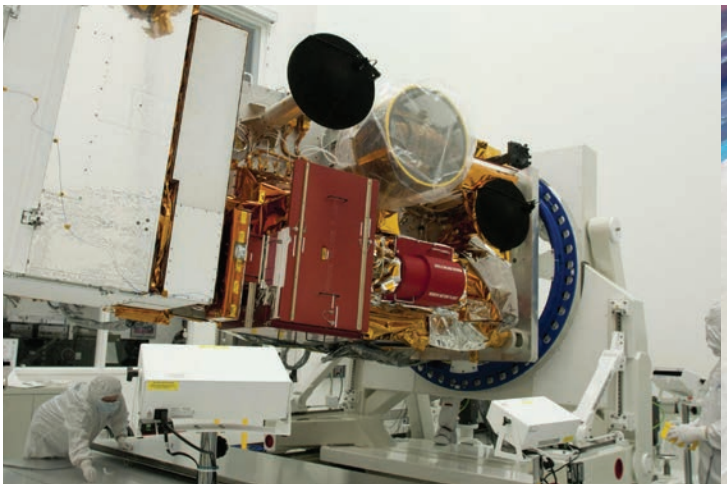
THRU HOLE MOUNT SINGLE AXIS

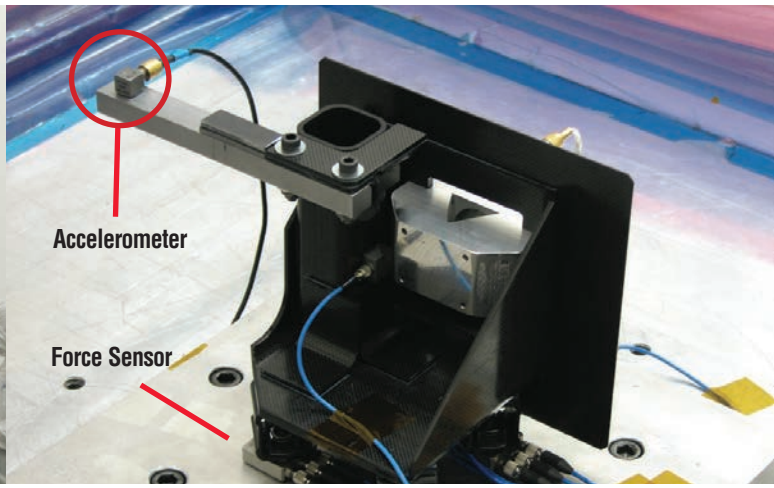
MODEL 3991B112KG
MODEL 3991B1120KG
MODEL 3991B1160KG



THRU HOLE MOUNT TRIAXIAL

MODEL 3503A112KG
MODEL 3503A1120KG
MODEL 3503A1160KG





PCB® Model 356M208 accelerometer & force sensors used during vibration testing of bracket assembly at Utah State Space Dynamics Lab

LOW OUTGASSING ICP® ACCELEROMETERS AND CABLES

PCB's low outgassing accelerometers and cables are standard products whose specifications are designed for use in high-vacuum applications such as satellite ground testing and in space.

THERMAL VACUUM VIBRATION TESTING

Exposure to the high vacuum level of a space environment induces material outgassing in ordinary accelerometers and cables. Any substance subjected to a vacuum has the potential to release trapped gasses. Contaminants from outgassing can condense onto nearby surfaces obscuring them, rendering them useless during their intended application.

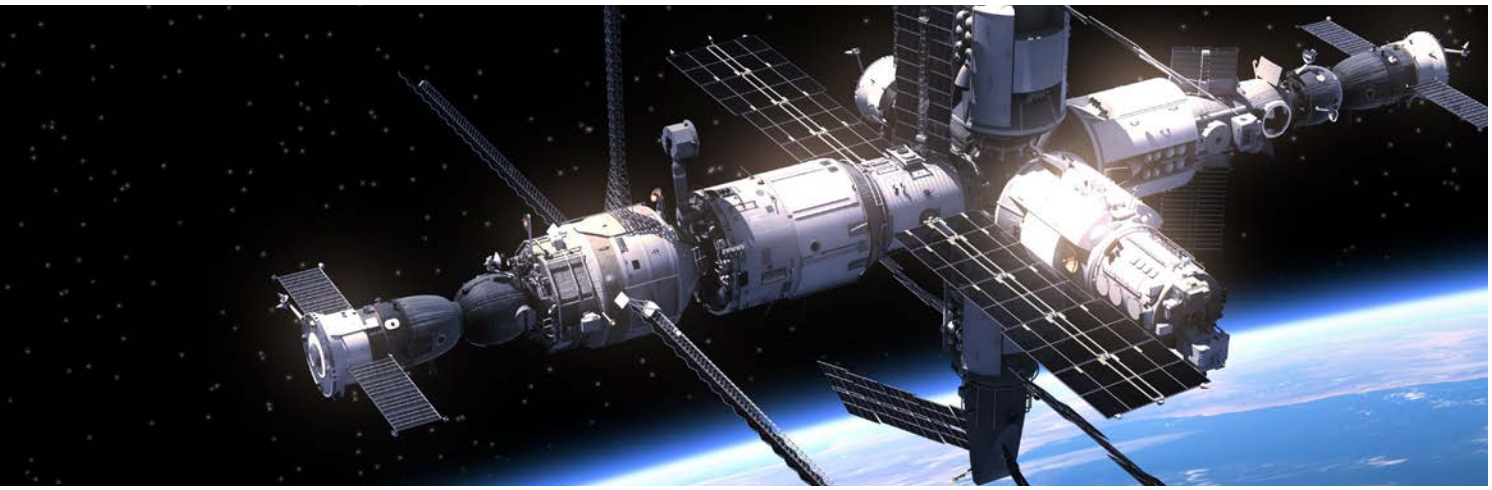
Many hermetic accelerometer designs have inherent low outgassing qualities. Cables with rubberized boots or shrink tubing typically do not have low outgassing qualities.

For all non-metallic materials outside of a hermetic package required for an application in a vacuum environment, PCB® verifies that the material has less than or equal to 1% TML (total mass loss) and a CVCM (collected volatile condensable mass material) less than or equal to 0.1%. This is verified either using NASA documentation or test results from an outside laboratory.

In any application involving a vacuum environment, the important things to consider when selecting low outgassing accelerometers and cables are: welded hermetic housings, polymers and epoxies that have low TML and CVCM values, and leak testing services for low outgas verification of accelerometers.

Highlights:

- Vibration measurements in Thermal Vacuum or Space environment
- Welded hermetic accelerometer designs have low outgassing qualities
- Hermeticity testing is performed on all hermetic products at PCB®
- Cables with strain relief use polymers are verified for Total Mass Loss and Collected Volatile Condensable Material
- Materials selected using NASA guidelines



LOW OUTGASSING ACCELEROMETERS



LOW OUTGASSING MINIATURE CHARGE OUTPUT ACCELEROMETER

MODEL 357A07

Sensitivity: 1.7 pC/g (0.17 pC/(m/s²))

Measurement Range:
±2000 g pk (±19620 m/s² pk)

Frequency Range (+5%): 15000 Hz



MINIATURE CHARGE OUTPUT ACCELEROMETER WITH CABLE

MODEL P357A09/030EK001PH

Sensitivity: 1.7 pC/g
(0.17 pC/(m/s²))

Measurement Range:
±2000 g pk (±19620 m/s² pk)

Frequency Range (+5%): 10000 Hz



LOW OUTGASSING SHOCK ICP® ACCELEROMETER

MODEL 350M88A

Sensitivity: 0.5 mV/g
(0.05 mV/(m/s²))

Measurement Range:
±10000 g pk (±98000 m/s² pk)

Frequency Range (±1dB):
0.4 - 10000 Hz



LOW OUTGASSING MINIATURE LIGHTWEIGHT ICP® ACCELEROMETER

MODEL 352M208

Sensitivity: 10 mV/g (1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range (±5%): 2 - 10000 Hz



LOW OUTGASSING SHOCK ICP® ACCELEROMETER

MODEL 352M212

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range (±5%):
0.5 - 10000 Hz





LOW OUTGASSING MINIATURE ICP® TRIAXIAL ACCELEROMETER

MODEL 356M57

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range (±5%):
2 - 10000 Hz (y or z axis)
2 - 7000 Hz (x axis)



LOW OUTGASSING MINIATURE LIGHTWEIGHT ICP® TRIAXIAL ACCELEROMETER

MODEL 356A06/NC & 356A09/NC

Sensitivity: Available in 5 mV/g and 10 mV/g

Measurement Range:
±1000 g pk (±9810 m/s² pk)

Frequency Range (±5%):
2 - 8000 Hz (y or z axis)
2 - 5000 Hz (x axis)



LOW OUTGASSING MINIATURE LIGHTWEIGHT ICP® TRIAXIAL ACCELEROMETER

MODEL 356M208/NC & 356M239

Sensitivity: Available in 5 mV/g and 10 mV/g

Measurement Range:
±1000 g pk (±9810 m/s² pk)

Frequency Range (±5%):
2 - 8000 Hz (y or z axis)
2 - 5000 Hz (x axis)



LOW OUTGASSING ICP® TRIAXIAL ACCELEROMETER WITH LOW MASS CABLE

MODEL 356M234

Sensitivity: 5 mV/g
(0.51 mV/(m/s²))

Measurement Range:
±1000 g pk (±9810 m/s² pk)

Frequency Range (±5%):
2 - 8000 Hz (y or z axis)
2 - 5000 Hz (x axis)



HIGH AMPLITUDE ICP® TRIAXIAL ACCELEROMETER WITH LOW-PASS FILTER

MODEL 350B50/XXXBZ/NC

Sensitivity: (±30%) 0.5 mV/g
(0.05 mV/(m/s²))

Measurement Range:
±10000 g pk (±98000 m/s² pk)

Frequency Range (±1 dB):
3 to 10000 Hz



LOW OUTGASSING ICP® TRIAXIAL ACCELEROMETER

MODEL TLD356M131

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range (±5%): 2 - 3000 Hz





LOW OUTGASSING TITANIUM ICP® TRIAXIAL ACCELEROMETER

MODEL 356M98

Sensitivity: 1000 mV/g
(102 mV/(m/s²))

Measurement Range:
±5 g pk (±49 m/s² pk)

Frequency Range (±5%):
0.5 - 3000 Hz



LOW OUTGASSING HIGH SENSITIVITY ICP® TRIAXIAL ACCELEROMETER

MODEL 356M132

Sensitivity: 500 mV/g
(51 mV/(m/s²))

Measurement Range:
±10 g pk (±98 m/s² pk)

Frequency Range (±5%):
0.5 - 3000 Hz



LOW OUTGASSING MINIATURE ICP® TRIAXIAL ACCELEROMETER

MODEL 354M56

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range (±5%): 2 - 8000 Hz



LOW OUTGASSING ICP® TRIAXIAL ACCELEROMETER WITH TEDS

MODEL TLD356M155

Sensitivity: 2.5 mV/g
(0.26 mV/(m/s²))

Measurement Range:
±2000 g pk (±19620 m/s² pk)

Frequency Range (±5%):
1 - 10000 Hz (y or z axis)
1 - 6000 Hz (x axis)



LOW OUTGASSING ICP® TRIAXIAL ACCELEROMETER WITH TEDS

MODEL 356A19

Sensitivity: 10 mV/g
(1.02 mV/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Range (±5%):
1 - 13000 Hz (all axis)



LOW OUTGASSING CABLES FOR SINGLE AXIS ACCELEROMETERS



MODEL 002A10

Sensor connecting cable for ICP®

General purpose, coaxial FEP

10-ft, 10-32 plug to 10-32 plug



MODEL 003A10

Sensor connecting cable

Low-noise, coaxial TFE

10-ft, 10-32 plug to 10-32 plug



MODEL 003M208

Sensor connecting cable

Low-noise, coaxial TFE

10-ft, 5-44 plug to 10-32 plug



MODEL 003M269/010

Connecting cable

Low-noise, coaxial TFE

10-ft, 10-32 plug to BNC plug



MODEL 030B10

Sensor connecting cable

Low-noise, coaxial FEP

10-ft, M3 plug to 10-32 jack



MODEL 030A10

Sensor connecting cable

Low-noise, coaxial FEP

10-ft, 3-56 plug to 10-32 plug



MODEL 030EK010PH

Sensor connecting cable

Low-noise, coaxial FEP

10-ft, 3-56 plug to 10-32 jack



MODEL 098EB010EB

Extension cable

Low-noise, coaxial TFE

10-ft, 10-32 plug to 10-32 plug



MODEL 098PW010PW

Connecting cable

Low-noise, green, coaxial, TFE cable with stranded conductor

10 ft, BNC plug to BNC plug (both with gold plated pins)



LOW OUTGASSING CABLES FOR TRIAXIAL ACCELEROMETERS



MODEL 034M22

Sensor connecting cable

4-conductor shielded, FEP

20-ft, 4-pin 1/4-28 plug to
(3) BNC plugs



MODEL 034M51

Extension cable

4-conductor shielded, FEP

40-ft, 4-pin 1/4-28 plug to
4-pin 1/4-28 plug



MODEL 034M28/020

Sensor connecting cable

4-conductor shielded, FEP

20-ft, 4 pin 1/4-28 plug to
(3) 10-32 plugs



MODEL 034M21

Sensor connecting cable

4-conductor shielded, FEP

10-ft, mini 4-pin 8-36 plug to
(3) BNC plugs



MODEL 010M128/040

Extension cable

4-conductor shielded, FEP

40-ft, 4-pin 1/4-28 plug to
4-pin 1/4-28 jack



MODEL 068M01/020

Sensor connecting cable

4-conductor, 85% shield for low mass

20-ft, 4 pin 1/4-28 plug to blunt cut

Also available to (3) BNC or
(3) 10-32 plugs



MODEL 070B14

Hermetic bulkhead feed-thru adaptor

Low outgassing

10-32 jack to 10-32 jack

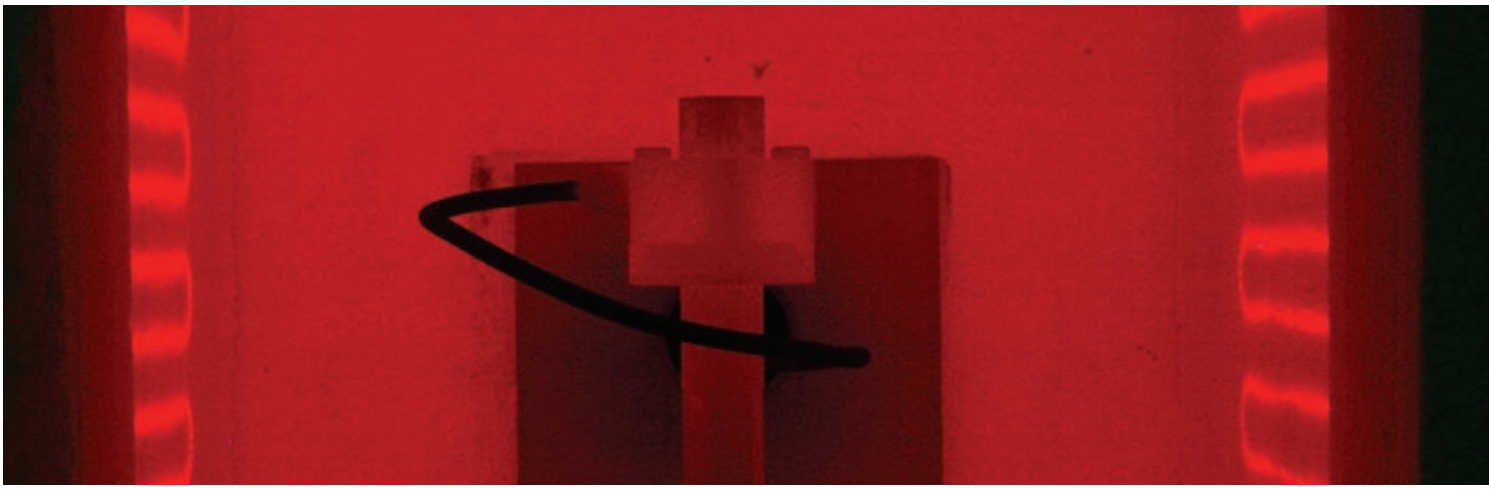


MODEL 080M233

Hermetic bulkhead feed-thru adaptor

Low outgassing

4-pin 1/4-28 jack to 1/4-28 jack



HIGH TEMPERATURE CHARGE MODE ACCELEROMETERS

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. These sensors are also required for automotive exhaust monitoring, engine system testing, catalytic converter testing, and brake testing.

UHT-12™ is a proprietary crystal designed for more accurate, lower noise measurements at elevated temperatures and trusted in the most demanding test environments. PCB® sensors made with UHT-12™ technology have an improved data quality compared to ceramic crystal designs.

The main technical advantages include:

- Absence of pyroelectric noise spikes up to 1200 °F (649 °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 gas turbine installations for research and monitoring

Applications:

- High Temperature Vibration Measurements
- Engine Compartment Studies
- Exhaust Component Vibration Tests
- Steam Turbine Testing
- Engine Vibration Analysis





500°F (260 °C)

HIGH TEMPERATURE CHARGE OUTPUT ACCELEROMETER

MODEL 357B03

Sensitivity: 10 pC/g (1.02 pC/(m/s²))

Measurement Range: ±2000 g pk (±19600 m/s² pk)

Frequency Response (+5%): 9000 Hz



500°F (260 °C)

HIGH TEMPERATURE RAD HARDENED CHARGE OUTPUT ACCELEROMETER

MODEL 357B53

Sensitivity: 100 pC/g (10.2 pC/(m/s²))

Measurement Range: ±150 g pk (±1470 m/s² pk)

Frequency Response (+5%): 3000 Hz



500°F (260 °C)

HIGH TEMPERATURE MINIATURE CHARGE OUTPUT ACCELEROMETER

MODEL 357B11

Sensitivity: 3 pC/g (0.31 pC/(m/s²))

Measurement Range: ±2300 g pk (±22600 m/s² pk)

Frequency Response (+5%): 12000 Hz



500°F (260 °C)

MINIATURE CHARGE OUTPUT ACCELEROMETER

MODEL 357B06

Sensitivity: 5 pC/g (0.51 pC/(m/s²))

Measurement Range: ±500 g pk (±4900 m/s² pk)

Frequency Response (+5%): 10000 Hz



500°F (260 °C)

HIGH TEMPERATURE CHARGE OUTPUT ACCELEROMETER

MODEL 357B21

Sensitivity: 30 pC/g (3.1 pC/(m/s²))

Measurement Range: ±1500 g pk (±14700 m/s² pk)

Frequency Response (+5%): 6000 Hz



500°F (260 °C)

HIGH TEMPERATURE CHARGE OUTPUT ACCELEROMETER

MODEL 357B22

Sensitivity: 30 pC/g (3.1 pC/(m/s²))

Measurement Range: ±1500 g pk (±14700 m/s² pk)

Frequency Response (+5%): 6000 Hz



HIGH TEMPERATURE CHARGE MODE ACCELEROMETERS

Because of its temperature and high/complex vibration environment, the turbine engine measurement environment is perhaps the most demanding application for accelerometers. With 30 years of high temperature measurement experience, PCB® has developed a range of piezoelectric materials and technologies that provide accurate, reliable measurements in this challenging environment. With the cost (and non-repeatability) of each turbine engine test, PCB®'s customers have come to expect and rely on this accuracy and reliability of our sensors.



MINIATURE TRIAXIAL CHARGE OUTPUT ACCELEROMETER

MODEL 356A70

Sensitivity: 2.7 pC/g (0.28 pC/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Response (+5%): 5000 Hz



MINIATURE TRIAXIAL CHARGE OUTPUT ACCELEROMETER

MODEL 356A71

Sensitivity: 10 pC/g (1.02 pC/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Response (+5%): 5000 Hz



INTRINSICALLY SAFE TRIAXIAL CHARGE OUTPUT ACCELEROMETER

MODEL EX356A73

Sensitivity: 2.5 pC/g (0.25 pC/(m/s²))

Measurement Range:
±500 g pk (±4900 m/s² pk)

Frequency Response (+5%): 4000 Hz





900°F (482 °C)

HIGH TEMPERATURE CHARGE OUTPUT ACCELEROMETER

MODEL 357B69

Sensitivity: 3 pC/g (0.357 pC/(m/s²))

Measurement Range: ±500 g pk (±4900 m/s² pk)

Frequency Response (+5%): 6000 Hz



900°F (482 °C)

HIGH TEMPERATURE CHARGE OUTPUT ACCELEROMETER

MODEL 357B61

Sensitivity: 10 pC/g (1.02 pC/(m/s²))

Measurement Range: ±1000 g pk (±9810 m/s² pk)

Frequency Response (+5%): 5000 Hz



1200°F (649 °C)

UHT-12™ CHARGE OUTPUT ACCELEROMETER

MODELS 357E90/91/92/93

357E90/91 Sensitivity: 5.0 pC/g (0.51 pC/(m/s²))

357E92/93 Sensitivity: 2.3 pC/g (0.23 pC/(m/s²))

Measurement Range: ±1000 g pk (±9800 m/s² pk)

Frequency Response (+5%): 3000 Hz



900°F (482 °C)

UHT-12™ CHARGE OUTPUT ACCELEROMETER

MODEL 357A63

Sensitivity: 0.53 pC/g (.054 pC/(m/s²))

Measurement Range: ±5000 g pk (±49050 m/s² pk)

Frequency Response (+10%): 10000 Hz



1200°F (649 °C)

UHT-12™ CHARGE OUTPUT ACCELEROMETER

MODEL 357A64

Sensitivity: 0.53 pC/g (.054 pC/(m/s²))

Measurement Range: ±5000 g pk (±49050 m/s² pk)

Frequency Response (+10%): 10000 Hz



1200°F (649 °C)

UHT-12™ CHARGE OUTPUT DIFFERENTIAL ACCELEROMETER

MODELS 357A94/95

Sensitivity: 3.3 pC/g (0.34 pC/(m/s²))

Measurement Range: ±1000 g pk (±9800 m/s² pk)

Frequency Response (+5%): 3000 Hz



CRYOGENIC ICP® ACCELEROMETERS

Cryogenic ICP® accelerometers are specifically designed to operate at temperatures below the typical -65 °F (-54 °C) temperature limit of most voltage mode sensors. The use of specialized, built-in, cryogenic circuitry and quartz shear sensing technology promote survivability in demanding environments such as liquid nitrogen. Each sensor is hermetically sealed and individually tested to determine the thermal coefficient of sensitivity at -320 °F (-196 °C) ensuring reliable operation and accurate measurements. These sensors have been successfully used in the presence of liquid helium during structural testing of rocket boosters. Choose from a variety of 351 series accelerometers ranging from lightweight units for minimizing mass loading effects to high sensitivity versions for sensing low-level vibrations.

Applications:

- Cryogenic Pumps
- Rocket Motors
- Refrigerant Handling



CRYOGENIC ICP® ACCELEROMETER

MODEL 351B03

- Sensitivity: 10 mV/g (1.02 mV/(m/s²))
- Measurement Range: ±150 g pk (±1472 m/s² pk)
- Frequency Range (±5%): 1 - 6000 Hz



GROUND ISOLATED CRYOGENIC ICP® ACCELEROMETER

MODEL J351B03

- Sensitivity: 10 mV/g (1.02 mV/(m/s²))
- Measurement Range: ±150 g pk (±1472 m/s² pk)
- Frequency Range (±5%): 1 - 6000 Hz



CRYOGENIC ICP® ACCELEROMETER

MODEL 351B04

- Sensitivity: 10 mV/g (1.02 mV/(m/s²))
- Measurement Range: ±150 g pk (±1472 m/s² pk)
- Frequency Range (±5%): 1 - 6000 Hz
- Available with ground isolation (J)





CRYOGENIC ICP® ACCELEROMETER

MODEL 351B41

Sensitivity: 100 mV/g (10.2 mV/(m/s²))

Measurement Range: ±15 g pk (±147 m/s² pk)

Frequency Range (±5%): 1 - 2000 Hz

Available with ground isolation (J)



CRYOGENIC ICP® ACCELEROMETER

MODEL 351B42

Sensitivity: 100 mV/g (10.2 mV/(m/s²))

Measurement Range: ±15 g pk (±147 m/s² pk)

Frequency Range (±5%): 1 - 2000 Hz

Available with ground isolation (J)



CRYOGENIC ICP® ACCELEROMETER

MODEL 351B31

Sensitivity: 50 mV/g (5.10 mV/(m/s²))

Measurement Range: ±30 g pk (±294 m/s² pk)

Frequency Range (±5%): 1 - 4000 Hz

Available with ground isolation (J)



CRYOGENIC MINIATURE ICP® ACCELEROMETER

MODEL 351B11

Sensitivity: 5 mV/g (0.51 mV/(m/s²))

Measurement Range: ±300 g pk (±2943 m/s² pk)

Frequency Range (±5%): 1 - 10000 Hz

Available with ground isolation (J)



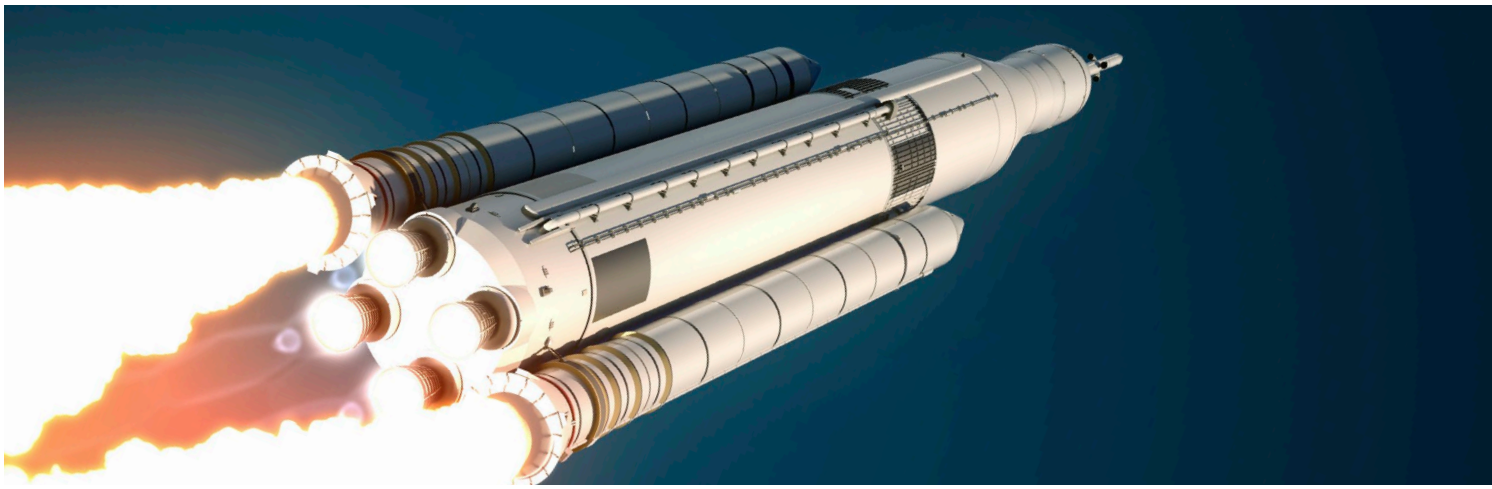
CRYOGENIC MINIATURE ICP® ACCELEROMETER

MODEL 351B14

Sensitivity: 5 mV/g (0.51 mV/(m/s²))

Measurement Range: ±300 g pk (±2943 m/s² pk)

Frequency Range (±5%): 1 - 8000 Hz



EXTREME ENVIRONMENT ICP® & CHARGE OUTPUT PRESSURE SENSORS

WATER COOLED, HELIUM BLEED PRESSURE SENSORS

Series 123 rocket motor sensors are designed for measuring dynamic combustion instability pressures in intense heat flow associated with high temperature rocket motor environments. The sensors are suited for long duration measurements in environments where a severe and rapid temperature increase in the sensor mounting location or high soaking temperature after rocket motor shut down exists.

Sensors incorporate helium bleed, water cooling construction. The helium bleed design involves enveloping the case and diaphragm of a miniature quartz sensor with a cool flow of helium gas. The gas cools the sensor and insulates the unit from hot combustion gases, while cleaning and improving the frequency response of the connecting passage. Available in ICP® and charge designs, a ceramic-coated end piece protects the sensor from the intense flow and combustion gasses.

Applications:

- Combustion Dynamics
- Instabilities
- Pulsations

Highlights:

- Ability to withstand intense heat at sensor tip
- Sensor diaphragm enveloped in cool, helium gas
- Water cooling adaptor for greater thermal stability
- Integral acceleration compensation to reduce unwanted vibration sensitivity
- Helium flow increases frequency response of the short connecting passage
- Ceramic coated diaphragm for thermal protection





ROCKET MOTOR ICP® PRESSURE SENSOR

MODEL 123B22

Sensitivity: 1.0 mV/psi
(0.145 mV/kPa)

Measurement Range:
3000 psi (20685 kPa)

Temperature Range: -100 to +250 °F
(-73 to +121 °C)



ROCKET MOTOR ICP® PRESSURE SENSOR

MODEL 123B23

Sensitivity: 0.5 mV/psi
(0.07 mV/kPa)

Measurement Range:
10 kpsi (68950 kPa)

Temperature Range: -100 to +250 °F
(-73 to +121 °C)



ROCKET MOTOR ICP® PRESSURE SENSOR

MODEL 123B24

Sensitivity: 5.0 mV/psi
(0.725 mV/kPa)

Measurement Range:
1 kpsi (6895 kPa)

Temperature Range: -100 to +250 °F
(-73 to +121 °C)



CHARGE OUTPUT ROCKET MOTOR PRESSURE SENSOR

MODEL 123B

Sensitivity: 1.1 pC/psi
(0.159 pC/kPa)

Measurement Range:
3000 psi (20685 kPa)

Temperature Range
(with water cooling on):
-450 to +500 °F (-268 to +260 °C)



ROCKET MOTOR ICP® PRESSURE SENSOR

MODEL 124A24

Sensitivity: 5.0 mV/psi
(0.725 mV/kPa)

Measurement Range:
1 kpsi (6895 kPa)

Temperature Range: -100 to +250 °F
(-73 to +121 °C)



PCB® HIGH TEMPERATURE CHARGE OUTPUT SENSORS

PCB® High Temperature quartz dynamic pressure sensors are designed for operation at the highest temperatures. They are structured with quartz crystals and operate, without cooling, up to 1200 °F (650 °C) on compressors and pumps. Special mounting adaptors can be supplied to fit existing mounting holes. Water cooled adaptors are available to provide a lower temperature thermally stable environment that allow sensors to operate in applications above their normal operating range.

Hard-line cables are recommended for operating temperatures above +500 °F (+260 °C). The cable can be welded to the sensor for operation in pressurized environments. All of these features ensure reliable operation in high temperature environments.

Highlights:

- Laser welded, hermetically sealed quartz sensing elements
- Fused ceramic insulation connectors
- Internal acceleration compensation minimizes vibration sensitivity
- Calibration supplied at room temperature with thermal coefficients up to 1200 °F (650 °C)

PCB® CRYOGENIC ICP® PRESSURE SENSORS

PCB® Cryogenic quartz dynamic pressure sensors are a high resolution ICP® pressure sensor design, specially made for cryogenic environments. They consistently follow dynamic events found in cryogenic turbo pumps for liquid fuel handling systems or biomedical research.

Highlights:

- Fast rise time of ≤ 2 µsec from quartz element, with high resonant frequency ≥ 250 kHz
- Welded, hermetically sealed, stainless steel construction
- Electrically ground isolated, which helps prevent ground loop challenges
- Calibration supplied at room temperature with thermal coefficients at -320 °F (-196 °C)



HIGH TEMPERATURE PRESSURE PROBE

MODEL 112B05

Sensitivity: 1.1 pC/psi (0.160 pC/kPa)

Measurement Range:
5000 psi (34475 kPa)

Temperature Range: -400 to +500 °F
(-240 to +316 °C)



WATER-COOLED ADAPTOR

MODEL 064B01

Sensitivity: 1/2-20 External thread

1.0” hex (for Model 112A05)

MODEL 064B06

M20 x 1.5 External thread

1.25” hex (for Model 112B05)



HIGH TEMPERATURE PRESSURE SENSOR

MODEL 116B

Sensitivity: 6 pC/psi (0.870 pC/kPa)

Measurement Range:
100 psi (690 kPa)

Temperature Range: -400 to +650 °F
(-240 to +345 °C)



CRYOGENIC ICP® PRESSURE SENSOR

MODEL 102B10

Sensitivity: 50 mV/psi
(7.25 mV/kPa)

Measurement Range:
100 psi (690 kPa)

Temperature Range: -320 to +212 °F
(-196 to +100 °C)



CRYOGENIC ICP® PRESSURE SENSOR

MODEL 102B11

Sensitivity: 5.0 mV/psi
(0.725 mV/kPa)

Measurement Range:
1 kpsi (6895 kPa)

Temperature Range: -320 to +212 °F
(-196 to +100 °C)



CRYOGENIC ICP® PRESSURE SENSOR

MODEL 102B13

Sensitivity: 0.5 mV/psi
(0.073 mV/kPa)

Measurement Range:
10000 psi (68950 kPa)

Temperature Range: -320 to +212 °F
(-196 to +100 °C)



CRYOGENIC ICP® PRESSURE SENSOR

MODEL 102B14

Sensitivity: 1 mV/psi (0.145 mV/kPa)

Measurement Range:
5000 psi (34475 kPa)

Temperature Range: -320 to +212 °F
(-196 to +100 °C)



CHARGE OUTPUT PRESSURE SENSOR

MODEL 176A07

Sensitivity: 7 pC/psi (101.5 pC/bar)

Measurement Range:
725 psi (50 bar)

Temperature Range: -94 to +1200 °F
(-70 to +650 °C)



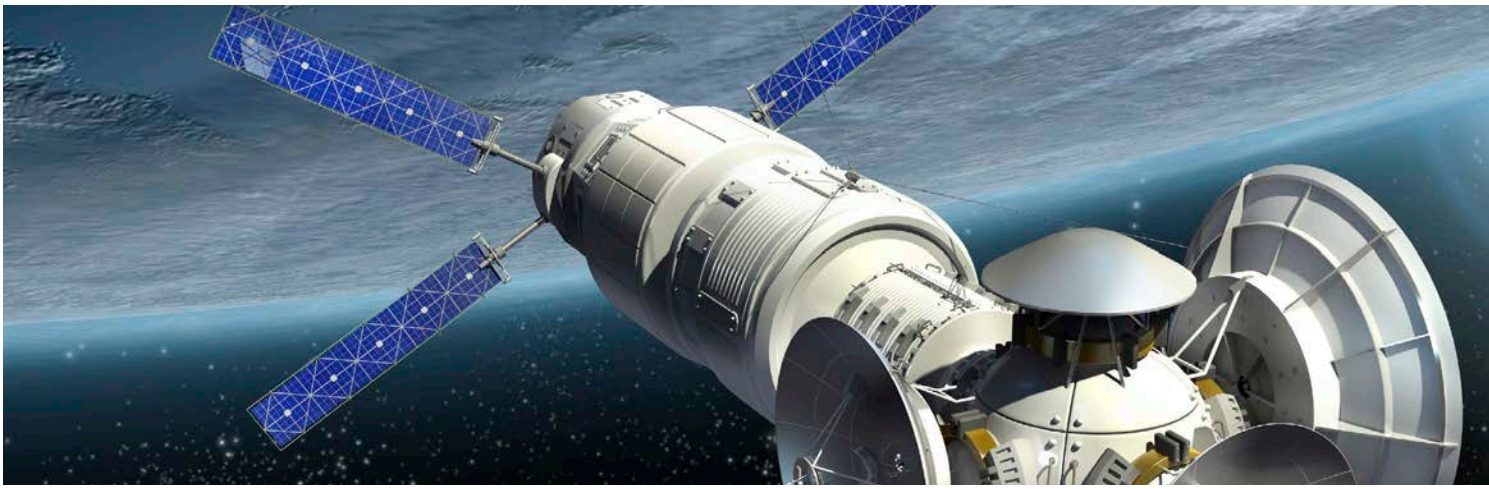
CHARGE OUTPUT PRESSURE SENSOR

MODEL 176M47

Sensitivity: 15 pC/psi (217.5 pC/bar)

Measurement Range:
500 psi (34.47 bar)

Temperature Range: -70 to 1200 °F
(-57 to 650 °C)



FORCE LIMITED VIBRATION TESTING SYSTEMS

Force limited vibration testing system for easy and accurate measurement of the input force. Optimizing 3 component force sensor installation for satellite force limited vibration testing.

Due to the high cost, long development times, and uniqueness of sophisticated aerospace and other high-tech equipment, it has become imperative to implement techniques that ensure the safety of such items during vibration qualification testing.

Conventional control using acceleration has been shown to cause significant over-testing that may result in damage to the unit under test (UUT). In force limited vibration testing, the total input force to the UUT is measured and controlled, thereby limiting the "quasi-static" acceleration of the center-of-gravity and ensuring the integrity of the equipment.

The PCB® Force Limited Vibration Testing System meets most requirements for limiting the reaction force between the shaker and unit under test in random vibration testing. The use of piezoelectric, 3-component force sensors facilitates easy and accurate measurement of the input force. This force relates directly, using Newton's Second Law, F=ma, to the "quasi-static" acceleration of the structure's center-of-gravity. Since design loads for aerospace equipment are often given in terms of the "quasi-static" acceleration, the use of force sensors represents an ideal measurement approach for this application.

Highlights:

- Minimizes Over-testing
- Reduces Risk of Damage to Critical Structures
- Measures Summed Forces
- Measures Force Differences (Moments)
- Simplifies and Expedites the Test Process
- Convenient and Easy to Implement

3-COMPONENT ICP® & CHARGE OUTPUT QUARTZ FORCE RINGS



TRIAXIAL ICP® FORCE SENSOR

MODEL 260A01

Sensitivity (z-axis): 2.5 mV/lb (0.56 mV/N)

Sensitivity (x or y axis): 10 mV/lb (2.25 mV/N)

Measurement Range (z-axis): ±1000 lb (±4.45 kN)

Measurement Range (x or y axis): ±500 lb (±2.22 kN)

Temperature Range: -65 to +250 °F (-54 to +121 °C)



TRIAXIAL ICP® FORCE SENSOR

MODEL 260A02

Sensitivity (z-axis): 2.5 mV/lb (0.56 mV/N)

Sensitivity (x or y axis): 5 mV/lb (1.12 mV/N)

Measurement Range (z-axis): ±1000 lb (±4.45 kN)

Measurement Range (x or y axis): ±1000 lb (±4.45 kN)

Temperature Range: -65 to +250 °F (-54 to +121 °C)



TRIAXIAL ICP® FORCE SENSOR

MODEL 260A03

Sensitivity (z-axis): 0.25 mV/lb (0.06 mV/N)

Sensitivity (x or y axis): 1.25 mV/lb (0.28 mV/N)

Measurement Range (z-axis): ±10000 lb (±44.48 kN)

Measurement Range (x or y axis): ±4000 lb (±17.79 kN)

Temperature Range: -65 to +250 °F (-54 to +121 °C)



TRIAXIAL CHARGE OUTPUT FORCE SENSOR

MODEL 260A11

Sensitivity (z-axis): 15 pC/lb (3.37 pC/N)

Sensitivity (x or y axis): 32 pC/lb (7.19 pC/N)

Measurement Range (z-axis): ±1000 lb (±4.45 kN)

Measurement Range (x or y axis): ±500 lb (±2.22 kN)

Temperature Range: -100 to +350 °F (-73 to +177 °C)



TRIAXIAL CHARGE OUTPUT FORCE SENSOR

MODEL 260A12

Sensitivity (z-axis): 15 pC/lb (3.37 pC/N)

Sensitivity (x or y axis): 32 pC/lb (7.19 pC/N)

Measurement Range (z-axis): ±1000 lb (±4.45 kN)

Measurement Range (x or y axis): ±1000 lb (±4.45 kN)

Temperature Range: -100 to +350 °F (-73 to +177 °C)



TRIAXIAL CHARGE OUTPUT FORCE SENSOR

MODEL 260A13

Sensitivity (z-axis): 15 pC/lb (3.37 pC/N)

Sensitivity (x or y axis): 32 pC/lb (7.19 pC/N)

Measurement Range (z-axis): ±10000 lb (±44.48 kN)

Measurement Range (x or y axis): ±4000 lb (±17.7 kN)

Temperature Range: -100 to +350 °F (-73 to +177 °C)

3-COMPONENT ICP® & CHARGE OUTPUT QUARTZ FORCE LINKS



TRIAXIAL ICP® FORCE LINK

MODEL 261B01

Sensitivity (z-axis): 2.5 mV/lb (0.56 mV/N)

Sensitivity (x or y axis): 10 mV/lb (2.25 mV/N)

Measurement Range (z-axis): ±1000 lb (±4.45 kN)

Measurement Range (x or y axis): ±500 lb (±2.22 kN)

Temperature Range: -65 to +250 °F (-54 to +121 °C)



TRIAXIAL ICP® FORCE LINK

MODEL 261B02

Sensitivity (z-axis): 2.5 mV/lb (0.56 mV/N)

Sensitivity (x or y axis): 5 mV/lb (1.12 mV/N)

Measurement Range (z-axis): ±1000 lb (±4.45 kN)

Measurement Range (x or y axis): ±1000 lb (±4.45 kN)

Temperature Range: -65 to +250 °F (-54 to +121 °C)



TRIAXIAL ICP® FORCE LINK

MODEL 261B03

Sensitivity (z-axis): 0.25 mV/lb (0.06 mV/N)

Sensitivity (x or y axis): 1.25 mV/lb (0.28 mV/N)

Measurement Range (z-axis): ±10000 lb (±44.48 kN)

Measurement Range (x or y axis): ±4000 lb (±17.79 kN)

Temperature Range: -65 to +250 °F (-54 to +121 °C)



TRIAXIAL CHARGE OUTPUT FORCE LINK

MODEL 261B11

Sensitivity (z-axis): 15 pC/lb (3.37 pC/N)

Sensitivity (x or y axis): 32 pC/lb (7.19 pC/N)

Measurement Range (z-axis): ±1000 lb (±4.45 kN)

Measurement Range (x or y axis): ±500 lb (±2.22 kN)

Temperature Range: -100 to +350 °F (-73 to +177 °C)



TRIAXIAL CHARGE OUTPUT FORCE LINK

MODEL 261B12

Sensitivity (z-axis): 15 pC/lb (3.37 pC/N)

Sensitivity (x or y axis): 32 pC/lb (7.19 pC/N)

Measurement Range (z-axis): ±1000 lb (±4.45 kN)

Measurement Range (x or y axis): ±1000 lb (±4.45 kN)

Temperature Range: -100 to +350 °F (-73 to +177°C)



TRIAXIAL CHARGE OUTPUT FORCE LINK

MODEL 261B13

Sensitivity (z-axis): 15 pC/lb (3.37 pC/N)

Sensitivity (x or y axis): 32 pC/lb (7.19 pC/N)

Measurement Range (z-axis): ±10000 lb (±44.48 kN)

Measurement Range (x or y axis): ±4000 lb (±17.79 kN)

Temperature Range: -100 to +350 °F (-73 to +177°C)



SIGNAL CONDITIONING SYSTEM COMPONENT SPECIFICATIONS



SUMMING BLOCK FOR CHARGE MODE SENSORS

MODEL 070A15

Input: 4-Channels of charge input

Output: 1-Channel of summed charge output



DUAL-MODE CHARGE AMPLIFIER

MODEL 443B102

1-channel

Voltage Gain (ICP® sensor mode): x0.1 to x1000

Voltage Gain (charge mode): x0.1 to 10000 mV/pC



CHARGE SUMMATION NODE MODULE

MODEL 070M70

Input: 8-Channels of charge mode

Output: 1-Channel of summed charge output



COMPUTATIONAL SIGNAL CONDITIONER

MODEL 070M69

Input: 4 to 8-Channels of ICP® sensor or voltage signals

Output: 1-Channel

For summing or moment calculations



SUMMING AMPLIFIER FOR ICP® SENSORS

MODEL 070M90

Input: 12-Channels of ICP® signals

Output: 1-Channel

Gain: x0.1, x1, x10



COMBINED SYSTEM

EXAMPLE ONLY

Input: 12-Channels of ICP® signals

Output: 1-Channel

Gain: x0.1, x1, x10



RAPIDLY FLUCTUATING PRESSURE, FLOW, SCREW CAVITATION, & WAVE SLAP

Piezoelectric pressure & force sensors are suited for dynamic pressure measurements including turbulence and cavitation. These measurements require a fast response or rise time, ruggedness, and high stiffness in order to obtain a high frequency response.



HIGH RESOLUTION ICP® PRESSURE PROBE

MODEL S112A22

- 100 mV/psi, 50 psi
- Stainless steel for corrosion protection
- Acceleration compensated



HIGH FREQUENCY CVLD PRESSURE SENSOR

MODEL S112A22

- 100 µA/psi, 50 psi
- Emralon coated for electrical isolation
- Integral waterproof cable
- Acceleration compensated



ICP® QUARTZ FORCE RINGS

MODEL 202M44

- ±100 lbs. (0.4 kN)
- Measures dynamic excitation or reaction forces
- Integral waterproof cable

VIBRATION

Shear mode accelerometers isolate the sensing crystals from the base and housing, lowering thermal transients and signal noise resulting from base bending effects. This is a very important feature when attaching them to relatively thin walled vessel hull models during wave slap applications.



ICP® UNDERWATER ACCELEROMETER

MODEL 352M221

10 mV/g, ±500 g

2nd order LP filter

Frequency response:
1 Hz to 6000 Hz

Integral waterproof cable



MINIATURE RING-STYLE, CERAMIC SHEAR CVLD ACCELEROMETER

MODEL 355M87A

100 µA/g, ±50 g

Frequency response:
7 Hz to 9000 Hz

Integral waterproof cable

Case isolated



MINIATURE RING-STYLE, CERAMIC SHEAR ICP® ACCELEROMETER

MODEL 355M73

100 mV/g, ±50 g range

Frequency response:
7 Hz to 9000 Hz

Integral waterproof cable

Case isolated



TEARDROP ICP® ACCELEROMETER WITH FLEXIBLE, INTEGRAL CABLE

MODEL 352A74

100 mV/g, ±50 g range

Frequency response:
1 Hz to 8000 Hz

Hermetic housing



RING-STYLE SEISMIC SHEAR CVLD ACCELEROMETER

MODEL 631M21

1000 µA/g, ±2.5 g range

Frequency response:
1 Hz to 4000 Hz

Integral waterproof cable

Case isolated



PRECISION QUARTZ INDUSTRIAL ICP® ACCELEROMETER

MODEL 624B11

100 mV/g, ±50 g range

Frequency response:
0.8 Hz to 10000 Hz

Integral waterproof cable

Case isolated



THE SWIVELER® LOW COST INDUSTRIAL ICP® ACCELEROMETER

MODEL 607A11

100 mV/g, ±50 g range

Frequency response:
0.5 Hz to 10000 Hz

Integral waterproof cable

Patented 360° cable orientation

Case isolated



UNDERWATER BLAST

Piezoelectric pressure sensors measure shock waves and bubble energy associated with underwater explosion testing. Sensors structured with volumetrically sensitive, omnidirectional tourmaline crystal and ICP® microelectronics provide a high frequency, low impedance output in underwater test environments. Waterproof cables of customer requested lengths are factory installed.





TOURMALINE ICP® UNDERWATER BLAST SENSOR

SERIES 138AXX

- Volumetrically sensitive
- Ranges from 1000 to 50000 psi (6894 to 344,740 kPa)
- Rise time 1.5 µ sec
- Resonant frequency ≥ 1 MHz
- Water proof cable option



Photo Courtesy of Siemens and Belgian Defense

THE MODAL SHOP
AN AMPHENOL COMPANY

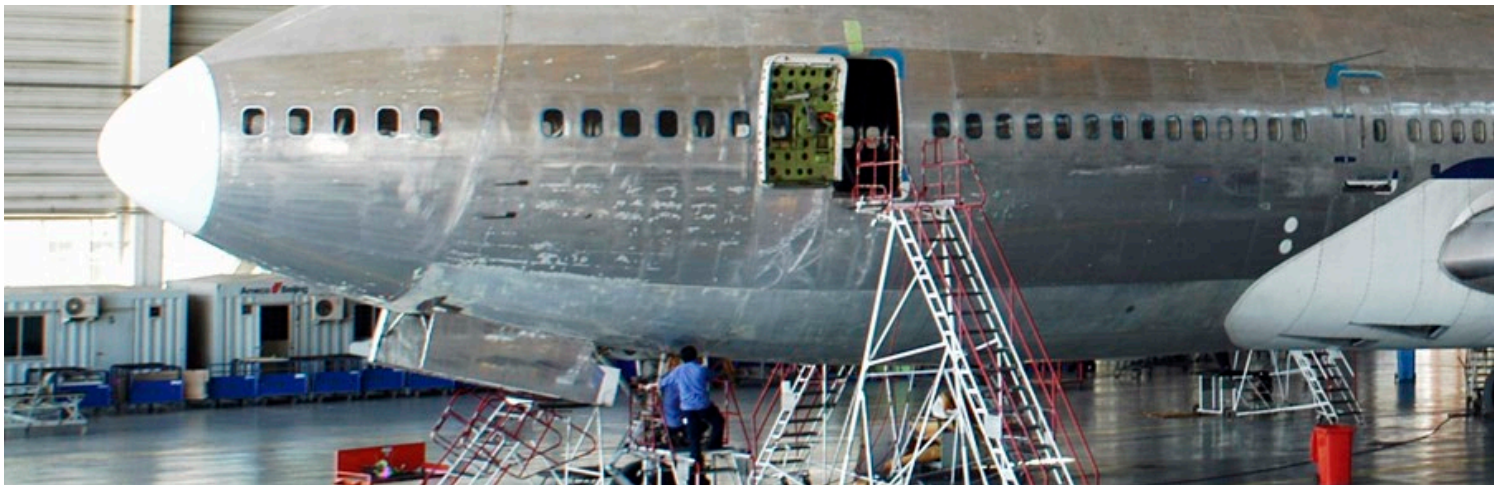
The Modal Shop, based in Cincinnati, Ohio, USA, offers a complete line of electrodynamic modal and vibration shakers ideal for applications ranging from experimental modal analysis and general vibration testing to accelerometer calibration. Shakers are also available through the TMS Rental Program in addition to accelerometers, force sensors, hammers, microphones and sound level meters. As a global leader in sound and vibration, The Modal Shop is PCB Group's focal point for a comprehensive product range of dynamic calibration systems. Visit www.modalshop.com for more information, or call +1-513-351-9919.

ELECTRODYNAMIC EXCITER FAMILY

The electrodynamic exciter family from The Modal Shop includes compact size shakers rated from 110 lbf (489 N) down to 2 lbf (9 N). Available designs include the revolutionary new SmartShaker™ with integrated power amplifier, a variety of mini, through-hole modal, inertial, and dual purpose platform shakers, and the new SmartAmp™ power amplifiers. These shakers are ideal for applications ranging from general vibration testing of small components and sub-assemblies to experimental modal analysis.



All shakers are supplied with stingers, trunnion bases, cables and other accessories. Shaker system kits make product selection easy; configuring each shaker with an appropriate amplifier and cooling package (if required). Dual purpose platform shakers offer the best of both worlds, a through-hole armature for easy stinger setup on modal applications, as well as a table top for mounting the test articles during testing. A head expander and horizontal table are also available to accommodate larger test articles.





SMARTSHAKER (INTEGRATED AMPLIFIER)

MODEL K2004E01

- Max. Force pk*: 4.5 lbf (20 N)
- Stroke pk-pk: 0.2 in (5.08 mm)
- Weight: 7 lb (3.10 kg)
- Max. Frequency: 11000 Hz

MODEL K2007E01

- Max. Force pk*: 7 lbf (31 N)
- Stroke pk-pk: 0.5 in (12.7 mm)
- Weight: 7 lb (3.10 kg)
- Max. Frequency: 9000 Hz

*Maximum force dependent on shaker, amplifier and cooling package



MINI SHAKER

MODEL 2004E

- Max. Force pk*: 4.5 lbf (20 N)
- Stroke pk-pk: 0.2 in (5.08 mm)
- Weight: 6 lb (2.72 kg)
- Max. Frequency: 11000 Hz

MODEL 2007E

- Max. Force pk*: 7 lbf (31 N)
- Stroke pk-pk: 0.5 in (12.7 mm)
- Weight: 6 lb (2.72 kg)
- Max. Frequency: 9000 Hz



MODAL SHAKER

MODEL 2025E

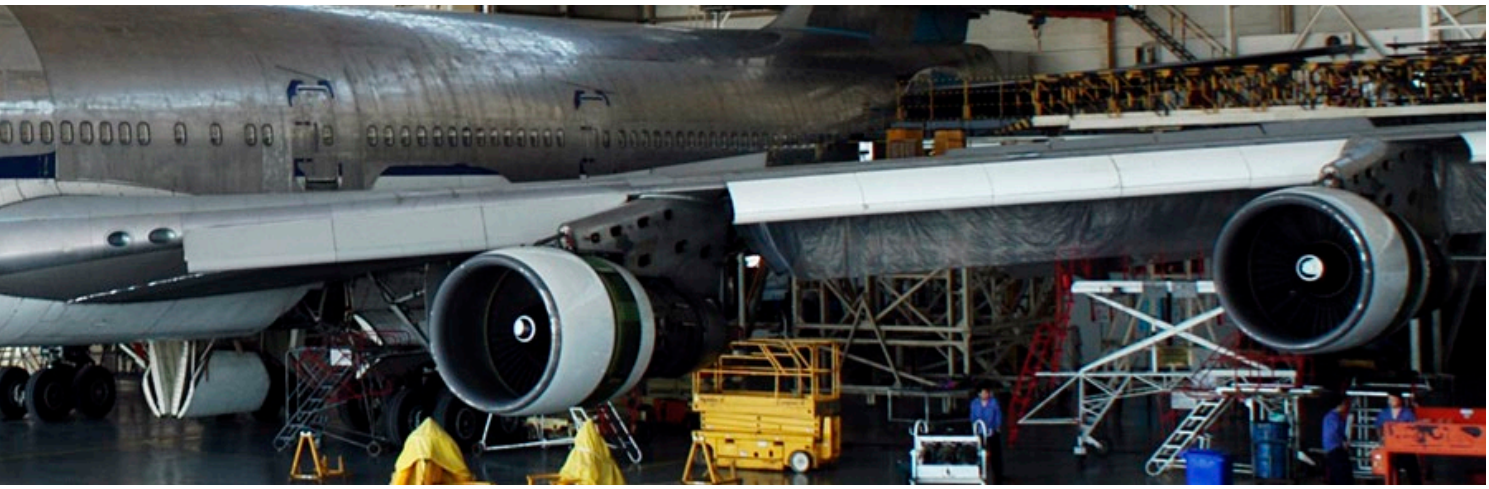
- Max. Force pk*: 13 lbf (58 N)
- Stroke pk-pk: 0.75 in (19 mm)
- Weight: 13 lb (16 kg)
- Max. Frequency: 9000 Hz



INERTIAL SHAKER SYSTEM

MODEL K2002E01

- Max. Force pk*: 2 lbf (9 N)
- Max. Displacement: 0.35 inch pk-pk (8.9 mm)
- Weight: 0.56 lb (0.25 kg)
- Max. Frequency: 3000 Hz



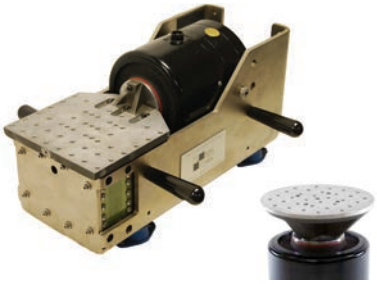
HORIZONTAL TABLE KITS

Model K2075E-HT and K2110E-HT Horizontal Tables are specially designed to support loads not suitable for direct shaker attachment. Test objects may be larger or heavier than what can be directly mounted to a particular shaker or test specifications may require test objects be oriented in a specific direction relative to gravity. In any of these situations, the Horizontal Table offers an easy to use, versatile solution. The Horizontal Table has a 6 x 7.5 inch (15 x 19 cm) platform and can operate both horizontally and vertically. Horizontal Table Kits include either the 2075E or 2110E Shaker, horizontal table, shaker mounting base for horizontal or vertical testing, power amplifier, cooling package, and accessories.

All shakers are supplied with stingers, trunnion bases, cables and other accessories. Shaker system kits make product selection easy; configuring each shaker with an appropriate amplifier and cooling package (if required). Dual purpose platform shakers offer the best of both worlds, a through-hole armature for easy stinger setup on modal applications, as well as a table top for mounting the test articles during testing. A head expander and horizontal table are also available to accommodate larger test articles.

HEAD EXPANDER

Model 2000X01 Head Expander, offers the ability to expand the mounting surface of the 2075E and 2110E vibration shakers. By providing a broader mounting surface, the Head Expander allows shaker users to test objects larger than those that can be attached directly to the shaker platform. Head Expanders offer an intermediate solution for testing larger objects.



HORIZONTAL TABLE AND VIBRATION SHAKER

MODEL K2075E-HT & K2110E-HT

Max. Load Capacity: 40 lbs (18 kg)

Max. Displacement: 1.0 inch pk-pk (25.4 mm)

2075E Max. Bare Table Acceleration, Sine (pk): 20 g

2110E Max. Bare Table Acceleration, Sine (pk) : 29 g

Table Mounting Surface: 6L x 7.5W in (15L x 19W cm)

Total Moving Element Weight: 3.8 lbs (1.72 kg)



PCB® MODEL 394C06 HANDHELD SHAKER

The Model 394C06 Handheld Shaker from PCB Piezotronics is a small, self-contained, battery powered vibration exciter specifically designed to conveniently verify accelerometer and vibration system performance. It accepts sensors weighing up to 210 grams and delivers a controlled 1 g mechanical excitation.



CALIBRATION OF SENSORS FOR ENVIRONMENTAL TEST

The Accelerometer Calibration Workstation Model 9155D is a turnkey solution that provides all the necessary components out of the box. Principal components include a Windows® PC Controller, software, printer, and 24-bit data acquisition card. System options allow custom configuration of the modular system with a variety of shakers and shock towers, accelerometer signal conditioning, test software modules and mounting accessories.

The system often includes the 9155D-830 or 9155D-831 air bearing shaker. With our air bearing shakers, customers benefit from two things: PCB's R&D investment in precision metrology and years of experience on PCB's accelerometer production line. The real world experience these shakers have in our factory results in a mature design that has been 'hardened' for durability and optimized for usability.



ACCELERATION CALIBRATION WORKSTATION

MODEL 9155





PRECISION CALIBRATION GRADE AIR-BEARING

SERIES 9155D-830/831

Precision air-bearing shaker with usable frequency range of 5 Hz to 15/20 kHz

Ultra-low transverse motion per ISO 16063-21:2003 recommendations

Includes integrated amplifier with safety interlocks for air pressure and amplifier temperature



LOW FREQUENCY LONG STROKE

SERIES 9155D-771

Allows low frequency calibration data to 0.5 Hz

Calibrate high sensitivity sensors to lower frequencies with industry leading usable stroke of 10 in (25 cm)

Precision air-bearing long stroke shaker



HIGH-G SHOCK CALIBRATION

SERIES 9155D-525

Provides calibration and linearity check from 20 g-pk to 10,000 g-pk per ISO 16063-22:2005.

Pneumatically actuated excited provides controlled and consistent impacts

Compatible with standard back-to-back shock reference accelerometer





PORTABLE VIBRATION CALIBRATOR

MODEL 9110D

The 9110D Portable Vibration Calibrator is a NIST-traceable, ISO 16063-21 compliant calibration system in a portable package. Battery powered, rugged and lightweight, it can be transported to the test site to ensure the accuracy of each measurement channel – from transducer to data acquisition – before critical tests. The product offers a wide frequency and amplitude range, perfect for testing accelerometers and velocity transducers. Using the built in memory and Microsoft Excel®, technicians can create frequency response and amplitude linearity calibration certificates.

- Modulated current sensor input tests transducers that produce AC current output
- Firmware options available for programming repetitive tests and providing pass/fail notification to the technician
- Simple plug and play DC power supplies available for testing 3-wire piezoresistive transducers



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