

Vibration, Shock, and Acceleration

Accelerometers for Test, Measurement, and Research & Development

Typical Applications

Product Testing

- Appliance Design
- Drop Testing
- Modal Analysis
- Package Testing
- Quality Assurance
- Shaker Control
- Sporting Equipment
- Structural Testing
- Vibration Control
- Vibration Stress Screening

Automotive & Transportation

- Balancing
- Body-in-white
- Crash Testing
- Drive Train Performance
- Dynamometer Testing
- NVH Studies
- Ride Simulation
- Road Response
- Squeak & Rattle Detection

Aerospace & Aviation

- Flight Flutter
- Flight Testing
- Ground Vibration Testing (GVT)
- HUMS
- Jet Engine Testing
- Landing Gear Response
- Launch Vehicle Monitoring
- Simulated Pyroshock

Research & Education

- Animal Studies
- Environmental Simulation
- Impact & Penetration Studies
- Seismic Monitoring



Vibration, Shock, and Acceleration

PCB® offers a vast selection of accelerometers to accommodate anything from routine measurement tasks to extraordinary testing requirements. Whether it's a cell phone quality assurance test or continuous monitoring of an aircraft engine, we can help, with sensors which are off-the-shelf or custom designed for a specific application.

What are ICP® sensors?

Integrated Circuit Piezoelectric (ICP®) sensors contain built-in microelectronic signal conditioning circuitry – yet operate over just two wires. This circuitry requires constant current excitation and serves to convert the high-impedance charge signal generated by the piezoelectric crystal into a low-impedance voltage signal, for ease of signal transmission and analysis. Low-cost coaxial or two-wire cables may be utilized with ICP® sensors. Signal fidelity is relatively unaffected by contamination or moisture. ICP® sensors offer trouble-free operation in dirty, industrial environments or submerged in liquids.

Generally, ICP® sensors are more cost effective and easier to use than charge output piezoelectric sensors; however, their temperature range is limited by the survivability of the built-in microelectronic circuitry.

General Purpose ICP® Accelerometers

- Lightweight titanium or aluminum construction
- Shear mode sensing geometry
- Resistant to base strain and thermal transient effects
- Laser-welded
- Hermetically sealed (most models)
- Adhesive and stud mount styles



Model 352A73

- 5 mV/g
- 0.51 mV/(m/s²)
- 1.5 to 25k Hz
- 0.3 gm
- Attached cable



Model 352C23

- 5 mV/g
- 0.51 mV/(m/s²)
- 1.5 to 15k Hz
- 0.2 gm
- 3-56 coaxial connector



Model 352C22

- 10 mV/g
- 1.0 mV/(m/s²)
- 0.7 to 13k Hz
- 0.5 gm
- 3-56 coaxial connector



Model 352A21

- 10 mV/g
- 1.0 mV/(m/s²)
- 0.7 to 13k Hz
- 0.6 gm
- 3-56 coaxial connector



Model 353B17

- 10 mV/g
- 1.0 mV/(m/s²)
- 0.7 to 20k Hz
- 1.7 gm
- Integral cable



Model 352C65

- 100 mV/g
- 10.2 mV/(m/s²)
- 0.3 to 12k Hz
- 2.0 gm
- 5-44 coaxial connector



Model 353B33

- 100 mV/g
- 10.2 mV/(m/s²)
- 0.7 to 6500 Hz
- 27 gm
- 10-32 coaxial connector



Model 352C33

- 100 mV/g
- 10.2 mV/(m/s²)
- 0.3 to 15k Hz
- 5.8 gm
- 10-32 coaxial connector



Model 352C44

- 100 mV/g
- 10.2 mV/(m/s²)
- 0.5 to 10k Hz
- 3.0 gm
- 10-32 coaxial connector



Model 355B03

- 100 mV/g
- 10.2 mV/(m/s²)
- 0.6 to 12k Hz
- 10 gm
- 10-32 coaxial connector

Triaxial ICP® Accelerometers

- Measure in three orthogonal directions
- Lightweight titanium construction
- Shear mode sensing geometry
- Single-point hookup for cable or connector



Model 356A01

- 5 mV/g
- 0.51 mV/(m/s²)
- 2 to 8000 Hz
- 1.0 gm
- Integral cable



Model 356B21

- 10 mV/g
- 1.02 mV/(m/s²)
- 2 to 10k Hz
- 4 gm
- 8-36, 4-pin connector



Model 354C10

- 10 mV/g
- 1.02 mV/(m/s²)
- 2 to 8000 Hz
- 5 gm
- 1/4-28, 4-pin connector



Model 356A34

- 50 mV/g
- 5.1 mV/(m/s²)
- 0.7 to 5000 Hz
- 6.6 gm
- 1/4-28, 4-pin connector



Model 356A15

- 100 mV/g
- 10.2 mV/(m/s²)
- 1.4 to 6500 Hz
- 10.5 gm
- 1/4-28, 4-pin connector

Structural Testing & Modal Analysis Products

- ICP® accelerometers with excellent phase characteristics and lightweight construction to minimize mass loading effects
- Intelligent mounting, signal conditioning, and cable routing schemes
- TEDS options – sensors with on-board memory, which report their identity and sensitivity
- Ideal for large channel count and MIMO tests



Model 333B32

- Single axis ICP® accelerometer
- 100 mV/g
- 10.2 mV/(m/s²)
- 0.5 to 3000 Hz
- 4.0 gm
- 10-32 coaxial connector



Model 333B52

- Single axis ICP® accelerometer
- 1000 mV/g
- 102 mV/(m/s²)
- 0.5 to 3000 Hz
- 7.5 gm
- 10-32 coaxial connector



Model 086C03

- ICP® Impact Hammer
- 10 mV/lbf
- 2.25 mV/N
- Frequencies to 8000 Hz
- 0.16 kg hammer mass



Model 333B

- Single axis ICP® accelerometer
- 100 mV/g
- 10.2 mV/(m/s²)
- 2 to 1000 Hz
- Plug-in socket base



Model 356A17

- Triaxial ICP® accelerometer
- 500 mV/g
- 51 mV/(m/s²)
- 0.3 to 4000 Hz
- 1/4-28, 4-pin connector



Model 356B18

- Triaxial ICP® accelerometer
- 1000 mV/g
- 102 mV/(m/s²)
- 0.3 to 5000 Hz
- 25 gm
- 1/4-28, 4-pin connector

High Temperature, Charge Output Accelerometers

- Engines
- Environmental chambers
- Gas turbines
- Radioactive environments



Actual Size

Model 357B06

- Through-hole mounted
- 5 pC/g
- 0.51 pC/(m/s²)
- Response to 15k Hz
- 2.3 gm
- -65 to +500 °F
- -54 to +260 °C



2x Actual Size

Model 357A09

- 1.7 pC/g
- 0.17 pC/(m/s²)
- Response to 13k Hz
- 0.6 gm
- -100 to +350 °F
- -73 to +177 °C



Actual Size

Model 357B81

- 20 pC/g
- 2.04 pC/(m/s²)
- Response to 9000 Hz
- 50 gm
- -65 to +500 °F
- -54 to +260 °C



Actual Size

Model 357B53

- Radiation-hardened
- 100 pC/g
- 10.2 pC/(m/s²)
- Response to 3500 Hz
- 51 gm
- -95 to +500 °F
- -71 to +260 °C



Actual Size

Model 357B03

- 10 pC/g
- 1.02 pC/(m/s²)
- Response to 12k Hz
- 11 gm
- -95 to +500 °F
- -71 to +260 °C



Actual Size

Model 357B61

- Radiation-hardened
- 10 pC/g
- 1.02 pC/(m/s²)
- Response to 5000 Hz
- 30 gm
- -65 to +900 °F
- -54 to +482 °C



Actual Size

Model 357C72

- Differential Output
- 50 pC/g
- 5.1 pC/(m/s²)
- Response to 2500 Hz
- 110 gm
- -65 to +900 °F
- -54 to +482 °C



Actual Size

Model 357B69

- 3 pC/g
- 0.31 pC/(m/s²)
- Response to 6000 Hz
- 14.3 gm
- -65 to +900 °F
- -54 to +482 °C



Actual Size

Model 340A50

- Triaxial, miniature
- 2.7 pC/g
- 0.28 pC/(m/s²)
- Response to 10k Hz
- 11.0 gm
- -94 to +500 °F
- -70 to +260 °C

Shock ICP® Accelerometers

- Individually qualified with high-amplitude Hopkinson Bar test
- Versions with internal filters for resonance suppression



Model 350B24

- 1.0 mV/g
- 0.1 mV/(m/s²)
- 0.4 to 10k Hz
- ± 5000 g pk
- Integral cable/
case isolated



Model 350C02

- 0.1 mV/g
- 0.01 mV/(m/s²)
- 4 to 10k Hz
- ± 50,000 g pk
- Integral cable/
case isolated



Model 350B03

- 0.5 mV/g
- 0.05 mV/(m/s²)
- 4 to 10k Hz
- ± 10,000 g pk
- 10-32 coaxial connector



Model 350B50

- Triaxial
- 0.5 mV/g
- 0.05 mV/(m/s²)
- 3 to 10k Hz
- ± 10,000 g pk
- Integral cable

Low Temperature ICP® Accelerometers

- Cryogenic pump testing
- Liquefied gas delivery systems
- Vacuum pump testing



Model 351B41

- 100 mV/g
- 10.2 mV/(m/s²)
- 0.7 to 3500 Hz
- 40 gm
- -320 to +250 °F
- -196 to +121 °C



Model 351B14

- 5 mV/g
- 0.51 mV/(m/s²)
- 0.7 to 10k Hz
- 1.8 gm
- -320 to +250 °F
- -196 to +121 °C



Model 351B03

- 10 mV/g
- 1.2 mV/(m/s²)
- 0.7 to 9000 Hz
- 10.5 gm
- -320 to +250 °F
- -196 to +121 °C

Low Frequency ICP® Accelerometers

- Bridges & civil structures
- Building vibration
- Floor & foundation monitoring
- Optical instrument studies
- Semiconductor manufacturing
- Site surveys for sensitive equipment



Model 393B05

- 10 V/g
- 1.02 V/(m/s²)
- 0.5 to 750 Hz
- 0.000004 g rms resolution
- 50 gm



Model 393A03

- 1000 mV/g
- 102 mV/(m/s²)
- 0.3 to 4000 Hz
- 0.00001 g rms resolution
- 210 gm



Model 393B31

- 10.0 V/g
- 1.02 V/(m/s²)
- 0.07 to 300 Hz
- 0.000001 g rms resolution
- 635 gm

DC Response Accelerometers

Unlike charge output piezoelectric and ICP® accelerometers, DC response accelerometers possess the capability to measure static or constant acceleration without a low frequency cut off restriction, since their frequency response extends to 0 Hz. PCB® offers several sensing technologies for DC response accelerometers, including piezoresistive and capacitive.

- Aerospace satellite & launch vehicle vibration
- Automotive crash sled testing
- Automotive road & load measurements
- Aviation ground vibration & flight testing
- Centrifuges
- Gravitational force



Model 3711D1FA3G
High Sensitivity DC Response

- ± 3 g range
- 700 mV/g
- 71.4 mV/(m/s²)
- 0 to 100 Hz
- 1.10 mg rms resolution
- 17.5 gm
- Titanium
- Welded case



Model 3713D1FD3G
Triaxial High Sensitivity DC Response

- Measure in three orthogonal directions
- Lightweight titanium construction
- Single-point hookup for cable or connector
- 700 mV/g (71.4 mV/(m/s²))
- 0 to 100 Hz
- 78.1 gm
- 9-pin connector
- Welded case



Model 3741D4HB200G
High Sensitivity DC Response

- ± 200 g range
- 10 mV/g
- 1.02 mV/(m/s²)
- 0 to 1500 Hz
- 5.1 g rms resolution
- 9.92 gm
- Anodized aluminum case

Test & Measurement Equipment Rental

In addition to the sensors and instrumentation shown here for purchase, PCB® sister company **The Modal Shop** offers Test Equipment and Accessory Rental, which allows customers the added flexibility to expand measurement capabilities and "try before you buy." This program allows customers to quickly obtain the most advanced instrumentation and monitors, for short-term or one-time applications, at minimal cost and no down payment required.

Products available for rental include:

- PCB Piezotronics and IMI Sensors ICP® and charge output piezoelectric, piezoresistive, TEDS, capacitive and DC response accelerometers
- Larson Davis Type 1 and Type 2 sound level meters; environmental kits; dosimeters; human vibration meters; microphones and preamplifiers
- A wide variety of data acquisition systems and software
- Signal conditioners, shakers, cables and test supports
- Application engineering consulting



A team of experienced application engineers is available to provide technical guidance and equipment recommendations. Stock products are available for overnight delivery. With The Modal Shop Rental Equity Program, rental payments may also be applied toward eventual equipment purchase. For more information, please contact **The Modal Shop** at (513)351-9919 or visit www.modalshop.com.

Flight Test Accelerometers – For Civilian and Military Applications

For 40 years, PCB® has assisted customers in the Aerospace and Defense industries, with the design and manufacturer of sensors for flight testing and monitoring of fixed wing, rotary aircraft, missiles and launch vehicles. In addition, when testing and monitoring applications require specialized sensor packaging, testing, or performance, PCB® can provide sensors that are custom engineered to meet demanding or unusual tasks. The sensors below represent a small sample of such units.

Quality Standards:

AS9100:2004 certified; ISO 9001:2000 certified; A2LA accredited to ISO 17025; Manufacturing capabilities to certain MIL & aerospace standards; Some designs have been qualified to RTCA-160E.

Recent Programs:

Airbus A380; Boeing 787; Delta Launch; F-18 Flight Test; GEnx™ Engine; Ground Missile Defense (GMD); National Missile Defense; Titan launch vehicle.



Accelerometers for On-board Diagnostics, Engine Monitoring, & Health and Usage Monitoring Systems (HUMS)

- ICP® and charge output types; ceramic and quartz sensing elements
- Molded integral cable; case isolated to reduce ground loop interference/EMI
- Hermetically sealed, stainless steel or Inconel® housing
- Operating temperatures to +900 °F (+482 °C)



1/2 Actual Size

Model 337A31 ICP® Accelerometer

- 10 mV/g
- 1.02 mV/(m/s²)
- 1 to 1000 Hz
- Continuous operation from -60 to +250 °F (-53 to +121 °C)
- Ideal for rotor track and balance



1/2 Actual Size

Model 337A30 ICP® Accelerometer

- 10 mV/g
- 1.02 mV/(m/s²)
- 2 to 15k Hz
- Continuous operation from -30 to +250 °F (-35 to +121 °C)
- Ideal for HUMS



1/2 Actual Size

Model 357C73 Charge Output Accelerometer

- 100 pC/g
- 10.2 pC/(m/s²)
- Response to 2000 Hz
- Continuous operation from -65 to +900 °F (-54 to +482 °C)
- Ideal for engine monitoring

Sensors for Flutter, Buffeting & Load Factor Tests



1/2 Actual Size

Series 3741 High Sensitivity DC Response Accelerometer

- Offered in ranges from 2 to 200 g
- Differential output
- Low-profile design, for mounting on restricted areas of aircraft wings
- Gas damped, temperature compensated for stable measurement in varying environments
- Isolated anodized aluminum housing
- Single & triaxial versions
- Ideal for flutter measurements, extremely low frequency measurements



Actual Size

Model 355B33 Ring Style, Quartz ICP® Accelerometer

- 100 mV/g
- 10.2 mV/(m/s²)
- 2 to 5000 Hz
- Ring-style, stable quartz shear sensing element
- Ideal for vibration measurements on large fixed wing aircraft



Actual Size

Model 352C44/43 Low-profile, Miniature ICP® Accelerometer

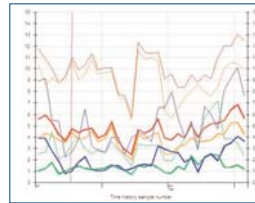
- 100 mV/g
- 10.2 mV/(m/s²)
- 1 to 8000 Hz
- Ground isolated
- Optional high temperature
- Ground vibration testing; modal & structural vibration analysis; general shock & vibration measurement

Special Purpose Products

PCB® offers customers the option to tailor sensors and instrumentation to satisfy virtually any application requirement. Capabilities range from single-copy, exclusive-use devices, to high volume sensors. An extensive commitment of resources for the design, development, manufacture, and test of sensors and instrumentation allows PCB® to respond to customer's needs. Models offered in this section are only a minor representation of available special purpose products. For more information, please consult factory.

Model HVM100 Human Vibration Meter

- Collects hand-arm and whole-body vibration data
- Meets ISO 5346/2631 and EU exposure directives, including 2002/44/EC and HSE (UK) recommended points system
- Connects to single axis, triaxial and ICP® accelerometers
- Offers filtering, integration, and data storage
- Available with dedicated sensors and adaptors for hand tool and seat pad studies
- Provides instantaneous tool assessments with HVManager™ software
- Offloads data to PC for further analysis and reporting with Blaze® software.

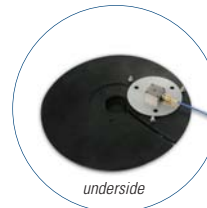


HVManager™ Software

- Creates a tool-based human vibration level database
- Projects tool users daily cumulative vibration exposure
- Simplifies tool use management, to stay within legal limits
- Presents vibration exposure time history graphs for X,Y,Z sum
- Supports compliance with ISO and EC directives

Model 356B41 Seat Pad Triaxial ICP® Accelerometer

- 100 mV/g
- 10.2 mV/(m/s²)
- 0.5 to 1000 Hz
- Integral cable
- 7.87" W × 0.472" H (200 x 12 mm)
- Operates directly with HVM100 for ride comfort studies



- Meets ISO 10326-1, ISO 2631 & ISO 8041 standards; supports compliance with EU Physical Agents Directives

Model 394C06 Handheld Shaker

- Conducts field check of accelerometer sensitivity
- Offers end-to-end system testing and troubleshooting
- Generates 1 g pk or 1 g rms at 159.2 Hz
- Battery operated, AC adaptable
- Provides 80 to 1600 calibration cycles, depending on accelerometer weight



LaserTach™ ICP™ Tachometer

- Simplifies acquisition of rotational speed signals
- Operates via ICP® sensor signal conditioning
- Easy to install – 20 in (0.5 m) range in a standard 5/8-18 UNF threaded package
- BNC output

