Sensor Technologies & Instrumentation

Sensors for Acceleration, Acoustics, Force, Load, Pressure, Shock, Strain, Torque & Vibration

PCB PIEZOTRONICS INC.

IMI SENSORS
A PCB PIEZOTRONICS DIV.

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

Helping You Make Better Measurements With Quality, Innovative Instruments.

PCB Piezotronics, Inc. manufactures accelerometers, force sensors, load cells, microphones, pressure transducers and transmitters, strain sensors, torque sensors, signal conditioners, cables, and accessories. This instrumentation is used for test, measurement, monitoring, and feedback control requirements in automotive, aerospace, industrial, R&D, military, educational, commercial, and OEM applications.

This catalog provides an overview of the products and services made available to you by PCB Piezotronics and its divisions. The sampling of products featured are intended to introduce our capabilities and core competencies. For a more complete product offering with detailed specifications, drawings, photographs, and technical information, please visit:

www.pcb.com

www.imi-sensors.com

www.larsondavis.com

USA Toll-Free Customer Service:
800-828-8840

International Customers:
716-684-0001

Fax:
716-684-0987

E-mail:
info@pcb.com

PCB® Web Site:
www.pcb.com

PCB® 24-Hour SensorLine℠:
716-684-0001

PCB-STC-0207

PCB is ISO 9001:2000 Certified
A2LA Accredited to ISO 17025
AS9100:2004 Certified

PCB is an EOE/AAP Employer

Printed in USA

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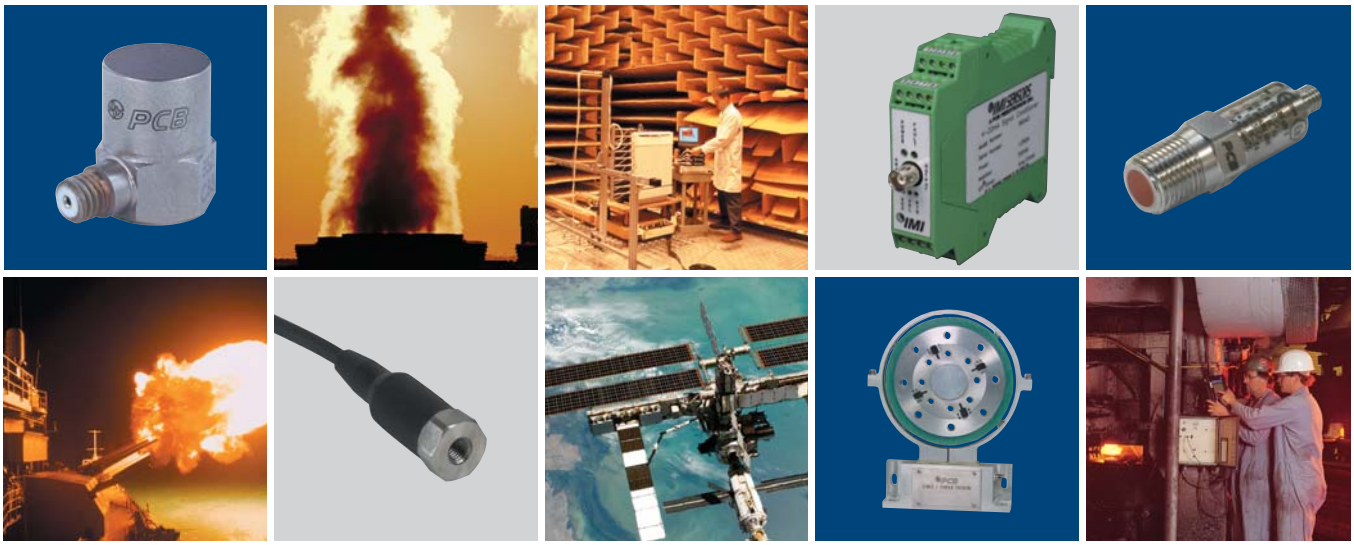


PCB PIEZOTRONICS INC.

About PCB Piezotronics, Inc.

www.pcb.com

Highlights

- PCB Piezotronics, Inc.
- PCB® Group Companies
- Manufacturing Capabilities
- 24-hour Customer Service (SensorLine℠)
- Representation in More than 60 Countries
- ISO 9001:2000 Certified
- A2LA Accredited to ISO 17025
- AS9100:2004 Certified

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

Subsequent growth and steady investment in facilities, machinery, and equipment permit a constant broadening of the product offering. Expanded measurement capabilities include piezoceramic, tourmaline, capacitive, piezoresistive, and strain gage sensing technologies. Ensuing products include industrial and DC response accelerometers, load cells, Modally Tuned® impact hammers, 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 by an unconditional warranty. Factory applications engineering and a worldwide network of sales offices and representatives are readily available 24-hours per day, seven days a week, to assist with customer requests.

Depew, New York

Provo, Utah

Cincinnati, Ohio

Virginia Beach, Virginia

Rochester, New York


Lackawanna, New York

PCB® Group Companies

The PCB "Measurement" Group, is a family of technology based companies offering a wide range of sensor technologies. With PCB Piezotronics as its flagship, individual PCB Group companies and core competencies include:

PCB Piezotronics, Inc. (www.pcb.com) specializes in piezoelectric, ICP®, charge output, piezoresistive and capacitive accelerometers, microphones, pressure sensors, force sensors, load cells, torque sensors, and signal conditioners for test, measurement, monitoring, and research & development.
Toll-free in USA: 800-828-8840 ▪ 24-hour SensorLine℠: 716-684-0001

IMI Sensors (www.imi-sensors.com) division of PCB Piezotronics specializes in vibration sensors, transmitters, switches, instrumentation, and accessories for machinery vibration monitoring and predictive maintenance in harsh industrial environments.
Toll-free in USA: 800-959-4464
24-hour SensorLine℠: 716-684-0001

Larson Davis (www.larsondavis.com) division of PCB Piezotronics specializes in sound level meters and precision microphones, portable and fixed noise monitoring systems, noise dosimeters, human vibration meters, and report generation software for industrial hygiene.
Toll-free in USA: 888-258-3222 ▪ Phone: 716-926-8243

The Modal Shop, Inc. (www.modalshop.com) specializes in multi-channel sound and vibration sensing systems for lab measurements and industrial process monitoring, including calibration systems and test and measurement equipment rental. Also, smart sensing systems applied to parts quality NDT analysis, process monitoring and machinery gauging.
Toll-free in USA: 800-860-4867 ▪ Phone: 513-351-9919

Oceana Sensor Technologies (www.oceanasensor.com) specializes in automated assembly of piezoelectric sensors for high-volume, low-cost OEM applications; Wireless e-Diagnostics® products, highlighting open system wireless platforms, including Bluetooth® and 802.11b.
Phone: 757-426-3678

STI Technologies, Inc. (www.sti-tech.com) is a mechanical engineering consulting firm specializing in finite element analysis, advanced analytical techniques, experimentation, technology development, and design optimization for life prediction, condition-based monitoring, as well as performance enhancement of turbomachinery, rotating machinery systems, and mechanical structures/components.
Phone: 585-424-2010

PCB Machining Solutions, Inc. (www.pcbmsi.com) specializes in precision machine components for the industrial, medical, aerospace, and defense industries. **Phone: 716-823-3193**

Precision Component Manufacturing & Machining

PCB® has a long history of sensor manufacturing and has invested heavily in facilities and equipment to ensure high quality standards and availability of key components. A vertically integrated manufacturing approach keeps PCB® in control of critical parts, processes, and procedures surrounding sensor assembly and testing to meet customer needs. A quality system based on ISO 9001 and AS9100:2004 requirements ensures any non-conforming product or process is addressed in a timely manner for continuous quality improvement. In addition to our 100,000 square foot Sensor Technology Center in Depew, New York; additional manufacturing operations in Lackawanna, New York; Roanoke Rapids, North Carolina; Virginia Beach, Virginia; Provo, Utah; and Cincinnati, Ohio; provide manufacturing support.

In-house Machining Capabilities

- Precision CNC Turning & Milling
- Wire EDM
- Sheet Metal Fabrication
- Grinding
- Lapping and Finishing
- Microscopic Deburring
- Tool Room

Approximately 125,000 individual parts per month are machined in-house using the latest CNC machinery

Skilled machinists create low-volume parts for customized products & engineering prototypes

Lapping and finishing machines provide product finishes down to four micro inches & flatness of three light bands or better; microscoping deburring is available for the most demanding part applications

Crystals Manufacturing

- Raw ceramic & quartz crystals
- Fully equipped mixing, firing & polling facilities
- Ensures quality, expedited delivery & reduced cost

Raw ceramic materials are mixed, fired & polled into a piezoelectric state

Quartz crystal used in piezoelectric sensors

Specialized Machining Components

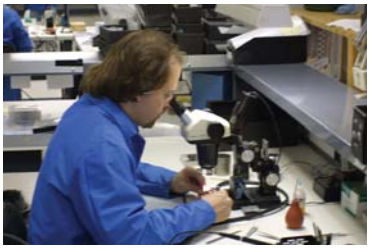
In addition to PCB® manufacturing capabilities shown here, sister company **PCB Machining Solutions, Inc.**, located in Lackawanna, New York, specializes in precision machined components for the Industrial, Aerospace, Defense and Medical industries. PCB Machining Solutions offers an additional 25,000 square feet of machining capability, on state-of-the-art equipment, in their ISO 9001:2000 certified facility. Production runs range from single specialty prototypes to production runs of more than 10,000 pieces. For more information on available services, please visit **www.pcbmsi.com**.

Sensor Microfabrication, Finishing and Housing Capabilities

As part of PCB®'s commitment to quality, in-house sensor finishing capabilities include precision etching of sensors and sensor housing, laser welding, microelectronics fabrication; and hermetic connectors manufacturing and assembly. These processes are internally managed, according to industry standards and our ISO 9001 quality system. With these capabilities, the development of sensors, cables and connectors are molded, manufactured and assembled to fit.

Microelectronics Fabrication & Assembly

- Controlled clean room environment ensures quality
- Sensors are meticulously assembled under microphone
- All technicians highly trained in micro assembly procedures
- Rigorous testing of sensors & components before delivery



Precision sensor assembly under microscope

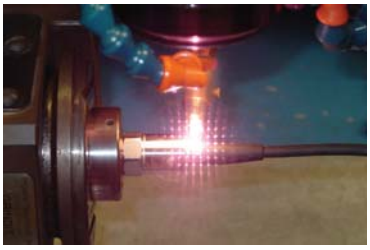
Microelectronic circuit fabrication is conducted in a clean room environment

Electronics assembly utilizes lean manufacturing techniques

Electronic devices are meticulously tested & calibrated to ensure proper performance

Laser Welding/Etching

- Precision parts marking without damage to housing
- State-of-the-art marking machines with fiber optic beam delivery system
- Single units to high volume runs may be accommodated



Laser welding fuses metal parts together without excessive heat, which could be damaging to internal electronics

Glove box handling with laser welding permits inert gas to be added within the sensor

Cables & Connector Manufacturing

- Injector molded connectors
- Hermetically sealed electrical connectors
- Specialty cables & connectors to meet specific customer requests

Electrical connectors with glass-to-metal fused hermetic sealing are processed in a conveyor furnace

Injection molding for watertight sealing of submersible integral cables, cable strain relieving boots & sensor accessories

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.

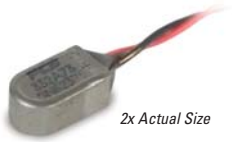
What are ICP® sensors?

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



2x Actual Size

Model 352A73
- 5 mV/g
- 0.51 mV/(m/s²)
- 1.5 to 25k Hz
- 0.3 gm
- Attached cable

2x Actual Size

Model 352C23
- 5 mV/g
- 0.51 mV/(m/s²)
- 1.5 to 15k Hz
- 0.2 gm
- 3-56 coaxial connector

2x Actual Size

Model 352C22
- 10 mV/g
- 1.0 mV/(m/s²)
- 0.7 to 13k Hz
- 0.5 gm
- 3-56 coaxial connector

2x Actual Size

Model 352A21
- 10 mV/g
- 1.0 mV/(m/s²)
- 0.7 to 13k Hz
- 0.6 gm
- 3-56 coaxial connector

Actual Size

Model 353B17
- 10 mV/g
- 1.0 mV/(m/s²)
- 0.7 to 20k Hz
- 1.7 gm
- Integral cable

Actual Size

Model 352C65
- 100 mV/g
- 10.2 mV/(m/s²)
- 0.3 to 12k Hz
- 2.0 gm
- 5-44 coaxial connector

Actual Size

Model 353B33
- 100 mV/g
- 10.2 mV/(m/s²)
- 0.7 to 6500 Hz
- 27 gm
- 10-32 coaxial connector

Actual Size

Model 352C33
- 100 mV/g
- 10.2 mV/(m/s²)
- 0.3 to 15k Hz
- 5.8 gm
- 10-32 coaxial connector

Actual Size

Model 352C44
- 100 mV/g
- 10.2 mV/(m/s²)
- 0.5 to 10k Hz
- 3.0 gm
- 10-32 coaxial connector

Actual Size

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

Actual Size

Model 356A01
- 5 mV/g
- 0.51 mV/(m/s²)
- 2 to 8000 Hz
- 1.0 gm
- Integral cable

Actual Size

Model 356B21
- 10 mV/g
- 1.02 mV/(m/s²)
- 2 to 10k Hz
- 4 gm
- 8-36, 4-pin connector

Actual Size

Model 354C10
- 10 mV/g
- 1.02 mV/(m/s²)
- 2 to 8000 Hz
- 5 gm
- 1/4-28, 4-pin connector

Actual Size

Model 356A34
- 50 mV/g
- 5.1 mV/(m/s²)
- 0.7 to 5000 Hz
- 6.6 gm
- 1/4-28, 4-pin connector

Actual Size

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

Actual Size

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

Actual Size

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

Actual Size

Model 333B
- Single axis ICP® accelerometer
- 100 mV/g
- 10.2 mV/(m/s²)
- 2 to 1000 Hz
- Plug-in socket base

Actual Size

Model 356A17
- Triaxial ICP® accelerometer
- 500 mV/g
- 51 mV/(m/s²)
- 0.3 to 4000 Hz
- 1/4-28, 4-pin connector

Actual Size

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

Actual Size

Model 350B24
- 1.0 mV/g
- 0.1 mV/(m/s²)
- 0.4 to 10k Hz
- ± 5000 g pk
- Integral cable/ case isolated

Actual Size

Model 350C02
- 0.1 mV/g
- 0.01 mV/(m/s²)
- 4 to 10k Hz
- ± 50,000 g pk
- Integral cable/ case isolated

Actual Size

Model 350B03
- 0.5 mV/g
- 0.05 mV/(m/s²)
- 0.4 to 10k Hz
- ± 10,000 g pk
- 10-32 coaxial connector


Actual Size

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

Actual Size

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

Actual Size

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

Actual Size

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

1/2 Actual Size

Model 393B05
- 10 V/g
- 1.02 V/(m/s²)
- 0.5 to 750 Hz
- 0.000004 g rms resolution
- 50 gm

1/2 Actual Size

Model 393A03
- 1000 mV/g
- 102 mV/(m/s²)
- 0.3 to 4000 Hz
- 0.00001 g rms resolution
- 210 gm

1/2 Actual Size

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

1/2 Actual Size

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

1/2 Actual Size

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

1/2 Actual Size

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

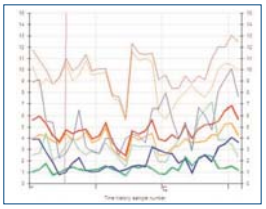
PCB® offers customers the option to tailor sensors and instrumentation to satisfy virtually any application requirement. Capabilities range from single-copy, exclusive-use devices, to high volume sensors. An extensive commitment of resources for the design, development, manufacture, and test of sensors 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/s^2)
- 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


underside

- 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


1/2 Actual Size

Industrial Vibration Monitoring

Rugged Sensors and Instrumentation for Continuous Vibration Monitoring, Predictive Maintenance & Machinery Protection

Typical Applications

Machinery

- Bearings
- Compressors
- Cooling Towers
- Fans
- Gearboxes
- HVAC Equipment
- Machine Tools
- Motors
- Pumps
- Turbines

Industries

- Aggregate & Concrete
- Assembly Plants
- Food, Dairy & Beverage
- Mining
- Navy
- Petrochemical
- Pharmaceutical
- Power Generation
- Pulp & Paper
- Steel & Aluminum
- Transportation
- Water & Waste Treatment

Industrial Vibration Monitoring

The IMI Sensors division of PCB® offers a vast selection of industrial accelerometers, vibration sensors, vibration switches, vibration transmitters, switch boxes, cables, and accessories for industrial and shipboard machinery health monitoring, analysis, and diagnostics. Sensors are available with choice of connector, integral cable, temperature signal output, velocity signal output, and hazardous area approval. Determining machinery health through vibration monitoring has proven effective for maintenance planning, reducing downtime, and avoiding catastrophic loss. Whether it's a cooling tower fan motor or a paper machine calendar bearing, we can help, with sensors that are off-the-shelf or custom designed for a specific application.

What is an "industrial" accelerometer?

Industrial accelerometers are built to endure the rigors of harsh factory environments. They are typically constructed with stainless steel housings to survive exposure to corrosive chemicals. Welded construction and hermetic sealing guard against any influx of dirt, oil, and other contaminants. Heavy duty electrical connectors are used to permit interface with strong, durable cables. Sealed, integral cables may be utilized to tolerate exposure to fluids, wash-down conditions, or submersion. Armored cables offer further protection from metal chips or being pinched or crushed.

Additionally, filtering is normally included to guard against RF interference caused by wireless communication equipment and high frequency saturation. Electrical case isolation and faraday shielding are used to protect against electromagnetic interference, surface noise pickup, and ground loop problems. Additional circuitry is normally included to guard against damage from mis-wiring and exposure to electrostatic discharge. These attributes permit industrial accelerometers to provide uncorrupted measurements and years of trouble-free, unattended service.

About Accelerometer Specifications…

The following specifications are common to **all** IMI accelerometers, unless otherwise noted:

- -65 to +250 °F (-54 to +121 °C)
- 1/4-28 mounting thread (M6 for metric versions)
- 2-pin MIL-C-5015 connector (Integral cable models also available with connector options)

Low-cost Industrial ICP® Accelerometers

- Ideal for permanent installations and use with continuous, on-line monitoring systems
- Promote safety when installed in hazardous or inaccessible locations
- Connect through switch or junction box for route-based data collection schemes
- NIST traceable, single-point calibration at 100 Hz
- Intrinsically safe versions available

Model 603C01

- 100 mV/g
- 10.2 mV/(m/s²)
- 0.4 to 10k Hz
- 26 to 600k cpm
- 11/16" hex × 1.65" (42 mm) H
- 1.8 oz (51 gm)

Model 601A01

- 100 mV/g
- 10.2 mV/(m/s²)
- 0.3 to 10k Hz
- 16 to 600k cpm
- 7/8" hex × 1.94" (49.3 mm) H
- 2.8 oz (80 gm)

Model 602D01

- 100 mV/g
- 10.2 mV/(m/s²)
- 0.5 to 8000 Hz
- 30 to 480k cpm
- 1.65" L × 0.74" W × 0.85" H (41.9 × 18.8 × 21.6 mm)
- 2.75 oz (78 gm)

Model 608A11

- 100 mV/g
- 10.2 mV/(m/s²)
- 0.4 to 10k Hz
- 26 to 600k cpm
- 9/16" hex × 2.5" (63.5 mm) H
- 1.8 oz (51 gm)

Precision Industrial ICP® Accelerometers

- Ideal for roving use with route-based data collectors
- Utilize for effective machinery analysis and fault diagnostics
- Velocity output, temperature output, high temperature (+325 °F/+163 °C), and intrinsically safe version available
- NIST traceable calibration through full frequency range

Model 626B02
Low Frequency
- 500 mV/g
- 51 mV/(m/s²)
- 0.2 to 6000 Hz
- 12 to 360k cpm
- 1-3/16" hex × 2.19" (55.6 mm) H
- 7.0 oz (199 gm)

Model 625B01
Low Frequency
- 100 mV/g
- 10.2 mV/(m/s²)
- 0.2 to 10.5k Hz
- 12 to 630k cpm
- 1.38" Dia × 1.13" H (35.1 × 28.7 mm)
- 5.1 oz (145 gm)

Model 625B02
Low Frequency
- 500 mV/g
- 51 mV/(m/s²)
- 0.2 to 6000 Hz
- 12 to 360k cpm
- 1.38" Dia × 1.13" H (35.1 × 28.7 mm)
- 6.1 oz (173 gm)

Model 622A01
- 100 mV/g
- 10.2 mV/(m/s²)
- 0.2 to 10k Hz
- 12 to 600k cpm
- 7/8" hex × 2.06" (52.3 mm) H
- 3.3 oz (94 gm)

Model 621B40
- High Frequency, even with a magnet
- 10 mV/g
- 1.02 mV(m/s²)
- 1.6 to 30k Hz
- 96 to 1800k cpm
- 5-40 mounting thread
- M3 for metric versions
- 0.10 oz (2.8 gm)

Model 623C01
High Frequency
- 100 mV/g
- 10.2 mV(m/s²)
- 0.8 to 15k Hz
- 48 to 900k cpm
- 11/16" hex × 1.97" (50 mm) H
- 1.8 oz (51 gm)

Multi-axis Industrial ICP® Accelerometers

- Measure acceleration simultaneously in up to three axes
- Through-bolt mounting for simplified alignment
- Simultaneous radial and axial bearing vibration measurements
- Interface directly with vibration data collectors and FFT analyzers
- Intrinsically safe versions available

Model 629A31
Triaxial
- 100 mV/g (all axes)
- 10.2 mV/(m/s²)
- 0.8 to 8000 Hz (all axes)
- 48 to 480k cpm
- 1.5" L × 1.5" W × 0.82" H (38.1 × 38.1 × 20.8 mm)
- 4.9 oz (139 gm)

Model 604B31
Triaxial
- 100 mV/g (all axes)
- 10.2 mV/(m/s²)
- 0.5 to 5000 Hz (all axes)
- 30 to 300k cpm
- 1.38" Dia × 1" H (35.1 × 25.4 mm)
- 4.4 oz (124 gm)

Model 605B61
Biaxial
- 100 mV/g (all axes)
- 10.2 mV/(m/s²)
- 0.5 to 5000 Hz
- 30 to 600k cpm
- 1.38" Dia × 1" H (35.1 × 25.4 mm)
- 4.0 oz (113.3 gm)

Swivel-mount Industrial ICP® Accelerometers

- Easy-to-install, patented, swivel mount design *(US Patent No. 6,435,902)*
- Cable rotates to any desired orientation
- Smaller and less costly than ring-style sensors
- Electrically protected from saturation problems
- Excellent for use on high-speed rotating machinery & spindles
- Available with temperature output
- Intrinsically safe versions available

Model 607A61 Spindler®
- 100 mV/g
- 10.2 mV/(m/s²)
- 0.5 to 10k Hz
- 30 to 600k cpm
- 9/16" hex × 1.0" (25.4 mm) H
- 1.1 oz (31 gm)

Model 607A01 Swiveler®
- 100 mV/g
- 10.2 mV/(m/s²)
- 0.5 to 10k Hz
- 30 to 600k cpm
- 7/8" hex × 1.23" (31.2 mm) H
- 3.7 oz (105 gm)

Model 607A11 Swiveler®
- 100 mV/g
- 10.2 mV/(m/s²)
- 0.5 to 10k Hz
- 30 to 600k cpm
- 9/16" hex × 0.97" (24.6 mm) H
- 1.1 oz (31 gm)

High Temperature Accelerometers

- Survive elevated surface or ambient temperatures
- Ideal for monitoring paper machines, steam handling systems, gas turbines, engines, & in steel mills
- Operate up to +900 °F (+482 °C)

Model 600A03
(+500 °F/+260 °C)
Accelerometer Kit
- Includes sensor, armor cable, & charge converter
- 100 mV/g
- 10.2 mV/(m/s²)
- 1 to 10k Hz
- 60 to 600k cpm
- -65 to +500 °F (-54 to +260 °C)

Model 600A13
(+900 °F/+482 °C)
Accelerometer Kit
- Includes sensor, hardline cable & differential charge converter
- 100 mV/g
- 10.2 mV/(m/s²)
- 2 to 8500 Hz
- 120 to 510k cpm
- -65 to +900 °F (-54 to +482 °C)

Model HT622A01
(+325 °F/+163 °C)
ICP® Accelerometer
- 100 mV/g
- 10.2 mV/(m/s²)
- 0.2 to 8000 Hz
- 12 to 480k cpm
- -65 to +325 °F (-54 to +163 °C)
- 7/8" hex × 2.0" (50.8 mm) H
- 3.3 oz (93 gm)

4-20 mA Industrial Vibration Sensors

- Adapts analog vibration signals to process monitoring instruments
- Facilitates low-cost, continuous vibration monitoring
- Connects to PLC, alarm & SCADA systems
- Two-wire, loop-powered
- Outputs proportional to peak velocity, rms velocity, or rms acceleration
- Optional analog vibration output signal for diagnostics
- Optional temperature output signal
- Optional raw vibration output signal
- Explosion-proof & intrinsically safe versions for all models
- High temperature models available to +257 °F (+125 °C)

Model 640B01

- 0.0 to 1.0 in/sec peak
- 0.0 to 25.4 mm/sec peak
- 180 to 60k cpm (3 to 1000 Hz)
- -40 to +185 °F (-40 to +85 °C)

Model 640B11

- 0.0 to 1.0 in/sec peak
- 0.0 to 25.4 mm/sec peak
- 180 to 60k cpm (3 to 1000 Hz)
- -40 to +185 °F (-40 to +85 °C)

Model 642A01

- 0.0 to 1.0 in/sec peak
- 0.0 to 25.4 mm/sec peak
- 180 to 60k cpm (3 to 1000 Hz)
- -40 to +185 °F (-40 to +85 °C)

Model 641B61

- 0.0 to 1.0 in/sec RMS
- 0.0 to 25.4 mm/sec RMS
- 600 to 60k cpm (10 to 1000 Hz)
- -40 to +185 °F (-40 to +85 °C)

Model EX640B71

- ATEX/ CSA approved intrinsically safe
- 0.0 to 1.0 in/sec peak
- 0.0 to 25.4 mm/sec peak
- 180 to 60k cpm, (3 to 1000 Hz)
- -40 to +176 °F (-40 to +80 °C)

Vibration Transmitters

- Interface vibration signals with PLC, alarm & SCADA systems

Model 682A03
- Accepts ICP® accelerometer input
- 4-20 mA output for rms acceleration, peak velocity, or peak-to-peak displacement with filtering options
- Analog vibration output signal for fault diagnostics
- Additional 4-20 mA output for temperature is available

Model 682A05
Bearing Fault Detector
(US Patent No. 6,889,553)
- Accepts ICP® accelerometer input
- Detects impacting faults due to bearing and gear problems
- Provides dual 4-20 mA signals for peaks & overall vibration
- Provides analog vibration output signal for fault diagnostics

Model 649A01
Reciprocating Machinery Protector
(patent pending)
- Detects faults and mechanical looseness in reciprocating compressors
- Improves on existing impact monitoring technology
- Provides continuous trending, with alarm and alert levels for early warning
- Field programmable set points & alarm levels optimize performance
- Hermetically sealed, loop-powered design

Vibration Alarms

- Accept vibration sensor input signals, detect vibration threshold exceedance, and provide relay outputs for alarm, annunciation, or emergency shutdown
- Versions for use with either ICP® or 4-20 mA vibration sensors. Digital display shows measured vibration level & provides visual alarm indication

Series 683
1/8 DIN Panel Mount Indicator/Alarm
- Provides loop power for two-wire 4-20 mA sensors
- Optional version provides ICP® sensor excitation
- Four-digit, high visibility LED display
- Offers up to four, user-programmable set points with relay outputs
- Time delay feature eliminates false alarms due to momentary upsets
- Optional 4-20 mA retransmission

Series 684
Indicator/Alarm Enclosures
- Available in two sizes
- Accommodates up to eight Series 683A indicators/alarms
- Optional BNC outputs for analog vibration signals

Model 682A06
Universal Transmitter
- Provides loop power for two-wire, 4-20 mA sensors and transmitters
- Accepts mA, VDC, RTD, TC, linear resistance, and potentiometer inputs
- Delivers current and voltage output signals
- Offers two set points with Form A relay outputs (2 amp AC, 1 amp DC)
- Fully programmable via detachable pushbutton display (**Model 070A80**)

Vibration Switches

- Provide essential protection for critical machinery
- Fully self-contained with vibration sensor & relay for alarm or shutdown
- Explosion proof versions
- Time delay included for all electronic versions
- Hermetically sealed versions available
- Remote reset options

Series 686A
Smart Vibration Switch
(patent pending)

- Universal, AC or DC-powered
- Hermetically sealed
- Built-in accelerometer
- Microprocessor controlled
- Two-wire simplicity
- Single relay
- Small footprint
- Magnetically Adjustable Vibration Threshold (MAVT™)

Series 685B

- Built-in or remote accelerometer
- Dual relays with time delay
- Analog output signal for diagnostics
- 4-20 mA overall vibration output
- Calibration signal insertion for accurate set-up
- AC or DC-powered (factory set)

Series 685Ax1

- Built-in accelerometer
- Single relay with time delay
- DC-powered

Models 685A07

- Spring-magnet actuated
- Single relay
- No power required
- NEMA 4 enclosure

Models 685A08

- Spring-magnet actuated
- Single relay
- No power required
- CSA/UL approved explosion-proof enclosure

Switch Boxes and Termination Boxes

- Simplify data collection by routing sensor cables to one central location
- Promote data collection safety by keeping workers out of hazardous areas
- Access more data points in less time
- Versions from 1 to 48 channels

Model 687A01 Portable Vibration Meter Kit

- Measures rms vibration levels
- 3-1/2 digit LCD display
- Headphones offer audible monitoring
- Supplied with **Model 603C01** industrial ICP® accelerometer, coiled cable & magnet

Cables and Installation Accessories

Magnetic Mounting Bases

Spot Face Preparation Tools

Cable Assemblies

Calibration Shakers

Model 699A02
Handheld Calibration Shaker

- 1 g RMS or 1 g peak output @ 159.2 Hz
- Battery operated (4 AA) or DC power supply option for continuous use
- Supplied nylon carrying pouch with belt loop

Model 699A04
Portable Calibration Shaker

- Choice of acceleration, velocity, or displacement
- Variable frequency and amplitude
- Built in NIST traceable reference accelerometer
- Calibrates instruments up to 8 lb (3.63 kg)
- Ideal for calibrating heavy instruments & switches

Acoustics, Sound, and Noise

Sound Level Meters, Noise Dosimeters, Microphones, Software, and Accessories for Precision Acoustic Measurements, Analysis, Troubleshooting, and Noise Exposure Monitoring

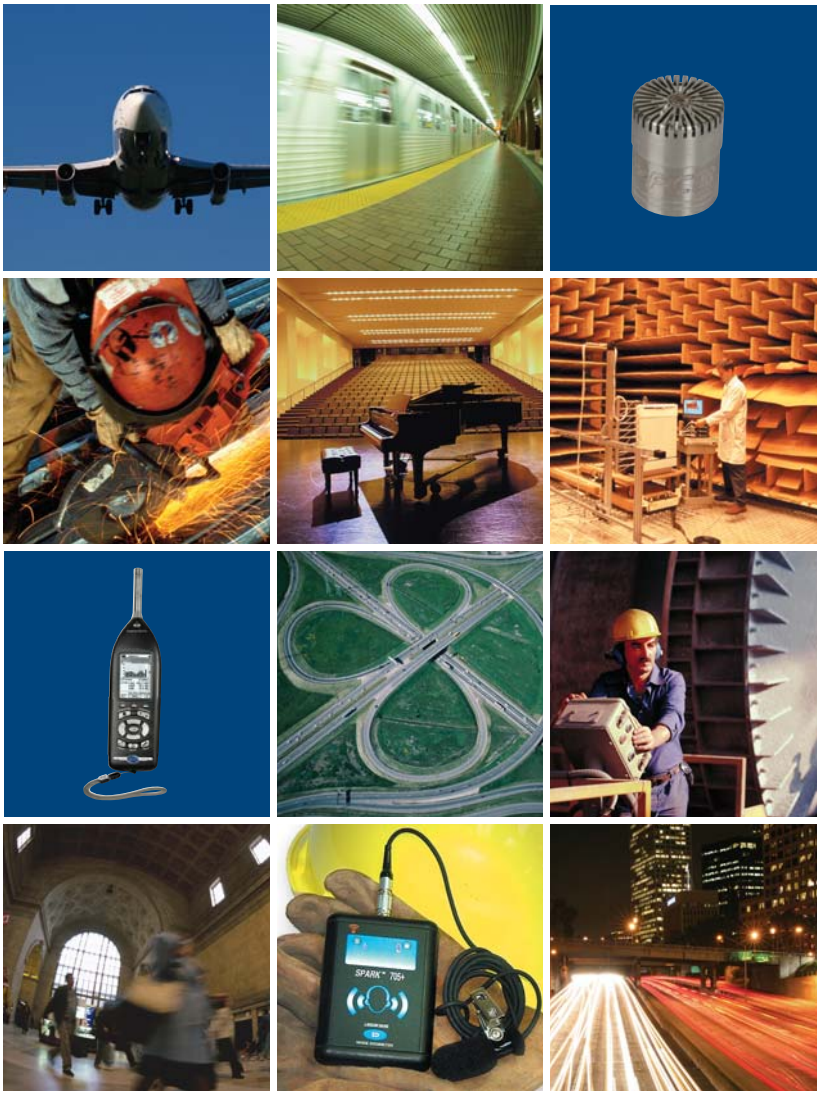
Typical Applications

Product Testing

- Acoustic Chamber Testing
- Acoustic Mode Analysis
- Appliance Noise
- Audiometric Calibration
- Cabin Noise
- Engine Noise Analysis
- Exhaust Pressure Pulsations
- Near-field Acoustic Holography
- Reverberation
- Sound Insulation & Absorption
- Sound Intensity
- Sound Power Testing
- Sound Pressure Mapping
- Tool Noise
- Vibro-acoustic Testing
- Wildlife Studies

Environmental Noise

- Aircraft Noise
- Airport Noise Monitoring
- Artillery Noise
- Building Acoustics
- Community Noise
- Factory Noise
- Industrial Hygiene
- Industrial Noise
- Jet Engine Noise
- Machinery Noise
- Noise Barrier Studies
- Noise Control Engineering
- Occupational Noise
- Sonic Boom
- Traffic Noise
- Transportation Noise
- Vehicle Passby



Acoustics, Sound, and Noise

PCB® and Larson Davis offer some of the most innovative acoustic analysis instruments available anywhere. Advanced sound level meters offer intuitive operation and a host of features to support all types of measurement, analysis, and monitoring tasks. Microphones and preamplifiers are manufactured to exacting standards for conducting precision measurements. Intelligent occupational noise dosimeters help assess noise exposure, while straightforward software aids in data management and compliance reporting. Whether the sound or noise is audible, ultrasonic, subsonic, desired, or undesired – we can help, with sensors and instruments that will satisfy virtually any acoustic measurement and analysis requirement. Products shown are also available for rental through The Modal Shop. *(see page 9 for details)*

Sound Level Meters

Model 831
Sound Level Meter for Environmental Noise

- Exceedance based logging
- Multiple communication options, including GPRS
- 2 GB data storage, including audio recording
- Small, lightweight, ergonomic design
- Interval 1/1 and 1/3 octave analysis
- Interfaces to outdoor microphones, up to 300 ft (91.4 m)
- Optional environmental enclosure
- Interfaces with DNA software for data reporting

System 824
Sound Level Meter & Real Time Analyzer

- Advanced sound level measurements
- Audiometer calibration (when used with AUDit™ software)
- Building acoustics
- Environmental noise monitoring
- Real-time FFT analysis
- Interfaces with DNA & AUDit™ software for data reporting

SoundTrack LxT®
Sound Level Meter for Safety & Health Professionals

- Real time 1/1 & 1/3 octave analysis
- Overall data capture with time history
- Simple operation – with just one hand
- Multiple dose & exposure calculations
- 16-hour battery runtime
- Available as Class 1 or Class 2
- Interfaces with Blaze® & DNA software for data reporting

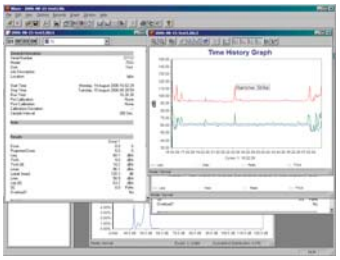
Spark® Occupational Noise Dosimeters

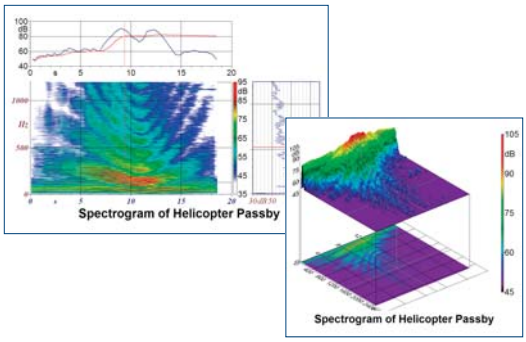
- Seven models, most with 100-hour battery life
- Universal noise exposure results with choice of multiple dose parameters
- Conforms to ANSI and IEC standards for dosimeters
- Conforms to MSHA, UL, ULC & ATEX standards for intrinsic safety
- High-speed IR data transfer to PC or 706RC without cable
- Interfaces with Blaze® software

Spark® Model		Major Features
703	Basic logging dosimeter (no LCD or keypad)	Downloads basic and summary reports to PC, controlled with Blaze®
703+	Logging dosimeter; remote response enabled (no LCD or keypad)	Complete report generation with Blaze®; can be operated, interrogated by 706RC
704	Stand-alone dosimeter for quick & easy measurements (with LCD and keypad)	Displays complete data; 4 doses, each with unique user defined settings
705	Logging dosimeter – super duty (no LCD or keypad)	Downloads basic and summary reports to PC, controlled with Blaze®
705+	Logging dosimeter – super duty; remote response (no LCD or keypad)	Complete report generation with Blaze®; can be operated, interrogated by 706RC or PC
706	Fully featured stand alone dosimeter, remote response	Complete report generation with Blaze®; can be operated, interrogated by 706RC or PC
706RC	Fully featured dosimeter with LCD, keypad & remote control capability	Full report generation using Blaze®; gives surrogate display for 703+ or 705+ Remote control function allows setup & control of other remote response Spark® dosimeters; interrogates & stores data from multiple dosimeters

Software

Larson Davis offers set-up utility and data analysis software to support sound level meters for remote noise monitoring & acoustic data logging.





Blaze®

for Spark®, HVM100 & SoundTrack LxT®

- Provides set-up, data downloading and reporting for Spark® dosimeters, HVM100 & SoundTrack LxT®
- Exposure data and work shift graph on a single page
- Integral exposure database
- "What if" analysis of administrative or engineering controls

DNA (Data, Navigation & Analysis)

for Series 831, 824 & SoundTrack LxT® & HVM100

- Recorded sound analysis
- Environmental noise analysis
- Provides data capture, analysis, & graphical reporting for sound level meters
- Remote data collection
- Room & building acoustics
- Statistical & spectral analysis
- Vibration analysis, including FFT

AUDit™ & System 824 Audiometric Calibration & Electro-Acoustic Test System

- Supra-aural, bone vibration, extended frequency earphone testing, TDH earphone & hearing aid testing
- Automatically correct RETSPL's, microphone, coupler & other software adjustments
- Calibrate hearing level; linearity; frequency accuracy & total harmonic distortion
- Qualify booth ambient noise with real-time 1/3 analysis & fast pass/fail results for ANSI S3.1-1991

Test and Measurement Microphones

PCB® offers both externally polarized and prepolarized (also know as "electret") microphones. Both types require a preamplifier for operation; however, prepolarized types may be powered with low voltage, constant current (2-20 mA) ICP® sensor signal conditioners and coaxial cables for an overall lower cost-per-channel. Externally polarized microphones require a 200 V polarization voltage. Free-field, random incidence, and pressure response versions are available for each microphone type. All microphones are individually tested for performance. A2LA accredited microphone calibration services are also available, for both PCB® and competitor models.

Precision Acoustic Microphones

- Modern prepolarized (electret) or traditional externally polarized types
- Can be utilized with Type 1 systems
- Meet IEC & ANSI standards

Actual Size

Model 377A50
- 1/8" pressure response
- 40 to 178 dB dynamic range
- 6.5 to 140k Hz

Actual Size

Model 377A12
- 1/4" pressure response
- 30 to 187 dB dynamic range
- 4 to 20k Hz

Actual Size

Model 377B02
- 1/2" free-field response
- 15 to 146 dB dynamic range
- 3.15 to 20k Hz

Actual Size

Model 377A60
- 1/2" externally polarized, random incidence
- 15 to 146 dB dynamic range
- 3.15 to 10k Hz

Actual Size

Model 377A42
- 1" free-field response
- 10 to 146 dB dynamic range
- 2.6 to 20k Hz

Preamplifiers

- Small and rugged
- Stainless steel housing
- Low noise floor
- Wide frequency bandwidth
- Compatible with ICP™ or 200 V externally polarized microphones

1/2 Actual Size

Model 426A30
- Compatible with 200 V externally polarized microphones
- 1/2" diameter
- -0.25 dB attenuation

1/2 Actual Size

Model 426A11
- Compatible with ICP™ prepolarized microphones
- 1/2" diameter
- Gain and filter switches

1/2 Actual Size

Model 426E01
- Compatible with ICP™ prepolarized microphones
- 1/2" diameter
- 2-wire operation; operates from ICP® sensor power
- -0.04 dB attenuation

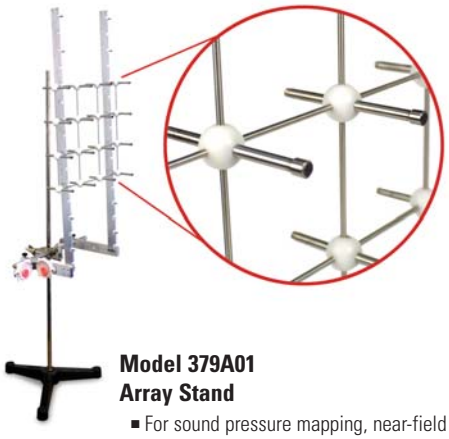
Actual Size

Model 426B03
- Compatible with ICP™ prepolarized microphones
- 1/4" diameter
- -0.25 dB attenuation

Model 480A25
Preamplifier Power Supply
- 0 & 200 V polarization voltage
- 0, 20 & 40 dB gain
- 7-pin LEMO input connector
- Extended battery life (40 hours)
- Selectable flat(Z), A & C weighting
- 8.02" L × 4.10" W × 1.29" H (204 × 104 × 32.8 mm)

ICP™ Array Microphones

- Cost-effective electret microphones for multi-channel measurements
- Integral preamplifier
- Operate from ICP® sensor power
- Interchangeable with ICP® accelerometer set-ups
- Array kits available for multi-channel applications
- TEDS compatible



Model 379A01
Array Stand

- For sound pressure mapping, near-field acoustic holography & vibro-acoustic testing
- Accommodates installing array microphones in a grid pattern
- Adjustable grid sizes & configurations
- Pivots and rotates to accommodate test requirements

Actual Size

Model 130D20

- 1/4" free-field response
- 30 to 122 dB range
- 20 to 15k Hz
- BNC connector

Actual Size

Model 130D21

- 1/4" free-field response
- 30 to 122 dB range
- 20 to 15k Hz
- 10-32 connector

Acoustic Calibrators

- For microphones that meet IEC and ANSI standards
- Lightweight, portable and battery operated
- Available with optional adaptors for a variety of microphone diameters

Model CAL200

- 1/8", 1/4" & 1/2" microphones (with optional adaptors)
- 1k Hz ± 1% frequency
- 94 dB, 114 dB ± 0.2 dB output level (re 20 µPa)
- Type 1 & Type 2 versions
- 4.18" L × 2.5" W × 1.02" D (106.1 × 63.4 × 25.9 mm)

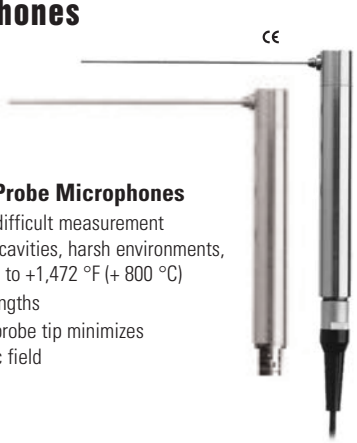
Model CAL250

- 1/8", 1/4", 1/2" & 1" microphones (with optional adaptors)
- 251.2 Hz ± 2.0 Hz frequency
- 114 dB, ± 0.1 dB output level (re 20 µPa)
- Automatic barometric pressure compensation
- 4.9" L × 1.75" Dia (124 × 44.5 mm)

Model 079A31

- 8-channel calibration coupler (for use with CAL250)

Specialty Microphones



High Temperature Probe Microphones

- Designed for use in difficult measurement environments, small cavities, harsh environments, or high temperatures to +1,472 °F (+ 800 °C)
- Multiple probe tip lengths
- High acoustic input probe tip minimizes influence on acoustic field

Low-profile Surface Microphone

- For automotive, aeronautical & general acoustic, sound pressure level testing
- 20 to 15k Hz
- 40 to 122 dB range
- Operates from ICP® sensor power

Microphone Accessories

Windscreens

Nose Cones

Adaptors/Holders

A-weight Filter
Compatible with ICP™ microphone preamplifiers

Cables

Microphone Stands

High Amplitude Acoustic Pressure Sensors

High sensitivity piezoelectric pressure sensors are well-suited for high-amplitude acoustic measurements in gases and liquids. They are capable of surviving extreme temperatures and fluid environments in which condenser microphones would normally fail. Fluid-borne noise, jet engine noise, air turbulence, and pulsation detection represent just a few measurement capabilities of such piezoelectric pressure sensors.

High Amplitude Acoustic Pressure Sensors

Series 103
ICP® Pressure Sensors

- 181 to 190 dB
- 13k Hz
- -100 to +250 °F (-73 to +121 °C)

Model 106B
ICP® Pressure Sensor

- 189 db
- 60k Hz
- -65 to +250 °F (-54 to +121 °C)

Series 106B51
ICP® Pressure Sensor

- 170 to 185 db
- 40k Hz
- -65 to +250 °F (-54 to +121 °C)

Series 116B
Charge Output Pressure Sensor

- 211 db
- 60k Hz
- -400 to +750 °F (-240 to +400 °C)

Pressure Sensors and Transmitters

For Test, Measurement, Monitoring, Research & Development

Typical Applications

Combustion
- Combustion Profiles
- Compression
- Fuel Burn Instabilities
- Fuel Injection
- Knock Detection

Explosives Testing
- Air Blast
- Ballistics
- Bubble Energy
- Closed Bombs
- Impulse
- Propellant Studies
- Shock Waves
- Time-of-arrival
- Underwater Blast

Process Monitoring
- Compressor Tuning & Monitoring
- Engine Test Stands
- Gas & Stream Turbine Performance
- Hydraulic Systems
- Liquid Level
- Pump Monitoring
- Surges
- Valve Dynamics
- Wind Tunnels

Product Testing
- Cavitations
- Flow Instabilities
- Fluctuations
- Fluid Pulsations
- Hydraulic Pulsations
- Pneumatic Pulsations
- Turbulence
- Water Hammer

Pressure Sensors and Transmitters

PCB® offers a wide variety of pressure sensors to satisfy a multitude of dynamic and static pressure measurement requirements. Piezoelectric, strain gage, thin film, and piezoresistive sensing technologies are offered. Whether it's a pharmaceutical injection design application, an explosives test, or a combustion instability study of a rocket motor, we can help with sensors, that are off-the-shelf or custom designed for the specific application.

Differences between static and dynamic pressure sensors.

Static pressure sensors most often use strain gage, piezoresistive, or capacitive sensing technologies. Such devices are capable of measuring slowly changing or static pressures and are ideal for many process monitoring requirements. Although some specialty silicon based sensors can achieve higher frequencies and faster rise times, most static pressure sensors have a response limited to about 1000 Hz and a respective 1 msec rise time. Potentially damaging pressure changes that occur faster than this can be missed by these sensors.

Dynamic pressure sensors are characterized by their ability to respond within microseconds and achieve frequencies well beyond 100k Hz. They most often use piezoelectric quartz sensing technology, however, other piezoelectric crystals may be used depending upon the application. Since piezoelectric sensors are AC coupled devices, they do not measure static pressure. This property provides these sensors with the unique ability to monitor low level dynamic pressures while being subjected to a high static background pressure level. Piezoelectric pressure sensors have no moving parts, are rigid, linear, durable, and extremely repeatable. They can withstand high static loads, yet accurately respond to small pressure fluctuations.

Dynamic General Purpose ICP® Pressure Sensors

- Adapt to any size mounting port
- Durable, welded, hermetically sealed construction
- Fast response, small size
- Ranges from 50 to 30k psi (345 to 207 MPa)
- Resolutions to 1 mpsi (0.007 kPa)
- Resonant frequencies to 500k Hz
- Rigid quartz sensing elements

Series 111, 112 & 113
- Probe-style pressure sensors

Series 101 & 102
- Probe installed into thread adaptors with ground isolation

Threaded Style
- With lock nut for flush diaphragm installations

Model 108A02
- High range with durable, monolithic diaphragm withstands many repetitive cycles

Series 105C
- Miniature ICP® styles for fuel injection studies
- Measurements on hydraulic systems such as steering, braking & clutch

Dynamic Combustion Studies & Engine Design

Model 175A01
- Engine cylinder pressure
- 4000 psi (275 bar)
- 1.5 pC/psi (22 pC/bar)
- Hermetic sealing

Series 106B, 116B
- High temperatures to +750 °F (+400 °C)
- Series 116B charge output styles for exhaust pulsation studies & flue gas flow anomalies
- High sensitivity, high resolution
- 1 to 100 psi (6.895 to 689.5 kPa)
- ICP® resolution to 0.02 mpsi (0.00013 kPa)

Series 122 & 123
- Rocket engine test sensors for burn instability detection
- Available with Helium purging & water cooling
- 1 to 5000 psi (6.895 kPa to 34.5 MPa)

Dynamic Turbine Monitoring

- Measure high-intensity acoustics & pulsations
- Measure combustion instability & onset of compressor surge
- Detect pressure fluctuations in turbines, pumps, furnaces & pipes

Series 171
- Sensitivities to 1200 pC/psi (174 pC/kPa)
- Ranges from 10 to 600 psi (70 to 4140 kPa)
- High temperatures to +500 °F (+260 °C)
- Case isolated; rugged, 2-pin MIL connector

Series 176
- Sensitivities to 17 pC/psi (2.5 pC/kPa)
- 20 psi (140 kPa) dynamic, 400 psi (2760 kPa) static
- High temperatures to +1,000 °F (+535 °C)
- Low-noise, in-line differential charge amplifier
- Case isolated

Dynamic Reciprocating Engine Monitoring

- Continuously monitor combustion pressure in diesel or gas engines
- Allows for engine turning and load balancing via cylinder pressure
- Frequency response tailored for stable output during engine power adjustments
- Integral charge amplifier at end of cable

Series 105
- Small and robust enough to fit inside engine
- Ranges to 3600 psi (250 bar)
- High temperatures to +570 °F (+300 °C)
- M5 floating nut with 4.2 mm front seal

Series 175
- Ranges to 4000 psi (275 bar)
- High temperatures to +600 °F (+315 °C)
- M14 thread

Dynamic Explosion, Blast & Shock Wave Testing

- Atmospheric re-entry studies
- Detdetonations
- Shock tube research

Series 137
- ICP® free-field blast pencil probes
- Ranges from 50 to 5000 psi (3.5 to 350 bar)
- Rise time <4 µsec
- Resonant frequency >500k Hz

Series 138
- ICP® underwater blast explosion pressure probes
- Ranges from 1000 to 50k psi (70 to 3500 bar)
- Rise time <1.5 µsec
- Resonant frequency >1M Hz

Series 132
- Shock wave time-of-arrival ICP® microsensors
- 50 psi (3.5 bar) range
- Rise time <3 µsec
- Resonant frequency >1M Hz
- 0.124" (3.15 mm) diameter diaphragm

Series 134
- Designed for reflected shock wave pressure measurement
- Unique non-resonating design, Tourmaline sensing element
- Pressure ranges from 1000 to 20k psi (70 to 1380 bar)
- Rise time ≤ 0.2 µsec
- +5,000 °F flash temperature (+2,760 °C)

Dynamic Ballistics Testing

- Ammunition testing
- Propellant studies

Series 117
- Conformal ballistics pressure sensors
- Diaphragm curvatures to match any cartridge diameter
- Measures pressure without modifying cartridge cases
- SAAMI approved

Series 108, 109, 118, 119, 165 & 167
- Case mouth & shot shell ballistic pressure sensors
- Ranges to 120k psi (827 MPa)
- Variety of configurations to match existing test barrel ports
- Acceleration compensated versions

Static Pressure Transducers and Transmitters

Pressure sensors for static, or slowly changing, pressure measurements use highly stable, thin-film, piezoresistive sensing elements. These elements are constructed without use of adhesives or fluid filling. The results are robust units, possessing the accuracy required for testing applications, yet which are economically attractive for rigorous industrial process control requirements. A variety of process fittings, electrical connections, output signal formats, accuracies, and full-scale ranges are available. These units are ideally suited for process monitoring and control, liquid level measurements, hydraulic system performance studies and test cell requirements.

Series 1500

- DC to ≤ 1 msec response time
- 17-4 stainless steel wetted parts
- Accuracies of 0.1%, 0.25%, or 0.5% full-scale
- All welded construction with no adhesives, seals, or fluid filling
- Amplified 0 to 5 VDC or 0 to 10 VDC outputs
- Loop-powered, 4-20 mA versions
- Gage, absolute, or compound pressure versions
- Ranges from 10 to 6000 psi (0.7 to 400 bar)
- Temperature range of -40 to +250 °F (-40 to +125 °C)
- Variety of connectors, submersible cables & process fittings

Intrinsically Safe Pressure Sensors

Sensors that offer intrinsically safe certifications are widely used on pumps, compressors, power generation equipment, and other machinery operating in hazardous environments. PCB® can also assist with providing many other styles of dynamic and static pressure sensors with hazardous area approvals. Piezoelectric pressure sensors offer the capability to detect and monitor dynamic pressure spikes, pulsations, and surges in gaseous or liquid media.

Dynamic Intrinsically Safe Monitoring

- ATEX Certifications
  - Ex ia IIC T4
  - Ex nL IIC T4
- CSA (Canada & US) Certifications
  - Division 1; Class 1; Group A, B, C & D; Temperature Code T4
  - Division 2; Class 1; Group A, B, C & D; Temperature Code T4

CE ATEX

C SP® US Ex

Series 102

- Ranges 50 to 5000 psi (345 to 345 MPa)
- Invar ablative coated diaphragm
- Ground isolated
- +250 °F (+121 °C)
- 1/8" NPT process fitting
- 10-32 connector

Series 121

- Ranges 50 to 5000 psi (345 to 345 MPa)
- 316 stainless steel diaphragm
- Case isolated
- +250 °F (+121 °C)
- 1/4" NPT process fitting
- Robust 2-pin MIL connector

Force, Load, and Strain

Sensors for Testing, Process Monitoring, Research & Development

Typical Applications

Product Testing

- Aerospace Structural Testing
- Automotive Ride Simulation
- Cable Tension
- Durability Testing
- Ejection Forces
- Endurance Testing
- Engine & Machinery Mount Analysis
- Fatigue Testing
- Force Limited Vibration Testing
- Fracture Analysis
- Impact & Drop Testing
- Life Cycle Testing
- Material Penetration Studies
- Materials Strength Testing
- Reaction Forces

Process Control & Quality Assurance

- Bearing Assembly & Test
- Clinching, Riveting, Orbital Forming
- Crimping
- Dynamic Balancing
- Machine Tool Cut Force Monitoring
- Machine Tool Wear Monitoring
- Metal Forming Press Monitoring
- Piercing & Punching
- Spot Welding
- Stamping
- Tablet Presses
- Wire Bonding

Research & Education

- Biomechanics
- Sports Therapy
- Robotics

Force, Load, and Strain – sensors for testing, monitoring, and process control

PCB® offers a vast selection of quartz piezoelectric and strain gage sensors for dynamic force, dynamic strain, and static load measurement requirements. The variety of available configurations supports a multitude of installation options. Whether it's a mechanical component durability test, assembly force control requirement, or an end-of-line quality check, we can help with sensors that are off-the-shelf or custom designed for the specific application.

Features and benefits of piezoelectric and strain gage force sensors.

Piezoelectric force sensors are well suited for measuring dynamic and quasi-static force. They feature high stiffness, fast response, and repeatable performance, permitting them to capture high frequencies and follow fast transient events such as impacts. The high stiffness allows them to survive repetitive cycles without fatigue. Quasi-static applications may include slow acting press or mechanical linkage forces acting in a cyclic manner during a production process.

Strain gage force sensors, or load cells, are well suited for measuring slowly changing or static force. They possess DC response and are appropriate for static applications. Fatigue rated versions are constructed of high-grade steel for surviving many repetitive cycles encountered during product durability testing. Strain gage load cells are not suitable for capturing frequencies in excess of several hundred Hz. They are also typically larger than similarly ranged piezoelectric force sensors.

Dynamic Force Sensors

- Piezoelectric quartz sensing elements
- Solid-state construction with stainless steel durability
- High stiffness for fast transient response & high frequency response
- Survive repetitive cycles without fatigue
- Hermetically sealed for use in harsh environments
- Much smaller than comparably ranged strain gage load cells
- Offered in both ICP® & charge output designs

General Purpose Configurations

- Compression, tension & impact
- Ranges from 10 to 5000 lb (45 to 22k N)
- Resolution to 0.0001 lb (0.00045 N)

Ring Configurations

- Install beneath a base or platform between plates, or in line with linkages & actuators
- Compression ranges from 10 to 100k lb (45 to 450k N)
- Resolution to 0.0002 lb (0.00045 N)
- Variety of sizes to fit most installations

Link Configurations

- Install in linkages or actuators
- Tension and compression ranges from 10 to 50k lb (45 to 220k N)
- Resolution to 0.0002 lb (0.00045 N)
- Variety of sizes to fit most installations

Impact Configurations

- Compression ranges from 10 to 50k lb (45 to 220k N)
- Resolution to 0.0002 lb (0.00045 N)

Multi-component Configurations

- Simultaneous measurements in three orthogonal directions
- Available in ring or link configurations
- Variety of sizes to fit most installations
- Compression ranges from 1000 to 10k lb (4500 to 45k N)
- Resolution to 0.002 lb (0.009 N)

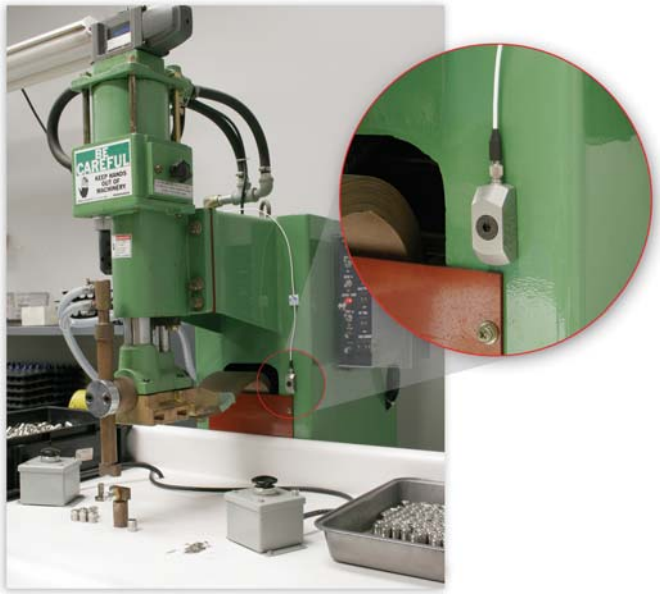
Dynamic ICP® Strain Sensors

M240 ICP® Strain Sensors are ideal for industrial applications that require the measurement of repetitive strain curves such as monitoring forces experienced during manufacturing, assembly, on-line processes, quality assurance, or end-of-line product testing.

In typical applications, upper and lower control limits are set to follow a desired force curve for the process, and if the actual force curve deviates from the control limits, the process is shut down. This prevents acceptance of non-conforming parts as finished goods. Mounted on a C-frame press or actuator with a single screw simplifies installation and keeps the sensor out of the machine tooling.

Optional JM240 ground isolated version available for resistance spot welding machines. For research and development applications or when a mounting screw is not permissible, the Model 740B02 allows for adhesive mounting.

- Measure longitudinal strain on machinery structures
- Offers indirect measurement of clamping & press forces
- Automates machinery processes for improved end product quality
- Detects tool wear
- High stiffness for repeatability
- Robust construction
- Easy to install



Series M240

- Ranges from 50 to 300 με
- 0.004 Hz low frequency response
- Resolution to 0.0001 με
- ICP® or charge output

Model 740B02 ICP® Dynamic Strain Sensor

- 50 mV/με
- 0.5 to 100k Hz
- 0.5 gm
- Integral cable
- Ideal for dynamic fatigue & structural health studies

ICP® & Charge Output Sensor Signal Conditioners

Model 410A01

- Delivers excitation power for ICP® sensors
- Provides +10 V peak hold & ± 10 V analog output signals
- Remote reset for synchronizing with machine cycles
- Eight gain settings
- 24V DC powered
- DIN rail

Series 421A11 & 421A31

- Condition charge output sensors in harsh industrial environments
- ± 5 V analog output
- Long discharge time constant for quasi-static & low frequency measurements
- Offered in single or three-channel configurations
- 24V DC powered

Series 421A25

- Condition charge output sensors in harsh industrial environments
- Long discharge time constant for quasi-static & low frequency measurements
- ± 10 V Analog, +10 V peak & two alarm outputs for monitoring applications
- 24V DC powered

Strain Gage Load Cells

- Combined accuracies to 0.07%
- General purpose & fatigue rated designs
- Variety of configurations & mounting schemes

Series 1100 & 1200
General Purpose Low Profile
- Capacities from 25 to 200k lb (110 to 900k N)

Series 1400 Fatigue Rated
- Over 100 million fully reversed cycles guaranteed
- Capacities from 250 to 100k lb (1100 to 450k N)

Series 1300 Rod Ends
- Capacities from 1000 to 20k lb (4450 to 89k N)
- Male & female rod ends

Strain Gage Signal Conditioners

- Provide necessary strain gage bridge excitation
- Variety of configurations
- Shut calibration feature

Series 8159
- Panel meter/controller
- AC-powered
- ± 10 V & 4-20 mA outputs
- Four set points with open collector outputs

Series 8162
- Rugged in-line style
- DC-powered
- ± 5 V, ± 10 V & 4-20 mA outputs

Series 8161
- DIN rail style
- DC-powered
- ± 5 V, ± 10 V & 4-20 mA outputs

Series 8160
- In-line style
- DC-powered
- ± 5 V, ± 10 V & 4-20 mA outputs

Torque Sensors

For Test, Measurement, Research & Development

Typical Applications

- Bearing Friction
- Brake Testing
- Electric Motors
- Engine & Chassis Dynamometer
- Fan & Blower Testing
- Gearbox Efficiency
- Hydraulic Pumps & Motors
- Pump Testing
- Stepper Motor Switch Torque
- Torsion Testing
- Transmission Development & Testing
- Viscosity & Lubrication Studies

Torque Sensors

PCB® offers an extensive range of strain-gage torque sensors for test, measurement, monitoring, and research & development applications. Both rotary torque and reaction torque measurements are accommodated with a variety of sensor configurations. Whether it's an automotive dynamometer test or a hydraulic pump end-of-line quality assurance check, we can help, with sensors standard or custom designed for your specific application.

Features and benefits of rotary transformer and digital telemetry signal transmission.

A primary challenge for rotary torque sensors is transferring the measurement signal from the rotating portion to the stationary portion of the sensor. Two techniques are used by PCB® for rotary torque sensor signal transmission – rotary transformer and digital telemetry. The rotary transformer is a non-contacting technique providing low maintenance and quiet operation. Digital telemetry offers noise-free operation and smaller size. For installations where space is a premium, the TORKDISC®, with digital telemetry, provides a shorter coupled installation.

Rotary Torque Sensors

- Choice of digital telemetry or non-contact rotary transformer signal transmission
- Tests rotating items such as drive shafts, motors, pumps & dynamometers

Series 5300 TORKDISC®

- 16-bit digital telemetry style
- Compact & lightweight
- Capacities from 1000 to 225k in-lb (113 to 25.4k N-m)
- Combined accuracy to 0.1% FSO
- Flange mount
- Immune to RF interference

Series 4100

- Rotary transformer style
- Capacities from 50 in-oz to 100k in-lb (0.35 to 11.3k N-m)
- Combined accuracies to 0.07% FSO
- Keyed shaft versions

Series 4115K

- Rotary transformer style
- Capacities from 50 to 10k in-lb (5.6 to 1130 N-m)
- Combined accuracies to 0.07% FSO
- Splined shaft-flange combinations
- AND 10262 & 20002

Reaction Torque Sensors

- Conduct friction & viscosity studies
- No moving parts
- Responds to torsional loads
- Test braking systems

Series 2300

- Capacities from 5 to 500k in-lb (0.56 to 56.5k N-m)

Signal Conditioners

- Provides required carrier based sensor excitation
- Recommended for use with PCB® Series 4100, 4115K & 4200 rotary transformer torque sensors
- When used with PCB® sensors, offers a complete NIST traceable torque measurement system, pre-calibrated to sensor requirements.

Series 8120

- AC bridge excitation
- ± 5 V analog output
- Shunt calibration
- 4-1/2 digit LED display
- Optional ± 10 V & 4-20 mA outputs
- Optional HI-LO set points & peak holds

Signal Conditioners, Cables, and Accessories

Highlights

Piezoelectric Sensor Signal Conditioning

- ICP® Sensor Power Supplies
- Alarm Relays
- Bank Switching Modules
- Battery Powered Signal Conditioners
- Display Meters
- Industrial Charge Amplifiers
- In-line Charge Converters
- In-line Electronic Filters
- Laboratory Charge Amplifiers
- Modular-style Signal Conditioners
- Peak Voltage Indicators
- Signal Converting Transmitters
- Summing Modules
- Telemetry Signal Conditioners

Additional Sensor Signal Conditioning

- DC Response Sensor Signal Conditioners
- Microphone & Preamplifier Power Supplies
- Strain Gage Signal Conditioners
- Torque Sensor Signal Conditioners

Accessories

- Installation Tools
- Mounting Hardware
- Nose Cones
- Patch Panels
- Tripods
- Windscreens

Signal Conditioners, Cables, and Accessories

PCB® provides the appropriate signal conditioning necessary for sensor excitation and to prepare measurement signals for readout, recording, analysis, or control. Available features include gain, integration, filtering, weighting, biasing, alarm relays, zero clamping, and conversion to rms or peak values. Additionally, essential cables and accessories to support a successful installation are typically available from stock for immediate delivery. Customized equipment is also available to satisfy unique requirements.

ICP® Sensor Power Supplies

— Battery or line-powered signal conditioners that provide ICP® sensor excitation and coupling of the voltage measurement signal to readout, recording, and analysis instruments. Additional features include gain, filtering, integration, and zero clamping.

Series 480
- Battery powered portability
- Up to 3 channels
- Gain of x1, x10, x100

Series 481 & 498 TEDS CE
- AC-powered
- 8 or 16 channels
- Many options available including switched output
- Can operate with charge output sensors
- Daisy-link multiple racks for up to 256 channels

Series 482C TEDS
- AC powered
- 4-channel
- Variety of gain and filtering configurations
- Can operate with charge output sensors

Model 485B36
USB Signal Conditioner
- Simplified data acquisition
- Utilizes USB port to provide 2-channels of ICP® sensor power
- Interfaces directly to laptop sound card or uses BNC breakout cable

Charge Amplifiers

— Laboratory, industrial, and in-line charge amplifiers provide the necessary impedance conversion for high-impedance, charge output piezoelectric sensors, thus permitting usability with voltage readout, recording, and analysis instruments. Additional features include gain, filtering, integration, and ground reset.

Series 421A11
- Rugged-duty industrial charge amplifiers
- DC-powered
- 1 or 3-channel configurations
- Electronic reset for machinery control applications
- Sealed aluminum enclosure

Series 422E
- In-line charge converters
- Operate with ICP® sensor signal conditioners
- Choice of many charge conversion values
- Single ended & differential styles

Series 443B
- Laboratory charge amplifiers
- AC-powered
- Ultra low noise
- Multiple filter settings
- Signal integration
- Serial communication to PC

Additional Signal Conditioners

Series 100A02
- Pressure indicator/controller
- AC or DC-powered
- Provides 24 VDC excitation
- Optional 4-20 mA output
- Optional programmable relays

Series 8159
- Force indicator/controller
- AC-powered
- Provides strain gage excitation
- ± 10 VDC & 4-20 mA outputs
- Four programmable set points

Series 8162
- DC-powered
- Provides strain gage excitation
- Strain gage signal conditioner
- Voltage & 4-20 mA outputs

Cables

— The weakest link in a measurement chain is often interconnecting cables. PCB® offers many types of cables, designed to endure various adverse operating conditions. Choices include cables with the flexibility of silicone, the resilience of Teflon®, the high-temperature capability of welded hard line, and the submergibility of molded polyurethane.

- Armored
- Coaxial
- Low-noise
- Mineral-insulated hardline
- Multi-conductor
- Submersible

Calibration Test Services and Equipment

Shock, Vibration, Acoustic, Pressure, Force & Torque Sensors

Highlights

- Full in-house calibration capabilities of PCB® & competitor models
- A2LA accredited to ISO 17025 for most services
- NIST & PTB traceability
- ISO 9001:2000 certified
- Specialized testing services
- Sensor performance evaluation testing
- Expedited services upon request
- Calibration workstations & turnkey systems
- Environmental stress chamber testing for HALT/HASS/ESS
- High amplitude Hopkinson bar
- Acoustic & sound level meter testing
- Shock tube, hydraulic step, pneumatic pulse, absolute calibration
- Torque sensor, load cell & strain gage calibration

Calibration Test Services and Equipment

PCB® provides calibration and test services for sensors and signal conditioners, according to recommended practices, and to either NIST or PTB, and ISO 9001 standards. Additionally, a variety of calibration equipment is available for customers wishing to conduct their own sensor calibrations. PCB® can also provide calibration services for other manufacturers' sensors. Most calibration services are accredited by A2LA to ISO 17025, as documented on the company's A2LA "Scope of Calibration." In addition, PCB® offers a number of portable, handheld sensor calibration instruments. For more information on available products and services, please consult the factory.

Vibration & Shock Sensor Testing

- Elevated & cryogenic temperatures
- High pressure static hydro
- Linearity determination
- Low amplitude back-to-back
- Piezoresistive calibration
- Primary calibration
- Random vibration screening
- Sensitivity & frequency response calibration
- Sensitivity & phase response
- Single point sensitivity
- Primary accelerometer calibration

Environmental Stress Chamber
HALT, HASS & other thermal chamber tests on prototypes and production output

Primary Accelerometer Calibration
Accelerometer is mounted to an air-bearing shaker beneath a laser vibrometer

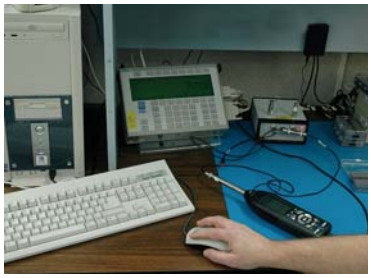
High-amplitude Hopkinson Bar
Linearity & zero shift tests with exposures to impact shocks of more than 100k g

Low-frequency Accelerometer Calibrator
6" (152 mm) stroke shaker provides displacement for calibrations to 0.5 Hz

Acoustics & Sound Level Meter Testing

- Microphone Electrostatic Calibration
  - Electrostatic actuator method
  - Voltage insertion method (IEC 1094 compliant microphones)
- Sound Level Meter Calibration
  - Calibration of sound level meters, dosimeters, HVM100 human vibration meter
- Pistonphone Method
  - 124 dB SPL reference at 250 Hz
  - Accuracy of 0.45 dB of reading

Microphone Electrostatic Calibration
Test base & enclosure isolates unit under test from ambient noise and adjusts for barometric pressures, while voltage insertion generates excitation for comparative results



Sound Level Meter Calibration
Sound Level Meter calibrations are NIST traceable, with calibration services compliant with ISO 17025

Pistonphone Kit - Model 915A01
Generates a constant sound pressure level at a controlled frequency for calibrating high-intensity acoustic sensors in the field

Specialized Pressure Calibration & Testing

In addition to the services listed below, PCB® is also able to perform a number of special calibration and testing services, upon request. These include acceleration sensitivity; Ballistics firing range; cold gas shock tube; discharge time constant; temperature effects from –320 to +1,000 °F (-196 to +535 °C); hydrostatic and hermeticity; mechanical shock; and PIND (Particle Impact Noise Detection).

Dynamic Pressure Sensor Calibration Services

- Pneumatic Pulse Method (low pressure) Series 903B
  - Strain gage pressure sensor reference
  - 0 to 100 psi (0 to 0.7 MPa) range
  - Accuracy to 0.8% FS
- Dynamic Step Pressure Method (medium pressure) Series 907A
  - Aronson shockless step pressure generator
  - Strain gage pressure sensor reference
  - 0 to 1000 psi (0 to 7 MPa) range
  - Accuracy to 1.3% FS
- Hydraulic, Dynamic Impulse Method (medium pressure) Series 913B
  - Piezoelectric pressure sensor reference
  - 0 to 25k psi (0 to 138 MPa) range
  - Accuracy to 1.3% FS
- Hydraulic, Step Method (high pressure) Series 905C
  - Strain gage pressure sensor reference
  - 0 to 100k psi (0 to 690 MPa) range
  - Accuracy to 1.7% FS

Aronson Step Pressure Calibrator Series 907A

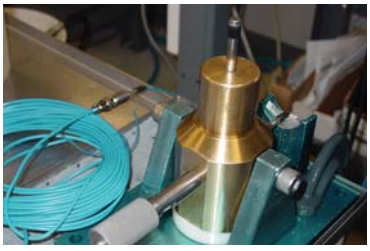
A guided mass impacts a plate, which quickly opens a poppet valve. This exposes the sensor under test (installed in a small volume manifold) to the step reference pressure, which is contained and regulated within a much larger storage cavity.

Hydraulic Step Pressure Calibrator Model 905C

High-pressure pump exposes unit under test to graduated pressure steps with a dump valve for rapid, full-scale pressure release

Pneumatic Pulse Calibrator Model 903B02

Manually actuated poppet valve exposes sensor under test (installed in a small volume manifold) to the step reference pressure, contained and regulated within a much larger storage cavity



Medium Pressure Hydraulic Impulse Calibration (to 25k psi) - Model 913B02

The piston rod on top is struck by a mass to generate a pressure pulse in the two-port manifold for reference comparative calibration

Shock Tube - Model 901A10

Helium shock wave is generated past a burst diaphragm to create sub-microsecond pressure steps for evaluating various sensor performance characteristics such as rise time and resonant frequency

Static Pressure Testing & Calibration Services

- Hydraulic Deadweight Tester Method (medium pressure)
  - 0 to 15k psi (0 to 138 MPa) range
  - Accuracy of ± 1.0% FS
- Pneumatic Comparator (Nitrogen gas)
  - 0 to 10k psi (0 to 69 MPa) range 0.021% FS accuracy
  - 0 to 1000 psi (0 to 7 MPa) range 0.015% FS accuracy

Static Pressure Comparison Calibration

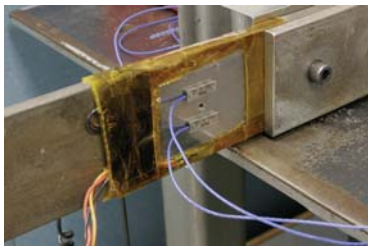
Pressure sensor is exposed to nitrogen pressurized manifold with output compared to reference standard sensor

Dynamic Strain, Force, and Strain Gage Torque & Load Calibrations

PCB® offers calibration services for dynamic strain and force sensors, as well as strain gage torque sensors and load cells. Each dynamic strain or force sensor is provided with a five-point ascending compression calibration. Sensitivity and non-linearity data are reported. Tension calibration may be supplied upon request. Strain gage torque sensors are calibrated in both clockwise and counterclockwise directions. Strain gage load cells are calibrated in both tension and compression. Sensitivity, non-linearity, hysteresis, and shunt calibration data are provided for static sensors.

Dynamic Strain Sensor Calibration Services

- Strain gage reference
- For Series 240 and 740 ICP® strain sensors



Dynamic Strain Sensitivity Calibrations
A known strain input is placed on the sensor, and sensitivity measured via reference sensor

Dynamic Force Sensor Calibration Services

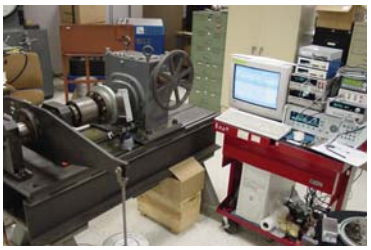
- Strain Gage Reference
  - 10 to 100k lb (445 to 450k N range)
  - 1.0 % FS accuracy

Comparison Calibration
A large, hydraulic press generates compressive loads for reference comparative testing

Torque Sensor Absolute Calibration

- Torque arm method, where known weights are applied from a beam at known distances from the sensor's axis of symmetry
  - 10 to 25k in-lb (1.10 to 2800 N-m) range 0.04% FS accuracy
  - 25k to 100k in-lb (11,300 to 56,500 N-m) range 0.14% FS accuracy
  - 100k to 300k in-lb (0 to 33,896 N-m) range 0.09% FS accuracy

Torque Sensor Absolute Calibration
Otherwise know as a "torque arm", known weights are suspended from the beam at known distances from the sensor's axis of symmetry



Static Load Cell Absolute Calibration

- Deadweight 10 to 500 lb (45 to 2230 N), 0.04 % FS accuracy
- Back-to-back to 100 to 10k lb (2230 to 45k N) 0.06% FS accuracy
- Back-to-back to 10k to 100k lb (45 to 450k N) 0.08% FS accuracy

Load Cell Absolute Calibration
Accurate dead weights are utilized for testing against basic physical parameters

Calibration Workstations & Turnkey Systems

In addition to the calibration and test services offered by PCB®, a number of calibration workstations and turnkey systems are available through sister company **The Modal Shop**. These systems are designed to offer automated, quality calibrations, which conform to recommended industry standards, and are available for rental or purchase. For more information on the products shown here, call **(513) 351-9919** or visit **www.modalshop.com**.

Workstation & Turnkey Systems

Model 9155C
Turnkey Accelerometer Calibration Workstation

- Accurate NIST or PTB traceable calibrations from 0.5 Hz to 20k Hz in less than one minute per axis
- Supports variety of accelerometer sizes & types and prints certificates compliant with ISO 17025
- Automates TEDS sensor updating
- Achieves 0.85% uncertainty with primary laser calibration
- Configure a system for any budget with customizable options

Model K394A30/31 Air Bearing Shaker (shown)

- High quality, calibration grade air bearing exciter easily adjusts to a wide range of sensor sizes
- 70k Hz mounted resonance of reference provides linearity over large frequency range
- Meets ISO 16063-21 recommendation for transverse motion

Model 9155C-525
PneuShock™ Shock Accelerometer Calibration System

- Provides calibration & linearity check from 20 to 10k g
- Pneumatically actuated exciter provides controlled & consistent impacts
- Electronic control of projectile drive pressure & pulse width
- Conforms to ISO 16063-22 shock calibration standard
- Stand-alone version available as Model 9525C PneuShock™

Model 9100C
Portable Vibration Calibration System

- Perform frequency & amplitude calibration with adjustable settings
- Acquire NIST traceable measurements with reliable instruments
- Displays information for acceleration, velocity & displacement
- Excel macro generates ISO 17025 compliant calibration certificates (K9100C)

Model 9350C
Turnkey Microphone Calibration Workstation

- Provides conformance testing for traditional and ICP™ preamplifiers
- Ensures accurate NIST traceable calibrations up to 100k Hz
- Automates calibration of 1/4", 1/2" & 1" precision condenser microphones & pistonphones
- Prints certificates compliant with ISO 17025

Modal Shakers & Accessories

- 100 lbf modal shaker with through-hole armature for easy connection to stingers
- 5 lbf shaker with integral amplifier in compact portable package
- 6" long stroke shaker for ultra-low frequency applications

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