Industrial Vibration Sensors, Switches & Instrumentation

Accelerometers, Vibration Transmitters & Switches, Pressure Sensors and Accessories

visit us at www.imi-sensors.com Toll-free in USA 800-959-4464 716-684-0003
Energy & Power Generation

IMI® Sensors specializes in the design and manufacture of innovative sensors and associated signal conditioning instrumentation to meet the demanding requirements of the energy, power generation, reciprocating equipment, oil & gas and petrochemical industries.

In particular, IMI’s instrumentation is ideally suited to detect and measure dynamic pressure and vibration of gas turbines in extreme heat environments. Our high temperature pressure sensors and accelerometers are intrinsically safe for measuring combustion dynamics and vibration levels in gas turbines.

Process Monitoring & Protection

IMI’s line of 4-20 mA vibration transmitters will interface directly with your PLC, DCS or SCADA system so data can be easily monitored and analyzed. Our electronic vibration switches and smart switches eliminate false trips, making it a technically superior option to traditional mechanical switches.

IMI’s impact detection products offer the ultimate machine protection, including the Bearing Fault Detector, which provides early warning of impending bearing failure. In addition, IMI’s DIN rail devices are designed to facilitate vibration monitoring with equipment that is familiar to the process control technician. Signals representing overall vibration levels are monitored with threshold points providing the judgment for alarm, control, or shutdown.
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IMI Sensors: A Division of PCB Piezotronics, Inc.

IMI® industrial sensors are used to spot imbalance, bearing faults and misalignment by measuring machine vibration, providing early fault diagnosis thus reducing downtime. Our vast product line interfaces directly with data acquisition equipment including online systems and handheld data collectors.

IMI® offers a full line of piezoelectric accelerometers, pressure sensors, velocity sensors, 4-20 mA vibration transmitters, switches, relays, cables, displays and accessories. Virtually all of our products are available with hazardous area certifications through CSA and ATEX. We are proud to state that all of our sensors are made in the USA and backed by our Total Customer Satisfaction policy.

At IMI Sensors we have experienced, dedicated staff members ready and waiting to exceed your expectations. This customer oriented organization makes it easier for you to find the best product and get technical support as fast as possible. Please call our dedicated hotline at any time at 800-959-4464; we look forward to helping you be successful.

visit us online at www.imi-sensors.com

IMI Sensors
A PCB Piezotronics Div.
Using this Catalog

Welcome to the newest edition of the IMI Sensors Product Catalog. We have made a number of improvements and additions to this catalog that we hope will enhance the usability, as well as provide a valuable resource beyond the purchasing of our products.

This catalog has two main sections (Application and technology) to give you insight beyond the products and into the applications for which they are designed. You will also find helpful “Tips from Techs” throughout the catalog to offer deeper insight into common issues with various applications and product categories.

The third section provides valuable technical information on sensor selection, hazardous area approvals, mounting techniques and sensor construction.

Products By Application
The Application Section of this catalog provides overviews of the most typical applications of IMI Sensors. Each application features products that are proven for the specific needs of the given application. You will also find useful information on the methods for taking measurements, as well as a Sensor Placement Illustration to give you an overview of suggested measurement points for that application. You can also request individual applications in brochure form by contacting an IMI® representative, or by visiting www.imi-sensors.com.

Products By Technology
The Products By Technology Section of this catalog focuses on the different sensing technologies that IMI Sensors offers, grouped by product type (ie: Precision ICP®, Low Frequency ICP®, Pressure Sensors, Cables & Connectors, Enclosures). You will find complete information on each product including: complete specifications, technical drawings and in some cases “actual size” product photographs.

Technical Information
The Technical Section features useful reference materials to assist you in selecting sensors, as well as installation and mounting techniques. The Accelerometer Selection Worksheet will help you choose the right sensor for your needs. You will also find illustrations of typical Industrial Vibration Measurement Systems to provide an overview of the components needed for specific systems.

Sensor Placement Illustrations
At the beginning of each application section you will find a Sensor Placement Illustration. These illustrations are designed to give you some insight into some typical measurement points for that specific application.

Suggested sensor placement is indicated using the red dot shown: ( )

Please note that illustrations represent only suggested sensor placements.

Please contact an IMI® application engineer for complete information.
Model Number Index

This index provides page references for accelerometers, signal conditioners and test equipment. For cables, mounting hardware and accessory items, please check the appropriate sections listed in the table of contents.

Red Part Numbers Indicate Platinum Stock Products

PCB® Platinum Products are available with our Lifetime Warranty and fast delivery. If any PCB® Platinum Product ever fails, PCB® will repair, replace or exchange the product at no charge. For U.S. customers orders up to 10 units will ship in three days, and orders over ten units will ship in thirty days or less. IF NOT, YOUR SHIPPING IS FREE! Visit www.imi-sensors.com for complete details.

Our Platinum products represent some of our most popular models and can be used in a wide range of applications. As you browse this catalog, you will find Platinum products indicated with the “Platinum Shield” icon (right).

![Model Number Index](image-url)

Visit us online at www.imi-sensors.com
# IMI Sensors Model Number Guide

Decoding IMI Sensors’ Model Numbers:

<table>
<thead>
<tr>
<th>Series Number</th>
<th>Revision Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>XX 6 NN XX C S</td>
<td>A, B, C, etc.</td>
</tr>
</tbody>
</table>

### Optional Version Prefix
- Intrinsically Safe (EX) & Metric (M)
  - Options are available on most products

### Product Technology
Indicates specific division of PCB Piezotronics.
- 0 = Accessory
- 1 = Pressure - Test
- 2 = Strain / Force - Test
- 3 = Vibration - Test
- 4 = Signal Conditioner - Test
- 5 = (Unassigned)
- 6 = Vibration - Industrial
- 7 = Wireless
- 8 = Signal conditioner/Transmitter
- 9 = Enclosure/shaker

### Category
- 0 = Low cost ICP® sensor
- 1 = High temperature charge output
- 2 = Precision ICP® sensor
- 3 = Precision ICP® sensor
- 4 = 4-20 mA sensor
- 5 = (Unassigned)
- 6 = Embeddable sensor
- 7 = Wireless
- 8 = Signal conditioner/Transmitter
- 9 = Enclosure/shaker

### Sensitivity
(IPC® Accelerometers Only)
- 0 = 10 mV/g
- 1 = 100 mV/g
- 2 = 500 mV/g
- 3 = 1 V/g
- 4 = 10 V/g
- 5 = 50 mV/g

### Electrical Connector / Integral Cable Type
(Sensors Only)
- 0 = 2-pin MIL
- 1 = Integral polyurethane jacketed cable
- 2 = Integral FEP jacketed cable
- 3 = Bayonet MIL
- 4 = 10-32 top exit
- 5 = 10-32 side exit
- 6 = Integral armored polyurethane jacketed cable
- 7 = Terminal block
- 8 = Mini MIL

### Example Model Number

**E X 6 0 3 C 0 1**

- Intrinsically Safe Option
- Series 603
  - Low Cost Industrial ICP® Accelerometer
- 100 mV/g
- Integral 2-pin MIL Cable
- Revision C

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Toll-Free in USA 800-959-4464  716-684-0003
Sensor Options

Option “EX”

ATEX Approved Intrinsically Safe (e.g., EX622A01)

For use in hazardous areas, the CS option designates a vibration sensor certified by the Canadian Standards Association as intrinsically safe, when used with a properly installed, intrinsic safety barrier in environments shown on the table to the right.

Model 602D01, Model 603C01, Model 607A01, Model 607A11, Model 608A11, Model 607A61
Class I, Div 1, Groups A, B, C, D
Class II, Div 1, Groups E, F, G
Class III, Div 1
Ex ia IIC T4
AExia IIC T4
Class I, Div 2, Groups A, B, C, D
ExnL IIC T4
AExnA IIC T4
Ex ia IIC T4, -40°C ≤ Ta ≤ 121°C, II 1 G
Ex nL IIC T4, -40°C ≤ Ta ≤ 121°C, II 3 G
GOST-R: 0ExialICT4 X

Model 628F01
EEx ia IIC T4, -54 °C≤Ta≤121 °C, II 1 G

Model 640B01, Model 640B02, Model 641B01, Model 641B02, Model EX640B71, Model EX640B72
DIV II, CI, GRPS A-D, ExnL, AExnA, IIC T4
EEx ia IIC T4, -40 °C≤Ta≤80 °C, II 1 G
EEx nl IIC T4, -40 °C≤Ta≤80 °C, III 2 G
DIV I, CI, II, III, GRPS A-G, Exia, AExia, IIC T4

Model 686B01, Model 686B02, Model 686B11
Current Rating (Relay Closed) 100 mA
Hazardous Area Approval CI I, Div 2, Groups A, B, C, D
Ex nL IIC3, AEx nA IIC3 Power Required 10 to 30 VDC
Relay 10 to 30 VDC, 100 mA

Option “M”

Metric Installation (e.g., M603C01)

This option permits installation of the vibration sensor into a tapped hole having a metric thread. It simply designates a change in the supplied mounting stud, screw, or bolt. Metric mounting studs are adaptor studs that have an English thread on the end that screws into the sensor base and a metric thread on the other end that screws into the test specimen. Metric screws or bolts are used for through-hole mounted sensors.

Supplied Accessories for Option “M”

Model 601A01, Model 601A02, Model 608A11, Model 627A01, Model 628F01, Series 640B
Model M081A61 Mounting Stud
1/4-28 to M6 X 1 (1) replaces Model 081A40

Model 607A11, Model 626B01, Model 626B02
Model M080A159 Mounting stud, 1/2-20 to M6 x 1 (1) replaces Model 080A156

Model 649A01, Model EX649A71
Model M081A61 Mounting Stud
1/4-28 to M6 X 1 (1) replaces Model 081A41

Model 603C01, Model 603C01, Model 603C01, Model 603C01
Model M081A61 Mounting Stud
1/4-28 to M6 X 1 (1)

Model 604B31, Model 605B01, Model 606B01
Model M081A68 Captive mounting bolt
M6 x 1 (1) replaces Model 081A68

Model 607A01, Model 625B02
Model M080A163 (1) replaces Model 080A162

Model 625B01
Model M081A73 Mounting Bolt
M6 x 1.00 replaces 081A73

Model 628F01
Model M081A97 Captive mounting bolt, M6 x 1 x 25.4 mm long, hex head (1 ) replaces 081A97

Model 640B01
Model M081A67 Captive mounting bolt, M6 x 1 (1) replaces Model 081A67

Model 622A01
Model M081A73 Mounting Bolt
M6 x 1.00 replaces 081A73

Model 626B01
Model M081A97 Captive mounting bolt, M6 x 1 x 25.4 mm long, hex head (1 ) replaces 081A97

Model 102
Model 065A40 Seal ring
0.435” OD x 0.397”ID x 0.030” thk brass (3) replaces Model 118B11

IMI Sensors Model Number Guide

Sensor Options

Option “EX”

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Class II, Div 1, Groups E, F, G
Class III, Div 1
Ex ia IIC T4
AExia IIC T4
Class I, Div 2, Groups A, B, C, D
ExnL IIC T4
AExnA IIC T4
Ex ia IIC T4, -40°C ≤ Ta ≤ 121°C, II 1 G
Ex nL IIC T4, -40°C ≤ Ta ≤ 121°C, II 3 G
GOST-R: 0ExialICT4 X

Model 628F01
EEx ia IIC T4, -54 °C≤Ta≤121 °C, II 1 G

Model 640B01, Model 640B02, Model 641B01, Model 641B02, Model EX640B71, Model EX640B72
DIV II, CI, GRPS A-D, ExnL, AExnA, IIC T4
EEx ia IIC T4, -40 °C≤Ta≤80 °C, II 1 G
EEx nl IIC T4, -40 °C≤Ta≤80 °C, III 2 G
DIV I, CI, II, III, GRPS A-G, Exia, AExia, IIC T4

Model 686B01, Model 686B02, Model 686B11
Current Rating (Relay Closed) 100 mA
Hazardous Area Approval CI I, Div 2, Groups A, B, C, D
Ex nL IIC3, AEx nA IIC3 Power Required 10 to 30 VDC
Relay 10 to 30 VDC, 100 mA

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Model 603C01, Model 603C01, Model 603C01, Model 603C01
Model M081A61 Mounting Stud
1/4-28 to M6 X 1 (1)

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Model 102
Model 065A40 Seal ring
0.435” OD x 0.397”ID x 0.030” thk brass (3) replaces Model 118B11

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USB Programmable Smart Vibration Sensors

IMI Sensors advances the industry exclusive USB Programmable Vibration Sensors with 2 additional products. The 649A03 4-20 mA output Bearing Condition Monitor offers a high level of bearing fault monitoring in the small package of a typical sensor housing. Five selectable measurement methods and selectable sensing range increase reliability and accuracy in every application. The 649A04 4-20 mA Output Universal Transmitter brings USB programmability to IMI’s tried and true current output vibration sensor line. Selectable displacement, velocity, or acceleration measurement coupled with selectable range scaling brings flexibility and “in field” programming.

Programmable 4-20 mA Universal Transmitter
Model 649A04
See page 123 for more information

Programmable 4-20 mA Bearing Condition Transmitter
Model 649A03
See page 122 for more information

Scan with smart phone for more information on new product releases from IMI Sensors

VI

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High Temperature Accelerometers

Get the best high temperature performance of any industrial ICP® accelerometer on the market with IMI's new line of high temperature, low profile sensors. Integral FEP jacketed cable versions are also ideal for acidic applications. IMI's EX600B13 and EX600B14 accelerometers can measure vibration in areas up to 900 °F.
Forget Cables, Go Wireless!

Wireless Vibration Sensor
Model 670A01
- Batteries last over 5 years
- Transmits long distances
- Eliminates expensive cable runs
See page 142 for more information

Receiver
Model 673A01
- Requires no repeaters, gateways, or mesh
- Outputs to ethernet
- Receives Echo® and EchoPlus® Signals
See page 143 for more information

Instantly Converts Installed Sensors to Wireless!

Wireless Junction Box
Model 672A01
- Converts existing sensors to wireless
- Runs independently or with existing junction box
- Uses 24 VDC or battery power
See page 143 for more information
Products By Application

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Industrial Vibration Measurements? We Do!

We do it all - sensors to measure vibration, acoustics, force, pressure, load, strain, shock and torque - Sure we do!

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Motor Vibration

Detect Mechanical & Electrical Motor Faults with Vibration Monitoring Instrumentation
Predictive Maintenance

Motor Vibration

Monitoring vibration on induction motors forms part of the core of any predictive maintenance program. Typical applications demand vibration measurements in the horizontal, vertical and axial direction on both the inboard and outboard motor bearings. Aside from typical mechanical issues, such as misaligned couplings and unbalance, the vibration analyst can also detect electrical issues that cause mechanical vibrations. Some common electrical faults include air gap variation, broken rotor bars and bearing fluting.

Vibration analysts can use one accelerometer, mounted magnetically and rotate it around the motor to capture various data collection points. In some cases the motor is in an inaccessible location and thus permanent mount sensors are used and routed to a junction box for walk up data collection. Accelerometers are permanently mounted by drilling and tapping into the motor housing or they can be adhesively affixed or welded using a mounting pad.
ICP® Accelerometers - Predictive Maintenance

**Low Cost ICP® Accelerometer**
- Model 602D01
- Easy installation in tight spaces
- Through-bolt aides in cable orientation
- Low profile, less than 1 in. height
See page 82 for more information

**Low Cost ICP® Accelerometer**
- Model 603C01
- General purpose, hermetically sealed
- IMI’s most popular accelerometer
- Small footprint
See page 82 for more information

**Precision Accelerometer**
- Model 622B01
- Full frequency sweep calibration: 5% sensitivity deviation tolerance
- 15 kHz high frequency response ideal for early detection of bearing fluting conditions
- Ideal for route-based data collection
See page 92 for more information

---

**Product Spotlight**

**Triaxial Accelerometers**
Monitor motor bearing vibration in all three axes with a single accelerometer

**Low Cost Triaxial Accelerometer**
- Model 604B31
- General purpose, hermetically sealed accelerometer
- Perfect for permanent mount applications
See page 90 for more information

**Precision Triaxial Accelerometer**
- Model 629A31
- Ideal for route-based data collection, magnet mount
- Full frequency sweep calibration, superior frequency response
Page 90 for more information

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Motor Vibration

Electric motors driving capital machinery and ancillary equipment are critical plant processes. Unscheduled shutdowns or failures result in costly downtime, equipment damage and possible safety hazards for personnel. Although your maintenance engineers can’t be everywhere at once, IMI® vibration and fault transmitters provide continuous protection and early detection of issues such as soft foot, imbalance, bearing faults, bearing fluting and misalignment. Using a 4-20 mA signal, our transmitters directly communicate with customer PLC, PI, SCADA, or DCS systems and data can be easily trended, managed, with proper alerts and notifications to keep your process up and running.

4-20 mA Transmitters - Process Monitoring & Protection

Vibration Transmitter
Model 682B03
- Outputs 4-20 mA signal proportional to acceleration, velocity, or displacement
- ICP® accelerometer input
- Analog vibration output via front BNC

See page 121 for more information

4-20 mA Output Sensor
Model 640B01
- Available in top or side exit casings
- Peak or RMS, or velocity
- Intrinsically safe/explosion proof versions available

See page 112 for more information

24 VDC Power Supply
Model 682A01
- 120 to 230 VAC powered
- 1000 mA maximum

See page 154 for more information

DIN Rail Enclosure
Model 682A00
- Strong fiberglass construction
- NEMA 4X rating

Visit www.imi-sensors.com for more information

Tips from Techs

Recommended Components for a Typical Installation

Sensor Cable
Permanently Installed, Low Cost, ICP® Accelerometer

Vibration Transmitter, Analog Signal Input, 4-20 mA and Analog Signal Outputs

4-20 mA Signal Cable

PLC, DCS, Alarm, or SCADA System

Vibration Data Collector or FFT Analyzer for Signal Analysis and Diagnostic Purposes

Sensor Cable

4-20 mA Vibration Sensor

PLC, DCS, Alarm, or SCADA System
Bearing Fluting in Electric Motors

Bearing fluting occurs when current is passed through the motor bearing instead of a grounded source. PWM (Pulse Width Modulated) drive switching frequencies result in undesirable motor shaft currents, a side effect that causes bearing damage including pitting and fluting. The pitting and fluting will result in undesirable bearing vibration. Because the Bearing Fault Detector's additional fault output is extremely sensitive to high frequency impacting, it provides an early indication that pitting or fluting has occurred. This will allow your motor to be serviced before catastrophic damage occurs.

Tips from Techs

Bearing Fault Detector - Process Monitoring & Protection

Bearing Fault Detector

Model 682B05

- Provides early warning of bearing and gear faults
- Operates with PLC, DCS, SCADA, alarm and control systems
- Outputs 4-20 mA signals for peak acceleration and overall vibration

See page 124 for more information

visit us online at www.imi-sensors.com
Motor Vibration

Accessories

Cables & Connectors

Polyurethane Cabling with Right Angle MIL-Style Connector
052B0XXXBZ

Polyurethane Cabling with MIL-Style Connector
052B0XXXBZ

FEP Cabling with Right Angle MIL-Style Connector
053B0XXXBZ

FEP Cabling with MIL-Style Connector
053B0XXXBZ

XXX = Denote cable length, 010 = 10 feet (Metric lengths available)

Mounting Hardware

Sensor Mounting Pad
Model 080A33: Ø0.75"
Model 080A118: Ø1.0"

Curved Surface Magnet
Model 080A131: Ø1.0"
Model 080A132: Ø1.5"

Small Adhesive Kit
Model 075A05

Tips from Techs

Typical Inaccessible Motor Monitoring System

Permanently Installed, Low cost ICP® Accelerometers for Axial and Radial Vibration Monitoring

Product Spotlight

BNC Switch Boxes & Termination Enclosures
Safe, Convenient, Centralized Access for Efficient Data Collection

- Consolidate up to 48 channels of outputs into one enclosure
- Switch boxes save time and extend cable life; connect once, change the channel
- Factory installed cord grips provide simple, quick and convenient installation

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IMI SENSORS
A PCB PIEZOTRONICS DIV.

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Pumps & Submersible Pumps

Highlighting Hermetic Sensors for Pump Cavitation, Recirculation & Resonance
Predictive Maintenance

**Pumps & Submersible Pumps**

There are dozens of different types of pumps and a seemingly endless list of applications but industrial accelerometers can often help the maintenance professional diagnose sometimes tricky issues with pump operation. Using vibration monitoring in your predictive maintenance program can help identify pump problems such as cavitation, recirculation and resonance.

A good rule of thumb is to select an accelerometer that has a linear high frequency response capability to three times the pump’s vane pass frequency (vane pass frequency = # of vanes x RPM). Most general purpose accelerometers will have more than adequate high frequency response and thus the next key is selecting a transducer that will survive the application. For this purpose IMI® has a wide range of submersible accelerometers as well as sensors and cabling that will survive in corrosive environments.

**Output Flange**

**Input Flange**

**Motor**

---

**Suggested Sensor Placement**
Corrosive Applications

In some cases accelerometers installed on pumps must survive in acidic applications. In these situations it’s best to use FEP jacketed cables. Special attention should be given to materials used to make the cable connector. For example, polyurethane cable and a connector that uses a silicone boot will degrade rapidly in most corrosive applications. Connectors made out of ryton or FKM are generally recommended for corrosive applications. Please contact an IMI® Applications Engineer for a proper chemical compatibility study.

FEP Jacketed Cable with Right Angle
PPS 2-pin MIL-style Connector
05SPBXXXXBZ

XXX = Denote cable length, 010 = 10 feet (Metric lengths available)
Pump failure can lead to costly unexpected shutdowns and expensive damage to plant processes and equipment. IMI’s low cost current output (mA) transmitters offer continuous protection to critical equipment and provide maintenance professionals information between scheduled walk-around data collection. IMI’s 4-20 mA loop powered transmitters provide an easy and low cost continuous monitoring solution and are directly compatible with PLC, DCS, SCADA and PI systems. External DIN rail transmitters are an excellent solution for customers interested in both Predictive Maintenance and Continuous Monitoring. Using an external ICP® accelerometer, the DIN rail transmitters power the sensor and convert the raw vibration data to a 4-20 mA signal proportional to RMS or Peak. Raw vibration data is available from the BNC connector during schedule route data collection. Additionally, the transmitter provides a 4-20 mA signal proportional to temperature for sensors with the TO (Temperature Output) option. Both of these solutions will provide you 24/7 protection from critical failures preventing downtime and expensive repairs.
4-20 mA Sensors - Process Monitoring & Protection

4-20 mA Output Transmitter
Series 640
- Multiple ranges available
- Peak or RMS, acceleration or velocity
- Intrinsically safe / explosion proof versions available
- Temperature output and raw vibration output options available
- 24 volt Loop Powered
See page 112-119 for more information

ICP® DIN Rail Transmitters - Process Monitoring & Protection

DIN Rail Enclosure
Model 682A00
Visit www.imi-sensors.com for more information

Low Cost ICP® Accelerometer
Series 607A
See page 84 for more information

Vibration Transmitter
Model 682B03
- Outputs 4-20 mA signal proportional acceleration, velocity, or displacement
- ICP® accelerometer input
- Analog vibration output via front BNC
See page 121 for more information

Low Cost ICP® Accelerometer
Model 608A11
See page 84 for more information

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Toll-free in USA 800-959-4464 716-684-0003
Pump & Submersible Pumps

Accessories

**Mounting Hardware**

- **Sensor Mounting Pad**
  - Model 080A93: 0.75”
  - Model 080A118: 01.0”

- **1.25” Spot Face Tool**
  - Model 080A128

**Cables & Connectors**

- **Polyurethane Cabling with Right Angle MIL-Style Connector**
  - 052BQXXXBZ

- **Polyurethane Cabling with MIL-Style Connector**
  - 052BRXXXBZ

  XXX = Denote cable length, 010 = 10 feet (Metric lengths available)

**Enclosures**

- **BNC Termination Enclosure**
  - Model 691A51/04

- **BNC Termination Enclosure**
  - Model 691A50/12

- **BNC Switch Box**
  - Model 691B42

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**Product Spotlight**

**Model 608A11 Easy-mount Method**

Easy installation of sensors with a long integral cable

- Permits mounting and dismounting without twisting sensor and integral cable
- Speeds sensor dismount for routine sensitivity verification or system troubleshooting

- **Mounting Stud**
  - Model 080A162

- **Floating Hex Nut**
  - Model 080A165

Mounting stud is tightened to recommended torque with appropriately sized hex Allen key.

Mounting hole is prepared into machine surface to accept sensor’s mounting stud. Sensor integral cable is threaded through the floating hex nut.

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visit us online at www.imi-sensors.com

Toll-free in USA 800-959-4464  716-684-0003
Paper Machines & Conveyors

Sensors Built to Survive Hot, Wet and Debris Filled Environments
Rolling-element bearings are the lifeblood of many industrial processes including the manufacturing of paper and plastics as well as mining. Often these bearings are located in hot, wet or dangerous areas that are inaccessible to the predictive maintenance professional. Using permanent mount accelerometers will allow the vibration analyst an opportunity to detect critical bearing faults such as pitting or spalling as well as lubrication issues before they cause a critical shutdown.

High temperature ICP® accelerometers outlined on page 17 allow for affordable protection. These designs offer the best high temp capability of any industrial sensor in the industry without an external charge amplifier. Integrated circuit high temp accelerometers can be routed straight to portable data collectors, saving the company money and providing a simple, clean installation.

Suggested Sensor Placement
High Temp ICP® Accelerometer
Model HT602D01
- Ceramic sensing element
- Low profile design
- Through-bolt mount
See page 100 for more information

High Temp ICP® Accelerometer
Model HT622A01
- Ceramic sensing element
- Short settling time
- Welded hermetic
Visit www.imi-sensors.com for more information

High Temp ICP® Accelerometer
Model HT628F01
- Quartz sensing element
- Excellent thermal stability
- Welded hermetic
See page 101 for more information

Accelerometers for Dryer Section - Predictive Maintenance

High Temperature ICP® Accelerometers
Model HT602D11 & Model HT602D61
- Ideal for high temp applications to 325 °F (163 ºC)
- Hermetically sealed with integral FEP jacketed cable (optional armor jacket)
- Low profile design eliminates concerns about cable bend radius
See page 100 for more information

Product Spotlight

Visit us online at www.imi-sensors.com
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IMI SENSORS
A PCB PIEZOTRONICS DIV.
Predictive Maintenance

Paper Machines & Conveyors

Often in paper and plastics manufacturing locations rolling-element bearings are difficult to monitor because of their slow speeds. The 1x running speed of the bearing may be lower in frequency than the low frequency range of a typical piezoelectric accelerometer.

For these applications IMI Sensors offers low frequency accelerometers. In these models the discharge time constant has been extended, thus allowing the sensor to monitor slower speeds down to 12 CPM (0.2 Hz). These sensors are ideal for both permanent mount applications and route-based applications. They are all welded hermetic, case isolated construction and built to survive harsh environments.

**Accelerometers for Slow Speed - Predictive Maintenance**

**Low Frequency, 500 mV/g Accelerometers**

Slow speed applications such as slow moving roller element bearings in a paper mill produce lower vibration levels. Consider increasing the sensor’s sensitivity to 500 mV/g, thus increasing signal resolution in these applications.

**Tips From Techs**

**Low Cost Industrial ICP® Accelerometer**

- Low Noise

See page 88 for more information

**Low Frequency Industrial ICP® Accelerometer**

- Full sweep calibration certificate provided

See page 94 for more information

**Precision ICP® Accelerometer**

- Side exit, ring-style
- Low frequency response to 12 cpm (0.2 Hz)
- Ceramic sensing element

See page 92 for more information

**Precision ICP® Accelerometer**

- Low noise floor
- Low frequency response to 12 cpm (0.2 Hz)
- Full sweep calibration

See page 94 for more information

**Low Frequency Industrial ICP® Accelerometer**

- Full sweep calibration certificate provided

See page 94 for more information

visit us online at www.imi-sensors.com
General Purpose Accelerometers - Predictive Maintenance

- **Low Cost ICP® Accelerometer Model 602D01**
  - Easy installation in tight spaces
  - Through-bolt aids in connector orientation
  - Less than 1 in. height
  - See page 82 for more information

- **Low Cost ICP® Accelerometer Model 603C01**
  - Cost-effective sensor option
  - IMI’s most popular accelerometer
  - Small footprint
  - See page 82 for more information

- **Low Cost ICP® Accelerometer Series 607A**
  - Unique 360º swivel design
  - Allows for easy cable orientation
  - Integral or armored integral cable options available
  - See page 84 for more information

Mining Industry, Conveyors - Predictive Maintenance

- **Low Cost ICP® Accelerometer Model 607A61**
  - Unique 360º swivel design
  - Allows for easy cable orientation
  - Armored integral cable
  - See page 85 for more information
The continuous monitoring of bearing health is critical to the uptime and safety of paper machines and conveyor systems. IMI's Bearing Fault Detector directly interfaces with PLC, DCS, PI and other control systems providing an easy continuous monitoring solution. Not only does the Bearing Fault Detector provide overall RMS and Peak vibration, but also provides a 4-20 mA signal proportional to True Peak acceleration that is sensitive to early bearing faults. Paper machines and other conveyor processes often expose accelerometers and transmitters to extreme environments including high temperature, debris and caustic chemicals. IMI® offers ICP® accelerometers able to handle the harshest of environments with temperatures up to 325 °F and integral armor jacketed cable.

**Recommended Components for a Typical Installation**

- **Bearing Fault Detector**
  Model 682B05
  - Provides early warning of bearing and gear faults
  - Operates with PLC, DCS, SCADA, alarm and control systems
  - Outputs 4-20 mA signals for peak acceleration and overall vibration
  See page 124 for more information

- **High Temperature ICP® Accelerometer**
  Model HT62D11
  See page 100 for more information

- **High Temperature ICP® Accelerometer**
  Model HT62D61
  See page 100 for more information

- **DIN Rail Enclosure**
  Model 682A00
  - Strong fiberglass construction
  - NEMA 4X rating

Visit www.imi-sensors.com for more information.
Combustion Dynamics Instrumentation
For the Most Demanding Gas Turbine Measurement & Monitoring Requirements
Energy & Power Generation

Combustion Dynamics Instrumentation

For more than 40 years, PCB® has specialized in the design and manufacture of innovative sensors and measurement systems for the gas turbine market. In those four decades, our expertise in combustion dynamics instrumentation has met the industry's most demanding requirements for dynamic combustion measurement and turbine engine monitoring.

With the move toward increased fuel efficiency and lower exhaust emissions, today's gas turbine engines are based on technological innovation yet also bring potential problems. Burning a leaner flame keeps NOx emissions low but at the same time increases instability (combustion dynamics) in the gas turbine engine. This instability can damage components in the combustion chamber such as nozzles, baskets and transition pieces, as well as downstream components such as blades, resulting in downtime and loss of revenue.

IMI's instrumentation is designed to detect and measure dynamic pressure spikes, pulsations and surges in gas turbine engines. Our pressure sensors have three basic applications for detecting and measuring dynamic pressure phenomena and combustion instability in gas turbine engines: remote sensors, close coupled sensors and On-turbine Instability Sensors.

The diagram above shows a typical setting for a gas turbine in a power generation plant. Shown within the illustration are the three standard methods of measuring pressure; Remote, Close Coupled and On-Turbine Instability Sensor (OTIS). The red bullets indicate the location of the actual sensor for each different method.

visit us online at www.imi-sensors.com

Toll-free in USA 800-959-4464 716-684-0003
These pressure sensors have either a portable or permanent configuration. Portable systems consist of pressure sensors that are connected to sensing lines running to some or all of the combustors. Similar to the portable systems, permanent systems provide sensors mounted outside the turbine enclosure.

The sensors are then connected through sensing lines (tubing) to each combustor. Because of the long sensing lines involved, the ability to “purge” condensation is required. There are advantages to this simple, Low Cost approach. Because the sensors are mounted outside the turbine enclosure, the conditions the sensors must endure are relatively mild, thus allowing for the use of less expensive sensors with longer life expectancy. In addition, these sensors can be serviced while the turbine is online.
Close coupled sensors permanently mounted to a gas turbine are ideal for monitoring combustion dynamics (instability). Operating at a wider frequency range than remote sensors, the high sensitivity and higher-temperature capability of these sensors allow for precision measurement in turbine locations where the application of other instrumentation is not possible.

Close coupling of the sensors to the combustor enables the measurement and detection of dynamic pressure phenomena such as high frequency events that can cause damage to downstream components such as blades. Like the portable and permanent remote sensors, close coupled sensors also require a purging system to eliminate condensation.

High Sensitivity Pressure Sensor
Series 171
- Measurement range: 10 psi (68.9 kPa)
- Sensitivity: 1100 pC/psi (160 pC/kPa)
- 2-pin connector, 1-1/8"-12 UNF-2A port
- Weight: 6.5 oz (185 gm)

In-Line Charge Converter
Model 422E55/D
- Output voltage: (at specified measurement range) ±5 Vpk
- Sensitivity: (charge conversion) 0.5 mV/pC
- Frequency range (±5%) 0.5 Hz to 100 kHz
- Housing material: stainless steel

See page 141 for more information
High temperature sensors directly mounted to the combustor basket provide 24/7, consistent, reliable combustion dynamics data monitoring so that tuning changes can be made at anytime. On-Turbine Instability Sensors allow for diagnostics, part fatigue analysis and the ability to continuously monitor and control emissions. The higher frequency capability of the OTIS sensors enable the use of auto-tuning and online diagnostic monitoring systems. In addition, these sensors provide an output that can easily connect to legacy combustion dynamics monitoring systems. By having sensors directly mounted to the combustor, operators save time during combustion analysis.
Energy & Power Generation
Combustion Dynamics
Instrumentation

High Temperature Accelerometers - Energy & Power Generation

Vibration monitoring of gas turbines can provide crucial information to diagnose potential problems, leading to an increase in uptime and a decrease in unplanned maintenance, catastrophic failures and accidents.

ICP® Accelerometer with High Temperature Range Option
Model HT622A01
- Sensitivity: (±5%) 100 mV/g (10.2 mV/(m/s²))
- Frequency Range: (±3dB) 12 to 480 kcpm (0.2 to 8 kHz)
- Measurement Range: ±50 g (±490 m/s²)
- Electrical Connector: 2-Pin MIL-C-5015
Visit www.imi-sensors.com for more information

High Temperature Industrial Charge Accelerometer
Model 612A01
- Sensitivity: (±10%) 26 pC/g (2.6 pC/(m/s²))
- Temperature Range: (Operating) -65 to +500 °F (-54 to +260 °C)
- Electrical Connector: 2-Pin MIL-C-5015
- Electrical Connection Position: Top
Visit www.imi-sensors.com for more information

Very High Temperature Accelerometer
Series EX600B1X
- Sensitivity: 10 to 100 mV/g (10.2 mV/(m/s²))
- Frequency Range: (±5%) 282 to 240000 cpm (4.7 to 4 kHz)
- Measurement Range: ±50 to 500 g peak (±490 to 4900 m/s²)
- Mounting: Through Holes (3)
See page 106 for more information

Innovations in high temperature accelerometer technology for gas turbine monitoring now enable vibration measurement in extreme heat environments up to +1200 °F (+649 °C). IMI’s high-temp accelerometers come in a variety of frequencies, temperature ranges and configurations. Integral charge amplifiers allow for use with standard data acquisition equipment.

Extreme Temperature Charge Accelerometer with Integral Hardline Cable
Series 35709X
- Sensitivity: (±10%) 5 pC/g (.51 pC/(m/s²))
- Measurement Range: ±1000 g pk (±9800 m/s² pk)
- Frequency Range: (±5%) 2.5 kHz
- Electrical Connector: Integral Hardline Cable
See page 108 for more information

Visit us online at www.imi-sensors.com
Combustion Dynamics Instrumentation

Accessories

**Accessories** - For Remote Sensors

- Low Noise, TFE, Coaxial Cable 10-32 Coaxial Plug to BNC Plug
  003CXX Cabling
- Polyurethane, Twisted Pair Cable with Composite 2-Socket MIL-style Connector to BNC Plug
  052FVXXXAC Cabling
- Low noise, PFA, Twisted Pair Cable 2-Socket MIL to BNC Plug
  045ERXXXAC Cabling

**Accessories** - For Close Coupled Sensors

Accessories - For On-Turbine Instability Sensors

- Polyurethane Cable, BNC Plug to Pig Tails
  052ACXXXAD Cabling
- Low Noise, PFA Cable, 2-socket 7/16 MIL to 2-Socket MIL-C-5015
  045M19 Cabling
- Polyurethane Cable, Composite 2-Socket MIL-style Connector to BNC Plug
  052BRXXXAC Cabling

XXX = Denote cable length, 010 = 10 feet (Metric lengths available)

visit us online at www.imi-sensors.com

IMI SENSORS
A PCB PIEZOTRONICS DIV.
Cooling Tower Measurements? We Do!

We do it all - sensors to measure vibration, acoustics, force, pressure, load, strain, shock and torque - Sure we do!

www.imi-sensors.com/sure
Protecting Cooling Towers & HVAC Systems

Reliable and Cost-Effective Vibration Monitoring Solutions for Cooling Fans and Other Low Frequency Equipment
Cooling Towers are a critical component of production in many industries today. Most towers use the same design, which is a horizontal electric motor driving a jack shaft into a right angle gearbox with vertical output to a large fan. Vibration monitoring of this drive train is essential to provide signals for early warning or provide shutdown when vibration levels exceed a predetermined threshold. The classic legacy solution involved the use of “earthquake” mechanical switches. These devices utilize a spring and magnet concept and are designed to mechanically trip during high vibration. Reliability becomes an issue with mechanical switches due to harsh cooling tower environments, especially in critical applications.

The next generation 686B Smart Vibration Switches are USB programmable and employ piezoelectric sensing elements coupled with field adjustable threshold settings. Also integrated programmable time delays virtually eliminate false trips. When streaming vibration data is required, the 685B Series electronic vibration switch provides 4-20 mA output as well as analog vibration data output for data analysis. Two separate relay outputs, for alert and alarm, are field adjustable with separate time delays for each relay. Other IMI® solutions include 4-20 mA output sensors for continuous monitoring in conjunction with existing PLCs, DCS and SCADA systems. All products are available with hazardous area approvals.
Electronic Vibration Switches - Process Monitoring & Protection

**Electronic Vibration Switch**
Series 685B
- Lower cost than competitive models
- Dual set points (relays)
- Explosion proof options available
- On-board or remote piezoelectric accelerometer

See page 132 for more information

**USB Programmable Smart Switch**
Model 686B01
- Programmable delays eliminate false trips
- Competitive price compared to mechanical switches
- Hazardous area approvals available

See page 130 for more information

Mechanical Vibration Switches - Process Monitoring & Protection

**Mechanical Vibration Switch**
Model 685A07
- Cost-effective protection for less critical applications
- Utilizes spring-loaded, magnetically coupled mechanism
- External reset button

See page 134 for more information

**Mechanical Vibration Switch**
Model 685A08
- Weatherproof & CSA/UL approved, explosion proof
- Cost-effective protection for less-critical applications
- Requires no power

See page 135 for more information
In other cooling applications there may be a need for vibration trending or route based inspection of critical bearing and critical gearbox conditions. In this case vibration switches may not be the correct solution. IMI Sensors supplies industry leading general purpose vibration sensors to interface with any data collector used for classic condition monitoring applications. For 24/7 vibration trending the 640 Series 4-20 mA output sensors provide current signals to interface with any PLC, SCADA, or DCS panel. These sensors are available in several measurement ranges RMS or Peak and various measurement methods (displacement, velocity, acceleration). For the best of both worlds, IMI's din-rail transmitters output 4-20 mA signals for trending plus voltage signals for time waveform and spectral analysis.
Gearboxes

Instrumentation Built to Survive in Grease & Grime and Pickup Gear Mesh Faults
Predictive Maintenance

Gearboxes

The sensor has to be chosen based on calculated gear mesh frequency and bearing defect frequencies. The gear mesh frequency is easily determined by multiplying the number of teeth on a gear by the rotational frequency. For example, a motor with 1800 rpm (30 Hz) and a gear with 50 teeth results in a gear mesh frequency of 1500 Hz. This result multiplied by a factor of 3.25 will provide the maximum frequency the sensor should be able to measure for best results. If the number of teeth on a gear is unknown, as a rule of thumb, the maximum sensor frequency should be assumed to be 200 times rpm (in Hz). Typically high speed input and low speed output frequencies need to be measured near shaft bearings. Sensors should not be mounted on resonance frequency prone housing locations to improve accuracy of the readings. Sensors can be placed in radial, ideally two sensors with a 90 degree angle and axial locations. Radial sensors can be used to spot imbalance and axial sensors will best analyze gear mesh and bearing faults. Most IMI® sensors can be offered with an option to safely affix them inside of the gear housing for best measurement results. Sensors can be pressure tested, can withstand oils and chemicals inside of the case and are available in high temperature versions. Advanced vibration monitoring systems in combination with experienced analysis can deliver a broad range of results. Tooth wear, gear eccentricity & misalignment, damaged teeth and other potential problems can be spotted instantly while the transmission is in service.
High Speed / Gear Mesh - Predictive Maintenance

Precision ICP® Accelerometer
Model 625B01
- Side exit, ring-style
- Ceramic sensing element
- Available with intrinsically safe, velocity output
See page 92 for more information

Precision ICP® Accelerometer
Model 626B01
- High sensitivity
- 12 cpm
- Available with temperature output
See page 94 for more information

Low Cost ICP® Accelerometer
Model 603C00
- 10 mV/g sensitivity
- 500 g measurement range
- Small footprint
See page 88 for more information

Low Cost ICP® Accelerometer
Model 607A11
- Unique 360° swivel design
- Allows for easy cable orientation
- Integral or armored integral cable options available
See page 84 for more information

Precision ICP® Accelerometer
Model 622B01
- Full frequency sweep calibration: 5% sensitivity deviation tolerance
- 15 kHz high frequency response ideal for early detection of bearing fluting conditions
- Ideal for route-based data collection
See page 92 for more information

Reducer / Slow Speed - Predictive Maintenance

Precision ICP® Accelerometer
Model 622B01
- Full frequency sweep calibration: 5% sensitivity deviation tolerance
- 15 kHz high frequency response ideal for early detection of bearing fluting conditions
- Ideal for route-based data collection
See page 92 for more information
Gearboxes

Accessories

Cables & Connectors

- Polyurethane Cabling with MIL-Style Connector
  052BRXXXBZ
- Polyurethane Cabling with Right Angle MIL-Style Connector
  052B0XXXBZ

XXX = Denote cable length, 010 = 10 feet
(Metric lengths available)

Mounting Hardware

- Sensor Mounting Pad
  Model 080A33: Ø0.75”
  Model 080A118: Ø1.0”
- Flat Surface Magnet
  Model 080A157
- Small Adhesive Kit
  Model 075A05

Product Spotlight

Very High Frequency Accelerometer Kit
Model 600A12

This high frequency 10 mV/g accelerometer kit features a very small accelerometer with a magnet and cable assembly:

- High frequency response to 30 kHz, even when mounted magnetically
- Supplied with 5 ft. cable with BNC plug termination
- Kit features Model 621B40 accelerometer, with titanium housing
Wind Turbine Condition Monitoring & Assessment

Sensors and Instrumentation for Permanent Installation and Testing of Wind Turbines and Turbine Components

IMI Sensors - A PCB Piezotronics Division
Some of the world’s largest wind farms rely on IMI Sensors to keep their wind turbine operations at optimal performance by increasing reliability and reducing downtime. A broad range of industrial grade sensors from PCB® measure vibration, strain, torque and noise in new and existing wind turbines, providing measurements that are crucial to keep the operating health of these systems in tip-top shape.

**Sensor Placement Reference Key:**
- **Continuous Monitoring:**
  Measurements on gearboxes
- **Load & Torque:**
  Measurements on couplings & bolt tightness
- **Modal Analysis:**
  Measurements on turbine blades
Condition Monitoring Accelerometers - Energy & Power Generation

Low Cost ICP® Accelerometer
Series 607A
- Unique 360° swivel design
- Allows for easy cable orientation
- Integral or armored integral cable options available
See page 84 for more information

Low Cost ICP® Accelerometer
Model 602D01
- Easy installation in tight spaces
- 360° connector orientation
- Integral or armored integral cable options available
See page 82 for more information

Low Cost ICP® Accelerometer
Model 603C01
- General purpose, hermetically sealed
- IMI’s most popular accelerometer
- Small footprint
See page 82 for more information

Low Frequency ICP® Accelerometer
Model 626B01
- Ideal for slow rotating equipment
- Low noise floor
- High output sensitivity
See page 94 for more information

Embeddable Accelerometer
Series 660
- ICP®, charge and low power versions available
- Easily designed into PC boards
- Variety of sensitivities
See page 110 for more information

visit us online at www.imi-sensors.com
Toll-free in USA 800-959-4464 716-684-0003
Wind Turbine Assessment

Wind turbines and towers utilize literally thousands of fasteners. Selecting the proper tools and applying the correct amount of torque to each fastener is imperative for optimizing the costs of operation.

RS Technologies, a division of PCB Load & Torque, Inc., serves the product assembly and fastener manufacturing communities with a complete line of rotary and stationary torque sensors, hand torque wrenches, measuring instruments and threaded fastener torque-tension testing systems. For more information on any of these products, please visit www.pcbloadtorque.com

**Hand Torque Wrenches - Energy & Power Generation**

**Torque Wrench**
Series HT7000
- Durable ergonomic construction
- Lightweight and high strength
- Excellent accuracy of measurements
- Compatible with most data collectors

Visit www.pcbloadtorque.com for more information

**Rotary Torque Transducers - Energy & Power Generation**

**Rotary Torque Transducer**
Series PC9000
- Industrial-rated for power and pulse tools
- Measure torque only or torque and angle
- 2 mV/V output with matched shunt calibration

Visit www.pcbloadtorque.com for more information

**Portable Transducer, Model 962 - Energy & Power Generation**

**Portable Data Recorder**
Model 962
- Battery operated
- Cost-effective option
- Easy to operate
- Print both numeric and graphic data

Visit www.pcbloadtorque.com for more information

Model 962 Portable Data Recorder Instrument can be used with other RS Technologies’ products such as the Stationary Torque Transducer, Rotary Torque Transducers, Hand Torque Wrenches and more. The instrument is powerful and accurate enough to be used as a primary standard for auditing most torque applications in manufacturing and quality departments. When connected to a Rotary Torque Transducer, the unit can be used to test the capability of power tools, verify the accuracy of hand tools, monitor the capability of a fastening process, or audit the quality of an assembled joint.
Microphones & Preamplifiers - Energy & Power Generation

Microphones are used to measure the noise from the wind turbine both internally and externally. The gearbox and the main bearing are typical noise sources which should be measured internally, while the overall turbine noise is monitored externally. Larson Davis, a division of PCB Piezotronics, manufactures various Sound Level Meters and Microphones which can be used to make these different types of acoustic measurements.

By utilizing the built-in narrow band FFT analysis option on Model 831, higher frequency components can be analyzed to predict possible machine faults. An analysis of the source of the audible noise can result in gearbox modifications so that the equipment runs quietly and efficiently. In addition, the low frequency content of blade generated noise can be quantified using octave analysis.

- High-temperature (120 °C) 248 °F preamplifier for prepolarized microphones
- Type 1 compliant, modern prepolarized (0 V) and externally polarized (200 V) microphones
- Value oriented array microphones
- TEDS compliant with IEEE standards

Visit www.pcb.com/acoustics for more information

Sound Level Meters - Energy & Power Generation

The rugged, ergonomic design of the Larson Davis Sound Level Meter, Model 831, is ideal for one handed operation and its large display can be read in any lighting conditions. The 831 can also be used with a complete range of microphones and preamplifiers including weather-resistant units for unattended and semi-permanent wind turbine monitoring applications. Advances in technology provide 2GB of internal memory, with superior performance and a reliable design. The inclusion of Weather Parameters allows all environmental noise data to be integrated in one common report.

Sound Level Meter
Model 831
- Over 16 hours of runtime on 4 AA batteries
- USB 2.0 peripheral connectors
- 120dB dynamic range
- 2 GB memory standard
- RMS & peak A, C & Z frequency weighting
- RMS slow, fast & impulse detection characteristics
- Real time 1/1 & 1/3 octave frequency analysis
- 6400 line FFT analysis
- .WAV sound recording for source identification
- Automatic data logging (20ms to 24 hours)
- Complete environmental packages available

Visit www.larsondavis.com for more information

visit us online at www.imi-sensors.com
Wind Turbine Assessment

Instrumentation that can provide voltage excitation and bridge completion is ideal for this measurement. Strain gages can be placed anywhere on the blade, but the distribution varies with the amount of sensors. These sensors should be in a configuration to optimally model the stress on the blade, taking measurements from both the flap-wise and edge-wise directions.

**ICP® Strain Sensor**

Model RHM240A02
- Measure Longitudinal Strain on Machinery Structures
- Monitor Quality, Safety and Reliability
- Robust Construction Endures Harsh, Industrial Environments
- Simple Installation is Non-Invasive to Process

Visit www.pcb.com for more information

PCB Piezotronics, Inc. Model RHM240A02 single axis ICP® Strain Sensor is structured with a quartz sensing element and microelectronic circuitry in a low profile titanium housing, making this sensor ideal for high resolution measurements of dynamic strain on wind turbine blades. This unit is compatible with PCB’s ICP® Sensor signal conditioners and is capable of driving long cables.

**Load, Strain & Torque - Energy & Power Generation**

PCB Load & Torque, Inc., designs and manufactures a full line of load cell and torque sensors for numerous industries including: aerospace & defense, automotive, medical rehabilitation, material testing, textile, process control, robotics & automation and more. PCB Load & Torque offers exceptional customer service, 24-hour technical assistance and a Total Customer Satisfaction guarantee.

**Load Cells**

Series 1200 & Series 1400
- Low deflection, high accuracy
- Low profile for easy installation
- NIST traceable, A2LA accredited calibration to ISO 17025
- Temperature & pressure compensated

Visit www.pcbloadtorque.com for more information

PCB Load & Torque, Inc. manufactures a wide range of high accuracy, strain gage load cells. The 1200 and 1400 series load cells are compact and are available various capacities from 250 lbf and up. While the 1200 series is a general purpose load cell with a cycle life of 10 million plus reversing cycles, the 1400 series is a fatigue rated load cells with a life cycle of 100 million plus reversing cycles. The 1400 series load cell is available in both single and dual bridge configurations.

**TORKDISC® Rotary Torque Sensor System**

Series 5300
- Digital system alleviates noise & data corruption
- Immune to RF & EMI
- Maintenance free

Visit www.pcbloadtorque.com for more information

PCB Load & Torque, Inc. Series 5300 TORKDISC® in-line rotary torque sensor systems are designed for test applications requiring a robust rotary torque transducer where axial space is at a premium.

Visit us online at www.imi-sensors.com

Toll-free in USA 800-959-4464  716-684-0003
PCB Load & Torque, Inc., designs and manufactures a full line of load cells, torque sensors and telemetry systems for numerous industries including: aerospace & defense, automotive, energy & power generation, material testing, textile, process control, robotics & automation and more.

PCB Load & Torque, Inc. single channel telemetry systems provide a simple, accurate method of conditioning and transmitting strain signals on rotating or moving machinery while operating in a completely contactless mode. Power is transferred inductively and the signal is RF transferred between the moving and static component - no brushes or wires required. This method guarantees an absolute maintenance free continuous operation and accurate transmission of measured data. Series 8180 performs a remote shunt calibration when the unit is powered up.

- Factory configurable for strain, thermocouple, voltage, or ICP®
- Easy to use, wear & maintenance free
- Extremely robust, dust & waterproof, yet compact and lightweight
- Contact-free signal transmission and power supply for continuous operation
- Remote shunt calibration
- Adjustable output

Visit [www.pcbloadtorque.com](http://www.pcbloadtorque.com) for more information
Wind Turbine Assessment

Test engineers have used the principles of modal analysis, using PCB Piezotronics, Inc. ICP® accelerometers, Modally Tuned® Impulse Hammers and ICP® quartz force sensors to determine the strength and structural integrity. Single axis and triaxial MEMS DC accelerometers are placed on the tip of each blade. The photo on page 45 shows a wind turbine blade mounting in a dynamically controlled, hydraulic structural loading machine, along with the various sensors and cables mounted on the blade.

Modal Shakers & Hammers - Energy & Power Generation

ICP® Impact Hammer
Model 086D20
- Sensitivity: (±15%) 1 mV/lbf (0.23 mV/N)
- Measurement Range:
  ±5000 lbf pk (±22,240 N pk)
- Hammer Mass: 2.4 lb (1.1 kg)
Visit www.pcb.com for more information

Modal Shaker
Model 2100E11
- Through-hole armature provides simple setup with modal stingers
- Lightweight and portable – weighing just 33 lbs (15 kg)
- Trunnion base provides flexibility when choosing best exciter location(s)
- 1" stroke supplies adequate input energy for most modal test applications
Visit www.modalshop.com for more information

The Modal Shop, a PCB Group Company based in Cincinnati, Ohio, USA, offers a complete line of electrodynamic modal and vibration shakers ideal for applications ranging from experimental modal analysis and general vibration testing to accelerometer calibration. Shakers are also available through the TMS Rental Program in addition to accelerometers, force sensors, hammers, microphones and sound level meters. As a global leader in sound and vibration, The Modal Shop is PCB Group’s focal point for a comprehensive product range of dynamic calibration systems.

For structural excitation, Modally Tuned® ICP® impulse hammers and shakers are also available, allowing PCB® to be a complete, front-end instrumentation provider. If the excitation is coming from a shaker, The Modal Shop, a PCB Group Company, offers a full line of modal and vibration shakers. The Model 2100E11, a lightweight electrodynamic modal exciter, is capable of providing up to 100 lbf (440 N) of peak force excitation in a small footprint weighing just 33 pounds (15 kg).
Blade Pitch Control

Blade mounted pressure sensors can provide a signal to a blade pitch controller, which uses the signal to adjust the blade pitch to an acceptable level. PCB Piezotronics, Inc. pressure transducers, Series 1500, achieve the accuracy, repeatability and stability requirements of wind turbine measurement and control.

Pressure Transducers - Energy & Power Generation

PCB® pressure sensors have been specifically designed to provide high accuracy, excellent repeatability and unmatched long term stability. This is achieved by a unique thin-film process, which “atomically fuses” sensitive resistive material directly to the pressure sensing element. This process eliminates the traditional use of adhesives, as well as the need for a “fluid fill.” The pressure sensing element is mated to an integrated circuit, programmed to provide the required span, zero and output configuration. Then, to ensure reliability, the sensing cores are encapsulated by an all-welded, corrosion resistant, stainless steel diaphragm and housing.

Blade mounted pressure sensors can provide a signal to a blade pitch controller, which uses the signal to adjust the blade pitch to an acceptable level. PCB Piezotronics, Inc. pressure transducers, Series 1500, achieve the accuracy, repeatability and stability requirements of wind turbine measurement and control.

Pressure Transducers & Transmitters - Energy & Power Generation

PCB® pressure sensors have been specifically designed to provide high accuracy, excellent repeatability and unmatched long term stability. This is achieved by a unique thin-film process, which “atomically fuses” sensitive resistive material directly to the pressure sensing element. This process eliminates the traditional use of adhesives, as well as the need for a “fluid fill.” The pressure sensing element is mated to an integrated circuit, programmed to provide the required span, zero and output configuration. Then, to ensure reliability, the sensing cores are encapsulated by an all-welded, corrosion resistant, stainless steel diaphragm and housing.
Oil & Gas Pipeline Measurements?

We Do!™ We do it all - sensors to measure vibration, acoustics, force, pressure, load, strain, shock and torque - Sure we do!

www.imi-sensors.com/sure
Oil & Gas Wells and Pipelines

Sensors for Natural Gas Supply & Petrochemical Industry
Sensors that offer hazardous area approvals are widely used on gas and oil well heads, supply lines, natural gas power engines, multi-stage gas compressors and other machinery operating in hazardous environments. Piezoelectric pressure sensors offer the capability to detect and monitor dynamic pressure spikes, pulsations and surges in gaseous or liquid media. Engine pressure sensors offer walk-around or permanent monitoring capability, allowing engine balancing and emissions control. Vibration monitoring has proven effective for determining machinery health, planning maintenance intervals, reducing downtime and avoiding catastrophic loss.
Sensors for Motors & Pumps - Energy & Power Generation

**4-20 mA Vibration Transmitter**
Series EX640
- Available in velocity or acceleration output
- ATEX / CSA approved with explosion proof conduit
- Top exit, 2-pole terminal block
See page 116 for more information

**Low Cost ICP® Accelerometer**
Series 007
- Unique 360° Swivel Design
- Allows for easy cable orientation
- Integral or Armored Integral
  Cable options available
See page 84 for more information

Sensors for Compressors - Energy

**4-20 mA Pressure Transmitter**
Series 1903
- Ranges from 300 to 10,000 psi
- Withstands sour gas environments
- 1/2” NPT fitting
Visit www.pcb.com for more information

**ICP® Pressure Sensor**
Model 121A44
- Sensitivity: 10 to 100 mV/psi (1.45 to 14.5 mV/kPa)
- Measurement range: 50 to 500 psi
- 316 stainless steel diaphragm
- 1/4” NPT fitting
See page 138 for more information

**Tips from Techs**

Typical Intrinsically Safe Installation

Sensor Cable
Approved, Intrinsically Safe ICP® Accelerometer

Hazardous Area

Safe Area

Output Cable
Intrinsic Safety Barrier

Vibration Data Collector or Analyzer with ICP® Sensor Power

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Conveyor Vibration Measurements?
We Do!
We do it all - sensors to measure vibration, acoustics, force, pressure, load, strain, shock and torque - Sure we do!

www.imi-sensors.com/sure
Vibratory Screens & Feeders

Meeting the Demands of Environmental Vibration Measurement & Trending Applications
Vibration monitoring of vibrating screens and feeders is critical to determining machinery health and preventing overloading or catastrophic damage to equipment. Because this type of equipment is intended to operate with high levels of vibration, low sensitivity high range sensors are optimal. Because these types of processes are often dirty, wet and debris may damage cables, armor jacketed cables are recommended.
4-20 mA Transmitters - Process Monitoring & Protection

**4-20 mA Output Transmitter**
Series 642
- Cost-effective 4-20 mA output sensor
- Available in top or side exit casings
- Ruggedized industrial design

See page 118 for more information

**Intrinsically Safe 4-20 mA Output Transmitter**
Model EX640B71
- Available in velocity or acceleration output
- ATEX / CSA approved with explosion proof conduit
- Top exit, 2-pole terminal block

See page 116 for more information

**4-20 mA Sensor Retransmit Module**
Model 682B03
- Accepts ICP® sensor input, outputs 4-20 mA proportional to vibration
- Selectable displacement, velocity, or acceleration output
- Analog vibration output via front BNC for fault diagnostics

See page 121 for more information

Vibration Switches - Process Monitoring & Protection

**Electronic Vibration Switch**
Series 685B
- Lower cost than competitive models
- Dual set points (relays)
- Explosion proof options available

See page 132 for more information

**USB Programmable Smart Switch**
Model 686B01
- Programmable delays eliminate false trips
- Competitive price compared to mechanical switches
- Explosion proof options available

See page 130 for more information
Vibratory Screens & Feeders

Accessories

Accessories for 4-20 mA Transmitters

- Armor Jacketed, FEP Cable with MIL Connector to Blunt Cut
  - 048BPXXXBZ

- Sensor Mounting Pad
  - Model 080A91: Ø1.375"

- Mounting Stud for Side Exit Transmitters
  - Model 080A162

Accessories for Vibration Switches

- Polyurethane Cabling with Right Angle MIL-Style Connector
  - 052B0XXXBZ

- Adapter Plate for Model 685B
  - Model 080A209

- USB Programming Kit for Model 686B
  - 600A15 Kit

XXX = Denote cable length, 010 = 10 feet (Metric lengths available)
Reciprocating Machinery

Sensors Optimized for the Unique Challenges of Protecting & Monitoring Reciprocating Machinery
Process Monitoring & Protection

Reciprocating Machinery

Years of frustrating unanticipated reciprocating compressor failures have lead to the development of the new line of IMI® Reciprocating Machinery Protectors. We have learned that the proven successful methods of condition monitoring on rotating equipment do not yield good results on reciprocating devices. IMI® has developed the RMP product line to detect impacts caused by looseness of internal parts. Depending on the amplitude of the impact and how many times the impact occurs within a specified time window, the appropriate 4-20 mA signal is provided. The industry leading USB Programming capability makes it easy to match the RMP to any reciprocating application. For properly running machinery, the IMI® RMP allows you to trend peak acceleration data.

Sensor

Piston

Sensor

Suggested Sensor Placement
Sensors for Compressors - Process Monitoring & Protection

4-20 mA Pressure Sensor
Series 1503
- Mounts on the compressor
- Withstands sour gas environments
- 1/2" NPT fitting
Visit www.pcb.com for more information

Reciprocating Machinery Protector
Model 649A01
- Detects faults / mechanical looseness in reciprocating compressors
- Outperforms impact transmitters
- Continuous trending, with alarm & alert levels for early warning
See page 126 for more information

USB Programming Kits
- Customize settings on your USB programmable sensor
- Power-on, startup, & operating delays
- Kit includes CD-ROM software & cable adapters
See page 136 for more information

visit us online at www.imi-sensors.com
Machine Tool Measurements? We Do!™ We do it all - sensors to measure vibration, acoustics, force, pressure, load, strain, shock and torque - Sure we do!

www.imi-sensors.com/sure
Machine Tool Spindles

Eliminate the Guesswork, Use Vibration Trends to Change Tooling Efficiently
Predictive Maintenance
Machine Tool Spindles

Vibration monitoring of machine tools is useful for the analysis of tool life, tool integrity, part quality and preventing unexpected tool failure causing unscheduled downtime. Machining processes, like cutting, generate very high levels of vibration, therefore a 100 mV/g accelerometer or less is always recommended. Furthermore, cutting operations often leave the accelerometer exposed to large amounts of cutting fluids and razor sharp chips and metal scrap. To prevent damage, it is always recommended to utilize a sensor with integral armor jacketed cable in this environment.
**ICP® Accelerometers - Predictive Maintenance**

- **Low Cost ICP® Accelerometer**
  - Model 602D01
  - Easy installation in tight spaces
  - No cable/connector clearance required
  - Less than 1 in height
  - See page 82 for more information

- **Low Cost ICP® Accelerometer**
  - Model 603C01
  - General purpose, hermetically sealed
  - IMI’s most popular accelerometer
  - Small footprint
  - See page 82 for more information

- **Low Cost ICP® Accelerometer**
  - Model 607A61
  - Unique 360º swivel design
  - Allows for easy cable orientation
  - Integral or armored integral cable options available
  - See page 85 for more information

- **High Frequency ICP® Accelerometer**
  - Model 623C01
  - 15 kHz high frequency response
  - 10 mV/g or 100 mV/g options
  - Intrinsically safe models available
  - See page 96 for more information

- **Precision ICP® Accelerometer**
  - Model 625B01
  - Side exit, ring-style
  - Low frequency response to 12 cpm (0.2 Hz)
  - Ceramic sensing element
  - See page 92 for more information

- **Precision ICP® Accelerometer**
  - Model 625B61
  - 5% sensitivity tolerance
  - Through-hole mounting
  - Intrinsically safe, velocity output versions
  - Visit www.imi-sensors.com for more information
Machine Tool Spindles

Accessories

Cables & Connectors

Armor Jacketed, FEP Cable with MIL Connector to Blunt Cut
048BPXXXBZ

XXX = Denote cable length, 010 = 10 feet (Metric lengths available)

Mounting Hardware

Sensor Mounting Pad
Model 080A03: Ø0.75”
Model 080A118: Ø1.0”

Flat Surface Magnet
Model 080A120: Ø0.75”
Model 080A121 Ø1.0”

1/2-20 to 1/4-28 Mounting Stud
Model 080A156

Spot Face Tools
Model 080A128
Model 080A129

Product Spotlight

Swivel® & Spindler® Accelerometers

Model 607A11
Model 607A61

This industry exclusive product is innovative in both its small size and its convenient swiveling mounting method

- Patented 360° swivel mount allows for convenient cable orientation (US Patent #6,435,902)
- Lower cost alternative to through-bolt sensors
- Small footprint & very low profile for installation in tight spaces

See page 84 & 85 for more information

Industry Exclusive!

Using the 360° capabilities of the Swivel®, the cable is positioned into desired orientation & temporarily hand tightened. Using a wrench, the hex nut is tightened to the recommended torque while holding the cable or connector in the desired location.
Steel Rolling & Annealing

Sensors that stand up to the harsh, high temperature and extreme environments of steel mills
Predictive Maintenance

Steel Rolling & Annealing

Steel Mills not only have typical fans, pumps, compressors, gearboxes and cooling towers but also have machines and processes unique to the steel industry. The machine sizes, machine designs, operating speeds, cycle times, batch operations and harsh mill environments often command the use of carefully selected sensors and methods for effective equipment monitoring. Iron making and steel making areas often have an abundance of large belt conveyors, critical ultra-low speed machines with limited rotation, critical large EOT cranes and large volume turbo blowers coupled with >2300 ºF hot blast air, molten liquid iron, red hot slabs, often carbon monoxide risks and of course, rolling mills.

Sensor Selection - IMI® recognizes the varied needs and challenges of the steel industry and has successfully designed a wide variety of transducers and accessories to help meet the needs of their customers. While most sensors can be used in a wide range of applications, some sensors are better suited for the harsh conditions encountered in steel mill applications and have been pointed out in this section.

Cold Rolling Areas - Process Monitoring & Protection

Cold Rolling Mills have similar operating and cyclic challenges as hot rolling, but add in large numbers of roll “chock” bearings that are inherently difficult to instrument, run at varying speeds/loads in batch cycles. These “chocks” are removed and reinstalled into the mill with new rolls many times a day, after only minutes of operation at times. Couple this with stringent product quality critical requirements and again, many more extreme monitoring challenges are raised.

Precision ICP® Accelerometer
Model 626B01
- Low noise floor
- Low frequency response to 12 cpm (0.2 Hz)
- Full sweep calibration
See page 94 for more information

4-20 mA Output Sensor
Model 640B01
- Available in top or side exit casings
- Peak or RMS, acceleration or velocity
- Intrinsically safe / explosion proof versions available
See page 112 for more information

Bearing Fault Detector
Model 682B05
- Provides early warning of bearing and gear faults
- Operates with PLC, DCS, SCADA, alarm and control systems
- Outputs 4-20 mA signals for peak acceleration and overall vibration
See page 124 for more information

Low Cost ICP® Accelerometer
Model 608A11
- Ideal for submersible applications
- Small installation footprint
- Stock integral cable lengths of 10 ft, 20 ft, 30 ft and 50 ft
See page 84 for more information

visit us online at www.imi-sensors.com
Toll-free in USA 800-959-4464 716-684-0003
Hot Rolling Machines - Predictive Maintenance

Hot Rolling Mills have large low speed gearboxes, pinion stands, drive shafts and large diameter rolls in bearings to reduce the thickness of red hot steel slabs. Running these at variable loads/speeds and cycle times which may last only 30 seconds during speed variations of >500% presents challenges. Environmental factors here include reheat furnace temperatures, steam and scale from cooling water sprays and of course coiling red hot steel traveling at thousands of feet per minute.

Model 600A02
High Temperature Accelerometer Kit
- Includes accelerometer, cable and charge amplifier
- Sensor temperature range up to 500 °F (260 °C)
- Compatible with ICP® signal conditioners

Visit www.imi-sensors.com for more information

High Temperature ICP® Accelerometer
Model HT602D01
- Ceramic sensing element
- Low profile design
- Through-bolt mount

See page 100 for more information

High Temperature Precision ICP® Accelerometer
Model HT628F01
- Quartz sensing element
- Excellent thermal stability
- Welded hermetic

See page 101 for more information

Very High Temperature Accelerometer
Series EX600B1X
- Sensitivity: 10 to 100 mV/g
  (1.02 mV/(m/s²) to 10.2 mV/(m/s²))
- Frequency Range: (±5%)
  262 to 240,000 cpm (4.7 to 4 kHz)
- Measurement Range: ±50 to 500 g peak
  (±490 to 4900 m/s²)
- Mounting: Through Holes (3)

See page 106 for more information
Predictive Maintenance

Steel Rolling & Annealing

Annealing and coated product operations often run at quite low speeds and also have product quality critical requirements. Temperatures from annealing furnaces and molten zinc and aluminizing baths add many temperature, personnel safety and monitoring concerns as well.

**Low Cost ICP® Accelerometer**
*Model 603C01*
- General purpose, hermetically sealed
- IMI’s most popular accelerometer
- Small footprint

See page 82 for more information

**Low Cost ICP® Accelerometer**
*Model 607A11*
- Ideal for submersible applications
- Smallest true industrial accelerometer on the market
- Armored integral cable options available

See page 84 for more information

**Precision Accelerometer**
*Model 622B01*
- Full frequency sweep calibration: 5% sensitivity deviation tolerance
- 15 kHz high frequency response ideal for early detection of bearing fluting conditions
- Ideal for route-based data collection

See page 92 for more information

**Universal Transmitter**
*Model 682A16*
- Optional front panel programmer with LCD display
- Provides ICP® sensor power
- Accepts mA, ohm, RTD and thermocouple

See page 157 for more information
Rotary Screw Compressors

High Frequency Accelerometers Capable of Capturing Rotor Mesh and Bearing Faults
Predictive Maintenance

Rotary Screw Compressors

Rotary screw compressors, both oil-free and oil-flooded, can provide a unique set of challenges to the predictive maintenance professional. Accelerometers used in these applications must be capable of detecting vibration through a very wide frequency band allowing the user to pickup faults such as pitting in the race of the bearings, oil injection issues or rotor mesh. Mounting is generally recommended on the casing of the compressor as close to the radial bearings as possible. A comprehensive predictive maintenance program that includes monitoring vibration on typically critical rotary screw compressors can improve downtime and increase efficiency with maintenance scheduled in advance of catastrophic failure.
ICP® Accelerometers - Predictive Maintenance

**Very High Frequency Accelerometer**
Model 621B40
- 30 kHz frequency, even with magnet
- Titanium housing
- Smallest available footprint
See page 96 for more information

**Precision Accelerometer**
Model 622B01
- Full frequency sweep calibration: 5% sensitivity deviation tolerance
- 15 kHz high frequency response ideal for early detection of bearing fluting conditions
- Ideal for route-based data collection
See page 92 for more information

**Product Spotlight**

**Very High Frequency Accelerometer Kit**
Model 600A12
This high frequency 10 mV/g accelerometer kit features a very small accelerometer with a magnet and cable assembly
- High frequency response to 30 kHz, even when mounted magnetically
- Supplied with 5 ft. cable with BNC plug termination
- Kit features Model 621B40 accelerometer, with titanium housing
Rotary Screw Compressors

Accessories

Cables & Connectors

- Coiled TPE Cable with BNC Plug to 2-Pin MIL Connector
  050LQ006AC Cabling

- Polyurethane Cable with BNC Plug to 2-Pin MIL-style Connector
  052BR010AC Cabling

- Lightweight Coaxial Cable with BNC Plug to 5-44 Microdot Plug
  018C05 Cabling

Mounting Hardware

- Sensor Mounting Pad
  Model 080A93: Ø0.75"
  Model 080A118: Ø1.0"

- Flat Surface Magnet
  Model 080A121

- Curved Surface Magnet
  Model 080A131: Ø1.0"
  Model 080A132: Ø1.5"

- High Frequency Magnet
  Model 080A157

Enclosures

- BNC Termination Enclosure
  Model 691A50/12

- BNC Termination Enclosure
  Model 691A51/04

- BNC Switch Box
  Model 691B41

- BNC Switch Box
  Model 691B42

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Nuclear Power Instrumentation

Sensors featuring the radiation hardened approvals necessary for nuclear power environments
Energy & Power Generation

Nuclear Power Instrumentation

- High temperature vibration measurements
- Steam turbine testing
- Monitoring of boiling water reactors

PCB®’s Charge Output accelerometers utilize piezo ceramic sensing elements to directly output an electrostatic charge signal that is proportional to applied acceleration. Charge output accelerometers do not contain built-in signal conditioning electronics. As a result, external signal conditioning is required to interface their generated measurement signals to readout or recording instruments. The sensor’s charge output signals can be conditioned with an in-line, fixed charge converter.

Since there are no electronics built into Charge Output accelerometers, they can operate and survive exposure to very high temperatures (up to +1200 °F/+649 °C for some models). In addition, Charge Output accelerometers are used for thermal cycling requirements or to take advantage of existing charge amplifier signal conditioning equipment. It is important to note that measurement resolution and low frequency response for charge output, acceleration sensing systems are dependent upon the noise floor and discharge time constant characteristics of the signal conditioning and readout devices used.
Charge Output Radiation Hardened Accelerometers - Energy & Power Generation

- Survives integrated gamma flux to $10^8$ rads
- Survives integrated neutron flux to $10^{10}$ N/cm$^2$

Charge Output Accelerometer Model 357B53
- Sensitivity: (±15%) 100 pC/g (10.2 pC/(m/s$^2$))
- Measurement Range: ±150 g pk (±1470 m/s$^2$ pk)
- Frequency Range: (+5%) 3 kHz
- Electrical Connector: 10-32 Coaxial Jack

Charge Output Accelerometer Model 357B54
- Sensitivity: (±15%) 100 pC/g (10.2 pC/(m/s$^2$))
- Measurement Range: ±150 g pk (±1470 m/s$^2$ pk)
- Frequency Range: (+5%) 3 kHz
- Electrical Connector: 10-32 Coaxial Jack

Hardline Cable, Radiation Hardened

10-32 Coaxial Plug Model FZ

Shielded Hardline Cable Model 023

10-32 Coaxial Jack Model GA

In-line Charge Converters, Radiation Hardened

In-line Charge Converter Model 422E65/A
- Sensitivity: (Charge Conversion) 1 mV/pC
- Output Voltage: ±5 V
- Temperature Range: (Operating) -65 to +250 °F (-54 to +121 °C)

In-line Charge Converter Model 422E66/A
- Sensitivity: (Charge Conversion) 10 mV/pC
- Output Voltage: ±5 V
- Temperature Range: (Operating) -65 to +250 °F (-54 to +121 °C)

Recommended Components for a Typical Installation

A. Charge output, radiation hardened accelerometer
B. Model 023FZXXXFZ cable assembly, 10-32 plug to 10-32 plug
C. In-line charge converter, Model 422E65/A or 422E66/A
D. Model 023FZXXXGA cable assembly, 10-32 plug to 10-32 jack
E. Model 003C03 cable, 10-32 plug to BNC plug
F. ICP® sensor signal conditioner
G. Model 012A03 output cable, BNC plug each end
H. Readout, recording, or data acquisition device

XXX = Denote cable length, 010 = 10 feet (Metric lengths available)
Energy & Power Generation

Nuclear Power Instrumentation

High Temperature Charge Output Accelerometers, Radiation Hardened

Charge Output Accelerometer
Model 357B61
- Sensitivity: (±10%) 10 pC/g (1.02 pC/(m/s²))
- Measurement Range: ±1000 g pk (±9810 m/s² pk)
- Frequency Range: (±5%) 5 kHz
- Electrical Connector: 10-32 Coaxial Jack

Charge Output Accelerometer
Model 357B69
- Sensitivity: (±10%) 3.5 pC/g (0.357 pC/(m/s²))
- Measurement Range: ±500 g pk (±4950 m/s² pk)
- Frequency Range: (±5%) 6 kHz
- Electrical Connector: 10-32 Coaxial Jack

Hardline Cable, Radiation Hardened

In-line Charge Converter, Radiation Hardened

In-line Charge Converter
Model 422E65/A
- Sensitivity: (Charge Conversion) 1 mV/pC
- Output Voltage: ±5 V
- Temperature Range: (Operating) -65 to +250 °F (-54 to +121 °C)

In-line Charge Converter
Model 422E66/A
- Sensitivity: (Charge Conversion) 10 mV/pC
- Output Voltage: ±5 V
- Temperature Range: (Operating) -65 to +250 °F (-54 to +121 °C)

Recommended Components for a Typical Installation

A: High temperature, radiation hardened accelerometer, Model 357B61 or 357B69
B: Model 023A10 cable assembly, 10-32 plug to 10-32 jack
C: Model 003EBXXXAL cable, 10-32 plug to 10-32 jack
D: In-line charge converter, Model 422E65/A or 422E66/A
E: Model 003D03, BNC plug to BNC plug
F: ICP® sensor signal conditioner
G: Model 012A03 output cable, BNC plug each end
H: Readout, recording, or data acquisition device

XXX = Denote cable length, 010 = 10 feet (Metric lengths available)
High Temperature Radiation Hardened Accelerometers - Energy & Power Generation

Charge Output Accelerometer
Model 357C71
- Sensitivity: (±5%) 10 pC/g (1.02 pC/(m/s²))
- Measurement Range: ±1000 g pk (±9810 m/s² pk)
- Frequency Range: (±5%) 4 kHz
- Electrical Connector: 7/16-27 2-Pin
See page 104 for more information

Charge Output Accelerometer
Model 357C72
- Sensitivity: (±5%) 50 pC/g (5.1 pC/(m/s²))
- Measurement Range: ±500 g pk (±4905 m/s² pk)
- Frequency Range: (±5%) 2.5 kHz
- Electrical Connector: 7/16-27 2-Pin
See page 104 for more information

Charge Output Accelerometer
Model 357C73
- Sensitivity: (±5%) 100 pC/g (10.2 pC/(m/s²))
- Measurement Range: ±300 g pk (±2943 m/s² pk)
- Frequency Range: (±5%) 2 kHz
- Electrical Connector: 7/16-27 2-Pin
See page 104 for more information

PFA Jacketed Cable
Model 045M19, FEP cable with ET connector to EP connector
045M19 Cabling

High Temperature Radiation Hardened Accelerometers
- Energy & Power Generation

Differential Charge Converters
Differential Charge Converter
Model 422M182
- Sensitivity: 4 mV/pC
- Output Voltage: ±5 VpK
- Temperature Range: -60 to 185 °F
See page 158 for more information

Differential Charge Converter
Model 422M183
- Sensitivity: 6 mV/pC
- Output Voltage: ±5 VpK
- Temperature Range: -60 to 185 °F
Visit www.pcb.com for more information

Recommended Components for a Typical Installation
A. High temperature, radiation hardened accelerometer, Model 357C71, Model 357C72, Model 357C73
B. Model 013GNXXGPN plug, 2 socket plug, 7/16 to 2 pin jack
C. Model 045M19, FEP cable with ET connector to EP connector
D. Model 422M182, or Model 422M183
E. Model 003D03, BNC plug to BNC plug
F. ICP® sensor signal conditioner
G. Model 012A03 output cable, BNC plug each end
H. Readout, recording, or data acquisition device

Radiation Area
≤ 900 °F (482 °C)
Safe Zone
≤ 250 °F (121 °C)

XXX = Denote cable length, 010 = 10 feet (Metric lengths available)
Energy & Power Generation

Nuclear Power Instrumentation

Very High Temp Charge Output Accelerometers, Radiation Hardened

Charge Output Accelerometer
Model 357D90
- Resonant frequency over 14 kHz
- 10 ft integral, hardline cable to 10-32 jack
- Measurement range: ± 1000 g pk
- Sensitivity: (±10%) 5 pC/g (.51 pC/(m/s²))
- Output into sensor base

See page 108 for more information

Charge Output Accelerometer
Model 357D91
- Sensitivity in the transverse direction
- Resonant frequency over 14 kHz
- 10 ft integral, hardline cable to 10-32 jack
- Sensitivity: (±10%) 5 pC/g (.51 pC/(m/s²))
- Output perpendicular to sensor base

See page 108 for more information

Recommended Components for a Typical Installation

A High temperature, radiation hardened accelerometer
B Model 003AXX cable assembly, 10-32 plug to 10-32 jack
C In-line charge converter, Model 422E35/A or 422E36/A
D 003DXX BNC plug to BNC plug
E ICP® sensor signal conditioner.
F Model 012A03 output cable, BNC plug each end
G Readout, recording, or data acquisition device

XXX = Denote cable length, 010 = 10 feet (Metric lengths available)
Shock Monitoring

Miniature Embeddable Accelerometers for Monitoring Shock in Critical Shipping Containers
Process Monitoring & Protection

Shock Monitoring

Reusable ocean going shipping containers sometimes carry critical cargo that can be exposed to high shock levels during loading and unloading. It has become necessary to monitor shock and vibration loading to prevent damage and provide a record of these events.

IMI’s line of embeddable miniature accelerometers in conjunction with other geographical logging devices provides vibration and shock signals to logging devices creating a dock to dock record of events occurring during the shipment cycle.

Series 660 low cost embeddable accelerometers offer an affordable solution for vibration and shock measurements in high volume and commercial OEM applications. The units are particularly well suited for shock and impact detection of packages or components, as well as bearing and gear mesh vibration measurements in predictive maintenance and condition monitoring requirements. The compact designs may be embedded into machinery at the OEM level to provide value added monitoring protection.

The units employ field proven, solid state, piezoelectric sensing elements for durability and broadband performance. Choose from charge output types, which survive high operating temperatures, or voltage output ICP® types, with built-in signal conditioning microelectronics, for simplified operation and connectivity to data acquisition and vibration monitoring instrumentation.
Low-power Pellet Accelerometers - Process Monitoring & Protection

- Choice of standard TO-5 or TO-8 transistor style packages
- Variety of sensitivities to accommodate a wide range of applications
- Charge output piezoelectric, voltage output ICP® and 3-wire low power options
- Mountable via adhesive or soldering and choice of either integral cable or solder pin electrical connections
- Broadband width, high shock survivability, wide operating temperature range, high resolution and large dynamic range

Embeddable Accelerometer
Low Profile TO-5
See page 110 for more information

Embeddable Accelerometer
TO-5
See page 110 for more information

Embeddable Accelerometer
TO-8
See page 110 for more information

Embeddable Accelerometer Mounting Examples
IMI’s embeddable accelerometers are an excellent choice for monitoring shock and vibration in a very small package. Examples to the right show different options for potting or complete encapsulation into mounting hardware, creating the optimal solution.
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General Purpose
Low Cost ICP® Accelerometers

- Economical designs ideal for permanent mounting
- Rugged stainless steel housings with hermetic sealing
- Case isolated electronics eliminate noise issues

Low Cost Industrial ICP® Accelerometer
Model 601A01
- 100 mV/g (50 g measurement range)
- Frequency range: 16 to 600,000 cpm (0.27 to 10 kHz)
- Very good signal to noise ratio
- Integral cable option available

Product shown at actual size

Low Cost Industrial ICP® Accelerometer
Model 602D01
- 100 mV/g (50 g measurement range)
- Frequency Range: ±3dB
  30 to 480,000 cpm (0.5 to 8 kHz)
- Side exit, through-bolt design
- Available in high temperature (+325 °F)
  & dual temperature/vibration output

Product shown at actual size

Low Cost Industrial ICP® Accelerometer
Model 603C01
- 100 mV/g (50 g measurement range)
- Frequency Range: ±3dB
  30 to 600,000 cpm (0.5 to 10 kHz)
- Also available in 10, 50 and 500 mV/g

Product shown at actual size

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LIFETIME WARRANTY
Visit us online at www.imi-sensors.com
Toll-Free in USA 800-959-4464 716-684-0003
Low Cost Industrial ICP® Accelerometer
Model 606B01
- 100 mV/g (50 g measurement range)
- Frequency Range: (±3dB)
  30 to 600,000 cpm (0.5 to 10 kHz)
- Side exit, through-bolt design

Swivel® Industrial ICP® Accelerometer
Model 607A01
- 100 mV/g (50 g measurement range)
- Frequency Range: (±3dB)
  30 to 600,000 cpm (0.5 to 10 kHz)
- Electrical Connector: 2-pin MIL-C-5015
- Patented swivel mounting base for ease of cable orientation (US patent #6,435,902)

**Technical Specifications**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>601A01</th>
<th>602D01</th>
<th>603C01</th>
<th>606B01</th>
<th>607A01</th>
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<tr>
<td>Sensitivity</td>
<td>100 mV/g</td>
<td>100 mV/g</td>
<td>100 mV/g</td>
<td>100 mV/g</td>
<td>100 mV/g</td>
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<td>±10 %</td>
<td>±20 %</td>
<td>±15 %</td>
<td>±15 %</td>
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<td>Measurement Range</td>
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<td>±50 g</td>
<td>±50 g</td>
<td>±50 g</td>
<td>±50 g</td>
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<td>16 to 600,000 cpm</td>
<td>30 to 600,000 cpm</td>
<td>30 to 600,000 cpm</td>
<td>30 to 600,000 cpm</td>
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<td>1,000 kcps</td>
<td>1,000 kcps</td>
<td>1,000 kcps</td>
<td>1,000 kcps</td>
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<td>49.3 µm/sec²</td>
<td>350 µg</td>
<td>3,243 µm/sec²</td>
<td>3,243 µm/sec²</td>
<td>3,243 µm/sec²</td>
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<td>Non-linearity</td>
<td>±1 % (B)</td>
<td>±1 % (B)</td>
<td>±1 % (B)</td>
<td>±1 % (B)</td>
<td>±1 % (B)</td>
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<tr>
<td>Transverse Sensitivity</td>
<td>≤ 7 %</td>
<td>≤ 7 %</td>
<td>≤ 7 %</td>
<td>≤ 7 %</td>
<td>≤ 7 %</td>
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<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Overload Limit (Shock)</td>
<td>5,000 g pk</td>
<td>49,050 mV/g pk</td>
<td>49,050 mV/g pk</td>
<td>49,050 mV/g pk</td>
<td>49,050 mV/g pk</td>
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<tr>
<td>Temperature Range</td>
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<td>-45 to 250 °F</td>
<td>-45 to 250 °F</td>
<td>-45 to 250 °F</td>
<td>-45 to 250 °F</td>
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<td>Temperature Range</td>
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<td>50.7 to 121 °C</td>
<td>50.7 to 121 °C</td>
<td>50.7 to 121 °C</td>
<td>50.7 to 121 °C</td>
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<td>IP68</td>
<td>IP68</td>
<td>IP68</td>
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<tr>
<td><strong>Electrical</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Setting Time (within 1% of bias)</td>
<td>≤ 4.0 sec</td>
<td>≤ 4.0 sec</td>
<td>≤ 4.0 sec</td>
<td>≤ 4.0 sec</td>
<td>≤ 4.0 sec</td>
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<tr>
<td>Discharge Time</td>
<td>≥ 0.6 sec</td>
<td>≥ 0.6 sec</td>
<td>≥ 0.6 sec</td>
<td>≥ 0.6 sec</td>
<td>≥ 0.6 sec</td>
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<tr>
<td>Excitation Voltage</td>
<td>16 to 28 VDC</td>
<td>16 to 28 VDC</td>
<td>16 to 28 VDC</td>
<td>16 to 28 VDC</td>
<td>16 to 28 VDC</td>
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<tr>
<td>Current Constant</td>
<td>2 to 20 mA</td>
<td>2 to 20 mA</td>
<td>2 to 20 mA</td>
<td>2 to 20 mA</td>
<td>2 to 20 mA</td>
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<tr>
<td>Output Impedance</td>
<td>&lt;150 ohm</td>
<td>&lt;150 ohm</td>
<td>&lt;150 ohm</td>
<td>&lt;150 ohm</td>
<td>&lt;150 ohm</td>
</tr>
<tr>
<td>Output Bias Voltage</td>
<td>8 to 12 VDC</td>
<td>8 to 12 VDC</td>
<td>8 to 12 VDC</td>
<td>8 to 12 VDC</td>
<td>8 to 12 VDC</td>
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<tr>
<td>Spectral Noise (10 Hz)</td>
<td>3.2 µg/√Hz</td>
<td>3.2 µg/√Hz</td>
<td>3.2 µg/√Hz</td>
<td>3.2 µg/√Hz</td>
<td>3.2 µg/√Hz</td>
</tr>
<tr>
<td>Spectral Noise (100 Hz)</td>
<td>1.0 µg/√Hz</td>
<td>1.0 µg/√Hz</td>
<td>1.0 µg/√Hz</td>
<td>1.0 µg/√Hz</td>
<td>1.0 µg/√Hz</td>
</tr>
<tr>
<td>Spectral Noise (1 kHz)</td>
<td>4.0 µg/√Hz</td>
<td>4.0 µg/√Hz</td>
<td>4.0 µg/√Hz</td>
<td>4.0 µg/√Hz</td>
<td>4.0 µg/√Hz</td>
</tr>
<tr>
<td>Spectral Noise (10 kHz)</td>
<td>28.2 µg/√Hz</td>
<td>28.2 µg/√Hz</td>
<td>28.2 µg/√Hz</td>
<td>28.2 µg/√Hz</td>
<td>28.2 µg/√Hz</td>
</tr>
<tr>
<td>Electrical Isolation (Case)</td>
<td>&gt;10⁶ ohm</td>
<td>&gt;10⁶ ohm</td>
<td>&gt;10⁶ ohm</td>
<td>&gt;10⁶ ohm</td>
<td>&gt;10⁶ ohm</td>
</tr>
</tbody>
</table>

**Supplied Accessories**

- Model 081A97: Through-bolt Mounting Stud
- Model 081A40: Captive Mounting Bolt

**Optional Versions**

- EX - Hazardous Area Approval
- M - Metric Mount
- TO - Temperature Output

**Notes**

- 1/4-28 has no equivalent in S.I. units.
- Conversion Factor: 1g = 9.81 m/s².
- For CE reference PCB® Declaration of Conformance PS023 for details.
- The high frequency tolerance is accurate within ±10% of the specified frequency.
- Zero-based, least-squares, straight line method.
- Stainless steel armor jacket over twisted shielded pair.
- Visit us online at www.imi-sensors.com

**Technical Specifications**

- Model 606B01
- Model 607A01
- Model 601A01
- Model 602D01
- Model 603C01

**Related Documents**

- Accessories & Cables: Pages 162-176
**Low Cost ICP® Accelerometers**

- Integral cable designs meet IP68 qualification
- Save conduit and tray space with smaller diameter polyurethane cable
- Smallest footprints of any true industrial accelerometer

### Swiveler® Industrial ICP® Accelerometer

**Model 607A11**

- 100 mV/g (50 g measurement range)
- Frequency Range: ±3dB
  - 30 to 600,000 cpm (0.5 to 10 kHz)
- Versions with 10 ft and 30 ft integral cable are available in stock
- Patented swivel mounting base for ease of cable orientation
  ([US Patent #6,435,902](#))

### Low Cost Industrial ICP® Accelerometer

**Model 608A11**

- 100 mV/g (50 g measurement range)
- Frequency Range: ±3dB
  - 30 to 600,000 cpm (0.5 to 10 kHz)
- Versions with 10 ft, 20 ft, 30 ft and 50 ft integral cable are available in stock

#### Alternate Mounting Method for 608A11

When stud mounting the model 608A11 we suggest taking a look at a couple accessories that might make the job easier: model 080A162 floating hex nut and model 080A165 mounting stud. Simply drill and tap into the machine and then screw down the 080A162 mounting stud, then slide the floating hex nut over the end of the integral cable. The hex nut mates with the stud and allows the installer to lock the sensor in place, turning the nut from the side. It is sometimes preferred in lieu of turning down the entire sensor and its integral cable.

#### Patented Mounting of Swiveler® and Spindler® Accelerometers

Models 607A11 and 607A61 feature a unique mounting system patented to IMI Sensors ([US Patent #6,435,902](#)). First, screw down the supplied mounting stud. Then simply get the sensor started on the thread. At this point one can orient the integral cable in any direction. Finally, lock the sensor down with 2 to 5 ft-lbs of torque. This locks the cable in place and provides a secure mount that will not come loose.

---

**Tips & Techs**

Visit us online at [www.imi-sensors.com](http://www.imi-sensors.com)
## Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>607A11</th>
<th>607A61</th>
<th>608A11</th>
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<tbody>
<tr>
<td><strong>Performance</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity (± 15 %)</td>
<td>100 mV/g</td>
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</tr>
<tr>
<td>Measurement Range</td>
<td>± 50 g</td>
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</tr>
<tr>
<td>Frequency Range (± 3 dB)</td>
<td>30 to 600,000 cpm</td>
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<td></td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>1,500 kcpm</td>
<td>1,320 kcpm</td>
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</tr>
<tr>
<td>Broadband Resolution</td>
<td>500 µg</td>
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</tr>
<tr>
<td>Non-linearity</td>
<td>± 1 % [8]</td>
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</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>≤ 7 %</td>
<td></td>
<td></td>
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<tr>
<td><strong>Environmental</strong></td>
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<tr>
<td>Overload Limit (Shock)</td>
<td>5,000 g pk</td>
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<td>Temperature Range</td>
<td>-66 to +256 °F</td>
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<tr>
<td><strong>Electrical</strong></td>
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<td>Discharge Time Constant</td>
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<tr>
<td>Excitation Voltage</td>
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<tr>
<td>Constant Current Excitation</td>
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<tr>
<td>Output Impedance</td>
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<tr>
<td>Output Bias Voltage</td>
<td>8 to 12 VDC</td>
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<tr>
<td>Spectral Noise (10 Hz)</td>
<td>78.5 µm/sec²/√Hz [8]</td>
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<tr>
<td>Spectral Noise (100 Hz)</td>
<td>5 µm/sec²</td>
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<td>Spectral Noise (1 kHz)</td>
<td>4 µm/sec²</td>
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<tr>
<td>Electrical Isolation (Case)</td>
<td>&gt;1G ohm</td>
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<tr>
<td><strong>Physical</strong></td>
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<tr>
<td>Size (Hex)</td>
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<td>9/16 in</td>
<td>9/16 in</td>
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<td>Size (Height)</td>
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<td>Weight</td>
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<td>Mounting Stud</td>
<td>1/4-28 [1]</td>
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<td>Mounting Thread</td>
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<td>Molded Integral Cable</td>
<td>Integral Armored Cable</td>
<td>Molded Integral Cable</td>
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<td>Electrical Connector Position</td>
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<td>Cable Length</td>
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<td><strong>Supplied Accessories</strong></td>
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<td>Model 080A156 Mounting Base (1)</td>
<td>Model 080A5 Mounting Stud (1)</td>
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<td>Model ICS-2 NIST-traceable single-axis single-point amplitude response calibration at 6000 cpm (100 Hz) (1)</td>
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<td>Notes</td>
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<td>All specifications are at room temperature unless otherwise specified</td>
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<td>[2] 1/4-28 has no equivalent in S.I. units.</td>
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<tr>
<td>[3] Conversion Factor 1g = 9.81 m/s².</td>
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## Optional Versions

- **EX - Hazardous Area Approval**
  - For Models: 607A11, 607A61, 608A11

- **M - Metric Mount**
  - For Models: 607A11, 607A61, 608A11

- **T0 - Temperature Output**
  - For Models: 607A11, 607A61, 608A11

---

### Armored Integral Cable

- **Low Cost Spindler® Industrial ICP® Accelerometer**
  - **Model 607A61**
    - 100 mV/g (50 g measurement range)
    - Frequency Range: ±(3dB)
      - 30 to 600,000 cpm (0.5 to 10 kHz)
    - Selectable armor length and overall cable length

- **Rugged design ideal for machine tool monitoring or mining applications**
- **Smallest footprint and profile of any industrial accelerometer**
- **Thin armor jacket for easy handling and installation**

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### Accessories & Cables: Pages 162-176

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Low Cost ICP® Accelerometers

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Hazardous Area Approved
Low Cost ICP® Accelerometers

- CSA & ATEX approvals for use in hazardous areas
- Use with or without energy limiting barriers depending upon area classification
- Trend critical vibration data from a safe location

Low Cost Industrial ICP® Accelerometer

Model EX9020D1
- 100 mV/g (50 g measurement range)
- Frequency Range: ±3dB
  30 to 480,000 rpm (0.5 to 8 kHz)
- Side exit, through-bolt design

Product shown at actual size
See page 83 for complete specifications

Low Cost Industrial ICP® Accelerometer

Model EX9030C1
- 100 mV/g (50 g measurement range)
- Frequency Range: ±3dB
  30 to 600,000 rpm (0.5 to 10 kHz)
- Also available in 10, 50 and 500 mV/g

Product shown at actual size
See page 83 for complete specifications

Low Cost Industrial ICP® Accelerometer

Model EX908A11
- 100 mV/g (50 g measurement range)
- Frequency Range: ±3dB
  30 to 600,000 rpm (0.5 to 10 kHz)
- Selectable cable length in meters or feet

Product shown at actual size
See page 83 for complete specifications

Low Cost Industrial ICP® Accelerometer

Model EX907A11
Swivelier® Industrial ICP® Accelerometer
- 100 mV/g (50 g measurement range)
- Frequency Range: ±3dB
  30 to 600,000 rpm (0.5 to 10 kHz)
- Supplied with 10 ft. integral cable
- Selectable cable length in meters or feet

Product shown at actual size
See page 83 for complete specifications

Low Cost Spindler® Industrial ICP® Accelerometer

Model EX907A61
- 100 mV/g (50 g measurement range)
- Frequency Range: ±3dB
  30 to 600,000 rpm (0.5 to 10 kHz)
- Selectable armor length and overall cable length

Product shown at actual size
See page 83 for complete specifications

Hazardous Area Approvals

IMI Sensors’ low cost accelerometers carry CSA & ATEX approvals as follows. Div 1 or Zone 0 or 1 installations require an energy limiting barrier. Div 2 or Zone 2 installations do not require an energy limiting barrier if an approved sensor power supply is used.

Class I, Div 1, Groups A, B, C, D
Class II, Div 1, Groups E, F, G
Class III, Div 1
Exia IIC T4
AExia IIC T4
Class I, Div 2, Groups A, B, C, D
ExnL IIC T4
AExnA IIC T4
Ex ia IIC T4, -40ºC ≤ Ta ≤ 121ºC, II 1 G
Ex nL IIC T4, -40ºC ≤ Ta ≤ 121ºC, II 3 G
GOST-R: 0ExiaIICT4 X

Technical Specifications for Hazardous Area Approved and Dual Temperature & Vibration Output sensors are equal to their standard model equivalent. See page 83 and 85 for complete specifications

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Toll-Free in USA 800-959-4464  716-684-0003
Low Cost ICP® Accelerometers

- Simultaneously measure vibration and temperature levels
- For use with multi-channel data acquisition systems
- Simple to read DC voltage temperature output

Low Cost Industrial ICP® Accelerometer
Model T0603C01
- 100 mV/g (50 g measurement range)
- Frequency Range: (±3dB) 30 to 600,000 cpm (0.5 to 10 kHz)
- 3-pin MIL connector

Swivel® Industrial ICP® Accelerometer
Model T0607A11
- 100 mV/g (50 g measurement range)
- Frequency Range: (±3dB) 30 to 600,000 cpm (0.5 to 10 kHz)
- Supplied with 10 ft. integral cable
- Selectable cable length in meters or feet

Low Cost Spindler® Industrial ICP® Accelerometer
Model T0607A61
- 100 mV/g (50 g measurement range)
- Frequency Range: (±3dB) 30 to 600,000 cpm (0.5 to 10 kHz)
- Selectable armor length and overall cable length

Dual Output Sensor Switch Box with 2 BNC Output (Temperature & Vibration)

Switch Box with 2 BNC Output (Temperature & Vibration)

Switch Box with 2 BNC Output (Temperature & Vibration)

Tips From Techs

Dual Temperature & Vibration Output Sensors

IMI’s dual temperature and vibration output sensors are an excellent asset for technicians using a 2 channel data collector or online monitoring system. The temperature output is a simple DC voltage scaled from 0 to 120 °C with 10 mV/°C sensitivity thus a 0 to 1.2 VDC output. One can send the temperature output to a 0-5 VDC input channel and scale it properly by making the full scale range 500 °C. The temperature sensor draws its power from the vibration electronics and can only be read when ICP® power is being applied to the vibration leads. All IMI® switch boxes come standard with two BNC’s for each channel: one for temperature and one for vibration.
Alternate Sensitivity
Low Cost ICP® Accelerometers

- Increase sensitivity for greater resolution on slow speed applications
- Decrease sensitivity for increased range on impacting applications
- Low frequency response down to 12 cycles per minute

Low Cost Industrial ICP® Accelerometer
Model 601A02
- 500 mV/g (10 g measurement range)
- Low frequency response down to 12 CPM
- Best value of any slow speed industrial accelerometer

Tips from Techs
Low Cost, Same High Quality

There is no “entry level” spending point with IMI Sensors industrial accelerometers. In fact, most of our Application Engineers — certified vibration analysts — recommend “low cost” sensors to customers as their first sensor option. Despite their economical moniker, low-cost accelerometers are ideal for applications where sensors will be permanently mounted to trend vibration 24/7, monthly or even quarterly. No matter how often data is taken one can count on low cost accelerometers to hold their sensitivity year after year, giving the analyst quality data from which to compare values from last collection. Low cost accelerometers are all hermetically sealed in stainless steel housings and most are covered by IMI Sensors’ Lifetime Warranty Plus program.
## Technical Specifications

### Performance

<table>
<thead>
<tr>
<th>Model Number</th>
<th>601A02</th>
<th>603C00</th>
<th>603C02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (±20%)</td>
<td>500 mV/g</td>
<td>10 mV/g</td>
<td>500 mV/g</td>
</tr>
<tr>
<td></td>
<td>51 mV/m/s² [2]</td>
<td>1.02 mV/m/s² [2]</td>
<td>51.0 mV/m/s² [2]</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>±10 g</td>
<td>±500 g</td>
<td>±10 g</td>
</tr>
<tr>
<td></td>
<td>±4,005 m/s²</td>
<td>±98 m/s²</td>
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<tr>
<td>Frequency Range (±3 dB)</td>
<td>10 to 60,000 cpm [4]</td>
<td>30 to 60,000 cpm</td>
<td>30 to 180,000 cpm</td>
</tr>
<tr>
<td></td>
<td>0.17 to 10 kHz</td>
<td>0.5 to 10 kHz [4]</td>
<td>0.5 to 3 kHz [4]</td>
</tr>
<tr>
<td>Frequency Range (±5 %)</td>
<td>28 to 240,000 cpm</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>0.47 to 4 kHz [4]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency Range (±10 %)</td>
<td>20 to 300,000 cpm</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>0.33 to 5 kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>N/A</td>
<td>1,500 kcpm</td>
<td>25 kHz [5]</td>
</tr>
<tr>
<td></td>
<td>25 kHz [5]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broadband Resolution (1 to 10 kHz)</td>
<td>36 µg</td>
<td>2,000 µg</td>
<td>300 µg</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>±1 % [6]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>±7 %</td>
<td></td>
<td></td>
</tr>
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</table>

### Environmental

<table>
<thead>
<tr>
<th>Model Number</th>
<th>601A02</th>
<th>603C00</th>
<th>603C02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload Limit (Shock)</td>
<td>5,000 g pk</td>
<td>49,050 m/s² pk</td>
<td>N/A</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-65 to 250 °F</td>
<td>-54 to 121 °C</td>
<td>N/A</td>
</tr>
<tr>
<td>Enclosure Rating</td>
<td>IP68</td>
<td>N/A</td>
<td>N/A</td>
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### Electrical

<table>
<thead>
<tr>
<th>Model Number</th>
<th>601A02</th>
<th>603C00</th>
<th>603C02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settling Time (within 1% of bias)</td>
<td>≤10 sec</td>
<td>≤3.0 sec</td>
<td>≤5.0 sec</td>
</tr>
<tr>
<td>Discharge Time Constant</td>
<td>≥1.0 sec</td>
<td>≤0.4 sec</td>
<td>≥0.3 sec</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt;150 ohm</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Output Bias Voltage</td>
<td>8 to 12 VDC</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Spectral Noise (10 Hz)</td>
<td>3.2 µg/√Hz</td>
<td>85 µg/√Hz</td>
<td>8 µg/√Hz</td>
</tr>
<tr>
<td>Spectral Noise (100 Hz)</td>
<td>0.5 µg/√Hz</td>
<td>50 µg/√Hz</td>
<td>3 µg/√Hz</td>
</tr>
<tr>
<td>Spectral Noise (1 kHz)</td>
<td>0.5 µg/√Hz</td>
<td>50 µg/√Hz</td>
<td>3 µg/√Hz</td>
</tr>
<tr>
<td></td>
<td>4.9 µm/sec²/√Hz</td>
<td>149 µm/sec²/√Hz [5]</td>
<td>29.4 µm/sec²/√Hz [5]</td>
</tr>
<tr>
<td>Electrical Isolation (Case)</td>
<td>N/A</td>
<td>N/A</td>
<td>&gt;10¹⁰ ohm</td>
</tr>
</tbody>
</table>

---

### Notes

All specifications are at room temperature unless otherwise specified.

[1] 1/4-28 has no equivalent in S.I. units.
[2] Conversion factor 1 g = 9.81 m/s².
[4] The high frequency tolerance is accurate within ±10% of the specified frequency.

---

### Optional Versions

- **EX** - Hazardous Area Approval
  - For Models: 603C00, 603C02
- **M** - Metric Mount
  - For Models: 601A02, 603C00, 603C02
- **TO** - Temperature Output
  - For Models: 603C02

---

### Model Number 601A02 603C00 603C02

<table>
<thead>
<tr>
<th>Physical</th>
<th>7/8 in</th>
<th>11/16 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size - Hex</td>
<td>22 mm</td>
<td>18 mm</td>
</tr>
<tr>
<td>Size - Height</td>
<td>1.94 in</td>
<td>1.65 in</td>
</tr>
<tr>
<td>Weight</td>
<td>2.8 oz</td>
<td>1.8 oz</td>
</tr>
<tr>
<td>Mounting</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Mounting Torque</td>
<td>2 to 5 ft-lb</td>
<td>2.7 to 8.8 N-m</td>
</tr>
<tr>
<td>Sensing Element</td>
<td>Ceramic Shear</td>
<td>N/A</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Stainless Steel</td>
<td>N/A</td>
</tr>
<tr>
<td>Sealing</td>
<td>Welded Hermetic</td>
<td>N/A</td>
</tr>
<tr>
<td>Electrical Connector</td>
<td>2-pin MIL-C-5015</td>
<td>N/A</td>
</tr>
</tbody>
</table>

---

**Supplied Accessories**

Model M081A61 Mounting Stud 1/4-28 to M6 X 1 (1) replaces Model 081A40

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**Accessories & Cables:** Pages 162-176
Multi-axis ICP® Accelerometers

- Triaxial designs measure vibration in horizontal, vertical and axial directions
- Side exit, through-bolt mount designs ideal for spaces with limited clearance and cable orientation
- Ideal for route-based PdM with 2 or 3 channel data collector

Multi-axis accelerometers contain two or three independent acceleration sensing elements within one housing. The sensing elements are oriented in mutually perpendicular geometries in order to respond to vibration in independent, orthogonal directions. Biaxial accelerometers contain two sensing elements, whereas triaxial versions contain three. Each sensing axis contains a dedicated, built in, low noise, microelectronic signal amplifier whose output signal is delivered to an independent cable lead or connector pin.

Multi-axis measurements are useful for radial vs. axial bearing vibration monitoring, machinery foundation troubleshooting, and structural impulse and response studies. Styles for low cost and precision requirements are differentiated by their sensitivity tolerances and extent of supplied NIST-traceable calibration.

Low Cost Triaxial Industrial ICP® Accelerometer
Model 604B31
- 100 mV/g (50 g measurement range)
- Frequency Range: (±3dB) 30 to 300,000 cpm (0.5 to 5 kHz)
- Side exit, through-bolt design

Product shown at actual size

Low Cost Biaxial Industrial ICP® Accelerometer
Model 605B01
- 100 mV/g (50 g measurement range)
- Frequency Range: (±3dB) 30 to 300,000 cpm (0.5 to 5 kHz)
- Side exit, through-bolt design

Product shown at actual size

Precision Triaxial Industrial ICP® Accelerometer
Model 629A31
- 100 mV/g (50 g measurement range)
- Frequency Range: (+/- 3dB) 48 to 480,000 cpm (0.8 to 8 kHz)
- Full frequency sweep calibration on all three axes

Product shown at actual size
## Technical Specifications

### Performance

<table>
<thead>
<tr>
<th>Model Number</th>
<th>604B31</th>
<th>605B01</th>
<th>629A31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (±20%)</td>
<td>100 mV/g</td>
<td>N/A</td>
<td>100 mV/g</td>
</tr>
<tr>
<td>Sensitivity (±5%)</td>
<td>N/A</td>
<td>10.2 mV/(m/s²)[2]</td>
<td>N/A</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>±60 g</td>
<td>±490 m/s²</td>
<td>±100 g</td>
</tr>
<tr>
<td>Frequency Range (±5%)</td>
<td>144 to 120,000 cpm</td>
<td>2.4 to 2 kHz[4]</td>
<td>102 to 300,000 cpm</td>
</tr>
<tr>
<td>Frequency Range (±10%)</td>
<td>N/A</td>
<td>0.8 to 8 kHz</td>
<td>N/A</td>
</tr>
<tr>
<td>Frequency Range (±3 dB)</td>
<td>30 to 300,000 cpm</td>
<td>2.4 to 2 kHz[4]</td>
<td>102 to 300,000 cpm</td>
</tr>
<tr>
<td>Broadband Resolution (1 to 10 kHz)</td>
<td>350 µg</td>
<td>100 µg</td>
<td>181 µm/sec²[5]</td>
</tr>
</tbody>
</table>

### Environmental

<table>
<thead>
<tr>
<th>Model Number</th>
<th>604B31</th>
<th>605B01</th>
<th>629A31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload Limit (Shock)</td>
<td>5,000 g pk</td>
<td>N/A</td>
<td>4,000 g pk</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-65 to 250 °F</td>
<td>N/A</td>
<td>-54 to 121 °C</td>
</tr>
<tr>
<td>Enclosure Rating</td>
<td>IP68</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Electrical

<table>
<thead>
<tr>
<th>Model Number</th>
<th>604B31</th>
<th>605B01</th>
<th>629A31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settling Time</td>
<td>≤ 2.0 sec</td>
<td>≤ 3.0 sec</td>
<td>N/A</td>
</tr>
<tr>
<td>Discharge Time Constant</td>
<td>≥ 0.3 sec</td>
<td>≥ 0.2 sec</td>
<td>N/A</td>
</tr>
<tr>
<td>Excitation Voltage</td>
<td>15 to 28 VDC</td>
<td>N/A</td>
<td>15 to 28 VDC</td>
</tr>
<tr>
<td>Constant Current Excitation</td>
<td>2 to 20 mA</td>
<td>N/A</td>
<td>2 to 20 mA</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt;150 ohm</td>
<td>N/A</td>
<td>&lt;100 ohm</td>
</tr>
<tr>
<td>Output Bias Voltage</td>
<td>8 to 12 VDC</td>
<td>N/A</td>
<td>8 to 12 VDC</td>
</tr>
<tr>
<td>Spectral Noise (10 Hz)</td>
<td>8 µg/√Hz</td>
<td>7 µg/√Hz</td>
<td>N/A</td>
</tr>
<tr>
<td>Spectral Noise (100 Hz)</td>
<td>78.5 µm/sec²/√Hz[5]</td>
<td>68.7 µm/sec²/√Hz[5]</td>
<td>N/A</td>
</tr>
<tr>
<td>Spectral Noise (1 kHz)</td>
<td>5 µg/√Hz</td>
<td>2.8 µg/√Hz</td>
<td>N/A</td>
</tr>
<tr>
<td>Spectral Noise (10 kHz)</td>
<td>49.1 µm/sec²/√Hz[5]</td>
<td>27.5 µm/sec²/√Hz[5]</td>
<td>N/A</td>
</tr>
<tr>
<td>Spectral Noise (100 kHz)</td>
<td>4.9 µg/√Hz</td>
<td>1.9 µg/√Hz</td>
<td>N/A</td>
</tr>
<tr>
<td>Spectral Noise (1 MHz)</td>
<td>39.2 µm/sec²/√Hz[5]</td>
<td>9.8 µm/sec²/√Hz[5]</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Notes

- All specifications are at room temperature unless otherwise specified.
- [1] 1/4-28 has no equivalent in S.I. units.
- [2] Conversion Factor 1g = 9.81 m/s².
- [4] The high frequency tolerance is accurate within ±10% of the specified frequency.
- [7] Division 1; Class I, Group C & D; Temperature Code T4

### Optional Versions

- CS - Canadian Standards Association Approved Intrinsically Safe
  For Models: 604B31
- M - Metric Mount
  For Models: 604B31, 605B01, 629A31

---

## Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>604B31</th>
<th>605B01</th>
<th>629A31</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size - Diameter</td>
<td>1.38 in</td>
<td>35.1 mm</td>
<td>N/A</td>
</tr>
<tr>
<td>Size - Length</td>
<td>N/A</td>
<td>38.1 mm</td>
<td>N/A</td>
</tr>
<tr>
<td>Size - Width</td>
<td>N/A</td>
<td>1.5 in</td>
<td>N/A</td>
</tr>
<tr>
<td>Size - Height</td>
<td>1.00 in</td>
<td>25.4 mm</td>
<td>38.1 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>4.4 oz</td>
<td>3.9 oz</td>
<td>4.9 oz</td>
</tr>
<tr>
<td>Mounting Torque</td>
<td>2 to 5 lbf</td>
<td>2 to 5 lbf</td>
<td>2.7 to 8.8 N-m</td>
</tr>
<tr>
<td>Sensing Element</td>
<td>Ceramic</td>
<td>Stainless Steel</td>
<td>Ceramic</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Stainless Steel</td>
<td>Ceramic</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Sealing</td>
<td>Welded Hermetic</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Electrical Mounting</td>
<td>Side</td>
<td>X-axis</td>
<td>Y-axis</td>
</tr>
<tr>
<td>Electrical Connections (Pin A)</td>
<td>2-axis</td>
<td>Ground</td>
<td>2-axis</td>
</tr>
<tr>
<td>Electrical Connections (Pin B)</td>
<td>2-axis</td>
<td>Ground</td>
<td>Ground</td>
</tr>
<tr>
<td>Electrical Connections (Pin C)</td>
<td>Z-axis</td>
<td>Ground</td>
<td>Ground</td>
</tr>
<tr>
<td>Electrical Connections (Pin D)</td>
<td>Ground</td>
<td>Ground</td>
<td>Ground</td>
</tr>
</tbody>
</table>

### Supplied Accessories

- Model 081A68 Captive mounting bolt 1/4-28 x .90" (1)
- Model 081A56 Captive mounting bolt 1/4-28 x .75" (1)
- Model ACS-2T NIST Traceable Single Point Calibration at 100 Hz for Each Axis (1)
- Model ICS-1 NIST-traceable single-axis amplitude response calibration from 600 cpm (10 Hz) to upper 5% frequency

### Optional Versions

- CS - Canadian Standards Association Approved Intrinsically Safe
  For Models: 604B31
- M - Metric Mount
  For Models: 604B31, 605B01, 629A31

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IMI SENSORS
A PCB PIEZOTRONICS DIV.
Precision ICP® Accelerometers

- Full frequency sweep calibration data provided
- Additional Built in RF & EMI protection
- Tighter sensitivity tolerances
- Quartz elements available with superior thermal stability
- Velocity output options with integral integration

Precision industrial ICP® accelerometers are recommended for route-based vibration data collection and quantitative diagnostic measurements on industrial machinery. These sensors are directly compatible with most commercially available vibration data collectors and FFT analyzers that supply excitation power for ICP® sensors. These precision, shear structured sensors offer tighter sensitivity tolerances than low cost series units and are supported with full NIST-traceable calibration data that encompasses an extensive frequency range. All units are laser welded and leak tested to ensure a truly hermetic seal. Shock protection to 5,000 g (49 k m/s²) guards against damage due to accidental overloads. A host of available options, including velocity and temperature outputs and hazardous area approvals adapt units for virtually any machinery vibration monitoring requirement.

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## Technical Specifications

### Performance

<table>
<thead>
<tr>
<th>Model Number</th>
<th>622B01</th>
<th>624B01</th>
<th>625B01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (±5 %)</td>
<td>100 mV/g</td>
<td>10.2 mV/°C [2]</td>
<td>100 mV/g</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>±20 g</td>
<td>±490 m/s²</td>
<td>±20 g</td>
</tr>
<tr>
<td>Frequency Range (±5 %)</td>
<td>35 to 360,000 cpm</td>
<td>144 to 300,000 cpm</td>
<td>35 to 360,000 cpm</td>
</tr>
<tr>
<td>Size - Diameter</td>
<td>N/A</td>
<td>1.37 in</td>
<td>N/A</td>
</tr>
<tr>
<td>Size - Height</td>
<td>2.06 in</td>
<td>24.3 mm</td>
<td>2.06 in</td>
</tr>
<tr>
<td>Size - Hex</td>
<td>7/8 in</td>
<td>1.36 in</td>
<td>7/8 in</td>
</tr>
<tr>
<td>Weight</td>
<td>3.3 oz</td>
<td>34.8 mm</td>
<td>3.3 oz</td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>1,800 Hz</td>
<td>1800 Hz</td>
<td>1,800 Hz</td>
</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>≤5 %</td>
<td>≤5 %</td>
<td>≤5 %</td>
</tr>
</tbody>
</table>

### Environmental

<table>
<thead>
<tr>
<th>Measurement</th>
<th>622B01</th>
<th>624B01</th>
<th>625B01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload Limit (Shock)</td>
<td>5,000 g</td>
<td>49,050 m/s²</td>
<td>5,000 g</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-65 to 250 °F</td>
<td>-54 to 121 °C</td>
<td>-65 to 250 °F</td>
</tr>
<tr>
<td>Enclosure Rating</td>
<td>IP68</td>
<td>IP68</td>
<td>IP68</td>
</tr>
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</table>

### Electrical

<table>
<thead>
<tr>
<th>Measurement</th>
<th>622B01</th>
<th>624B01</th>
<th>625B01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing Time (with 1% of bias)</td>
<td>≤5.0 sec</td>
<td>≤10 sec</td>
<td>≤8.0 sec</td>
</tr>
<tr>
<td>Discharge Time Constant</td>
<td>≥0.8 sec</td>
<td>≥0.2 sec</td>
<td>≥1.0 sec</td>
</tr>
<tr>
<td>Excitation Voltage</td>
<td>18 to 28 VDC</td>
<td>18 to 28 VDC</td>
<td>18 to 28 VDC</td>
</tr>
<tr>
<td>Constant Current Excitation</td>
<td>2 to 20 mA</td>
<td>2 to 20 mA</td>
<td>2 to 20 mA</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt;100 ohm</td>
<td>&lt;100 ohm</td>
<td>&lt;100 ohm</td>
</tr>
<tr>
<td>Output Bias Voltage</td>
<td>8 to 12 VDC</td>
<td>8 to 12 VDC</td>
<td>8 to 12 VDC</td>
</tr>
<tr>
<td>Spectral Noise (10 Hz)</td>
<td>4.0 µg/√Hz</td>
<td>50 µg/√Hz</td>
<td>2.5 µg/√Hz</td>
</tr>
<tr>
<td>Spectral Noise (100 Hz)</td>
<td>0.8 µg/√Hz</td>
<td>20 µg/√Hz</td>
<td>0.8 µg/√Hz</td>
</tr>
<tr>
<td>Spectral Noise (1 kHz)</td>
<td>0.4 µg/√Hz</td>
<td>6 µg/√Hz</td>
<td>0.5 µg/√Hz</td>
</tr>
<tr>
<td>Electrical Protection</td>
<td>HIP/ESD</td>
<td>HIP/ESD</td>
<td>HIP/ESD</td>
</tr>
<tr>
<td>Electrical Isolation</td>
<td>&gt;10⁹ ohm</td>
<td>&gt;10⁹ ohm</td>
<td>&gt;10⁹ ohm</td>
</tr>
</tbody>
</table>

### Supplied Accessories

- Model 081A40 Mounting Stud
- Model ICS-1 NIST-traceable single-axis amplitude response calibration from 600 cpm (10 Hz) to upper 5% frequency
- Model 081A67 Captive mounting bolt 1/4-28 x 1.12"
- Model ICS-1 NIST-traceable single-axis amplitude response calibration from 600 cpm (10 Hz) to upper 5% frequency
- Model 080B45 Thermal Boot
- Model 081A73 Captive mounting bolt 1/4-28 x 1.34"
- Model ICS-1 NIST-traceable single-axis amplitude response calibration from 600 cpm (10 Hz) to upper 5% frequency

### Notes

- All specifications are at room temperature unless otherwise specified.
- [1] 1/4-20 has no equivalent in S.I. units.
- [2] Conversion Factor 1 g = 9.81 m/s².
- [4] The high frequency tolerance is accurate within ±10% of the specified frequency.

### Optional Versions

- CS - Canadian Standards Association Approved Intrinsically Safe For Models: 625B01
- M - Metric Mount For Models: 622B01, 624B01, 625B01
- TO - Temperature Output For Models: 624B01, 625B01

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(IMI SENSORS)
A PCB PIEZOTRONICS DIV.

93
Low Frequency Precision ICP® Accelerometers

Low amplitude vibration levels go hand-in-hand with low frequency vibration measurements. For this reason, IMI Sensors offers accelerometers combining extended low frequency response with high output sensitivity. This is in order to obtain desired resolution characteristics and strong output signal levels, necessary for conducting low frequency vibration measurements and analysis.

The most sensitive IMI Sensors low frequency accelerometers are known as seismic accelerometers. These models are larger in size to accommodate their larger seismic, internal masses necessary to generate a stronger output signal. These sensors have limited amplitude range, which renders them unsuitable for many general purpose industrial vibration measurement applications. However, when measuring vibration of slow, rotating machinery, buildings, bridges and large structures, these low frequency, low noise accelerometers will provide characteristics required for successful results.

Low frequency industrial ICP® accelerometers benefit from the same advantages offered by IMI Sensors general purpose industrial accelerometers: rugged, laser welded, stainless steel housing with ability to endure dirty, wet, or harsh environments; hermetically sealed military connector or sealed integral cable; and a low noise, low-impedance, voltage output signal with long distance, signal transmission capability.
## Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>625B02</th>
<th>626B01</th>
<th>626B02</th>
</tr>
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<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Sensitivity (±5 %)</td>
<td>500 mV/g</td>
<td>100 mV/g</td>
<td>500 mV/g</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>±10 g</td>
<td>±50 g</td>
<td>±10 g</td>
</tr>
<tr>
<td>Frequency Range (±5 %)</td>
<td>30 to 120,000 cpm</td>
<td>30 to 300,000 cpm</td>
<td>30 to 120,000 cpm</td>
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<tr>
<td>Frequency Range (±10 %)</td>
<td>22 to 240,000 cpm</td>
<td>22 to 420,000 cpm</td>
<td>22 to 240,000 cpm</td>
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<tr>
<td>Frequency Range (±3 dB)</td>
<td>0.37 to 4 kHz</td>
<td>0.37 to 7 kHz</td>
<td>0.37 to 4 kHz</td>
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<tr>
<td>Resonant Frequency</td>
<td>720 kcpm</td>
<td>1,380 kcpm</td>
<td>720 kcpm</td>
</tr>
<tr>
<td>Broadband Resolution (1 to 10 kHz)</td>
<td>15 µg</td>
<td>100 µg</td>
<td>20 µg</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>±1 %</td>
<td>±1 %</td>
<td>±1 %</td>
</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>≤ 7 %</td>
<td>≤ 5 %</td>
<td>≤ 7 %</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload Limit (Shock)</td>
<td>2,500 g pk</td>
<td>5,000 g pk</td>
<td>2,500 g pk</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-65 to 250 °F</td>
<td>-65 to 250 °F</td>
<td>-65 to 250 °F</td>
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<tr>
<td>Enclosure Rating</td>
<td>IP68</td>
<td>IP68</td>
<td>IP68</td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Settling Time (within 1% of bias)</td>
<td>≤ 4.5 sec</td>
<td>≤ 5.0 sec</td>
<td>≤ 3.0 sec</td>
</tr>
<tr>
<td>Discharge Time Constant</td>
<td>≥ 1.0 sec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excitation Voltage</td>
<td>18 to 28 VDC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant Current Excitation</td>
<td></td>
<td>≥ 20 mA</td>
<td></td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt;100 ohm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Bias Voltage</td>
<td>8 to 12 VDC</td>
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<td></td>
</tr>
<tr>
<td>Spectral Noise (1 Hz)</td>
<td>N/A</td>
<td>14.7 µm/sec²/√Hz [5]</td>
<td>N/A</td>
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<tr>
<td>Spectral Noise (10 Hz)</td>
<td>0.9 µg/V</td>
<td>4.0 µg/V</td>
<td>0.9 µg/V</td>
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<tr>
<td>Spectral Noise (100 Hz)</td>
<td>0.7 µg/V</td>
<td>1.5 µg/V</td>
<td>0.7 µg/V</td>
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<tr>
<td>Spectral Noise (1 kHz)</td>
<td>0.3 µg/V</td>
<td>0.7 µg/V</td>
<td>0.3 µg/V</td>
</tr>
<tr>
<td>Electrical Protection</td>
<td>RF/ESD</td>
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<tr>
<td>Electrical Isolation (Case)</td>
<td>&gt;10 MΩ</td>
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<tr>
<td><strong>Notes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All specifications are at room temperature unless otherwise specified</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>[1] 1/4-28 has no equivalent in S.I. units.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[2] Conversion Factor 1 g = 9.81 m/s².</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>[3] For CE reference PCB® Declaration of Conformance PS023 for details</td>
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<tr>
<td>[4] The high frequency tolerance is accurate within ±10% of the specified frequency.</td>
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<thead>
<tr>
<th>Model Number</th>
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<tbody>
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<td>Size - Diameter</td>
<td>1.3 in</td>
<td>N/A</td>
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<tr>
<td>Size - Hex</td>
<td>9/32 in</td>
<td>N/A</td>
<td>3/8 in</td>
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<tr>
<td>Size - Height</td>
<td>13/32 in</td>
<td>2 3/16 in</td>
<td>2 3/16 in</td>
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<tr>
<td>Weight</td>
<td>6.1 oz</td>
<td>5.3 oz</td>
<td>7.0 oz</td>
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<td>Mounting Thread</td>
<td>1/4-28 UNF</td>
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<td>Mounting Torque</td>
<td>2 to 5 ft-lb</td>
<td>2 to 5 ft-lb</td>
<td>2.7 to 6.8 N·m</td>
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<tr>
<td>Sensing Element</td>
<td>Ceramic</td>
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<td>Housing Material</td>
<td>Stainless Steel</td>
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<td>Sealing</td>
<td>Welded Hermetic</td>
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<td>Electrical Connector</td>
<td>2-pin MIL-C-5015</td>
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<tr>
<td><strong>Supplied Accessories</strong></td>
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<tr>
<td>Model 080B45</td>
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<td>Model 081A40</td>
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<tr>
<td>Thermal Boot (1)</td>
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<td>Mounting Stud (1)</td>
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<tr>
<td>Model 081A31</td>
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<td>Model 080A31</td>
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<tr>
<td>Captive Mounting Bolt (1)</td>
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<td>Protective Thermal Jacket (1)</td>
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<tr>
<td>1/4-28 x 1.34” (1)</td>
<td></td>
<td>Model ICS-1 NIST-traceable single-axis amplitude response calibration from 600 cpm (10 Hz) to upper 5% frequency</td>
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<tr>
<td>Model ICS-1 NIST-traceable single-axis amplitude response calibration from 600 cpm (10 Hz) to upper 5% frequency</td>
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<th>626B01</th>
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<tr>
<td><strong>Optional Versions</strong></td>
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<tr>
<td>M - Metric Mount</td>
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<td>For Models: 625B02, 626B01, 626B02</td>
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<tr>
<td>TO - Temperature Output</td>
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<td>For Models: 625B02, 626B01</td>
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High Frequency Precision ICP® Accelerometers

- Increased dynamic range
- Superior high frequency response
- Full frequency sweep NIST-traceable calibration

Vibration measurements in applications that involve high speed metal-to-metal contact, such as gearboxes and screw compressors, sometimes call for accelerometers with greater linear high frequency response or reduced sensitivity. These applications often produce higher vibration levels and shock events. Accurate measurement hinges on the sensor’s dynamic range and high frequency response. By lowering the sensitivity to 10 mV/g one is able to achieve 500 g acceleration measurement range.

Very High Frequency ICP® Accelerometer
Model 621B40
- Sensitivity: 10 mV/g (500 g measurement range)
- High Frequency Range to 1,800,000 cpm (30 kHz)
- Weighs just 0.10 oz (2.8 grams)

High Frequency Industrial ICP® Accelerometer
Model 623C00
- Sensitivity: 10 mV/g (500 g measurement range)
- High Frequency Range to 900,000 cpm (15 kHz)
- Case-isolated design with RF/EMI blocker

High Frequency Industrial ICP® Accelerometer
Model 623C01
- Sensitivity: 100 mV/g (50 g measurement range)
- High Frequency Range to 900,000 cpm (15 kHz)
- Case-isolated design with RF/EMI blocker

Visit us online at www.imi-sensors.com
Toll-Free in USA 800-959-4464 716-684-0003

IMI SENSORS
A PCB PIEZOTRONICS DIV.
## Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>621B40</th>
<th>623C00</th>
<th>623C01</th>
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<tbody>
<tr>
<td><strong>Performance</strong></td>
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<tr>
<td>Sensitivity (±5 %)</td>
<td>N/A</td>
<td>10 mV/g</td>
<td>100 mV/g</td>
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<tr>
<td>Sensitivity (±10 %)</td>
<td>10 mV/g</td>
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<td>N/A</td>
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<tr>
<td>Measurement Range</td>
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<td>±0.00 g</td>
<td>±0.00 g</td>
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<tr>
<td>Frequency Range (±5 %)</td>
<td>N/A</td>
<td>144 to 480,000 cpm</td>
<td>1.6 to 30 kHz</td>
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<tr>
<td>Frequency Range (±10 %)</td>
<td>204 to 1,080,000 cpm</td>
<td>102 to 600,000 cpm</td>
<td>3.4 to 18 kHz</td>
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<td>Resonant Frequency</td>
<td>5,100 kcpm</td>
<td>2,400 kcpm</td>
<td>85 kHz</td>
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<tr>
<td>Non-linearity</td>
<td>±1 %</td>
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</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>≤ 5 %</td>
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<td></td>
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<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload Limit (Shock)</td>
<td>10,000 g pk</td>
<td>5,000 g pk</td>
<td>96 to 1,080,000 cpm</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-65 to 250 °F</td>
<td>-54 to 121 °C</td>
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</tr>
<tr>
<td>Enclosure Rating</td>
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<td>IP68</td>
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<tr>
<td>Setting Time (within 1% of bias)</td>
<td>≤ 3.0 sec</td>
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<td></td>
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<tr>
<td>Discharge Time Constant</td>
<td>≥ 0.1 sec</td>
<td>≥ 0.2 sec</td>
<td></td>
</tr>
<tr>
<td>Excitation Voltage</td>
<td>18 to 28 VDC</td>
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</tr>
<tr>
<td>Constant Current Excitation</td>
<td>2 to 20 mA</td>
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<td></td>
</tr>
<tr>
<td>Output Impedance</td>
<td>≤ 100 ohm</td>
<td></td>
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<tr>
<td>Output Bias Voltage</td>
<td>6 to 12 VDC</td>
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<tr>
<td>Spectral Noise (10 Hz)</td>
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<tr>
<td></td>
<td>100 µg/√Hz</td>
<td>12 µg/√Hz</td>
<td>7.0 µg/√Hz</td>
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<tr>
<td>Spectral Noise (100 Hz)</td>
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<tr>
<td></td>
<td>300 µg/√Hz</td>
<td>4.5 µg/√Hz</td>
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<td>Spectral Noise (1 kHz)</td>
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<tr>
<td></td>
<td>98.1 µg/√sec/√Hz</td>
<td>26.5 µg/√sec/√Hz</td>
<td>4.9 µg/√sec/√Hz</td>
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<td>Electrical Protection</td>
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<td>RF/ESD</td>
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<tr>
<td>Electrical Isolation</td>
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<tr>
<td></td>
<td>N/A</td>
<td>&gt;150 ohm</td>
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## Model Number

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<thead>
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<th>623C00</th>
<th>623C01</th>
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<tbody>
<tr>
<td><strong>Physical</strong></td>
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</tr>
<tr>
<td>Size - Hex</td>
<td>3/8 in</td>
<td>11/16 in</td>
<td>9.6 mm</td>
</tr>
<tr>
<td>Size - Height</td>
<td>0.66 in</td>
<td>1.97 in</td>
<td>17.5 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>0.18 oz</td>
<td>1.80 oz</td>
<td>51 g</td>
</tr>
<tr>
<td>Mounting Thread</td>
<td>M-40 Male</td>
<td>M3 x 0.50 Male</td>
<td>1/4-28 Female [1]</td>
</tr>
<tr>
<td>Mounting Torque</td>
<td>18 to 20 in lb</td>
<td>2 to 5 ft lb</td>
<td>203 to 226 N-cm</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Titanium</td>
<td>Stainless Steel</td>
<td>Ceramic Shear</td>
</tr>
<tr>
<td>Elect. Connector</td>
<td>5-44 Coaxial Jack</td>
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<td>2-pin MIL-C-5015</td>
</tr>
<tr>
<td>Electrical Connection</td>
<td>Top</td>
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</tr>
<tr>
<td><strong>Supplied Accessories</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Model ICS-1 NIST-traceable single-axis amplitude response calibration from 600 cpm (10 Hz) to upper 5% frequency</td>
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</tr>
<tr>
<td>Model ICS-1 NIST-traceable single-axis amplitude response calibration from 600 cpm (10 Hz) to upper 5% frequency (1)</td>
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</tbody>
</table>

## Notes

- All specifications are at room temperature unless otherwise specified.
- [1] 1/4-28 has no equivalent in S.I. units.
- [2] Conversion Factor 1 g = 9.81 m/s².
- [4] The high frequency tolerance is accurate within ±10% of the specified frequency.

## Optional Versions

- EX - ATEX Approved Intrinsically Safe Hazardous Area Approval
  For Models: 621B40, 623C01
- CS - Canadian Standards Association Approved Intrinsically Safe
  For Models: 621B40, 623C01
- M - Metric Mount
  For Models: 621B40, 623C00, 623C01
Quartz ICP® Accelerometers

- Ideal for permanent installations & online monitoring systems
- Promote safety when installed in hazardous or inaccessible locations
- Connect through switch or junction box for route-based data collection

Low Cost Quartz Industrial ICP® Accelerometer
Model 627A01
- 100 mV/g (50 g measurement range, +/-15%)
- Frequency Range: (±3dB)
  20 to 600,000 cpm (0.33 to 10 kHz)
- Electrical Connector: 2-pin MIL-C-5015

Product shown at actual size

Precision Quartz Industrial ICP® Accelerometer
Model 628F01
- 100 mV/g (50 g measurement range)
- Frequency Range: (±3dB)
  20 to 720,000 cpm (0.33 to 12 kHz)
- Available in high temperature version (325 ºF)

Product shown at actual size

Piezoelectric Accelerometers: Benefits of Quartz vs. Ceramic
Piezoelectric materials emit a unit of electrical charge when compressed, stressed or sheared and form the core of most industrial accelerometers. Many sensors utilize artificially piezoelectric ceramics as their sensing element. An alternate option is to use quartz which is naturally piezoelectric and thus exhibits some technical advantages. Quartz sensors remain more linear in environments where temperature fluctuates. They also exhibit superior stability over time. In fact, quartz sensors that are recalibrated as much as a decade later sometimes show no sensitivity deviation from when they were originally made.
## Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>627A01</th>
<th>628F01</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
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</tr>
<tr>
<td>Sensitivity (±15%)</td>
<td>100 mV/g</td>
<td>N/A</td>
</tr>
<tr>
<td>Sensitivity (±5%)</td>
<td>N/A</td>
<td>100 mV/g</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>±50 g</td>
<td>±40 m/s²</td>
</tr>
<tr>
<td>Frequency Range (±3 dB)</td>
<td>20 to 600,000 cpm</td>
<td>20 to 720,000 cpm</td>
</tr>
<tr>
<td>Frequency Range (±5%)</td>
<td>0.33 to 10 kHz [4]</td>
<td>0.33 to 12 kHz</td>
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<td>60 to 340,000 cpm</td>
<td>1 to 4 kHz [4]</td>
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<td>Frequency Range (±10%)</td>
<td>N/A</td>
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<td>Resonant Frequency</td>
<td>1,080 kcpm</td>
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<tr>
<td>Broadband Resolution (1 to 10 kHz)</td>
<td>1,000 µg</td>
<td>0.019 µm/sec² [5]</td>
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<tr>
<td>Non-linearity</td>
<td>± 1% [6]</td>
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</tr>
<tr>
<td>Transverse Sensitivity</td>
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</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload Limit (Shock)</td>
<td>5,000 g pk</td>
<td>49,050 m/s² pk</td>
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<td>Temperature Range</td>
<td>-54 to 121 °C</td>
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<td>Enclosure Rating</td>
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<tr>
<td><strong>Electrical</strong></td>
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<td></td>
</tr>
<tr>
<td>Settling Time (within 1% of bias)</td>
<td>≤ 10 sec.</td>
<td></td>
</tr>
<tr>
<td>Discharge Time Constant</td>
<td>≥ 0.5 sec.</td>
<td></td>
</tr>
<tr>
<td>Excitation Voltage</td>
<td>18 to 30 VDC</td>
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</tr>
<tr>
<td>Constant Current Excitation</td>
<td>2 to 20 mA</td>
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</tr>
<tr>
<td>Output Impedance</td>
<td>&lt;100 ohm</td>
<td></td>
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<tr>
<td>Output Bias Voltage</td>
<td>8 to 12 VDC</td>
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<tr>
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<td>Spectral Noise (1 kHz)</td>
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<td>Electrical Protection</td>
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<td>Electrical Isolation (Case)</td>
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<tr>
<td><strong>Physical</strong></td>
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<td>Size - Hex</td>
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<td>22 mm</td>
</tr>
<tr>
<td>Size - Height</td>
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<td>94 gm</td>
</tr>
<tr>
<td>Mounting Thread</td>
<td>1/4-28 Female [1]</td>
<td></td>
</tr>
<tr>
<td>Mounting Torque</td>
<td>2 to 5 ft-lb</td>
<td>2.7 to 6.8 N·m</td>
</tr>
<tr>
<td>Sensing Element</td>
<td>Quartz Shear</td>
<td></td>
</tr>
<tr>
<td>Housing Material</td>
<td>Stainless Steel</td>
<td></td>
</tr>
<tr>
<td>Sealing</td>
<td>Welded Hermetic</td>
<td></td>
</tr>
<tr>
<td>Electrical Connector</td>
<td>2-pin MIL-C-5015</td>
<td></td>
</tr>
<tr>
<td>Electrical Connection Position</td>
<td>Top</td>
<td></td>
</tr>
<tr>
<td><strong>Supplied Accessories</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 081A04 Mounting Stud (1)</td>
<td></td>
<td>Model 081A40 Mounting Stud (1)</td>
</tr>
</tbody>
</table>

### Notes

- **All specifications are at room temperature unless otherwise specified.**
- **EX - ATEX Approved Intrinsically Safe Hazardous Area Approval**
  - For Models: 628F01
- **CS - Canadian Standards Association Approved Intrinsically Safe**
  - For Models: 628F01
- **M - Metric Mount**
  - For Models: 627A01, 628F01

### Optional Versions

- **EX - ATEX Approved Intrinsically Safe Hazardous Area Approval**
- **CS - Canadian Standards Association Approved Intrinsically Safe**
- **M - Metric Mount**

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**716-684-0003**

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99
High Temperature Accelerometers

- Industry leading high temperature performance in ICP® designs
- Variety of rugged connector and integral cable options
- Top and side exit versions available for easy installation

IMI Sensors is the industry leader in high temperature accelerometers. Our high temperature accelerometers with internal electronics (ICP®) have the best temperature capability of any design on the market today. Often used by predictive maintenance departments in the industry of paper, plastics and steel manufacturing, these accelerometers provide critical machinery data that prevents failures and reduces downtime.

All of these high temperature ICP® accelerometers are capable of withstanding continuous temperatures of 325 °F (162 °C). For applications that exceed these temperatures we have a variety of charge mode accelerometers that can reach 1200 °F (649 °C).

---

**High Temperature Industrial ICP® Accelerometer**

- Model HT602D01
- 100 mV/g (50 g measurement range)
- Frequency Range: ±3dB 48 to 480,000 cpm (0.8 to 8 kHz)
- Low profile, through-bolt design
- 2-pin MIL connector

---

**High Temperature Industrial ICP® Accelerometer**

- Model HT602D11
- 100 mV/g (50 g measurement range)
- Frequency Range: ±3dB 48 to 480,000 cpm (0.8 to 8 kHz)
- Low profile, through-bolt design
- Integral FEP cable

---

**High Temperature Industrial ICP® Accelerometer**

- Model HT602D61
- 100 mV/g (50 g measurement range)
- Frequency Range: ±3dB 48 to 480,000 cpm (0.8 to 8 kHz)
- Low profile, through-bolt design
- Armored integral, FEP jacketed cable

---

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TEL: Toll-Free in USA 800-959-4464 716-684-0003
## Technical Specifications

### Model Number

<table>
<thead>
<tr>
<th>Model Number</th>
<th>HT602D01</th>
<th>HT602D11</th>
<th>HT602D61</th>
<th>HT628F01</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity (±10 %)</td>
<td>100 mV/g</td>
<td>±10 mV/g</td>
<td>±10 mV/g</td>
<td>±10 mV/g</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>±50 g</td>
<td>±50 g</td>
<td>±50 g</td>
<td>±50 g</td>
</tr>
<tr>
<td>Frequency Range (±5%)</td>
<td>N/A</td>
<td>144 to 180,000 cpm</td>
<td>2.4 to 3 kHz [6]</td>
<td>2.4 to 3 kHz [6]</td>
</tr>
<tr>
<td>Frequency Range (±10%)</td>
<td>102 to 150,000 cpm</td>
<td>N/A</td>
<td>102 to 300,000 cpm</td>
<td>N/A</td>
</tr>
<tr>
<td>Frequency Range (±3 dB)</td>
<td>48 to 480,000 cpm</td>
<td>N/A</td>
<td>1.7 to 3 kHz [4][7]</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Environmental

<table>
<thead>
<tr>
<th></th>
<th>HT602D01</th>
<th>HT602D11</th>
<th>HT602D61</th>
<th>HT628F01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload Limit (Shock)</td>
<td>5,000 g pk</td>
<td>1,000 g pk</td>
<td>2,000 g pk</td>
<td>409,600 m/s² pk [8]</td>
</tr>
<tr>
<td>Temperature Range (survivable limit)</td>
<td>-54 to 162 °C</td>
<td>N/A</td>
<td>N/A</td>
<td>350 °F</td>
</tr>
<tr>
<td>Temperature Range (350 °C)</td>
<td>176 °C</td>
<td>N/A</td>
<td>N/A</td>
<td>91 °C</td>
</tr>
</tbody>
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### Electrical

<table>
<thead>
<tr>
<th></th>
<th>HT602D01</th>
<th>HT602D11</th>
<th>HT602D61</th>
<th>HT628F01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settling Time (within 1% of bias)</td>
<td>≤ 2.0 sec</td>
<td>≤ 3 sec</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Discharge Time Constant</td>
<td>≥ 0.2 sec</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Excitation Voltage</td>
<td>18 to 28 VDC</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Constant Current Excitation</td>
<td>2 to 20 mA</td>
<td>2 to 10 mA [8]</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt;150 ohm</td>
<td>&lt;500 Ohm</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Output Bias Voltage</td>
<td>8 to 12 VDC</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Spectral Noise (10 kHz)</td>
<td>9.0 µg/√Hz</td>
<td>50 µg/√Hz</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Spectral Noise (100 kHz)</td>
<td>88.9 µm/sec/√V Hz [2]</td>
<td>491 µm/sec/√V Hz [3]</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Spectral Noise (1 kHz)</td>
<td>4.0 µg/√Hz</td>
<td>20 µg/√Hz</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Spectral Noise (10 kHz)</td>
<td>39.2 µm/sec/√V Hz [5]</td>
<td>196 µm/sec/√V Hz [3]</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Electrical Isolation (Case)</td>
<td>≥ 10¹⁰ ohm</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

## Optional Versions

- **M - Metric Mount**

For Models: HT602D01, HT602D11, HT602D61, HT628F01

## Notes

- All specifications are at room temperature unless otherwise specified.
- [1] 4/28-20 has no equivalent in S.I. units.
- [2] Conversion Factor 1 g = 9.81 m/s².
- [4] The high frequency tolerance is accurate within ±10% of the specified frequency.
- [7] 1Hz = 60 cpm (cycles per minute).
- [8] Constant current should be reduced to ≤ 6 mA when operating sensor above 250°F.
- [9] Not recommended for use with magnetic mounting base.
High Temperature Accelerometers

- 550 °F (288 °C) accelerometer
- Electrically ground isolated
- 10/32 connector (side or top exit)

These units are structured with a piezoelectric ceramic sensing element, operating in a shear mode geometry, for stable operation in the presence of thermal transients and base bending. Welded, hermetically sealed, titanium construction prevents any influx of dirt or moisture. Electrical ground isolation prevents ground loop problems and noise pick-up from the surface of the monitored device.

Since the output of these accelerometers is at a very high impedance, a high degree of insulation resistance is required of the signal transmission path. Low noise cables are recommended for routine, high temperature applications and hardline cables are advised for radiation environments. The use of an in-line charge converter is recommended to convert the measurement signal to a low-impedance voltage for long distance transmission.

<table>
<thead>
<tr>
<th>Technical Specifications</th>
<th>357B53</th>
<th>357B54</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity (± 15%)</td>
<td>100 pC/g</td>
<td>100 pC/g</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>± 150 g pk</td>
<td>± 150 g pk</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>± 150 g pk</td>
<td>± 150 g pk</td>
</tr>
<tr>
<td>Frequency Range (±5%)</td>
<td>3 kHz [2]</td>
<td>3 kHz [2]</td>
</tr>
<tr>
<td>Frequency Range (±10%)</td>
<td>3.5 kHz [2]</td>
<td>3.5 kHz [2]</td>
</tr>
<tr>
<td>Frequency Range (±3 dB)</td>
<td>5.5 kHz [2]</td>
<td>5.5 kHz [2]</td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>≥ 12 kHz</td>
<td>≥ 12 kHz</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>≤ 1 % [3]</td>
<td>≤ 1 % [3]</td>
</tr>
<tr>
<td>Temperature Sensitivity</td>
<td>≤ 5 %</td>
<td>≤ 5 %</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload Limit (Shock)</td>
<td>± 2,000 g pk</td>
<td>± 10,000 m/s² pk</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-100 °F to 150 °F</td>
<td>-23 °C to 288 °C</td>
</tr>
<tr>
<td>Base Strain Sensitivity</td>
<td>0.0003 g/µ</td>
<td>0.0003 m/s²/µ [1]</td>
</tr>
<tr>
<td>Radiation Exposure Limit (Integrated Gamma Flux)</td>
<td>≤ 10¹⁸ rad</td>
<td>≤ 10¹⁸ rad</td>
</tr>
<tr>
<td>Radiation Exposure Limit (Integrated Neutron Flux)</td>
<td>≤ 10¹⁰ N/cm²</td>
<td>≤ 10¹⁰ N/cm²</td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation Resistance (at 550°F)</td>
<td>≥ 10¹⁰ ohm [1]</td>
<td>≥ 10¹⁰ ohm [1]</td>
</tr>
<tr>
<td>Insulation Resistance (at 70°F [21°C])</td>
<td>≥ 10¹⁰ ohm [1]</td>
<td>≥ 10¹⁰ ohm [1]</td>
</tr>
<tr>
<td>Output Polarity</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>Electrical Isolation (Base)</td>
<td>≥ 10¹⁰ ohm</td>
<td>≥ 10¹⁰ ohm</td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensing Element</td>
<td>Ceramic</td>
<td>Ceramic</td>
</tr>
<tr>
<td>Sensing Geometry</td>
<td>Shear</td>
<td>Shear</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Titanium</td>
<td>Titanium</td>
</tr>
<tr>
<td>Sealing</td>
<td>Hermetic</td>
<td>Hermetic</td>
</tr>
<tr>
<td>Size (Hex x Height)</td>
<td>3/4 in x 1.13 in</td>
<td>3/4 in x 1.43 in</td>
</tr>
<tr>
<td></td>
<td>3/4 in x 28.7 mm</td>
<td>3/4 in x 36.3 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>1.80 oz</td>
<td>1.80 oz</td>
</tr>
<tr>
<td></td>
<td>51 gm [1]</td>
<td>51 gm [1]</td>
</tr>
<tr>
<td>Electrical Connector</td>
<td>10-32 Coaxial Jack (side)</td>
<td>10-32 Coaxial Jack (side)</td>
</tr>
<tr>
<td>Mounting Thread</td>
<td>10-32 Female</td>
<td>10-32 Female</td>
</tr>
</tbody>
</table>

**Supplied Accessories**

- Model 081B05 Mounting Stud (10-32 to 10-32) [1]
- Model ACS-1 NIST traceable frequency response (10 Hz to upper 5% point) [1]
- Model M081B05 Mounting Stud 10-32 to M6 x 0.75 [1]

**Notes**

- All specifications are at room temperature unless otherwise specified.
- [1] Typical
- [2] Low frequency response is determined by external signal conditioning electronics.

**Accessories & Cables: Pages 162-176**
### High Temperature Charge Output Accelerometer

**Series 357B8X**

- **Sensitivity:** (±5%)
  - Model 357B81: 20 pC/g
  - Model 357B82: 50 pC/g
  - Model 357B83: 100 pC/g

- **Measurement Range:**
  - Model 357B81: ±2,000 g pk
  - Model 357B82: ±1,000 g pk
  - Model 357B83: ±500 g pk

- **Frequency Range:** (±5%)
  - Model 357B81: 9 kHz
  - Model 357B82: 6 kHz

- **Electrical Connector:** 7/16-27 2-pin

### Technical Specifications

<table>
<thead>
<tr>
<th>Performance</th>
<th>Model Number</th>
<th>357B81</th>
<th>357B82</th>
<th>357B83</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (± 5 %)</td>
<td>20 pC/g</td>
<td>50 pC/g</td>
<td>100 pC/g</td>
<td></td>
</tr>
<tr>
<td>Measurement Range</td>
<td>± 2,000 g pk</td>
<td>± 1,000 g pk</td>
<td>± 500 g pk</td>
<td></td>
</tr>
<tr>
<td>Frequency Range (± 5 %)</td>
<td>9 kHz</td>
<td>6 kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>≥ 35 kHz</td>
<td>≥ 20 kHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-linearity (1000 g, 19620 m/s²)</td>
<td>≤ 1 %</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-linearity (500 g, 9800 m/s²)</td>
<td>N/A</td>
<td>≤ 1 %</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>N/A</td>
<td>≤ 5 % [2]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental</th>
<th>Model Number</th>
<th>357B81</th>
<th>357B82</th>
<th>357B83</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload Limit (Shock)</td>
<td>± 4,000 g pk</td>
<td>± 2,000 g pk</td>
<td>± 1,000 g pk</td>
<td></td>
</tr>
<tr>
<td>Temperature Range (Maximum)</td>
<td>350 °F</td>
<td>288 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base Strain Sensitivity</td>
<td>0.004 g/µ</td>
<td>0.001 g/µ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation Exposure Limit (Integrated Neutron Flux)</td>
<td>1E10 N/cm²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation Exposure Limit (Integrated Gamma Flux)</td>
<td>100 rad</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Range (Maximum)</td>
<td>550 °F</td>
<td>288 °C</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical</th>
<th>Model Number</th>
<th>357B81</th>
<th>357B82</th>
<th>357B83</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitance (Pin to Pin)</td>
<td>2,400 pf [1]</td>
<td>2,300 pf [1]</td>
<td>10,000 pf [1]</td>
<td></td>
</tr>
<tr>
<td>Capacitance (Pin to Case)</td>
<td>30 pf [1]</td>
<td>≤ 2 pf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation Resistance (Pin to Case at 70°F [21°C])</td>
<td>≥ 1 GΩ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation Resistance (Pin to Pin at 500°F [260°C])</td>
<td>≥ 10 MΩ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation Resistance (Pin to Case at 500°F [260°C])</td>
<td>≥ 1 GΩ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Polarity</td>
<td>Differential</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical</th>
<th>Model Number</th>
<th>357B81</th>
<th>357B82</th>
<th>357B83</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing Element</td>
<td>Ceramic Shear</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housing Material</td>
<td>Stainless Steel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sealing</td>
<td>Hermetic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size (Height x Diameter)</td>
<td>1.00 in x .75 in</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (Maximum)</td>
<td>1.75 oz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Connector</td>
<td>7/16-27 2-pin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td>Through Holes (3)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplied Accessories</th>
<th>Model 081A99 Cap Screw (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes</td>
<td>All specifications are at room temperature unless otherwise specified</td>
</tr>
</tbody>
</table>

[1] Typical
[2] Transverse sensitivity is typically ≤ 3%.

**Notes**

All specifications are at room temperature unless otherwise specified.

**Accessories & Cables:** Pages 162-176
# High Temperature Accelerometers

- Case isolated charge output accelerometers
- Available with hazardous area approvals
- Differential output for long term monitoring

## Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>357C71</th>
<th>357C72</th>
<th>357C73</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity (± 5%)</td>
<td>10 pC/g</td>
<td>50 pC/g</td>
<td>100 pC/g</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>± 1,000 g pk</td>
<td>± 500 g pk</td>
<td>± 300 g pk</td>
</tr>
<tr>
<td>Frequency Range (± 5%)</td>
<td>± 4 kHz</td>
<td>± 2.5 kHz</td>
<td>± 2 kHz</td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>≥ 25 kHz</td>
<td>≥ 13 kHz</td>
<td>≥ 11 kHz</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>≤ 1 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>≤ 5 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload Limit/Shock</td>
<td>± 2,000 g pk</td>
<td>± 1,000 g pk</td>
<td></td>
</tr>
<tr>
<td>Base Strain Sensitivity</td>
<td>0.033 mV/g</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation Exposure Limit (Integrated Neutron Flux)</td>
<td>1 E10 N/cm²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiation Exposure Limit (Integrated Gamma Flux)</td>
<td>1 E11 rad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-50 to +900 °F</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacitance (Pin to Case)</td>
<td>26 pF [1]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacitance (Unbalance Between Pins)</td>
<td>≤ 2 pF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation Resistance (Pin to Pin 70°F)</td>
<td>&gt;108 ohm [1]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation Resistance (Pin to Pin 90°F)</td>
<td>&gt;100 kohm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Polarity</td>
<td>Differential</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Physical

<table>
<thead>
<tr>
<th>Model Number</th>
<th>357C71</th>
<th>357C72</th>
<th>357C73</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing Element</td>
<td>Ceramic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sealing</td>
<td>Hermetic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size (Height x Diameter)</td>
<td>1.0 in x 0.75 in</td>
<td>1.25 in x 0.75 in</td>
<td>1.48 in x 0.75 in</td>
</tr>
<tr>
<td>Weight</td>
<td>2.6 oz</td>
<td>3.15 oz</td>
<td>3.8 oz</td>
</tr>
<tr>
<td>Electrical Connector</td>
<td>7/16-27 2-pin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement Position</td>
<td>Side</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Supplied Accessories</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case Height (Value A)</td>
<td>Model 357C71 = 1.48 in (37.6 mm)</td>
<td>Model 357C72 = 1.25 in (31.8 mm)</td>
<td>Model 357C73 = 1.00 in (25.4 mm)</td>
</tr>
<tr>
<td>Model 081A99 Cap Screw (3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model ACS-1 NIST traceable frequency response (10 Hz to upper 5% point)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Notes

- All specifications are at room temperature unless otherwise specified
- [1] Typical
- [3] Transverse sensitivity is typically ≤ 3%.

### Optional Versions

- EX - ATEX Approved Intrinsically Safe Hazardous Area Approval
  - For Models: 357C71, 357C72

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## High Temperature Charge Output Accelerometer

**Model 357B61**
- **Sensitivity:** (±10%) 10 pC/g
- **Measurement Range:** ±1,000 g pk
- **Frequency Range:** (±5%) 5 kHz
- **Electrical Connector:** 10-32 coaxial jack

**Model 357B69**
- **Sensitivity:** (±10%) 3.5 pC/g (.357 pC/(m/s²))
- **Measurement Range:** ±500 g pk (±2450 m/s² pk)
- **Frequency Range:** (±5%) 6 kHz
- **Electrical Connector:** 10-32 Coaxial Jack

### Physical Specifications

<table>
<thead>
<tr>
<th></th>
<th>357B61</th>
<th>357B69</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model Number</strong></td>
<td>357B61</td>
<td>357B69</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity (±10%)</td>
<td>10 pC/g</td>
<td>3.5 pC/g</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>±1,000 g pk</td>
<td>±500 g pk</td>
</tr>
<tr>
<td>Frequency Range (±5%)</td>
<td>5 kHz</td>
<td>6 kHz</td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>≥ 24 kHz</td>
<td>≥ 35 kHz</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>≤ 1 % [2]</td>
<td>≤ 1 %</td>
</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>≤ 3 %</td>
<td>≤ 5 %</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload Limit (Shock)</td>
<td>±5,000 g pk</td>
<td>±3,000 g pk</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-66 to +800 °F</td>
<td>-54 to +822 °C</td>
</tr>
<tr>
<td>Base Strain Sensitivity</td>
<td>0.001 g/με</td>
<td>0.0008 g/με</td>
</tr>
<tr>
<td>Radiation Exposure Limit (Integrated Gamma Flux)</td>
<td>1 E10 N/cm²</td>
<td>1 E10 N/cm²</td>
</tr>
<tr>
<td>Radiation Exposure Limit (Integrated Neutron Flux)</td>
<td>1 E8 rad</td>
<td>1 E8 rad</td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation Resistance (70°F [21°C])</td>
<td>&gt;100 kohm</td>
<td>&gt;100 kohm</td>
</tr>
<tr>
<td>Insulation Resistance (at 250°F [121°C])</td>
<td>&gt;10 ohm</td>
<td>&gt;10 ohm</td>
</tr>
<tr>
<td>Output Polarity</td>
<td>Negative</td>
<td>Negative</td>
</tr>
</tbody>
</table>

### Technical Specifications

<table>
<thead>
<tr>
<th></th>
<th>357B61</th>
<th>357B69</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Physical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensing Element</td>
<td>Ceramic</td>
<td>N/A</td>
</tr>
<tr>
<td>Sensing Geometry</td>
<td>Compression</td>
<td>Compressible</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Inconel</td>
<td>N/A</td>
</tr>
<tr>
<td>Sealing</td>
<td>Hermetic</td>
<td>N/A</td>
</tr>
<tr>
<td>Size (Hex x Height)</td>
<td>5/8 in x 1.0 in</td>
<td>5/8 in x 25.4 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>1.1 oz</td>
<td>0.56 oz</td>
</tr>
<tr>
<td>Mounting Thread</td>
<td>10-32 Female</td>
<td>10-32 Female</td>
</tr>
<tr>
<td>Mounting torque</td>
<td>18 in-lb</td>
<td>2 N·m</td>
</tr>
<tr>
<td>Electrical Connector</td>
<td>10-32 Coaxial Jack</td>
<td>10-32 UNF-2B Mounting Thread</td>
</tr>
<tr>
<td>Electrical Connection Position</td>
<td>Side</td>
<td>Side</td>
</tr>
</tbody>
</table>

### Supplied Accessories

- Model 023A10 Hardline cable, 10-ft, 10-32 plug to 10-32 jack (1)
- Model 081A107 Mounting stud (10-32 to 10-32) (1)
- Model ACS-1 NIST traceable frequency response (10 Hz to upper 5% point) (1)
- Model M081A107 Metric mounting stud (10-32 to M6 x 0.75) (1)

### Notes

- All specifications are at room temperature unless otherwise specified.
- [1] Typical
- [2] Low frequency response is determined by external signal conditioning electronics.

### Optional Versions

- P - Positive Output Polarity For Model 357B69

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IMI SENSORS

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High Temperature Accelerometers

- One piece construction with hermetically sealed integral hardline cable
- Hazardous area approvals
- Multiple sensitivities available

Very High Temperature ICP® Accelerometer
Model EX600B13
- Sensitivity: (±5%) 100 mV/g
- Measurement Range: ±50 g pk
- Frequency Range: (±5%) 4 kHz
- Electrical Connector: 2-pin MIL-C-5015

Product shown at actual size

Very High Temperature ICP® Accelerometer
Model EX600B14
- Sensitivity: (±5%) 10 mV/g
- Measurement Range: ±500 g pk
- Frequency Range: (±5%) 4 kHz
- Electrical Connector: 2-pin MIL-C-5015

Product shown at actual size

Signal/Power

Ground

2-pin Connector MIL-C-5015
Technical Specifications

<table>
<thead>
<tr>
<th>Part Number</th>
<th>EX600B13</th>
<th>EX600B14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (± 5 %)</td>
<td>100 mV/g</td>
<td>10 mV/g</td>
</tr>
<tr>
<td></td>
<td>10.2 mV/m/s² [2]</td>
<td>1.0 mV/m/s² [2]</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>± 50 g pk</td>
<td>± 500 g pk</td>
</tr>
<tr>
<td></td>
<td>± 490 m/s² pk</td>
<td>± 4,900 m/s² pk</td>
</tr>
<tr>
<td>Frequency Range (± 5 %)</td>
<td>282 to 310,000 cpm</td>
<td>4.7 to 3.5 kHz [3] [4]</td>
</tr>
<tr>
<td>Frequency Range (± 10 %)</td>
<td>204 to 300,000 cpm</td>
<td>3.4 to 5 kHz</td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>1,300 kipm</td>
<td>20 kHz [1]</td>
</tr>
<tr>
<td>Broadband Resolution (1 to 10 kHz)</td>
<td>450 µg</td>
<td>4,415 µm/sec² [2]</td>
</tr>
<tr>
<td>Non-linearity (per full scale range)</td>
<td>≤ 1 % [5]</td>
<td></td>
</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>≤ 5 %</td>
<td></td>
</tr>
<tr>
<td>Environmental Overload Limit (Shock)</td>
<td>± 1,000 g pk</td>
<td>± 9,810 m/s² pk [2]</td>
</tr>
<tr>
<td>Temperature Range (Accelerometer)</td>
<td>-65 to 900 °F</td>
<td>-54 to 482 °C</td>
</tr>
<tr>
<td>Temperature Range (Charge Amplifier)</td>
<td>-60 to 250 °F</td>
<td>-51 to 121 °C</td>
</tr>
<tr>
<td>Base Strain Sensitivity</td>
<td>≤ 0.006 g/µε</td>
<td>≤ 0.06 (m/s²)/µε [2]</td>
</tr>
<tr>
<td>Electrical Settling Time</td>
<td>≤ 1 sec</td>
<td></td>
</tr>
<tr>
<td>Discharge Time Constant</td>
<td>≥ 0.1 sec</td>
<td></td>
</tr>
<tr>
<td>Excitation Voltage</td>
<td>22 to 28 VDC</td>
<td></td>
</tr>
<tr>
<td>Constant Current Excitation</td>
<td>2.2 to 20 mA</td>
<td></td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt;1,000 ohm [1]</td>
<td></td>
</tr>
<tr>
<td>Output Bias Voltage</td>
<td>12 to 16 VDC</td>
<td></td>
</tr>
<tr>
<td>Spectral Noise (10 Hz)</td>
<td>30 µV/√Hz</td>
<td>294 (µm/sec²)/√Hz [1][2]</td>
</tr>
<tr>
<td>Spectral Noise (100 Hz)</td>
<td>8 µV/√Hz</td>
<td>78 (µm/sec²)/√Hz [1][2]</td>
</tr>
<tr>
<td>Spectral Noise (1 kHz)</td>
<td>4 µV/√Hz</td>
<td>39 (µm/sec²)/√Hz [1][2]</td>
</tr>
<tr>
<td>Electrical Isolation (Case)</td>
<td>&gt;10⁷ ohm</td>
<td></td>
</tr>
<tr>
<td>Physical Size (Diameter x Height)</td>
<td>1.5 in x 0.75 in</td>
<td>38.1 mm x 19.1 mm</td>
</tr>
<tr>
<td>Weight (without cable)</td>
<td>9.5 oz</td>
<td>270 gm</td>
</tr>
<tr>
<td>Electrical Connector</td>
<td>2-pin MIL-C-5015</td>
<td></td>
</tr>
<tr>
<td>Cable Length</td>
<td>10 ft</td>
<td></td>
</tr>
<tr>
<td>Cable Type</td>
<td>Integral Hardline</td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td>Through Holes [3]</td>
<td></td>
</tr>
<tr>
<td>Supplied Accessories</td>
<td>Model 081A99 Cap Screw (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Model 1CS-1 NIST traceable single-axis amplitude response calibration from 600 cpm (10 Hz) to upper 5% frequency [1]</td>
<td></td>
</tr>
</tbody>
</table>

Optional Versions

All specifications are at room temperature unless otherwise specified

1. Typical
2. Conversion Factor 1g = 9.81 m/s²
3. Hz = 60 cpm (cycles per minute)
4. The high frequency tolerance is accurate within ±10% of the specified frequency.
5. Zero-based, least-squares, straight line method
6. For CE reference PCB® Declaration of Conformance PS023 for details
7. Class 1, Div. 1, Groups A, B, C and D; Class II, Div. 1, Groups E, F and G; Class III, Div. 1
8. Class 1, Div. 1, Groups A, B, C, D
9. Ex ia IIC T4
10. Ex ia IC T1, T3 G

Single Ended vs. Differential Output

Many operating engine environments generate temperatures in excess of 550 °F (288 °C). Above this temperature, many of the design features and materials used in high temperature accelerometers change considerably. For 550 °F to 1,200 °F (288 °C to 650 °C) operating environments, PCB® offers a range of both single ended output (measurement output as a signal and ground) and differential output (measurement output as a plus and minus signal) sensors. The former tend to be smaller and more suitable for short term testing needs, while the latter are more appropriate for long term monitoring applications. Obviously, the environments in which these sensors operate are challenging. In fact, in some of the highest temperature operating environments, the operating sensor measures vibration signatures while glowing red hot. These sensors are complemented by both lab grade and in-line charge amplifier systems. This differential charge amplifier is suitable for interfacing to any of PCB’s differential charge output accelerometers.
High Temperature Accelerometers

- Sensors operating to 1,200 °F (649 °C)
- Ideal for monitoring gas turbines
- Integral hardline cable
- Welded, hermetically sealed

High Temperature Charge Output Accelerometer
Model 357D90

- Sensitivity: (±10%) 5 pC/g
- Measurement Range: ±1,000 g pk
- Frequency Range: (±5%) 2.5 kHz
- Electrical Connector: Integral hardline cable

Product shown at actual size

High Temperature Charge Output Accelerometer
Model 357D91

- Sensitivity: (±10%) 5 pC/g
- Measurement Range: ±1,000 g pk
- Frequency Range: (±5%) 2.5 kHz
- Sensitivity in the transverse direction

Product shown at actual size
High Temperature Accelerometers

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High Temperature Sensing Technology

It is often necessary to monitor vibration levels of rotating machinery operating at elevated temperatures or in high temperature environments. Such circumstances place extreme demands on vibration sensors and require use of accelerometers with special design characteristics that extend their usable temperature range beyond that of other conventional units. For these demanding situations, IMI Sensors offers two styles of high temperature industrial vibration sensors.

A variety of ICP® piezoelectric industrial accelerometers are available with high temperature “HT” option, which extends their usable range to +325 °F (+163 °C). This option replaces their standard, internal signal conditioning circuitry with circuitry specifically designed and tested to reliably withstand elevated temperatures. These accelerometers, though equipped with the “HT” option, will operate in the same manner and with the same cable, data collection and signal conditioning equipment as standard, ICP® industrial accelerometers.

For extreme, high temperature requirements, charge output accelerometers are recommended. Designed to withstand temperatures to 1,200 °F (649 °C), charge output accelerometers do not contain internal signal conditioning circuits which impose temperature limits on standard piezoelectric ICP® accelerometers. However, since there is no signal conditioning circuitry within charge output accelerometers, alternative cable and signal conditioning equipment are required. To simplify installation of these sensors, IMI Sensors offers complete kits that include the necessary low noise cable and in-line charge converter to adapt a charge output accelerometer to conventional ICP® sensor signal conditioners and data collection equipment.

Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>357D90</th>
<th>357D91</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>5 pC/g</td>
<td>0.51 pC/(m/s²)</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>± 1,000 g pk</td>
<td>± 9,800 m/s² pk</td>
</tr>
<tr>
<td>Frequency Range (± 5 %)</td>
<td>2.5 kHz</td>
<td>4 kHz</td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>≥ 14 kHz</td>
<td>≥ 13.5 kHz</td>
</tr>
<tr>
<td>Non-linearity (per full scale range)</td>
<td>≤ 2.5 %</td>
<td>≤ 2.5 %</td>
</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>≤ 5 %</td>
<td>≤ 5 %</td>
</tr>
<tr>
<td>Environmental</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overload Limit (Shock)</td>
<td>± 2,000 g pk</td>
<td>± 19,600 m/s² pk</td>
</tr>
<tr>
<td>Temperature Response</td>
<td>± 16 % [1]</td>
<td>± 16 % [1]</td>
</tr>
<tr>
<td>Temperature Range (Survivable Limit)</td>
<td>67 to 1,400 °F</td>
<td>67 to 900 °F</td>
</tr>
<tr>
<td>Temperature Range (Operating)</td>
<td>67 to 1,200 °F</td>
<td>67 to 480 °C</td>
</tr>
<tr>
<td>Electrical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacitance</td>
<td>990 pF [1]</td>
<td>1,000 pF [1][2]</td>
</tr>
<tr>
<td>Insulation Resistance (68°F [20°C])</td>
<td>≥ 10 kohm</td>
<td>≥ 10 Mohm</td>
</tr>
<tr>
<td>Insulation Resistance (68°F [21°C])</td>
<td>≥ 100 Mohm</td>
<td>≥ 100 Mohm</td>
</tr>
<tr>
<td>Output Polarity</td>
<td>Negative</td>
<td>Negative</td>
</tr>
<tr>
<td>Electrical Isolation</td>
<td>Signal isolated from case</td>
<td>Signal isolated from case</td>
</tr>
<tr>
<td>Physical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensing Geometry</td>
<td>Shear</td>
<td>Shear</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Inconel</td>
<td>Inconel</td>
</tr>
<tr>
<td>Sealing (Sensor Housing)</td>
<td>Hermetic</td>
<td>Hermetic</td>
</tr>
<tr>
<td>Sealing (Connector)</td>
<td>Welded Hermetic</td>
<td>Welded Hermetic</td>
</tr>
<tr>
<td>Size (Height x Length x Width)</td>
<td>0.66 in x 1.26 in x 0.66 in</td>
<td>16.7 mm x 32.0 mm x 16.7 mm</td>
</tr>
<tr>
<td>Weight (without cable)</td>
<td>1.8 oz</td>
<td>50 gm [1]</td>
</tr>
<tr>
<td>Electrical Connector</td>
<td>Integral Hardline Cable</td>
<td>Integral Hardline Cable</td>
</tr>
<tr>
<td>Cable Length</td>
<td>10 ft</td>
<td>10 ft</td>
</tr>
<tr>
<td>Cable Type</td>
<td>MI Hardline Cable</td>
<td>MI Hardline Cable</td>
</tr>
<tr>
<td>Cable Termination</td>
<td>10-32 Coaxial Jack</td>
<td>10-32 Coaxial Jack</td>
</tr>
<tr>
<td>Mounting</td>
<td>Through Hole</td>
<td>Through Hole</td>
</tr>
</tbody>
</table>

Supplied Accessories

- Model 081B108 Mounting Screw, 1/4-28x1 (1)
- Model ACS-1 NIST traceable frequency response (10 Hz to upper 5% point) (1)

Notes

- All specifications are at room temperature unless otherwise specified
- [1] Typical
- [2] Additional cable length will add approximately 100 pF/ft

Accessories & Cables: Pages 162-176
Embeddable Accelerometers

- Choice of standard TO-5 or TO-8
- Choice of charge mode piezoelectric, voltage mode ICP®, and 3-wire low power varieties
- Range of sensitivities to accommodate a variety of applications

The Series 660 low cost accelerometers offer an affordable solution for vibration and shock measurements in high volume and commercial OEM applications. The units are particularly well suited for shock and impact detection of packages or components, as well as bearing and gear mesh vibration measurements in predictive maintenance and condition monitoring requirements. The compact designs may be imbedded into machinery at the OEM level to provide value added monitoring protection.

The units employ field proven, solid state, piezoelectric sensing elements for durability and broadband performance. Choose from either charge mode types, which achieve high operating temperatures or voltage mode ICP® types, with Built in signal conditioning microelectronics, for simplified operation and connectivity to data acquisition and vibration monitoring instrumentation.

How To Order 660 Series, Low Cost, Embeddable Accelerometer

<table>
<thead>
<tr>
<th>Orientation/Polarity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PZ</td>
<td>Positive output for acceleration along z-axis (in upward direction when pin mounted)</td>
</tr>
<tr>
<td>NZ</td>
<td>Negative output for acceleration along z-axis (in upward direction when pin mounted)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical Connection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Header Pins</td>
</tr>
<tr>
<td>2</td>
<td>Integral 1 ft. (0.3 m) cable</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Options</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XX</td>
<td>Overall integral cable length in “XX” ft (other than standard 1 ft.)</td>
</tr>
<tr>
<td>MX</td>
<td>Overall integral cable length in “XX” meters (other than standard 0.3 m)</td>
</tr>
</tbody>
</table>

Example

| 66162A | PZ | 1 | (66162APZ1) Low cost, Low Profile TO-5, 1 mV/g, 5000g, 2 wire ICP® accelerometer with positive polarity and header pin connections |

Pellet Type Accelerometer

- Low Profile T-05, Model 66103PPZ1
  - 3-wire voltage output (power, signal, ground)
  - Sensitivity: (+20%) 10 mV/g
  - Low power consumption
  - Product shown at actual size

Pellet Type Accelerometer

- Standard T-05, Model 66292CNZ1
  - 2-wire charge output (signal, ground)
  - Sensitivity: (+20%) 11 pC/g
  - Power supply not required
  - Product shown at actual size

Pellet Type Accelerometer

- Standard T-08, Model 66332APZ1
  - 2-wire ICP® power (power/signal, ground) current regulated power
  - Sensitivity: (+20%) 1,000 mV/g
  - High resolution
  - Product shown at actual size

Visit us online at www.imi-sensors.com

Toll-Free in USA 800-959-4464 716-684-0003
### Technical Specifications

#### 2-Wire ICP® Configuration

<table>
<thead>
<tr>
<th>Package Size</th>
<th>Low Profile TO-5</th>
<th>Standard TO-5</th>
<th>Standard TO-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (± 20%)</td>
<td>1 mV/g</td>
<td>10 mV/g</td>
<td>59 mV/g</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>5000 g</td>
<td>500 g</td>
<td>100 g</td>
</tr>
<tr>
<td>Frequency Range (± 3 dB)</td>
<td>0.5 to 10 kHz</td>
<td>0.5 to 5 kHz</td>
<td></td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>&gt;25 kHz</td>
<td>&gt;16 kHz</td>
<td></td>
</tr>
<tr>
<td>Broadband Resolution</td>
<td>0.003 g pk</td>
<td>0.0005 g pk</td>
<td>0.00005 g pk</td>
</tr>
<tr>
<td>Excitation Voltage</td>
<td>18 to 28 VDC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excitation Constant Current</td>
<td>2 to 20 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt;100 ohm</td>
<td>&lt;150 ohm</td>
<td>&lt;550 ohm</td>
</tr>
<tr>
<td>Output Bias Voltage</td>
<td>8 to 12 VDC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge Time Constant</td>
<td>≥0.3 sec</td>
<td>≥1 sec</td>
<td></td>
</tr>
<tr>
<td>Settling Time</td>
<td>≤2 sec</td>
<td>≤10 sec</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-65 to +185 °F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor Configuration Number</td>
<td>66162A</td>
<td>66162A</td>
<td>66122A</td>
</tr>
</tbody>
</table>

#### 3-Wire Low Power Configuration

<table>
<thead>
<tr>
<th>Package Size</th>
<th>Low Profile TO-5</th>
<th>Standard TO-5</th>
<th>Standard TO-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (± 20%)</td>
<td>10 mV/g</td>
<td>50 mV/g</td>
<td>100 mV/g</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>0.5 to 10 kHz</td>
<td>0.5 to 5 kHz</td>
<td></td>
</tr>
<tr>
<td>Frequency Range (± 3 dB)</td>
<td>3 to 12 VDC</td>
<td>0.75 mA</td>
<td></td>
</tr>
<tr>
<td>Broadband Resolution</td>
<td>0.007 g pk</td>
<td>0.002 g pk</td>
<td>.001 g pk</td>
</tr>
<tr>
<td>Excitation Voltage</td>
<td>350 pf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excitation Constant Current</td>
<td>0.15 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt;100 ohm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Bias Voltage</td>
<td>0.5 x Excitation Voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge Time Constant</td>
<td>≥0.3 sec</td>
<td>≥0.4 sec</td>
<td></td>
</tr>
<tr>
<td>Settling Time</td>
<td>≤2.5 sec</td>
<td>≤2 sec</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-65 to +185 °F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor Configuration Number</td>
<td>66103P</td>
<td>66203P</td>
<td>66123P</td>
</tr>
</tbody>
</table>

#### 2-Wire Charge Mode Configuration

<table>
<thead>
<tr>
<th>Package Size</th>
<th>Low Profile TO-5</th>
<th>Standard TO-5</th>
<th>Standard TO-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (± 20%)</td>
<td>5 pC/g</td>
<td>11 pC/g</td>
<td>100 pC/g</td>
</tr>
<tr>
<td>Capacitance</td>
<td>350 pf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-65 to +185 °F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensor Configuration Number</td>
<td>66192C</td>
<td>66292C</td>
<td>66392C</td>
</tr>
</tbody>
</table>

#### Common Configuration

<table>
<thead>
<tr>
<th>Package Size</th>
<th>Low Profile TO-5</th>
<th>Standard TO-5</th>
<th>Standard TO-8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resonant Frequency</td>
<td>&gt;25 kHz</td>
<td>&gt;16 kHz</td>
<td></td>
</tr>
<tr>
<td>Non-Linearity</td>
<td>≤1 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>≤7 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over Limit (Shock)</td>
<td>5000 g pk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td>0.10%/°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housing Material</td>
<td>Stainless Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sealing</td>
<td>Hermetic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td>Adhesive or Solder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0.08 oz</td>
<td>0.1 oz</td>
<td>0.88 oz</td>
</tr>
<tr>
<td>Size</td>
<td>8.36 x 0.26 in</td>
<td>8.36 x 0.38 in</td>
<td>16.3 x 14.5 mm</td>
</tr>
</tbody>
</table>

#### Notes

* Measurement range achieved is dependent upon excitation voltage supplied, i.e.: Measurement Range = (0.5 x Excitation Voltage) - 0.5 V / Sensitivity (V/g)

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Accessories & Cables: Pages 162-176
Vibration Transmitters

- 4-20 mA sensors for permanent installation that interface directly to a PLC, DCS and SCADA systems
- Provides continuous, 24/7 monitoring of critical machinery
- Cost-effective monitoring solution

### 4-20 mA Output Transmitter

**Model 640B01**
- Measurement range: 0 to 1 in/sec pk (0 to 25.4 mm/s pk)
- Frequency range: (±10%)
  - 180 to 60,000 cpm (3 to 1 kHz)
- Raw vibration or temperature output signal options, intrinsically safe options available

Product shown at actual size

**Model 640B02**
- Measurement range: 0 to 2 in/sec pk (0 to 50.8 mm/s pk)
- Frequency range: (±10%)
  - 180 to 60,000 cpm (3 to 1 kHz)
- Raw vibration or temperature output signal options, intrinsically safe options available

Product shown at actual size

**Model 641B01**
- Measurement range: 0 to 1 in/sec rms (0 to 25.4 mm/s rms)
- Frequency range: (±10%)
  - 600 to 60,000 cpm (10 to 1 kHz)
- Raw vibration or temperature output signal options, intrinsically safe options available

Product shown at actual size

**Model 641B02**
- Measurement range: 0 to 2 in/sec rms (0 to 50.8 mm/s rms)
- Frequency range: (±10%)
  - 600 to 60,000 cpm (10 to 1 kHz)
- Raw vibration or temperature output signal options, intrinsically safe options available

Product shown at actual size

**Model 645B00**
- Measurement range: 0 to 5 g rms (0 to 49 m/s² rms)
- Frequency range: (±10%)
  - 180 to 60,000 cpm (3 to 1 kHz)
- Raw vibration or temperature output signal options, intrinsically safe options available

Product shown at actual size

**Model 646B02**
- Measurement range: 0 to 10 g rms (0 to 98.1 m/s² rms)
- Frequency range: (±10%)
  - 600 to 600,000 cpm (10 to 10 kHz)
- Raw vibration or temperature output signal options, intrinsically safe options available

Product shown at actual size

### Tips From Techs

**Getting Started with Loop Powered Vibration Sensors**

Starting a vibration monitoring program is not always easy. It requires investing human resources for training and capital dollars to obtain data acquisition equipment. But most plants already have PLC, DCS or SCADA systems in place monitoring pressure, flow and temperature. IMI’s loop-powered 4-20 mA vibration transmitters are “plug and play” with today’s plant control systems. Thus 4-20 mA vibration transmitters are an excellent way to monitor vibration and protect critical equipment without the expense of additional costly data acquisition systems. While 4-20 mA sensors cannot perform diagnostic tasks they provide early warnings that help maintenance technicians avoid catastrophic failure.

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## Technical Specifications

### Model Number
- **640B01**
- **640B02**
- **641B01**
- **641B02**
- **645B00**
- **646B02**

### Performance

<table>
<thead>
<tr>
<th>Measurement Range</th>
<th>640B01</th>
<th>640B02</th>
<th>641B01</th>
<th>641B02</th>
<th>645B00</th>
<th>646B02</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 to 1 in/sec pk</td>
<td>0.0 to 1 in/sec pk</td>
<td>0.0 to 2 in/sec pk</td>
<td>0.0 to 1 in/sec rms</td>
<td>0.0 to 2 in/sec rms</td>
<td>0.0 to 5 g rms</td>
<td>0.0 to 10 g rms</td>
</tr>
<tr>
<td>0.0 to 25.4 mm/s pk [2]</td>
<td>0.0 to 50.8 mm/s pk [2]</td>
<td>0.0 to 25.4 mm/s rms [2]</td>
<td>0.0 to 50.8 mm/s rms [2]</td>
<td>0.0 to 49 m/s² rms [2]</td>
<td>0.0 to 98.1 m/s² rms [2]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Output</th>
<th>4-20 mA</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Frequency Range (±10 %)</th>
<th>180 to 60,000 cpm</th>
<th>600 to 6,000,000 cpm</th>
<th>180 to 60,000 cpm</th>
<th>180 to 60,000 cpm</th>
<th>180 to 600,000 cpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 to 1 kHz [1][2][3]</td>
<td>10 to 1 kHz [1][3]</td>
<td>3 to 1 kHz [1][3]</td>
<td>3 to 10 kHz [1][3]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Broadband Resolution</th>
<th>0.005 in/sec pk</th>
<th>0.01 in/sec pk</th>
<th>0.005 in/sec rms</th>
<th>0.01 in/sec rms</th>
<th>0.025 g rms</th>
<th>0.05 g rms</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.13 mm/s pk [5]</td>
<td>0.26 mm/s pk [5]</td>
<td>0.13 mm/s rms [5]</td>
<td>0.26 mm/s rms [5]</td>
<td>0.24 m/s² rms [5]</td>
<td>0.49 m/s² rms</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Non-linearity</th>
<th>±1 %</th>
</tr>
</thead>
</table>

### Environmental

<table>
<thead>
<tr>
<th>Temperature Range</th>
<th>40 to 115 °F</th>
<th>-40 to 85 °C</th>
</tr>
</thead>
</table>

### Electrical

<table>
<thead>
<tr>
<th>Excitation Voltage</th>
<th>12 to 30 VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load Resistance</td>
<td>50 (Vs-12) ohms</td>
</tr>
<tr>
<td>Setting Time</td>
<td>&lt;15 sec</td>
</tr>
<tr>
<td>Electrical Isolation (Case)</td>
<td>&gt;10¹ ohms</td>
</tr>
</tbody>
</table>

### Physical

| Size - Hex | 1.0 in |
| Size - Height | 25.4 mm |
| Size - Height | 2.6 in |
| Weight | 4.7 oz |
| Mounting Thread | 1/4-20 UNF |
| Mounting Torque | 3 to 5 ft-lb |
| Sensing Element | Ceramic Shear |
| Housing Material | Stainless Steel |
| Sealing | Welded Hermetic |
| Electrical Connector | 2-pin MIL-C-5015 (Top) |
| Electrical Connections (Pin A) | 4-20 mA Pos (+) |
| Electrical Connections (Pin B) | 4-20 mA Neg (-) |

### Supplied Accessories

- Model 081A40 Mounting Stud (1)
- Model ICS-4 NIST-traceable single-axis amplitude response calibration from 0 cpm (0 Hz) to upper 10% frequency for 4 - 20 mA output vibration sensor (1)

### Notes

- All specifications are at room temperature unless otherwise specified

1. 1 Hz = 60 cpm (cycles per minute)
2. Conversion Factor 1 in/sec = 0.0254 m/sec.
3. Current will fluctuate at frequencies below 5 Hz.
4. For CE reference PCB® Declaration of Conformance PS039 or PS053 for details.
5. Typical.

### Optional Versions

- **EX** - Hazardous Area Approval
  - For Models: 640B01, 640B02, 641B01, 641B02
- **M** - Metric Mount
  - For Models: 640B01, 640B02, 641B01, 641B02
- **RV** - Buffered Analog Signal Output 100 mV/g (±20%)
  - For Models: 640B01, 640B02, 641B01, 641B02
- **RVVO** - Buffered Analog Signal Output 100 mV/in/sec (±20%)
  - For Models: 640B01

### Accessories & Cables: Pages 162-176
Displacement

Vibration Transmitters

- Industry leading low frequency response
- Interface directly to PLC, DCS and SCADA systems
- Superior signal resolution on slow speed machinery

4-20 mA Output Transmitter
Model 653A01
- Effective on slow speed machinery
- Measures absolute p-p displacement
- Accurate down to 90 cpm

Product shown at actual size

4-20 mA Indicator / Alarm
Model 683A

The model 683A panel meter can be used with either ICP® sensors or 4-20 mA vibration transmitters depending on the options selected. Each display also features two programmable relays with time delays and optional 4-20 mA re-transmit.

- Provides 24 VDC excitation for loop powered 4-20 mA sensors, or ICP® power
- Up to four programmable set-point relays
- Highly visible, fully scalable LED display and user friendly, menu-driven setup

4-20 mA Alarm Enclosure
Series 684A
- Houses 1 to 8 panel meters
- Fiberglass NEMA 4X enclosure
- BNC’s for walk up analysis when ICP® option is selected
Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>653A01</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
</tr>
<tr>
<td>Measurement Range</td>
<td>2 to 40 mil pk - pk</td>
</tr>
<tr>
<td></td>
<td>0.05 to 1.02 mm pk - pk   [2]</td>
</tr>
<tr>
<td>Output</td>
<td>4-20 mA</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>90 to 18,000 rpm</td>
</tr>
<tr>
<td></td>
<td>1.5 to 300 Hz    [1]</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>±2%</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-60 to 250 °F</td>
</tr>
<tr>
<td></td>
<td>-54 to 121 °C</td>
</tr>
<tr>
<td>Overload Limit</td>
<td>2,500 g pk</td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
</tr>
<tr>
<td>Excitation Voltage</td>
<td>12 to 30 VDC</td>
</tr>
<tr>
<td>Load Resistance</td>
<td>50 (V/12) ohms</td>
</tr>
<tr>
<td>Settling Time</td>
<td>60 sec [3]</td>
</tr>
<tr>
<td>Electrical Isolation</td>
<td>&gt;10⁸ ohm</td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
</tr>
<tr>
<td>Size - Hex</td>
<td>1.25 in</td>
</tr>
<tr>
<td></td>
<td>31.75 mm</td>
</tr>
<tr>
<td>Size - Height</td>
<td>2.6 in</td>
</tr>
<tr>
<td></td>
<td>66 mm</td>
</tr>
<tr>
<td>Size - Height</td>
<td>5.36 oz</td>
</tr>
<tr>
<td></td>
<td>152 gm</td>
</tr>
<tr>
<td>Mounting Thread</td>
<td>1/4-28 UNF</td>
</tr>
<tr>
<td>Mounting Torque</td>
<td>3 to 5 ft-lb</td>
</tr>
<tr>
<td></td>
<td>4 to 7 N-m</td>
</tr>
<tr>
<td>Sensing Element</td>
<td>Ceramic</td>
</tr>
<tr>
<td>Sensing Geometry</td>
<td>Flexural</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Sealing</td>
<td>Welded Hermetic</td>
</tr>
<tr>
<td><strong>Supplied Accessories</strong></td>
<td>Model 081A41 Mounting stud 1/4-28 socket head set screw brass tip stainless steel 5/8&quot; long [1]</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td></td>
</tr>
<tr>
<td>All specifications are at room temperature unless otherwise specified</td>
<td></td>
</tr>
</tbody>
</table>

[1] 1Hz = 60 cpm (cycles per minute).
[2] Conversion Factor 1 in/sec = 0.0254 m/sec.
[3] Typical

Optional Versions

M - Metric Mount
For Model 653A01

Ultra Low Frequency Displacement Sensor

Until now users that wanted to monitor equipment turning at speeds below 180 cpm (3 Hz) with one simple sensor were limited in the frequency bands and scale which they could measure. IMI’s 4-20 mA displacement sensor changes the game, allowing user’s to trend vibration in displacement at speeds as low as 90 CPM (1.5 Hz). Displacement, as opposed to the traditionally offered velocity and acceleration scales, offers the best signal resolution at speeds below 600 CPM (10 Hz) and is ideal for detecting an unbalance condition in slow speed equipment such as fans.

The model 653A01 has a vibration range of 40 mils peak to peak. Its frequency span is 90 CPM to 18,000 CPM (1.5 Hz to 300 Hz), giving it the best low frequency response of any 4-20 mA sensor on the market today. The Ultra Low Frequency Displacement Sensor is available with industry standard 2-pin MIL connector or is fully submersible when ordered with integral cable.
Hazardous Area Approved
Vibration Transmitters

- CSA / ATEX D approved
- Supplied with explosion proof conduit elbow
- Electrical connector: terminal block

Loop Powered 4-20 mA Vibration Transmitter
Model EX640B71
- Measurement Range: 0 to 1 in/sec pk (0 to 25.4 mm/s pk)
- Frequency Range: (±10%) 180 to 60,000 cpm (3 to 1 kHz)
- Raw vibration or temperature output signal options

Product shown at actual size

Loop Powered 4-20 mA Vibration Transmitter
Model EX640B72
- Measurement Range: 0 to 2 in/sec pk (0 to 50.8 mm/s pk)
- Frequency Range: (±10%) 180 to 60,000 cpm (3 to 1 kHz)
- Raw vibration and temperature output signal options

Product shown at actual size

Loop Powered 4-20 mA Vibration Transmitter
Model EX641B71
- Measurement Range: 0 to 1 in/sec rms (0 to 25.4 mm/s rms)
- Frequency Range (± 10%) 600 to 600,000 cpm (10 to 1 kHz)
- Raw vibration and temperature output options available

Product shown at actual size

Loop Powered 4-20 mA Vibration Transmitter
Model EX641B72
- Measurement Range: 0 to 2 in/sec rms (0 to 50.8 mm/s pk)
- Frequency Range (± 10%) 600 to 600,000 cpm (10 to 1 kHz)
- Raw vibration and temperature output options available

Product shown at actual size
**Technical Specifications**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>EX640B71</th>
<th>EX640B72</th>
<th>EX641B71</th>
<th>EX641B72</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement Range</td>
<td>0.0 to 1 in/sec pk</td>
<td>0.0 to 2.0 in/sec pk</td>
<td>0.0 to 1 in/sec rms</td>
<td>0.0 to 2.0 in/sec rms</td>
</tr>
<tr>
<td></td>
<td>0.0 to 25.4 mm/s pk [1]</td>
<td>0.0 to 50.8 mm/s pk [1]</td>
<td>0.0 to 25.4 mm/s rms [1]</td>
<td>0.0 to 50.8 mm/s rms [1]</td>
</tr>
<tr>
<td>Output</td>
<td>4-20 mA</td>
<td>4-20 mA</td>
<td>4-20 mA</td>
<td>4-20 mA</td>
</tr>
<tr>
<td>Frequency Range (± 3 dB)</td>
<td>180 to 60,000 cpm</td>
<td>600 to 60,000 cpm</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 to 1 kHz [2][3]</td>
<td>10 to 1 kHz [2][3]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Broadband Resolution</td>
<td>0.005 in/sec pk</td>
<td>0.01 in/sec pk</td>
<td>0.005 in/sec rms</td>
<td>0.01 in/sec rms</td>
</tr>
<tr>
<td></td>
<td>0.13 mm/s pk [4]</td>
<td>0.26 mm/s pk [4]</td>
<td>0.13 mm/s rms [4]</td>
<td>0.26 mm/s rms [4]</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-40 to 176 °F</td>
<td>-40 to 80 °C</td>
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<tr>
<td><strong>Electrical</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Excitation Voltage</td>
<td>12 to 30 VDC</td>
<td>12 to 30 VDC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Settling Time (within 2% of value)</td>
<td>&lt;15 sec</td>
<td>&lt;15 sec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Isolation (Case)</td>
<td>&gt;10^9 ohm</td>
<td>&gt;10^9 ohm</td>
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</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Size (Hex x Height)</td>
<td>3.85 in x 5.52 in</td>
<td>96 mm x 140 mm</td>
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<tr>
<td>Weight</td>
<td>1.2 lb</td>
<td>1.2 lb</td>
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<tr>
<td>Mounting Thread</td>
<td>1/4 NPT</td>
<td>1/4 NPT</td>
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<td></td>
</tr>
<tr>
<td>Sensing Element</td>
<td>Ceramic Shear</td>
<td>Ceramic Shear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housing Material</td>
<td>Stainless Steel</td>
<td>Stainless Steel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Connector</td>
<td>Removable Screw Terminals</td>
<td>Removable Screw Terminals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Connection Position</td>
<td>Top</td>
<td>Top</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Connections (Tab 1)</td>
<td>4-20 mA Pos (+)</td>
<td>4-20 mA Pos (+)</td>
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</tr>
<tr>
<td>Electrical Connections (Tab 2)</td>
<td>4-20 mA Neg (-)</td>
<td>4-20 mA Neg (-)</td>
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<td></td>
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<tr>
<td>Screw Terminal Wire Size</td>
<td>12-24 AWG</td>
<td>12-24 AWG</td>
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<tr>
<td><strong>Supplied Accessories</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Model ICS-4 NIST-traceable single-axis amplitude response calibration from 0 cpm (0 Hz) to upper 10% frequency for 4-20 mA output vibration sensor (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Easy Implementation**

IMI® 4-20mA Vibration Transmitters are particularly well suited for 24/7 vibration monitoring of critical rotating equipment. Simply install the transmitter on the bearing housing and run a cable to the nearest PLC, DCS, SCADA, or any plant information system. That is all it takes to begin continuous vibration monitoring and avoid costly unexpected down time. Using the reliable 4-20mA trending signal enables the user to schedule diagnostic testing based on real data rather than using time scheduled route based testing. This practice saves time and reduces overall costs of predictive maintenance.

These transmitters employ field proven solid state piezoelectric sensing technologies and are available in many measurement ranges of acceleration, velocity or displacement. Optional hazardous area approved models also available.

---

**Optional Versions**

- **EX** - Hazardous Area Approval
  - For Models: EX640B71, EX640B72, EX641B71, EX641B72

- **RV** - Buffered Analog Signal Output 100 mV/g (±20%)
  - For Models: EX640B71, EX640B72, EX641B71, EX641B72

---

**Notes**

All specifications are at room temperature unless otherwise specified.

1. Conversion Factor 1 in/sec = 0.0254 m/sec.
2. Current will fluctuate at frequencies below 5 Hz.
3. 1 Hz = 60 cpm (cycles per minute).
4. Typical.
5. For CE reference PCB® Declaration of Conformance PS039 or PS053 for details.
Vibration Transmitters

- 4-20 mA sensors for permanent mount installation that interface directly to a PLC, DCS, SCADA, or any PI systems
- Side exit versions allows for simple mounting in tight spaces
- Swivel mounting mechanism eliminates spinning sensors during installation

Loop Powered 4-20 mA Vibration Transmitter
Model 642A01
- Low profile, side exit
- Measurement range 0-1.0 ips velocity pk (0-25.4 mm/sec peak)
- 2-pin MIL-C-5015 connector
Product shown at actual size

Loop Powered 4-20 mA Vibration Transmitter
Model 642A11
- Measurement range 0-1.0 ips velocity pk (0-25.4 mm/sec peak)
- 10 ft (3 m) of Integral Cable
- Submersible
Product shown at actual size

Loop Powered 4-20 mA Vibration Transmitter
Model 642A61
- Measurement range 0-1.0 ips velocity pk (0-25.4 mm/sec peak)
- 10 ft (3 m) of Integral Armored Cable
- Useful in exceedingly rough environments
Product shown at actual size

Mounting Stud Model 080162

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A PCB PIEZOTRONICS DIV.
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# Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>642A01</th>
<th>642A11</th>
<th>642A61</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement Range</td>
<td>0.0 to 1 in/sec pk</td>
<td>0.0 to 25.4 mm/s pk [1]</td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>4-20 mA</td>
<td>4-20 mA</td>
<td>4-20 mA</td>
</tr>
<tr>
<td>Frequency Range (±3 dB)</td>
<td>180 to 60,000 cpm</td>
<td>3 to 1 kHz [1][3]</td>
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</tr>
<tr>
<td>Broadband Resolution</td>
<td>0.005 in/sec pk</td>
<td>0.13 mm/s pk [4]</td>
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</tr>
<tr>
<td>Non-linearity</td>
<td>± 1 %</td>
<td>± 1 %</td>
<td>± 1 %</td>
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<tr>
<td><strong>Environmental</strong></td>
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</tr>
<tr>
<td>Temperature Range</td>
<td>-40 to 185 °F</td>
<td>-40 to 85 °C</td>
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</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Excitation Voltage</td>
<td>12 to 30 VDC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Settling Time (within 2% of value)</td>
<td>&lt;15 sec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load Resistance</td>
<td>50 (Vs-12) ohms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Isolation (Case)</td>
<td>&gt;10^8 ohm</td>
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<td></td>
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<tr>
<td><strong>Physical</strong></td>
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<td></td>
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</tr>
<tr>
<td>Size (Hex x Height)</td>
<td>0.875 in x 1.41 in</td>
<td>22.2 mm x 35.8 mm</td>
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<tr>
<td>Weight</td>
<td>3.8 oz (without cable)</td>
<td>108 gm (without cable)</td>
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<tr>
<td>Mounting Thread</td>
<td>1/4-28 UNF</td>
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<tr>
<td>Mounting Torque</td>
<td>3 to 5 ft-lb</td>
<td>4 to 7 N-m</td>
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<tr>
<td>Sensing Element</td>
<td>Ceramic Shear</td>
<td>Stainless Steel</td>
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</tr>
<tr>
<td>Housing Material</td>
<td>Stainless Steel</td>
<td></td>
<td></td>
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<tr>
<td>Electrical Connector</td>
<td>2-pin MIL-C-5015</td>
<td>Integral Cable</td>
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<tr>
<td>Electrical Connection Position</td>
<td>Side</td>
<td>Side</td>
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<tr>
<td>Cable Termination</td>
<td>N/A</td>
<td>Pigtail Ends</td>
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<tr>
<td>Cable Length</td>
<td>N/A</td>
<td>10 ft</td>
<td></td>
</tr>
<tr>
<td>Cable Type</td>
<td>Polyurethane</td>
<td>Polyurethane</td>
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<tr>
<td>Electrical Connections</td>
<td>Pin A - 4-20 mA Pos (+)</td>
<td>Red - 4-20 mA Pos (+)</td>
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</tr>
<tr>
<td></td>
<td>Pin B - 4-20 mA Neg (-)</td>
<td>Blue - 4-20 mA Neg (-)</td>
<td></td>
</tr>
<tr>
<td><strong>Supplied Accessories</strong></td>
<td>Model 080A162 Mounting Stud (1)</td>
<td></td>
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<tr>
<td></td>
<td>Model ICS-4 NIST-traceable single-axis amplitude response calibration from 0 cpm (0 Hz) to upper 10% frequency for 4-20 mA output vibration sensor (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All specifications are at room temperature unless otherwise specified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[1] 1 Hz = 60 cpm (cycles per minute).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[2] Conversion Factor 1 in/sec = 0.0254 m/sec.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[3] Current will fluctuate at frequencies below 5 Hz.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[5] Typical</td>
<td></td>
<td></td>
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</tbody>
</table>

## Optional Versions

- EX - Hazardous Area Approval
  - For Models: 642A01, 642A11, 642A61
- M - Metric Mount
  - For Models: 642A01, 642A11, 642A61
- RV - Buffered Analog Signal Output
  - For Models: 642A01, 642A11, 642A61

[Accessories & Cables: Pages 162-176](#)
Vibration Transmitters

- ICP® in-line transmitter
- Converts ICP® sensors to loop powered transmitters
- Compact size fits easily in cable trays

Another IMI Sensors industry first, Model 682A09 installs in-line with any industrial accelerometer and converts the vibration signal to a 4-20 mA velocity output that can be trended with today's PLC, DCS and SCADA systems. Its sleek design installs right into the cable run, no DIN rails, cabinets or special power required. With a 3-pin output connector you can still gather dynamic vibration signals with a vibration analyzer while the PLC monitors overall trends. Now you can take your existing accelerometers and turn them into 24/7 vibration monitoring devices for your most critical machinery.

ICP® In-Line Vibration Transmitter
Model 682A09

- Outputs 4-20 mA proportional to velocity plus analog raw vibration output
- Measurement Range: 0.0 to 1.0 in/sec pk (0.0 to 25.4 mm/s pk)
- Interfaces directly with plant control systems

Product shown at actual size

<table>
<thead>
<tr>
<th>Technical Specifications</th>
<th>682A09</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model Number</strong></td>
<td>682A09</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td></td>
</tr>
<tr>
<td>Input Signal (ICP® Accelerometer)</td>
<td>100 mV/g</td>
</tr>
<tr>
<td>Frequency Response (&lt;3dB ±2dB)</td>
<td>600 to 60,000 cpm</td>
</tr>
<tr>
<td>Measurement Range</td>
<td>0.0 to 1.0 in/sec pk</td>
</tr>
<tr>
<td>Output Range</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td>Broadband Resolution</td>
<td>0.01 in/sec pk</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
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</tr>
<tr>
<td>Temperature Range</td>
<td>-40 to 185 °F</td>
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<tr>
<td>Temperature Response (Sensitivity Deviation)</td>
<td>≤ ±15%</td>
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<tr>
<td><strong>Electrical</strong></td>
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</tr>
<tr>
<td>Excitation Voltage</td>
<td>20 to 30 VDC</td>
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<tr>
<td>Electrical Isolation (Case)</td>
<td>&gt;100 ohm</td>
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<tr>
<td>Setting Time (within 2% of value)</td>
<td>&lt;80 sec</td>
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<tr>
<td>Load Resistance</td>
<td>50 (Vs-20) ohm</td>
</tr>
</tbody>
</table>

**Model Number** 682A09

- Size - Height | 4.0 in |
- Size - Diameter | 101.6 mm |
- Weight | 2.5 oz |
- Housing Material | Stainless Steel |
- Electrical Connector (#!) | 2-pin MIL-C-5015 |
- Electrical Connection Position (#!) | Sensor End |
- Electrical Connections (#!) (Pin A) | AC IN Pos |
- Electrical Connections (#!) (Pin B) | AC IN Neg |
- Electrical Connection Position (#!) | Output End |
- Electrical Connections (#!) (Pin A) | 4-20 mA Pos |
- Electrical Connections (#!) (Pin B) | 4-20 mA Neg & AC OUT Neg |
- Electrical Connections (#!) (Pin C) | AC OUT Pos |
- Sealing | Welded Hermetic |

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Accessories & Cables: Pages 162-176
# Technical Specifications

## Model Number

<table>
<thead>
<tr>
<th>Performance</th>
<th>682B03</th>
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<tbody>
<tr>
<td>Channels</td>
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<tr>
<td>Input Signal (Vibration)</td>
<td>±100 mV/g [10]</td>
</tr>
<tr>
<td>Input Signal (Temperature)</td>
<td>0 to 1.2 VDC [11]</td>
</tr>
<tr>
<td>Output Signal (DC Vibration)</td>
<td>±20 mV [8]</td>
</tr>
<tr>
<td>Output Signal (UIC Vibration)</td>
<td>U to 10 VDC [4][11]</td>
</tr>
<tr>
<td>Output Signal (Temperature)</td>
<td>±4 to 20 mA [11]</td>
</tr>
<tr>
<td>Output Signal (±0.01 %)</td>
<td>100 mV/g [2]</td>
</tr>
<tr>
<td>Output Signal (±0.01 %)</td>
<td>±10.2 mV/(m/s²)</td>
</tr>
<tr>
<td>Output Signal (Temperature)</td>
<td>0 to 1.2 VDC [11]</td>
</tr>
<tr>
<td>Output Signal (DC Vibration)</td>
<td>4 to 20 mA [11]</td>
</tr>
<tr>
<td>Output Signal (Temperature)</td>
<td>0 to 1.2 VDC [11]</td>
</tr>
<tr>
<td>Output Signal (DC Vibration)</td>
<td>±4 to 20 mA [11]</td>
</tr>
<tr>
<td>Output Signal (Temperature)</td>
<td>±4 to 20 mA [11]</td>
</tr>
</tbody>
</table>

## Electrical

<table>
<thead>
<tr>
<th>Performance</th>
<th>682B03</th>
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</thead>
<tbody>
<tr>
<td>Power Required</td>
<td>DC, power</td>
</tr>
<tr>
<td>DC Power</td>
<td>23 to 25 VDC</td>
</tr>
<tr>
<td>DC Power (maximum)</td>
<td>50 mA</td>
</tr>
<tr>
<td>Settling Time</td>
<td>&lt;2 min</td>
</tr>
<tr>
<td>Excitation Voltage (delivered to sensor)</td>
<td>±10.2 mV/(m/s²)</td>
</tr>
<tr>
<td>Constant Current Excitation (delivered to sensor)</td>
<td>0 to 9 mA [11]</td>
</tr>
<tr>
<td>Output Span (±0.01 %)</td>
<td>16 mA</td>
</tr>
<tr>
<td>Output Span (±0.01 %)</td>
<td>16 mA</td>
</tr>
<tr>
<td>Output Span (±0.01 %)</td>
<td>16 mA</td>
</tr>
<tr>
<td>Constant Current Excitation (delivered to sensor)</td>
<td>±5 or 10 VDC [11]</td>
</tr>
</tbody>
</table>

## Physical

<table>
<thead>
<tr>
<th>Performance</th>
<th>682B03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Connector (input/output)</td>
<td>Removable Screw terminals</td>
</tr>
<tr>
<td>Electrical Connector (raw vibration output)</td>
<td>BNC Jack</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Polyamide</td>
</tr>
<tr>
<td>Size - Height</td>
<td>3.9 in (99 mm)</td>
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<tr>
<td>Size - Width</td>
<td>0.9 in (22.5 mm)</td>
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<td>Size - Depth</td>
<td>4.5 in (114.5 mm)</td>
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<tr>
<td>Weight (Maximum)</td>
<td>6.4 oz</td>
</tr>
<tr>
<td>Screw Terminal Wire Size</td>
<td>24-14 AWG</td>
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<tr>
<td>Din Rail Mount</td>
<td>1.38 in (35 mm)</td>
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<tr>
<td>Status Indicator (Power “on”)</td>
<td>Green LED</td>
</tr>
<tr>
<td>Status Indicator (Input Fault)</td>
<td>Red LED</td>
</tr>
<tr>
<td>Status Indicator (Measurement Mode - Acceleration)</td>
<td>Green LED</td>
</tr>
<tr>
<td>Status Indicator (Measurement Mode - Velocity)</td>
<td>Green LED</td>
</tr>
<tr>
<td>Status Indicator (Measurement Mode - Displacement)</td>
<td>Green LED</td>
</tr>
</tbody>
</table>

## Notes

1. 4 mA constant current diode is internal to 9330VT
2. Achieved with 100 mV/g ICP® accelerometer input.
3. Attenuation is ±5 dB/decade.
4. Factory set, 0-5 VDC.
5. Jumper selectable for 18 VDC regulated, 24 VDC power supply voltage or ICP® sensor excitation disabled.
6. Output current voltage will fluctuate at frequencies below 5 Hz.
7. For CE reference PCB® Declaration of Conformance PS051 for details.
8. The high frequency tolerance is accurate within ±0.5 kHz of the specified frequency.
9. The low frequency tolerance is accurate within ±0.5 Hz of the specified frequency.

## Environmental

<table>
<thead>
<tr>
<th>Performance</th>
<th>682B03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Range (Operating)</td>
<td>32 to 108 °F</td>
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<tr>
<td>Temperature Range (Storage)</td>
<td>-40 to 70 °C</td>
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<tr>
<td>Humidity Range (Non-Condensing)</td>
<td>0 to 95 %</td>
</tr>
</tbody>
</table>

---

**Vibration Transmitters**

**ICP® Sensor to 4-20 mA Transmitter**

**Model 682B03**

- Provides constant current ICP® sensor excitation
- 24 VDC powered, DIN rail mount
- Analog vibration output for fault diagnostics (through BNC or terminals)
- Adjustable low pass and high pass filtering, selectable acceleration, velocity, or displacement output signal

**Product shown at actual size**
Programmable Vibration Transmitters

- Cost-effective 4-20 mA Loop Powered Transmitters
- Provide Continuous protection
- Work with PLCs, DCS and SCADA Plant information Systems

IMI Sensors advances the industry exclusive USB Programmable Vibration Sensors with 2 additional products. The 649A03 4-20 mA output Bearing Condition Monitor offers a high level of bearing fault monitoring in the small package of a typical sensor housing. Five selectable measurement methods and selectable sensing range increase reliability and accuracy in every application. The 649A04 4-20 mA output sensor brings USB programmability to IMI’s tried and true current output vibration sensor line. Selectable displacement, velocity, or acceleration measurement coupled with selectable range scaling brings flexibility and “in field” programming.

Programmable 4-20 mA
Bearing Condition Transmitter
Model 649A03

- Offers proven 4-20 mA bearing fault vibration technologies in a standard sensor housing package
- Industry exclusive USB programming technology
- Effective monitoring of constant speed and variable speed systems

Product shown at actual size

Technical Specifications

<table>
<thead>
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<th>Model Number</th>
<th>649A03</th>
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</thead>
<tbody>
<tr>
<td>Performance</td>
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<tr>
<td>Output (Loop Power)</td>
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<tr>
<td>Sampling Time</td>
<td>1 sec</td>
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<tr>
<td>Measurement Range (with HPF 250 Hz)</td>
<td>0-2 to 0-50 g pk (1)[2]</td>
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<tr>
<td>(with HPF 2,500 Hz) (Compensation pk)</td>
<td>0-2 to 0-50 RMS (2)[2]</td>
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<tr>
<td>Crest Factor (with HPF 250 Hz)</td>
<td>1 to 16 (1)</td>
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<tr>
<td>Crest Factor Plus</td>
<td>1 to 16 (1)</td>
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<tr>
<td>Bearing Diameter</td>
<td>1.57 to 39.37 in</td>
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<tr>
<td>Bearing Rotation Speed</td>
<td>600 to 3,600 RPM</td>
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<td>Linearity</td>
<td>10%</td>
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<td>Environmental</td>
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<tr>
<td>Temperature Range</td>
<td>-40 to +212 °F</td>
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<td>Storage Temperature Range</td>
<td>-40 to +100 °C</td>
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<td>Electrical</td>
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<tr>
<td>Excitation Voltage</td>
<td>15 to 30 VDC</td>
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<tr>
<td>Load Resistance</td>
<td>50 (Vs-15) ohm</td>
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<td>Electrical Isolation (Case)</td>
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<td>Weight</td>
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<td>Mounting Thread</td>
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<td>Mounting Torque</td>
<td>3 to 5 ft-lb</td>
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<tr>
<td>Sensing Element</td>
<td>Piezoelectric Accelerometer</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>Sealing</td>
<td>Welded Hermetic</td>
</tr>
<tr>
<td>Electrical Connector</td>
<td>2-pin MIL-C-5015</td>
</tr>
<tr>
<td>Electrical Connection Position</td>
<td>Top</td>
</tr>
<tr>
<td>Electrical Connections (Pin A)</td>
<td>4-20 mA Pos (+)</td>
</tr>
<tr>
<td>Electrical Connections (Pin B)</td>
<td>4-20 mA Neg (-)</td>
</tr>
<tr>
<td>Overload Limit (Shock)</td>
<td>5,000 g pk</td>
</tr>
<tr>
<td>Supplied Accessories</td>
<td>49,050 m/s^2 pk</td>
</tr>
</tbody>
</table>

Notes

All specifications are at room temperature unless otherwise specified

1) Customer programmable parameters
2) With 0.1 g step
3) For CE reference PCB® Declaration of Conformance PS039 or PS053 for details

Optional Versions
Optional versions have identical specifications and accessories as listed for the standard model except where noted below. More than one option may be used.

M - Metric Mount
For Model 649A03

Accessories & Cables: Pages 162-176
## Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>649A04</th>
</tr>
</thead>
</table>

### Performance

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measurement Range</strong></td>
<td></td>
</tr>
<tr>
<td><strong>(Velocity)</strong></td>
<td>0.5 to 3 m/sec pk [1][2][3][4]</td>
</tr>
<tr>
<td><strong>(Acceleration)</strong></td>
<td>1 to 10 g pk</td>
</tr>
<tr>
<td><strong>(Displacement)</strong></td>
<td>0.1 to 0.5 mm pk - pk [6][2][4]</td>
</tr>
<tr>
<td><strong>Output (± 5%)</strong></td>
<td>4-20 mA</td>
</tr>
</tbody>
</table>

| **Frequency Range (-6 dB)** | 180 to 60,000 cpm |
| **USB Programmable Options for Frequency Range** | 180 to 300,000 cpm |

### Environmental

| **Temperature Range** | -40 to +185 °F |
| **Electrical Excitation Voltage** | 12 to 30 VDC |

### Output Signal

- Output signal proportional to displacement, velocity or acceleration
- Selectable high pass and low pass filters, selectable full scale range
- Compatible with plant information systems

### Optional Versions

- **M** - Metric Mount for Model 649A04
- **RV** - Buffered Analog Signal Output for Model 649A04

---

**Supplied Accessories**

- Model 081A40 Mounting Stud (1)

**Notes**

- All specifications are at room temperature unless otherwise specified
- [1] Conversion Factor 1 in/sec = 25.4 mm/sec
- [2] FS - Full Scale
- [3] Factory set, 1 in/sec peak
- [4] USB Programmable with 600A21 kit
- [5] Conversion Factor 1 g = 9.81 m/s²
- [6] Conversion Factor 1 mil = 0.0254 mm
- [7] Current will fluctuate at frequencies below 5 Hz
- [8] 1 Hz = 60 cpm (cycles per minute)
- [9] Factory Set
- [10] Typical

---

**Programmable 4-20 mA Vibration Transmitter**

Model 649A04

- Output signal proportional to displacement, velocity or acceleration
- Selectable high pass and low pass filters, selectable full scale range
- Compatible with plant information systems

Product shown at actual size

---

**New!**

USB Programmable

Programmable 4-20 mA Vibration Transmitters

---

**Programmable 4-20 mA Vibration Transmitter**

Model 649A04

- Output signal proportional to displacement, velocity or acceleration
- Selectable high pass and low pass filters, selectable full scale range
- Compatible with plant information systems

Product shown at actual size

---

**Accessories & Cables: Pages 162-176**
Bearing Fault Detector

- Bearing condition transmitter
- Provides early warning of bearing and gear faults
- Detects impacting associated with spalling cracking and lubrication problems

Model 682A05 Bearing Fault Detector (BFD) is an advanced vibration signal conditioner designed to provide the earliest warning of imminent machinery failure. The unit works with a 100 mV/g ICP® accelerometer and serves to deliver two, 4-20 mA output signals that are proportional to the measured vibration levels of operating rotating machinery. In order to enable detection of a wide variety of machinery faults, the 4-20 mA signals are conditioned to characterize two unique vibration measurements; one containing high frequency peak data and the other containing low frequency rms data. These 4-20 mA signals may be monitored, alongside other plant process variables, using familiar PLC, DCS, SCADA, alarm and control systems. An additional analog voltage output signal is provided for spectral analysis of the monitored vibration for fault diagnostic purposes.

The unit employs a patented signal conditioning technique (US Patent #6,889,553) that provides the unique ability to detect bearing and gear problems at their earliest stages, thus permitting ample maintenance planning to avert a catastrophic failure. The simplified 4-20 mA signal monitoring approach represents a cost-effective alternative to complex vibration monitoring instrumentation and associated training.

Bearing Fault Detector
Model 682B05
- Provides early warning of bearing and gear faults
- Operates with PLC, DCS, SCADA, alarm, and control systems
- Outputs 2 discreet 4-20 mA signals; one proportional to peak acceleration, the other proportional to overall vibration

Product shown at actual size
Early Impact Detection

IMI Sensors Model 682B05 Bearing Fault Detector (US Patent 6,889,553) senses impacts within rolling element bearings caused by bearing faults. Typical bearing faults, such as cracked races, spalling, brinelling, fatigue failure, looseness and loss of lubrication result in impacts and high frequency vibrations inside the bearing. The impacts are represented as high amplitude, narrow peaks on the acceleration time waveform and add very little energy to the overall vibration level. As a result, they are often missed in normal trending analysis. The Bearing Fault Detector accurately measures these impacts and other high frequency vibrations, providing early warning of potential problems. This unit is also effective for monitoring other problems that produce similar impacts and vibrations data, such as a chipped tooth on a gear.

The Bearing Fault Detector is a DIN rail mount vibration transmitter that works in conjunction with a typical ICP® accelerometer. It supplies the constant current power required by the accelerometer, processes data and has the following three outputs: 4-20 mA proportional to peak amplitude, 4-20 mA proportional to overall vibration level and raw vibration signal via BNC connector for diagnostic analysis. To obtain peak amplitude (measured in a 7 second window) the signal is passed through a high pass filter, rectified and run through a high speed peak detection circuit. To obtain overall vibration level, the signal is passed through a low pass filter, integrated when velocity is required, processed through a true rms circuit and scaled, depending on the desired output type (rms or calculated peak). Bearing Fault Detector output is compatible with any vibration monitoring device or plant equipment that accepts a 4-20 mA signal. It can provide 24/7 protection when used with a PLC, DCS, or SCADA system. It can also be used with numerous off-the-shelf meters, alarms and recorders.
Reciprocating Machinery Protector

- Loop Powered 4-20 mA output reciprocating machinery protector (RMP)
- Outperforms impact transmitters
- Provides early warning of faults and mechanical looseness

Reciprocating Machinery Protector
Model 649A01
- Output Range: 4-20 mA
- Machinery RPM Range: 150 to 4,800 cpm (2.5 to 80 Hz)
- Sampling Time: 0.2 to 6.4 sec

Reciprocating Machinery Protector
Model EX649A71
- CSA/ATEX Approved
- Supplied with explosion proof conduit elbow
- Electrical Connector: Terminal block

Product shown at actual size

Reciprocating Machinery Protector
Model EX649A71

- Pins are Bi-polar
- 2-pin Threaded MIL-C-5015 Connector
- Connector: 1/4-28 UNF-2B
- 1 in NPT Capped Elbow
- POS 4-20 mA

Product shown at actual size

USB PROGRAMMABLE
Reciprocating Machinery Protector
Model 649A01

- Output Range: 4-20 mA
- Machinery RPM Range: 150 to 4,800 cpm (2.5 to 80 Hz)
- Sampling Time: 0.2 to 6.4 sec

Product shown at actual size

Reciprocating Machinery Protector
Model EX649A71

- CSA/ATEX Approved
- Supplied with explosion proof conduit elbow
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Product shown at actual size

Reciprocating Machinery Protector
Model EX649A71

- Pins are Bi-polar
- 2-pin Threaded MIL-C-5015 Connector
- Connector: 1/4-28 UNF-2B
- 1 in NPT Capped Elbow
- POS 4-20 mA

Product shown at actual size

Reciprocating Machinery Protector
Model EX649A71

- CSA/ATEX Approved
- Supplied with explosion proof conduit elbow
- Electrical Connector: Terminal block

Product shown at actual size
## Technical Specifications

<table>
<thead>
<tr>
<th>Performance</th>
<th>649A01</th>
<th>EX649A71</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>4-20 mA</td>
<td></td>
</tr>
<tr>
<td>Machinery RPM Range</td>
<td>150 to 4,000 cpm</td>
<td>2.5 to 80 Hz(10)</td>
</tr>
<tr>
<td>Sampling Time</td>
<td>0.2 to 6.4 sec</td>
<td></td>
</tr>
<tr>
<td>Weighting Factor</td>
<td>0.1 to 20 mA</td>
<td></td>
</tr>
<tr>
<td>Peak Coupling Current Range</td>
<td>4 to 20 mA</td>
<td></td>
</tr>
<tr>
<td>Shock Threshold Limit</td>
<td>2 to 50 g</td>
<td></td>
</tr>
</tbody>
</table>

### Environmental

| Temperature Range    | -40 to 212 °F | -40 to 100 °C |
| Storage Temperature Range | -40 to 257 °F | -40 to 125 °C |

### Electrical

| Excitation Voltage   | 15 to 30 VDC |          |
| Load Resistance      | 50(V-15) ohm |          |
| Electrical Isolation | >10^8 ohm   |          |

### Physical

| Size (Hex)           | 1.25 in | 1.375 in |
| Size (Height)        | 32 mm   | 35 mm    |
| Size (Width)         | 2.60 in | 5.8 in   |
| Weight               | 7 oz    | 1.1 lb   |
| Mounting Thread      | 1/4-28 UNF | 1/4 NPT |
| Mounting Torque      | 4 to 7 N-m | N/A     |

Sensing Element: Piezoelectric Accelerometer

### Housing Material: Stainless Steel

Sealing: Welded Hermetic

Electrical Connector: MIL-C-5015 (Top)

Electrical Connections (Pin A): 4-20 mA Pos (+)

Electrical Connections (Pin B): 4-20 mA Neg (-)

Overload Limit (Shock): 5,000 g pk

Screw Terminal Wire Size: 12-24 AWG

Conduit Housing Thread: 1" NPT Female

### Supplied Accessories

Model 649A01 Mounting stud 1/4-28 socket head set screw brass tip stainless steel 5/8" long (1)

### Notes

All specifications are at room temperature unless otherwise specified.

1. For CE reference P290® Declaration of Conformance PS039 or PS053 for details.
2. AEx ia IIC T4
3. AEx ia IIC T4
4. Class I, Div 1, Groups A, B, C, and D; Class II, Div 1, Groups E, F, and G; Class III, Div 1
5. Ex ia IIC T4, II G
6. Ex ia IIC T4, II G
7. Ex ia IIC T4, II G
8. Ex ia IIC T4, II G
9. Ex ia IIC T4, II G
10. 1Hz ~ 60 cpm (cycles per minute)

### Optional Versions

- EX - Hazardous Area Approval
- Contact factory for specific approvals
- For Models: 649A01, EX649A71
- M - Metric Mount
- For Models: 649A01, EX649A71

---

**Impact Detection: Preventing Failure**

Although overall vibration trending is an excellent tool for monitoring the health of rotating machinery, it is not generally effective for monitoring reciprocating machinery. Since impacts generally have little effect on overall vibration level, common faults are not detected at an early stage. As a result, abnormalities are not diagnosed until damage has occurred and it is too late to take simple corrective measures. There are several reciprocating machinery faults which do not significantly increase a machine’s overall vibration level until damage has reached a severe level, including: loose or broken bolts, excessive clearance in connecting pins, loose or cracked rod nuts, liquid or debris in the cylinder, cracked connecting or piston rod, scoring in the cylinder, excessive crosshead/slipper clearance and other broken parts.

The patented IMI Sensors Reciprocating Machinery Protector (RMP) Model 649A01 (US Patent #7,171,313) is very sensitive to these faults in their early stages of development. For this reason, the RMP is particularly effective in monitoring reciprocating compressors. Model 649A01 is a loop powered device which detects mechanical shock events occurring in or near the machine’s cylinder assembly. The Reciprocating Machinery Protector continuously outputs the peak acceleration value, as long as there is no fault condition detected. When a threshold is exceeded, the RMP recognizes a potential fault condition and accurately outputs a computed Reciprocating Fault Index (RFI) proportional to the severity of the fault. With configurable speed parameters, adjustable sampling time and ability to customize alarm levels, the RMP is a powerful tool for reciprocating machinery protection.

---

**Reciprocating Machinery Protector**

---

<table>
<thead>
<tr>
<th>Model Number</th>
<th>649A01</th>
<th>EX649A71</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output</td>
<td>4-20 mA</td>
<td></td>
</tr>
<tr>
<td>Machinery RPM Range</td>
<td>150 to 4,000 cpm</td>
<td>2.5 to 80 Hz(10)</td>
</tr>
<tr>
<td>Sampling Time</td>
<td>0.2 to 6.4 sec</td>
<td></td>
</tr>
<tr>
<td>Weighting Factor</td>
<td>0.1 to 20 mA</td>
<td></td>
</tr>
<tr>
<td>Peak Coupling Current Range</td>
<td>4 to 20 mA</td>
<td></td>
</tr>
<tr>
<td>Shock Threshold Limit</td>
<td>2 to 50 g</td>
<td></td>
</tr>
</tbody>
</table>

### Environmental

| Temperature Range    | -40 to 212 °F | -40 to 100 °C |
| Storage Temperature Range | -40 to 257 °F | -40 to 125 °C |

### Electrical

| Excitation Voltage   | 15 to 30 VDC |          |
| Load Resistance      | 50(V-15) ohm |          |
| Electrical Isolation | >10^8 ohm   |          |

### Physical

| Size (Hex)           | 1.25 in | 1.375 in |
| Size (Height)        | 32 mm   | 35 mm    |
| Size (Width)         | 2.60 in | 5.8 in   |
| Weight               | 7 oz    | 1.1 lb   |
| Mounting Thread      | 1/4-28 UNF | 1/4 NPT |
| Mounting Torque      | 4 to 7 N-m | N/A     |

Sensing Element: Piezoelectric Accelerometer

### Housing Material: Stainless Steel

Sealing: Welded Hermetic

Electrical Connector: MIL-C-5015 (Top)

Electrical Connections (Pin A): 4-20 mA Pos (+)

Electrical Connections (Pin B): 4-20 mA Neg (-)

Overload Limit (Shock): 5,000 g pk

Screw Terminal Wire Size: 12-24 AWG

Conduit Housing Thread: 1" NPT Female

### Supplied Accessories

Model 649A01 Mounting stud 1/4-28 socket head set screw brass tip stainless steel 5/8" long (1)

### Notes

1. For CE reference P290® Declaration of Conformance PS039 or PS053 for details.
2. AEx ia IIC T4
3. AEx ia IIC T4
4. Class I, Div 1, Groups A, B, C, and D; Class II, Div 1, Groups E, F, and G; Class III, Div 1
5. Ex ia IIC T4, II G
6. Ex ia IIC T4, II G
7. Ex ia IIC T4, II G
8. Ex ia IIC T4, II G
9. Ex ia IIC T4, II G
10. 1Hz ~ 60 cpm (cycles per minute)
Vibration Switches

- Provides continuous machinery protection
- Electronic & mechanical switches available
- Single or dual relay versions
- Responds to acceleration, velocity, or displacement
- Adjustable time delays to prevent false trips
- Works with PLC, DCS and SCADA systems for data trending

A vibration switch is a simple protection device that senses vibration and triggers an alarm or shuts down a machine if the vibration exceeds a preset threshold level. The vibration switch can sense vibration due to faults such as imbalance, misalignment, looseness, worn bearings, cracked gears or lack of lubrication. IMI Sensors offers a complete selection of electronic and mechanical vibration switches to suit many applications and installations. Mechanical switches provide basic protection at a low cost for less critical machinery. These switches are easy to install, do not require power to operate and are the most basic type of vibration switch protection available.

For more critical machinery, electronic vibration switches use a built-in precision accelerometer to accurately monitor vibration levels. An electronic switch consists of an accelerometer, circuit board and one or more electromechanical or solid state relays for alarm and shutdown protection. The internal circuitry monitors the sensor’s vibration level and compares it to a preset threshold or alarm value. When the vibration level exceeds this threshold, the relay is then activated. A typical electronic vibration switch has several advantages over a mechanical unit. It has no moving parts, is more reliable and has a much higher degree of accuracy and repeatability. Time delays can be used to avoid false trips during switch power up, equipment startup, operational changes and the chance occurrences of short term vibration increases.

visit us online at www.imi-sensors.com

Toll-Free in USA 800-959-4464 716-684-0003
Exclusive MAVT™ on the Model 686B Smart Vibration Switch

The Alarm Threshold Level (set point) can be set either numerically through USB programming, or if enabled, using Magnetically Adjustable Vibration Threshold (MAVT™). This feature can be enabled by the user via USB programming or, if requested, enabled by the factory.

The Exclusive MAVT™ feature can be used to automatically set the alarm threshold level in the field without knowing anything about the equipment’s actual vibration level. Mount the Smart Vibration Switch on an operating machine and touch the magnet (contained in the USB Switch Programmer Kit) to the sensor to start the process. Caution should be taken to disconnect the Smart Vibration Switch from the machine’s trip circuit when using this feature. This convenient feature permits any machine to become vibration switch protected within seconds. MAVT™ can also be used with the switch mounted on a calibrated vibration shaker for precise setting of the alarm threshold value. The MAVT™ circuit should always be disabled in the USB programming screen once the switch is reconnected to the motor control circuit.
Smart Vibration Switches

- Low cost fully USB Programmable vibration switch that replaces unreliable mechanical vibration switches
- 2-wire operation uses existing mechanical switch wires
- Features the accuracy and small footprint of a piezoelectric accelerometer

The all new electronic Smart Vibration Switch from IMI Sensors is highly versatile, fully user programmable via USB, low cost and a drop-in replacement for most popular mechanical vibration switches. The Smart Vibration Switch includes an embedded piezoelectric accelerometer for accurate measurement, monitors vibration velocity for more consistent results and provides the reliability not found in mechanical switches. It is a lower cost alternative when single relay action is required vs. higher cost dual relay models.

In addition to being a more reliable device than mechanical vibration switches, the unique Series 686B Smart Vibration Switch is a much lower cost solution for many conventional electronic vibration switch applications as well. The Smart Vibration Switch is a great choice in applications where a single relay provides sufficient protection and/or an overall vibration output (typically 4-20 mA) is not required. Multiple Smart Vibration Switches can be used in series or parallel to monitor several points or machines as necessary. They can also be used in conjunction with external SPST and DPDT relays to increase current capacity or when such relays are required.

**USB Programmable Electronic Vibration Switch**

**Model 686B01**
- 2-pin MIL-C-5015 connector
- Programmable alarm threshold, relay action (NO, NC) and 3 time delays
- Monitors in velocity

**Product shown at actual size**

**USB Programmable Electronic Vibration Switch**

**Model 686B11**
- Integral cable version for harsh environments
- Ideal for submersible applications
- Remote reset standard

**Product shown at actual size**
### Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>686B01</th>
<th>686B11</th>
<th>EX686B71</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm Threshold (±10%)</td>
<td>0.25 to 5 in/sec pk</td>
<td>4.5 to 90 mm/s rms [2]</td>
<td></td>
</tr>
<tr>
<td>Frequency Range (±3 dB)</td>
<td>180 to 60 kHz</td>
<td>7 to 1 kHz</td>
<td></td>
</tr>
<tr>
<td>Hysteresis (% &lt; Alarm Threshold)</td>
<td>3; 6; or 10 % [2]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual Vibration Level (Reference)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual Vibration Level (% Alarm Threshold)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAVT (Sets Alarm Threshold to 2X actual vibration)</td>
<td>Enabled or Disabled [2]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transverse Sensitivity</td>
<td>&lt;7 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power On Delay (±1 sec)</td>
<td>3 or 20 sec [2]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Startup Delay (±1 sec or 1 min) (Time)</td>
<td>1 to 60 sec or 1 to 30 min [2]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Startup Delay (Active)</td>
<td>x2; x4; x8; Blocked [2]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operational Delay (±1 sec)</td>
<td>1 to 60 sec [2]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay</td>
<td>SPDT, Form A or B, MOSFET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay Latching / Non-Latching</td>
<td>Enabled or Disabled [2]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay Normally Open / Closed</td>
<td>Enabled or Disabled [2]</td>
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<td></td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Range (Operating)</td>
<td>-40 to 185 °F</td>
<td>-40 to 185 °C</td>
<td></td>
</tr>
<tr>
<td>Temperature Range (Storage)</td>
<td>-40 to 257 °F</td>
<td>-40 to 125 °C</td>
<td></td>
</tr>
<tr>
<td>Overload Limit (Shock)</td>
<td>5,000 g pk</td>
<td>40,000 m/s² pk</td>
<td></td>
</tr>
<tr>
<td>Enclosure Rating</td>
<td>IP68</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Required</td>
<td>24 to 240 V DC/AC; 50/60 Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Rating (Relay Closed)</td>
<td>500 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leak Current (Relay Open)</td>
<td>≤ 1 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Isolation (Case)</td>
<td>&gt;10¹⁸ ohm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### USB Programmable

**Electronic Vibration Switch**

**Model EX686B71**
- 2-pin removable terminal block
- CSA and ATEX D hazardous area approvals
- 1/4” NPT integral mounting stud

#### Optional Versions
- EX - Hazardous Area Approval - Contact factory for specific approvals
- For Models: 686B01, 686B11, EX686B71
- M - Metric Mount
- For Models: 686B01, 686B11
- EP - Explosion Proof
- For Models: EX686B71

#### Notes
- All specifications are at room temperature unless otherwise specified

#### Supplied Accessories
- [3] For Models: EX686B71; Mating stud 1/4-28 socket head set screw brass tip stainless steel 5/8” long (1)

#### Accessories & Cables: Pages 162-176
Electronic Vibration Switches

- Offers two set points with individual alert and alarm relays
- 4-20 mA output signal for vibration monitoring
- Explosion proof models available

Electronic Vibration Switch
Series 685B

- Internal piezoelectric accelerometer
- Various measurement ranges available
- 85-245 VAC power or 24 VDC power

Product shown at actual size
Technical Specifications

**Model Number** 685B

**Performance**
- Measurement Range: See "Ordering Guide" (right)
- Frequency Range (x 3 dB): 120 to 60,000 cpm (6)
- Power On Delay: 20 sec (3)
- Relay (Alert): See "Ordering Guide" (right)
- Relay (Alarm): See "Ordering Guide" (right)
- Relay: Latching / Non-Latching
- Alarm Setpoint: 0 to 100% of Vibration Range
- Alert Setpoint: 0 to 100% of Alarm Setpoint
- Delay (Alert): See "Ordering Guide" (right)
- Delay (Alarm): See "Ordering Guide" (right)
- Acceleration Output (±10%)
  - 100 mV/g
  - 0.21 in
- Temperature Range (Operation): -40 to 125 °C
- Temperature Range (Storage): -40 to 265 °F
- Enclosure Rating: IP66

**Control Interface**
- Power LED: Green
- Alarm LED: Red
- Alert LED: Yellow
- Time Delay Adjustment: Single Turn Potentiometer
- Reset Function: Momentary Pushbutton Switch
- Self Test Function: Momentary Pushbutton Switch

**Environmental**
- Temperature Range (Operation): -22 to 131 °F
- Temperature Range (Storage): -40 to 265 °F
- Enclosure Rating: Nema 4X

**Fuel Power Required**
- 24 VDC ±/− 10%

**Enclosure Type**
- A1: Standard enclosure, NEMA 4X, CSA class 1 div 2 approved, internal reset and analog signal
- A2: Same as A1 plus external pushbutton reset
- A3: Same as A1 plus external BNC jack for analog vibration signal output
- A4: Same as A1 plus external pushbutton reset and external BNC jack for analog vibration signal output
- A5: Same as A3 plus LCD readout panel with velocity in inches per second
- C1: CSA approved explosion proof for class 1 div 1 installations

**Enclosure Connections**
- 0 Two ports with cord grips
- 1 Two ports with 1/2" NPT conduit hubs
- 2 One port with cord grip
- 3 One port with 1/2" NPT conduit hub
- 4 Two 1/2" NPT ports **must select C1 enclosure type
- 5 Two ports, cord grip left, conduit right
- 6 Two ports, cord grip right, conduit left

**Ordering Guide**

**Base Model**
- 685B Electronic Vibration Switch with two set point relays, time delays, internal push button reset, remote reset via contact closure, 4-20 mA test/calibration insertion signal capability and both 4-20 mA and analog 100 mV/g output signals available on screw terminals

**Package Size and Sensitivity**
- 0 Built in accelerometer
- 1 Remote 100 mV/g accelerometer (not supplied)
- 2 Remote 100 mV/g accelerometer, low frequency −1 Hz (not supplied)
- 3 Built in accelerometer, low frequency −1 Hz
- 4 Remote 100 mV/g accelerometer w/ sensor fault detection (not supplied)
- 5 Remote 100 mV/g accelerometer w/ sensor fault detection, low frequency −1 Hz (not supplied)

**Measurement Range**
- 0 0 to 1.5 in/sec peak velocity (0 to 38.1 mm/sec)
- 1 0 to 5 g peak acceleration (0 to 49.03 mm/sec² peak)
- 2 0 to 15 mils peak to peak displacement (.33 mm peak to peak)
- 3 0 to 50 mils peak to peak displacement (1.27 mm peak to peak)
- 4 0 to 0.3 in/sec peak velocity (0 to 76.2 mm/sec)

**Example**
- 685B 0 0 0 1 A1 1 Electronic vibration switch with built in sensor, CSA class 1 div 2 approved, 0 to 1.5 in/sec peak velocity range 85 to 245 VAC powered two Form C SPDT relays with 0-45 sec adjustable time delays, standard NEMA 4X enclosure with two 1/2" NPT conduit hubs

Selections in blue are not available with CSA class 1 div 2 hazardous area approval

CSA class 1 div 2 approval supplied standard for switches where all options are black
Mechanical Vibration Switches

- Offers cost-effective protection for less critical situations
- Utilizes spring-loaded, magnetically coupled sensor
- Provides single set point electromechanical relay
- Requires no power
- Weatherproof and explosion proof versions

Mechanical switches do not require power and utilize the resistive force and travel of a spring as a measure of vibration amplitude. When the travel of a spring exceeds the predetermined threshold, the switch is actuated and latched by magnetic attraction. The threshold value is adjustable by changing the proximity of the magnet to the spring and hence the spring travel required for actuation. Switch reset is accomplished manually by disengaging the magnet from the spring.

For machines requiring simplified contact closure protection, Models 685A07 and 685A08 offer a cost-effective approach to vibration protection. They offer the smallest mechanical switch footprint available in either NEMA 4 or explosion proof housings. The 3-axis protection allows confident, reliable monitoring of small plant equipment in less critical situations, where the precision of an electronic switch isn’t necessarily required. Both the weatherproof and explosion proof versions contain manual internal adjustability with an external reset switch for ease of operation.
### Mechanical Vibration Switch

**Model 685A08**
- Weatherproof & CSA / UL approved, explosion proof
- Cost-effective protection for less critical applications
- Requires no power

#### Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>685A07</th>
<th>685A08</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measurement Range</td>
<td>0 to 7 g pk</td>
<td>0 to 68.7 m/s² pk</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>0 to 100 Hz</td>
<td></td>
</tr>
<tr>
<td>Relay</td>
<td>5A Form C 480 VAC</td>
<td>5A Form C 480 VAC/3A Resistive, 1A Inductive Ø 30 VDC</td>
</tr>
<tr>
<td>Relay</td>
<td>Latching</td>
<td>Latching</td>
</tr>
<tr>
<td>Reset Function</td>
<td>Momentary Pushbutton Switch</td>
<td>Normally Open / Closed</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Range (Operating)</td>
<td>-40 to 140 °F</td>
<td>-40 to 60 °C</td>
</tr>
<tr>
<td>Enclosure Rating</td>
<td>IP50</td>
<td></td>
</tr>
<tr>
<td>Hazardous Area Approval</td>
<td>N/A</td>
<td>CSA Class I Div 1, Groups C &amp; D, UL 516 U Explosion Proof, Flame Proof</td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size - Width</td>
<td>4.35 in</td>
<td>6.38 in</td>
</tr>
<tr>
<td>Size - Height</td>
<td>110.5 mm</td>
<td>162 mm</td>
</tr>
<tr>
<td>Size - Depth</td>
<td>4.35 in</td>
<td>5.83 in</td>
</tr>
<tr>
<td>Size - DIameter</td>
<td>110.5 mm</td>
<td>143 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>2.1 lb</td>
<td>4.5 lb</td>
</tr>
<tr>
<td>Sensing Element</td>
<td>Magnet</td>
<td>Aluminum Alloy</td>
</tr>
<tr>
<td>Housing Material</td>
<td>Screw Terminal Wire Size</td>
<td>24-14 AWG</td>
</tr>
<tr>
<td>Electrical Connector</td>
<td>2/2.5 mm²</td>
<td></td>
</tr>
<tr>
<td>Cable Input</td>
<td>3/4-14 NPT</td>
<td>1/2-14 NPT</td>
</tr>
<tr>
<td>Mounting Hole Size</td>
<td>0.25 in</td>
<td>0.38 in</td>
</tr>
<tr>
<td>Sensing Geometry</td>
<td>Inertial Element</td>
<td></td>
</tr>
<tr>
<td>Notes</td>
<td>All specifications are at room temperature unless otherwise specified</td>
<td></td>
</tr>
</tbody>
</table>
USB Programming Kits

- Customize settings on your USB programmable sensor
- Kits include CD-ROM software & cable adapters
- Free software updates available at www.imi-sensors.com

USB Programming Kits for IMI’s exclusive line of USB programmable sensors include all the hardware and software needed. Use the programming cable to connect the sensors to any PC with the software installed and follow the simple programming steps to complete the process. Each software package allows the user to enter the variables available to customize the sensor to the specific application resulting in the most accurate output results.

686B01 Smart Switch Programming Kit

- Program the alarm threshold, normally open, normally closed, latching or non-latching relay action
- Time delays for power up, start up and operation create high reliability
- Kit includes 2-pin MIL to USB cable, terminal block adapter and CD-ROM software
- Programming screen creates a unique configuration part number for use when programming multiple sensors
- Kit 600A15 includes an additional adapter for use with integral cable and terminal block sensor connections
- Kit 600A16 is used on 2-pin MIL connections
USB Programming Kits

649A01 Reciprocating Machinery Protector Programming Kit
- Use programming Kit 600A21 for 2-pin MIL sensor connection. Use programming kit 600A24 for integral cable and terminal block sensor connection
- Simply enter the compressor RPM and let the software recommend all settings or independently setting each parameter
- Program 2 alarm levels with the related weighting values
- Kit can be used to program multiple RMP units

649A03 Bearing Condition Monitor Programming Kit
- Use programming Kit 600A21 for 2-pin MIL sensor connection. Use programming kit 600A24 for integral cable and terminal block sensor connection
- Choose from Acceleration Peak, Acceleration RMS, Acceleration with compensation, Crest Factor or Crest Factor Plus based on your unique application
- Choose whatever full scale range suits the specific application providing the most resolution
- Kit can be used to program multiple Bearing Condition Monitors

649A04 Programmable 4-20 mA Transmitter Programming Kit
- Use programming Kit 600A21 for 2-pin MIL sensor connection. Use programming kit 600A24 for integral cable and terminal block sensor connection
- Choose Displacement, Velocity or Acceleration measurement method
- Set full scale range
- Choose high pass and low pass filter options
- Kit can be used to program multiple Programmable 4-20 mA output transmitters
Pressure Sensors

- Detect and monitor pulsations, instability, surges, turbulence and acoustics
- Hazardous location troubleshooting, predictive maintenance and process improvement
- For gas compressors, chemical plants, power generation and other hazardous processes

Piezoelectric pressure sensors offer the unique ability to respond to very rapid pressure spikes, pulsations and surges. They can also sense minute pressure fluctuations, while subjected to very high static pressures. Series 121A44 case isolated and 102M205 ground isolated Hazardous Area Approved, dynamic ICP® pressure sensors satisfy such measurement requirements in monitoring, diagnostic, troubleshooting and control applications typical of hazardous factory environments.

Applications include monitoring dynamic pressure events such as surges, pulsations, spikes, leak detection, combustion instability, and acoustics found in operation of compressors, pumps, pipelines and gas turbines. Sensors may be used with ICP® signal conditioning and permit use of a variety of inexpensive 2-wire cable systems. The low-impedance signal may be transmitted over long cable distances and sensors may be used in dirty environments without signal degradation. PCB® Model 121A44 case isolation eliminates all electrical noise from both environment and structure. Model 102M205 ground isolation eliminates electrical noise from the structure under test.
### Technical Specifications

#### Model Number

<table>
<thead>
<tr>
<th>Performance</th>
<th>102M205</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Range (for ±5V output)</td>
<td>100 psi (689.5 kPa)</td>
</tr>
<tr>
<td>Useful Overrange (for ±10V output)</td>
<td>200 psi (1,379 kPa) [1]</td>
</tr>
<tr>
<td>Sensitivity (± 10 mV/psi)</td>
<td>50 mV/psi</td>
</tr>
<tr>
<td>Maximum Pressure</td>
<td>500 psi (3,448 kPa)</td>
</tr>
<tr>
<td>Resolution</td>
<td>2 mpsi</td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>≥ 250 kHz</td>
</tr>
<tr>
<td>Rise Time</td>
<td>≤ 2 µ sec</td>
</tr>
<tr>
<td>Low Frequency Response (-5 %)</td>
<td>0.50 Hz</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>≤ 1 % FS [2]</td>
</tr>
</tbody>
</table>

#### Environmental

- **Acceleration Sensitivity**
  - ± 0.004 psi/g
  - ± 0.0014 kPa/(m/s²) [1]

- **Temperature Range (Operating)**
  - -100 to +275 °F (-73 to +135 °C) [3]

- **Temperature Coefficient of Sensitivity**
  - ± 0.1 %/°F
  - ± 0.18 %/°C [2]

- **Maximum Flash Temperature**
  - 500 °F (260 °C) [4]

- **Maximum Vibration**
  - 200 g pk (19,614 m/s² pk)

- **Maximum Shock**
  - 20,000 g pk (196,140 m/s² pk)

#### Electrical

- **Output Polarity (Positive Pressure)**
  - Positive

- **Discharge Time Constant (at room temp)**
  - ≥ 1 sec

- **Excitation Voltage**
  - 20 to 30 VDC

- **Constant Current Excitation**
  - 2 to 20 mA

- **Output Bias Voltage**
  - 8 to 14 VDC

- **Electrical Isolation**
  - ≥ 108 ohm

#### Physical

- **Sensing Element**
  - Quartz

- **Housing Material**
  - 17-4 Stainless Steel

- **Diaphragm**
  - 316L Stainless Steel [3]

- **Sealing**
  - Welded Hermetic

- **Electrical Connector**
  - 10-32 Coaxial Jack (1)

- **Weight**
  - 0.4 oz (11 gm)

#### Supplied Accessories

- **Model 065A44 Seal ring 0.435” OD x 0.387” ID x 0.030” thk Cu (3)

#### Notes

- All specifications are at room temperature unless otherwise specified.

#### Optional Versions

- **M - Metric Mount**
  - Supplied Accessory: Model 065A40 Seal ring 0.435” OD x 0.397” ID x 0.030” thk brass (3)
  - For Model 121M205

- **W - Water Resistant Cable**
  - For Model 121M205

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### Technical Specifications

#### Model Number

<table>
<thead>
<tr>
<th>Performance</th>
<th>121A44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Range (for ±5V output)</td>
<td>50 psi (344.8 kPa)</td>
</tr>
<tr>
<td>Sensitivity (± 10 mV/psi)</td>
<td>100 mV/psi</td>
</tr>
<tr>
<td>Maximum Pressure</td>
<td>8 kpsi (55.16 MPa) [8]</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.5 mpsi</td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>≥ 60 kHz</td>
</tr>
<tr>
<td>Rise Time (Reflected)</td>
<td>≤ 4 µ sec</td>
</tr>
<tr>
<td>Low Frequency Response (-5 %)</td>
<td>0.5 Hz</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>≤ 2.0 % FS [9]</td>
</tr>
</tbody>
</table>

#### Environmental

- **Acceleration Sensitivity**
  - ± 0.005 psi/g
  - ± 0.035 kPa/(m/s²) [1]

- **Temperature Range (Operating)**
  - -65 to +250 °F (-54 to +121 °C) [2]

- **Hazardous Area Approval**
  - CSA (C-US) NRTL - Canadian Standards Association
  - ATEX [5] [6] [7]

#### Electrical

- **Output Polarity (Positive Pressure)**
  - Positive

- **Discharge Time Constant (at room temp)**
  - ≥ 1 sec

- **Excitation Voltage**
  - 22 to 28 VDC

- **Constant Current Excitation**
  - 2 to 20 mA

- **Output Bias Voltage**
  - 10 to 15 VDC

- **Electrical Isolation**
  - ≥ 10⁸ ohm

#### Physical

- **Sensing Geometry**
  - Compression

- **Sensing Element**
  - Quartz

- **Housing Material**
  - 316L Stainless Steel

- **Diaphragm**
  - 316L Stainless Steel

- **Sealing**
  - Welded Hermetic

- **Electrical Connector**
  - 2-pin MIL-C-5015 [3]

- **Weight**
  - 2.7 oz (75.6 gm)

#### Notes

- All specifications are at room temperature unless otherwise specified.

#### Optional Versions

- **AE** a IC T4, D191 CL1 GR A-D
- **Ex ia IIC T4, D191 CL1 GR A-D**
- **Ex ia IIC T4, D192 CL1 GR A-D**
- **Ex ib IA Gb IIC T4, D192 CL1 GR A-D**
- **Ex ia IIC T4, D192 CL1 GR A-D**
- **Ex ia IIC T4, D192 CL1 GR A-D**
- **Ex ia IIC T4, D192 CL1 GR A-D**
- **Ex ia IIC T4, D192 CL1 GR A-D**
- **Ex ia IIC T4, D192 CL1 GR A-D**
- **Ex ia IIC T4, D192 CL1 GR A-D**
- **Ex ia IIC T4, D192 CL1 GR A-D**

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716-684-0003

IMI SENSORS

A PCB PIEZOTRONICS DIV.
Pressure Sensors

- On-Turbine Instability Sensor (OTIS)
- Detects and measures dynamic pressure phenomena
- Various configurations available

When directly mounted to a gas turbine's combustor, IMI's Series 176 high temperature dynamic pressure sensors provide 24/7, consistent, reliable combustion dynamics data monitoring to help control instability which can damage components in the combustion chamber as well as downstream equipment.

By mounting the Series 176 high temperature dynamic pressure sensors to the combustor, gas turbine operators can rely on critical diagnostics, part fatigue analysis and the ability to continuously monitor and control emissions.

[Diagram shows technical details of the sensors, including dimensions and specifications.]

High Temperature Dynamic Pressure Sensor
Series 176M0X
- Sensitivities to 17 pC/psi
- Dynamic measurement range 20 psi
- Removable clamp nut

Product shown at actual size

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Model 176M03 & Model 176M09 Technical Drawing

Model 176M07 Technical Drawing

Model 176M12 Technical Drawing

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Toll-Free in USA 800-959-4464 716-684-0003
### Technical Specifications

<table>
<thead>
<tr>
<th>Performance</th>
<th>176M03</th>
<th>176M09</th>
<th>176M07</th>
<th>176M12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensitivity (± 20 %)</strong></td>
<td>17 pC/psi</td>
<td>2.47 pC/kPa</td>
<td>2.47 pC/kPa</td>
<td>2.47 pC/kPa</td>
</tr>
<tr>
<td><strong>Measurement Range</strong></td>
<td>20 psi</td>
<td>137.9 kPa</td>
<td>20 psi</td>
<td>137.9 kPa</td>
</tr>
<tr>
<td><strong>Maximum Pressure (static)</strong></td>
<td>400 psi</td>
<td>2,758 kPa</td>
<td>400 psi</td>
<td>2,758 kPa</td>
</tr>
<tr>
<td><strong>Resonant Frequency</strong></td>
<td>≥ 25 kHz</td>
<td>≥ 25 kHz</td>
<td>≥ 25 kHz</td>
<td>≥ 25 kHz</td>
</tr>
<tr>
<td><strong>Rise Time (Reflected)</strong></td>
<td>≤ 10 µ sec</td>
<td>≤ 10 µ sec</td>
<td>≤ 10 µ sec</td>
<td>≤ 10 µ sec</td>
</tr>
<tr>
<td><strong>Non-linearity</strong></td>
<td>≤ 1.0 % FS [1]</td>
<td>≤ 1.0 % FS [1]</td>
<td>≤ 1.0 % FS [1]</td>
<td>≤ 1.0 % FS [1]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Acceleration Sensitivity</strong></td>
<td>&lt;0.01 psi/g</td>
<td>&lt;0.007 kPa/(m/s²)</td>
<td>&lt;0.01 psi/g</td>
<td>&lt;0.007 kPa/(m/s²)</td>
</tr>
<tr>
<td><strong>Temperature Range (Continuous)</strong></td>
<td>986°F</td>
<td>530°C</td>
<td>1,040°F</td>
<td>560°C</td>
</tr>
<tr>
<td><strong>Temperature Range (Intermittent)</strong></td>
<td>986°F</td>
<td>530°C</td>
<td>1,040°F</td>
<td>560°C</td>
</tr>
<tr>
<td><strong>Temperature Range (Receptacle)</strong></td>
<td>986°F</td>
<td>530°C</td>
<td>1,040°F</td>
<td>560°C</td>
</tr>
<tr>
<td><strong>Temperature Coefficient of Sensitivity</strong></td>
<td>≤ 0.01 %/°F</td>
<td>≤ 0.02 %/°C</td>
<td>≤ 0.01 %/°F</td>
<td>≤ 0.02 %/°C</td>
</tr>
<tr>
<td><strong>Hazardous Area Approval</strong></td>
<td>ATEX [4][5][6][8]</td>
<td>CSA (C-US) NRTL - Canadian Standards Association [1][2][5][7]</td>
<td></td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Electrical</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacitance</strong></td>
<td>&lt;165 pF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Internal Resistance (room temp)</strong></td>
<td>≥ 1.0×10⁶ ohm</td>
<td>≥ 100 kohm</td>
<td>≥ 1.0×10⁶ ohm</td>
<td>≥ 100 kohm</td>
</tr>
<tr>
<td><strong>Internal Resistance (986 °F/527 °C)</strong></td>
<td>≥ 50 kohm</td>
<td>≥ 50 kohm</td>
<td>≥ 50 kohm</td>
<td>≥ 50 kohm</td>
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<tr>
<td><strong>Insulation Resistance (986 °F/527 °C)</strong></td>
<td>≥ 100 kohm</td>
<td>≥ 100 kohm</td>
<td>≥ 100 kohm</td>
<td>≥ 100 kohm</td>
</tr>
<tr>
<td><strong>Electrical Connector</strong></td>
<td>2-pin</td>
<td>2-pin</td>
<td>2-pin</td>
<td>2-pin</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>4.9 oz</td>
<td>8.3 oz</td>
<td>11.1 oz</td>
<td>4.9 oz</td>
</tr>
<tr>
<td><strong>Cable Type</strong></td>
<td>2-conductor</td>
<td>2-conductor</td>
<td>2-conductor</td>
<td>2-conductor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensing Geometry</strong></td>
<td>Compression</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Housing Material</strong></td>
<td>Inconel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sealing</strong></td>
<td>Welded Hermetic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Electrical Connector</strong></td>
<td>2-pin</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Supplied Accessories**

- Model 30488-01 Clamp nut (1)
- Model 30736-01 Seal-G-.75-.50-.030 (3)

**Notes**

- All specifications are at room temperature unless otherwise specified.
- [1] ATEX ia IIC T1, II 3G
- [2] ATEX ia IIC T4, II 3G
- [3] EX ia IIC T1, II 3G
- [4] EX ia IIC T4, II 3G
- [5] EX ia IIC T1, II 3G
- [6] EX ia IIC T4, II 3G
- [7] EX ia IIC T1, II 3G
- [8] EX ia IIC T4, II 3G

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### Technical Specifications

<table>
<thead>
<tr>
<th>Performance</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensitivity (± 20 %)</strong></td>
<td>1,100 pC/psi</td>
<td>161 pC/kPa</td>
<td>161 pC/kPa</td>
<td>161 pC/kPa</td>
</tr>
<tr>
<td><strong>Measurement Range</strong></td>
<td>10 psi</td>
<td>68.9 kPa</td>
<td>10 psi</td>
<td>68.9 kPa</td>
</tr>
<tr>
<td><strong>Maximum Pressure (static)</strong></td>
<td>600 psi</td>
<td>4,136 kPa</td>
<td>600 psi</td>
<td>4,136 kPa</td>
</tr>
<tr>
<td><strong>Resonant Frequency</strong></td>
<td>≥ 25 kHz</td>
<td>≥ 25 kHz</td>
<td>≥ 25 kHz</td>
<td>≥ 25 kHz</td>
</tr>
<tr>
<td><strong>Rise Time (Reflected)</strong></td>
<td>≤ 10 µ sec</td>
<td>≤ 10 µ sec</td>
<td>≤ 10 µ sec</td>
<td>≤ 10 µ sec</td>
</tr>
<tr>
<td><strong>Non-linearity</strong></td>
<td>≤ 1.0 % FS [10]</td>
<td>≤ 1.0 % FS [10]</td>
<td>≤ 1.0 % FS [10]</td>
<td>≤ 1.0 % FS [10]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acceleration Sensitivity</strong></td>
<td>&lt;0.01 psi/g</td>
<td>&lt;0.007 kPa/(m/s²)</td>
<td>&lt;0.01 psi/g</td>
<td>&lt;0.007 kPa/(m/s²)</td>
</tr>
<tr>
<td><strong>Temperature Range (Operating)</strong></td>
<td>0 to 560 °F</td>
<td>-18 to 280 °C</td>
<td>0 to 560 °F</td>
<td>-18 to 280 °C</td>
</tr>
<tr>
<td><strong>Temperature Coefficient of Sensitivity</strong></td>
<td>≤ 0.08 %/°F</td>
<td>≤ 0.144 %/°C</td>
<td>≤ 0.08 %/°F</td>
<td>≤ 0.144 %/°C</td>
</tr>
<tr>
<td><strong>Hazardous Area Approval</strong></td>
<td>ATEX [4][5][6][8]</td>
<td>CSA (C-US) NRTL - Canadian Standards Association [1][2][5][7]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacitance</strong></td>
<td>&lt;165 pF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Internal Resistance (room temp)</strong></td>
<td>≥ 1.0×10¹² ohm</td>
<td>≥ 50 kohm</td>
<td>≥ 1.0×10¹² ohm</td>
<td>≥ 50 kohm</td>
</tr>
<tr>
<td><strong>Internal Resistance (986 °F/527 °C)</strong></td>
<td>≥ 50 kohm</td>
<td>≥ 50 kohm</td>
<td>≥ 50 kohm</td>
<td>≥ 50 kohm</td>
</tr>
<tr>
<td><strong>Insulation Resistance (986 °F/527 °C)</strong></td>
<td>≥ 100 kohm</td>
<td>≥ 100 kohm</td>
<td>≥ 100 kohm</td>
<td>≥ 100 kohm</td>
</tr>
<tr>
<td><strong>Electrical Connector</strong></td>
<td>2-pin</td>
<td>2-pin</td>
<td>2-pin</td>
<td>2-pin</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>6.5 oz</td>
<td>11.1 oz</td>
<td>11.1 oz</td>
<td>11.1 oz</td>
</tr>
<tr>
<td><strong>Cable Type</strong></td>
<td>2-conductor</td>
<td>2-conductor</td>
<td>2-conductor</td>
<td>2-conductor</td>
</tr>
</tbody>
</table>

**Supplied Accessories**

- Model 31061-01 SEAL, 1.370“ OD x 1.130” ID x .030”, BRASS (2)

**Notes**

- All specifications are at room temperature unless otherwise specified.
- [1] Typical

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**Accessories & Cables:** Pages 162-176

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High Sensitivity Pressure Sensor  
Model 171M01  
- Dynamic measurement range: 10 psi  
- Sensitivity: 1,100 pC/psi (160 pC/kPa)  
- 2-pin connector, 1-1/8”-12 UNF-2A port
Echo® Wireless Vibration System

Performance
The Echo® Wireless Vibration System has been tested and found to perform very well, in a number of different types of plants including: power, steel, food processing, paper, chemical and automotive. The system has performed reliably and provided accurate and useful data regarding machinery health.

Fault Detection
The Echo® Wireless Vibration Sensor and the EchoPlus® Wireless Junction Box make the set of overall vibration measurements, listed below, that are sure to provide early warning of most common machine faults. In addition to these measurements, Echo® provides accurate battery status. Using a user programmable vibration threshold, Echo® can detect if the machine is not running and if not, skip a measurement to conserve battery power. It also has an optional Raw Vibration Output (requires optional Model 070A86 cable) for use with a portable data collector.

- RMS Velocity - for “Balance-of-plant” faults such as imbalance, misalignment and flow problems
- RMS Acceleration - for higher frequency faults and high frequency energy (HFE) detection such as high speed gear mesh, broken rotor bars and loss of bearing lubrication
- True Peak Acceleration - for bearing, gear and impulsive faults, including looseness
- Crest Factor - for fault severity indication

Wireless Vibration Sensor Model 670A01
- Batteries last over 5 years
- Transmits long distances
- Eliminates expensive cable runs

Product shown at actual size

The Echo® Wireless Vibration Sensor is a stand alone, battery powered, industrial vibration sensor. At the default setting of three measurements per day (user programmable) battery life is greater than 5 years. A Raw Vibration (RV) output version includes an integral connector that can be used with an optional cable and a standard vibration data collector for fault analysis. The sensor can be programmed via RS-232 to set the transmission (collection) interval and a Residual Vibration Level (RVL) if desired. Echo® has an LED that provides visual feedback on the status of the sensor, including: on, off, measuring, transmitting, or changing states. The sensor has an embedded magnetic switch and can be activated or deactivated by holding a strong magnet next to the sensor. Upon activation, the sensor makes and transmits a set of measurements.
The EchoPlus® Wireless Junction Box is an 8 channel junction box that instantly converts installed industrial sensors to wireless operation. This incredibly economical device periodically powers each sensor, makes the same set of overall measurements as Echo® and transmits them wirelessly. The default transmission interval is 8 hours but is user programmable. Additionally, it operates as a standard junction box allowing full data collection with a portable data collector at the box. It can be powered using either standard 24 VDC or any battery between 6 and 13 VDC. The unit can be used by itself or in conjunction with an existing junction box by simply jumping wires between them.

**Wireless Junction Box**
Model 672A01
- Converts existing sensors to wireless
- Runs independently or with existing junction box
- Uses 24 VDC or battery power

The Echo® Receiver is a stand alone unit that communicates point-to-point with Echo® Wireless Vibration Sensors and EchoPlus® Wireless Junction Boxes. Operating in the 916 MHz range, using an ultra-narrow bandwidth filter with Extended Range RF (ERRF) technology, it has unprecedented -145 dBm sensitivity and can detect and decode RF signals as low as about a millionth of a billionth of a milliwatt. This results in very long distance point-to-point communications in plants, eliminating the need for repeaters or complicated mesh networks. Actual tests in a typical power plant achieved successful signal transmission distances of over 1/3 mile and even through buildings. Outdoor tests have achieved transmission distances measured in miles and transmissions are at only 0.75 mW ERP using very little battery power.

**Receiver**
Model 673A01
- Requires no repeaters, gateways, or mesh
- Outputs to ethernet
- Installs easily

The Echo® Receiver is a stand alone unit that communicates point-to-point with Echo® Wireless Vibration Sensors and EchoPlus® Wireless Junction Boxes. Operating in the 916 MHz range, using an ultra-narrow bandwidth filter with Extended Range RF (ERRF) technology, it has unprecedented -145 dBm sensitivity and can detect and decode RF signals as low as about a millionth of a billionth of a milliwatt. This results in very long distance point-to-point communications in plants, eliminating the need for repeaters or complicated mesh networks. Actual tests in a typical power plant achieved successful signal transmission distances of over 1/3 mile and even through buildings. Outdoor tests have achieved transmission distances measured in miles and transmissions are at only 0.75 mW ERP using very little battery power.
Echo® Wireless Vibration System

The Echo® Wireless Vibration System is simple in design, easy to install, cost-effective and flexible in configuration. With 12 independent RF bands and over 400 points per receiver, the system can monitor over 5,000 points even within the same RF coverage area. Outside the same coverage area, the number is even higher. Stand alone Echo® Sensors and EchoPlus® Junction Boxes can be mixed and matched as desired. EchoPlus® and optional RV Echo® provide a raw vibration output via cable to a data collector for detailed fault analysis. Echo® Monitoring Software provides standard monitoring features such as: machine status, reports, trend plots and email alerts. It can be run single or multi-user at no additional charge per user.

Direct point to point transmission typical distance = 1/3 to 1/2 mile radius
Actual distances can vary widely based on conditions

EchoPlus® Wireless Junction Box
See page 143 for more information

Echo® Receiver
See page 143 for more information

EchoPlus® Wireless Junction Box & Echo® Wireless Vibration Sensor
Data collector connects directly to:
- EchoPlus® Wireless Junction Box via standard BNC connector
- Echo® Wireless Vibration Sensor with optional RV output and 070A86 cable
See page 142 for more information

Vibration Analysis Using Data Collector
Wireless transmission stops while analog acceleration output is acquired via BNC. After handheld data collection, device returns to regular transmission schedule

Transmissions temporarily paused during handheld data collection

Monitor Machinery

Traditional, Wired Sensor
Connected to EchoPlus® Wireless Junction Box

100-240 VAC to 12 VDC Universal Power Supply

TCP/IP

Optional high gain antenna
Echo® Monitoring Software

Echo® Data Client Service
- Collects transmission
- Formats data
- Stores in database
- Generates alarm email
- Integrated or standalone Modbus TCP/ICP Server interface

Echo® Data Presentation SW
- Trend plots
- Status
- Alarms
- Reports
- Echo® sensor configuration utilities

Ethernet TCP/IP

Echo® Sensor Data

MS SQL Server 2005

All monitor stations, either through LAN or remote access, have all the same functionality as server system, but do not store data

Echo® Data Presentation SW
Access to SQL Database through internet with LAN
- Trend plots
- Status
- Alarms
- Reports
- Sensor configuration

Echo® Data Presentation SW
Access to SQL Database through internet with VPN
- Trend plots
- Status
- Alarms
- Reports
- Sensor configuration

Echo® Wireless Vibration Sensors

See page 146 for more information
Echo® Monitoring Software

Echo® sensor data is stored by the Echo® Data Client Service software in a Microsoft SQL 2005 database. The database structure is available from IMI® so it can be accessed by users directly using any ODBC compliant application. The Echo® Data Client Service can also be configured as a Modbus TCP/IP Server to service Modbus requests from an existing Modbus Client application. The Modbus capability can coexist with the SQL database capability or function as a standalone application without the SQL database. However, the SQL interface is required if the Echo® Data Presentation Software is to be used.

Echo® data can also be exported from the Echo® Data Presentation Software to a tab delimited spreadsheet file that is suitable for use with Excel or other data viewing applications for post processing. Contact IMI® to discuss other interfaces to legacy condition monitoring programs and plant monitoring systems.

Echo® Monitoring Software
Model 600A20

Echo® Data Client Service
- Installs locally or on a server
  It is highly recommended that the service is installed on a dedicated PC or Server running 24/7
- Runs continuously whether a user is logged on or not
- SQL Database interface and/or Modbus TCP/IP
- Provides email alerts if SQL interface is enabled
- Service Status application runs from notification tray to view service / receiver status

Echo® Data Presentation Software
- Runs in single or multi-user environments, and does not affect the Data Client Service that collects
  Ideally a dedicated PC would also be used to run the Presentation Software continuously for constant monitoring of the alarm display
- Provides data alarms, trend plots and history
- Provides sensor status and configuration utility
- Live data window to view receiver activity

The Echo® Monitoring Software provides two major functions
- Collect transmission data reported by the receiver and store in the SQL database and/or Modbus response file
- Present Echo® sensor data to the user through an intuitive and concise interface that includes:
  - Configuration utilities to setup a machinery database and set alarms levels
  - Tabular displays to view live and historical data.
  - System level sensor status display to warn of low batteries, low RF signal, or missed measurements
  - Alarm reporting - graphically via system status screens and electronically via email

  - Single and multi-sensor plot displays with alarm levels to show trends
  - Hardcopy report generation for last transmission and alarm events
  - Additional utilities to query and program Echo® Sensors, EchoPlus® Junction Boxes and Echo® Receivers.

Sensor Vibration Trend Plot
Sensor Alarm Panel
Sensor Status Window

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Technical Specifications

**Measurements**

<table>
<thead>
<tr>
<th>Echo® RMS Velocity (x dB)</th>
<th>4 Hz to 2.3 kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Echo® RMS Acceleration (x dB)</td>
<td>2.2 kHz to 15 kHz</td>
</tr>
<tr>
<td>EchoPlus® RMS Velocity (x dB)</td>
<td>4 Hz to 2.3 kHz, may be limited by sensor FR</td>
</tr>
<tr>
<td>EchoPlus® RMS Acceleration (x dB)</td>
<td>2 kHz to 15 kHz, may be limited by sensor FR</td>
</tr>
<tr>
<td>True Peak Acceleration</td>
<td>of 2 kHz LP filtered acceleration</td>
</tr>
</tbody>
</table>

**Battery voltage at maximum load**

For battery status report

**System Information Provided**

- **Date**
- **Time**
- **Sensor ID**
  - Factory set unique ID
- **RMS Velocity**
- **Derived Peak Velocity**
  - 1.414 x RMS Velocity
- **RMS Acceleration**
  - 2 kHz high pass filtered for improved HFE detection
- **Derived Peak Acceleration**
  - 1.414 x RMS Acceleration
- **True Peak Acceleration**
  - 3.7 x true time sample @ 61 kHz sample rate, 2 kHz HPF
- **Filtered Crest Factor**
  - True Peak / RMS Acceleration
- **Maximum Value** = 16
- **Battery Status**
  - 4-levels, status based on previous transmission @ max load
- **RF Status**
  - 4 levels
- **Noise Power**
  - Background noise level (dBm)
- **Average Power**
  - Average transmission power (dBm)
- **Average SNR**
  - Difference between Noise and Average Power (dB)

**Radio & Standard Specifications**

- **Modulation**
  - Narrowband FSK
- **Transmission Range**
  - 250’ to >1 mile radius, installation dependent
- **Transmission Interval**
  - Programmable from 12 sec to 34 hours in 4 sec increments (default = 8 hours)
- **Certifications**
  - FCC, IC
- **Minimum Noise Floor**
  - 150 dBm
- **Radio Sensitivity**
  - 145 dBm
- **Frequency Band**
  - 900 MHz ISM Band
- **Number of RF Bands**
  - 12 (User selectable)
- **Maximum Power (ERP)**
  - 0.75 mW
- **Signal Attenuation**
  - 40 dBm, user selectable for sensors close to receiver
- **RF Data Rate**
  - 20 bps
- **Programming**
  - RS-232 (Echo® sensor requires optional FAS-820 adapter, EchoPlus® uses standard 9-pin serial cable.)

- **Number of receivers handled by a single computer**
  - Limited Only by End User Network and Computer Hardware
- **Sensors per receiver @ 3 meas/day, 1% miss rate, measurement spaced**
  - ~400
- **Sensors per receiver @ 2 meas/day, 5% miss rate, measurements spaced**
  - ~2,000
- **Amping**
  - Integral 1/2” Ceramic

**Performance**

<table>
<thead>
<tr>
<th>Echo® Acceleration Linearity (0 to 20 g pk)</th>
<th>&lt;1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>EchoPlus® Acceleration Linearity (0 to 20 g rms)</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Derived Peak Acceleration</td>
<td>1.414 x RMS Acceleration</td>
</tr>
<tr>
<td>Minimum True Peak Acceleration Pulse Width</td>
<td>~50 s</td>
</tr>
<tr>
<td>Modified Crest Factor (1 kHz HPF)</td>
<td>True Peak / RMS Acceleration, Maximum Value = 16</td>
</tr>
<tr>
<td>AIC/dynamic range</td>
<td>16 bit /-90 dB</td>
</tr>
<tr>
<td>Residual Voltage Level (IPV)</td>
<td>If RVL = 0, collect on normal transmission period and collect data only if RMS velocity &gt; RVL</td>
</tr>
<tr>
<td>Operation Status Indicator</td>
<td>LED</td>
</tr>
</tbody>
</table>

**Environmental**

- **Echo® Mechanical Shock Limit**
  - 1,000 g through mounting base
- **Temperature Range**
  - -30° to 70°C (4° to 158° F)
- **Humidity**
  - 5% - 100%
- **Echo® Enclosure Rating**
  - IP 66

- **Echo® Electrical**
  - **Echo® Power**
    - 7.2V Lithium Battery
    - (073A20 battery replacement kit)
  - **Replaceable**
    - Yes
  - **Battery Operating Temperature**
    - -40° to 85° C (-4° to 158° F)
  - **Battery Life**
    - >5 years with 3 measurements per day, room temperature
  - **Electrical Isolation (Case)**
    - >102 ohm

- **Echo® Physical**
  - **Dimensions**
    - Base Assembly: 1-3/8” Hex
    - Housing: 1.86” Dia
    - Weight (including battery pack): 450 g (15.9 Oz)
    - Mounting Thread: 1/4-28 Female
    - Mounting Torque: 2 to 5 lb-ft
  - **Sensing Element**: Piezo Ceramic Shear
  - **Material**
    - Base: 304L Stainless Steel
    - Housing Material: 304L Stainless Steel
    - Housing Cap: Polycarbonate
    - Mechanical Isolator: Urethane
    - Mounting: 1/4-28 Stud
    - Sealing: O-ring

- **EchoPlus® Parameter**
  - **Channels per box**
    - 8
  - **Channels Active**
    - User selectable in any combination
  - **Channel ID**
    - Individual factory set unique ID per channel
  - **Sensors Supported**
    - 10, 50, 100, 500 mV/g
  - **EchoPlus® Velocity Linearity (0 to 1 g rms)**
    - <1%
  - **EchoPlus® Velocity Linearity (0 to 1 g ms)**
    - <1%
  - **EchoPlus® Velocity Linearity (0 to 5 g rms)**
    - <1%
  - **EchoPlus® Velocity Linearity (0 to 5 g ms)**
    - <1%
  - **EchoPlus® Velocity Linearity (0 to 100 g rms)**
    - <1%
  - **EchoPlus® Voltage Power (battery not supplied)**
    - 6 to 13 VDC
  - **EchoPlus® Over Voltage Protection on Battery Terminals**
    - 14 to 30 VDC (Fuse auto resets after voltage removed)
  - **EchoPlus® Reverse Polarity Protection**
    - Yes
  - **EchoPlus® Transmission Interval**
    - Programmable in 4 sec increments up to 24 hours, default = 8 hours, minimum dependent on the number of active channels

**EchoPlus® Physical**

- **Echo® Enclosure Rating**
  - Die Cast Aluminum
- **Echo® Receiver Measurement**
  - **Echo® Receiver Specifications**
    - **Echo® Power**
      - 12 VDC, 15 W max, User supplied AC adapter power
      - Power (supplied with receiver)
    - **Echo® Receiver Measurements**
      - 147 mV/g
      - Weight (without mounting bracket)
      - ~2.84 lb (1.23 kg)
      - Weight (with mounting bracket)
      - ~3.76 lb (1.71 kg)
- **Antenna**
  - N-type female
- **Ethernet Connector**
  - RJ-45 Waterproof (with mating connector cover)
- **Interface**
  - Ethernet TCP/IP packet containing XML text
  - Antenna supplied
  - Ethernet Connector: RJ-45 Waterproof (with mating connector cover)
  - **Echo® Enclosure Rating**
    - MIL STD 810 Method 506.4 Procedure 1 Blowing Rain MIL 510.4, Procedure A 6, Sand & Dust

**All specifications are at room temperature unless otherwise specified**
Echo® Wireless Accessories

- Programming and antenna cables
- Multiple antenna options
- Replacement batteries

**Echo® RV Output Cable**
Model 070A86
Model 070A86 is a 4-pin mini connector to BNC power adapter and cable. When used in conjunction with a portable data collector, this cable converts standard sensor power to low voltage power required by Echo® Wireless Vibration Sensors. It also allows normal cabled broadband data collection when used with the RV Echo® Sensor, Model RV670A01.

**Echo® Programming Cable**
Model 070A87
Model 070A87 is a special RS-232 adapter cable with a DB9 connector to a Micro USB connector that allows serial communication with Echo® Wireless Vibration Sensors. The cable’s Micro USB connector mates with a Micro USB connector in the sensor and is used to read and program the units.

**Echo® Receiver Serial Cable**
Model 009M201
Model 009M201 is a special RS-232 serial cable with a DB9 connector to a MIL-style bayonet connector that allows serial communication with Echo® Receivers. The cable’s MIL-style connector mates with a MIL-style connector on the receiver and is used to read and program the units.

**Echo® RV Shorting Cap**
Model 070A88
Model 070A88 is a shorting cap that is used with the RV670A01 Echo® Wireless Vibration Sensor for normal wireless use. When removed, a Model 070A86, Echo® RV Output Cable can be used to obtain Raw Vibration output from the sensor for input to a portable data collector for diagnostic analysis.

**Echo® Replacement Battery Kit**
Model 073A20
Model 073A20 is a battery replacement kit that includes a battery pack, O-ring, silicon grease, foam compressor and instructions.

**Low Loss Antenna Cable**
Model 009M205
Model 009M205/xxx is a high performance, low loss antenna cable with N-Male to N-Male connectors. xxx is the length in feet. Valid Models are as follows:

- 009M205/002 (2’)
- 009M205/004 (4’)
- 009M205/010 (10’)
- 009M205/020 (20’)
- 009M205/025 (25’)
- 009M205/030 (30’)
- 009M205/040 (40’)
- 009M205/050 (50’)

**900 MHz Antenna, 8 dBi**
Model 070A91
Model 070A91 is an 800/900 MHz, 8 dBi omnidirectional antenna & bracket for use with the Echo® Wireless Vibration System.

**900 MHz Antenna, 6 dBi**
Model 070A90
Model 070A90 is an 800/900 MHz, 6 dBi omnidirectional antenna & bracket for use with the Echo® Wireless Vibration System.

**900 MHz Antenna, 13 dBi**
Model 070A92
Model 070A92 is a 900 MHz, 13 dBi directional Yagi antenna with N female connector.

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Wireless Vibration Measurements? We Do! We do it all - sensors to measure vibration, acoustics, force, pressure, load, strain, shock and torque - Sure we do!

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BNC Termination Boxes

Enclosures

- Access vibration data from remote accelerometers at a safe location
- Provides central collection point saving time during route-based analysis
- Installed cord grips make for easy sensor hookup

Small BNC termination boxes offer a simple, economical and safe method for accessing up to four sensors that are installed in remote locations. Each features a wall mountable, fiberglass, NEMA 4X (IP65) enclosure, an internal terminal strip for connection to pigtailed sensor cables and externally mounted BNC jack connectors for interface to data collection equipment. BNC termination boxes do not supply sensor excitation power. Simply connect a data collector, with sensor excitation power, to the BNC jack of the sensor channel of interest to access that sensor’s measurement signal.

BNC Termination Box
Series 691A51

- For use with data collectors that supply ICP® sensor power
- 1-4 input channels via terminal strip
- 1-4 output channels via BNC

Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>691A51/01</th>
<th>691A51/02</th>
<th>691A51/03</th>
<th>691A51/04</th>
</tr>
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<tbody>
<tr>
<td>Channels</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Environmental</td>
<td></td>
<td></td>
<td>NEMA 4X</td>
<td></td>
</tr>
<tr>
<td>Physical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Connector (Input)</td>
<td>Terminal Block</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Connector (Output)</td>
<td>BNC Jack</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cable Input</td>
<td>PGM07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housing Material</td>
<td>Fiberglass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size - Height</td>
<td>4.20 in</td>
<td>110 mm</td>
<td>110 mm</td>
<td>110 mm</td>
</tr>
<tr>
<td>Size - Width</td>
<td>2.95 in</td>
<td>80 mm</td>
<td>80 mm</td>
<td>80 mm</td>
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<tr>
<td>Size - Depth</td>
<td>2.16 in</td>
<td>55 mm</td>
<td>55 mm</td>
<td>55 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>90 lb</td>
<td>90 lb</td>
<td>130 lb</td>
<td>130 lb</td>
</tr>
<tr>
<td>Notes</td>
<td>All specifications are at room temperature unless otherwise specified</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
BNC termination enclosures offer a simple, economical and safe method for accessing up to 12 sensors that are installed in remote locations. Each features a wall mountable, fiberglass NEMA 4X (IP66) enclosure, an internal terminal strip for connection to pigtailed sensor cables and internally mounted BNC jack connectors for interface to data collection equipment. BNC termination enclosures do not supply sensor excitation power turn on. Simply open the enclosure door and connect a data collector, with sensor excitation power turned on, to the BNC jack of the sensor channel of interest to access that sensor’s measurement signal.

**BNC Termination Box**
**Series 691A50**
- Consolidate up to 12 channels in a centralized location
- Connections protected by NEMA 4X enclosure
- Includes installed cord grips

### Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>691A50/06</th>
<th>691A50/12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
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<tr>
<td>Channels</td>
<td>6</td>
<td>12</td>
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<tr>
<td><strong>Environmental</strong></td>
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<td></td>
</tr>
<tr>
<td>Enclosure Rating</td>
<td>NEMA 4X</td>
<td>IP66</td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Connector (Input)</td>
<td>Terminal Block</td>
<td></td>
</tr>
<tr>
<td>Electrical Connector (Output)</td>
<td>BNC Jack</td>
<td></td>
</tr>
<tr>
<td>Cable Input</td>
<td>PGME07</td>
<td></td>
</tr>
<tr>
<td>Housing Material</td>
<td>Fiberglass</td>
<td></td>
</tr>
<tr>
<td>Size - Height</td>
<td>8 in</td>
<td>203 mm</td>
</tr>
<tr>
<td></td>
<td>215.9 mm</td>
<td></td>
</tr>
<tr>
<td>Size - Width</td>
<td>6 in</td>
<td>152 mm</td>
</tr>
<tr>
<td></td>
<td>102 mm</td>
<td></td>
</tr>
<tr>
<td>Size - Depth</td>
<td>4 in</td>
<td>102 mm</td>
</tr>
<tr>
<td></td>
<td>102 mm</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>2.5 lb</td>
<td>1.14 kg</td>
</tr>
</tbody>
</table>

**Notes**
- All specifications are at room temperature unless otherwise specified
Switch Boxes

Enclosures

- Enclosures provide a convenient, centralized data collection point
- Improve efficiency with temperature & vibration outputs in one enclosure
- Help extend cable life by reducing the number of connections needed

Switch boxes assist with route-based data collection by terminating the cables of permanently installed sensors at convenient, safe, data collection locations.

The unit does not contain a power supply rather it relies on transferring excitation power provided by the vibration data collector or signal conditioner to connected sensors. Since excitation power is presented to each sensor when its measurement channel is selected, the sensor’s settling time must be considered prior to taking measurements. Models 691B41 and 691B42 are available with a variety of cord grip options. When cord grips are ordered, the enclosure will be provided with holes drilled for the appropriate cord grips.

Rotary Switch Box
Model 691B41
- Dual BNC connector for vibration and temperature output
- Variety of cord grip options available
- Fiberglass or painted steel enclosure

Rotary Switch Box
Model 691B42
- 12 input channels
- Fiberglass enclosure
- For use with data collectors that supply ICP® power

Model 691B41 Technical Drawing
Model 691B42 Technical Drawing
## Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>691B41</th>
<th>691B41/691010</th>
<th>691B42</th>
<th>691B42/691020</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channels</td>
<td>6</td>
<td>6</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enclosure Rating</td>
<td></td>
<td></td>
<td>NEMA 4X</td>
<td></td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Connector (Input)</td>
<td></td>
<td>Terminal Block</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housing Material</td>
<td></td>
<td>Fiberglass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size - Height</td>
<td>8 in</td>
<td>203 mm</td>
<td>102 mm</td>
<td></td>
</tr>
<tr>
<td>Size - Width</td>
<td>6 in</td>
<td>102 mm</td>
<td>4 in</td>
<td></td>
</tr>
<tr>
<td>Size - Depth</td>
<td></td>
<td></td>
<td>102 mm</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>5 lb</td>
<td></td>
<td>2.3 kg</td>
<td></td>
</tr>
<tr>
<td>Cable Entry</td>
<td>None</td>
<td></td>
<td>Cord Grips</td>
<td>None</td>
</tr>
<tr>
<td><strong>Supplied Accessories</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 800A192 4-socket terminal block (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Optional Versions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>691010 - 6 Individual Cord Grips, PGME07</td>
<td></td>
<td>691020 - 12 Individual Cord Grips, PGME07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>691011 - 1 Individual Cord Grip, PGME29</td>
<td></td>
<td>691021 - 2 Individual Cord Grips, PGME29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>691012 - 1 Individual Cord Grip, PGME13</td>
<td></td>
<td>691022 - 2 Individual Cord Grips, PGME13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>691013 - 1 Conduit Fitting, 1.5 Inch.</td>
<td></td>
<td>691023 - 1 Individual Cord Grip, PGME36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>691014 - 2 Individual Cord Grips, PGME13</td>
<td></td>
<td>691024 - 1 Individual Cord Grip, PGME21</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>691025 - 1 Conduit Fitting, 1.5 Inch.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>691026 - 2 Conduit Fittings, 1.5 Inch</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>691027 - 1 Individual Cord Grip, PGME29</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Enclosure Versions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PS - Painted Steel</td>
<td></td>
<td></td>
<td>NEMA 12</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>7 lb</td>
<td></td>
<td>3.2 kg</td>
<td></td>
</tr>
<tr>
<td>SS - Stainless Steel</td>
<td></td>
<td></td>
<td>NEMA 4X</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>9 lb</td>
<td></td>
<td>3.6 kg</td>
<td></td>
</tr>
</tbody>
</table>

All specifications are at room temperature unless otherwise specified.
**Signal Conditioners**

- Conveniently mounts to any standard DIN rail
- Capable of powering transmitters & ICP® sensors
- Easy to use terminal strip connection

---

**DIN Rail Mounting Power Supply**

Model 682A01

- Provides 24 VDC, 1.0 amps power
- Operates from 120 to 230 VAC line power
- Powers transmitters, signal conditioners, and alarm modules

---

**Technical Specifications**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>682A01</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
</tr>
<tr>
<td>MTBF</td>
<td>&gt;500,000h</td>
</tr>
<tr>
<td>Efficiency</td>
<td>&gt;80%</td>
</tr>
<tr>
<td><strong>Control Interface</strong></td>
<td></td>
</tr>
<tr>
<td>Display</td>
<td>LED</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature Range (Operating)</td>
<td>-13 to 104 °F</td>
</tr>
<tr>
<td></td>
<td>-25 to 70 °C</td>
</tr>
<tr>
<td>Temperature Range (Storage)</td>
<td>-40 to 185 °F</td>
</tr>
<tr>
<td></td>
<td>-40 to 85 °C</td>
</tr>
<tr>
<td>Humidity Range (Non-Condensing)</td>
<td>&lt;95 %</td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
</tr>
<tr>
<td>Power Input</td>
<td>85-264 VAC / 95-350 VDC</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>24 VDC</td>
</tr>
<tr>
<td>Output Current</td>
<td>1.0 amps</td>
</tr>
<tr>
<td>Input Frequency</td>
<td>45 to 63 Hz</td>
</tr>
<tr>
<td>Inrush Current (at 25 deg C)</td>
<td>&lt;15A</td>
</tr>
<tr>
<td>Current Consumption (230/120 VAC)</td>
<td>0.3/0.5A</td>
</tr>
<tr>
<td>Fuse</td>
<td>1.25A / 250V</td>
</tr>
<tr>
<td>Mains Buffering</td>
<td>&gt;20/150ms (120/230 VAC)</td>
</tr>
<tr>
<td>Surge Voltage Protection</td>
<td>Varistor</td>
</tr>
<tr>
<td>T0-90% Load Tolerance</td>
<td>+/– 3%</td>
</tr>
<tr>
<td>Turn On Delay</td>
<td>&lt;0.5/1s (230/120 VAC)</td>
</tr>
<tr>
<td>Turn Off Delay</td>
<td>&lt;150ms</td>
</tr>
<tr>
<td>Internal Surge Voltage Protection</td>
<td>35 VDC +/- 5%</td>
</tr>
<tr>
<td>Parallel Switching</td>
<td>Redundant Systems Only</td>
</tr>
<tr>
<td>Ripple Voltage</td>
<td>&lt;100 mV pp</td>
</tr>
<tr>
<td>Maximum Power Loss</td>
<td>0.9/4.5W (No Load/Load)</td>
</tr>
<tr>
<td>DC OK (Active)</td>
<td>24V / 20mA</td>
</tr>
<tr>
<td>Fuse</td>
<td>1.25A/250V</td>
</tr>
<tr>
<td>Insulation Voltage</td>
<td>3kV</td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
</tr>
<tr>
<td>Size - Height</td>
<td>99 mm</td>
</tr>
<tr>
<td>Size - Width</td>
<td>89.88 mm</td>
</tr>
<tr>
<td>Size - Depth</td>
<td>22.5 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>7.4 oz</td>
</tr>
<tr>
<td>Conductor Cross Section</td>
<td>AWG 14-24</td>
</tr>
<tr>
<td>Vibration (10Hz-150Hz)</td>
<td>0.25mm/2</td>
</tr>
<tr>
<td>Shock (3 directions for 18 ms)</td>
<td>0.19mm</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td></td>
</tr>
</tbody>
</table>

All specifications are at room temperature unless otherwise specified.

[1] In the case of DC applications it is necessary to connect an adequate fuse in series
[3] This device is in compliance with the EMC guideline 89/336/EEC and the low voltage guideline 73/23/EEC
[4] This device must be installed in accordance with the specifications of EN60950

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## Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>682A02</th>
</tr>
</thead>
</table>

### Performance
- **Channels**: 1
- **Voltage Gain**: 1/10/100 [1]
- **Frequency Range (±1 dB)**: 60 to 6 ppm
- **Non-linearity**: ≤ 2 %

### Environmental
- **Temperature Range**: 32 °F to 104 °F [2]

### Electrical
- **Power Required (Standard)**: DC power
- **Excitation Voltage (±1 VDC) (To Sensor)**: 18 VDC [4]
- **DC Power**: 24 VDC
  - **60 mA**
- **Constant Current Excitation (To Sensor)**: 4/10 mA [5]
- **Spectral Noise (10 Hz)**: 0.8 µV/√Hz [1]
- **Spectral Noise (100 Hz)**: 0.5 µV/√Hz [1]
- **Spectral Noise (1 kHz)**: 0.5 µV/√Hz [1]
- **Spectral Noise (10 kHz)**: 0.8 µV/√Hz [1]
- **Broadband Electrical Noise (1 to 10 kHz) (Gain x1)**: 100 µV
- **Spectral Noise (10 Hz)**: 7.5 µV/√Hz [2]
- **Spectral Noise (100 Hz)**: 3.6 µV/√Hz [2]
- **Spectral Noise (1 kHz)**: 3.2 µV/√Hz [2]
- **Spectral Noise (10 kHz)**: 6.0 µV/√Hz [2]
- **Broadband Electrical Noise (1 to 10 kHz) (Gain x10)**: 400 µV
- **Spectral Noise (10 Hz)**: 80 µV/√Hz [3]
- **Spectral Noise (100 Hz)**: 40 µV/√Hz [3]
- **Spectral Noise (1 kHz)**: 32 µV/√Hz [3]
- **Spectral Noise (10 kHz)**: 50 µV/√Hz [3]
- **Broadband Electrical Noise (1 to 10 kHz) (Gain x100)**: 3.5 mV
- **Fuse**: 1 A

### Physical
- **Size - Height**: 3.1 in (78.7 mm)
- **Size - Width**: 0.97 in (24.6 mm)
- **Size - Depth**: 3.3 in (83.8 mm)
- **Weight**: 0.194 lb (0.088 kg)

### Notes
- **All specifications are at room temperature unless otherwise specified**

[1] Gain x1
[2] Gain x10
[3] Gain x100
[4] If unit is used in conjunction with a sensor having a bias over 13 VDC, full scale output may be affected or sensor may not power up.

---

**ICP® Signal Conditioner**

**Model 682A02**

- Frequency range: 1 Hz to 100 kHz
- Single channel
- 24 VDC input

Product shown at actual size
**Signal Conditioners**

- Accepts mA, VDC, RTD, TC, Linear Resistance and Potentiometer input signals
- Delivers either current or voltage output signals
- Offers two set points with Form A relay outputs (2 Amp AC, 1 Amp DC)

Model 682A06 is a DIN rail mounted, general purpose, universal transmitter for industrial monitoring, control and alarm requirements. It accepts a variety of sensor input signals and provides excitation voltage for 2-wire loop powered sensors and transmitters. This unit is especially well-suited for industrial machinery protection and vibration monitoring applications with IMI Sensors’ Series 640 loop powered 4-20 mA output vibration sensors.

Model 682A06 operated as a blind transmitter and delivers VDC, isolated mA and relay outputs; however, it may be fitted with an optional display module (Model 070A80) to view measurement data. The display module also offers pushbutton programmability of many setup parameters, including: zero, span, set point threshold, set point hysteresis and relay action time delay, as well as TC and RTD linearization. The unit also supports password protection for security purposes and memory retention of all set up parameters, to permit common setup of additional transmitters for quick deployment.

Model 682A16 (see page 157) provides ICP® power for voltage output sensors and provides all the same output technology found in the 682A06.
### Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>682A06</th>
<th>682A16</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Range (Operating)</td>
<td>-04 to 140 °F</td>
<td>-20 to 60 °C</td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supply Voltage</td>
<td>19.2 to 300 VDC</td>
<td></td>
</tr>
<tr>
<td>Current Consumption</td>
<td>≤ 2.5 W</td>
<td></td>
</tr>
<tr>
<td>Excitation Voltage (delivered to sensor)</td>
<td>24 V Loop Power</td>
<td>23 to 25 VDC</td>
</tr>
<tr>
<td>Constant Current Excitation (delivered to sensor)</td>
<td>N/A</td>
<td>3 to 5 mA</td>
</tr>
</tbody>
</table>

### Notes

All specifications are at room temperature unless otherwise specified

[1] For CE reference appropriate Declaration of Conformance for details

——

**Universal Transmitter**

**Model 682A16**

- Provides ICP® power for sensors
- Offers two set points with Form A relay outputs (2 amp AC, 1 amp DC)
- Optional, removable programming / display module 070A80

Product shown at actual size
## In-line Charge Converters

- All charge converters shown are ICP® powered
- Industry standard input and output connectors
- Specifically designed for use with charge mode sensors

### Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>422M182</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
</tr>
<tr>
<td>Sensitivity (± 5 %) (Charge Conversion)</td>
<td>4 mV/pC</td>
</tr>
<tr>
<td>Low Frequency Response (± 5 %)</td>
<td>2 Hz</td>
</tr>
<tr>
<td>High Frequency Response (2.2 mA)</td>
<td>30 kHz [2]</td>
</tr>
<tr>
<td>High Frequency Response (4 mA)</td>
<td>40 kHz [2]</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>≤ 1.0 % FS</td>
</tr>
<tr>
<td><strong>Environmental</strong></td>
<td></td>
</tr>
<tr>
<td>Temperature Range (Operating)</td>
<td>-60 to +185 ºF</td>
</tr>
<tr>
<td>Temperature Response (Sensitivity Deviation)</td>
<td>≤ 1 %</td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
</tr>
<tr>
<td>Excitation Voltage</td>
<td>22 to 28 VDC</td>
</tr>
<tr>
<td>Constant Current Excitation</td>
<td>2.2 to 20 mA</td>
</tr>
<tr>
<td>Output Voltage (at specified measurement range)</td>
<td>± 5 Vpk</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt;250 ohm</td>
</tr>
<tr>
<td>Output Bias Voltage</td>
<td>12 to 18 VDC</td>
</tr>
<tr>
<td>Broadband Electrical Noise (1 to 10 kHz)</td>
<td>28 µV [1]</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td></td>
</tr>
<tr>
<td>All specifications are at room temperature unless otherwise specified</td>
<td></td>
</tr>
</tbody>
</table>

- [1] Tested using voltage source and input capacitor equal to the feedback capacitor, to simulate a charge output sensor.
- [2] Above stated frequency, the amplifier becomes slew rate limited.

### Differential Charge Converter

**Model 422M182**
- Sensitivity: 4 mV/pC
- Output Voltage: ±5 Vpk
- Temperature Range: -60 to 185 ºF

Product shown at actual size

![Differential Charge Converter](image)

### Model Number

<table>
<thead>
<tr>
<th>Model Number</th>
<th>422M182</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
</tr>
<tr>
<td>Spectral Noise (1 Hz)</td>
<td>10.0 µV/√Hz [1]</td>
</tr>
<tr>
<td>Spectral Noise (10 Hz)</td>
<td>-100 dB</td>
</tr>
<tr>
<td>Spectral Noise (100 Hz)</td>
<td>3.2 µV/√Hz [1]</td>
</tr>
<tr>
<td>Spectral Noise (1 kHz)</td>
<td>1.0 µV/√Hz [1]</td>
</tr>
<tr>
<td>Spectral Noise (1 kHz)</td>
<td>-120 dB</td>
</tr>
<tr>
<td>Spectral Noise (1 kHz)</td>
<td>0.56 µV/√Hz [1]</td>
</tr>
<tr>
<td>Spectral Noise (1 kHz)</td>
<td>-125 dB</td>
</tr>
<tr>
<td>Discharge Time Constant</td>
<td>0.25 sec</td>
</tr>
<tr>
<td>Resistance (Minimum required at input)</td>
<td>50,000 ohm</td>
</tr>
<tr>
<td>Source Capacitance Loading</td>
<td>0.0005 %/pf</td>
</tr>
<tr>
<td><strong>Physical</strong></td>
<td></td>
</tr>
<tr>
<td>Housing Material</td>
<td>Aluminum</td>
</tr>
<tr>
<td>Electrical Connector (Input)</td>
<td>2-pin</td>
</tr>
<tr>
<td>Electrical Connector (Output)</td>
<td>BNC Jack</td>
</tr>
<tr>
<td>Weight</td>
<td>3.5 oz</td>
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<tr>
<td></td>
<td>109 gm</td>
</tr>
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</table>
### Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>422E35</th>
<th>422E36</th>
<th>422E55/D</th>
<th>422E55/A</th>
<th>422E66/A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity (±2 %) (Charge Conversion)</td>
<td>1 mV/pC</td>
<td>1 mV/pC</td>
<td>N/A</td>
<td>1 mV/pC</td>
<td>N/A</td>
</tr>
<tr>
<td>Sensitivity (±2.5 %) (Charge Conversion)</td>
<td>N/A</td>
<td>0.5 mV/pC</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Input Range</td>
<td>±2,500 pC</td>
<td>±2,500 pC</td>
<td>±2,500 pC</td>
<td>±5,000 pC</td>
<td>±5,000 pC</td>
</tr>
<tr>
<td>High Frequency Response (5 %)</td>
<td>10 kHz</td>
<td>10 kHz</td>
<td>10 kHz</td>
<td>10 kHz</td>
<td>10 kHz</td>
</tr>
<tr>
<td>High Frequency Response (2.2 mA)</td>
<td>30 kHz [3]</td>
<td>50 kHz [3]</td>
<td>30 kHz [3]</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>High Frequency Response (50 mA)</td>
<td>100 kHz [3]</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Non-linearity</td>
<td>≤ 1.0 % FS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Environmental** | | | | | |
| Temperature Range (Operating) | -45°C to +250 °F | -54 to +121 °C | | | |
| Temperature Response (Sensitivity Deviation) | <2% | | | | |
| Maximum Shock | 1,000 g pk | 9,810 m/s² pk | | | |
| Humidity Range | 100% | | | | |
| Radiation Exposure Limit (Integrated Gamma Flux) | N/A | ≤ 1 Mrad | | | |

| **Electrical** | | | | | |
| Excitation Voltage | ±18 to 28 VDC | | | | |
| Constant Current Excitation | 2.2 to 20 mA | | | | |
| Settling Time | <8 min | N/A | | | |
| Output Voltage | ±2.5 V | ±5 V | | | |
| Output Polarity | Inverted | | | | |
| Output Impedance | <10 ohm | <20 ohm | | | |
| Output Bias Voltage | 12 to 15 VDC | 9 to 13 VDC | | | |
| Maximum Input Voltage | 30 V | | | | |
| Broadband Electrical Noise (1 to 10 kHz) | 14 µV | 26 µV | 14 µV | 7.9 µV [1] | 17 µV [1] |
| | 47 dB | 60 dB | 47 dB | -103 dB | -95 dB |
| Spectral Noise (1 Hz) | 0.02 µV/pC [1] | 0.03 µV/pC [1] | 0.02 µV/pC | 10 µV/pC [1] | 10 µV/pC [1] |
| | -101 dB | -102 dB | -106 dB | -106 dB | -100 dB |
| Spectral Noise (10 Hz) | 0.05 µV/pC [1] | 0.06 µV/pC [1] | 0.05 µV/pC | 1.6 µV/pC [1] | 1.6 µV/pC [1] |
| | -121 dB | -122 dB | -125 dB | -114 dB | -114 dB |
| Spectral Noise (100 Hz) | 0.10 µV/pC [1] | 0.10 µV/pC [1] | 0.10 µV/pC | 0.5 µV/pC [1] | 0.3 µV/pC [1] |
| | -136 dB | -136 dB | -136 dB | -136 dB | -136 dB |
| Spectral Noise (1 kHz) | 0.13 µV/pC [1] | 0.13 µV/pC [1] | 0.13 µV/pC | 0.5 µV/pC [1] | 0.5 µV/pC [1] |
| | -144 dB | -144 dB | -144 dB | -144 dB | -144 dB |
| Spectral Noise (10 kHz) | 0.20 µV/pC [1] | 0.20 µV/pC [1] | 0.20 µV/pC | 0.5 µV/pC [1] | 0.5 µV/pC [1] |
| | -143 dB | -143 dB | -143 dB | -143 dB | -143 dB |
| Capacitance (Maximum allowable at input) | 20,000 pF | 2,000 pF | 20,000 pF | | |
| Discharge Time Constant | N/A | ≥ 0.1 sec | ≥ 0.05 sec | | |
| Resistance (Minimum required at input) | 10,000 ohm | | | | |
| Source Capacitance Loading | <0.0005 %/pF | <0.0005 %/pF | <0.0005 %/pF | | |

| **Physical** | | | | | |
| Housing Material | Stainless Steel | | | | |
| Sealing | Welded | Epoxy | Welded | | |
| Electrical Connector (Input) | BNC Jack | | | | |
| Electrical Connector (Output) | 10-32 Coaxial | 10-32 Coaxial | | | |
| Size (Diameter x Length) | Ø0.50 in x 3.4 in | Ø0.50 in x 3.0 in | 13 mm x 86 mm | 13 mm x 76 mm | |
| Weight | 1.1 oz | 1.15 oz | 0.8 oz | | |

| **Notes** | | | | | |
| All specifications are at room temperature unless otherwise specified | | | | |

[1] Tested using voltage source and input capacitor equal to the feedback capacitor, to simulate a charge output sensor.
[2] The low frequency tolerance is accurate within ±10% of the specified frequency.
[3] Above stated frequency, the amplifier becomes slew rate limited.
[5] Typical
[6] High frequency response may be limited by supply current and output cable length.

| **Optional Versions** | | | | | |
| T - TEDS Capable of Digital Memory and Communication Compliant with IEEE P1451.4 | N/A | | | | |
| Temperature Range (Operating) | -40° to +185°F | N/A | | | |

---

**In-line Charge Converter**

**Model 422E55/D**
- Sensitivity: ±2% 0.5 mV/pC
- Low frequency 0.5 Hz (-5%)
- 33 µV broadband electrical noise
- Common BNC connectors

**Model 422E65/A**
- Sensitivity: ±2% 1 mV/pC
- Model 422E65/A: 10 mV/pC
- Output Voltage: ±5 V
- Temperature Range: (Operating) -65 to +250 °F (-54 to +121 °C)

**Model 422E66/A**
- Sensitivity: ±2% 1 mV/pC
- Model 422E66/A: 10 mV/pC
- Output Voltage: ±5 V
- Temperature Range: (Operating) -65 to +250 °F (-54 to +121 °C)

---

**In-line Charge Converter for Radiation Hardened Sensors**

**Model 422E35**
- Sensitivity: ±2% (Charge Conversion)
- Model 422E35: 1 mV/pC

**Model 422E36**
- Sensitivity: ±2% (Charge Conversion)
- Model 422E36: 10 mV/pC
- Output Voltage: ±5 V
- Temperature Range: (Operating) -65 to +250 °F (-54 to +121 °C)

---

**In-line Charge Converter for High Temperature Sensors**

**Model 422E55/D**
- Sensitivity: ±2% (Charge Conversion)
- Model 422E55/D: 1 mV/pC

**Model 422E65/A**
- Sensitivity: ±2% (Charge Conversion)
- Model 422E65/A: 10 mV/pC
- Output Voltage: ±5 V
- Temperature Range: (Operating) -65 to +250 °F (-54 to +121 °C)

---

**In-line Charge Converter for High Temperature Sensors**

**Model 422E35**
- Sensitivity: ±2% (Charge Conversion)
- Model 422E35: 1 mV/pC

**Model 422E36**
- Sensitivity: ±2% (Charge Conversion)
- Model 422E36: 10 mV/pC
- Output Voltage: ±5 V
- Temperature Range: (Operating) -65 to +250 °F (-54 to +121 °C)

---

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A PCB Piezotronics Div.
Portable Calibration Units

- Quickly verify sensor sensitivity while working in the field
- Lightweight designs transport easily
- Long battery life, rechargeable options

Industrial Portable Vibration Calibrator
Model 699A06
- Perform variable frequency & amplitude calibration
- Calibrate proximity probes with optional adaptor kit
- Portable, plug in or use battery power

The 699A06 Industrial Portable Vibration Calibrator is the ideal tool to field check accelerometers, velocity transducers and proximity probes over a wide operating frequency and amplitude range. The unit is a small, handy, completely self-contained vibration reference source which can be conveniently used to validate the entire channel of transducers through measurement, monitoring or recording systems. Packaged in a ruggedized, weatherproof enclosure with two press and pull latches and padlockable clasps, the 699A06 is always ready for travel to test sites. With an integral, precision quartz reference accelerometer, the shaker table is built with robust carbon fiber composite armature flexure supports. Closed loop level control gives the 699A06 superior quality vibration calibration from 7 Hz to 10 kHz compared with other portable field calibrators.

Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>699A06</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Performance</strong></td>
<td></td>
</tr>
<tr>
<td>Frequency Range (operating, 100 gram payload)</td>
<td>7 Hz to 10 kHz</td>
</tr>
<tr>
<td>Maximum Amplitude (100 Hz with no payload)</td>
<td>20 g pk (196 m/s² pk)</td>
</tr>
<tr>
<td>Weight</td>
<td>8.2 kg</td>
</tr>
<tr>
<td>Sensor Mounting Platform Thread Size</td>
<td>1/4-28</td>
</tr>
<tr>
<td><strong>Accuracy of Readout</strong> (measured with 10 gram quartz reference accelerometer)</td>
<td></td>
</tr>
<tr>
<td>Acceleration (100 gram, 100 Hz)</td>
<td>±3%</td>
</tr>
<tr>
<td>Displacement (100 Hz to 150 Hz)</td>
<td>±3%</td>
</tr>
<tr>
<td>Amplitude Linearity, (100 gram, 100 Hz)</td>
<td>&lt;1% up to 10 g pk</td>
</tr>
<tr>
<td>Waveform Distortion (100 gram, 30 Hz to 2 kHz)</td>
<td>5% THD up to 5 g pk</td>
</tr>
<tr>
<td><strong>Units of Readout</strong></td>
<td></td>
</tr>
<tr>
<td>Acceleration</td>
<td>g pk, g rms, m/s² pk, m/s² rms</td>
</tr>
<tr>
<td>Velocity</td>
<td>m/s pk, mm/s pk</td>
</tr>
<tr>
<td>Frequency</td>
<td>Hz, CPM</td>
</tr>
<tr>
<td><strong>Power Requirements</strong></td>
<td></td>
</tr>
<tr>
<td>Internal Battery (sealed solid gel lead acid)</td>
<td>12 VDC, 4 amp hours</td>
</tr>
<tr>
<td>AC Power (for recharging battery)</td>
<td>110-240 Volts, 50-60 Hz</td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td></td>
</tr>
<tr>
<td>[1] Operating range reduced at higher payloads. Reference manual for full details</td>
<td></td>
</tr>
<tr>
<td>[2] As shipped from factory in new condition</td>
<td></td>
</tr>
</tbody>
</table>

Accessory Products for 699A06
- 600A22 Proximity probe adaptor kit, supports probes with common case threads ranging from M6 to 3/8”. Includes Mitutoyo micrometer (metric) and nickel plated 4140 steel target.
- 600A23 Proximity probe adaptor kit, supports probes with common case threads ranging from M6 to 3/8”. Includes Mitutoyo micrometer (metric) and nickel plated 4140 steel target.
- 600A24 Mounting accessory kit for 699A06 Portable Vibration Calibrators to adapt to 1/4-20 threaded mounting platforms. Includes studs/inserts (1/4-28, 10-32, 6-32 and 5-40) and bases (for adhesive, magnetic and custom thread patterns).
- 600A25 18 Volt, 1 amp power supply/charger for 9100D Portable Vibration Calibrator, universal 100-240 V, 50/60 Hz
- 9100-BAT01 Replacement battery for 699A06 Portable Vibration Calibrators
This handheld, portable shaker delivers a controlled, 1.0 g rms or 1 g pk vibration, at 159.2 Hz, for verifying vibration sensor operation and sensitivity. The unit accommodates sensors weighing up to 250 grams and is powered by four standard “AA” type batteries. An automatic shut off feature preserves battery life, however, continuous operation is switch selectable and an external DC power supply (Model 073A16) is available. Included is a nylon carry pouch with carry strap/belt loop.

### Portable Reference Shaker

**Model 699A02**
- Calibrates permanently mounted accelerometers at the machine
- Verifies system performance
- Confirms operation of cables, switching devices and monitoring systems
- Can perform up to 1,600 operating cycles without loss of battery power

### Technical Specifications

<table>
<thead>
<tr>
<th>Performance</th>
<th>699A02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Frequency (± 1 %)</td>
<td>159.2 Hz</td>
</tr>
<tr>
<td>Acceleration Output (± 3 %)</td>
<td>1 g rms</td>
</tr>
<tr>
<td>Velocity Output</td>
<td>9.81 mm/s rms [5]</td>
</tr>
<tr>
<td>Displacement Output</td>
<td>9.81 mil rms [5]</td>
</tr>
<tr>
<td>Transverse Output</td>
<td>≤ 3 %</td>
</tr>
<tr>
<td>Distortion (0 to 200 grams load)</td>
<td>≤ 7 % [6]</td>
</tr>
<tr>
<td>Maximum Load</td>
<td>8.8 oz</td>
</tr>
<tr>
<td>Automatic Switch Off Time</td>
<td>1.0 to 2.5 minutes [8]</td>
</tr>
<tr>
<td>Calibration Cycles (250 gram load)</td>
<td>90 cycles [3]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental</th>
<th>699A02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Range (Operating)</td>
<td>-10 to 55 °C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical</th>
<th>699A02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ramp-Up time</td>
<td>≤ 3 sec [1]</td>
</tr>
<tr>
<td>Power Required (Standard)</td>
<td>Internal Battery</td>
</tr>
<tr>
<td>Power Required (Alternate)</td>
<td>DC power</td>
</tr>
<tr>
<td>Internal Battery (Quantity)</td>
<td>4</td>
</tr>
<tr>
<td>Internal Battery (Type)</td>
<td>AA [2]</td>
</tr>
<tr>
<td>DC Power (± 5 %)</td>
<td>to 10 VDC</td>
</tr>
<tr>
<td>DC Power</td>
<td>to 2.4 amps</td>
</tr>
<tr>
<td>Battery Life (250 gram load)</td>
<td>2.3 hours [3]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical</th>
<th>699A02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (Diameter x Height)</td>
<td>2.2 in x 7.8 in</td>
</tr>
<tr>
<td>Weight (with batteries)</td>
<td>31 oz</td>
</tr>
<tr>
<td>Mounting Thread</td>
<td>1/4-28 Female [9][10]</td>
</tr>
<tr>
<td>Mounting Torque (Maximum)</td>
<td>to 10 in-lb [9]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supplied Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 073A15 Battery Pack [1]</td>
</tr>
<tr>
<td>Model 081A40 Mounting Stud [1]</td>
</tr>
<tr>
<td>Model M081A19 Mounting stud, 1/4-28 to M6 x 1, SS with shoulder [1]</td>
</tr>
</tbody>
</table>

### Notes

- All specifications are at room temperature unless otherwise specified
- [1] Typical
- [2] Alkaline type recommended for longest service life
- [3] Approximate values, based on automatic switch off time and dependent on type of batteries
- [4] Unit supplied set to rms; see manual for peak selection
- [5] Calculated values for reference only
- [6] Typical max for range
- [7] For sensors weighing >75 grams add Model 080A136 mass
- [8] Unit supplied set to auto shut off; see manual for continuous use selection
- [9] Transducer to shaker table
- [10] Test sensor should be hand tightened (without tools)

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Mounting Hardware

Magnetic mounting offers the most convenient method of temporary sensor installation for route-based measurements and data collection. IMI Sensors magnetic mounting bases feature rare-earth magnet elements to achieve high attraction forces to the test structure. This aids in high frequency transmissibility and assures attraction for weighty sensors and conditions of high vibration. Rail mount styles are utilized for curved surfaces, such as motor housings and pipes. Knurled housings aid in gripping for removal.

Note: Exercise caution when installing magnetically mounted sensors by engaging the edge of the magnet with the structure and carefully rolling the sensor/magnet assembly to an upright position. Never allow the magnet to impact against the structure as this may create shock acceleration levels that saturate the sensor. When the sensor is saturated users should wait a few seconds for the accelerometer to settle prior to taking data.

### Magnetic Mounting Bases

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Diameter</th>
<th>Thread</th>
<th>Pull Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For Flat Surface</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 080A120*</td>
<td>0.75 in (19 mm)</td>
<td>1/4-28 (M6 x 1.0) stud</td>
<td>15 lb (67 N)</td>
</tr>
<tr>
<td>Model 080A121*</td>
<td>1 in (25 mm)</td>
<td>1/4-28 (M6 x 1.0) stud</td>
<td>35 lb (156 N)</td>
</tr>
<tr>
<td>Model 080A122*</td>
<td>1.5 in (38 mm)</td>
<td>1/4-28 (M6 x 1.0) stud</td>
<td>50 lb (222 N)</td>
</tr>
<tr>
<td><strong>For Curved Surface</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 080A130*</td>
<td>0.75 in (19 mm)</td>
<td>1/4-28 (M6 x 1.0) stud</td>
<td>15 lb (67 N)</td>
</tr>
<tr>
<td>Model 080A131*</td>
<td>1 in (25 mm)</td>
<td>1/4-28 (M6 x 1.0) stud</td>
<td>35 lb (156 N)</td>
</tr>
<tr>
<td>Model 080A132*</td>
<td>1.5 in (38 mm)</td>
<td>1/4-28 (M6 x 1.0) stud</td>
<td>55 lb (245 N)</td>
</tr>
<tr>
<td>Model 080A133*</td>
<td>2 in (51 mm)</td>
<td>1/4-28 (M6 x 1.0) stud</td>
<td>85 lb (378 N)</td>
</tr>
</tbody>
</table>

Notes:
- For models with metric dimensions, please use “M” prefix with model number listed above.
These mounting pads may be adhesively bonded or welded to machinery surfaces at specific vibration sensor installation points. The pads ensure that periodic measurements are always taken from the exact same location, lending to more accurate and repeatable measurement data. Pads with tapped holes are for use with stud mounted sensors whereas the untapped pads are intended for use with magnetically mounted sensors. For permanent installations, the pads facilitate mounting of sensors without actually machining the surface onto which they are to be installed. Untapped pads may be utilized to achieve magnetic attraction on non-ferrous surfaces. All mounting pads are manufactured from resilient, stainless steel.

The quick disconnect adhesive pad and mating connector system allows for 1/4-turn mounting of sensors during route-based measurements. Simply install the adhesive pad at your monitoring locations and screw the mate onto the bottom of the accelerometer. The system shortens data collection time while providing a target for consistent sensor placement.
Mounting Hardware

Spot face tools install into a drill and prepare the machine surface for accelerometer mounting, creating a smooth surface and pilot hole. The pilot hole is then tapped to fit the sensor’s mounting thread.

IMI Sensors offers Data Collection Extension Poles which allow vibration technicians the ability to stay on the ground, away from heat sources, while collecting the data required to maintain the reliability of your machinery. The extension pole also offers quick access to measurement points, contributing to the overall efficiency of your routes.

The data collection poles are designed to be flexible to your specific applications and equipment. IMI® supplies cables & connectors to perfectly fit any modern data collector/analyzer manufacturer. High temperature bushings are included to adapt to your preferred sensor.

IMI Sensors offers Data Collection Extension Poles which allow vibration technicians the ability to stay on the ground, away from heat sources, while collecting the data required to maintain the reliability of your machinery. The extension pole also offers quick access to measurement points, contributing to the overall efficiency of your routes.

Data Collection Extension Pole
Model 080A225: 4-7 ft
Model 080A226: 6-11 ft

- Keeps technicians on the ground and away from heat sources, reducing the need for safety harnesses and other equipment
- Non-conductive properties reduce the risk of electric shock
- Includes multiple high temperature bushings to fit your preferred vibration sensor
- Spring loaded head tilts 180° for proper sensor placement (US Patent #27,076,138)

Sensor Bushings
400 °F (204 °C) High Temp Bushings, 70 Durometer
1/2” Outer Diameter 1” Outer Diameter
5/8” Outer Diameter 1 1/4” Outer Diameter
7/8” Outer Diameter

These epoxy kits provide a secure means for mounting accelerometers and adhesive mounting bases to machine structures. The small kit is intended for mounting approximately 10 sensors; and the large kit is intended for approximately 100 sensors.

Small Adhesive Kit
Model 075A05

Large Adhesive Kit
Model 075A06

Spot face tools install into a drill and prepare the machine surface for accelerometer mounting, creating a smooth surface and pilot hole. The pilot hole is then tapped to fit the sensor’s mounting thread.

1” Spot Face Tool
Model 080A137

1.25” Spot Face Tool
Model 080A128

1.5” Spot Face Tool
Model 080A129

1.25” Spot Face Tool
Model 080A128

1.5” Spot Face Tool
Model 080A129

Small Adhesive Kit
Model 075A05

Large Adhesive Kit
Model 075A06

These epoxy kits provide a secure means for mounting accelerometers and adhesive mounting bases to machine structures. The small kit is intended for mounting approximately 10 sensors; and the large kit is intended for approximately 100 sensors.

1” Spot Face Tool
Model 080A137

1.25” Spot Face Tool
Model 080A128

1.5” Spot Face Tool
Model 080A129

1.25” Spot Face Tool
Model 080A128

1.5” Spot Face Tool
Model 080A129

Small Adhesive Kit
Model 075A05

Large Adhesive Kit
Model 075A06

These epoxy kits provide a secure means for mounting accelerometers and adhesive mounting bases to machine structures. The small kit is intended for mounting approximately 10 sensors; and the large kit is intended for approximately 100 sensors.
Cables & Connectors

How To Order Custom Cables:
1. First determine whether the cable shall be ordered in English or Metric unit lengths
2. Choose the desired cable. (See “Standard Cable Types” below for cable specifications)
3. Find the connector that mates to the sensor.
4. Determine the length of cable required
5. Choose the cable termination connector. (See “Standard Connector Types” below)
6. Fill the squares with appropriate letter or number designation.

Example:
Model 052BR010AC defines a 10 ft, general purpose, polyurethane jacketed, shielded, twisted pair cable with a 2-pin socket MIL-style MS3106 composite sensor connector and a BNC plug termination connector.
Cables & Connectors

Polyurethane Cable, 2-conductor Twisted Pair, Shielded
Model 052 Cable
- Flexible cable, durable and easy to work with.
- Braided shield twists into drain wire
- Seals out moisture

Cable Information & Cordset Options

Model 052 Cable

Cable Construction

<table>
<thead>
<tr>
<th>Technical Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Jacket Material: Polyurethane</td>
</tr>
</tbody>
</table>
| Temperature Range: -58 to 250 °F
-50 to 121 °C |
| Capacitance: 36 pF/ft
118 pF/m |
| Cable Jacket Diameter: 6.35 mm |
| Number of Conductors: 2 |
| Shield Type: Braid (90% minimum coverage) |
| AWG (Gauge): 20 |

Conductor #1 Red (signal)
Conductor #2 Blue (ground)
Black Polyurethane Jacket
Braid Shield
22 AWG Drain Wire

Popular Cable Assemblies

- Molded Composite 2-socket MIL to Blunt Cut
  Model 052BRXXXBZ

- Silicone Environmental Push-On Boot 2-socket MIL to Blunt Cut
  Model 052AEXXXBZ

- Molded Composite Right Angle 2-socket MIL to BNC Plug
  Model 052BRXXXAC

- Molded Composite Right Angle 2-socket MIL to Blunt Cut
  Model 052BQXXXBZ

- Molded Composite 2-socket MIL To BNC Plug
  Model 052BRXXXAC

Performance	Typical Usage	Stock Cable Lengths
052BXXXBZ
Indoor/outdoor permanent mount sensor applications where low profile is required
10 ft, 30 ft, 50 ft
052AEXXXBZ
Indoor/outdoor applications where sensor will need to endure extreme wet conditions
30 ft, 50 ft
052BRXXXAC
Straight cable with BNC for route-based data collection or permanent mount installations
10 ft
052BQXXXBZ
Straight cable with BNC and right angle 2-socket MIL for route-based data collection
Built to order
High Temperature FEP Cable
2-conductor Twisted Pair with Drain, Shielded
Model 053 Cable
- Thin, slides easily, ideal for pulling through conduit & cable trays
- Drain wire attached to foil shield
- High temperature capability when paired with proper connector

Cable Information & Cordset Options

<table>
<thead>
<tr>
<th>Model 053 Cable</th>
<th>Technical Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cable Construction</strong></td>
<td><strong>Foil Shield</strong></td>
</tr>
<tr>
<td>Red FEP Jacket</td>
<td></td>
</tr>
<tr>
<td><strong>FEP Jacket Material</strong></td>
<td>FEP</td>
</tr>
<tr>
<td><strong>Temperature Range</strong></td>
<td>-90 to 392 °C</td>
</tr>
<tr>
<td><strong>Capacitance</strong></td>
<td>51 pF/ft</td>
</tr>
<tr>
<td><strong>Cable Jacket Diameter</strong></td>
<td>0.154 in</td>
</tr>
<tr>
<td><strong>Number of Conductors</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>Shield Type</strong></td>
<td>Aluminum/Mylar</td>
</tr>
<tr>
<td><strong>AWG (Gauge)</strong></td>
<td>18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Model 053 Cable</strong></th>
<th><strong>Technical Specifications</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model 053BRXXXBZ</strong></td>
<td><strong>Model 053AEXXXBZ</strong></td>
</tr>
<tr>
<td><strong>Model 053BPXXXBZ</strong></td>
<td><strong>Model 053BPXXXBZ</strong></td>
</tr>
</tbody>
</table>

Molded Composite Right Angle
2-socket MIL-style to Blunt Cut
Model 053BPXXXBZ

Silicone Environmental Push-On Boot
2-socket MIL-style to Blunt Cut
Model 053AEXXXBZ

Aluminum 2-socket MIL with Collar Strain Relief to Blunt Cut
Model 053BPXXXBZ

Cable Information & Cordset Options

<table>
<thead>
<tr>
<th><strong>Model 053 Cable</strong></th>
<th><strong>Typical Usage</strong></th>
<th><strong>Stock Cable Lengths</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>053BP000BZ</td>
<td>Indoor/Outdoor permanent mount sensor applications</td>
<td>10 ft, 20 ft, 30 ft, 50 ft</td>
</tr>
<tr>
<td>053BQXXXXBZ</td>
<td>Indoor/Outdoor permanent mount sensor applications where low profile is required</td>
<td>Built to order</td>
</tr>
<tr>
<td>053ADXXXXBZ</td>
<td>High temperature installations (over 250 °F) and extreme wet conditions</td>
<td>Built to order</td>
</tr>
<tr>
<td>053BPXXXXBZ</td>
<td>High temperature installations (over 250 °F) where metal sensor connector is preferred</td>
<td>Built to order</td>
</tr>
</tbody>
</table>

Performance Typical Usage Stock Cable Lengths

Visit us online at www.imi-sensors.com Toll-Free in USA 800-959-4464 716-684-0003
High Temperature FEP Cable
2-conductor Twisted Pair, Shielded

Model 055 Cable

- Slides easily, ideal for pulling through conduit and cable trays
- Larger diameter for harsh applications
- High temperature capability when paired with proper connector

<table>
<thead>
<tr>
<th>Cable Information &amp; Cordset Options</th>
<th>Technical Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 055 Cable</td>
<td></td>
</tr>
<tr>
<td><strong>Cable Construction</strong></td>
<td><strong>Cable Jacket Material</strong></td>
</tr>
<tr>
<td>Orange FEP Jacket</td>
<td>Temperature Range</td>
</tr>
<tr>
<td>Conductor #1 Red (signal)</td>
<td>-45 to 200 °C</td>
</tr>
<tr>
<td>Conductor #2 Black (ground)</td>
<td>Capacitance</td>
</tr>
<tr>
<td>Braid Shield</td>
<td>Cable Jacket Diameter</td>
</tr>
<tr>
<td></td>
<td>Number of Conductors</td>
</tr>
<tr>
<td></td>
<td>Shield Type</td>
</tr>
<tr>
<td></td>
<td>AWG (Gauge)</td>
</tr>
</tbody>
</table>

Popular Cable Assemblies

- High Temperature Molded Composite 2-socket MIL-style to Blunt Cut
  Model 055PAXXXBZ

- Silicone Environmental Push-on Boot 2-socket MIL-style to Blunt Cut
  Model 055AEXXXBZ

- Aluminum 2-socket MIL with Collar Strain Relief to Blunt Cut
  Model 055BPXXXBZ

- High Temperature Molded Composite Right Angle 2-socket MIL-style to Blunt Cut
  Model 055PBXXXBZ

- Silicone Environmental Push-On Boot 2-socket MIL-style to Blunt Cut
  Model 055ECXXXBZ

- FKM Environmental Push-On Boot 2-socket MIL-style to Blunt Cut
  Model 055M05/XXX

<table>
<thead>
<tr>
<th>Performance</th>
<th>Typical Usage</th>
<th>Stock Cable Lengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>055PAXXXBZ</td>
<td>High temperature (over 250 °F) permanent mount sensor applications</td>
<td>Built to order</td>
</tr>
<tr>
<td>055PBXXXBZ</td>
<td>High temperature (over 250 °F) permanent mount sensor applications where low profile is required</td>
<td>30 ft, 50 ft</td>
</tr>
<tr>
<td>055AXXXBZ</td>
<td>High temperature installations (over 250 °F) and extreme wet conditions</td>
<td>Built to order</td>
</tr>
<tr>
<td>055EAXXXBZ</td>
<td>High temperature installations (over 250 °F), extreme wet conditions, cable must be locked on sensor</td>
<td>Built to order</td>
</tr>
<tr>
<td>055BPXXXBZ</td>
<td>High temperature installations (over 250 °F) where metal sensor connector is preferred</td>
<td>Built to order</td>
</tr>
<tr>
<td>055M05</td>
<td>Acidic or corrosive installations</td>
<td>Built to order</td>
</tr>
</tbody>
</table>
Cables & Connectors

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Extreme high temperature installations up to 500 ºF
Built to order

Extreme High Temperature Low Noise PFA Cable 2-conductor Twisted Pair, Shielded
Model 045 Cable

- Designed for extreme high temperature applications
- Slides easily, ideal for pulling through conduit & cable trays
- Larger diameter for harsh applications

Cable Information & Cordset Options

Model 045 Cable

<table>
<thead>
<tr>
<th>Performance</th>
<th>Typical Usage</th>
<th>Stock Cable Lengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>045ERXXXXBZ</td>
<td>Extreme high temperature installations up to 500 ºF</td>
<td>Built to order</td>
</tr>
<tr>
<td>045ETXXXXBZ</td>
<td>Connects to on-turbine combustion dynamics pressure sensors</td>
<td>Built to order</td>
</tr>
</tbody>
</table>

Technical Specifications

- Cable Jacket Material: PFA
- Temperature Range: -190 to 500 ºF
- Capacitance: 35 pF/ft
- Cable Jacket Diameter: .204 in
- Number of Conductors: 2
- Shield Type: Braid (85% minimum coverage)
- AWG (Gauge): 22

Available Cable Assemblies

Extreme High Temperature 2-socket MIL to Blunt Cut
Model 045ERXXXXBZ

Extreme High Temperature 2-socket Mini-MIL to Blunt Cut
Model 045ETXXXXBZ
High Temperature Armor Jacketed FEP Cable
2-conductor, Twisted Pair with Drain, Shielded
Model 048 Cable

- Armor jacket protects cable from abuse
- Small diameter armor jacket makes for easy handling and installation
- High temperature capability when paired with proper connector

<table>
<thead>
<tr>
<th>Model 048 Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cable Information &amp; Cordset Options</strong></td>
</tr>
<tr>
<td><strong>Technical Specifications</strong></td>
</tr>
<tr>
<td>Cable Jacket Material: FEP</td>
</tr>
<tr>
<td>Temperature Range: -90 to 392 °F (−70 to 200 °C)</td>
</tr>
<tr>
<td>Capacitance: 51.6 pF/ft (167.3 pF/m)</td>
</tr>
<tr>
<td>Cable Jacket Diameter: .154 in (3.91 mm)</td>
</tr>
<tr>
<td>Number of Conductors: 2</td>
</tr>
<tr>
<td>Shield Type: Aluminum / Mylar</td>
</tr>
<tr>
<td>AWG Gauge: 18</td>
</tr>
</tbody>
</table>

| **Cable Construction** |
| Stainless Steel Armor Jacket |
| Foil Shield |
| Conductor #2 Blue (ground) |
| Conductor #1 Red (signal) |
| FEP Jacket |
| 20 AWG Drain Wire |

<table>
<thead>
<tr>
<th>Model 048 Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cable Assembly Options</strong></td>
</tr>
<tr>
<td><strong>Performance</strong></td>
</tr>
<tr>
<td>048APXXXBZ: High Temperature Aluminum 2-socket MIL with Collar Strain Relief to Blunt Cut</td>
</tr>
<tr>
<td>048BPXXXBZ: Silicone Environmental Push-On Boot 2-socket MIL-style to Blunt Cut</td>
</tr>
<tr>
<td>048AEXXXBZ: High Temperature Aluminum 2-socket MIL with Collar Strain Relief to Blunt Cut</td>
</tr>
<tr>
<td>048ECXXXBZ: Silicone Environmental Push-On Boot with Steel Locking Ring 2-socket MIL-style to Blunt Cut</td>
</tr>
</tbody>
</table>

| **Typical Usage** |
| Rugged installations where metal sensor connector is preferred |
| Rugged high temperature installations (over 250 °F) where metal sensor connector is preferred |
| Rugged high temperature installations (over 250 °F) and extreme wet conditions |
| Rugged high temperature installations (over 250 °F), extreme wet conditions, cable must be locked on sensor |

| **Stock Cable Lengths** |
| Built to order |
| Built to order |
| Built to order |
| Built to order |
**Cables & Connectors**

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---

**Armor Jacketed Polyurethane Cable, 2-conductor Twisted Pair, Shielded**

**Model 047 Cable**

- Armor jacket protects cable from abuse
- Largest diameter armor jacket
- Heat-shrink at blunt end seals out moisture

---

**Cable Information & Cordset Options**

**Model 047 Cable**

**Cable Construction**

- Stainless Steel Armor
- Braid Shield
- Conductor #1
  - Red (signal)
- Conductor #2
  - Blue (ground)
- Polyurethane Jacket
- 22 AWG Drain Wire

**Technical Specifications**

<table>
<thead>
<tr>
<th>Cable Jacket Material</th>
<th>Polyurethane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Range</td>
<td>-58 to 250 °F</td>
</tr>
<tr>
<td></td>
<td>-50 to 121 °C</td>
</tr>
<tr>
<td>Capacitance</td>
<td>36 pF/ft</td>
</tr>
<tr>
<td></td>
<td>118 pF/m</td>
</tr>
<tr>
<td>Cable Jacket Diameter</td>
<td>.250 in</td>
</tr>
<tr>
<td></td>
<td>6.35 mm</td>
</tr>
<tr>
<td>Number of Conductors</td>
<td>2</td>
</tr>
<tr>
<td>Shield Type</td>
<td>Braid (90% minimum coverage)</td>
</tr>
<tr>
<td>AWG (Gauge)</td>
<td>20</td>
</tr>
</tbody>
</table>

---

**Popular Cable Assemblies**

**Aluminum 2-socket MIL to Blunt Cut**

Model 047AMXXXBXZ

**Silicone Environmental Push-On Boot with Steel Locking Ring 2-socket MIL-style to Blunt Cut**

Model 047ECXXXBZ

---

**Performance**

**Typical Usage**

<table>
<thead>
<tr>
<th>Model</th>
<th>Usage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>047AMXXXBXZ</td>
<td>Rugged installations where metal sensor connector is preferred</td>
</tr>
<tr>
<td>047ECXXXBZ</td>
<td>Rugged installations (over 250 °F), wet conditions, cable must be locked on sensor</td>
</tr>
</tbody>
</table>

**Stock Cable Lengths**

- Built to order

---

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Cables & Connectors

General Purpose, Coiled Polyurethane Jacket Twisted Pair, Shielded
Model 050 Cable
- Ideal for route-based predictive maintenance with portable analyzer
- Many major data collector terminations available for immediate delivery
- Stays coiled despite heavy usage

<table>
<thead>
<tr>
<th>Model 050 Cable</th>
<th>Technical Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Construction</td>
<td>Cable Jacket Material</td>
</tr>
<tr>
<td></td>
<td>Temperature Range</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Capacitance</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cable Jacket Diameter</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of Conductors</td>
</tr>
<tr>
<td></td>
<td>Shield Type</td>
</tr>
<tr>
<td></td>
<td>AWG (Gauge)</td>
</tr>
</tbody>
</table>

Cable Information & Cordset Options

Model 050 Cable

Cable Construction

- Black Polyurethane Jacket
- Conductor #1 Red (signal)
- Conductor #2 Blue (ground)
- Braid shield over each conductor

Technical Specifications

- Cable Jacket Material: Thermoplastic Elastomer
- Temperature Range: -22 to 176 °F
- Capacitance: 31 pF/ft
- Cable Jacket Diameter: .21 in
- Number of Conductors: 2
- Shield Type: Braid (90% minimum coverage)
- AWG (Gauge): 23

Popular Cable Assemblies

2-socket MIL with Extended Strain Relief Ergonomic Design to 7-pin Connector
Model 050LQXXXDP

2-socket MIL with Extended Strain Relief to 25-pin D-Sub
Model 050FVXXXCW

2-socket MIL with Extended Strain Relief to 6-pin Connector
Model 050FVXXXHM

7-pin Connector to BNC Plug
Model 050DPXXXAC

5-pin Connector to BNC Plug
Model 050HXXXXAC

BNC Plug to BNC Plug
Model 050ACXXXAC

BNC Plug to 25-pin D-sub
Model 050ACXXXCV

See Page 176 for Information on Optional Breakaway Safety Connector

Performance | Typical Usage
---|---
EMI/RFI Chapman & Datamate analyzers
050LQXXXAC Emerson/CSI 2130 analyzer
050LQXXXHX Rockwell/Entek Datapak/Empac analyzers
050LQXXXDP Emerson/CSI 2110, 2115 & 2120 analyzers
050FVXXXCW SKF Microsig® analyzers
050FVXXXHM SKF Gx® series & Azema-DL OCA-31 analyzers
050ACXXXAC Connect accelerometer switch box outputs to Chapman & Datamate analyzers
050HPXXXAC Connect accelerometer switch box outputs to Rockwell/Entek Datapak/Empac analyzers
050HXXXAC Connect accelerometer switch box outputs to Emerson/CSI 2110, 2115 & 2120 analyzers
050BACXXXAC Connect accelerometer switch box outputs to Emerson/CSI 2130 analyzer

Stock Cable Lengths

- 6 ft & 10 ft
- Built to order
- Built to order

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4-conductor, Shielded, Polyurethane Jacketed Cable

Model 059 Cable
- Four conductor cable for use with triaxial, biaxial, dual temperature and vibration accelerometers
- Ideal for 4-20 mA loop-powered sensors with additional raw vibration or temperature output
- Braided shield twists into drain wire

**Cable Information & Cordset Options**

**Model 059 Cable**

<table>
<thead>
<tr>
<th>Cable Construction</th>
<th>Technical Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black Polyurethane Jacket</td>
<td>Cable Jacket Material: Polyurethane</td>
</tr>
<tr>
<td>4-conductors (black, white, green, red)</td>
<td>Temperature Range: -58 to 250 ºF</td>
</tr>
<tr>
<td>Braid Shield</td>
<td>-50 to 121 ºC</td>
</tr>
<tr>
<td>4-conductors</td>
<td>Capacitance: 36 µF/ft</td>
</tr>
<tr>
<td>(black, white, green, red)</td>
<td>118 µF/m</td>
</tr>
<tr>
<td>Braid Shield</td>
<td>Cable Jacket Diameter: .250 in</td>
</tr>
<tr>
<td></td>
<td>6.35 mm</td>
</tr>
<tr>
<td></td>
<td>Number of Conductors: 4</td>
</tr>
<tr>
<td></td>
<td>Shield Type: Braid (90% minimum coverage)</td>
</tr>
<tr>
<td></td>
<td>AWG (Gauge): 20</td>
</tr>
</tbody>
</table>

**Popular Cable Assemblies**

### Aluminum 4-socket MIL to Blunt Cut
Model 059ANXXXBZ

### Aluminum 4-socket MIL to 3 BNC's Labeled X, Y, Z, Shield Grounded
Model 059ANXXXNF

### Aluminum 4-socket MIL to 5-pin Connector
Model 059ANXXXHX

### Aluminum 4-socket MIL to 11-pin Connector
Model 059ANXXXGV

### Molded Composite 3-socket MIL-style to Blunt Cut
Model 059BVXXXBZ

### Molded Composite 3-socket MIL-style to 2 BNC's Labeled Temperature & Vibration
Model 059BVXXXLH

### Molded Composite 3-socket MIL-style to 2 BNC's Labeled X & Y
Model 059EFXXXLG

### Molded Composite 3-socket MIL-style to 2 BNC's Labeled X & Y
Model 059BVXXXLG

### Molded Composite 3-socket MIL-style to 2 BNC's Labeled X & Y
Model 059EFXXXLG

**Performance**

<table>
<thead>
<tr>
<th>Performance</th>
<th>Typical Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>059ANXXXBZ</td>
<td>Triaxial accelerometers to terminal block</td>
</tr>
<tr>
<td>059ANXXXNF</td>
<td>Triaxial accelerometers to DAQ with BNC jack input</td>
</tr>
<tr>
<td>059ANXXXHX</td>
<td>Triaxial accelerometers to CSI 2130 analyzer</td>
</tr>
<tr>
<td>059ANXXXGV</td>
<td>Triaxial accelerometers to Azima DLI DCM analyzer</td>
</tr>
<tr>
<td>059BVXXXBZ</td>
<td>Dual temperature &amp; vibration accelerometers, 4-20 mA transmitters with raw vibration to terminal block</td>
</tr>
<tr>
<td>059BVXXXLG</td>
<td>Dual temperature &amp; vibration accelerometers, 4-20 mA transmitters with raw vibration to DAQ with BNC jack input</td>
</tr>
<tr>
<td>059EFXXXBZ</td>
<td>Bi-axial accelerometers to terminal block</td>
</tr>
<tr>
<td>059EFXXXLG</td>
<td>Bi-axial accelerometers to DAQ with BNC jack input</td>
</tr>
<tr>
<td>059FXXXBZ</td>
<td>Rugged connection of temperature &amp; vibration, bi-axial or 4-20 with raw vibration to terminal block</td>
</tr>
<tr>
<td>059HCXXXBZ</td>
<td>4-20 mA vibration transmitters with temperature output (TEB series)</td>
</tr>
</tbody>
</table>

**Stock Cable Lengths**

- Built to order
- 10 ft
- Built to order
- Built to order
- Built to order
- Built to order
- Built to order
- Built to order
- Built to order
- Built to order
- Built to order

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Cables & Connectors

Contact IMI Sensors for more information on configurations for the cables featured on this page

**High Temperature FEP Cable, 4-conductor, Shielded**
Model 057 Cable
- Four-conductor cable for use with triaxial, biaxial, dual temperature and vibration accelerometers
- Ideal for 4-20 mA loop-powered sensors with additional raw vibration or temperature output
- For corrosive and high temperature applications when paired with proper connector

**Armor Jacketed, Polyurethane Cable, 4-conductor, Shielded**
Model 043 Cable
- Four-conductor cable for use with triaxial, biaxial, dual temperature and vibration accelerometers
- Ideal for 4-20 mA loop-powered sensors with additional raw vibration or temperature output
- Armor jacket protects cable from abuse

**High Temperature FEP Cable, 3-conductor Twisted, Shielded**
Model 056 Cable
- Three-conductor cable for use with triaxial, biaxial, dual temperature and vibration accelerometers
- Ideal for 4-20 mA loop-powered sensors with additional raw vibration or temperature output
- For corrosive and high temperature applications when paired with proper connector

**24-conductor Cable with Overall Shield and PVC Jacket**
Model 049 Cable
- Consolidate up to 12 channels worth of data into one cable bundle
- For use with cable interface boxes and cable-consolidating switch boxes
- Saves money and space over long cable runs to control room

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Technical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>057 Cable</th>
<th>043 Cable</th>
<th>056 Cable</th>
<th>049 Cable</th>
<th>046 Cable</th>
<th>044 Cable</th>
<th>058 Cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Jacket Material</td>
<td>FEP</td>
<td>Polyurethane</td>
<td>FEP</td>
<td>Polyvinyl Chloride</td>
<td>Polyvinyl Chloride</td>
<td>Polyurethane</td>
<td>Polyvinyl Chloride</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-85 to 392 ºF</td>
<td>-58 to 250 ºF</td>
<td>-85 to 392 ºF</td>
<td>-40 to 221 ºF</td>
<td>-40 to 221 ºF</td>
<td>-76 to 176 ºF</td>
<td>-58 to 250 ºF</td>
</tr>
<tr>
<td>Capacitance</td>
<td>24 pF/ft</td>
<td>36 pF/ft</td>
<td>27 pF/ft</td>
<td>23 pF/ft</td>
<td>23 pF/ft</td>
<td>20 pF/ft</td>
<td>38 pF/ft</td>
</tr>
<tr>
<td>Cable Jacket Diameter</td>
<td>.19 in</td>
<td>.250 in</td>
<td>.19 in</td>
<td>.61 in</td>
<td>.70 in</td>
<td>.17 in</td>
<td>.250 in</td>
</tr>
<tr>
<td>Number of Conductors</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>24</td>
<td>32</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Shield Type</td>
<td>Braid (85% minimum coverage)</td>
<td>Braid (90% minimum coverage)</td>
<td>Braid (85% minimum coverage)</td>
<td>Aluminum / Mylar</td>
<td>Aluminum / Mylar</td>
<td>Spiral (90% minimum coverage)</td>
<td>Braid (97% minimum coverage)</td>
</tr>
<tr>
<td>AWG (Gauge)</td>
<td>22</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>
Breakaway Safety Connector

- Prevents technicians from being pulled into rotating machinery
- Flexible ordering options allows for quick, in-field adaptations
- Many popular data collector terminations in stock

Product shown at actual size

Cable Information & Cordset Options

<table>
<thead>
<tr>
<th>Breakaway Safety Connector</th>
<th>Technical Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cable Construction</strong></td>
<td><strong>Connector Style</strong></td>
</tr>
<tr>
<td>2.09 in (53 mm)</td>
<td>Circular breakaway</td>
</tr>
<tr>
<td>Ø0.63 in (16 mm)</td>
<td></td>
</tr>
<tr>
<td>2.19 in (56 mm)</td>
<td></td>
</tr>
<tr>
<td>3.87 in (98 mm) Connected Lengths</td>
<td>3-Socket (female) / 3 Pin (male)</td>
</tr>
<tr>
<td></td>
<td>Coupling Method</td>
</tr>
<tr>
<td></td>
<td>Snap-On</td>
</tr>
<tr>
<td></td>
<td>Strain Relief</td>
</tr>
<tr>
<td></td>
<td>Potted</td>
</tr>
<tr>
<td></td>
<td>Temperature Range</td>
</tr>
<tr>
<td></td>
<td>-40 to +176 °F</td>
</tr>
<tr>
<td></td>
<td>-40 to +80 °C</td>
</tr>
<tr>
<td></td>
<td>Shell Protection</td>
</tr>
<tr>
<td></td>
<td>IP67</td>
</tr>
<tr>
<td></td>
<td>Housing Material</td>
</tr>
<tr>
<td></td>
<td>Plastic</td>
</tr>
<tr>
<td></td>
<td>Size (OD x Length)</td>
</tr>
<tr>
<td></td>
<td>0.75 in x 2.2 in</td>
</tr>
<tr>
<td></td>
<td>19 mm x 57 mm</td>
</tr>
<tr>
<td></td>
<td>Weight</td>
</tr>
<tr>
<td></td>
<td>0.39 oz</td>
</tr>
<tr>
<td></td>
<td>11.1 gm</td>
</tr>
</tbody>
</table>

6 ft. Coiled Cable, 2-socket MIL with Extended Strain Relief to 3-pin Half Breakaway Connector

Model 050LQ006LU Cable*

*Model 050LQ006LU required. Choose option below that corresponds with your data acquisition equipment.

- 3-Socket Half Breakaway Connector to 5-pin Connector
  Model 052LXXXHX

- 3-Socket Half Breakaway Connector to 7-pin Connector
  Model 052LXXXDP

- 3-Socket Half Breakaway Connector to 6-pin Connector
  Model 052LXXXHM

- 3-Socket Half Breakaway Connector to 25-pin D-Sub
  Model 052LXXXCV

- 3-Socket Half Breakaway Connector to 25-pin D-Sub
  Model 052LXXXCW

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- Technical Information - Pressure Sensors . 185
## Accelerometer Selection Worksheet

Answering the following questions will help define the sensor best suited for a particular application. Refer to the following pages on “Accelerometer Selection Guidelines”, for detailed information regarding each of the questions below.

### 1. Measurement Range / Sensitivity

Enter the highest overall acceleration level to be measured. _________ g (m/sec^2)

- If < 10 g (98 m/sec^2), choose 100 mV/g (most commonly used).
- If > 10 g (98 m/sec^2), choose 10 mV/g.
- If < 0.001g (0.0098 m/sec^2), choose 500 mV/g.
- If monitoring slow speed machinery, <500 cpm (8 Hz) or seismic (e.g., building or bridge vibrations), choose 500 mV/g or higher sensitivity.

### 2. Frequency Range

Lowest frequency to be analyzed _______ cpm (Hz)

Highest frequency to be analyzed _______ cpm (Hz)

### 3. Broadband Resolution

(select the smallest of the two)

Lowest vibration amplitude of interest _________ g (m/sec^2)

Smallest change in vibration level to be resolved _________ g (m/sec^2)

### 4. Temperature Range (select one)

- Normal Temperature ___ <250 °F (121 °C)
- High Temperature ___ <325 °F (162 °C)
- Very High Temperature ___ <500 °F (260 °C)
- Cryogenic (contact IMI) ___ < -65 °F (-54 °C)

### 5. Size

Max footprint allowable ________ in (mm)

Max height allowable (clearance) ________ in (mm)

### 6. Duty

(accuracy/sensitivity tolerance required)

- ___ Permanent mount
- ___ Walk-a-round

### 7. Cable

Integral cable required ____ Yes ____ No

If Yes, enter length _________ ft (m)

Temperature Range:

- For -58 to 250 °F (-50 to 121 °C), use polyurethane jacketed cable, (Models 042 or 052) or equivalent.
- For -90 to 392 °F (-70 to 200 °C), use (FEP) jacketed cable, Model 053.
- For -130 to 500 °F (-90 to 260 °C), use (PFA) jacketed cable, Model 045.

Armored Cable Required ____ Yes ____ No

### 8. Submersion

If used in a submerged application up to 750 psi (51.7 bar), select an integral polyurethane cable (Models 042, 052, or 059). Note: Any accelerometer, whose model number includes a one (1) in the second to last character, is supplied with an integral polyurethane cable, (e.g. Model 623C10).

### 9. Intrinsically Safe / Explosion Proof

Intrinsically safe required ____ Yes ____ No

- ____ “EP”—Explosion Proof Condulit Enclosure
- ____ “EX”—Intrinsically Safe Approved
- ____ “MS”—Mine Safety Administration Approved
- ____ “MX”—CENELEC Approved

Intrinsically Safe for Mining

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There will usually be several accelerometer models that will meet the required measurement parameters, so the question naturally arises, which should be used? This section provides detailed explanations for the questions on the “Accelerometer Selection Worksheet” on page 178. Use the information provided here to help answer the questions on the Worksheet as accurately as possible. This will result in a set of key specifications required for the accelerometer. For detailed specifications on these sensors, refer to the “Products by Technology Section” (pages 81-176).

1. Measurement Range / Sensitivity — Determine the maximum peak vibration amplitude that will be measured and select a sensor with an appropriate measurement range. For a typical accelerometer, the maximum measurement range is equal to ±5 volts divided by the sensitivity. For example, if the sensitivity is 100 mV/g then the measurement range is \((5 \text{ V} / 0.1 \text{ V/g}) = ±50 \text{ g}\). Allow some overhead in case the vibration is a little higher than expected.

2. Frequency Range — Determine the lowest and highest frequencies to be analyzed. If you are not sure what the upper frequency range should be, use the following table showing “Recommended Frequency Spans” as a guideline.

   **Recommended Frequency Spans (Upper Frequency)**
   - Shaft Vibration ............... 10 x RPM
   - Gearbox ...................... 3 x GMF
   - Rolling Element Bearings .... 10 x BPFI
   - Pumps ......................... 3 x VP
   - Motors / Generators .......... 3 x (2 x LF)
   - Fans .......................... 3 x BP
   - Sleeve Bearings .............. 10 x RPM
   - RPM — Revolutions Per Minute
   - GMF — Gear Mesh Frequency
   - BPFI — Ball Pass Frequency Inner race
   - VP — Vane Pass frequency
   - LF — Line Frequency (60 Hz in USA)
   - BP — Blade Pass frequency


   Select an accelerometer that has a frequency range that encompasses both the low and high frequencies of interest. In some cases, it may not be possible to measure the entire range of interest with a single accelerometer. In such a case, select the sensor that comes the closest to what is needed.

   High Frequency Caution — Many machines, such as pumps, compressors, and some spindles, generate high frequencies beyond the measurement range of interest. Even though these vibrations are out of the range of interest, the accelerometer is still excited by them. Since high frequencies are usually accompanied by high accelerations, they will often drive higher sensitivity accelerometers (100 and 500 mV/g models) into saturation causing erroneous readings. If a significant high frequency vibration is suspected or if saturation occurs, a lower sensitivity (typically 10 or 50 mV/g) accelerometer should be used. For some applications, IMI offers higher sensitivity accelerometers with built in low pass filters. These sensors filter out the unwanted high frequency signals and thus provide better amplitude resolution at the frequencies of interest. Contact an IMI® Application Specialist for assistance if you experience this problem.

   To determine if you have a condition that will overdrive (saturate) the accelerometer, look at the raw vibration signal in the time domain on a data collector, spectrum analyzer, or oscilloscope. Set the analyzer for a range greater than the maximum rated output of the accelerometer. If the amplitude exceeds the maximum rated measurement range of the accelerometer (typically 5 volts or 50 g for a 100 mV/g unit), then a lower sensitivity sensor should be selected. If the higher sensitivity sensor is used, clipping of the signal and saturation of the electronics is likely to occur. This will result in false harmonics, “ski slope” as well as many other serious measurement errors.

3. Broadband Resolution (Noise) — Determine the amplitude resolution that is required. This will be the smaller of either the lowest vibration level or the smallest change in amplitude that must be measured. Select a sensor that has a broadband resolution value equal to or less than this value. For example, if measuring a precision spindle with 0.0001 g minimum amplitude, choose an accelerometer with 100 g or better resolution. If the known vibration levels are in velocity (in/s) or displacement (mils), convert the amplitudes to acceleration (g) at the primary frequencies.

Note: The lower the resolution value, the better the resolution is. Generally, ceramic sensing elements have better resolutions (less noise) than do quartz.
Accelerometer Selection Guidelines

4. Temperature Range — Determine the highest and lowest temperatures that the sensor will be subjected to and verify that they are within the specified range for the sensor.

Temperature Transients — In environments where the accelerometer will be subjected to significant temperature transients, quartz sensors may achieve better performance than ceramic. Ceramic sensing elements are subject to the pyroelectric effect, which can cause significant changes in the sensitivity and result in erroneous outputs with changes in temperature. These outputs typically occur as drift (very low frequency) and usually cause significant “ski slope” in the velocity spectrum. Accelerometer temperature response curves, as shown below, are provided throughout this catalog. If temperature transients are suspected, refer to these graphs.

5. Size — In many cases, the style of the sensor used can be restricted by the amount of space that is available on a machine to mount the sensor. There are typically two parameters that govern which sensors will fit, the footprint and the clearance. The footprint is the area covered by the base of the sensor. The clearance is the height above the surface required to fit the sensor and cable. As an example, a top exit sensor will require more clearance than a side exit model. Footprint (hex, length, width) and clearance (height) values are provided in this catalog.

Space Constraints — Select a sensor that will fit into the space that is available. Basic dimensions are provided in this catalog for that purpose. Caution: Before machining any surfaces or tapping any holes, contact IMI for a current installation drawing. One of the main reasons for different accelerometer designs (top exit, side exit, swivel mount, etc.) is the need to fit the accelerometer into a particular space on a machine. For example, top exit models are typically more cost effective than side exit models but require much more clearance space than side exit models.

Orientation — Cable orientation is another consideration. Ring style, side exit models can be oriented 360°, however, in some very tight spaces, even these may be difficult to install. For example, there may not be enough height clearance to fit a wrench to tighten the unit. In that case, a Series 607A swivel mount style accelerometer may be required.

Side Exit Accelerometer

Swivel Mount Accelerometer

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6. Duty (Accuracy, Sensitivity Tolerance, and Safety)—The duty refers to the type of use that a sensor will see. The most typical uses for predictive maintenance applications are either in a walk around application, as with a portable data collector, or permanently mounted to a particular machine. In permanent mount applications, the sensor may terminate at a junction box where measurements are taken with a portable data collector or tied to an online monitoring system. 4-20 mA output sensors would usually be tied to existing plant systems such as a PLC.

Sensitivity Tolerance (Absolute Accuracy)—Sensitivity tolerance is the maximum deviation that the actual sensitivity of an accelerometer can vary from its published nominal sensitivity and still be within specification. IMI offers accelerometers with ±5%, ±10%, ±15%, and ±20% tolerances on sensitivity. Thus, a nominal 100 mV/g sensor with a ±5% tolerance could have an actual sensitivity between 95 and 105 mV/g. A ±20% tolerance unit could vary between 80 and 120 mV/g. If the nominal sensitivity is used to convert to engineering units (e.g., the calibration used with a data collection device), then a looser tolerance sensor will be less accurate, in general, than a tighter tolerance model. However, if the actual calibration value that is supplied with the sensor is used, then both readings will be equally accurate. In applications where absolute accuracy is important (e.g., in acceptance testing) then either higher tolerance sensors or actual calibration factors should be used. Lower tolerance sensors are typically provided with a single point calibration rather than full calibration. This, coupled with the looser tolerance, helps keep costs down and allows them to be offered at a much more economical price. Normally, these sensors are selected for permanent mount applications where larger numbers of accelerometers are needed.

Repeatability—All IMI® sensors, regardless of their sensitivity tolerance, are very repeatable. That means, a given measurement will repeat time and again, thus giving very accurate trends. If trend data is of primary importance, any IMI sensor will work fine even when using the nominal sensitivity.

Calibration Interval—Due to the inherent stability of quartz, accelerometers with quartz sensing elements have a longer recommended calibration interval than do ceramic sensors. The recommended time between calibrations is 1 year for ceramic sensors and 5 years for quartz. As a practical matter, however, it may not be possible to send ceramic sensors in for yearly recalibration. As long as the sensor is permanently mounted and not going through severe thermal transients on a regular basis, its sensitivity should remain fairly stable. However, if it is seeing repeated shocks (as with magnetic mounting in a walk around system) or severe thermal transients, it is highly recommended that the sensor be recalibrated yearly. One advantage of quartz sensors is its long-term stability even in high shock and thermally transient environments. It may also be advantageous to purchase a portable shaker for in-place sensitivity verification. See the Model 699A02 Portable Shaker on page 161.

Accessibility, Safety, and Production Considerations—Monitoring locations on machines are often inaccessible due to shrouds, space constraints, or other physical obstacles. Additionally, they may be in hazardous areas or have limited access due to pressing production schedules. In cases like these, low-cost, permanent mount accelerometers should be selected. This provides a fast, easy, and safe way to collect vibration data. When selecting these sensors, remember to also select the appropriate cabling, connectors, and switch or termination boxes.

7. Cable—It is recommended, in most cases, that connector style accelerometers be used rather than ones with integral cable. Cables are very susceptible to damage and are usually the source of most sensor problems, therefore, it is much easier and more cost effective to replace a cable rather than the entire accelerometer/cable assembly. Integral cable models are recommended in submersible applications where sealing is of prime importance. Armored cable is recommended in applications where sharp objects could cut the cable, such as metal chips in machining operations.

8. Submersion—If the accelerometer is used in a submersed application, it is generally recommended to use an integral cable. For submersed applications up to 750 psi (51.7 bar), select an integral polyurethane cable (IMI cable model numbers 042, 052, 059, or 062). Note: Any accelerometer, whose model number includes a one (1) in the second to last character, is supplied with an integral polyurethane cable (e.g., Model 623C10).

9. Intrinsically Safe/Explosion Proof—Many sensor models are approved for use in hazardous areas when used with a properly installed intrinsic safety (I.S.) barrier. Approval authorities include Canadian Standards Association, CENELEC, Factory Mutual, and Mine Safety Administration. Check the specification table of the sensor of interest to see which I.S. approvals are available for that model. IMI 4-20 mA models are also available with an explosion proof conduit enclosure.

10. Factory Assistance—When questions arise, do not hesitate to contact the factory to speak with an Application Specialist about your requirements.
Technical Information

Accelerometers

Piezoelectric Sensing Materials
Two categories of piezoelectric materials predominantly used in accelerometer designs are quartz and polycrystalline ceramics. Quartz is a naturally occurring crystal. However, the quartz used in sensors today is produced by a process that creates material free from impurities. Ceramic materials, on the other hand, are man-made. Different specific ingredients yield ceramic materials that possess certain desired sensor properties. Each material offers distinct benefits, and material choice depends on the particular performance features desired of the accelerometer.

Quartz
Quartz is widely known for its ability to perform accurate measurements tasks and contributes heavily in everyday applications for time and frequency measurements, such as wrist watches, radios, computers, and home appliances. Accelerometers also benefit from several unique characteristics of quartz. Since quartz is naturally piezoelectric, it has no tendency to relax to an alternative state and is considered the most stable of all piezoelectric materials. Quartz-based sensors, therefore, make consistent, repeatable measurements and continue to do so over long periods of time. Also, quartz has no output occurring from temperature fluctuations, a formidable advantage when placing sensors in thermally active environments. Because quartz has a low capacitance value, the voltage sensitivity is relatively high compared to most ceramic materials, making it ideal for use in voltage-amplified systems. Conversely, the charge sensitivity of quartz is low, limiting its usefulness in charge-amplified systems, where low noise is an inherent feature.

Ceramics
A wide variety of ceramic materials are used for accelerometers, and which material to use depends on the requirements of the particular application. All ceramic materials are man-made and are forced to become piezoelectric by a polarization process. This process, known as “poling,” exposes the material to a high-intensity electrical field, which aligns the electric dipoles, causing the material to become piezoelectric. Ceramics offer a higher output than quartz when using similar size crystals. They are an ideal choice for use with a large output is required from a very small sensor. Different ceramic packages may be used to determine such factors as charge sensitivity, voltage sensitivity, and temperature range. Charge output ceramics may be mated with built-in charge amplifier circuits to achieve high output signals, high resolution, and an excellent signal to noise ratio. High temperature ceramics are now being incorporated into charge mode accelerometers to operate to temperatures exceeding 900 °F (482 °C).

Structures for Piezoelectric Accelerometers
A variety of mechanical structures are available to perform the transduction principles required of a piezoelectric accelerometer. These configurations are defined by the nature in which the inertial force of an accelerated mass acts upon the piezoelectric material. Such terms as compression mode, flexural mode and shear mode describe the nature of the stress acting upon the piezoelectric material. Current designs of IMI® accelerometers utilize, almost exclusively, the shear mode of operation for their sensing elements. Therefore, the information provided herein is limited to that pertaining to shear mode accelerometers.
Shear Mode
Shear mode accelerometer designs feature sensing crystals attached between a center post and a seismic mass. A compression ring or stud applies a pre-load force to the element assembly to insure a rigid structure and linear behavior. Under acceleration, the mass causes a shear stress to be applied to the sensing crystals. This stress results in a proportional electrical output by the piezoelectric material. The output is collected by electrodes and transmitted by lightweight lead wires to either the built-in signal conditioning circuitry of ICP® sensors, or directly to the electrical connector for charge mode types. By having the sensing crystals isolated from the base and housing, shear mode accelerometers excel in rejecting thermal transient and base-bending effects. Also, the shear geometry lends itself to small size, which promotes high frequency response while minimizing mass loading effects on the test structure. With this combination of ideal characteristics, shear mode accelerometers offer optimum performance.

Sensor Mounting and Frequency Response
One of the most important considerations in dealing with accelerometer mounting is the effect the mounting technique has on the accuracy of the usable frequency response. The accelerometer’s operating frequency range is determined, in most cases, by securely stud mounting the test sensor directly to the reference standard accelerometer. The direct, stud mounted coupling to a very smooth surface generally yields the highest mounted resonant frequency and therefore, the broadest usable frequency range. The addition of any mass to the accelerometer, such as an adhesive or magnetic mounting base, lowers the resonant frequency of the sensing system and may affect the accuracy and limits of the accelerometer’s usable frequency range. Also, compliant materials, such as a rubber interface pad, can create a mechanical filtering effect by isolating and damping high-frequency transmissibility.

Surface Preparation
For best measurement results, especially at high frequencies, it is important to prepare a smooth and flat machined surface where the accelerometer is to be attached. Inspect the area to ensure that no metal burrs or other foreign particles interfere with the contacting surfaces. The application of a thin layer of silicone grease between the accelerometer base and the mounting surface also assists in achieving a high degree of intimate surface contact required for best high-frequency transmissibility.

Stud Mounting
For permanent installations, where a very secure attachment of the accelerometer to the test structure is preferred, stud mounting is recommended. First, grind or machine on the test object a smooth, flat area at least the size of the sensor base, per the manufacturer’s specifications. Then, prepare a tapped hole in accordance with the supplied installation drawing, ensuring that the hole is perpendicular to the mounting surface. Install accelerometers with the mounting stud and make certain that the stud does not bottom in either the mounting surface or accelerometer base. Most IMI® mounting studs have depth-limiting shoulders that ensure that the stud cannot bottom-out into the accelerometer’s base. Each base incorporates a counterbore so that the accelerometer does not rest on the shoulder. Acceleration is transmitted from the structure’s surface into the accelerometer’s base. Any stud bottoming or interfering between the accelerometer base and the structure inhibits acceleration transmission and affects measurement accuracy. When tightening, apply only the recommended torque to the accelerometer. A thread-locking compound may be applied to the threads of the mounting stud to safeguard against loosening.
Technical Information
Accelerometers

Screw Mounting
When installing accelerometers onto thin-walled structures, a cap screw passing through a hole of sufficient diameter is an acceptable means for securing the accelerometer to the structure. The screw engagement length should always be checked to ensure that the screw does not bottom into the accelerometer base. A thin layer of silicone grease at the mounting interface ensures high-frequency transmissibility.

Adhesive Mounting
Mounting by stud or screw may not always be practical. Adhesive mounting offers an alternative mounting method. The use of separate adhesive mounting bases is recommended to prevent the adhesive from damaging the accelerometer base or clogging the mounting threads. Miniature accelerometers that normally contain integral mounting studs may have the stud machined off to form a flat base. Most adhesive mounting bases available from PCB® also provide electrical isolation. This eliminates potential noise pick-up and ground loop problems.

The type of adhesive recommended depends on the particular application. Petro Wax (available from PCB®) offers a very convenient, easily removable approach for room temperature use. Two-part epoxies offer stiffness, which maintains high-frequency response and as the installation becomes a permanent mount. Other adhesives, such as dental cement, hot glues, instant glues, and duct putty are also viable options with a history of success. There is no one “best” adhesive for all applications because of the many different structural and environmental considerations, such as temporary or permanent mount, temperature, type of surface finish, and so forth.

To avoid damaging the accelerometers mounted with permanent adhesives, a debonding agent must be applied to the adhesive prior to sensor removal. With so many adhesives in use (everything from super glues, dental cement, epoxies, etc), there is no universal debonding agent available. The debonder for the Loctite 454 adhesive that PCB® Suggests is Acetone. If you are using anything other than Loctite 454, you will have to check with the individual manufactures for their debonding recommendations. The debonding agent must be allowed to penetrate the surface in order to properly react with the adhesive, so, after the application of the agent, it is advisable to wait a few minutes before removing the sensor. Once the debonding agent has set, you can use an ordinary open-end wrench applied to the hex or square base and, with a gentle shear (or twisting) motion (by hand only) the sensor can be removed from the test structure. Base or square base, or miniature teardrop accelerometers are supplied with a removal tool for use in the shearing motion.

Magnetic Mounting
Magnetic mounting bases offer a very convenient, temporary attachment to magnetic surfaces. Magnets offering high pull strengths provide best high-frequency response. Wedged dual-rail magnetic bases are generally used for installations on curved surfaces, such as motor and compressor housings and pipes. However, dual-rail magnets usually significantly decrease the operational frequency range of an accelerometer. For best results, the magnetic base should be attached to a smooth, flat surface. A thin layer of silicone grease should be applied between the sensor and magnetic base, as well as between the magnetic base and the structure to improve surface contact continuity. When surfaces are uneven or non-magnetic, steel pads can be welded or epoxied in place to accept the magnetic base.

Caution: Magnetically mounting an accelerometer has the potential to generate very high and very damaging acceleration levels. To prevent such damage, exercise caution when attaching the magnet to your test structure and gently “rock” or “slide” the assembly in place. Do not allow the magnet to “snap” on to the test structure as excessive “shocks” are generated. These “shocks” could damage the sensor. Another more ideal mounting method is to attach the magnetic base to your test structure first, and then screw the accelerometer on to the magnetic base.
Technical Information

Pressure Sensors

Typical Piezoelectric System Output
Piezoelectric pressure sensors measure fast responding, microsecond dynamic pressure events. They are not suited for longer, static events. Dynamic pressure measurements including turbulence, blast, ballistics and engine combustion may require sensors with special capabilities. Fast response, ruggedness, high stiffness, extended ranges, and the ability to also measure “quasi-static” pressures are standard features associated with PCB® quartz pressure sensors. The following information presents some of the design and operating characteristics of PCB® pressure sensors to help you better understand how they function, which, in turn, helps you make better dynamic measurements.

Types of Pressure Sensors
Piezoelectric pressure sensors are available in various shapes and thread configurations to allow suitable mounting for various applications. IMI® manufactures two types of piezoelectric sensors. Charge mode pressure sensors generate a high-impedance charge output. ICP® (Integrated Circuit Piezoelectric) voltage mode-type sensors feature built-in microelectronic amplifiers, which convert the high-impedance charge into a low-impedance voltage output. (ICP® is a registered trademark of PCB Group, Inc.)

Why Can Dynamic Pressure Only Be Measure with Piezoelectric Pressure Sensors?
The quartz crystals of a piezoelectric pressure sensor generate a charge when pressure is applied. However, even though the electrical insulation resistance is quite large, the charge eventually leaks to zero. The leakage rate is dependent on the electrical insulation resistance. In a pressure sensor with built-in ICP® electronics, the resistance and capacitance of the crystal and the built-in ICP® electronics normally determine the leakage rate. In a charge mode pressure sensor used with a voltage amplifier, the leakage rate is fixed by values of capacitance and resistance in the sensor, by low-noise cable, and by the external source follower voltage amplifier used. In the case of a charge mode pressure sensor used with a charge amplifier, the leakage rate is fixed by the electrical feedback resistor and capacitor in the charge amplifier.

The output characteristic of piezoelectric pressure sensor systems is that of an AC-coupled system, where repetitive signals decay until there is an equal area above and below the original base line. As magnitude levels of the monitored event fluctuate, the output remains stabilized around the base line with the positive and negative areas of the curve remaining equal. The graph (right) represents an AC signal following this curve. (Output from sensors operating in DC mode follow this same pattern but over an extended time frame associated with system discharge time constant values.)

Assume that a 0 to 3 volt output signal is generated from an AC-coupled pressure application with a one-second steady-state pulse rate and one second between pulses. The frequency remains constant, but the natural decay associated with a piezoelectric sensors will cause the signal to quickly decay negatively until the signal centers around the original base line. Eventually the signal reaches an equilibrium point, where the area above the baseline equals the area below the (area A = area B. The original output signal remains the same, though one is now reading a peak to peak output , from -1 Volt to +1 Volt, instead of an output from 0 to 3 Volts.

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Technical Information

Pressure Sensors

High Frequency Response
Most PCB® piezoelectric pressure sensors are constructed with either compression mode quartz crystals preloaded in a rigid housing, or unconstrained tourmaline crystals. These designs give the sensors microsecond response times and resonant frequencies in the hundreds of kHz, with minimal overshoot or ringing. Small diaphragm diameters ensure spatial resolution of narrow shockwaves. High-frequency response and rise time can be affected by mounting port geometry and associated electronics. Check all system component specifications before making measurements, or contact PCB® for application assistance.

Installation
Precision mounting of pressure sensors is essential for good pressure measurements. Although some mounting information is shown in this catalog, always check the installation drawings supplied in the product manual, or contact PCB® to request detailed mounting instructions. Good machining practices will improve the drilling and threading of mounting ports. Use the proper mounting torque, as noted on the specification sheet and/or installation drawing, during sensor installation. Mounting hardware is supplied with PCB® sensors, as noted on a product specification sheet. Various standard thread adaptors are available to simplify sensor installations. For free field blast applications, try to use “aerodynamically clean” mounts, minimizing unwanted reflections from mounting brackets or tripods.

The sensing crystals of many pressure sensors described in this catalog are located in the diaphragm end of the sensor. Side loading of this part of the sensor during a pressure measurement creates distortions in the signal output.

Also important is the avoidance of unusual side loading stresses and strains on the upper body of the sensor. Proper installation minimizes distortions in the output signal. A taut cable pulling at right angles to the electrical connector or a heavy electrical adaptor added to a smaller sensor connector are two examples of putting a side strain into the body. In the later case, the added connector mass, when used in a high vibration environment may cause the connector to break away from the sensor housing. In some applications, such as free-field blast measurements, a pressure sensor mounted in a thin plate can be subjected to side loading stresses caused when the plate flexes, under pressure. Use of an O-ring mounts suited to withstand the pressure levels under test minimizes this effect.

Flush vs. Recess Mounting
Flush mounting of pressure sensors in a plate or wall is desirable for maximizing the sensors frequency response, minimizing turbulence, avoiding a cavity effect, or avoiding an increase in a chamber volume. Recess mounting is more desirable in applications where the diaphragm end of the pressure sensor is likely to be subjected to potential damage, possibly from heat, excessive flash temperatures or particle impingement. Most PCB® pressure sensors are supplied with seal rings for flush mounting. Certain models can be provided with seal sleeves for recess mounting ports, as shown in the illustration (right). Consider ordering enough spare seal rings or sleeves, particularly in applications that require frequent removal and reinstallation of the pressure sensor. Before reinstalling a pressure sensor, be sure to check the mounting port to be sure that an old, distorted seal ring is not still in the mounting hole. If you are using PCB® pressure sensors and find that you have lost or misplaced the seals, call PCB® and request that the needed items be sent out as no-charge samples. Various mounting adaptors facilitate mounting of the pressure sensors. Note that pressure sensors and adaptors with straight machined threads use a seal ring as a pressure seal. Pipe thread adaptors have a tapered thread, which results in the threads themselves creating the pressure seal.
Flush vs. Recess Mounting (continued)

Control of the location of the pressure sensor diaphragm is achieved with a straight thread/seal ring mount. Reference the sensors installation instructions for proper mounting hole preparation instructions to achieve a flush mount. Pipe thread mounts do not allow a precision positioning of the depth of the sensor since the seal is provided by progressive tightening of threads in the tapered hole until the required thread engagement is reached. However, pipe threads do offer a convenience of an easier machined port than straight threads. Pipe thread mounts are well suited for some general applications.

Thermal Shock

Thermal shock can be in the form of a radiant heat, such as the flash from an explosion, heat from convection of hot gasses passing over a pressure sensor’s diaphragm, or conductive heat from a hot liquid. Virtually all piezoelectric pressure sensors are sensitive to thermal shock. As mentioned, most PCB® pressure sensors use quartz as the sensing crystal. Quartz, itself, is thermally insensitive to thermal transients. However, the crystals are preloaded between parts within the sensor itself, the sensors element package. When heat strikes the diaphragm of a piezoelectric pressure sensor, the heat can cause an expansion of the material surrounding the internal crystals. Although quartz crystals are not significantly sensitive to thermal shock, the case expansion causes a lessening of the preload force on the crystals, which will cause the signal to drift as a result of this change in preload. Usually, as heat goes up, sensor sensitivity will decrease causing a negative-going signal output drift. Precautions can be made to the test setup in an effort to minimize or delay thermal shock from distorting the intended output signal.

Certain PCB quartz pressure sensors feature thermal isolation designs to minimize the effects of thermal shock. Some feature baffled diaphragms. Other models designed for maximizing the frequency response may require thermal protection coating, recess mounting, or a combination to lessen the effects of thermal shock. Examples of coatings include silicone grease, which may also be used to fill a recess mounting hole, RTV silicone rubber, vinyl electrical tape, and ceramic coatings. The RTV and tape are used as ablatives, while the ceramic coating is also used to protect some diaphragms from corrosive gasses and particle impingements.

Crystals other than quartz are used in some PCB® sensors. Tourmaline is used for shock tube and underwater blast sensors because of its superior frequency characteristics. In shock tube measurements, the duration of the pressure measurement is usually so short that a layer of vinyl tape is sufficient to delay the thermal event from affecting the desired pulse for the duration of the desired measurement. In underwater blast applications, heat transfer through the water is not significant.

Note that thermal shock effects do not relate to the “temperature coefficient” pressure sensor specification. The temperature coefficient specification refers to the change in sensitivity of the sensor relative to the static, ambient temperature of the sensor. Unfortunately, since the thermal shock effects cannot be easily quantified, they must be anticipated and minimized by one of the above mentioned techniques in order to ensure better measurement data.

Polarity

When a positive pressure is applied to the diaphragm of an ICP® pressure sensor, the sensor yields a positive voltage. The polarity of PCB® charge mode pressure sensors is just the opposite: when a positive pressure is applied, the sensor yields a negative output. Charge output sensors are usually used with external charge amplifiers that invert the signal. Therefore, the resulting system output polarity of a charge output sensor used with a charge amplifier will produce a positive going output for a positive event. (Reverse polarity sensors are also available.)
Technical Information

Strain Sensors

Introduction
ICP® quartz strain sensors incorporate a built-in MOSFET microelectronic amplifier. This serves to convert the high impedance charge output into a low impedance voltage signal for analysis or recording. ICP® quartz strain sensors, powered from a separate constant current source, operate over long ordinary coaxial or ribbon cable without signal degradation. The low impedance voltage signal is not affected by triboelectric cable noise or environmental contaminants. Power to operate ICP® sensors is generally in the form of a low cost, 24-27 VDC, 2-20 mA constant current supply. The illustration below depicts a typical ICP® strain sensor system. PCB® offers a number of AC or battery-powered, single or multi-channel power/signal conditioners, with or without gain capabilities for use with strain sensors. In addition, many data acquisition systems now incorporate constant current power for directly powering ICP® sensors. Because static calibration or quasi-static short-term response lasting up to a few seconds is often required, PCB® manufactures signal conditioners that provide DC coupling.

ICP® quartz strain sensors are well suited for continuous, unattended strain monitoring in harsh factory environments. Also, ICP® sensor cost-per-channel is substantially lower, since they operate through standard, low-cost coaxial cable, and do not require expensive charge amplifiers. Refer to the installation/outline drawing and specification for details and dimensions of the particular sensor model number(s) purchased.

Description
240 series quartz strain sensors are used to monitor the dynamic response of crimping, stamping, punching, forming and any other applications where it is crucial to maintain process control. These sensors are ideal in applications where mounting directly in the load path with a force sensor is not possible. Instead, the sensor can be mounted in an area that will provide the highest mechanical stress for the process to be monitored. Strain sensors are mounted to a structure by means of a supplied socket flat head screw, which threads into a corresponding tapped hole, and is then fastened securely. When used with a constant current signal conditioner, the sensor output voltage can be resolved in units of strain and then related to specific events that must be monitored in the process. After defining a signature voltage response for properly manufactured parts, the user can then determine an acceptable upper and lower control limit in order to maintain process control thereby preventing the acceptance of non-conforming products as finished goods. Versions offering full-scale measurements of 10 µ to 300 µ are available. When powered by a constant current power supply and subjected to an input strain, an ICP® strain sensor will provide a corresponding output voltage. A positive output voltage indicates that the structure being monitored is being subjected to a tensile force in the sensor mounting area and can also be resolved in units of strain. Likewise, a compressive force in this area will result in a negative output voltage.

Typical ICP® Strain Sensor System
**General Installation**

Refer to the Installation Drawing for specific outline dimensions and installation details for your particular model.

It is important that the mounting surface is clean and free of paint, oil, or other coatings that could prevent the proper transfer of strain into the mounting pads of the sensor. Poor surface contact may affect sensor sensitivity and result in erroneous data. Prior to mounting, it is recommended that the machine surface and the mounting pads of the sensor be cleaned with acetone. This will maintain proper coupling with these mating surfaces and prevent slippage at peak strain. Connect one end of the coaxial cable to the sensor connector and the other end to the XDCR jack on the signal conditioner. Make sure to tighten the cable connector to the sensor. DO NOT spin the sensor onto the cable, as this fatigues the cable’s center pin, resulting in a shorted signal and a damaged cable. If the cable cannot be attached prior to sensor installation, the protective cap should remain on the connector to prevent contamination or damage.

For installation in dirty, humid, or rugged environments, it is suggested that the connection be shielded against dust or moisture with shrink tubing or other protective material. Strain relieving the cable/sensor connection can also prolong cable life. Mounting cables to a test structure with tape, clamps, or adhesives minimizes the chance of damage.

**Strain Sensor Installation**

The illustration (left) displays the sensor mounted using the supplied mounting screw to a minimum torque of 10 N-m. Allow for the static component of the signal to discharge prior to calibration. Installations not preloaded to the recommended value, or that utilizes a screw of different material and/or dimensions than the supplied screw, may yield inaccurate output readings. The supplied screw allows proper strain transmission to the sensor while holding the sensor in place. Properly machined holes for the mounting screw will ensure proper vertical orientation of the sensor. Refer to the installation drawing for additional mounting details. Consult a PCB® applications engineer for calibration and output recommendations.

**Polarity**

Extension of the mounting area of an ICP® strain sensor produces a positive-going voltage output. The retraction of the mounting area produces a negative-going voltage output.

**Low Frequency Monitoring**

Strain sensors used for applications in short term, steady-state monitoring, such as sensor calibration, or short term, quasistatic testing should be powered by signal conditioners that operate in DC-coupled mode. PCB® Series 484 Signal Conditioner operates in either AC or DC-coupled mode and may be supplied with gain features or a zero “clamped” output often necessary in repetitive, positive polarity pulse train applications.

If you wish to learn more about ICP® sensors, consult PCB’s General Signal Conditioning Guide, a brochure outlining the technical specifics associated with piezoelectric sensors. This brochure is available from PCB® by request, free of charge.

**Low Frequency Monitoring**

Strain sensors are calibrated relative to a strain gage reference sensor. A calibration certificate is supplied with each strain sensor providing its relative voltage sensitivity (mV/µ). A calibration must be performed once strain sensors are installed in the specific equipment being measured. This is necessary so that a direct comparison of relative data can be made thereby allowing the user to set control limits and properly monitor a specific event as well as the entire process.
Services & Qualifications


**Toll-free Customer Service** — IMI® offers direct, Toll-free telephone numbers for customer use. Specific numbers are available for the area in which your product interest lies. When uncertain, call our general number at 800-959-4464. Customer Service Representatives and Application Engineers are available to assist with requests for product literature, price quotations, discuss application requirements, orders, order status, expedited delivery, troubleshooting equipment, or arranging for returns. Our general fax number is: 716-684-3823. We look forward to hearing from you.

**24-hour SensorLineSM** — IMI® offers to all customers, at no charge, 24-hour emergency product or application support, day or night, seven days per week, anywhere in the world. To reach a IMI® SensorLineSM Customer Service Representative, call 716-684-0003.


**AS9100 and ISO 9001 Certifications** — IMI® is registered by the Underwriters Laboratory, Inc. as an AS9100 and ISO 9001 facility and maintains a quality assurance system dedicated to resolving any concern to ensure Total Customer Satisfaction. IMI® also conforms to the former MIL-STD-45662 and MIL-Q-9858.

**A2LA Accredited Calibration Facility** — PCB Piezotronics microphones, accelerometers, pressure and force transducers are calibrated with full traceability to NIST (National Institute of Standards & Technology) to ensure conformance to published specifications. Certificates of calibration are furnished which include actual measured data. Calibration systems utilized are kept in full compliance with ISO 9001:2000 standards. Calibration methods are accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories, as well as AS9100 and ISO 10012-1 standards. PCB® also meets requirements of ANSI/NCSL Z540-1-1994 and any additional program requirements in the field of calibration.

**Delivery Policy** — IMI® is committed to making every effort possible to accommodate all delivery requests. Our extensive in-house production capabilities permit us to manufacture most products to order in a timely fashion. In the event that a specific model is unavailable in the time frame that you need, we can usually offer a comparable unit, for sale or loan, to satisfy your urgent requirements. Many products are available from stock for immediate shipment. Standard cable assemblies and accessory hardware items are always stocked for immediate shipment and IMI® never requires a minimum order amount. If you have urgent requirements, call a factory representative and every effort will be made to fulfill your needs.

**Custom Products** — IMI® prides itself on being able to respond to customers’ needs. Heavy investment in machinery, capabilities, and personnel allow us to design, test, and manufacture products for specialized applications. Please contact us to discuss your special needs.

**CE Marking** — Many IMI® products are designed, tested, and qualified to bear CE marking in accordance with European Union EMC Directive. Products that have earned this qualification are so indicated by the logo.

**Hazardous Area Use** — Certain equipment is available with CSA® and/or ATEX® certifications to enable use in hazardous environments. Contact IMI® for detailed specifications, which will identify the specific approved environments for any particular model.

**Accuracy of Information** — IMI® has made a reasonable effort to ensure that the specifications contained in this catalog were correct at the time of printing. In the interest of continuous product improvement, IMI® reserves the right to change product specifications without notice at any time. Dimensions and specifications in this catalog may be approximate and for reference purposes only. Before installing sensors, machining any surfaces, or tapping any holes, contact a IMI® application specialist to obtain a current installation drawing and the latest product specifications.

**Routine Modification of Standard Models** — In addition to the product options noted in our catalogues, customers from all business sectors regularly request adjustments for their specific implementation and measurement needs. IMI® has accommodated customers by making numerous standard adjustments to thousands of sensors, as well as to associated electronics. These adjustments to sensitivity, range, frequency response, resolution, grounding issues, mounting, cabling, and electrical requirements can often be made for a certain premium over the base model.

**Stock Products** — For the added convenience of our customers, IMI® offers a wide selection of sensors and instrumentation as stock products, available in-house and off the shelf, competitively priced with expedited delivery. These products have been identified and stocked based upon customer demand, with models that offer reliability and versatility across multiple application environments. We also manufacture custom products made to your requirements. We invite our customers to work with our Applications Engineers in evaluating your application first, to see if we might have a stock product alternative that fits your requirements with a short delivery time.

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**IMI Sensors**
A PCB Piezotronics Div.

IMI Sensors designs and manufactures a full line of accelerometers, sensors, vibration switches, vibration transmitters, cables and accessories for predictive maintenance, continuous vibration monitoring, and machinery and equipment protection. Products include rugged industrial ICP® accelerometers; 4-20 mA industrial vibration sensors and transmitters for 24/7 monitoring; electronic and mechanical vibration switches; the patented Bearing Fault Detector, for early warning of rolling element bearing faults; high temperature accelerometers to +900 °F (+482 °C); 2-wire Smart Vibration Switch, with MAVIT™ technology, which automatically sets trip level; and the patented Reciprocating Machinery Protector, which outperforms conventional impact transmitters. CE approved and intrinsically safe versions are available for most products. Toll-free 1-800-959-4464; email: imi@pcb.com; [www.imi-sensors.com](http://www.imi-sensors.com)

**PCB® Aerospace & Defense**
A PCB Piezotronics Div.

PCB® Aerospace & Defense specializes in products and programs developed exclusively for the global aerospace, civil and military aviation, defense, homeland security, nuclear, power generation, and test and measurement markets. Products include space-rated high temperature and high-g shock accelerometers; space-qualified hardware, sensors and instrumentation for Health and Usage Monitoring Systems (HUMS), for UAV’s, helicopters, fixed wing aircraft and ground vehicles; system electronics; combustion monitoring pressure sensors; high temperature engine vibration monitoring sensors; launch and separation shock sensors; Active Noise Cancellation products, and aircraft hydraulic pressure sensors, among others. Typical applications include vibration and fatigue testing; qualification testing; aircraft and engine ground, flutter and flight testing; blast pressure and hydraulic system pressure measurements; structural dynamics; engine vibration monitoring; launch and separation shock studies; pressure, wind tunnel and aerodynamic studies; aircraft and ground vehicle prognostics; and noise cancellation applications. Toll-free in the USA 1-866-816-8892; email: aerosales@pcb.com.

**PCB® Automotive Sensors**
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PCB® Automotive Sensors is a dedicated sales and technical support facility, located in Novi, Michigan, devoted to the testing and instrumentation needs of the global automotive test market. This new team is focused on development and application of instrumentation technologies for specific vehicle development test programs, in the areas of modal and structural analysis, vehicle and component NVH characterization, powertrain testing, vehicle and component durability, vehicle dynamics, safety and regulatory testing, component and system level performance, driveability, road load, and crash, among others. PCB® designs and manufactures sensors for automotive testing, including vibration, acoustic, pressure, force, load, dynamic strain and torque sensing technologies. These robust sensors are designed to excel in a variety of automotive applications. Toll-free in the USA 1-888-684-0014; email: automotivesales@pcb.com

**Larson Davis Environmental Noise Monitoring and Industrial Hygiene**

Larson Davis Environmental Noise Monitoring and Industrial Hygiene offers a full line of Noise and Vibration measurement instrumentation, including Type 1 sound level meters, personal noise dosimeters, octave band, audiometric calibration systems, microphones and preamplifiers, hearing conservation software, and Human Vibration Exposure Monitor for Hand-Arm/Whole Body Vibration for evaluating human exposures to ISO 2631 and 5349, as well as to help ensure compliance with a number of ANSI and OSHA and other related industrial hygiene standards, as well as for measurement of building acoustics, community and environmental noise monitoring, as well as supporting various automotive, aerospace and industrial applications. Toll-free 1-888-258-3222; email: sales@larsondavis.com; [www.larsondavis.com](http://www.larsondavis.com)

**PCB Piezotronics Test & Measurement Products**

PCB Piezotronics Test & Measurement Products supports the application of traditional sensor technologies of acoustics, pressure, force, load, strain, torque, acceleration, shock, vibration, electronics and signal conditioning within product design and development, consumer product testing, quality assurance, civil structure monitoring, research and development, education and engineering application areas. Visit [wwwpcb.com](http://wwwpcb.com) for more details

**The Modal Shop, Inc.**  ([www.modalshop.com](http://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.

**PCB Load & Torque, Inc.,** a wholly-owned subsidiary of PCB Piezotronics, is a manufacturer of high quality, precision load cells, torquu transducers, telemetry units, fastener technology test systems, and threaded fastener torque / angle / tension systems. In addition to the quality products produced, the PCB Load & Torque facility offers many services.

**Company Information**

**PCB Piezotronics**  
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