Model EX611A20

Charge Output Accelerometer

Installation and Operating Manual

**For assistance with the operation of this product,
contact PCB Piezotronics, Inc.**

Toll-free: 800-828-8840
24-hour SensorLine: 716-684-0001
Fax: 716-684-0987
E-mail: info@pcb.com
Web: www.pcb.com

Repair and Maintenance

PCB guarantees Total Customer Satisfaction through its "Lifetime Warranty Plus" on all Platinum Stock Products sold by PCB and through its limited warranties on all other PCB Stock, Standard and Special products. Due to the sophisticated nature of our sensors and associated instrumentation, **field servicing and repair is not recommended and, if attempted, will void the factory warranty**.

Beyond routine calibration and battery replacements where applicable, our products require no user maintenance. Clean electrical connectors, housings, and mounting surfaces with solutions and techniques that will not harm the material of construction. Observe caution when using liquids near devices that are not hermetically sealed. Such devices should only be wiped with a dampened cloth—never saturated or submerged.

In the event that equipment becomes damaged or ceases to operate, our Application Engineers are here to support your troubleshooting efforts 24 hours a day, 7 days a week. Call or email with model and serial number as well as a brief description of the problem.

Calibration

Routine calibration of sensors and associated instrumentation is necessary to maintain measurement accuracy. We recommend calibrating on an annual basis, after exposure to any extreme environmental influence, or prior to any critical test.

PCB Piezotronics is an ISO-9001 certified company whose calibration services are accredited by A2LA to ISO/IEC 17025, with full traceability to SI through N.I.S.T. In addition to our standard calibration services, we also offer specialized tests, including: sensitivity at elevated or cryogenic temperatures, phase response, extended high or low frequency response, extended range, leak testing, hydrostatic pressure testing, and others. For more information, contact your local PCB Piezotronics distributor, sales representative, or factory customer service representative.

Returning Equipment

If factory repair is required, our representatives will provide you with a Return Material Authorization (RMA) number, which we use to reference any information you have already provided and expedite the repair process. This number should be clearly marked on the outside of all returned package(s) and on any packing list(s) accompanying the shipment.

Contact Information

PCB Piezotronics, Inc.
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Depew, NY14043 USA
Toll-free: (800) 828-8840
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General inquiries: info@pcb.com
Repair inquiries: rma@pcb.com

For a complete list of distributors, global offices and sales representatives, visit our website, www.pcb.com.

Safety Considerations

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the precautions required to avoid injury. While our equipment is designed with user safety in mind, the protection provided by the equipment may be impaired if equipment is used in a manner not specified by this manual.

Discontinue use and contact our 24-Hour Sensorline if:

- Assistance is needed to safely operate equipment
- Damage is visible or suspected
- Equipment fails or malfunctions

For complete equipment ratings, refer to the enclosed specification sheet for your product.

Definition of Terms and Symbols

The following symbols may be used in this manual:

DANGER
Indicates an immediate hazardous situation, which, if not avoided, may result in death or serious injury.

CAUTION
Refers to hazards that could damage the instrument.

NOTE
Indicates tips, recommendations and important information. The notes simplify processes and contain additional information on particular operating steps.

The following symbols may be found on the equipment described in this manual:

This symbol on the unit indicates that high voltage may be present. Use standard safety precautions to avoid personal contact with this voltage.

This symbol on the unit indicates that the user should refer to the operating instructions located in the manual.

This symbol indicates safety, earth ground.

PCB工业监视和测量设备 - 中国RoHS2公布表

PCB Industrial Monitoring and Measuring Equipment - China RoHS 2 Disclosure Table

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
住房	O	O	O	O	O	O
PCB板	X	O	O	O	O	O
电气连接器	O	O	O	O	O	O
压电晶体	X	O	O	O	O	O
环氧	O	O	O	O	O	O
铁氟龙	O	O	O	O	O	O
电子	O	O	O	O	O	O
厚膜基板	O	O	X	O	O	O
电线	O	O	O	O	O	O
电缆	X	O	O	O	O	O
塑料	O	O	O	O	O	O
焊接	X	O	O	O	O	O
铜合金/黄铜	X	O	O	O	O	O

本表格依据 SJ/T 11364 的规定编制。

O： 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

X： 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

铅是欧洲RoHS指令2011/65/ EU附件三和附件四目前由于允许的豁免。

CHINA RoHS COMPLIANCE

Component Name	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Chromium VI Compounds (Cr(VI))	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
Housing	O	O	O	O	O	O
PCB Board	X	O	O	O	O	O
Electrical Connectors	O	O	O	O	O	O
Piezoelectric Crystals	X	O	O	O	O	O
Epoxy	O	O	O	O	O	O
Teflon	O	O	O	O	O	O
Electronics	O	O	O	O	O	O
Thick Film Substrate	O	O	X	O	O	O
Wires	O	O	O	O	O	O
Cables	X	O	O	O	O	O
Plastic	O	O	O	O	O	O
Solder	X	O	O	O	O	O
Copper Alloy/Brass	X	O	O	O	O	O

This table is prepared in accordance with the provisions of SJ/T 11364.

O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

X: Indicates that said hazardous substance contained in at least one of the homogeneous materials for this part is above the limit requirement of GB/T 26572.
Lead is present due to allowed exemption in Annex III or Annex IV of the European RoHS Directive 2011/65/EU.

General

OPERATING GUIDE

for use with

PIEZOELECTRIC CHARGE MODE ACCELEROMETERS

SPECIFICATION SHEET, INSTALLATION DRAWING
AND CALIBRATION INFORMATION ENCLOSED

PCB ASSUMES NO RESPONSIBILITY FOR DAMAGE CAUSED TO THIS PRODUCT AS A RESULT OF PROCEDURES THAT ARE INCONSISTENT WITH THIS OPERATING GUIDE.

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INTRODUCTION

Congratulations on the purchase of a quality PCB charge mode accelerometer. In order to ensure the highest level of performance for this product, it is imperative that you properly familiarize yourself with the correct mounting and installation techniques before attempting to operate this device. If, after reading this manual, you have any additional questions concerning this sensor or its application, feel free to call an Application Engineer at 716-684-0001 or the closest PCB representative.

1.1 Cables in Explosive Atmospheres

The cable lengths (Integral and Cable and Cable Assemblies) INSTALLED IN AN EXPLOSIVE ATMOSPHERE IS DEFINED IN THE ATEX, IECEx, CSA, ETC. APPROVAL CERTIFICATES.

1.2 High Temperature Differential Charge Output Sensor

Ceramic or Single crystal shear-structured accelerometers offer high performance for precision vibration measurements in high-temperature environments. The use of ceramic or single crystal sensing crystals, operating in the shear mode, reduces erroneous output due to base strain, thermal transients, and transverse motion.

Charge mode accelerometers output a strong, high-impedance charge signal directly from their piezoelectric sensing element. They do not contain built-in signal conditioning electronics; the signal is conditioned externally by either a laboratory-style charge amplifier or in-line charge converter prior to being analyzed by a readout or recording device. The absence of built-in electronics permits operation to elevated temperatures of 500 °F (260 °C) for most models or up to 1300 °F (700 °C) for special applications.

These accelerometers are ideal for structural testing, machine monitoring, ~~and~~ vehicular shock, high temperature machinery and power generation turbine and other vibration measurement tasks where high temperatures preclude the use of accelerometers with built-in microelectronics.

Enclosed is a **Specification Sheet**, which lists the complete performance characteristics of the particular accelerometer.

2 CABLING

2.1 General Precautions and Considerations

2.1.1 Proper Cable Type and Care

Ascertain that you have ordered the correct cable type. Due to the high-impedance nature of the output signal generated by charge mode accelerometers, several important precautionary measures must be followed. When using soft-line cable always use special low-noise PCB Series 045 Low-Noise Cable (or equivalent) for connecting to the input of the differential charge-output accelerometers. For extremely high temperature charge mode applications use mineral insulated (MI) hard-line.

Care and attention to installation is essential, as the reliability and accuracy of your system is no better than that of the output cable. Cables and connectors must be kept clean and dry to maintain high insulation resistance and low frequency responce. In the event that the insulation resistance is compromised, inspect, clean, and bake cables and connectors to restore insulation resistance.

2.2 Softline Cable

Special high temperature low-noise, shielded cable 2-wire cable assembly is required with charge mode sensors for applications up to 500°F to connect the transducer to the charge amp. When additional mechanical protection is required a stainless steel armor can be used.

The shield acts as a Faraday cage to reduce electrical noise from corrupting the signals, and minimizes capacitively coupled noise from other electrical sources.

Standard, two-wire, or coaxial cable, when flexed, generates a charge between the conductors. This is referred to as triboelectric noise and cannot be distinguished from the sensor's charge output. Low-noise cables have a special graphite lubricant between the dielectric and the braided shield, which minimizes the triboelectric effect and improves the quality of the sensor's charge output signal.

When using separate cables connect the cable to the accelerometer. A small amount of thread-locking compound placed on the connector prior to attachment helps secure the cable during testing. In harsh environments, the connection can be sealed with silicone rubber, O-rings, and flexible heat-shrink tubing.

2.3 Integral Hardline Cable

For extremely high temperature (>500°F) charge mode applications use mineral insulated (MI) hardline. Keep cable clean to maintain insulation resistance and good low-frequency response

2.4 Hardline Connection Type

2.4.1 PCB / Lemo type connector

The Lemo connector is PCA.0S.302.CLAC42 that is specially adapted for use with hardline cable. The connector is a self-latching system that allows the connector to be mated by simply pushing the plug axially into the socket. When required the connector is disengage by a single axial pull on the outer release sleeve.

2.4.2 High Temperature 2 –pin 7/16-27 UNS connector

This connector is a Model GP, 2 Pin Jack, 7/16-27 thread. The connector is welded to the hardline to provide a high temperature, hermetic connection. The GP connector uses a threaded connction to mate with a GN or QY 2-Socket plug and torqued to 5 ft*lbs +/- 1 ft*lb

2.5 Differential Charge Amplifier

The differential charge amplifier is purchased separately

A conventional method for conditioning the high-impedance signal generated by a charge output sensor is to use a differential charge amplifiers operate from an ICP ® signal conditioner. The unit employs a high gain amplifier to perform the impedance transformation. The charge output of the transducers may be scaled in terms of acceleration, pressure or force. The output is then mV/g, mV/psi or mV/lb, respectively.

3 INSTALLATION OVERVIEW

3.1 Equipment Inspection

Before installing the accelerometer, verify the insulation resistance (I/R) of the sensor is per specification. I/R can be out of specification due to mishandling and/or damage.

3.2 Polarity Test

Use this test to verify the proper polarity response. Improper polarity will adversely affect the use of the sensor for machinery diagnostics such as balancing.
Step 1 – Connect the sensor to a charge amp and any ICP ® signal conditioner. Using standard cable, connect the powered sensor to an oscilloscope.
Step 2 – Set the time scale to 20 milliseconds/division
Step 3 – Hold the transducer in hand and tap the bottom. The wavefrom on the oscilloscope first goes positive as shown in Figure 1. If the waveform goes negative the wiring is reversed, contact PCB for technical support.

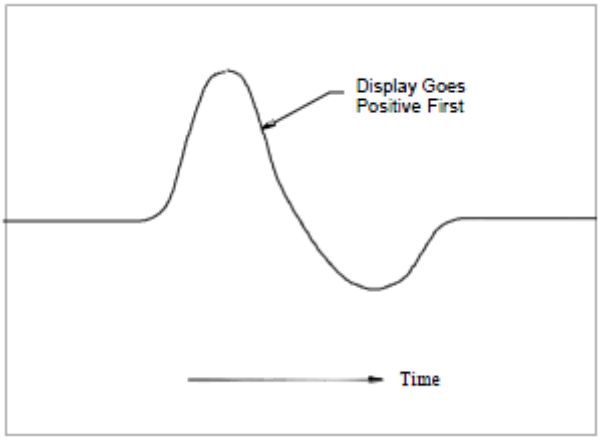


FIGURE 1

3.3 Sensor Location

Characteristics like location, ruggedness, amplitude range, accessibility, temperature, and portability are extremely critical.

For optimum performance and measurement find a rigid location on the machine casing that most accurately represents the vibration of the rotor, bearing, fan, etc. to be measured.).

3.4 Mounting Sensor

When choosing a mounting method, consider closely both the advantages and disadvantages of each technique. Characteristics like location, ruggedness, amplitude range, accessibility, temperature, and portability are extremely critical. However, the most important and often overlooked consideration is the effect the mounting technique has on the high-frequency performance of the accelerometer.

Shown hereafter are six possible mounting techniques and their effects on the performance of a typical piezoelectric accelerometer. (Note that not all of the mounting methods may apply to your particular sensor.) The mounting configurations and corresponding graph demonstrate how the high-frequency response of the accelerometer may be compromised as mass is added to the system and/or the mounting stiffness is reduced.

Note: *The low-frequency response is unaffected by the mounting technique. Its roll-off behavior is dependent*

upon the coupling type or time constant of the external charge amplifying device. This characteristic may be fixed or adjustable, depending on the charge amplifier. Please refer to the appropriate charge amplifier specification sheet for information on low-frequency characteristics.

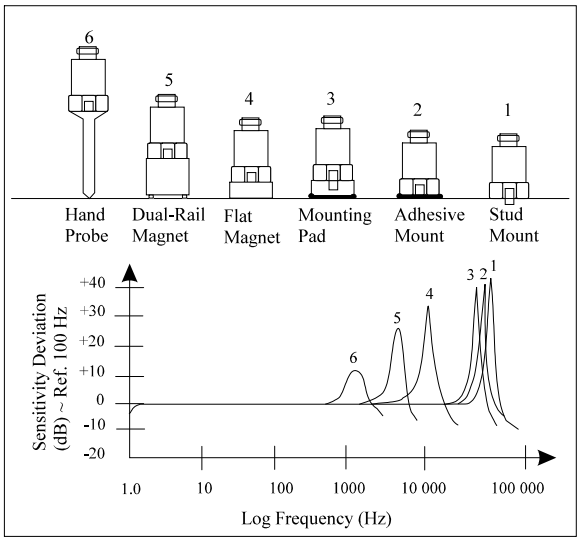


Figure 1. Assorted Mounting Configurations and Their Effects on High Frequency

3.4.1 STUD MOUNT

This mounting technique requires smooth, flat contact surfaces for proper operation and is recommended for permanent and/or secure installations. Stud mounting is also recommended when testing at high frequencies.

Note: *Do NOT attempt mounting on curved, rough, or uneven surfaces, as the potential for misalignment and limited contact surface may significantly reduce the sensor's upper operating frequency range.*

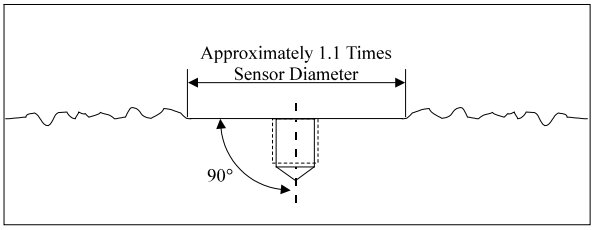


Figure 2. Mounting Surface Preparation

STEP 1: First, prepare a smooth, flat mounting surface, then drill and tap a mounting hole in the center of this area as shown in Figure 2 and in accordance with the **Installation Drawing** for the specific sensor that is being mounted**.**

A precision-machined mounting surface with a minimum finish of 63 μin (0.00016 mm) is recommended. (If it is not possible to properly prepare the test structure mounting surface, consider adhesive mounting as a possible alternative.) Inspect the area, checking that there are no burrs or other foreign particles interfering with the contact surface.

STEP 2: Wipe clean the mounting surface and spread on a light film of grease, oil, or similar coupling fluid prior to installation.

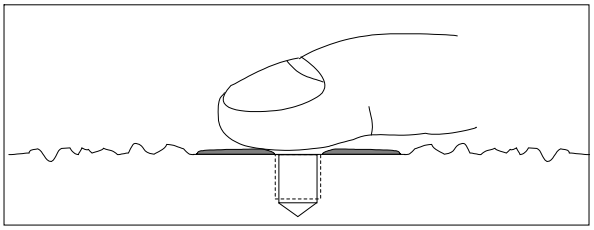


Figure 3. Mounting Surface Lubrication

Adding a coupling fluid improves vibration transmissibility by filling small voids in the mounting surface and increasing the mounting stiffness. For semi-

permanent mounting, substitute epoxy or another type of adhesive.

STEP 3: Screw the mounting stud into the base of the accelerometer and hand-tighten. Then, screw the sensor/stud assembly into the prepared tapped hole and tighten to the recommended mounting torque as indicated on the **Installation Drawing**.

Note: *It is important to use a torque wrench during this step. Under-torquing the sensor may not adequately couple the device; over-torquing may result in stud failure.*

3.4.2 ADHESIVE MOUNT
Adhesive mounting is often used for temporary installation or when the test object surface cannot be adequately prepared for stud mounting. Adhesives like hot glue and wax work well for temporary mounts; two-part epoxies and quick-bonding gels provide a more permanent mount.

Note: *Adhesively mounted sensors often exhibit a reduction in high-frequency range. Generally, smooth surfaces and stiff adhesives provide the best frequency response.*

METHOD 1 - Adhesive Mounting Base
This method involves attaching a base to the test structure, then securing the sensor to the base. This allows for easy removal of the accelerometer. Also, since the bases are of a "hard-coated" aluminum design, they provide electrical isolation to eliminate ground loops and reduce electrical interference that may be present on the surface of the test object.

STEP 1: Prepare a smooth, flat mounting surface. A minimum surface finish of 63 μin (0.00016 mm) generally works best.

STEP 2: Stud-mount the sensor to the appropriate adhesive mounting base according to the guidelines set forth in **STEPS 2** and **3** of the Stud Mount Procedure.

STEP 3: Place a small portion of adhesive on the underside of the mounting base. Firmly press down on the assembly to displace any extra adhesive remaining under the base.

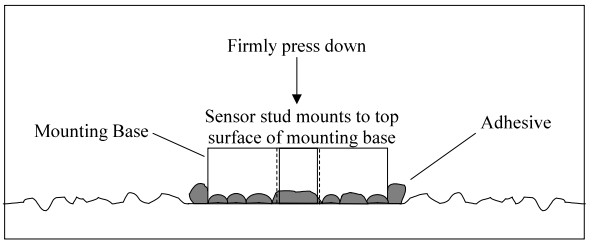


Figure 4. Mounting Base: Adhesive Installation

METHOD 2 - Direct Adhesive Mount
For restrictions of space or for convenience, most sensors (with the exception of integral stud models) can be adhesive-mounted directly to the test structure.

STEP 1: Prepare a smooth, flat mounting surface. A minimum surface finish of 63 μin (0.00016 mm) generally works best.

STEP 2: Place a small portion of adhesive on the underside of the sensor. Firmly press down on the top of the assembly to displace any adhesive. Be aware that excessive amounts of adhesive can make sensor removal difficult.

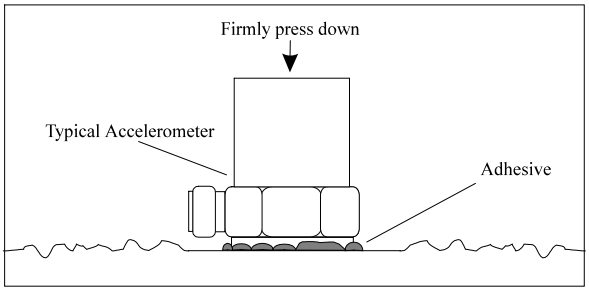


Figure 5. Direct Adhesive Mounting

3.4.3 HANDHELD OR PROBE TIP MOUNT
This method is NOT recommended for most applications. It is generally used only for machinery monitoring and other portable trending applications. Both the accuracy and repeatability at low (<5 Hz) and high frequency (>1 kHz) ranges are questionable.

3.5 Route Mineral Insulated Hardline Cable

3.5.1 Care

Certain precautions should be used to avoid physical damage and minimize electrical noise. For instance, route the cables away from points that may exceed its

3.5.2 Bend Radius

The minimum bend radius (r) for both soft-line and hardline cable is determined by the cable diameter as shown below:

Bends Allowed	Cable Diameter	Minimum Bending Radius
Total	d	r
1	0.125” (3.2 mm)	0.60” (16 mm)
20	0.125” (3.2 mm)	2.0” (50 mm)

3.5.3 Clamp Cable

To minimize triboelectric (motion-induced) noise from the cable interfering with the sensors high impedance charge output cable clamps must be used. Clamp the cable as close to the transducer as possible and should be attached to the same surface that the head is mounted (See Figure 3) taking care not to induce stress into the cable and possibly leading to intermittent or broken connections. Continue to clamp the cable at regular intervals of approximately 1.5 ft (0.5 m)

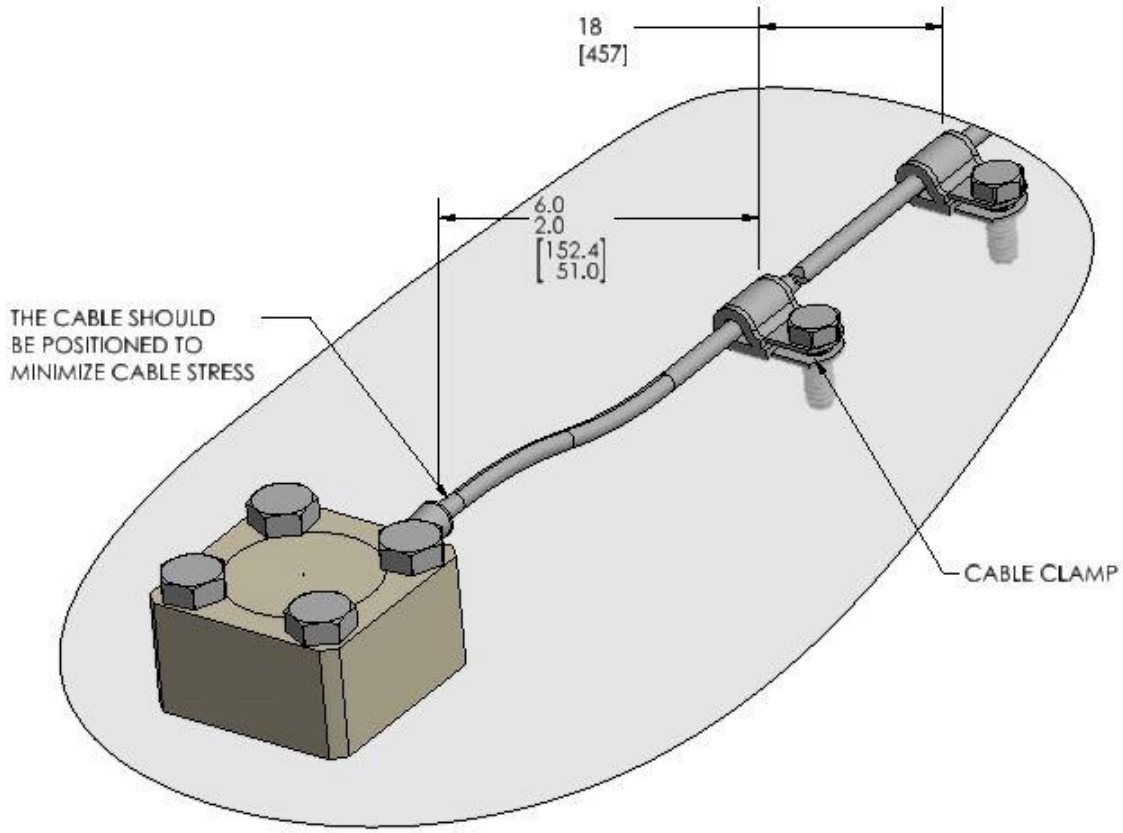
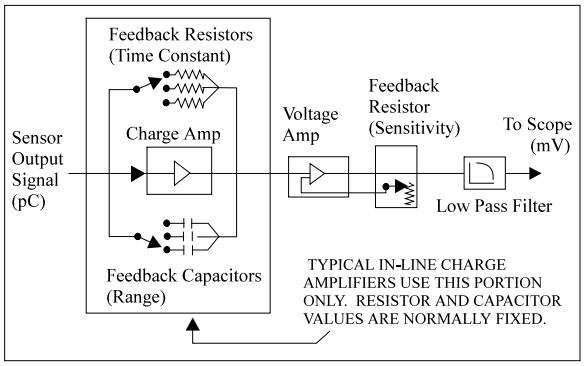


Figure 3

4 POWERING

4.1 Installation

Before connecting the low-noise cable from the accelerometer to the charge amplifier, be sure to ground both the charge amplifier and the cable. This ensures that an excessive static charge that may have accumulated across the accelerometer or cable is harmlessly discharged. Failure to observe this precaution can result in the destruction of the input FET of certain amplifiers.



Connect the transducer to the input of a PCB differential or equivalent charge amp using low noise cable. ***Note:*** *For optimum noise performance, the cable length between the sensor and the charge AMP should be minimized.*

Connect the output of the charge AMP to any ICP ® signal conditioner using standard cable. Finally, the output of the signal conditioner may then be connected to an oscilloscope or other monitoring device. This output will be an AC signal (see ***specification*** for actual frequency response) with a DC bias. Many PCB signal conditioners remove the bias via an AC coupling circuit.

4.2 Operation

Once each element is connected, allow a few minutes for the system to thermally stabilize. Place the switch on the charge amplifier in the OPERATE position and proceed with the measurement.

It is often convenient to normalize the accelerometer and charge amplifier system to a precise sensitivity, such as 10.0 or 100.0 mV/g for ease of data analysis. This is accomplished with most PCB laboratory charge amplifiers and some miniature in-line units as well.

For fixed sensitivity charge converters, the system sensitivity (mV/g) is determined as the product of the charge amplifier sensitivity (mV/pC) and the charge sensitivity of the accelerometer (pC/g).

Note: *When using charge-amplified systems, the noise floor of the system is dependent on the input capacitance to the charge amplifier. Since the cable adds to the capacitance and to minimize the noise threshold, keep the cable length between the accelerometer and the charge amplifier to a minimum. Cable length does not affect the system sensitivity of charge-amplified systems.*

Since charge amplifier operation varies, please contact the respective signal conditioner manufacturer or check the product manual for additional information.

5 HIGH-TEMPERATURE OPERATION

5.1 Introduction

When subjected to elevated temperature, all piezoelectric sensors/hardline cable systems exhibit decreased insulation resistance, due in part to the piezoelectric element, but due mostly to the hardline cable necessary to withstand the high temperatures. This situation can cause serious voltage offset problems in direct-coupled charge amplifiers. To solve this problem, the user must AC couple (capacitor) the charge amplifier to the sensor/cable system. See 5.3 Solution to Reduced Resistance , for complete details, or use different amplifiers.

5.2 Reduced Resistance at Charge Amplifier Input

Figure 5.1 illustrates a simplified schematic of a typical direct-coupled charge amplifier where:

R_f = Feedback resistor (ohms)
R_i = Input leakage resistance (ohms)
E_o = Steady-state output voltage (volts)
e_i = Offset voltage: FET leakage (volts)
C_f = Feedback capacitor (farads)

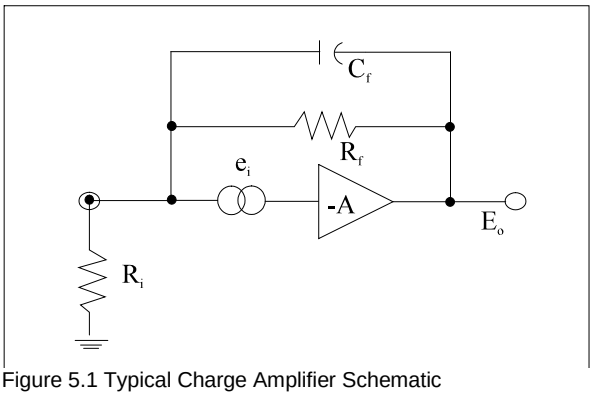


Figure 5.1 Typical Charge Amplifier Schematic

The feedback capacitor C_f comes into play only in the dynamic situation and its influence does not affect the steady-state situation. The voltage e_i is a DC offset voltage, usually very tiny (microvolts), that exists at the input gate of the MOSFET circuit. This minute leakage current exists in all real devices.

As demonstrated in Equation 1, the steady-state (DC) output voltage E_o is:

Equation 1

$$E_o = e_i\left(1+\frac{R_f}{R_i}\right)$$

This equation shows that if the input (leakage) resistance at the charge amplifier is extremely high (approaching infinity), the output DC voltage approaches e_i, usually a very tiny voltage. However, as R_i decreases, the term

$$1+\frac{R_f}{R_i}$$

increases, such that the output voltage can, with large ratios of R_f/ R_i, become large enough to result in a large E_o, perhaps large enough to be outside the normal output voltage range of the charge amplifier.

Because of the feedback capacitor C_f, this output voltage change usually does not occur rapidly but rather, it manifests itself as a slow drift in the output voltage level. If R_i is low enough with respect to R_f, the voltage drift may continue until saturation of the charge amplifier occurs.

5.3 Solution to Reduced Resistance

Since the drift or offset problem is caused by a static or steady-state imbalance at the input of the charge amplifier, the solution involves blocking this steady-state effect while allowing the desired dynamic phenomena to pass. This may be accomplished by installing a series capacitor at the input of the charge amplifier, between the offending sensor (or low-impedance hardline) and the input.

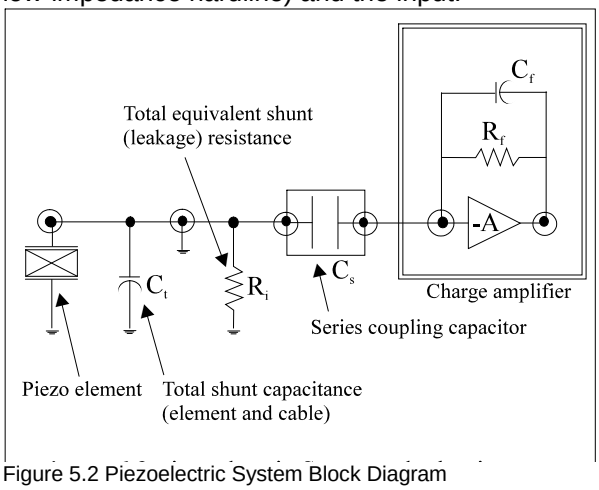


Figure 5.2 Piezoelectric System Block Diagram

Figure 5.2 illustrates a block diagram of the piezo-electric system where:

C_t = Shunt capacitor
C_s = Series blocking capacitor

With the series blocking capacitor C_s in place as shown, the dynamic charge (Q) generated by the sensor element is distributed across the two capacitors, C_t and C_s, in proportion to the size (capacitance) of each. If C_s, for example, is equal to 100 times C_t, 99% of the charge appears at the input of the charge amplifier, while 1% is across the shunt capacitor C_t. This results in a 1% decrease in apparent sensitivity of the system.

This therefore demonstrates the importance of selecting the series blocking capacitor at least two orders of magnitude higher than the total shunt capacitance C_t across the input of the charge amplifier.

It is also important that this capacitor be of high quality, with a leakage resistance of greater that 10^{12} ohms, to avoid the DC offset discussed previously in 5.1, Introduction.

5.4 Low-Frequency Response Limitations

In a normal charge amplifier, the low-frequency response is set by the RC time constant, as established by the product of C_f and R_f. The system acts like a high-pass first order RC filter with a -3 dB frequency established by the relationship:

Equation 2

$$f_o = \frac{.16}{R_f C_f}$$

where:

f_o = -3 dB Frequency (Hz)
R_f = Feedback resistor (ohms)
C_t = Feedback capacitor (farads)

However, after the addition of the series blocking capacitor C_s, the system becomes the equivalent of two high-pass filters in series, one as previously mentioned and one comprised of series capacitor C_s and total equivalent shunt resistance R_i. This new cutoff frequency is:

Equation 3

$$f_o = \frac{.16}{R_i C_s}$$

To avoid compromise of the low-frequency response established by the charge amplifier parameters and illustrated by Equation 2, the product of R_iC_s should be several orders of magnitude higher than R_fC_f.

The approximate final system discharge time constant becomes:

Equation 4a

$$TC = \frac{1}{\frac{1}{R_i C_s} + \frac{1}{R_f C_f}} \qquad \text{seconds}$$

If the input coupling time constant (R_iC_s) is very much greater than the discharge time constant of the charge amplifier (R_fC_f), Equation 4a then becomes:

Equation 4b

$$\frac{1}{R_i C_s} \Rightarrow 0 \text{ Seconds}$$

Equation 5

$$TC = R_f C_f$$

With the product R_iC_s chosen to be much greater than R_fC_f , the system discharge time constant is simply R_fC_f (seconds). The feedback parameters of the charge amplifier establish the low frequency characteristics of the system, unaffected by the degraded input resistance parameters of the test sensor and/or cable.

5.5 Other Precautions

Always remember to keep the OPR-GND switch on the charge amplifier in the GND position while connecting or disconnecting sensors, cable, or capacitor to the input connector. Stray or accumulated electrostatic charges may build to the point that they may saturate or even damage the input circuitry of the charge amplifier.

Operate the charge amplifier in the SHORT time constant while the sensor is subject to elevated or changing temperatures.

If it is not necessary to procure data during the transition from room temperature to operating temperature, place the OPR-GND switch in the

GND position to keep spurious, thermally generated charges grounded.

It is prudent to momentarily switch to the GND position even during the measurement period to ensure that excess charges do not accumulate at the input of the charge amplifier.

6 ACCELEROMETER CALIBRATION

Accelerometer calibration provides, with a definable degree of accuracy, the necessary link between the physical quantity being measured and the electrical signal generated by the sensor. In addition, other useful information concerning operational limits, physical parameters, electrical characteristics, or environmental influences may also be determined. Without this link, analyzing data becomes a nearly impossible task. PCB provides a calibration record that documents the exact characteristics of each sensor. (The type and amount of data varies depending on the sensor type, contractual regulations, and other special requirements.)

Under normal operating conditions, piezoelectric sensors are extremely stable, and their calibrated performance characteristics do not change over time. However, harsh environments or other unusual conditions that cause the sensor to experience dynamic phenomena outside of its specified operating range may temporarily or permanently affect the sensor. This change manifests itself in a variety of ways, including a shift of the sensor resonance due to a cracked crystal, or a temporary loss of low-frequency measuring capability due to a drop in insulation resistance.

For these reasons, it is recommended that a recalibration cycle be established for each accelerometer. This schedule is unique and is based on a variety of factors, such as extent of use, environmental conditions, accuracy requirements, trend information obtained from previous calibration records, contractual regulations, frequency of "cross-checking" against other equipment, manufacturer recommendation, and any risk associated with incorrect readings. International standards, such as ISO 10012-1, provide insight and suggested methods for determining recalibration intervals for most measuring equipment. With the above information in mind and under "normal" circumstances, PCB conservatively suggests a 12- to 24-month recalibration cycle for most piezoelectric accelerometers.

Note: *It is good measurement practice to verify the performance of each accelerometer with a Handheld Shaker or other calibration device before and after each measurement. The PCB Model 394C06 Handheld Shaker operates at a fixed frequency and known amplitude (1.0 g) to provide a quick check of sensor sensitivity.*

6.1.1 SENSOR RECALIBRATION

Accelerometer recalibration services are typically performed by PCB's internal metrology laboratory. (Other international and private laboratories are also available.) The PCB laboratory is certified to ISO 9001, accredited by A2LA to ISO 17025, complies with ISO 10012-1 (and former MIL-STD-45662A), and uses equipment directly traceable to N.I.S.T. This assures an accurate calibration of relevant specifications.

In addition, many companies choose to purchase the equipment necessary to perform the recalibration procedure themselves. While this may result in both a savings of time and money, it has also been attributed to incorrect readings and costly errors. Therefore, in an effort to prevent the common mistakes associated with customer-performed calibration, this document includes a broad overview of the Back-to-Back Calibration technique. This technique provides a quick and easy method for determining the sensitivity of a test accelerometer over a wide frequency range.

6.1.2 BACK-TO-BACK CALIBRATION THEORY

Back-to-Back Calibration is perhaps the most common method for determining the sensitivity of piezoelectric accelerometers. This method relies on a simple comparison to a previously calibrated accelerometer, typically referred to as a reference standard.

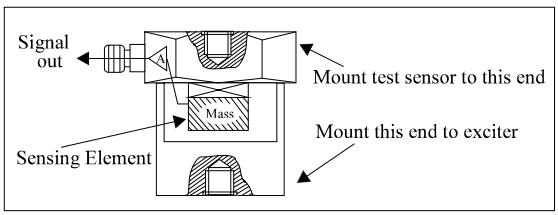


Figure 1. Reference Standard Accelerometer

These high-accuracy devices, which are directly traceable to a recognized standards laboratory, are designed for stability, as well as configured to accept a test accelerometer. By mounting a test accelerometer to the reference standard and then connecting this combination to a suitable vibration source, it is possible to vibrate both devices and compare the data as shown in Figure 2. (Test set-ups may be automated and vary, depending on the type and number of accelerometers being calibrated.)

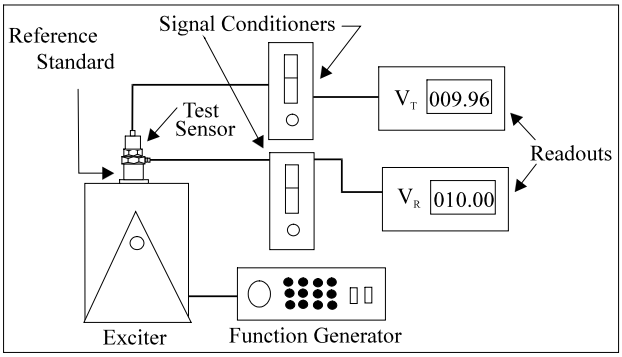


Figure 2. Typical Back-to-Back Calibration System

Because the acceleration is the same on both sensors, the ratio of their outputs (V_T/V_R) must also be the ratio of their sensitivities. With the sensitivity of the reference standard (S_R) known, the exact sensitivity of the test sensor (S_T) is easily calculated by using the following equation:

$$S_T = S_R (V_T/V_R)$$

By varying the frequency of the vibration, the sensor may be calibrated over its entire operating frequency range. The typical response of an unfiltered accelerometer is shown in Figure 3.

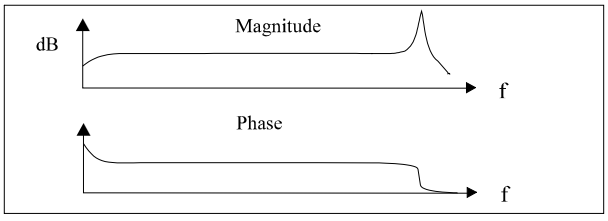


Figure 3. Typical Test Accelerometer Response

6.1.3 PCB CALIBRATION PROCEDURE

Numerous precautions are taken at PCB to insure accurate and repeatable results. This section provides a brief overview of the primary areas of concern.

Since the Back-to-Back Calibration technique relies on each sensor experiencing an identical acceleration level, proper mounting of the test sensor to the reference standard is imperative. Sensors with mounting holes are attached directly to the reference standard with a stud tightened to the recommended mounting torque. A shouldered mounting stud is typically used to prevent the stud from "bottoming out" in the hole.

Both mounting surfaces are precision-machined and lapped to provide a smooth, flat interface according to the manufacturer's specification. A thin layer of silicone grease is placed between the mating surfaces to fill any imperfections and increase the mounting stiffness. The cables are stress-relieved by first routing them to the shaker head, securing them with tape or cable ties, then routing them to a nearby stationary location. This reduces cable motion, which is especially important when testing charge output sensors and helps to prevent extraneous noise or stresses from being imparted into the system. A typical set-up is shown in Figure 4.

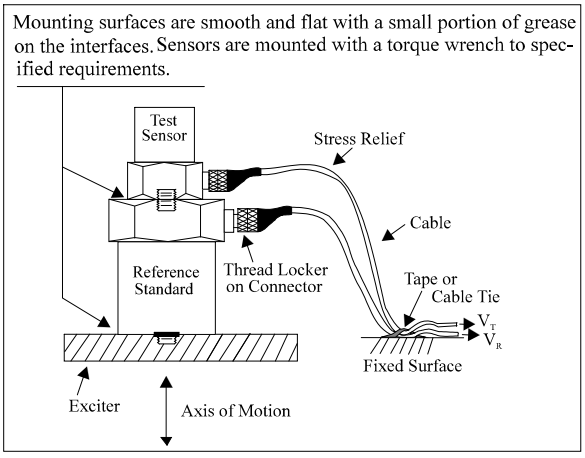


Figure 4. Typical Calibration Set-Up

Adhesively mounted sensors use similar practices. However, in this case, a small portion of quick-bonding gel or similar temporary adhesive is used to attach the test sensor to a reference standard designed with a smooth, flat mounting surface.

In addition to mounting, the selection of the proper equipment is critical. Some of the more important considerations include: 1) the reference standard must be specified and previously calibrated over the frequency and/or amplitude range of interest; 2) the shaker should be selected to provide minimal transverse (lateral) motion and minimal distortion; and 3) the quality of the meters, signal generator, and other devices should be selected so as to operate within the limits of permissible error.

7.4 COMMON MISTAKES

Most calibration errors are caused by simply overlooking some of the fundamental principals of dynamics. This section attempts to address some of the more common concerns.

For stud-mount sensors, always mount the accelerometer directly to the reference standard. Ensure that the mounting surfaces are smooth, flat, and free of any burrs. Always use a coupling fluid, such as silicone grease, in the mounting interface to maintain a high mounting stiffness. Mount the sensor according to the manufacturer's recommended mounting torque. DO NOT use any intermediate mounting adaptors, as the mounted resonant frequency may be reduced and thereby compromise the high-frequency performance. If necessary, use adaptor studs.

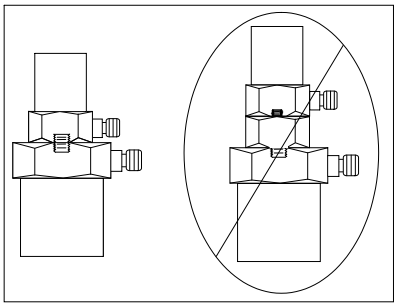


Figure 5. Stud Mounting

Understand Back-to-Back Calibration limitations. Do not expect the uncertainty of calibration to be any better than ±2%. (In fact, the uncertainty may be as high as ±3% or ±4% for frequencies <10 Hz or >2 kHz.) Since large sensors may affect high-frequency accuracy, verify that the test sensor does not mass load the reference standard. Validate your calibration system with another accelerometer prior to each calibration session. Check with the manufacturer for exact system specifications.

7.5 CONCLUSIONS

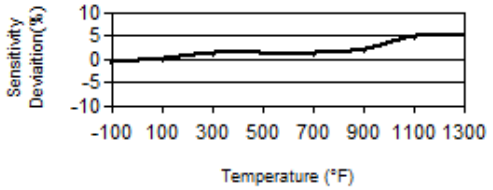
Without an adequate understanding of dynamics, determining what, when, and how to test a sensor is a difficult task. Therefore, each user must weigh the cost, time, and risk associated with self-calibration versus the services of an accredited laboratory.

PCB PIEZOTRONICS INC.
VIBRATION DIVISION
3425 Walden Avenue, Depew, NY 14043
Toll Free: 888-684-0013 • 24-hour SensorLine℠: 716-684-0001 • FAX: 716-685-3886
E-mail: vibration@pcb.com • Website: www.pcb.com

Model Number	CHARGE OUTPUT ACCELEROMETER	Revision: D
EX611A20		ECN #: 46623

Performance	**ENGLISH**	**SI**	
Sensitivity(± 5 %)	10 pC/g	1.02 pC/(m/s²)	
Measurement Range	± 200 g pk	± 1962 m/s² pk	
Frequency Range(± 5 %)	2.8 kHz	2.8 kHz	[4]
Frequency Range(+10 %)	3.7 kHz	3.7 kHz	[4]
Resonant Frequency	>17 kHz	>17 kHz	[1]
Non-Linearity	≤ 1 %	≤ 1 %	[5]
Transverse Sensitivity	≤ 5 %	≤ 5 %	[6]
Environmental			
Overload Limit(Shock)	± 5000 g pk	± 49,050 m/s² pk	
Temperature Range	-65 to +1200 °F	-54 to +650 °C	[2]
Temperature Range	-165 to +1300 °F	-109 to +704 °C	[3]
Temperature Response	See Graph	See Graph	[1]
Base Strain Sensitivity	0.005 g/με	0.05 (m/s²)/με	[1]
Radiation Exposure Limit(Integrated Neutron Flux)	1 E10 N/cm²	1 E10 N/cm²	
Radiation Exposure Limit(Integrated Gamma Flux)	1 E8 rad	1 E8 rad	
Hazardous Area Approval	Ex ia IIC T6 . . . T 710°C Ga	Ex ia IIC T6 . . . T 710°C Ga	
Hazardous Area Approval	IECEx Ex ia IIC T6 . . . T 710°C Ga	IECEx Ex ia IIC T6 . . . T 710°C Ga	
Electrical			
Capacitance(Pin to Pin)	320 pF	320 pF	[1]
Capacitance(Pin to Case)	360 pF	360 pF	[1]
Insulation Resistance(Pin to Case 70° F)	$>10^9$ Ohm	$>10^9$ Ohm	[1]
Insulation Resistance(Pin to Pin 70° F)	$>10^9$ Ohm	$>10^9$ Ohm	
Insulation Resistance(Pin to Pin 900° F)	>100 kohm	>100 kohm	
Insulation Resistance(Pin to Pin 1200° F)	>20 kohm	>20 kohm	
Output Polarity	Differential	Differential	
Physical			
Sensing Element	UHT-12™	UHT-12™	
Sensing Geometry	Shear	Shear	
Housing Material	Inconel	Inconel	
Sealing	Hermetic	Hermetic	
Size (Height x Length x Width)	.787 in x 1.465 in x 1.456 in	20 mm x 37 mm x 37 mm	
Weight(without cable)	6.3 oz	180 gm	[1]
Electrical Connector	LEMO PCA.0S.302.CLLC42	LEMO PCA.0S.302.CLLC42	
Electrical Connection Position	Side	Side	
Cable Length	10 ft	3 m	
Cable Type	MI Hardline Cable	MI Hardline Cable	
Mounting	Through Hole	Through Hole	

Typical Sensitivity Deviation vs Temperature



CE[7]

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.

NOTES:

[1] Typical.
[2] Continuous
[3] Extreme
[4] Low frequency response is determined by external signal conditioning electronics.
[5] Zero-based, least-squares, straight line method.
[6] Transverse sensitivity is typically ≤ 3%.
[7] See PCB Declaration of Conformance PS122 for details.

SUPPLIED ACCESSORIES:

Model 081A115 M6 x 1 x 25 mm long (1)
Model ICS-1 NIST-traceable single-axis amplitude response calibration from 600 cpm (10 Hz) to upper 5% frequency

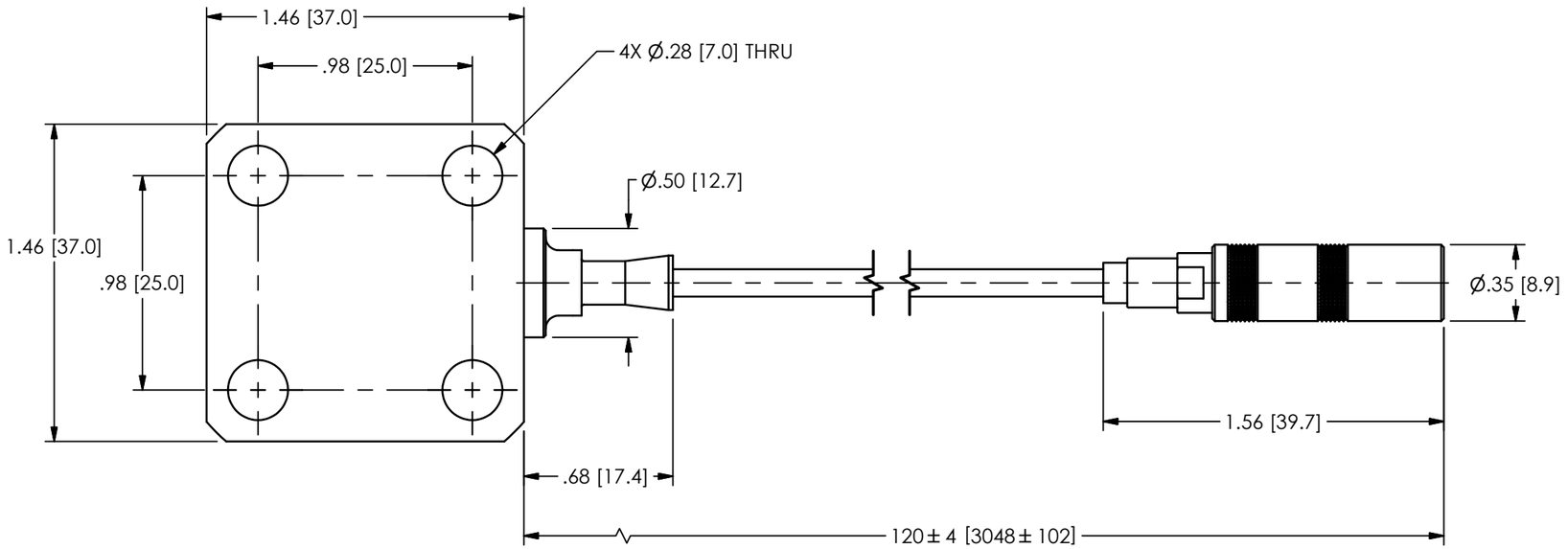
Entered: LK	Engineer: GJR	Sales: JC	Approved: BAM	Spec Number:
Date: 3/30/2017	Date: 3/30/2017	Date: 3/30/2017	Date: 3/30/2017	**50208**

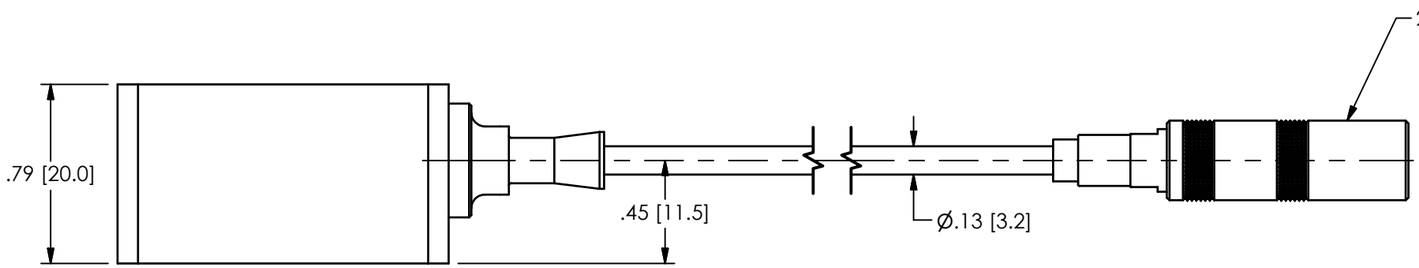
All specifications are at room temperature unless otherwise specified.
In the interest of constant product improvement, we reserve the right to change specifications without notice.

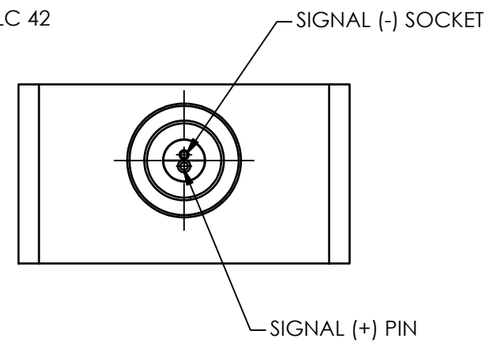
PCB PIEZOTRONICS
3425 Walden Avenue, Depew, NY 14043
Phone: 716-684-0001
Fax: 716-684-0987
E-Mail: info@pcb.com

49582

REVISIONS		
REV	DESCRIPTION	DIN
B	UPDATED CABLE LENGTH	44951







UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:	
DIMENSIONS IN INCHES DECIMALS XX ±.03 XXX ±.010 ANGLES ± 2 DEGREES	DIMENSIONS IN MILLIMETERS [IN BRACKETS] DECIMALS X ± 0.8 XX ± 0.25 ANGLES ± 2 DEGREES
FILLETS AND RADII .003 - .005	FILLETS AND RADII 0.07 - 0.13

DRAWN		CHECKED		ENGINEER	
BB	1/18/16	ECB	1/18/16	JJD	1/18/16

TITLE

OUTLINE DRAWING
MODEL EX611A20

PCB PIEZOTRONICS
3425 WALDEN AVE. DEPEW, NY 14043
(716) 684-0001 E-MAIL: sales@pcb.com

CODE IDENT. NO.	DWG. NO.	
52681	49582	
SCALE: 1.5X	SHEET 1 OF 1	

64270

SCHEDULE DRAWING

NO MODIFICATIONS PERMITTED WITHOUT REFERENCE TO THE NOTIFIED BODY

REVISIONS		
REV	DESCRIPTION	DIN
NR	RELEASED TO DRAFTING	45417

5 Ci AND Li BASED ON CABLE WITH 30 pF/ft AND .33 µH/ft WITH A MAXIMUM CABLE LENGTH OF 100ft. Ci AND Li WILL BE DECREASED WITH SHORTER CABLE LENGTHS.

4 SHIELDS TO BE EARTHED AT BARRIER END.

3 THE INSTALLER SHALL INSURE THAT THE TRANSDUCER MOUNTING STRUCTURE IS AT THE SAME GROUNDING POTENTIAL AS THE BARRIER GROUND. TOTAL EARTH LOOP IMPEDANCE SHALL BE LESS THAN ONE OHM.

2 BARRIER WILL BE MOUNTED IN AN ENCLOSURE THE SUITABILITY OF WHICH WILL BE DETERMINED BY LOCAL AUTHORITIES.

1 ENTITY APPLICATION:

Barrier	I.S. Apparatus
Voc/Uo	< V /Ui
Isc/Io	I /Ii
Ca/Co	Ci + C
La/Lo	Li + L
Po	< Pi (CENELEC ONLY)

BARRIERS WITHIN THE SPECIFIED LIMITATIONS ARE PERMITTED.

ENTITY PARAMETERS:

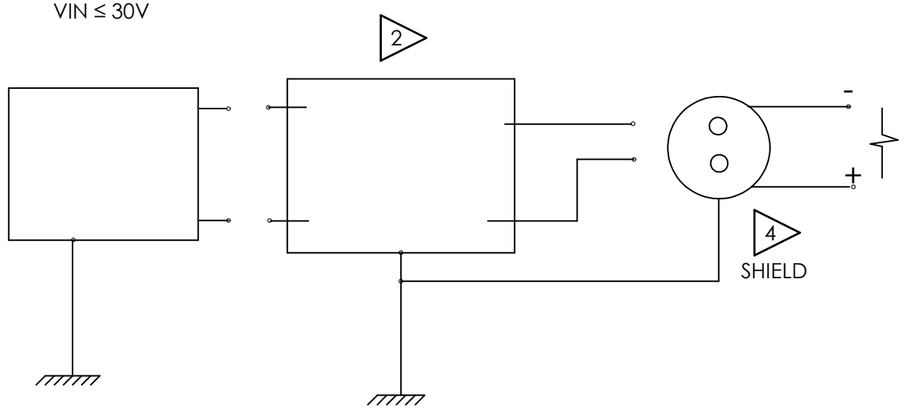
Ui = 30 V
Ii 100 mA
Pi 0.7 W
5 Ci 3300 pF
5 Li 30 µH

CERTIFIED BY THE APPROPRIATE APPROVAL AUTHORITY FOR CONNECTION TO THE FOLLOWING AREAS:

ZONE 0
Exia IIC
AExia IIC
DIV 1
CLASS I, GROUPS A,B,C,D
CLASS II, GROUPS E,F,G
CLASS III

NON-HAZARDOUS / SAFE AREA

HAZARDOUS AREA
DIV 1
ZONE 0



NO CHANGES WITHOUT CSA APPROVAL

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES DECIMALS X ± .05 XX ± .01 XXX ± .005 XXXX ± .0005 ANGLES ± 2 DEGREES FILLETS AND RADII .003 - .005
HEX DIMENSIONS ARE: ≤ .5 + .000 / - .003 > .5 + .000 / - .005
INTERNAL THREAD DEPTH MIN. REMOVE ALL BURRS SHARP = R.000 - R.003

CAUTION
ELECTROSTATIC DISCHARGE SENSITIVE

DRAWN		CHECKED		ENGINEER	
JDM	5/3/16	ECB	5/3/16	GGS	5/3/16

TITLE
CSA APPROVAL
EX611 SERIES
INTERCONNECTIONS

PCB PIEZOTRONICS
3425 WALDEN AVE. DEPEW, NY 14043
(716) 684-0002 E-MAIL: sales@pcb.com

CODE IDENT. NO.	DWG. NO.
52681	64270
SCALE: NONE	SHEET 1 OF 1

Certificate of Compliance

Certificate: 70089987 **Master Contract:** 184981 (103164_0_000)

Project: 70089987 **Date Issued:** 2016-08-09

Issued to: **Industrial Monitoring Instr. (IMI)**
A Div. of PCB Piezotronics, Inc.
3425 Walden Ave
Depew, New York 14043
USA

Attention: Carrie Termin

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

Issued by: *Konstantin Rybalko*
Konstantin Rybalko

PRODUCTS

CLASS - C225804 - PROCESS CONTROL EQUIPMENT-Intrinsically Safe, Entity - For Hazardous Locations-
CLASS - C225884 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe, Entity-- For Hazardous Locations - Certified to US Standards

Class I, Div. 1, Group A, B, C & D;

Class II, Div. 1, Group E, F & G;
Class III, Div. 1;
Ex ia IIC T6 – T710, Ga;
Class I, Zone 0, AEx ia IIC T6 – T710, Ga

Models EX611XYY/(M)NNNZZ High Temperature Vibration Sensor; intrinsically safe with entity parameters as shown below; must be installed as per installation drawing 64270; temperature code as shown below. Ambient temperature –196^{O}C to +700^{O}C

Certificate: 70089987 **Master Contract:** 184981

Project: 70089987 **Date Issued:** 2016-08-09

Entity Parameters	Temperature Code
Ui / Vmax = 30V Ii / Imax = 100mA Pi / Pmax = 0.7W Ci = 3300nF Li = 30µH	T6 (–196°C to +80°C) T5 (–196°C to +95°C) T4 (–196°C to 130°C) T3 (–196°C to 195°C) T2 (–196°C to 290°C) T1 (–196°C to 440°C) T710 (–196°C to 700°C)

Notes:

1. For Canadian Installations, sensor case must be bonded to ground according to Section 18-182 of the CEC, Part 1.
2. For US Installations, sensor case must be bonded to ground according to Article 501.16 of the NEC.

APPLICABLE REQUIREMENTS

CSA-C22.2 No. 0-10 (R2015)	-	General requirements – Canadian Electrical Code, Part II
C22.2 No. 61010-1-12	-	Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements
ANSI/UL 61010-1 3rd Ed.	-	Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements
C22.2 No. 60079-0: 2015	-	Explosive atmospheres – Part 0: Equipment – General requirements
ANSI/UL 60079-0 6th Ed.	-	Explosive atmospheres – Part 0: Equipment – General requirements
C22.2 No. 60079-11: 2014	-	Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “i”
ANSI/UL 60079-11 6th Ed.	-	Explosive atmospheres – Part 11: Equipment protection by intrinsic safety “i”

Supplement to Certificate of Compliance

Certificate: 70089987 **Master Contract:** 184981 (103164_0_000)

The products listed, including the latest revision described below, are eligible to be marked in accordance with the referenced Certificate.

Product Certification History

Project	Date	Description
70089987	2016-08-09	Certification of EX611 Series High Temperature Vibration Sensor.

Repair and Maintenance

PCB guarantees Total Customer Satisfaction through its "Lifetime Warranty Plus" on all Platinum Stock Products sold by PCB and through its limited warranties on all other PCB Stock, Standard and Special products. Due to the sophisticated nature of our sensors and associated instrumentation, **field servicing and repair is not recommended and, if attempted, will void the factory warranty**.

Beyond routine calibration and battery replacements where applicable, our products require no user maintenance. Clean electrical connectors, housings, and mounting surfaces with solutions and techniques that will not harm the material of construction. Observe caution when using liquids near devices that are not hermetically sealed. Such devices should only be wiped with a dampened cloth—never saturated or submerged.

In the event that equipment becomes damaged or ceases to operate, our Application Engineers are here to support your troubleshooting efforts 24 hours a day, 7 days a week. Call or email with model and serial number as well as a brief description of the problem.

Calibration

Routine calibration of sensors and associated instrumentation is necessary to maintain measurement accuracy. We recommend calibrating on an annual basis, after exposure to any extreme environmental influence, or prior to any critical test.

PCB Piezotronics is an ISO-9001 certified company whose calibration services are accredited by A2LA to ISO/IEC 17025, with full traceability to SI through N.I.S.T. In addition to our standard calibration services, we also offer specialized tests, including: sensitivity at elevated or cryogenic temperatures, phase response, extended high or low frequency response, extended range, leak testing, hydrostatic pressure testing, and others. For more information, contact your local PCB Piezotronics distributor, sales representative, or factory customer service representative.

Returning Equipment

If factory repair is required, our representatives will provide you with a Return Material Authorization (RMA) number, which we use to reference any information you have already provided and expedite the repair process. This number should be clearly marked on the outside of all returned package(s) and on any packing list(s) accompanying the shipment.

Contact Information

PCB Piezotronics, Inc.
3425 Walden Ave.
Depew, NY14043 USA
Toll-free: (800) 828-8840
24-hour SensorLine: (716) 684-0001
General inquiries: info@pcb.com
Repair inquiries: rma@pcb.com

For a complete list of distributors, global offices and sales representatives, visit our website, www.pcb.com.

Safety Considerations

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the precautions required to avoid injury. While our equipment is designed with user safety in mind, the protection provided by the equipment may be impaired if equipment is used in a manner not specified by this manual.

Discontinue use and contact our 24-Hour Sensorline if:

- Assistance is needed to safely operate equipment
- Damage is visible or suspected
- Equipment fails or malfunctions

For complete equipment ratings, refer to the enclosed specification sheet for your product.

Definition of Terms and Symbols

The following symbols may be used in this manual:

DANGER
Indicates an immediate hazardous situation, which, if not avoided, may result in death or serious injury.

CAUTION
Refers to hazards that could damage the instrument.

NOTE
Indicates tips, recommendations and important information. The notes simplify processes and contain additional information on particular operating steps.

The following symbols may be found on the equipment described in this manual:

This symbol on the unit indicates that high voltage may be present. Use standard safety precautions to avoid personal contact with this voltage.

This symbol on the unit indicates that the user should refer to the operating instructions located in the manual.

This symbol indicates safety, earth ground.

PCB工业监视和测量设备 - 中国RoHS2公布表

PCB Industrial Monitoring and Measuring Equipment - China RoHS 2 Disclosure Table

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
住房	O	O	O	O	O	O
PCB板	X	O	O	O	O	O
电气连接器	O	O	O	O	O	O
压电晶体	X	O	O	O	O	O
环氧	O	O	O	O	O	O
铁氟龙	O	O	O	O	O	O
电子	O	O	O	O	O	O
厚膜基板	O	O	X	O	O	O
电线	O	O	O	O	O	O
电缆	X	O	O	O	O	O
塑料	O	O	O	O	O	O
焊接	X	O	O	O	O	O
铜合金/黄铜	X	O	O	O	O	O

本表格依据 SJ/T 11364 的规定编制。

O： 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

X： 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

铅是欧洲RoHS指令2011/65/ EU附件三和附件四目前由于允许的豁免。

CHINA RoHS COMPLIANCE

Component Name	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Chromium VI Compounds (Cr(VI))	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
Housing	O	O	O	O	O	O
PCB Board	X	O	O	O	O	O
Electrical Connectors	O	O	O	O	O	O
Piezoelectric Crystals	X	O	O	O	O	O
Epoxy	O	O	O	O	O	O
Teflon	O	O	O	O	O	O
Electronics	O	O	O	O	O	O
Thick Film Substrate	O	O	X	O	O	O
Wires	O	O	O	O	O	O
Cables	X	O	O	O	O	O
Plastic	O	O	O	O	O	O
Solder	X	O	O	O	O	O
Copper Alloy/Brass	X	O	O	O	O	O

This table is prepared in accordance with the provisions of SJ/T 11364.

O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

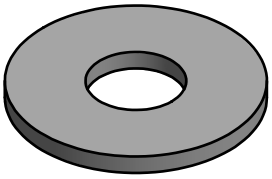
X: Indicates that said hazardous substance contained in at least one of the homogeneous materials for this part is above the limit requirement of GB/T 26572.
Lead is present due to allowed exemption in Annex III or Annex IV of the European RoHS Directive 2011/65/EU.

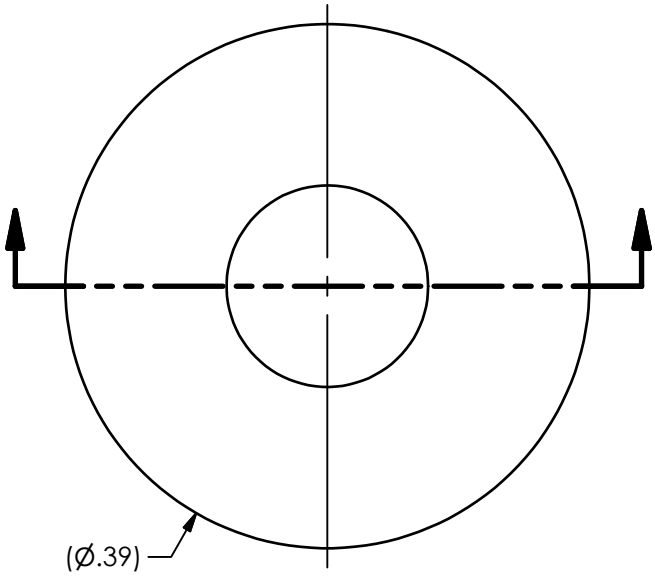
64992

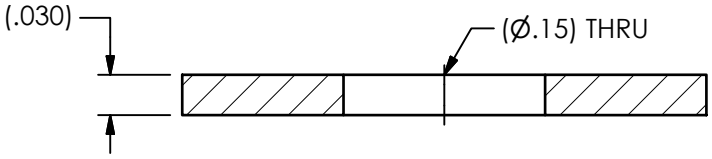
SCHEDULE DRAWING

NO MODIFICATIONS PERMITTED WITHOUT REFERENCE TO THE NOTIFIED BODY

REVISIONS		
REV	DESCRIPTION	DIN
NR	RELEASED TO DRAFTING	45417







1.) CAPACITANCE < 30pF

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES DECIMALS X ± .05 XX ± .01 XXX ± .005 XXXX ± .0005 ANGLES ± 2 DEGREES FILLETS AND RADII .001 - .005	MATERIAL PIEZOELECTRICAL CRYSTAL	DRAWN	CHECKED	ENGINEER	TITLE	PCB PIEZOTRONICS 3425 WALDEN AVE. DEPEW, NY 14043 (716) 684-0002 E-MAIL: sales@pcb.com	
		JDM 7/29/16	ECB 7/29/16	GGS 7/29/16	XTAL APPROVAL DRAWING		
HEX DIMENSIONS ARE: ≤ .5 + .000 / - .003 > .5 + .000 / - .005	HEAT TREAT (AFTER MACHINING)					CODE IDENT. NO. 52681	DWG. NO. 64992
INTERNAL THREAD DEPTH MIN. REMOVE ALL BURRS SHARP = R.000 - R.003	FINISH 32					SCALE: 7X	SHEET 1 OF 1

Model EX611A20

Charge Output Accelerometer

Installation and Operating Manual

**For assistance with the operation of this product,
contact PCB Piezotronics, Inc.**

Toll-free: 800-828-8840
24-hour SensorLine: 716-684-0001
Fax: 716-684-0987
E-mail: info@pcb.com
Web: www.pcb.com

Repair and Maintenance

PCB guarantees Total Customer Satisfaction through its "Lifetime Warranty Plus" on all Platinum Stock Products sold by PCB and through its limited warranties on all other PCB Stock, Standard and Special products. Due to the sophisticated nature of our sensors and associated instrumentation, **field servicing and repair is not recommended and, if attempted, will void the factory warranty**.

Beyond routine calibration and battery replacements where applicable, our products require no user maintenance. Clean electrical connectors, housings, and mounting surfaces with solutions and techniques that will not harm the material of construction. Observe caution when using liquids near devices that are not hermetically sealed. Such devices should only be wiped with a dampened cloth—never saturated or submerged.

In the event that equipment becomes damaged or ceases to operate, our Application Engineers are here to support your troubleshooting efforts 24 hours a day, 7 days a week. Call or email with model and serial number as well as a brief description of the problem.

Calibration

Routine calibration of sensors and associated instrumentation is necessary to maintain measurement accuracy. We recommend calibrating on an annual basis, after exposure to any extreme environmental influence, or prior to any critical test.

PCB Piezotronics is an ISO-9001 certified company whose calibration services are accredited by A2LA to ISO/IEC 17025, with full traceability to SI through N.I.S.T. In addition to our standard calibration services, we also offer specialized tests, including: sensitivity at elevated or cryogenic temperatures, phase response, extended high or low frequency response, extended range, leak testing, hydrostatic pressure testing, and others. For more information, contact your local PCB Piezotronics distributor, sales representative, or factory customer service representative.

Returning Equipment

If factory repair is required, our representatives will provide you with a Return Material Authorization (RMA) number, which we use to reference any information you have already provided and expedite the repair process. This number should be clearly marked on the outside of all returned package(s) and on any packing list(s) accompanying the shipment.

Contact Information

PCB Piezotronics, Inc.
3425 Walden Ave.
Depew, NY14043 USA
Toll-free: (800) 828-8840
24-hour SensorLine: (716) 684-0001
General inquiries: info@pcb.com
Repair inquiries: rma@pcb.com

For a complete list of distributors, global offices and sales representatives, visit our website, www.pcb.com.

Safety Considerations

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the precautions required to avoid injury. While our equipment is designed with user safety in mind, the protection provided by the equipment may be impaired if equipment is used in a manner not specified by this manual.

Discontinue use and contact our 24-Hour Sensorline if:

- Assistance is needed to safely operate equipment
- Damage is visible or suspected
- Equipment fails or malfunctions

For complete equipment ratings, refer to the enclosed specification sheet for your product.

Definition of Terms and Symbols

The following symbols may be used in this manual:

DANGER
Indicates an immediate hazardous situation, which, if not avoided, may result in death or serious injury.

CAUTION
Refers to hazards that could damage the instrument.

NOTE
Indicates tips, recommendations and important information. The notes simplify processes and contain additional information on particular operating steps.

The following symbols may be found on the equipment described in this manual:

This symbol on the unit indicates that high voltage may be present. Use standard safety precautions to avoid personal contact with this voltage.

This symbol on the unit indicates that the user should refer to the operating instructions located in the manual.

This symbol indicates safety, earth ground.

PCB工业监视和测量设备 - 中国RoHS2公布表

PCB Industrial Monitoring and Measuring Equipment - China RoHS 2 Disclosure Table

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
住房	O	O	O	O	O	O
PCB板	X	O	O	O	O	O
电气连接器	O	O	O	O	O	O
压电晶体	X	O	O	O	O	O
环氧	O	O	O	O	O	O
铁氟龙	O	O	O	O	O	O
电子	O	O	O	O	O	O
厚膜基板	O	O	X	O	O	O
电线	O	O	O	O	O	O
电缆	X	O	O	O	O	O
塑料	O	O	O	O	O	O
焊接	X	O	O	O	O	O
铜合金/黄铜	X	O	O	O	O	O

本表格依据 SJ/T 11364 的规定编制。

O： 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

X： 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。

铅是欧洲RoHS指令2011/65/ EU附件三和附件四目前由于允许的豁免。

CHINA RoHS COMPLIANCE

Component Name	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Chromium VI Compounds (Cr(VI))	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
Housing	O	O	O	O	O	O
PCB Board	X	O	O	O	O	O
Electrical Connectors	O	O	O	O	O	O
Piezoelectric Crystals	X	O	O	O	O	O
Epoxy	O	O	O	O	O	O
Teflon	O	O	O	O	O	O
Electronics	O	O	O	O	O	O
Thick Film Substrate	O	O	X	O	O	O
Wires	O	O	O	O	O	O
Cables	X	O	O	O	O	O
Plastic	O	O	O	O	O	O
Solder	X	O	O	O	O	O
Copper Alloy/Brass	X	O	O	O	O	O

This table is prepared in accordance with the provisions of SJ/T 11364.

O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

X: Indicates that said hazardous substance contained in at least one of the homogeneous materials for this part is above the limit requirement of GB/T 26572.
Lead is present due to allowed exemption in Annex III or Annex IV of the European RoHS Directive 2011/65/EU.

EU Declaration of Conformity PS122

In Accordance with ISO/IEC 17050

Manufacturer: PCB Piezotronics, Inc. 3425 Walden Avenue Depew, New York 14043 USA	**Authorized European Representative:** PCB Piezotronics Europe GmbH Porschestrasse 20-30 41836 Hückelhoven,Germany

Certifies that type of equipment: **High Temperature Accelerometer(s)**

Whose Product Models Include: **EX611XXX Series**

This declaration is applicable to all High Temperature Accelerometer(s) of the above series which have the CE & ATEX mark on their data sheets and where those data sheets refer to this declaration of conformity. The data sheets for all model numbers referenced above, which include the CE & ATEX mark on such data sheets and refer to this Declaration of Conformity are hereby incorporated by reference into this Declaration.

Conform to the following EU Directive(s) when installed per product documentation:	2014/34/EU 2011/65/EU w/2015/863/EU	ATEX Directive RoHS Directive

Standards to which Conformity is Declared:

Harmonized Standards	EN 60079-0:2018 EN 60079-11 2012 EN 63000:2018	General Explosive Atmosphere Intrinsic safe, i Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances
EC Type Examination	ATEX Certification	LCIE 12 ATEX 3053 X Ex ia II C T6 ...710ºC Ga, II 1G
Other International Certifications	IECEx Certification	ICECX LCIE 12.0002X Ex ia II C T6 ...710ºC Ga
Notified Body Name		Laboratoire Central des Industries Electriques (0081)
Notified Body's Address		**FONTENAY-AUX-ROSES (Head Office)** 33, avenue du Général Leclerc FR- 92260 Fontenay-aux-Roses Tel. : + 33 1 40 95 60 60 Fax : + 33 1 40 95 86 56

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) Standard(s)

Place: Depew, NY **Date:** 4/04/2022

Signature: 

Name: Carrie Termin

Title: Regulatory Affairs and Product Certification Specialist

ATTESTATION D'EXAMEN UE DE TYPE
EU TYPE EXAMINATION CERTIFICATE

1 **Version : 01** — **LCIE 12 ATEX 3053 X** — **Issue : 01**

Directive 2014/34/UE / **Directive 2014/34/EU**

2 Appareil ou Système de Protection destiné à être utilisé en Atmosphères Explosibles / Equipment or Protective System Intended for use in Potentially Explosive Atmospheres

3 Produit : Capteurs de vibrations / Product : Vibration sensors

Type: EX611*/*****

4 Fabricant : / Manufacturer :

PCB Piezotronics

5 Adresse : / Address :

3425 Walden Avenue
Depew, New York 14043
USA

6 Ce produit et ses variantes éventuelles acceptées sont décrits dans l'annexe de la présente attestation et dans les documents descriptifs cités en référence. / This product and any acceptable variations thereto are specified in the schedule to this certificate and the documents therein referred to.

7 Le LCIE, Organisme Notifié sous la référence 0081 conformément à l'article 17 de la directive 2014/34/UE du Parlement européen et du Conseil du 26 février 2014, certifie que ce produit est conforme aux Exigences Essentielles de Sécurité et de Santé pour la conception et la construction de produits destinés à être utilisés en atmosphères explosibles, données dans l'annexe II de la Directive. / LCIE, Notified Body number 0081 in accordance with article 17 of the Directive 2014/34/EU of the European Parliament and the Council of 26 February 2014 certifies that product has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres, given in Annex II to the Directive.

Les résultats des vérifications et essais figurent dans le(s) rapport(s) confidentiel(s) N° : / The examination and test results are recorded in confidential report(s) N°:

113365-625323, 157330-726954

8 Le respect des Exigences Essentielles de Sécurité et de Santé est assuré par la conformité à : / Compliance with the Essential Health and Safety Requirements has been assured by compliance with :

EN 60079-0:2012+A11:2013 ; EN 60079-11:2012

9 Le signe « X » lorsqu'il est placé à la suite du numéro de l'attestation, indique que cet appareil est soumis aux conditions particulières d'utilisation, mentionnées dans l'annexe de cette attestation. / If the sign "X" is placed after the certificate number, it indicates that the product is subject to the Specific Conditions of Use specified in the schedule to this certificate.

10 Cette Attestation d'Examen UE de Type concerne uniquement la conception et la construction du produit spécifié. Des exigences supplémentaires de la directive sont applicables pour la fabrication et la fourniture du produit. Ces dernières ne sont pas couvertes par la présente attestation. / This EU Type Examination Certificate relates only to the design and construction of the specified product. Further requirements of the Directive apply to the manufacturing process and supply of this product. These are not covered by this certificate.

11 Le marquage du produit est mentionné dans l'annexe de cette attestation. / The marking of the product is specified in the schedule to this certificate.

Fontenay-aux-Roses, le 31 janvier 2019

Responsable de Certification
Certification Officer
Julien Gauthier

LABORATOIRE CENTRAL DES INDUSTRIES ELECTRIQUES
S.A.S au capital de 15.745.984 €
RCS Nanterre B 408 363 174
33 avenue du Général Leclerc
F - 92266 FONTENAY AUX ROSES

LCIE
Laboratoire Central des Industries Electriques
Une société de Bureau Veritas

33 Avenue du Général Leclerc
92260 Fontenay-aux-Roses
FRANCE

WWW.LCIE.FR

1 **Version : 01** **LCIE 12 ATEX 3053 X** **Issue : 01**

12 **DESCRIPTION DU PRODUIT**

L'équipement est un capteur de vibration basé sur une technologie de cristal piézo-électrique (capacité ≤ 300 pF).
Les séries EX611***/***** sont des capteurs haute température avec, soit uniquement une sortie par connecteur, soit un câble intégral équipé d'un connecteur de sortie.
Le capteur de vibration fournit un signal lorsqu'il est soumis à un mouvement.
Le capteur est fabriqué en acier inoxydable, avec une tête carrée ou triangulaire selon les modèles concernés.

DESCRIPTION OF PRODUCT

The equipment is a vibration sensor based on a piezo-electric crystal as sensing element (capacitance ≤ 300 pF).
EX611***/***** series apparatus are high temperature sensors with either only an output connector, or with an integral cable and output connector.
The vibration sensors provide a charge output when subjected to a mechanical motion.
The sensors have stainless steel housings, with square base or triangular base mounting according to the models concerned.

DETAILS DE LA GAMME

Capteurs de vibrations sont de type :

RANGE DETAILS

Vibration sensors types are as following:

EX611 * ** / *** **

- * : Révision / *Revision* (une lettre / *one letter* A-Z, M = modèle spécial client / *customer special model*)
- ** : Type de connecteur / *Connector type* (00 = mini mil, 20 = Lemo)
- *** : Longueur câble / *Cable length* (exemple / *example* : 020 = 20ft, M020 = 20 m)
- ** : Type de connecteur spécial / *Specialty connector*

CARACTERISTIQUES

Paramètres électriques pour tous modèles avec connecteurs seuls ou avec câbles équipés de connecteurs de sortie (100 ft maximum) :

U_i : 30V, I_i : 100mA, P_i : 0,7W, C_i : 3300pF, L_i : 33µH.

RATINGS

Electrical parameters for all models with either only an output connector, either an integral cable with output signal (100 ft maximum):

U_i : 30V, I_i : 100mA, P_i : 0.7W, C_i : 3300pF, L_i : 33µH.

MARQUAGE

Le marquage du produit doit comprendre :

Marquage complet :
PCB Piezotronics Inc. ou IMI Sensors ou IMI
Adresse : …
Type : EX611***/***** (1)
N° de fabrication : …
Année de fabrication : …
Ⓔx II 1 G
Ex ia IIC T6…T710°C Ga (2)
LCIE 12 ATEX 3053 X
-196°C ≤ T_{amb} ≤ +700°C
U_i : 30V, I_i : 100mA, P_i : 0,7W, C_i : 3300pF, L_i : 33µH

Marquage réduit :
PCB Piezotronics Inc. ou IMI Sensors ou IMI
Type : EX611***/***** (1)
N° de fabrication : …
Ⓔx II 1 G
Ex ia IIC T6…T710°C Ga (2)
LCIE 12 ATEX 3053 X
U_i : 30V, I_i : 100mA, P_i : 0,7W, C_i : 3300pF, L_i : 33µH
(1) complété avec le modèle de la gamme
(2) température côté capteur et câble

MARKING

The marking of the product shall include the following :

Complete marking :
PCB Piezotronics Inc. or IMI Sensors or IMI
Address : …
Type : EX611***/***** (1)
Serial number : …
Year of construction : …
Ⓔx II 1 G
Ex ia IIC T6…T710°C (2)
LCIE 12 ATEX 3053 X
-196°C ≤ T_{amb} ≤ +700°C
U_i : 30V, I_i : 100mA, P_i : 0.7W, C_i : 3300pF, L_i : 33µH

Reduced marking :
PCB Piezotronics Inc. or IMI Sensors or IMI
Type : EX611***/***** (1)
Serial number : …
Ⓔx II 1 G
Ex ia IIC T6…T710°C (2)
LCIE 12 ATEX 3053 X
U_i : 30V, I_i : 100mA, P_i : 0.7W, C_i : 3300pF, L_i : 33µH
(1) completed by the range model
(2) temperature sensor and cable side

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Une société de Bureau Veritas
33 Avenue du Général Leclerc
92260 Fontenay-aux-Roses
FRANCE
WWW.LCIE.FR

1 **Version : 01** **LCIE 12 ATEX 3053 X** **Issue : 01**

MARQUAGE (suite)

L'appareil doit également comporter le marquage normalement prévu par les normes de construction qui le concernent sous la responsabilité du fabricant.

MARKING (continued)

The equipment shall also bear the usual marking required by the product standards applying to such equipment under the manufacturer responsibility.

13 CONDITIONS PARTICULIERES D'UTILISATION

SPECIFIC CONDITIONS OF USE

a) Température ambiante d'utilisation : de - 196°C à + 700°C.

Ambient temperature range: from - 196°C to + 700°C.

b) Classement en température :

Temperature classification:

T6 : -196°C ≤ T_{amb} ≤ +80°C,
T5 : -196°C ≤ T_{amb} ≤ +95°C,
T4 : -196°C ≤ T_{amb} ≤ +130°C,
T3 : -196°C ≤ T_{amb} ≤ +190°C,
T2 : -196°C ≤ T_{amb} ≤ +290°C,
T1 : -196°C ≤ T_{amb} ≤ +440°C,
T710°C : -196°C ≤ T_{amb} ≤ +700°C.

c) L'appareil ne peut être raccordé qu'à des équipements certifiés de sécurité intrinsèque. Ces associations doivent répondre aux exigences de la norme EN 60079-25 (voir plan n°52744).

The apparatus can be only connected to intrinsically safe certified equipment. These combinations shall comply with the requirements of the standard EN 60079-25 (see drawing n°52744).

d) Les câbles utilisés doivent avoir une température d'utilisation supérieure aux classements en température indiqués en fonction des températures ambiantes d'utilisation.

Cables used shall have operating temperature greater than temperature classification mentioned according to operating temperature range.

14 EXIGENCES ESSENTIELLES DE SANTE ET DE SECURITE

ESSENTIAL HEALTH AND SAFETY REQUIREMENTS

Couvertes par les normes listées au point 8.

Covered by standards listed at 8.

15 DOCUMENTS DESCRIPTIFS

DESCRIPTIVE DOCUMENTS

N°	Description	Reference	Rev.	Date	Page(s)
1.	Dossier technique ATEX / *Technical file ATEX*	52740	A	2018/07/12	11
2.	Manuel d'instruction / *Instruction notice*	69820	-	-	2

16 INFORMATIONS COMPLEMENTAIRES

ADDITIONAL INFORMATIONS

Essais individuels

Néant

Routine tests

None

Conditions de certification

Les détenteurs d'attestations d'examen UE de type doivent également satisfaire les exigences de contrôle de production telles que définies à l'article 13 de la Directive 2014/34/UE.

En accord avec l'Article 41 de la Directive 2014/34/UE, les attestations d'examen CE de type mentionnant la Directive 94/9/CE émises avant la date d'application de la Directive 2014/34/UE (20 avril 2016) peuvent être considérées comme émises en accord avec la Directive 2014/34/UE. Les nouvelles versions de ces attestations peuvent conserver le numéro de l'attestation d'origine émise avant le 20 avril 2016.

Conditions of certification

Holders of EU type examination certificates are also required to comply with the production control requirements defined in article 13 of Directive 2014/34/EU.

In accordance with Article 41 of Directive 2014/34/EU, EC-Type Examination Certificates referring to Directive 94/9/EC that were in existence prior to the date of application of Directive 2014/34/EU (20 April 2016) may be referenced as if they were issued in accordance with Directive 2014/34/EU. New issues of such certificates may continue to bear the original certificate number issued prior to 20 April 2016.

17 DETAILS DES MODIFICATIONS DE L'ATTESTATION

DETAILS OF CERTIFICATE CHANGES

Version 00 : 30/08/2012 — Evaluation selon les normes EN 60079-0:2009 et EN 60079-11:2012.

Issue 00 : 2012/08/30 — Assessment according to EN 60079-0:2009 and EN 60079-11: 2012 standards.

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1 **Version : 01** **LCIE 12 ATEX 3053 X** **Issue : 01**

17 **DETAILS DES MODIFICATIONS DE L'ATTESTATION (suite)**

Version 01 :
- Mise à jour normative selon la norme EN 60079-0:2012 + A11:2013.
- Ajout d'un modèle plus petit de base triangulaire
- IMI devient PCB Piezotronics.

DETAILS OF CERTIFICATE CHANGES (continued)

Issue 01:
- Normative update according to EN 60079-0:2012 + A11:2013 standard.
- Addition of a smaller model with triangular base
- IMI becomes PCB Piezotronics.

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FRANCE
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L C I E

1 ATTESTATION D'EXAMEN CE DE TYPE

2 **Appareil ou système de protection** destiné à être utilisé en atmosphères explosibles **(Directive 94/9/CE)**

3 Numéro de l'attestation d'examen CE de type
LCIE 12 ATEX 3053 X

4 Appareil ou système de protection :
Capteurs de vibrations
Type : EX611xxx/xxxxx

5 Demandeur : IMI
Adresse : A PCB Piezotronics Div.
3425 Walden Avenue
Depew, New York, 14043 USA

6 Fabricant : IMI
Adresse : A PCB Piezotronics Div.
3425 Walden Avenue
Depew, New York, 14043 USA

7 Cet appareil ou système de protection et ses variantes éventuelles acceptées sont décrits dans l'annexe de la présente attestation et dans les documents descriptifs cités en référence.

8 Le LCIE, organisme notifié sous la référence 0081 conformément à l'article 9 de la directive 94/9/CE du Parlement européen et du Conseil du 23 mars 1994, certifie que cet appareil ou système de protection est conforme aux exigences essentielles de sécurité et de santé pour la conception et la construction d'appareils et de systèmes de protection destinés à être utilisés en atmosphères explosibles, données dans l'annexe II de la directive.
Les résultats des vérifications et essais figurent dans le rapport confidentiel N°113365-625323.

9 Le respect des exigences essentielles de sécurité et de santé est assuré par la conformité à :

EN 60079-0:2009, EN 60079-11:2012

10 Le signe X lorsqu'il est placé à la suite du numéro de l'attestation, indique que cet appareil ou système de protection est soumis aux conditions spéciales pour une utilisation sûre, mentionnées dans l'annexe de la présente attestation.

11 Cette attestation d'examen CE de type concerne uniquement la conception et la construction de l'appareil ou du système de protection spécifié, conformément à l'annexe III de la directive 94/9/CE.
Des exigences supplémentaires de la directive sont applicables pour la fabrication et la fourniture de l'appareil ou du système de protection. Ces dernières ne sont pas couvertes par la présente attestation.

12 Le marquage de l'appareil ou du système de protection doit comporter les informations détaillées au point 15.

Fontenay-aux-Roses, le 30 août 2012

1 EC TYPE EXAMINATION CERTIFICATE

2 **Equipment or protective system** intended for use in potentially explosive atmospheres **(Directive 94/9/EC)**

3 EC type examination certificate number
LCIE 12 ATEX 3053 X

4 Equipment or protective system :
Vibration sensors
Type : EX611xxx/xxxxx

5 Applicant : IMI
Address : A PCB Piezotronics Div.
3425 Walden Avenue
Depew, New York, 14043 USA

6 Manufacturer : IMI
Address : A PCB Piezotronics Div.
3425 Walden Avenue
Depew, New York, 14043 USA

7 This equipment or protective system and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

8 LCIE, notified body number 0081 in accordance with article 9 of the Directive 94/9/EC of the European Parliament and the Council of 23 March 1994, certifies that this equipment or protective system has been found to comply with the essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II to the Directive.
The examination and test results are recorded in confidential report N°113365-625323.

9 Compliance with the Essential Health and Safety Requirements has been assured by compliance with :

10 If the sign X is placed after the certificate number, it indicates that the equipment or protective system is subject to special conditions for safe use specified in the schedule to this certificate.

11 This EC type examination certificate relates only to the design and construction of this specified equipment or protective system in accordance with annex III to the directive 94/9/EC.

Further requirements of the directive apply to the manufacturing process and supply of this equipment or protective system. These are not covered by this certificate.

12 The marking of the equipment or protective system shall include information as detailed at 15.

Le Responsable de Certification ATEX
ATEX Certification Officer
Michel BRENNON

LCIE
Laboratoire Central
des Industries Electriques
Une société de Bureau Veritas
33, av du Général Leclerc
BP 8
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www.lcie.fr
Société par Actions Simplifiée
au capital de 15 745 984 €
RCS Nanterre B 408 363 174

13 **ANNEXE**

14 **ATTESTATION D'EXAMEN CE DE TYPE**

LCIE 12 ATEX 3053 X

15 **DESCRIPTION DE L'APPAREIL OU DU SYSTEME DE PROTECTION**

Capteurs de vibrations
Type : EX611xxx/xxxxx

L'appareil est un capteur de vibration haute température avec un câble intégré et une sortie par connecteur.
Le capteur de vibration fournit un signal lorsqu'il est soumis à un mouvement.
Le capteur est fabriqué en acier inoxydable.

Paramètres spécifiques du ou des modes de protection concernés :
Ui ≤ 30V, Ii ≤ 100mA, Pi ≤ 0,7W, Ci ≤ 3300pF, Li ≤ 30µH

Le marquage doit être :
IMI Adresse :
Type : 611xxx/xxxxx (1)
N° de fabrication : ... Année de fabrication : ...
Ex II 1G Ex ia IIC T6...T710°C Ga (2)
LCIE 12 ATEX 3053 X
Ui ≤ 30V, Ii ≤ 100mA, Pi ≤ 0,7W, Ci ≤ 3300pF, Li ≤ 30µH
(1)complété avec le modèle
(2)température coté capteur et câble

L'appareil doit également comporter le marquage normalement prévu par les normes de construction qui le concerne.

16 **DOCUMENTS DESCRIPTIFS**

Dossier technique n°52740 rev.NR du 03/08/2012.
Ce document comprend 5 rubriques (7 pages).

17 **CONDITIONS SPECIALES POUR UNE UTILISATION SÛRE**

L'appareil ne peut être raccordé qu'à des équipements certifiés de sécurité intrinsèque. Ces associations doivent être compatibles vis-à-vis de la sécurité intrinsèque (voir les paramètres électriques au paragraphe 15 et le plan n°52744).
Température ambiante d'utilisation : - 196°C à + 700°C.
Classement en température : T6 à +80°C, T5 à +95°C, T4 à +130°C, T3 à +190°C, T2 à +290°C, T1 à +440°C, T710°C à +700°C.

18 **EXIGENCES ESSENTIELLES DE SECURITE ET DE SANTE**

Couvertes par les normes listées au point 9.

19 **VERIFICATIONS ET ESSAIS INDIVIDUELS**

Néant.

20 **CONDITIONS DE CERTIFICATION**

Les détenteurs d'attestations d'examen CE de type doivent également satisfaire les exigences de contrôle de production telles que définies à l'article 8 de la directive 94/9/CE.

13 **SCHEDULE**

14 **EC TYPE EXAMINATION CERTIFICATE**

LCIE 12 ATEX 3053 X

15 **DESCRIPTION OF EQUIPMENT OR PROTECTIVE SYSTEM**

Vibration sensors
Type : EX611xxx/xxxxx

The apparatus is a vibration sensor, series high temperature sensor with integral cable and connector output.
The vibration sensors provide a charge output when subjected to mechanical motion.
The sensors have stainless steel housings.

Specific parameters of the concerned protection mode:

Ui ≤ 30V, Ii ≤ 100mA, Pi ≤ 0,7W, Ci ≤ 3300pF, Li ≤ 30µH

The marking shall be :
IMI Address : ...
Type : 611xxx/xxxxx (1)
Serial number : ... Year of construction : ...
Ex II 1G Ex ia IIC T6...T710°C Ga (2)
LCIE 12 ATEX 3053 X
Ui ≤ 30V, Ii ≤ 100mA, Pi ≤ 0,7W, Ci ≤ 3300pF, Li ≤ 30µH
(1)completed by the model
(2)temperature sensor and cable side

The equipment shall also bear the usual marking required by the manufacturing standards applying to such equipment.

16 **DESCRIPTIVE DOCUMENTS**

Certification file n°52740 rev.NR dated 2012/08/03.
This file includes 5 items (7 pages).

17 **SPECIAL CONDITIONS FOR SAFE USE**

The apparatus can be only connected to intrinsically safe certified equipment. These combinations shall be compatible as regard intrinsic safety rules (see electrical parameters clause 15 and drawing n°52744).
Ambient temperature of use : - 196°C to + 700°C.
Temperature classification : T6 at +80°C, T5 at +95°C, T4 at +130°C, T3 at +190°C, T2 at +290°C, T1 at +440°C, T710°C at +700°C.

18 **ESSENTIAL HEALTH AND SAFETY REQUIREMENTS**

Covered by standards listed at 9.

19 **ROUTINE VERIFICATIONS AND TESTS**

None.

20 **CONDITIONS OF CERTIFICATION**

Holders of EC type examination certificates are also required to comply with the production control requirements defined in article 8 of directive 94/9/EC.

LB-01

IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification Scheme for Explosive Atmospheres

for rules and details of the IECEx Scheme visit www.iecex.com

Certificate No.:	IECEx LCIE 12.0002X issue No.:1	Certificate history: Issue No. 1 (2015-11-9) Issue No. 0 (2012-8-30)
Status:	**Current**	
Date of Issue:	**2015-11-09**	Page 1 of 4
Applicant:	**IMI Sensors, a PCB Piezotronics Div.** 3425 Walden Avenue Depew, NY 14043 **United States of America**	
Electrical Apparatus: *Optional accessory:*	**Vibration sensors** type EX611xxx/xxxxx	
Type of Protection:	**Ex ia**	
Marking:	Ex ia IIC T6...T710℃ Ga IECEx LCIE 12.0002 X	
Approved for issue on behalf of the IECEx Certification Body:	Julien GAUTHIER	
Position:	Certification Officer	
Signature: *(for printed version)*		
Date:	2015-11-09	

1. This certificate and schedule may only be reproduced in full.
2. This certificate is not transferable and remains the property of the issuing body.
3. The Status and authenticity of this certificate may be verified by visiting the Official IECEx Website.

Certificate issued by:

Laboratoire Central des Industries Electriques (LCIE)
33 Avenue du General Leclerc
FR-92260 Fontenay-aux-Roses
France

Documents relative to LCIE certification activites (Certificates, QARs, ExTRs) can be registered under the references "LCI" or "LCIE".

L C I E

IECEx Certificate of Conformity

Certificate No.: IECEx LCIE 12.0002X

Date of Issue: **2015-11-09** Issue No.: **1**

Manufacturer:

PCB Piezotronics
3425 Walden Avenue
Depew, NY 14043
United States of America

Additional Manufacturing location (s):

PCB Piezotronics of North Carolina Inc.
10869 Hwy 903
Halifax, NC 27839
United States of America

This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements. This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended.

STANDARDS:
The electrical apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

IEC 60079-0 : 2007-10 Edition: 5	Explosive atmospheres - Part 0:Equipment - General requirements
IEC 60079-11 : 2011 Edition: 6.0	Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"

*This Certificate **does not** indicate compliance with electrical safety and performance requirements other than those expressly included in the Standards listed above.*

TEST & ASSESSMENT REPORTS:
A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in

Test Report:
FR/LCIE/ExTR12.0003/00 FR/LCIE/ExTR15.0107/00

Quality Assessment Report:

NL/DEK/QAR14.0004/01

IECEx Certificate of Conformity

Certificate No.: IECEx LCIE 12.0002X

Date of Issue: **2015-11-09** Issue No.: **1**

Schedule

EQUIPMENT:
Equipment and systems covered by this certificate are as follows:

The apparatus is a vibration sensor, series high temperature sensor with integral cable and connector output.The vibration sensors provide a charge output when subjected to mechanical motion.
The sensors have stainless steel housings.

CONDITIONS OF CERTIFICATION: YES as shown below:

The apparatus can be only connected to intrinsically safe certified equipment. These combinations shall be compatible as regard intrinsic safety rules (see drawing n°52744).

Ambient temperature of use : - 196°C to + 700°C.

Temperature classification : T6 at +80°C, T5 at +95 °C, T4 at +130°C, T3 at +190°C, T2 at +290°C, T1 at +440°C, T710°C at +700°C.

IECEx Certificate of Conformity

Certificate No.: IECEx LCIE 12.0002X

Date of Issue: **2015-11-09** Issue No.: **1**

DETAILS OF CERTIFICATE CHANGES (for issues 1 and above):

Issue 01 :
Modification of QAR
Addition of a manufacturing site
Modification of the applicant name

Annex: IECEx LCIE 12.0002 X - issue 01 - Annex 01.pdf

Annex 01 to Certificate
IECEx LCIE 12.0002 X issue 01

Marking :

IMI Sensors
Address : ...
Type : EX611XXX/XXXXX (1)
Serial number : ...
Year of construction : ...
Ex ia IIC T6...T710°C Ga (2)
IECEx LCIE 12.0002 X
U_i : 30V, I_i : 100mA, P_i : 0.7W, C_i : 3300pF, L_i : 30µH

(1) *completed by the model*
(2) *temperature sensor and cable side*

Electrical parameters :

U_i : 30V, I_i : 100mA, P_i : 0.7W, C_i : 3300pF, L_i : 30µH

IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification Scheme for Explosive Atmospheres

for rules and details of the IECEx Scheme visit www.iecex.com

Certificate No.:	IECEx LCIE 12.0002X issue No.:0	Certificate history:
Status:	**Current**	
Date of Issue:	**2012-08-30**	Page 1 of 3

Applicant: **IMI**
3425 Walden Avenue
Depew, NY 14043
United States of America

Electrical Apparatus: **Vibration sensors type EX611xxx/xxxxx**
Optional accessory:

Type of Protection: **ia**

Marking: Ex ia IIC T6...T710°C Ga

Approved for issue on behalf of the IECEx Certification Body: Michel BRENON

Position: Certification Officer

Signature:
(for printed version)

Date: August 28, 2012

1. This certificate and schedule may only be reproduced in full.
2. This certificate is not transferable and remains the property of the issuing body.
3. The Status and authenticity of this certificate may be verified by visiting the Official IECEx Website.

Certificate issued by:

Laboratoire Central des Industries Electriques (LCIE)
33 Avenue du General Leclerc
FR-92260 Fontenay-aux-Roses
France
Documents relative to LCIE certification activites (Certificates, QARs, ExTRs) can be registered under the references "LCI" or "LCIE".

IECEx Certificate of Conformity

Certificate No.: IECEx LCIE 12.0002X

Date of Issue: **2012-08-30** Issue No.: **0**

Manufacturer: **IMI**
3425 Walden Avenue
Depew, NY 14043
United States of America

Manufacturing location(s):

This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements. This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended.

STANDARDS:
The electrical apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

IEC 60079-0 : 2007-10 Edition: 5	Explosive atmospheres - Part 0:Equipment - General requirements
IEC 60079-11 : 2011-06 Edition: 6.0	Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"

*This Certificate **does not** indicate compliance with electrical safety and performance requirements other than those expressly included in the Standards listed above.*

TEST & ASSESSMENT REPORTS:
A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in

Test Report:
FR/LCIE/ExTR12.0003/00

Quality Assessment Report:

CA/CSA/QAR09.0018/00 CA/CSA/QAR09.0018/01

IECEx Certificate of Conformity

Certificate No.: IECEx LCIE 12.0002X

Date of Issue: **2012-08-30** Issue No.: **0**

Schedule

EQUIPMENT:
Equipment and systems covered by this certificate are as follows:

The apparatus is a vibration sensor, series high temperature sensor with integral cable and connector output.The vibration sensors provide a charge output when subjected to mechanical motion.
The sensors have stainless steel housings.

Marking :
IMI Address : ...
Type : EX611XXX/XXXXX (1)
Serial number : ... Year of construction : ...
Ex ia IIC T6...T710°C Ga (2)
IECEx LCIE 12.0002 X
Ui ≤ 30V, Ii ≤ 100mA, Pi ≤ 0,7W, Ci ≤ 3300pF, Li ≤ 30µH
(1)completed by the model
(2)temperature sensor and cable side

Electrical parameters :
Ui ≤ 30V, Ii ≤ 100mA, Pi ≤ 0,7W, Ci ≤ 3300pF, Li ≤ 30µH

CONDITIONS OF CERTIFICATION: YES as shown below:

The apparatus can be only connected to intrinsically safe certified equipment. These combinations shall be compatible as regard intrinsic safety rules (see drawing n°52744).
Ambient temperature of use : - 196°C to + 700°C.
Temperature classification : T6 at +80°C, T5 at +95°C, T4 at +130°C, T3 at +190°C, T2 at +290°C, T1 at +440°C, T710°C at +700°C.