



Model EX619A11
Charge Output Accelerometer
Installation and Operating Manual

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

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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

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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	0	0	0	0	0	0
PCB板	X	0	0	0	0	0
电气连接器	0	0	0	0	0	0
压电晶体	X	0	0	0	0	0
环氧	0	0	0	0	0	0
铁氟龙	0	0	0	0	0	0
电子	0	0	0	0	0	0
厚膜基板	0	0	X	0	0	0
电线	0	0	0	0	0	0
电缆	X	0	0	0	0	0
塑料	0	0	0	0	0	0
焊接	X	0	0	0	0	0
铜合金/黄铜	X	0	0	0	0	0
本表格依据 SJ/T 11364 的规定编制。						
0：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 response. 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 connection 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 waveform 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.

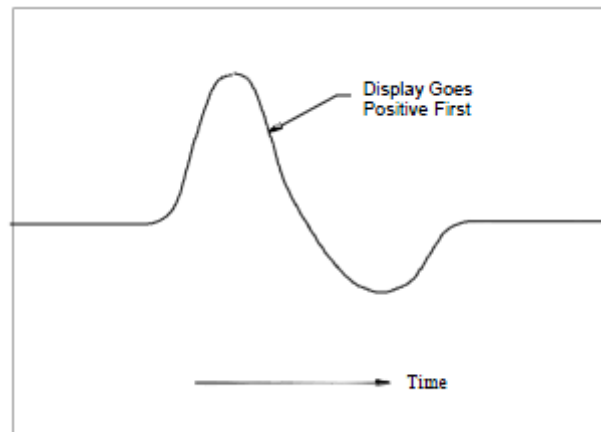


FIGURE 1

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.

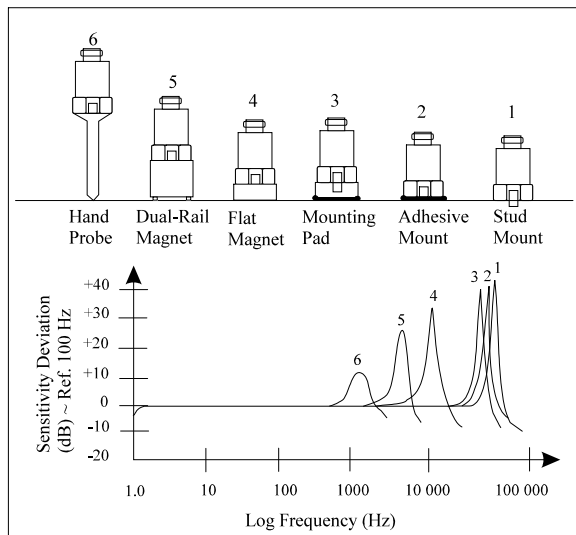


Figure 1. Assorted Mounting Configurations and Their Effects on High Frequency

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.*

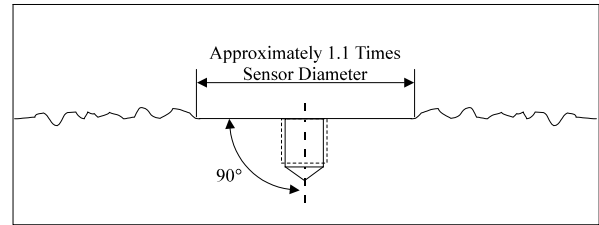


Figure 2. Mounting Surface Preparation

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.

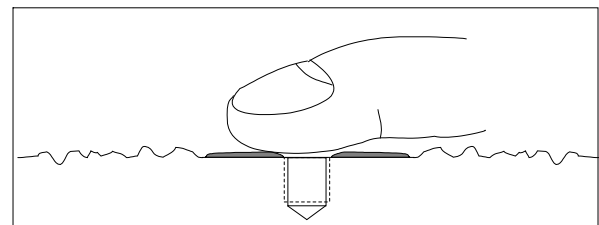


Figure 3. Mounting Surface Lubrication

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.

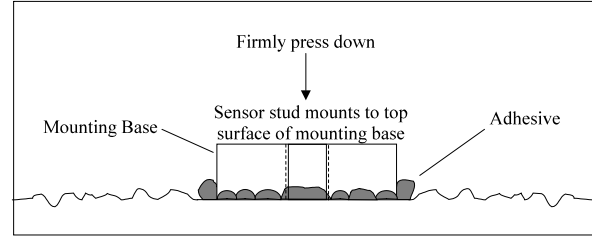


Figure 4. Mounting Base: Adhesive Installation

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.

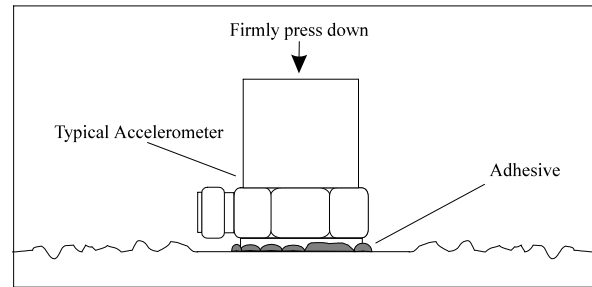


Figure 5. Direct Adhesive Mounting

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)

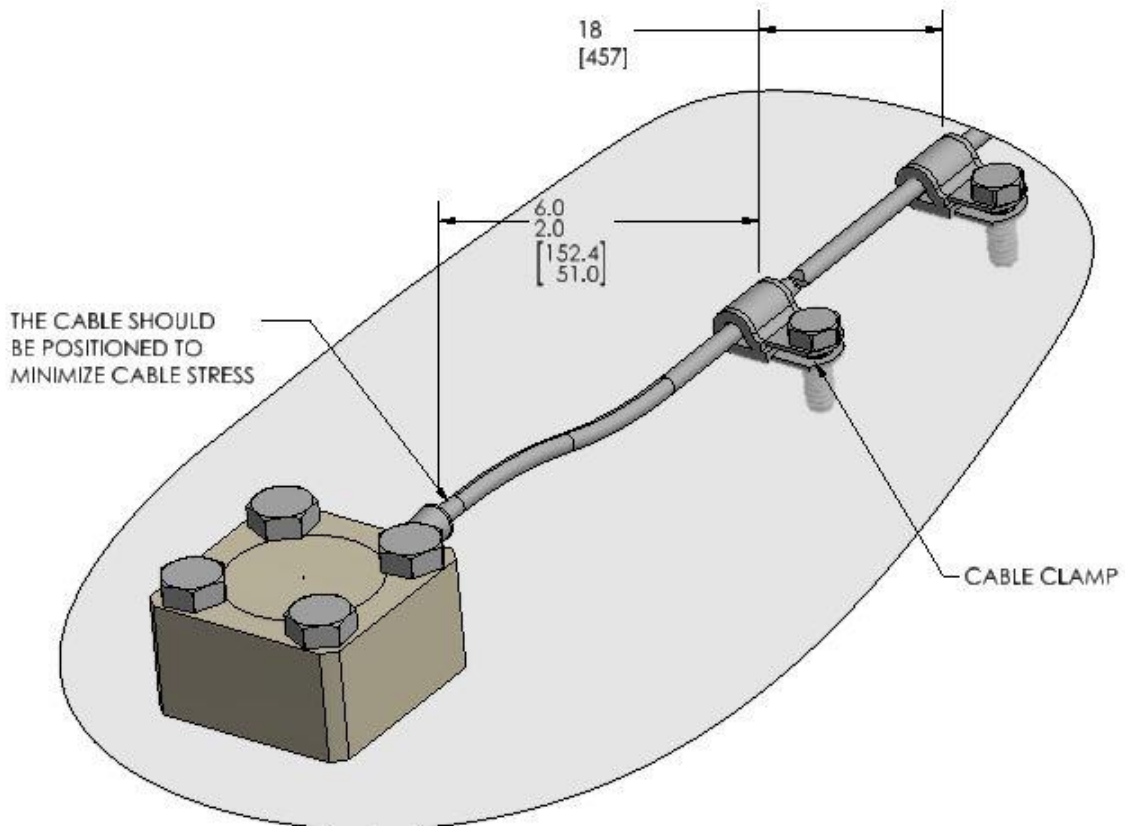
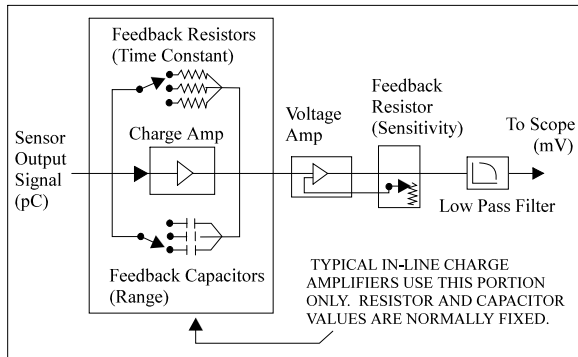


Figure 3

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)

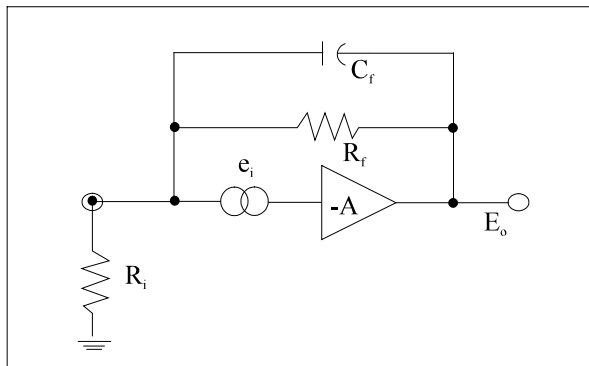


Figure 5.1 Typical Charge Amplifier Schematic

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.

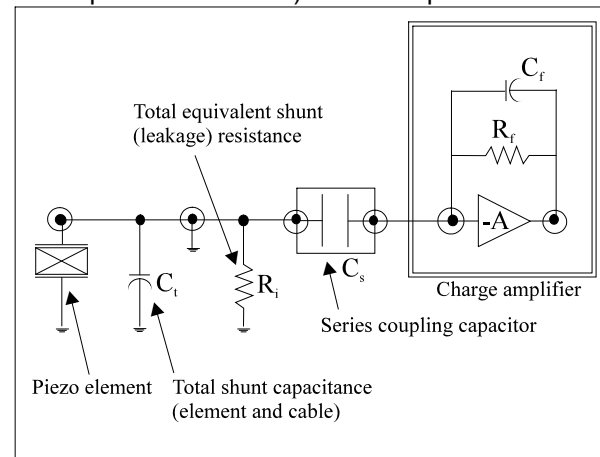


Figure 5.2 Piezoelectric System Block Diagram

Figure 5.2 illustrates a block diagram of the piezoelectric 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 than 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_t 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

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

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 $R_i C_s$ should be several orders of magnitude higher than $R_f C_t$.

The approximate final system discharge time constant becomes:

Equation 4a

$$TC = \frac{1}{\frac{1}{R_i C_s} + \frac{1}{R_f C_t}} \quad \text{seconds}$$

If the input coupling time constant ($R_i C_s$) is very much greater than the discharge time constant of the charge amplifier ($R_f C_t$), Equation 4a then becomes:

Equation 4b

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

Equation 5

$$TC = R_f C_t$$

With the product $R_i C_s$ chosen to be much greater than $R_f C_t$, the system discharge time constant is simply $R_f C_t$ (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.

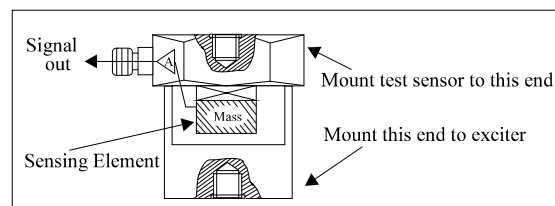


Figure 1. Reference Standard Accelerometer

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 setups may be automated and vary, depending on the type and number of accelerometers being calibrated.)

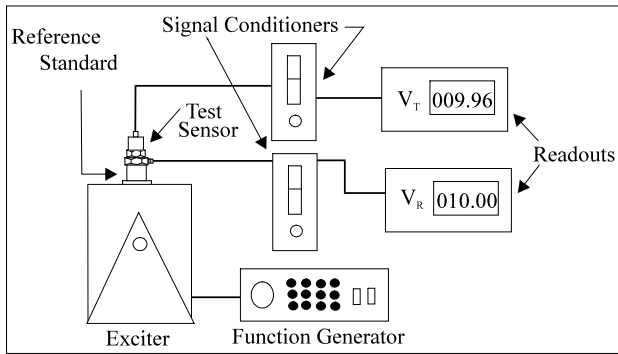


Figure 2. Typical Back-to-Back Calibration System

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.

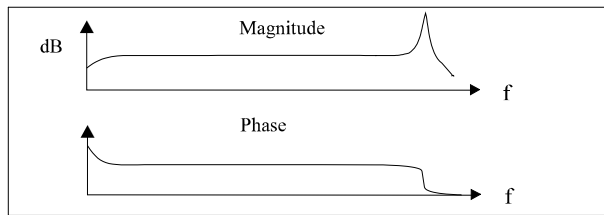


Figure 3. Typical Test Accelerometer Response

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.

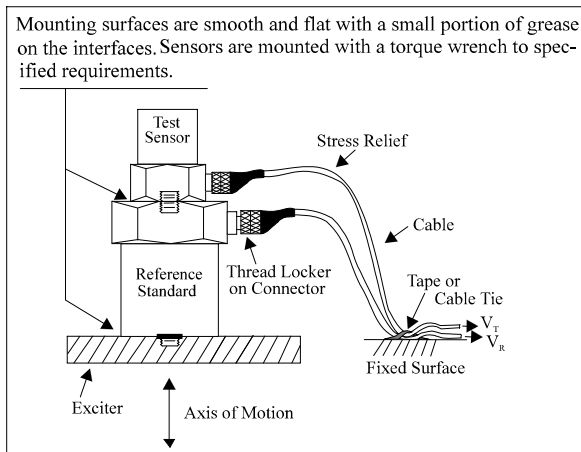


Figure 4. Typical Calibration Set-Up

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.

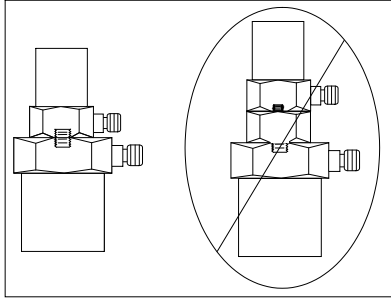


Figure 5. Stud Mounting

Understand Back-to-Back Calibration limitations. Do not expect the uncertainty of calibration to be any better than $\pm 2\%$. (In fact, the uncertainty may

be as high as $\pm 3\%$ or $\pm 4\%$ 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.



3425 Walden Avenue,

Depew, NY 14043

Toll Free: 888-684-0013 • 24-hour SensorLineSM: 716-684-0001 • FAX: 716-685-3886

E-mail: vibration@pcb.com • Website: www.pcb.com

	<u>ENGLISH</u>	<u>SI</u>	
Performance			
Sensitivity(± 5 %)	50 pC/g	5.1 pC/(m/s ²)	
Measurement Range	± 500 g pk	± 4905 m/s ² pk	
Frequency Range(± 5 %)	3 kHz	3 kHz	[2]
Frequency Range(+10 %)	5 kHz	5 kHz	[2]
Resonant Frequency	>18 kHz	>18 kHz	[1]
Non-Linearity	≤ 1 %	≤ 1 %	[3]
Transverse Sensitivity	≤ 5 %	≤ 5 %	[4]
Environmental			
Overload Limit(Shock)	± 2000 g pk	± 19,620 m/s ² pk	
Temperature Range(Operating)	-65 to +900 °F	-54 to +482 °C	
Temperature Range(Cable Termination)	-65 to +500 °F	-54 to +260 °C	
Temperature Response	See Graph	See Graph	[1]
Base Strain Sensitivity	≤ 0.033 g/με	≤ .32 (m/s ²)/με	
Electrical			
Capacitance(Pin to Pin)	1525 pF	1525 pF	[1]
Capacitance(Pin to Case)	250 pF	250 pF	[1]
Insulation Resistance(Pin to Case 70° F)	>10 ⁹ Ohm	>10 ⁹ Ohm	
Insulation Resistance(Pin to Pin 70° F)	>10 ⁹ Ohm	>10 ⁹ Ohm	
Insulation Resistance(Pin to Pin 900° F)	>100 kohm	>100 kohm	
Output Polarity	Differential	Differential	
Physical			
Sensing Element	Ceramic	Ceramic	
Sensing Geometry	Compression	Compression	
Housing Material	Inconel	Inconel	
Sealing	Hermetic	Hermetic	
Size (Height x Length x Width)	1.49 in x 1.63 in x 1.63 in	38 mm x 41.4 mm x 41.4 mm	
Weight(with cable)	19.4 oz	550 gm	[1]
Electrical Connector	2-Pin MIL-C-5015	2-Pin MIL-C-5015	
Electrical Connection Position	Side	Side	
Cable Length	7 ft	2.1 m	
Cable Type	MI Hardline Cable	MI Hardline Cable	
Mounting	Through Holes (4)	Through Holes (4)	

OPTIONAL VERSIONS

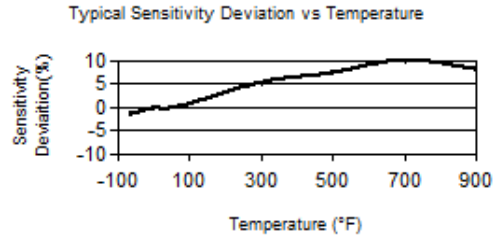
Optional versions have identical specifications and accessories as listed for the standard model except where noted below. More than one option may be used.

NOTES:

[1] Typical.
 [2] Low frequency response is determined by external signal conditioning electronics.
 [3] Zero-based, least-squares, straight line method.
 [4] Transverse sensitivity is typically ≤ 3%.
 [5] See PCB Declaration of Conformance PS141 for details.

SUPPLIED ACCESSORIES:

Model 62177-01 1/4-28 x 1 1/4in long (4)
 Model ICS-1 NIST-traceable single-axis amplitude response calibration from 600 cpm (10 Hz) to upper 5% frequency



Entered: LK	Engineer: JJD	Sales: MC	Approved: NJF	Spec Number:
Date: 6/28/2019	Date: 6/28/2019	Date: 6/28/2019	Date: 6/28/2019	62610

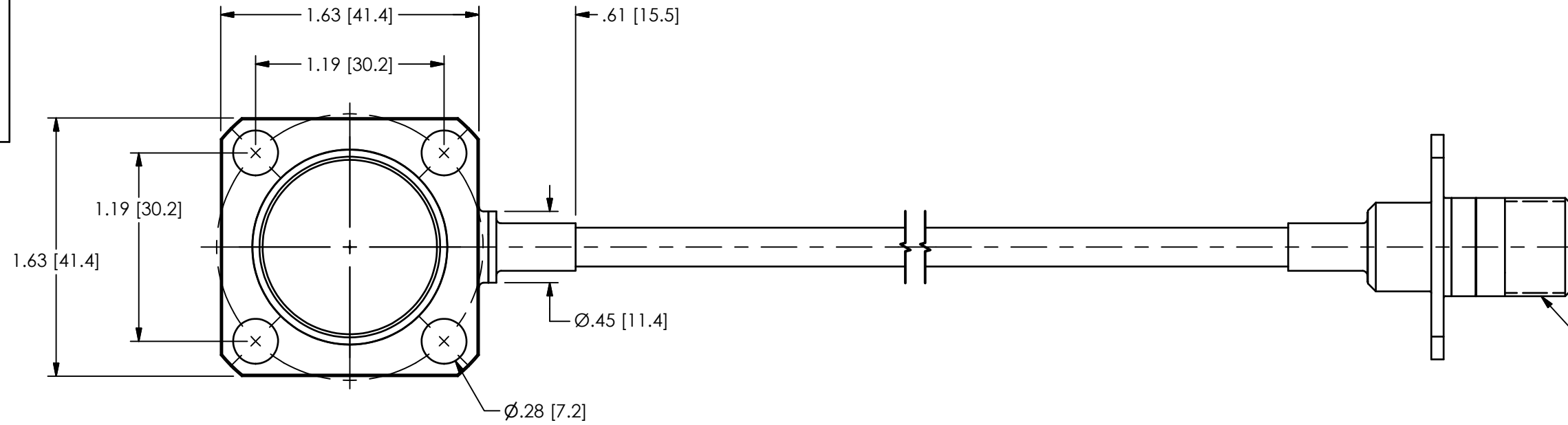


All specifications are at room temperature unless otherwise specified.
 In the interest of constant product improvement, we reserve the right to change specifications without notice.
 ICP® is a registered trademark of PCB Group, Inc.

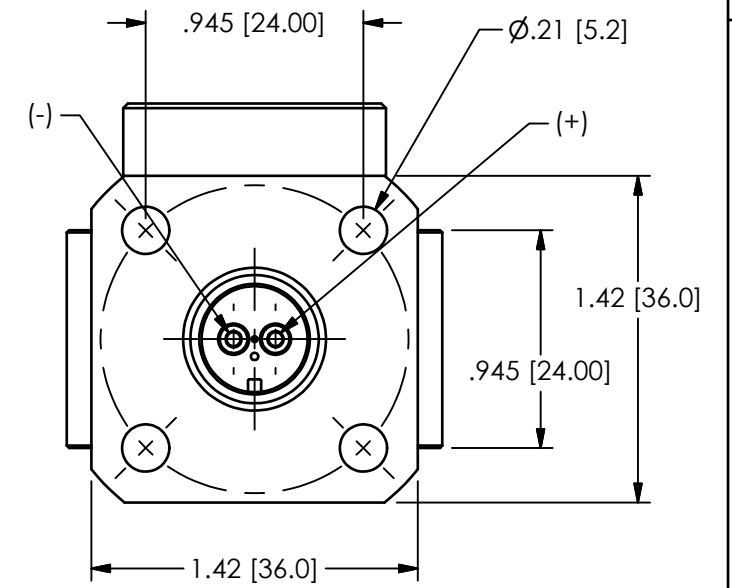
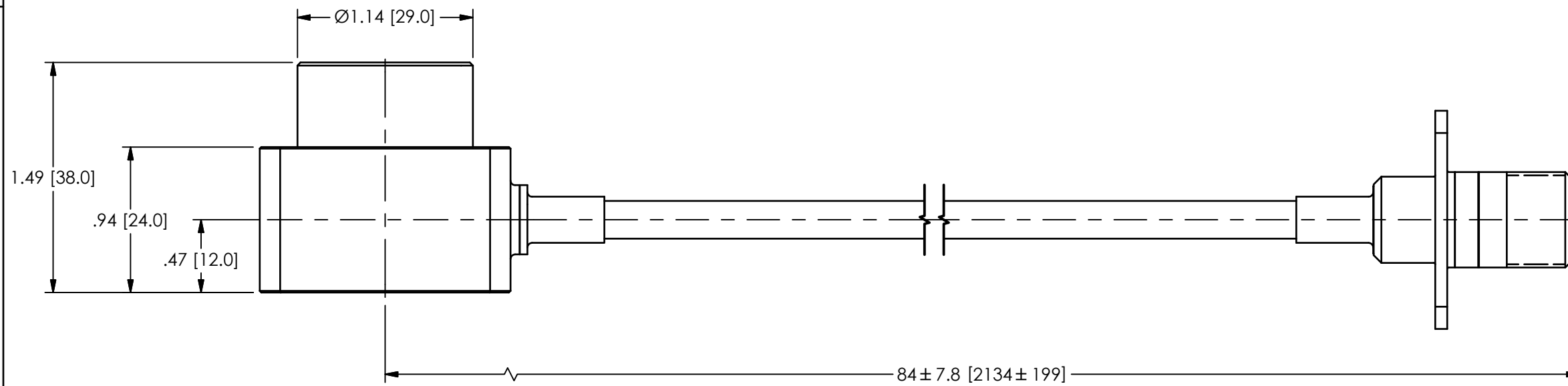
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59256

REVISIONS		
REV	DESCRIPTION	DIN
NR	RELEASED TO DRAFTING	44641



5/8-24 UNEF - 2A
CONNECTOR
MATES WITH
MIL-C-5015



UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:		DRAWN		CHECKED		ENGINEER		 3425 WALDEN AVE. DEPEW, NY 14043 (716) 684-0001 E-MAIL: sales@pcb.com
DIMENSIONS IN INCHES	DIMENSIONS IN MILLIMETERS [IN BRACKETS]	BB	9/30/15	ECB	9/30/15	JJD	9/30/15	
DECIMALS XX ±.03 XXX ±.010	DECIMALS X ±0.8 XX ±0.25	TITLE OUTLINE DRAWING HIGH TEMP ACCELEROMETER						DWG. NO. 59256
ANGLES ± 2 DEGREES	ANGLES ± 2 DEGREES							SCALE: 1.2X
FILLETS AND RADII .003 - .005	FILLETS AND RADII 0.07 - 0.13							

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61067

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SCHEDULE DRAWING
NO MODIFICATIONS PERMITTED WITHOUT REFERENCE TO THE NOTIFIED BODY

REVISIONS		
REV	DESCRIPTION	DIN
NR	RELEASED TO DRAFTING	44641

B

A

B

A

5 Ci AND Li BASED ON CABLE WITH 20 pF/ft AND .3 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:

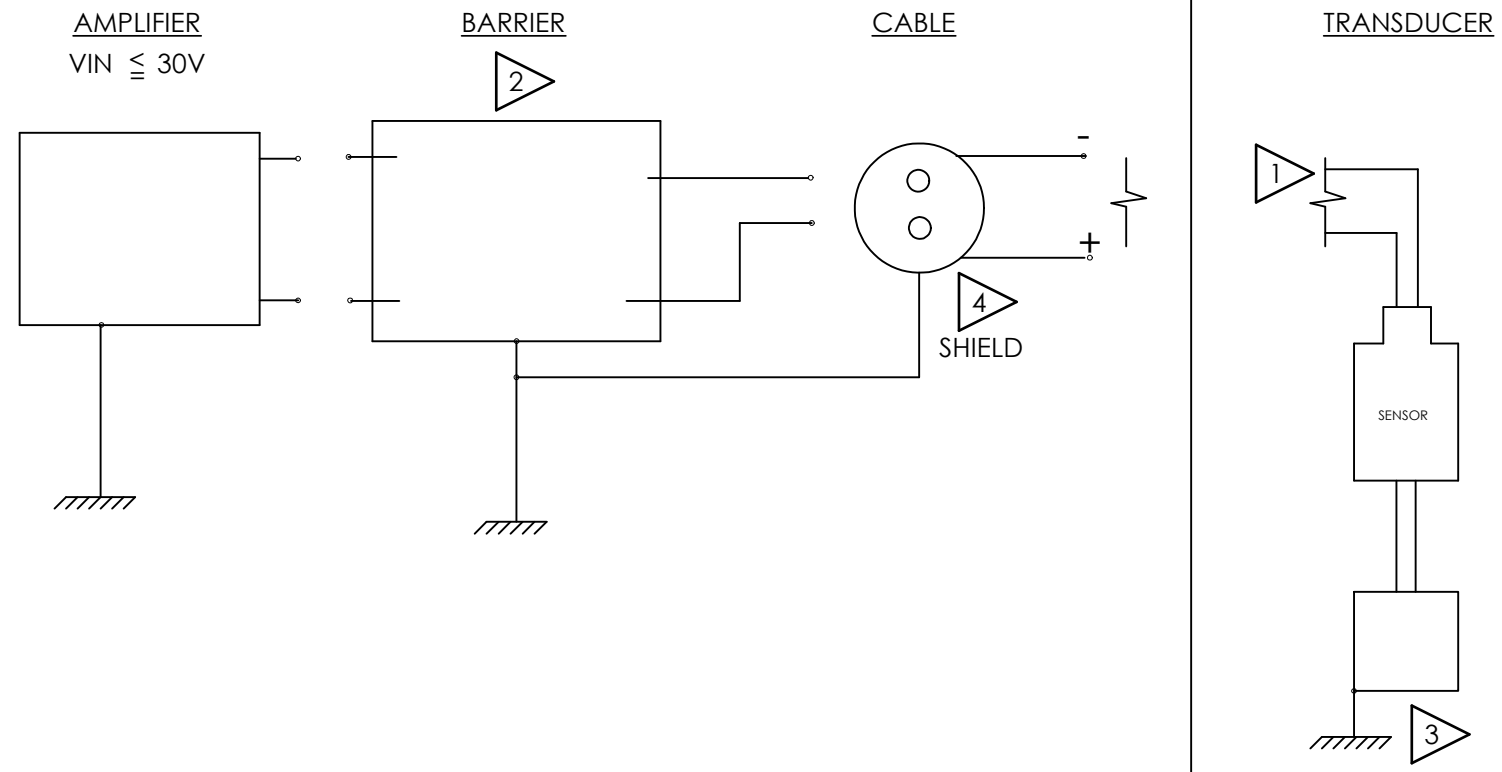
- 5 Ui <= 30 V
- 5 Ii <= 130 mA
- 5 Pi <= 0.8 W
- 5 Ci <= 5 nF
- 5 Li <= 30 μH

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

- ZONE 0
- CL I, Zn 0 AEx ia/Exia IIB Tx Ga (SEE SHEET 2 FOR T CODES)
- DIV 1
- CL I, DIV 1 GR C,D: T6...T1
- CL II, DIV 1 GR E,F (MAX amb 200°C), G (MAX amb 165°C)
- CL III:

NON-HAZARDOUS / SAFE AREA

HAZARDOUS AREA
DIV 1
ZONE 0



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



DRAWN	CHECKED		ENGINEER			
	JDM	9/17/15	ECB	9/17/15	JJD	9/17/15
TITLE						
CONTROL DRAWING						
619XY/MNNZZ						

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

CODE IDENT. NO. 52681	DWG. NO. 61067
SCALE: NONE	SHEET 1 OF 2

4

3

2

1

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61067

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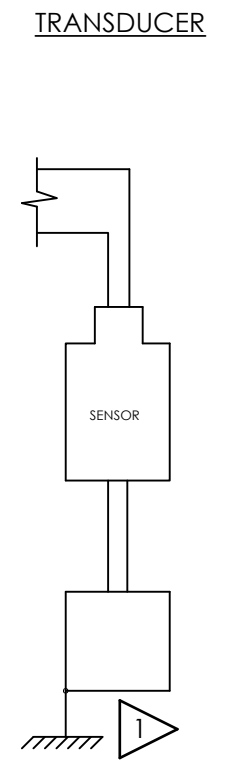
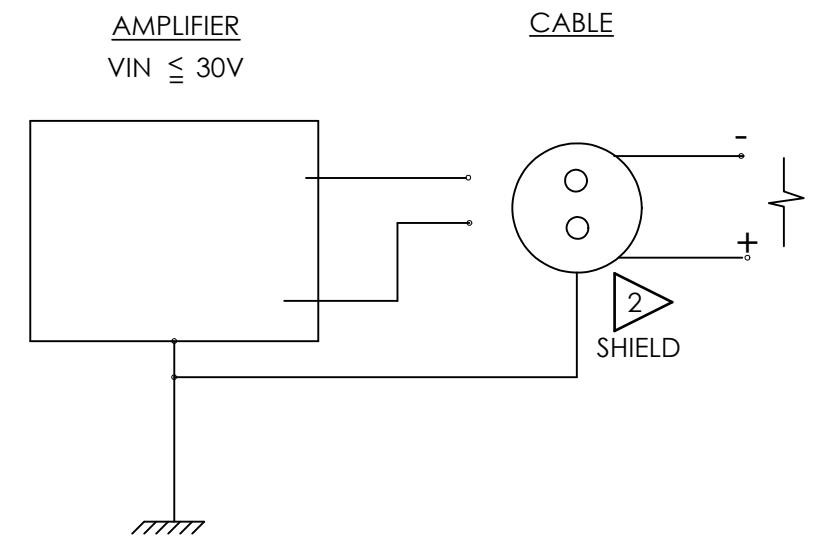
SCHEDULE DRAWING
NO MODIFICATIONS PERMITTED WITHOUT REFERENCE TO THE NOTIFIED BODY

T-CODE	AMBIENT
T6	75°C
T5	90°C
T4	125°C
T3	190°C
T2	290°C
T1	440°C
N/A	510°C

REVISIONS		
REV	DESCRIPTION	DIN
	-SEE SHEET 1-	

NON-HAZARDOUS / SAFE AREA

HAZARDOUS AREA
DIV 2
ZONE 2



2 SHIELDS TO BE EARTHED AT BARRIER END.

1 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.

ENTITY PARAMETERS:

- U_i ≤ 30 V
- I_i ≤ 130 mA
- P_i ≤ 0.8 W
- C_i ≤ 5 nF
- L_i ≤ 30 μH

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

- ZONE 2
- CL I, Zn 2, AEx/Ex ic IIB T6...T510 Gc
- DIV 2
- CL I, DIV 2 GR A,B,C,D: T6...T1

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



DRAWN	CHECKED		ENGINEER		
	JDM	9/17/15	ECB	9/17/15	JJD
TITLE					
CONTROL DRAWING					
619XY/MNNZZ					

PCB PIEZOTRONICS
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(716) 684-0002 E-MAIL: sales@pcb.com

CODE IDENT. NO. 52681	DWG. NO. 61067
SCALE: NONE	SHEET 2 OF 2

bbbehinger 15:20 9/30/2015



LCIE



ATTESTATION D'EXAMEN DE TYPE VOLONTAIRE

VOLUNTARY TYPE EXAMINATION CERTIFICATE

Appareil ou composant destiné à être utilisé en atmosphères explosibles (Directive 94/9/CE)

Equipment or component intended for use in potentially explosive atmospheres (Directive 94/9/EC)

Version : 00

LCIE 15 ATEX 1026 X

Issue : 00

Appareil : Capteurs de vibration

Equipment: Vibration sensors

Type: EX619XYY/MNNZZ

Demandeur - Fabricant

Applicant - Manufacturer

PCB Piezotronics

Adresse : 3425 Walden Avenue Depew, New York 14043 USA

Address : 3425 Walden Avenue Depew, New York 14043 USA

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

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

Le LCIE certifie que cet appareil ou composant est conforme aux Exigences Essentielles de Sécurité et de Santé pour la conception d'appareils ou composants électriques de catégorie 3 ou non électriques de catégorie 2 et 3, destinés à être utilisés en atmosphères explosibles. Ces Exigences Essentielles de Sécurité et de Santé sont données dans l'annexe II de la directive 94/9/CE du Parlement européen et du Conseil du 23 mars 1994.

LCIE certifies that this equipment or component has been found to comply with the Essential Health and Safety Requirements that relates to the design, of category 3 electrical or categories 2 and 3 non electrical equipment or component, which is intended for use in potentially explosive atmospheres. These Essential Health and Safety Requirements are given in Annex II of the Directive 94/9/EC of the European Parliament and the Council of 23 March 1994.

Les résultats des vérifications et essais figurent dans le rapport confidentiel :

The examination and test results are recorded in confidential report:

N°134802-670680

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 60079-15:2010

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

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

Cette attestation d'examen de type volontaire concerne uniquement la conception et la construction de l'appareil ou composant spécifié conformément à la Directive 94/9/CE.

This voluntary type examination certificate relates only to the design, examination and tests of this specified equipment or component in accordance to the Directive 94/9/EC.

Des exigences supplémentaires de la directive sont applicables pour la fabrication et la fourniture de l'appareil, système de protection ou composant. Ces dernières ne sont pas couvertes par la présente attestation.

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

Le marquage de l'appareil ou composant est mentionné dans l'annexe de cette attestation.

The marking of the equipment or component is specified in the schedule to this certificate.

Fontenay-aux-Roses, le 04 AOUT 2015

Responsable de Certification Certification Officer Remi Hanot



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ATTESTATION D'EXAMEN DE TYPE VOLONTAIRE

Appareil ou composant destiné à être utilisé en
atmosphères explosibles
(Directive 94/9/CE)

VOLUNTARY TYPE EXAMINATION CERTIFICATE

Equipment or component intended for use in potentially
explosive atmospheres
(Directive 94/9/EC)

3 Version : 00

LCIE 15 ATEX 1026 X

Issue : 00

13

ANNEXE

SCHEDULE

15 DESCRIPTION DE L'APPAREIL OU DU COMPOSANT

Les capteurs piézoélectriques de vibration type EX619XYY/MNNZZ utilise un cristal de quartz pour convertir une mesure de vibration mécanique en un signal électrique.

Le capteur consiste en une enveloppe métallique scellée contenant un élément cristal de quartz.

Le cristal de quartz est raccordé à un connecteur ou a câble intégral.

Paramètres électriques :

U : 30V, I : 130 mA, P : 0,8W

Définition des modèles :

EX619XYY/MNNZZ :

- X : type de la famille (désigné par une lettre)
- YY : différent type (désigné par un nombre à deux digits)
- MNNZZ : spécifie le type de raccordement et la longueur du câble-optionnel

M n'est présent que pour une longueur métrique-optionnel
NNN spécifie la longueur du câble (3 chiffres)-optionnel
ZZ spécifie le type de raccordement (2 lettres)-optionnel

MARQUAGE

Le marquage de l'appareil ou du composant doit comprendre :

PCB Piezotronics

Adresse : ...

Type : EX619XYY/MNNZZ (complété par le modèle)

N° de fabrication : ...

Année de fabrication : ...

Ex II 3 G

Ex nA IIC T6...T510°C Gc

LCIE 15 ATEX 1026 X

-54°C ≤ Ta ≤ +500°C

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

16 DOCUMENTS DESCRIPTIFS

Dossier de certification N°61065 Rév.NR du 17/03/2015.

Ce dossier comprend 4 rubriques (8 pages).

DESCRIPTION OF EQUIPMENT OR COMPONENT

The model EX619XYY/MNNZZ piezoelectric vibration sensors utilize a quartz crystal to convert a mechanical vibration measurement into an electric signal.

The sensor consists of a sealed metal case, which houses a piezo crystal element.

The quartz crystal is connected to a connector or an integral cable.

Electrical parameters :

U : 30V, I : 130 mA, P : 0,8W

Definition of models :

EX619XYY/MNNZZ :

- X : family type (assigned as a letter)
- YY : variation type (assigned as a two digit number)
- MNNZZ : specifies termination type and cable length-optional

M is present only for metric length units-optional
NNN specifies cable length (three numbers)-optional
ZZ specifies termination type (two letters)-optional

MARKING

The marking of the equipment or component shall include the following :

PCB Piezotronics

Address :

Type : EX619XYY/MNNZZ (completed with the model)

Serial number : ...

Year of construction : ...

Ex II 3 G

Ex nA IIC T6...T510°C Gc

LCIE 15 ATEX 1026 X

-54°C ≤ Ta ≤ +500°C

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

DESCRIPTIVE DOCUMENTS

Certification file N°61065 Rev.NR dated 2015/03/17.

This file includes 4 items (8 pages).



LCIE

1 **ATTESTATION D'EXAMEN DE TYPE
VOLONTAIRE**

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



**VOLUNTARY TYPE EXAMINATION
CERTIFICATE**

Equipment or component intended for use in potentially
explosive atmospheres
(Directive 94/9/EC)

3 **Version : 00**

LCIE 15 ATEX 1026 X

Issue : 00

13

ANNEXE

SCHEDULE

17 **RECAPITULATIF DES LIMITATIONS**

SCHEDULE OF LIMITATIONS

L'appareil ne doit être raccordé qu'à un équipement dont les paramètres électriques sont compatibles avec les paramètres électriques.

The apparatus must be only connected to an equipment whose electrical parameters are compatible with the electrical parameters.

Température ambiante d'utilisation :

- 54°C à +500°C (connecteur haute température)
- 54°C à +260°C (connecteur température standard)
- 54°C à +150°C (connecteur style lemo)

Operating ambient temperature :

- 54°C to +500°C (high temperature connector)
- 54°C to +260°C (standard temperature connector)
- 54°C to +150°C (lemo style connector)

Classement en température :

- T6 à Tamb +75°C
- T5 à Tamb +90°C
- T4 à Tamb +125°C
- T3 à Tamb +190°C
- T2 à Tamb +290°C
- T1 à Tamb +440°C
- T510°C à Tamb +500°C

Temperature classification :

- T6 at Tamb +75°C
- T5 at Tamb +90°C
- T4 at Tamb +125°C
- T3 at Tamb +190°C
- T2 at Tamb +290°C
- T1 at Tamb +440°C
- T510°C at Tamb +500°C

L'appareil doit être raccordé conformément au plan n°61067 (page 2/2).

The apparatus shall be connected according to drawing n°61067 (page 2/2).

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

ESSENTIAL HEALTH AND SAFETY REQUIREMENTS

Couvertes par les normes listées au point 9.

Covered by standards listed at 9.

19 **INFORMATIONS COMPLEMENTAIRES**

ADDITIONAL INFORMATION

Essais individuels

Routine tests

Chaque exemplaire du matériel devra avoir subi un essai de rigidité diélectrique d'une valeur efficace égale à 500V pendant 1minute sous une tension sinusoïdale de 50 Hz.

Each single apparatus must be submitted to a dielectric strength test of 500V r.m.s. during 1 minute, with a sine-shaped voltage 50Hz.

20 **DETAILS DES MODIFICATIONS**

DETAILS OF CHANGES

Version 00 : version initiale

Issue 00 : Initial issue



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.: issue No.:

Status:

Date of Issue: **2015-08-04** Page 1 of 3

Applicant: **PCB Piezotronics**
3425 Walden Avenue
Depew, New York 14043
United States of America

Electrical Apparatus: **Vibration sensors type EX619XYY/MNNZZ**
Optional accessory:

Type of Protection: **ia and nA**

Marking: Ex ia IIC T6...T510°C Ga
Ex nA IIC T6...T510°C Gc
IECEX LCIE 15.0041X
(see attachment for more informations)

Approved for issue on behalf of the IECEx Certification Body: Rémi Hanot

Position: Certification Officer

Signature:
(for printed version)

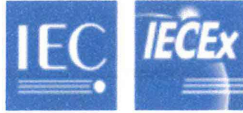
Date:

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](http://www.iecex.com).

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 activities (Certificates, QARs, ExTRs) can be registered under the references "LCI" or "LCIE".





IECEX Certificate of Conformity

Certificate No.: IECEx LCIE 15.0041X

Date of Issue: 2015-08-04

Issue No.: 0

Page 2 of 3

Manufacturer: **PCB Piezotronics**
3425 Walden Avenue
Depew, New York 14043
United States of America

Additional 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 : 2011 Explosive atmospheres - Part 0: General requirements
Edition: 6.0

IEC 60079-11 : 2011 Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"
Edition: 6.0

IEC 60079-15 : 2010 Explosive atmospheres - Part 15: Equipment protection by type of protection "n"
Edition: 4

*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/ExTR15.0064/00](#)

Quality Assessment Report:

[NL/DEK/QAR14.0004/01](#)



IECEX Certificate of Conformity

Certificate No.: IECEx LCIE 15.0041X

Date of Issue: 2015-08-04

Issue No.: 0

Page 3 of 3

Schedule

EQUIPMENT:

Equipment and systems covered by this certificate are as follows:

The model EX619XY/MNNZZ piezoelectric vibration sensors utilize a quartz crystal to convert a mechanical vibration measurement into an electric signal. The sensor consists of a sealed metal case, which houses a piezo crystal element. The quartz crystal is connected to a connector or an integral cable.
(see attachment for more informations)

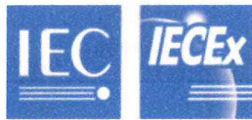
Electrical parameters : see annex

Routine test : see annex

CONDITIONS OF CERTIFICATION: YES as shown below:

Version "ia" :The apparatus must be only connected to a certified associated intrinsically safe equipment. This combination must be compatible regarding intrinsic safety rules (see electrical parameters).
Operating ambient temperature : -54°C to +500°C (high temperature connector), -54°C to +260°C (standard temperature connector), -54°C to +150°C (lemo style connector).
Temperature classification : T6 at Tamb +75°C, T5 at Tamb +90°C, T4 at Tamb +125°C, T3 at Tamb +190°C, T2 at Tamb +290°C, T1 at Tamb +440°C, T510°C at Tamb +500°C.
The apparatus shall be connected according to drawing n°61067 (page 1/2).

Version "nA" :The apparatus must be only connected to an equipment whose electrical parameters are compatible with the electrical parameters.
Operating ambient temperature : -54°C to +500°C (high temperature connector), -54°C to +260°C (standard temperature connector), -54°C to +150°C (lemo style connector).
Temperature classification : T6 at Tamb +75°C, T5 at Tamb +90°C, T4 at Tamb +125°C, T3 at Tamb +190°C, T2 at Tamb +290°C, T1 at Tamb +440°C, T510°C at Tamb +500°C.
The apparatus shall be connected according to drawing n°61067 (page 2/2).



Annex 01 to Certificate IECEX LCIE 15.0041X issue 00



Description of the equipment :

The model EX619XYY/MNNZZ piezoelectric vibration sensors utilize a quartz crystal to convert a mechanical vibration measurement into an electric signal.

The sensor consists of a sealed metal case, which houses a piezo crystal element.

The quartz crystal is connected to a connector or an integral cable.

Designation of the type :

EX619XYY/MNNZZ :

- X : family type (assigned as a letter)
- YY : variation type (assigned as a two digit number)
- MNNZZ : specifies termination type and cable length-optional
 - M is present only for metric length units-optional
 - NNN specifies cable length (three numbers)-optional
 - ZZ specifies termination type (two letters)-optional

The sensor have stainless steel housings. They have a piezoelectric sensing element with capacitance value of $< 2\text{nF}$ and a total cable capacitance $\leq 2\text{nF}$ (total capacitance $\leq 4\text{nF}$).

Series part numbers determine integral cable length or termination to a connector at the sensor (no cable).

Cable for applicable series part numbers have a two conductor mineral insulated hardline cable with stainless steel sheath.

Cable length will be ≤ 100 feet and will either have (specified by part number) exposed connection wires or a connector.

Series part numbers specifying integral connector (no cable) will have a connector type that will have temperature ratings of $+260^\circ\text{C}$ for the standard connector and $+500^\circ\text{C}$ for the high temperature version.

Marking :

PCB Piezotronics

Address :

Type : EX619XYY/MNNZZ (completed with the model)

Serial number : ...

Year of construction : ...

Ex ia IIC T6...T510°C Ga

Ex nA IIC T6...T510°C Gc

IECEX LCIE 15.0041 X

$-54^\circ\text{C} \leq T_a \leq +500^\circ\text{C}$

Version "ia" only :

$U_i : 30\text{V}, I_i : 130\text{ mA}, P_i : 0,8\text{W}, C_i : 2\text{nF} + \text{cable nF}, L_i : 30\mu\text{H}$

Electrical parameters :

Version "ia":

$U_i : 30\text{V}, I_i : 130\text{ mA}, P_i : 0,8\text{W}, C_i : 2\text{nF} + \text{cable nF}, L_i : 30\mu\text{H}$

Cable : 2nF for 100 feet

Version "nA":

$U : 30\text{V}, I : 130\text{ mA}, P : 0,8\text{W}$

Routine test :

Version "ia" : None.

Version "nA" : each apparatus must be submitted to a dielectric strength 500V 50Hz during 1min between the terminals and the housing.



Certificate of Compliance

Certificate: 70028914 **Master Contract:** 184981
Project: 70028914 **Date Issued:** September 23, 2015
Issued to: Industrial Monitoring Instr. (IMI)
 A Div. of PCB Piezotronics, Inc.
 3425 Walden Ave
 Depew, NY 14043
 USA
 Attention: Jim Devine

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.



Zafar Iqbal

Issued by: Zafar Iqbal

PRODUCTS

- CLASS 2258 03** - PROCESS CONTROL EQUIPMENT - Intrinsically Safe and Non - Incendive Systems - For Hazardous Locations
CLASS 2258 83 - PROCESS CONTROL EQUIPMENT-Intrinsically Safe and Non- Incendive - Systems-For Hazardous Locations-Certified to U.S. Standards

Class I, Zone 2, AEx / Ex ic IIB T6... T510°C Gc

Class I, Division 2, Groups A, B, C, D: T6...T1

Accelerometer Type EX619XYY/MNNZZ; Non-incendive with entity parameters as shown below; must be installed per installation drawing 61067; temperature code as shown below;

Entity Parameters	Temperature Code
Ui / Vmax = 30V	
Ii / Imax = 130mA	T6 (-55°C to 80°C)
Pi / Pmax = 0.8W	T5 (-55°C to 95°C)



Certificate: 70028914

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Project: 70028914

Date Issued: September 23, 2015

Ci = 5nF	T4 (-55°C to 130°C)
Li = 30μH	T3 (-55°C to 195°C)
	T2 (-55°C to 290°C)
	T1 (-55 °C to 440°C)

Notes:

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

CLASS2258 04 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe Entity - For Hazardous Locations

CLASS2258 84 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe Entity - For Hazardous Locations - CERTIFIED TO U.S. STANDARDS

Class I, Zone 0, AEx / Ex ia IIB T6... T510°C Ga

Class I, Division 1, Groups C, D: T6...T1

Class II, Division 1, Group E, F (Max amb 200 °C) , G (Max amb 165 °C)

Class III:

Accelerometer Type EX619XYY/MNNZZ; intrinsically safe with entity parameters as shown below; must be installed per installation drawing 61067; temperature code as shown below;



Certificate: 70028914

Master Contract: 184981

Project: 70028914

Date Issued: September 23, 2015

Entity Parameters	Temperature Code
U _i / V _{max} = 30V	
I _i / I _{max} = 130mA	T6 (-55°C to 80°C)
P _i / P _{max} = 0.8W	T5 (-55°C to 95°C)
C _i = 5nF	T4 (-55°C to 130°C)
L _i = 30µH	T3 (-55°C to 195°C)
	T2 (-55°C to 290°C)
	T1 (-55 °C to 440°C)

Notes:

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

APPLICABLE REQUIREMENTS

CAN/CSA-C22.2 No. 0-M91 (R2001)	General Requirements – Canadian Electrical Code, Part II
C22.2 No. 142-M1987 (R2009)	Process Control Equipment
C22.2 No. 213-M1987 (R2008)	Non-Incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations
CAN/CSA-C22.2 No. 60079-0:11 Ed. 5	Explosive Atmospheres - Part 0: Equipment - General requirements



Certificate: 70028914

Master Contract: 184981

Project: 70028914

Date Issued: September 23, 2015

CAN/CSA-C22.2 No. 60079-11:14	Explosive Atmospheres – Part 11: Equipment protection by intrinsic safety "i"
CAN/CSA-C22.2 No. 60079-15:12 Ed. 3	Electrical apparatus for explosive gas atmospheres - Part 15: Construction, test and marking of type of protection "n" electrical apparatus
UL 916 (4th Ed.)	Energy Management Equipment
UL 913 (8th Ed.)	Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II and III, Division 1, Hazardous Locations
FM Std. No. 3600-1998	Electrical Equipment for Use in Hazardous (Classified) Locations – General Requirements
ANSI/ISA-12.12.01-2012	Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations
ANSI/UL 60079-15:09	Electrical apparatus for Explosive Gas Atmospheres - Part 15: Type of Protection "n"
ANSI/UL 60079-15:02	Electrical Apparatus for Explosive Gas Atmospheres - Part 15: Type of Protection "n".
ANSI/UL 60079-0:13	Electrical Apparatus for Explosive Gas Atmospheres - Part 0: General Requirements
ANSI/UL 60079-11:13	Electrical apparatus for Explosive Gas Atmospheres - Part 11: Intrinsic Safety "i"



Supplement to Certificate of Compliance

Certificate: 70028914

Master Contract: 184981

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
70028914	Sep 23, 2015	New CSA C-US certification for model EX619XYY/ MNNNZZ for the following markings: Class I, Div 1, Groups C-D, Class II, Div 1 Groups E-G, Class III Class I, Div 2, Groups A-D, Ex ia IIB T6-T1 Ga / Ex ic IIB T6-T1 Gc

EU Declaration of Conformity PS141

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
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Certifies that type of equipment:

Whose Product Models Include: EX619XY/MNNZZ Series

Note: "X" is a place holder for one letter
 "YY" is a place holder for two numbers
 "M" is only present for metric length units (optional)
 "NNN" is a place holder for up to 3 numbers indicating cable length (optional)
 "ZZ" is a place holder for up to two letters indicating termination type (optional)

For example: EX619A11

These letters and numbers are included in the model numbers of the series. For details see the related data sheets.

This declaration is applicable to all EX619(s) of the above series which have the CE & (EX) 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 & (EX) 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
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Standards to which Conformity is Declared:

Harmonized Standards	EN 60079-0:2012+ A11:2013 EN 60079-11: 2012 EN 60079-15:2010 EN 63000:2018	General Explosive Atmosphere Explosive atmospheres — Part 11: Equipment protection by intrinsic safety 'i' Explosive atmospheres — Part 15: Equipment protection by type of protection 'n' Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances
EC Type Examination	ATEX Certification	LCIE 15 ATEX 3052 X Ex ia IIC T6...T510°C Ga, II 1 G
Voluntary Certification	Supplemental ATEX Certification	LCIE 15 ATEX 1026 X Ex nA IIC T6...T510°C Gc, II 3 G
IEC Certification Scheme	IECEX Certification	IECEX LCIE 15.0041X Ex ia IIC T6...T510°C Ga Ex nA IIC T6...T510°C Gc
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
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I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) Standard(s)

Place: Depew, NY **Date:** 07/12/2021

Signature:



Name:

Carrie Termin

Title: Regulatory Affairs and Product Certification Specialist