# Model EX619A11

## 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**

**Warranty, Service, Repair, and Return Policies and Instructions**

**The information contained in this document supersedes all similar information that may be found elsewhere in this manual.**

**Total Customer Satisfaction** – PCB Piezotronics guarantees Total Customer Satisfaction. If, at any time, for any reason, you are not completely satisfied with any PCB product, PCB will repair, replace, or exchange it at no charge. You may also choose to have your purchase price refunded in lieu of the repair, replacement, or exchange of the product.

**Service** – Due to the sophisticated nature of the sensors and associated instrumentation provided by PCB Piezotronics, user servicing or repair is not recommended and, if attempted, may void the factory warranty. Routine maintenance, such as the cleaning of electrical connectors, housings, and mounting surfaces with solutions and techniques that will not harm the physical material of construction, is acceptable. Caution should be observed to insure that liquids are not permitted to migrate into devices that are not hermetically sealed. Such devices should only be wiped with a dampened cloth and never submerged or have liquids poured upon them.

**Repair** – In the event that equipment becomes damaged or ceases to operate, arrangements should be made to return the equipment to PCB Piezotronics for repair. User servicing or repair is not recommended and, if attempted, may void the factory warranty.

**Calibration** – Routine calibration of sensors and associated instrumentation is recommended as this helps build confidence in measurement accuracy and acquired data. Equipment calibration cycles are typically established by the users own quality regimen. When in doubt about a calibration cycle, a good “rule of thumb” is to recalibrate on an annual basis. It is also good practice to recalibrate after exposure to any severe temperature extreme, shock, load, or other environmental influence, or prior to any critical test.

PCB Piezotronics maintains an ISO-9001 certified metrology laboratory and offers calibration services, which are accredited by A2LA to ISO/IEC 17025, with full traceability to SI through N.I.S.T. In addition to the normally supplied calibration, special testing is also available, such as: sensitivity at elevated or cryogenic temperatures, phase response, extended high or low frequency response, extended range, leak testing, hydrostatic pressure testing, and others. For information on standard recalibration services or special testing, contact your local PCB Piezotronics distributor, sales representative, or factory customer service representative.

**Returning Equipment** – *Following these procedures will insure that your returned materials are handled in the most expedient manner*. Before

returning any equipment to PCB Piezotronics, contact your local distributor, sales representative, or factory customer service representative to obtain a Return **Warranty, Service, Repair, and Return Policies and Instructions** Materials Authorization (RMA) Number. This RMA number should be clearly marked on the outside of all package(s) and on the packing list(s) accompanying the shipment. A detailed account of the nature of the problem(s) being experienced with the equipment should also be included inside the package(s) containing any returned materials.

A Purchase Order, included with the returned materials, will expedite the turn-around of serviced equipment. It is recommended to include authorization on the Purchase Order for PCB to proceed with any repairs, as long as they do not exceed 50% of the replacement cost of the returned item(s). PCB will provide a price quotation or replacement recommendation for any item whose repair costs would exceed 50% of replacement cost, or any item that is not economically feasible to repair. For routine calibration services, the Purchase Order should include authorization to proceed and return at current pricing, which can be obtained from a factory customer service representative.

**Warranty** – All equipment and repair services provided by PCB Piezotronics, Inc. are covered by a limited warranty against defective material and workmanship for a period of one year from date of original purchase. Contact PCB for a complete statement of our warranty. Expendable items, such as batteries and mounting hardware, are not covered by warranty. Mechanical damage to equipment due to improper use is not covered by warranty. Electronic circuitry failure caused by the introduction of unregulated or improper excitation power or electrostatic discharge is not covered by warranty.

**Contact Information** – International customers should direct all inquiries to their local distributor or sales office. A complete list of distributors and offices can be found at www.pcb.com. Customers within the United States may contact their local sales representative or a factory customer service representative. A complete list of sales representatives can be found at www.pcb.com. Toll-free telephone numbers for a factory customer service representative, in the division responsible for this product, can be found on the title page at the front of this manual. Our ship to address and general contact numbers are:

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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。<br>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.

*DOCUMENT NUMBER: 21354*
*DOCUMENT REVISION: **C***
*ECN: 45605*

## 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.

DOC: 55308
REV: NR
ECO:41036

# TABLE OF CONTENTS

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 ET 2-Socket plug and torqued to 5 ft*lbs +/- 1 ft*lb

## *2.5 In Line Differential Charge Amplifier*

The differential in line 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 422 series in-line 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 422 style 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.

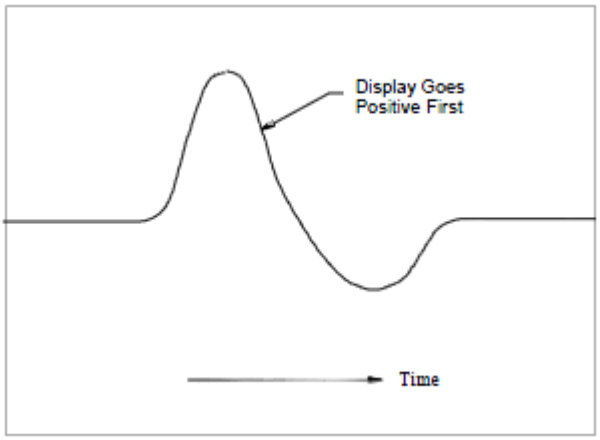



FIGURE 1

## *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*

Bolt mounting requires smooth, flat contact surfaces for proper operation and is recommended for permanent and/or secure installations. Stud or bolt 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.*

**STEP 1: Verify that the ambient and surface temperature of the mounting location are within the temperature range of the sensor.**

**Step 2:** Prepare a smooth, flat mounting surface on the machine casing. Then drill and tap a mounting hole in the center or on the corresponding bolt circle of the sensor–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) and flatness of at least .001" (25.4μm) is recommended. Inspect the area, checking that there are no burrs or other foreign particles interfering with the contact surface.

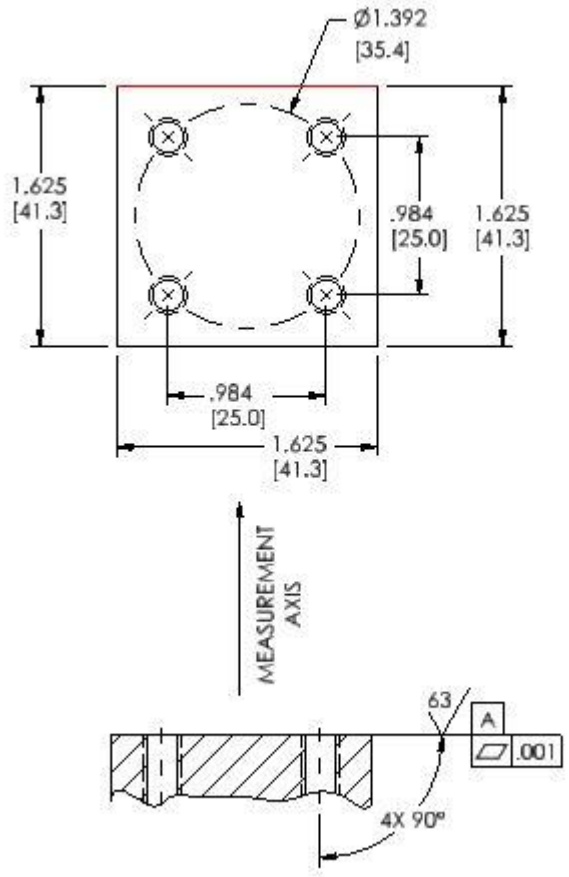



**Figure 2.** Mounting Surface Preparation

**STEP 3:** Wipe the mounting surface clean, prior to installation.

**STEP 4:** Place the sensor on the mounting surface and attach with mounting bolts and tighten to the recommended torque as indicated on the specification.

**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 bolt failure.*

## *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 operating temperature, avoid routing cables near high-voltage wires. Do not route

cables along floors or walkways where they may be stepped on or become damaged or contaminated. Avoid twisting, kinking, or straining the cable. Shielded cables should have the shield grounded at one end only.

## 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)

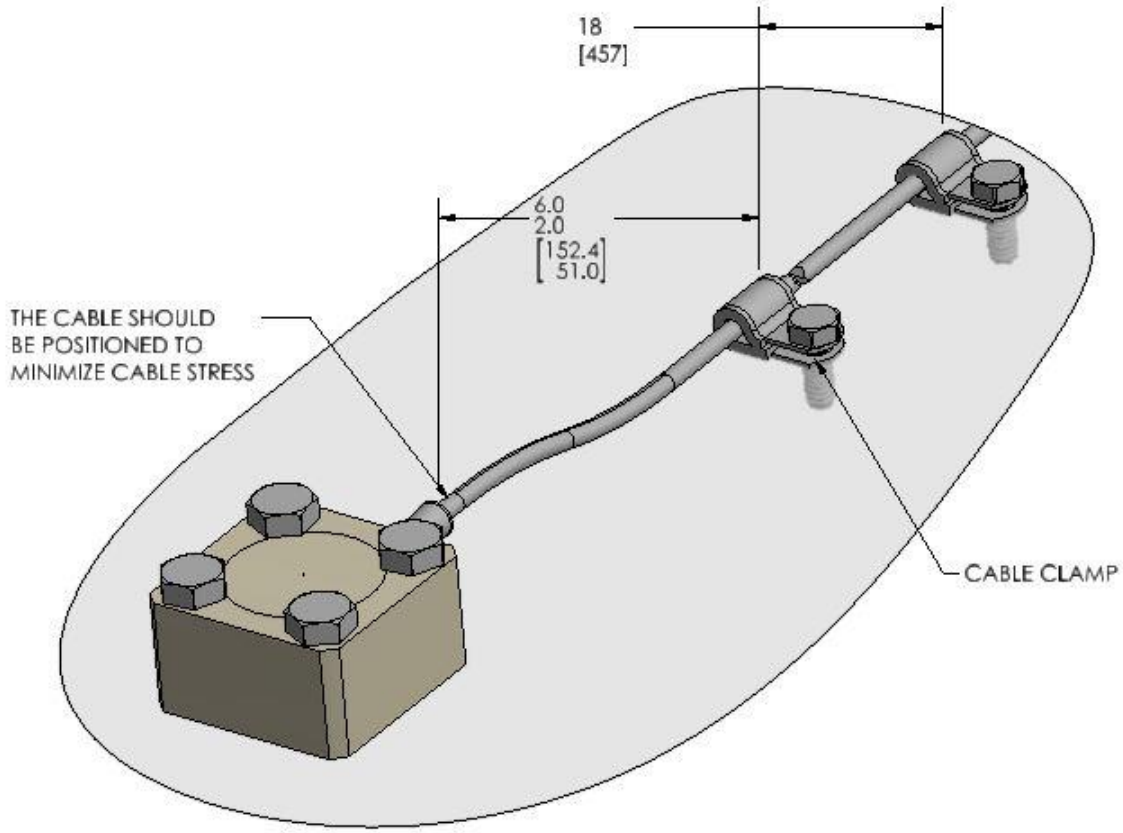
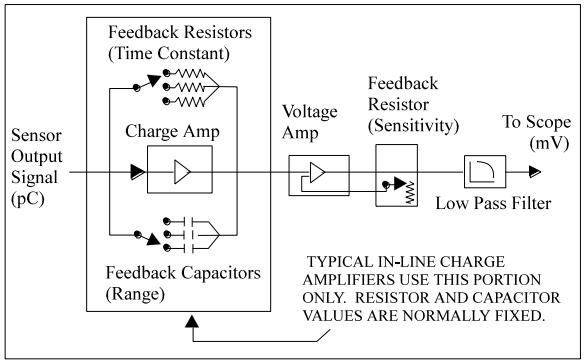



Figure 3

# 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 422 series or equivalent charge amp using low noise cable. ***Note:*** *For optimum noise performance, the cable length between the sensor and the 422 should be minimized.*

Connect the output of the 422 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 in-line charge converters, such as the PCB Series 422, 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)

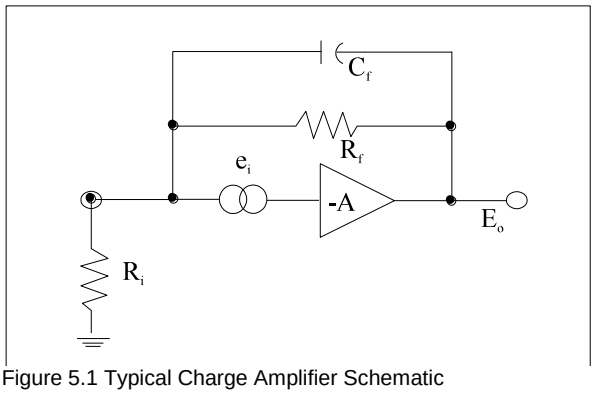


Figure 5.1 Typical Charge Amplifier Schematic

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.

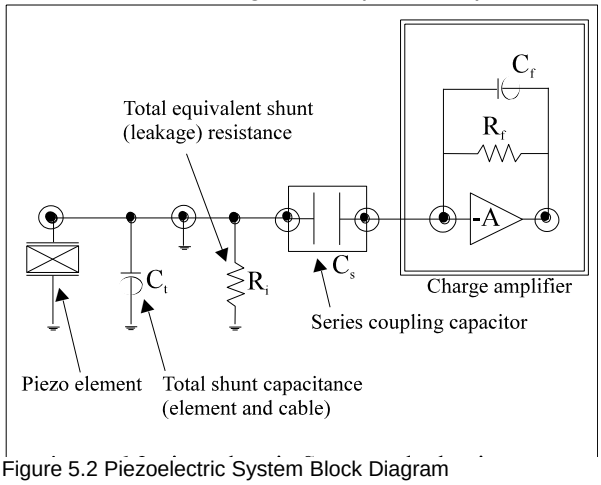


Figure 5.2 Piezoelectric System Block Diagram

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*

$TC = R_fC_f$

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.

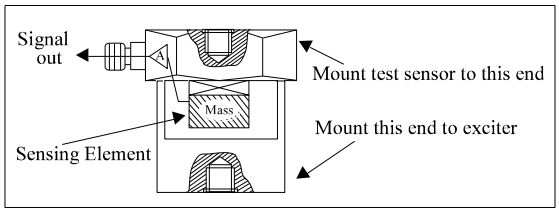



**Figure 1.** Reference Standard Accelerometer

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.)

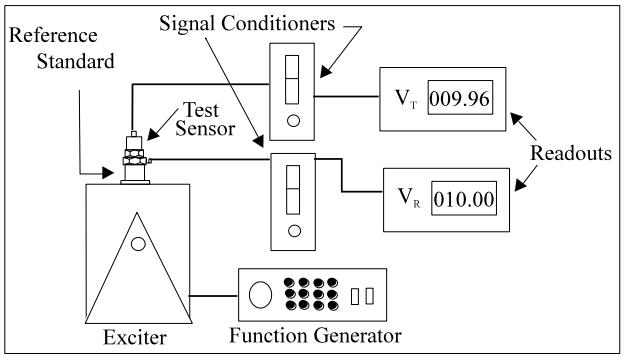



**Figure 2.** Typical Back-to-Back Calibration System

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.

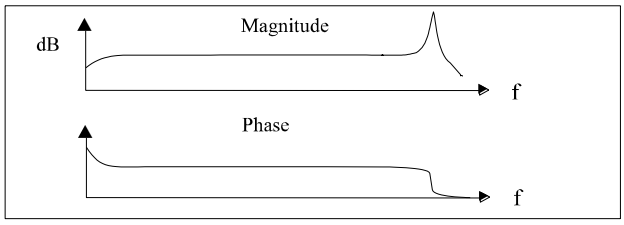



**Figure 3.** Typical Test Accelerometer Response

## 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.

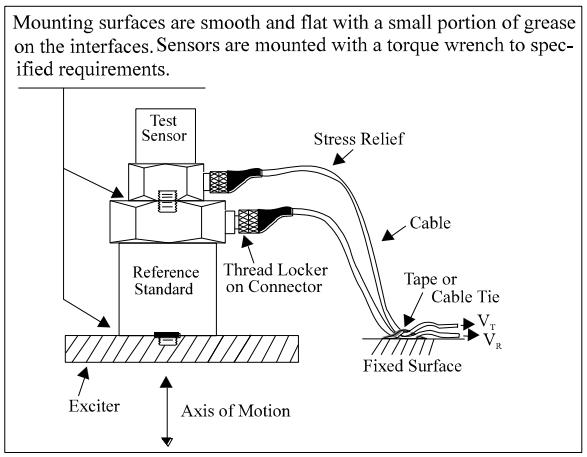



**Figure 4.** Typical Calibration Set-Up

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.

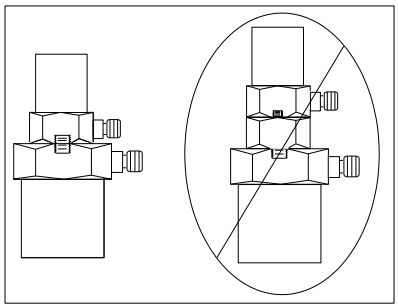


**Figure 5.** Stud Mounting

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**

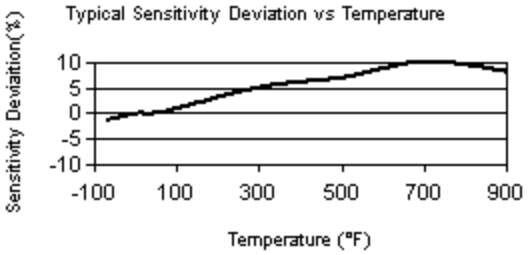
Without an adequate understanding of dynamics, determining what, when, and how to test a sensor is a difficult task. Therefore, each user must weigh the cost, time, and risk associated with self-calibration versus the services of an accredited laboratory.

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

| Model Number | CHARGE OUTPUT ACCELEROMETER | Revision: NR |
|---|---|---|
| EX619A11 | | ECN #: 44641 |

| Performance | ENGLISH | SI | |
|---|---|---|---|
| Sensitivity(± 5 %) | 50 pC/g | 5.1 pC/(m/s²) | |
| Measurement Range | ± 500 g pk | ± 4905 m/s² pk | |
| Frequency Range(± 5 %) | 3000 Hz | 3000 Hz | [2] |
| Frequency Range(+10 %) | 5000 Hz | 5000 Hz | [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/s² pk | |
| Temperature Range | -65 to +900 °F | -54 to +482 °C | |
| Temperature Response | See Graph | See Graph | [1] |
| Temperature Response | See Graph | See Graph | |
| Temperature Response | See Graph | See Graph | |
| Base Strain Sensitivity | ≤ 0.033 g/με | ≤ .32 (m/s²)/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) | |

CE[5]




Ex

SP C US

*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.

## 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 (1)
Model ICS-1 NIST-traceable single-axis amplitude response calibration from 600 cpm (10 Hz) to upper 5% frequency

| Entered: JM | Engineer: JJD | Sales: EGY | Approved: NJF | Spec Number: |
|---|---|---|---|---|
| Date: 9/30/2015 | Date: 9/30/2015 | Date: 9/30/2015 | Date: 9/30/2015 | 62610 |

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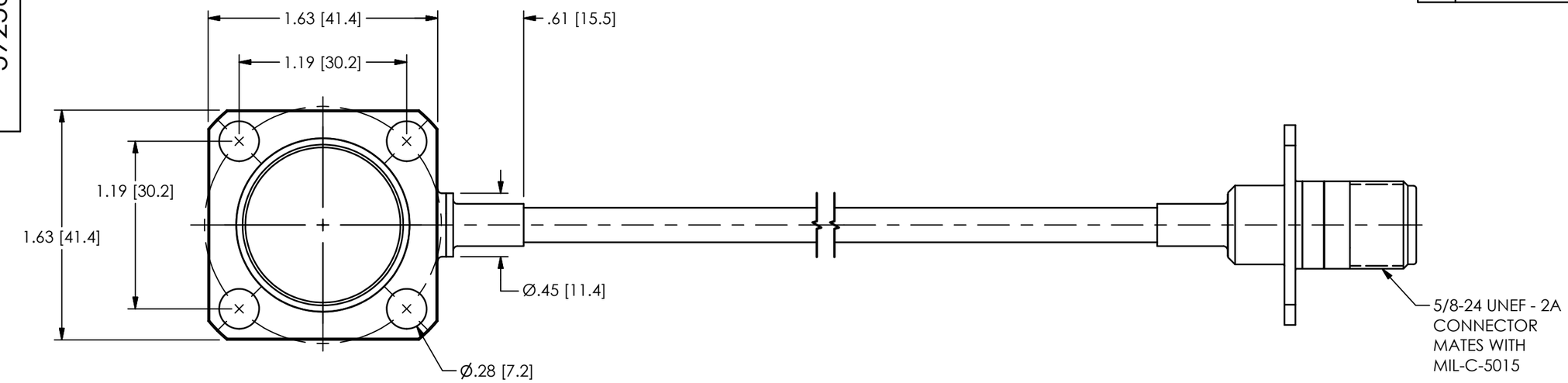
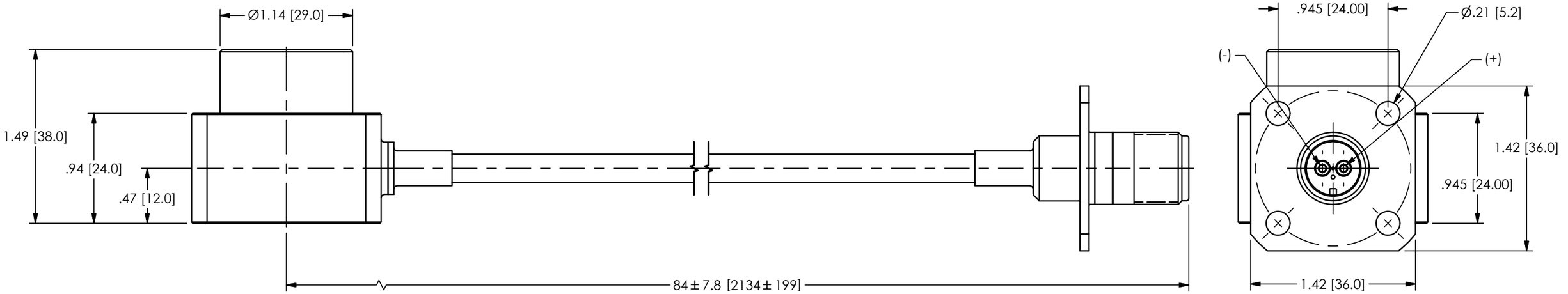
3425 Walden Avenue, Depew, NY 14043
Phone: 716-684-0001
Fax: 716-684-0987
E-Mail: info@pcb.com

59256

| REVISIONS | | |
|---|---|---|
| REV | DESCRIPTION | DIN |
| NR | RELEASED TO DRAFTING | 44641 |




| UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: | | DRAWN | | CHECKED | | ENGINEER | |
|---|---|---|---|---|---|---|---|
| DIMENSIONS IN INCHES<br>DECIMALS XX ±.03<br>XXX ±.010<br>ANGLES ± 2 DEGREES | DIMENSIONS IN MILLIMETERS [ IN BRACKETS ]<br>DECIMALS X ± 0.8<br>XX ± 0.25<br>ANGLES ± 2 DEGREES | BB | 9/30/15 | ECB | 9/30/15 | JJD | 9/30/15 |
| FILLETS AND RADII .003 - .005 | FILLETS AND RADII 0.07 - 0.13 | TITLE: OUTLINE DRAWING HIGH TEMP ACCELEROMETER | | | | | |

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

| CODE IDENT. NO. 52681 | DWG. NO. 59256 |
|---|---|
| SCALE: 1.2X | SHEET 1 OF 1 |

bbehringer 16:19 9/30/2015

L C I E

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**

4 Appareil :
Capteurs de vibration

Equipment:
Vibration sensors

Type: EX619XYY/MNNNZZ

5 Demandeur - Fabricant

Applicant - Manufacturer

**PCB Piezotronics**

6 Adresse : 3425 Walden Avenue
Depew, New York 14043
USA

Address : 3425 Walden Avenue
Depew, New York 14043
USA

7 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.

8 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.

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

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.
The examination and test results are recorded in confidential report:

N°134802-670680

9 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

10 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.

11 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.

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.

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

12 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 0 4 AOUT 2015

Responsable de Certification
Certification Officer
Remi Hanot





LCIE
Laboratoire Central des Industries Electriques
Une société de Bureau Veritas

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www.lcie.fr

Société par Actions Simplifiée
au capital de 15 245 984 €
RCS Nanterre B 408 363 174

DWG: 62689
REV: NR
DIN: 44641

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

15 **DESCRIPTION DE L'APPAREIL OU DU COMPOSANT**

Les capteurs piézoélectriques de vibration type EX619XYY/MNNNZZ 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/MNNNZZ :
- X : type de la famille (désigné par une lettre)
- YY : différent type (désigné par un nombre à deux digits)
- MNNNZZ : 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/MNNNZZ (complété par le modèle)
N° de fabrication : ...
Année de fabrication : ...
Ⓔx 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).

# SCHEDULE

**DESCRIPTION OF EQUIPMENT OR COMPONENT**

The model EX619XYY/MNNNZZ 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/MNNNZZ :
- X : family type (assigned as a letter)
- YY : variation type (assigned as a two digit number)
- MNNNZZ : 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/MNNNZZ (completed with the model)
Serial number : ...
Year of construction : ...
Ⓔx 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).





DWG: 62689
REV: NR
DIN: 44641

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

17 **RECAPITULATIF DES LIMITATIONS**

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

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)

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

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

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

Couvertes par les normes listées au point 9.

19 **INFORMATIONS COMPLEMENTAIRES**

**Essais individuels**

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.

20 **DETAILS DES MODIFICATIONS**

Version 00 : version initiale

# SCHEDULE

**SCHEDULE OF LIMITATIONS**

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).

**ESSENTIAL HEALTH AND SAFETY REQUIREMENTS**

Covered by standards listed at 9.

**ADDITIONAL INFORMATIONS**

**Routine tests**

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.

**DETAILS OF CHANGES**

Issue 00 : Initial issue





DWG: 62689
REV: NR
DIN: 44641

L C I E

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

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

**EC TYPE EXAMINATION CERTIFICATE**

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

3 **Version : 00** **LCIE 15 ATEX 3052 X** **Issue : 00**

4 Appareil :
Capteurs de vibration

Equipment:
Vibration sensors

Type: EX619XYY/MNNNZZ

5 Demandeur - Fabricant

Applicant - Manufacturer

**PCB Piezotronics**

6 Adresse : 3425 Walden Avenue
Depew, New York 14043
USA

Address : 3425 Walden Avenue
Depew, New York 14043
USA

7 Cet appareil, système de protection 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, protective system or component and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

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 appareil, système de protection ou composant est conforme aux Exigences Essentielles de Sécurité et de Santé pour la conception et la construction d'appareil, système de protection ou composant 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 :

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, protective system or component 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°134802-670680

9 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 :

EN60079-0:2012 + A11:2013
EN 60079-11:2012

10 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.

11 Cette attestation d'examen CE de type concerne uniquement la conception et la construction de l'appareil, système de protection ou composant spécifié.
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.

This EC type examination certificate relates only to the design and construction of the specified equipment, protective system or component.
Further requirements of the directive apply to the manufacturing process and supply of this equipment, protective system or component. These are not covered by this certificate.

12 Le marquage de l'appareil, système de protection ou composant est mentionné dans l'annexe de cette attestation.

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

Fontenay-aux-Roses, le 0 4 AOUT 2015

Responsable de Certification
Certification Officer
Remi Hanot



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Laboratoire Central des Industries Electriques
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www.lcie.fr
Société par actions Simplifiée
au capital de 15 745 981 €
RCS Nanterre B 408 363 174



DWG: 62690
REV: NR
DIN: 44641

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

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

**EC TYPE EXAMINATION CERTIFICATE**

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

3 **Version : 00** **LCIE 15 ATEX 3052 X** **Issue : 00**

13 # ANNEXE

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

Les capteurs piézoélectriques de vibration type EX619XYY/MNNNZZ 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 :**
*Ui* : 30V, *Ii* : 130mA, *Pi* : 0,8W, *Ci* : 2nF + câble, *Li* : 30µF
Câble : 2nF pour 30 mètres.

**Définition des modèles :**
EX619XYY/MNNNZZ :
- X : type de la famille (désigné par une lettre)
- YY : différent type (désigné par un nombre à deux digits)
- MNNNZZ : 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 du système de protection ou du composant doit comprendre :

PCB Piezotronics
Adresse : ....
Type : EX619XYY/MNNNZZ (complété avec le modèle)
N° de fabrication : ...
Année de fabrication : ...
Ⓔx II 1 G
Ex ia IIC T6...T510°C Ga
LCIE 15 ATEX 3052 X
-54°C ≤ Tamb ≤ +500°C
*Ui* : 30V, *Ii* : 130mA, *Pi* : 0,8W, *Ci* : 2nF + câble, *Li* : 30µF
Câble : 2nF pour 30 mètres.

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°61063 rév.NR du 17/03/2015.
Ce dossier comprend 4 rubriques (8 pages).

# SCHEDULE

**DESCRIPTION OF EQUIPMENT, PROTECTIVE SYSTEM OR COMPONENT**

The model EX619XYY/MNNNZZ 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 :**
*Ui* : 30V, *Ii* : 130mA, *Pi* : 0,8W, *Ci* : 2nF + cable, *Li* : 30µF
Cable : 2nF for 100 feet

**Definition of models :**
EX619XYY/MNNNZZ :
- X : family type (assigned as a letter)
- YY : variation type (assigned as a two digit number)
- MNNNZZ : 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, protective system or component shall include the following :

PCB Piezotronics
Address : ...
Type : EX619XYY/MNNNZZ (completed with the model)
Serial number : ...
Year of construction : ...
Ⓔx II 1 G
Ex ia IIC T6...T510°C Ga
LCIE 15 ATEX 3052 X
-54°C ≤ Tamb ≤ +500°C
*Ui* : 30V, *Ii* : 130mA, *Pi* : 0,8W, *Ci* : 2nF + câble, *Li* : 30µF
Cable : 2nF for 100 feet.

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°61063 rev.NR dated 2015/03/17.
This file includes 4 items (8 pages).





DWG: 62690
REV: NR
DIN: 44641

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

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

**EC TYPE EXAMINATION CERTIFICATE**

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

3 **Version : 00** **LCIE 15 ATEX 3052 X** **Issue : 00**

13 # ANNEXE

17 **CONDITIONS SPECIALES POUR UNE UTILISATION SURE**

L'appareil ne peut être raccordé qu'à un équipement certifié de sécurité intrinsèque. Cette association doit être compatible vis-à-vis de la sécurité intrinsèque (voir paramètres électriques).

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)

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

L'appareil doit être raccordé conformément au plan n°61067 (page 1/2).

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

Couvertes par les normes listées au point 9.

19 **INFORMATIONS COMPLEMENTAIRES**

**Essais individuels**

Néant

**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.

20 **DETAILS DES MODIFICATIONS**

Version 00 : version initiale

# SCHEDULE

**SPECIAL CONDITIONS FOR SAFE USE**

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).

**ESSENTIAL HEALTH AND SAFETY REQUIREMENTS**

Covered by standards listed at 9.

**ADDITIONAL INFORMATIONS**

**Routine tests**

None

**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.

**DETAILS OF CHANGES**

Issue 00 : Initial issue





DWG: 62690
REV: NR
DIN: 44641

61067

**SCHEDULE DRAWING**

NO MODIFICATIONS PERMITTED WITHOUT REFERENCE TO THE NOTIFIED BODY

| REVISIONS | | |
|---|---|---|
| REV | DESCRIPTION | DIN |
| NR | RELEASED TO DRAFTING | 44641 |

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:

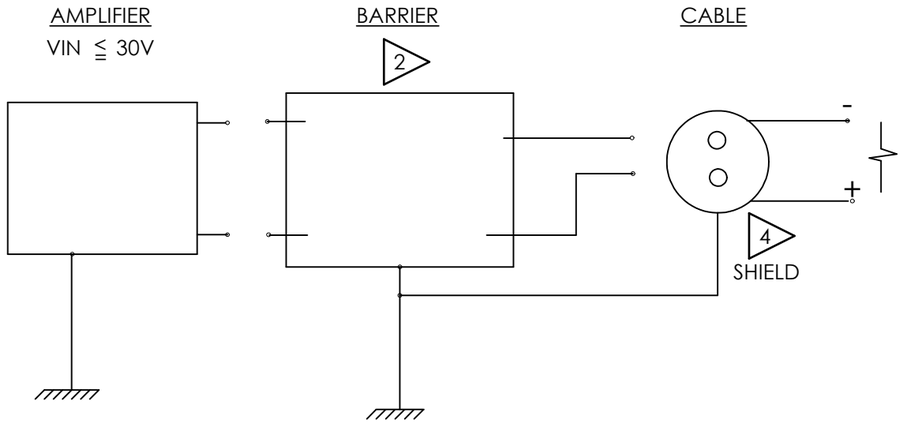
Ui <= 30 V
Ii <= 130 mA
Pi <= 0.8 W
5 Ci <= 5 nF
5 Li <= 30 µH

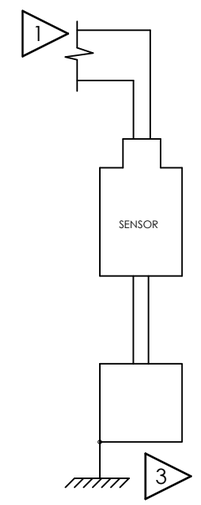
CERTIFIED BY THE APPROPRIATE APPROVAL AUTHORITY FOR CONNECTION TO THE FOLLOWING AREAS:

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

**CAUTION**
ELECTROSTATIC DISCHARGE SENSITIVE

| DRAWN | | CHECKED | | ENGINEER | |
|---|---|---|---|---|---|
| JDM | 9/17/15 | ECB | 9/17/15 | JJD | 9/17/15 |

TITLE
CONTROL DRAWING
619XYY/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 |

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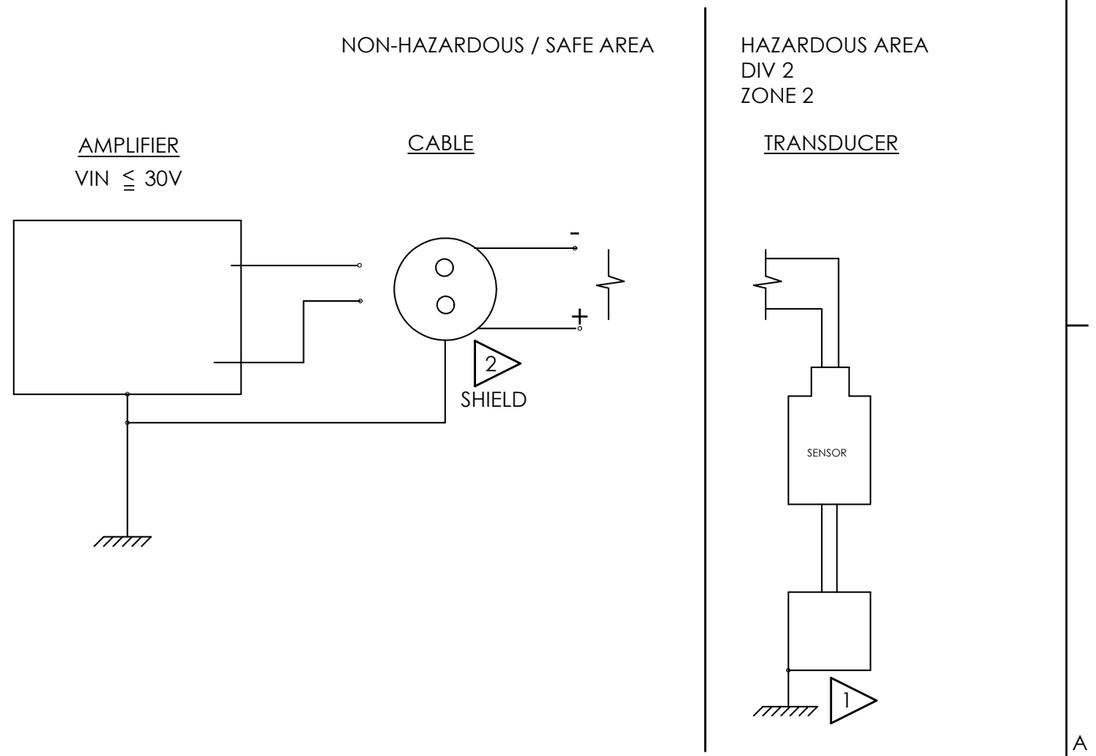
61067

**SCHEDULE DRAWING**

NO MODIFICATIONS PERMITTED WITHOUT REFERENCE TO THE NOTIFIED BODY

| REVISIONS | | |
|---|---|---|
| REV | DESCRIPTION | DIN |
| | -SEE SHEET 1- | |

| 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 |




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:

Ui <= 30 V
Ii <= 130 mA
Pi <= 0.8 W
CI <= 5 nF
LI <= 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

**CAUTION**
ELECTROSTATIC DISCHARGE SENSITIVE

| DRAWN | | CHECKED | | ENGINEER | |
|---|---|---|---|---|---|
| JDM | 9/17/15 | ECB | 9/17/15 | JJD | 9/17/15 |

TITLE
CONTROL DRAWING
619XYY/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 2 OF 2

bbehringer 15:20 9/30/2015

# 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/MNNNZZ; 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) |

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DIN: 44641

| | |
|---|---|
| Ci = 5nF<br>Li = 30µH | T4 (-55°C to 130°C)<br>T3 (-55°C to 195°C)<br>T2 (-55°C to 290°C)<br>Tl (-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 ºC) , G (Max amb 165 ºC)**

**Class III:**

Accelerometer Type EX619XYY/MNNNZZ; intrinsically safe 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<br>Ii / Imax = 130mA<br>Pi / Pmax = 0.8W<br>Ci = 5nF<br>Li = 30µH | T6 (-55°C to 80°C)<br>T5 (-55°C to 95°C)<br>T4 (-55°C to 130°C)<br>T3 (-55°C to 195°C)<br>T2 (-55°C to 290°C)<br>Tl (-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 |



DWG: 62686
REV: NR
DIN: 44641