Repair and Maintenance

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

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

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

Calibration

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

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

Returning Equipment

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

Contact Information

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

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

Safety Considerations

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

Discontinue use and contact our 24-Hour Sensorline if:

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

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

Definition of Terms and Symbols

The following symbols may be used in this manual:

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

CAUTION
Refers to hazards that could damage the instrument.

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

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

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

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

This symbol indicates safety, earth ground.

PCB工业监视和测量设备 - 中国RoHS2公布表

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

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

本表格依据 SJ/T 11364 的规定编制。

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

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

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

CHINA RoHS COMPLIANCE

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

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

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

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

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MANUAL NUMBER: 29014
MANUAL REVISION: NR
ECO NUMBER:

1.0 INTRODUCTION

PCB Piezotronics 3-component force link sensors are designed to simultaneously measure dynamic and quasi-static force measurements in three orthogonal directions; F_X, F_Y, and F_Z. **(Figure 1)** The sensors utilize an array of precision aligned, quartz sensing crystals stacked in a preloaded arrangement.

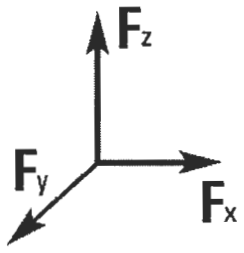

Figure 1 - 3-Component Force Link Axis Definition

2.0 DESCRIPTION

A link consists of a standard PCB 3-component force sensor, preloaded between two precision ground plates. **(Figure 2)** The plates are internally threaded to facilitate fixturing for both tensile and compressive force measurements. External preloads are not required with these sensors, as they are internally preloaded during manufacture.

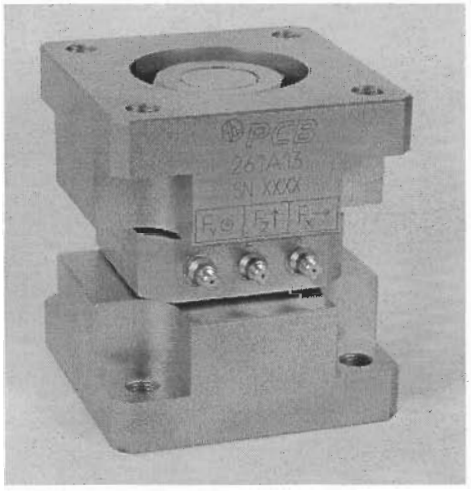

Figure 2 - Charge-Mode 3-Component Force Link

Caution: Loosening or tightening of the hex nuts will change the internal preload of the sensor. At this point, the sensitivity provided on the calibration certificate will no longer represent that of the sensor.

If this should occur, refer to the service and repair document for proper information.

Measurements along the z-axis are proportional to applied compression, tension, and impact forces. Measurements along the x- and y-axis are proportional to shear forces imposed upon the sensor.

Charge output sensors do not contain built-in signal conditioning circuitry. They require external signal conditioning from in-line charge converters or laboratory-style charge amplifiers and use special, low noise cables for signal transmission. The sensor is capable of high temperature operation. The system output signal can be ranged by the charge amplifier to suit this particular application.

If questions arise regarding the operation or characteristics of the force sensor products as outlined in this manual, feel free to contact an experienced applications engineer from the Force/Torque Division of PCB toll-free 888-684-0004.

3.0 INSTALLATION

Refer to the installation/outline drawing supplied with this manual for specific outline dimensions and installation details for your particular model. The specification is also included to provide details of the sensor's characteristic properties.

The condition of the mating surfaces can adversely affect the sensitivity of the sensor. It is essential that all surfaces be clean, rigid and perfectly flat to avoid erroneous data. A good mating surface may be obtained by lapping, turning, spot-facing, or surface grinding. Surface flatness should be held to within 0.001 (TIR) over the entire mating surface. The protective cap should remain on the connectors during installation to prevent contamination or damage.

A light coating of silicon grease (DC-4 or equivalent) on the mating surface enhances the coupling between the mounting base and mounting surface and provides the best high-frequency response.

Caution!
High Insulation Resistance – Do not touch connector. Keep clean and dry.

Connect one end of a low noise interconnect cable to the sensor connector and the other end to the XDCR jack on the signal conditioner. Make sure to tighten the cable connector to the sensor. DO NOT spin the sensor onto the cable, as this fatigues the cable's center pin, resulting in a shorted signal and a damaged cable.

For installation in dirty, humid, or rugged environments, it is suggested that the connection be shielded against dust or moisture with shrink tubing or other protective material. Strain relieving the cable/sensor connection can also prolong cable life. Mounting cables to a test structure with tape, clamps, or adhesives minimizes cable whip.

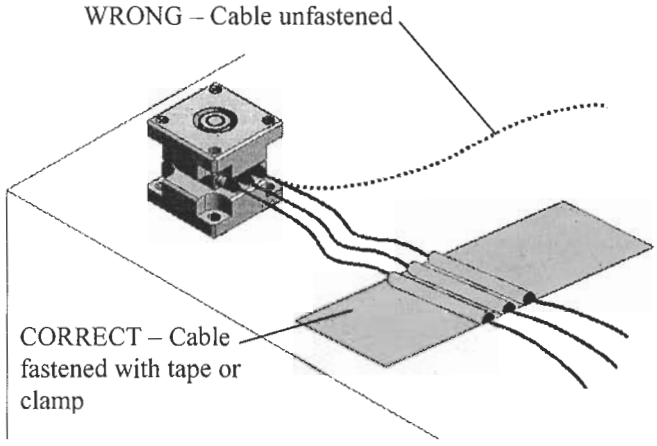

Figure 3 - Cable Strain Relief

4.0 OPERATION

Caution: Please read all instructions before attempting to operate this product.

Charge mode sensors require an external charge amplifier for impedance conversion. The charge amplifier should be placed as close to the sensor as possible to avoid contamination and minimize triboelectric (cable) noise. The rubbing of the strands within the cable that creates a static charge causes this triboelectric noise. It is important to keep the cable well strain relieved during testing to help reduce noise.

Each cable also has a capacitance-per-length specification, measured in Pico farads. This additional capacitance must be taken into account when determining total system capacitance. It is important to keep the low-noise cable length between the sensor and charge amplifier, or charge converter, as short as possible.

During applications in which the charge amplifier cannot be placed near the sensor, an external charge converter or source follower may be substituted. PCB Series 402 (non-signal inverting) and Series 422 (signal inverting) miniature charge amplifiers can be installed in-line with the charge sensor. These charge converters convert the sensor's high impedance charge signal to a low-impedance voltage that is transmitted across long cables to the signal conditioner and readout. The small size of these converters allows signal conversion in remote or restricted areas.

Operation requires the connection of the force sensor first to a charge amplifier or charge converter. PCB Series 003 Low-Noise Cable should be incorporated at this location. Tighten the coaxial cable to the sensor by hand to ensure good electrical contact. DO NOT spin the sensor onto the mating cable connector, as this fatigues the cable's center pin, resulting in a shorted signal and a damaged cable. If operating directly to a charge amplifier, the signal may then be routed from a charge amplifier to the readout devices. If an in-line charge converter is used (Series 402 or 422), the signal may be routed from the converter to an ICP® constant-current signal conditioner, such as Series 440, 480,482, or 484. From the signal conditioner, readout instruments may be directly connected. It is recommended to use a source follower as close as possible to the charge output sensor. Driving long cables in a charge mode system is not suggested due to the induced noise.

5.0 POLARITY

Compressive forces upon a charge mode force sensor produce a negative output. Tensile forces produce a positive output. Most charge amplifiers invert the signal from piezoelectric sensors. Sensors with reversed polarity are available upon request.

6.0 LOW-FREQUENCY MONITORING

Low frequency response of high-impedance systems is determined by the electrical characteristics of the charge amplifier. Consult the charge amplifier specifications for these characteristics.

PCB charge amplifiers have settings for short, medium, and long time constants. The short time constant is provided for use during repetitive, or transient, dynamic applications. The medium time constant is designed for slightly longer applications and some calibrations. The long time constant is provided for even longer quasi-static applications, as well as calibrations. The low frequency response of the application depends on the input resistance of the sensing system, namely the sensor cable, amplifier and readout device.

7.0 DISCHARGE TIME CONSTANT

The discharge time constant represents the decay rate of an input signal. One DTC represents the amount of time taken for the signal to decay to 37% of the initial peak value. As illustrated in **Figure 3**, this is an exponential decay. Approximately five DTC intervals are needed for a peak signal to naturally decay back to zero.

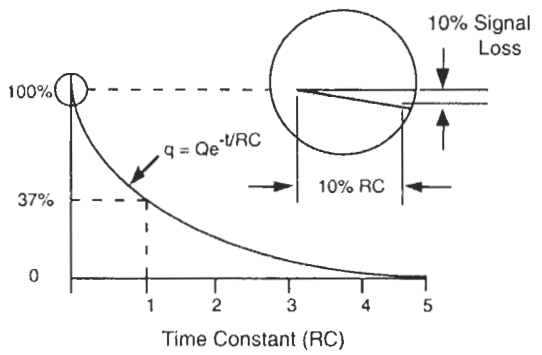

Figure 4 - Characteristic Discharge Time Constant Curve

The rule of thumb for signal discharge, as outlined in **Figure 3**, is this: for the first 10% of the DTC, the signal lost is approximately proportional to the time elapsed.

Time Constant Determination in Charge Mode Systems

Discharge Time Constant (DTC) of a charge mode system is determined by multiplying the desired operating range setting of the charge amplifier by setting of the amplifier DTC switch, located on the charge amplifier (refer to specific charge amplifier for the DTC settings). Many PCB charge amplifiers have short, medium, and long DTC settings. See the operating manual of the specific charge amplifier in question for DTC position factors.

It is possible to measure quasi-static events with piezoelectric sensors. Over the first 10% of the DTC, signal decay and accuracy represent a one-to-one relationship. Over 2% of the DTC, a 2% signal loss has occurred. Over 7%, a 7% signal loss has occurred, and so on. For 1% measurement accuracy, it is recommended that the reading be taken within the first 1% of the DTC. (**Figure 4**) If it is possible to avoid AC coupling somewhere in the sensing system, try to keep the coupling time constant at least an order of magnitude longer than the DTC of the force sensor. This avoids compromising the sensor DTC.

Step Function Response

For example, a sensor with a 500-second DTC loses approximately 1% of its output level the first five seconds (1% of 500) after the application of a steady state force within the measuring range. In this case, the output reading must be taken within five seconds of the force application for 1% accuracy. If it is impossible to avoid AC coupling somewhere in the sensing system, try to keep the coupling DTC at least an order of magnitude longer than the DTC of the force sensor. This avoids compromising the sensor DTC.

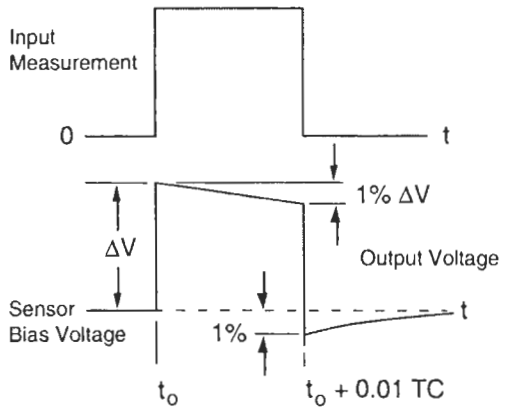

Figure 5 – Step Function Response

8.0 CALIBRATION

A NIST (National Institute of Standards and Technology) traceable calibration graph is supplied with each force sensor certifying its voltage sensitivity (mV/lb). Calibration procedures follow accepted guidelines as recommended by ANSI (American National Standards Institute), ISA (Instrument Society of America), and ISO (International Organization for Standardization). These standards provide the establishment and management of complete calibration systems, thus controlling the accuracy of a sensor's specifications by controlling measuring and test equipment accuracy. PCB is A2LA accredited for technical competence in the field of calibration, meeting the requirements of ISO/IEC 17025-1999 and ANSI/NCSL 2540-1-1994.

9.0 TROUBLESHOOTING

Problem:	Possible Cause(s):	Solution:
No Output	Faulty or no cable connection	Properly attach or replace cable
	Improper time constant (TC) switch setting	Ensure switch is set properly (SHORT/ MED/ LONG)
	Low sensor capacitance	Call factory for service
	Faulty charge amp	Call factory for service
	Low sensor insulation (less than $1x10^{12}$)	Call factory for service
Intermittent Output	Faulty cable connection	Properly attach or replace cable
	Improper charge amp setting	Set charge amp to proper setting
	Intermittent sensor	Call factory for service
Output Drift	Faulty cable	Replace cable
	Rapid Temperature Change	Allow sensor to adapt to environment
	Low charge amp insulation	Call factory for service
	Low sensor insulation	Call factory for service
	Faulty sensor	Call factory for service
Improper Sensor Sensitivity	Improper XDCR sensitivity dial setting	Ensure dial is adjusted and locked into proper setting
	Faulty sensor	Call factory for service

10.0 MAINTENANCE

The sensor connector must be kept clean, especially if it is operating in a dusty and/or wet environment. Because the force sensor is of welded construction, it should be returned to the factory for servicing in the event of serious malfunction.

Observe the following precautions in using the sensor:

- Do not exceed the maximum load levels for the force sensor (see specification sheet).
- Do not subject the sensor to temperatures exceeding that of the specification, normally 350°F (177°C).
- Do not apply voltage or current to the sensor.
- When mounting the force sensor, observe installation procedures detailed in Section 3.0 and as outlined on the specific sensor installation/outline drawing to avoid overtorquing when mounting.
- Avoid metal-to-metal impacts during applications, which can produce high frequency ringing. Electrical low-pass filtering or a damping material can help reduce such effects.
- Do not spin the sensor onto the cable. This may fatigue the cable center pin, causing cable damage. Always insert the cable pin into the sensor and tighten the knurled cable nut to the sensor.

ICP® is a registered trademark of PCB Piezotronics, Inc.

Model Number 261B11	3-COMPONENT CHARGE OUTPUT FORCE SENSOR	Revision: B ECN #: 52939

Performance	ENGLISH	SI	
Sensitivity(± 10 %)(Z Axis)	15 pC/lb	3.37 pC/N	
Sensitivity(± 10 %)(X or Y Axis)	32 pC/lb	7.19 pC/N	
Measurement Range(Z Axis)	1,000 lb	4.45 kN	
Measurement Range(X or Y Axis)	500 lb	2.22 kN	
Maximum Force(Z Axis)	1,320 lb	5.87 kN	
Maximum Force(X or Y Axis)	660 lb	2.94 kN	
Maximum Moment(Z Axis)	14 ft-lb	19.0 Nm	
Maximum Moment(X or Y Axis)	13 ft-lb	17.6 Nm	
Non-Linearity	≤ 1 % FS	≤ 1 % FS	[1]
Cross Talk(between X and Y Axis)	± 3 %	± 3 %	
Cross Talk(between (X or Y axis) and Z Axis)	± 5 %	± 5 %	
Environmental			
Temperature Range	-100 to +350 °F	-73 to +177 °C	
Electrical			
Capacitance(all channels)	18 pF	18 pF	[2]
Insulation Resistance(all channels)	≥ 10^{12} Ohm	≥ 10^{12} Ohm	
Output Polarity(in direction of markings)	Negative	Negative	
Electrical Isolation	≥ 10^{8} Ohm	≥ 10^{8} Ohm	
Physical			
Stiffness(X or Y Axis)	1.9 lb/µin	330 N/µm	[2]
Stiffness(Z Axis)	4.9 lb/µin	860 N/µm	[2]
Stiffness(RX or RY Axis)	7.5E5 lbf*in/radian	8.5E4 N*m/radian	[2][3]
Stiffness(RZ Axis)	3.4E5 lbf*in/radian	3.8E4 N*m/radian	[2][3]
Coupled Stiffness(X-RY or Y-RX Axis)	1.0 lbf*in/µin	4.4 N*m/µm	[2][3]
Weight	13.60 oz	386 gm	
Housing Material	Stainless Steel	Stainless Steel	
Sealing	Hermetic	Hermetic	
Electrical Connector(Quantity, 3)	10-32 Coaxial Jack	10-32 Coaxial Jack	
Electrical Connection Position	Side	Side	

CE[4]

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.

OPTIONAL VERSIONS

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

M - Metric Mount

W - Water Resistant Cable

NOTES:

[1]Zero-based, least-squares line method.
[2]Typical.
[3]See PCB White Paper WPL_88_1121 for details.
[4]See PCB Declaration of Conformance PS158 for details.

Entered: ND	Engineer: EB	Sales: DPC	Approved: RPF	Spec Number:
Date: 08/16/2022	Date: 08/16/2022	Date: 08/16/2022	Date: 08/16/2022	69903

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AN AMPHENOL COMPANY
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3425 Walden Avenue, Depew, NY 14043

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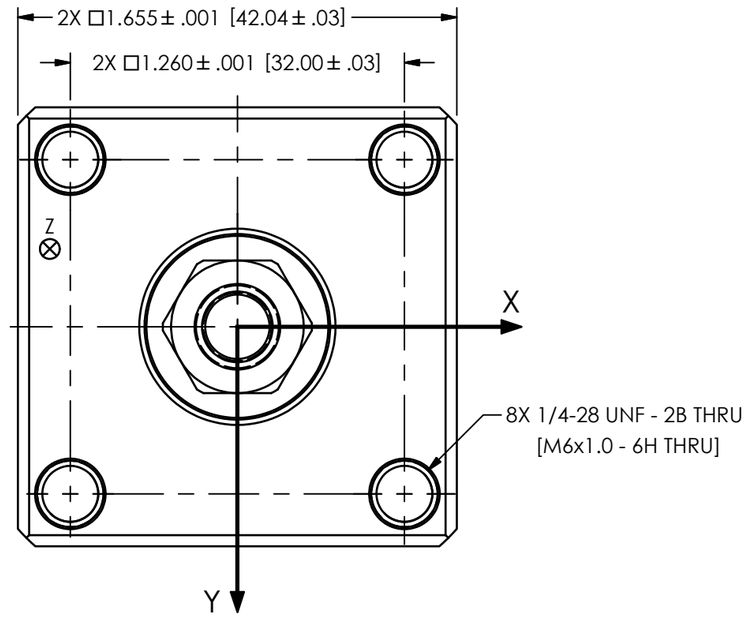
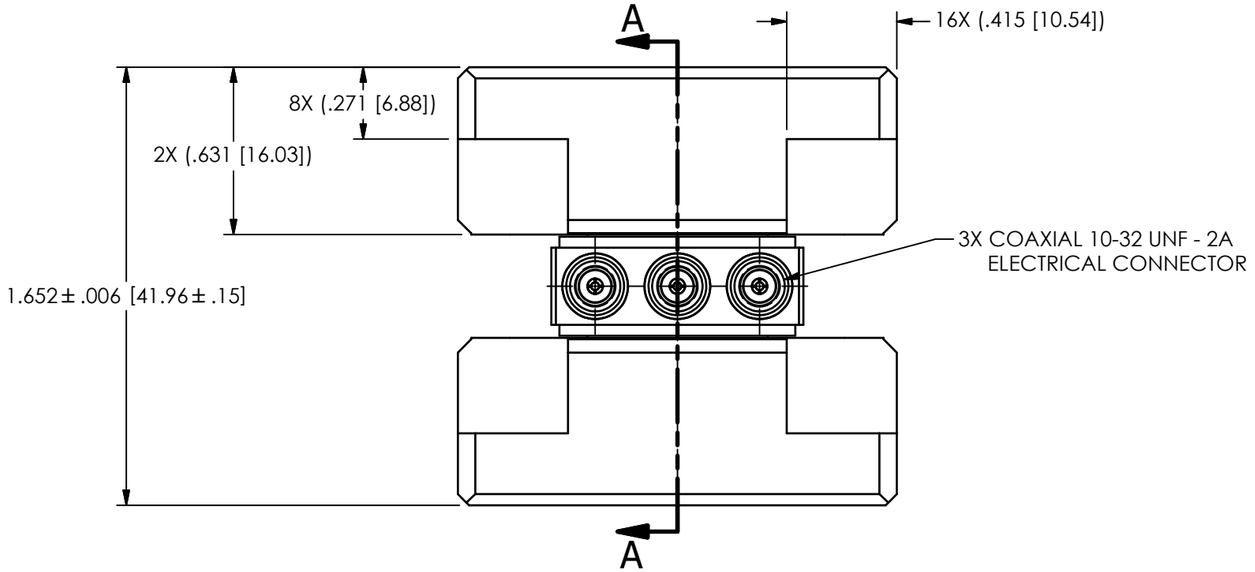
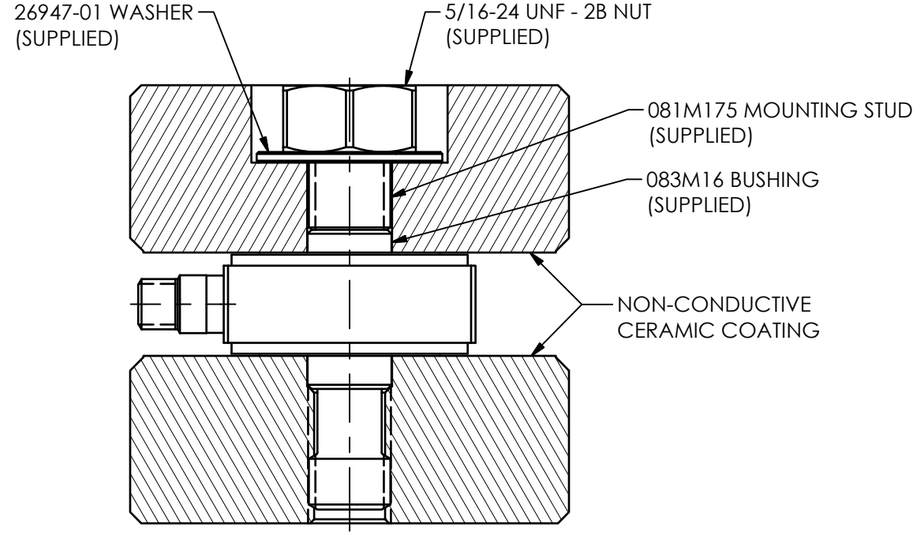
69904

REVISIONS		
REV	DESCRIPTION	DIN
B	UPDATED REFERENCE DIMENSIONS & VIEWS	52939







SECTION A-A

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:	
DIMENSIONS IN INCHES DECIMALS XX ±.03 XXX ±.010 ANGLES ± 2 DEGREES	DIMENSIONS IN MILLIMETERS [IN BRACKETS] DECIMALS X ± 0.8 XX ± 0.25 ANGLES ± 2 DEGREES
CABLE TOLERANCES IN ENGLISH 1"≤ LENGTH < 1' = +1"/ - 0 1'≤ LENGTH < 5' = +2"/ - 0 5'≤ LENGTH < 100' = +6"/ - 0 100'≤ LENGTH = +1'/ - 0	CABLE TOLERANCES IN METRIC 2.54cm ≤ LENGTH < 30.5cm = +2.54cm/ - 0 30.5cm ≤ LENGTH < 1.5m = +5.1cm/ - 0 1.5m ≤ LENGTH < 30.5m = +15.2cm/ - 0 30.5m ≤ LENGTH = +30.5cm/ - 0
FILLETS AND RADII .003 - .005	FILLETS AND RADII 0.07 - 0.13

DRAWN		CHECKED		ENGINEER	
NJF	08/11/22	JDM	08/11/22	EDB	08/11/22

TITLE

OUTLINE DRAWING
MODEL 261B11, M261B11
TRIAXIAL FORCE SENSOR

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

CODE IDENT. NO.	DWG. NO.	
52681	69904	
SCALE: 1.75X	SHEET 1 OF 1	