PCB PIEZOTRONICS
AN AMPHENOL COMPANY

# Model 422M182

## In-line differential charge converter, 4 mV/pC, 2-pin Mil input to BNC output, ICP® powered

## Installation and Operating Manual


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

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

PCB PIEZOTRONICS INC.
ELECTRONICS DIVISION

*Total Customer Satisfaction Guarantee*

*ACCELERATION • ACOUSTICS • ACTUATION • FORCE • LOAD • PRESSURE • SHOCK • STRAIN • TORQUE • VIBRATION*

# *In-Line Differential Charge Converter*

## *Operating Guide with Enclosed Warranty Information*

***3425 Walden Avenue, Depew, New York 14043-2495***

*Phone* ***716 684-0001***

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*MANUAL NUMBER: 35938*
*MANUAL REVISION: NR*

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### *introduction*

The differential in-line charge converters are designed to convert the high impedance of a differential, charge mode piezoelectric transducer to a low-impedance voltage by means of an ICP ® signal conditioner. These units may be used with either quartz or ceramic, differential charge-mode piezoelectric sensors.

### *description*

The 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.

### *installation*

Connect the differential 422 series to the transducer with low-noise cable only. Standard coaxial or two-wire cable may be used between the amplifier and the signal conditioner, and between the signal conditioner and the readout device.

***Note:*** *For optimum noise performance, the cable length between the sensor and the 422 should be minimized.*

### *operation*

To operate, simply connect the input of the differential 422 series to the transducer using low-noise cable and the output to any ICP ® signal conditioner using standard cable. 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.

***calculation of output scaling***

The differential 422 series contain high-gain, low-noise amplifiers connected in a charge amplifier configuration. The charge output of the transducer is transferred to the feedback capacitors of the amplifiers to develop a voltage which may be calculated using the following equation.

$$V_{out} = 422\ Scaling\ (mV/pC) \times Transducer\ Sensitivity\ (pC/Engineering\ Unit)$$

**where:**

*Transducer sensitivity = positive sensitivity minus negative sensitivity*

$V_{out}$ = *Output of 422 in mV/Engineering Unit*

*the Engineering Unit may be g's, Newtons, psi, etc., depending on the sensor*

***Example:*** *A (3 pC/g) differential server is used with a 422M175 (6 mV/pC). Calculate the output in mV/g.*

***Answer:*** *6 mV/pC x 3 pC/g = 18 mV/g*

### *special considerations*

High source capacitance may degrade the performance of the differential charge amp (source capacitance is the input capacitance defined as transducer capacitance + cable capacitance). In particular, noise may increase and high frequency response may decrease as source capacitance increases.

### *Use with high temperature sensors*

The differential 422 series have been specifically designed to operate with the lower insulation resistance values which piezoelectric sensors may exhibit when subjected to very high temperatures (generally greater than 500° F). Both units will operate with insulation resistances as low as 50kΩ.

***Note**: Because of its high sensitivity value, the 422M180 has a longer turn on time than typical charge amplifiers designed for use with sensors with high insulation resistance. Consult the **specifications** for details.*

***Caution!** Excessive accumulated charges on the input cables can destroy the field effect transistor (FET) in the amplifier. These charges can be grounded by shorting the center pin on the cable connector plug to its knurled nut with any metallic object.*

***warning 1 – ESD sensitivity***

***The power supply/signal conditioner should not be opened by anyone other than qualified service personnel.*** This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid injury.

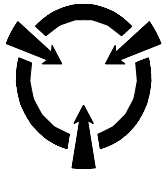
***warning 2 – ESD sensitivity***

This equipment is designed with user safety in mind; however, the protection provided by the equipment may be impaired if the equipment is used in a manner not specified by PCB Piezotronics, Inc.

***caution 1 – ESD sensitivity***

***Cables can kill your equipment.*** High voltage electrostatic discharge (ESD) can damage electrical devices. Similar to a capacitor, a cable can hold a charge caused by triboelectric transfer, such as that which occurs in the following:

- *Laying on and moving across a rug,*
- *Any movement through air,*
- *The action of rolling out a cable, and/or*
- *Contact with a non-grounded person.*



CAUTION
ELECTROSTATIC
DISCHARGE
SENSITIVE

***The PCB solution for product safety:***

- *Connect the cables only with the AC power off.*
- *Temporarily "short" the end of the cable before attaching it to any signal input or output.*

***caution 2 – ESD sensitivity***

***ESD considerations should be made prior to performing any internal adjustments on the equipment.*** Any piece of electronic equipment is vulnerable to ESD when opened for adjustments. Internal adjustments should therefore be done ONLY at an ESD-safe work area. Many products have ESD protection, but the level of protection may be exceeded by extremely high voltage.

***warranty***

PCB instrumentation is warranted against defective material and workmanship for 1 year unless otherwise expressly specified. Damage to instruments caused by incorrect power or misapplication, is not covered by warranty. *If there are any questions regarding power, intended application, or general usage, please consult with your local sales contact or distributor.* Batteries and other expendable hardware items are not covered by warranty.

***service***

Because of the sophisticated nature of PCB instrumentation, field repair is typically **NOT** recommended and may void any warranty. If factory service is required, return the instrumentation according to the "Return Procedure" stated below. *A repair and/or replacement quotation will be provided prior to servicing at no charge.* Before returning the unit, please consult a factory PCB applications engineer concerning the situation as certain problems can often be corrected with simple on-site procedures.

***return procedure***

*To expedite returned instrumentation, contact a factory PCB applications engineer for a RETURN MATERIAL AUTHORIZATION (RMA) NUMBER.* Please have information available such as model and serial number. Also, to insure efficient service, *provide a written description of the symptoms and problems with the equipment to a local sales representative or distributor, or contact PCB if none are located in your area.*

Customers outside the U.S. should consult their local PCB distributor for information on returning equipment. For exceptions, please contact the International Sales department at PCB to request shipping instructions and an RMA. For assistance, please call (716) 684-0003, or fax us at (716) 684-3823. You may also receive assistance via e-mail at **electronics@pcb.com** or visit our web site at **www.pcb.com**.

***customer service***

PCB 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, within the warranty period, to have your purchase price refunded.

PCB offers to all customers, at no charge, 24-hour phone support. This service makes product or application support available to our customers, day or night, seven days a week. When unforeseen problems or emergency situations arise, call the **24 Hour SensorLine at 716 684-0001**, and an application specialist will assist you.

PCB PIEZOTRONICS INC.
ELECTRONICS DIVISION

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***ISO 9001 Certified***

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| Model Number | DIFFERENTIAL INPUT IN-LINE CHARGE AMPLIFIER | Revision: B |
|---|---|---|
| **422M182** | | ECN #: 39690 |

| **Performance** | **ENGLISH** | **SI** | |
|---|---|---|---|
| Sensitivity(± 5 %)(Charge Conversion) | 4 mV/pC | 4 mV/pC | |
| Low Frequency Response(-5 %) | 2 Hz | 2 Hz | [2] |
| High Frequency Response(2.2 mA) | 30 kHz | 30 kHz | [3] |
| High Frequency Response(4 mA) | 45 kHz | 45 kHz | [3] |
| High Frequency Response(20 mA) | 55 kHz | 55 kHz | [3] |
| Non-Linearity | ≤ 1.0 % FS | ≤ 1.0 % FS | |
| **Environmental** | | | |
| Temperature Range(Operating) | -60 to +185 °F | -51 to +85 °C | |
| Temperature Response(Sensitivity Deviation) | <1 % | <1 % | |
| **Electrical** | | | |
| Excitation Voltage | 22 to 28 VDC | 22 to 28 VDC | |
| Constant Current Excitation | 2.2 to 20 mA | 2.2 to 20 mA | |
| Output Voltage(at specified measurement range) | ± 5 Vpk | ± 5 Vpk | |
| Output Impedance | <250 Ohm | <250 Ohm | |
| Output Bias Voltage | 12 to 16 VDC | 12 to 16 VDC | |
| Broadband Electrical Noise(1 to 10,000 Hz) | 28 µV | -91 dB | [1] |
| Spectral Noise(1 Hz) | 10.0 µV/√Hz | -100 dB | [1] |
| Spectral Noise(10 Hz) | 3.2 µV/√Hz | -110 dB | [1] |
| Spectral Noise(100 Hz) | 1.0 µV/√Hz | -120 dB | [1] |
| Spectral Noise(1 kHz) | 0.56 µV/√Hz | -125 dB | [1] |
| Spectral Noise(10 kHz) | 0.56 µV/√Hz | -125 dB | [1] |
| Discharge Time Constant | 0.25 sec | 0.25 sec | |
| Resistance(Minimum required at input) | 50,000 Ohm | 50,000 Ohm | |
| Source Capacitance Loading | 0.0009 %/pF | 0.0009 %/pF | |
| **Physical** | | | |
| Housing Material | Aluminum | Aluminum | |
| Electrical Connector(Input) | 2-Pin | 2-Pin | |
| Electrical Connector(Output) | BNC Jack | BNC Jack | |
| Weight | 3.5 oz | 109 gm | |

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.*

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] Tested using voltage source and input capacitor equal to the feedback capacitor, to simulate a charge output sensor.
[2] The low frequency tolerance is accurate within ±20% of the specified frequency.
[3] Above stated frequency, the amplifier becomes slew rate limited.
[4] See PCB Declaration of Conformance PS024 for details. A low impendance connection from case to earth ground is required to maintain CE compliance.

| Entered: AP | Engineer: AJP | Sales: JJM | Approved: JWH | Spec Number: |
|---|---|---|---|---|
| Date: 1/31/2013 | Date: 1/31/2013 | Date: 1/31/2013 | Date: 1/31/2013 | **35828** |

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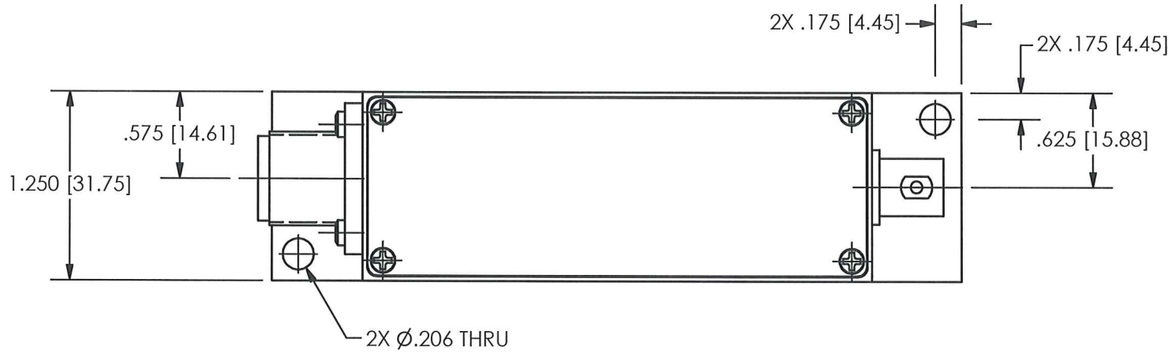
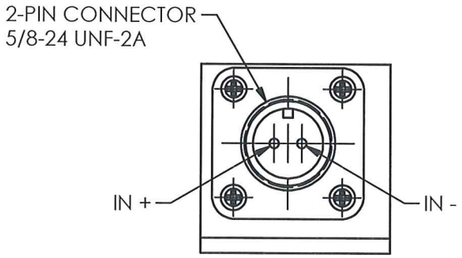
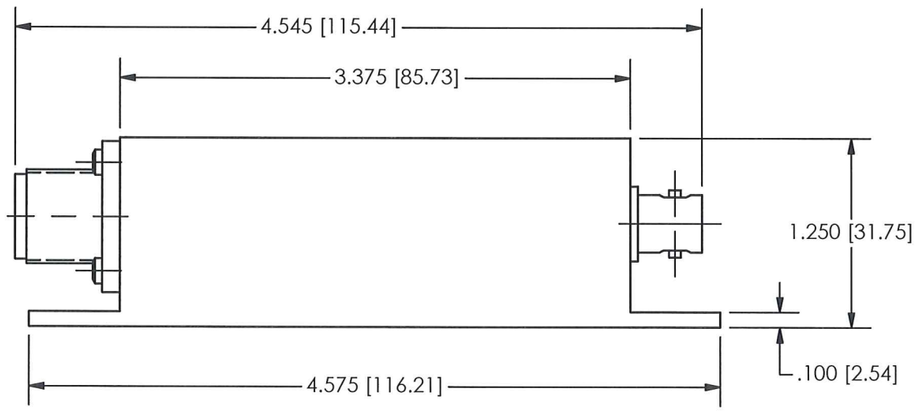
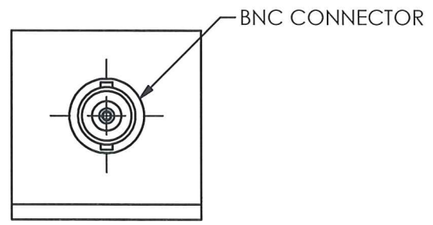
35827

| REVISIONS | | |
|---|---|---|
| REV | DESCRIPTION | DIN |
| A | UPDATE TITLE BLOCK DESCRIPTION | 36962 |




| UNLESS OTHERWISE SPECIFIED TOLERANCES ARE: | |
|---|---|
| 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 |
| FILLETS AND RADII .003 - .005 | FILLETS AND RADII 0.07 - 0.13 |

| DRAWN | CHECKED | ENGINEER |
|---|---|---|
| MDF 9/16/11 | [illegible] 9/16/11 | AJP 9/16/11 |

TITLE

OUTLINE DRAWING
MODEL 422M SERIES
DIFFERENTIAL AMPLIFIER

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

| CODE IDENT. NO. | DWG. NO. |
|---|---|
| 52681 | 35827 |
| SCALE: FULL | SHEET 1 OF 1 |

## 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- PCB工业监测和测量设备 - 中国RoHS 公布表

PCB Industrial Monitoring and Measuring Equipment - China RoHS Disclosure Table

| 部件名称<br>Part Name | 有毒和危险品<br>Toxic and Hazardous Substances or Elements | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Part | 铅<br>(Pb) | 水银<br>(Hg) | 镉<br>(Cd) | 六价<br>铬<br>(Cr(VI<br>) | 多溴化<br>苯<br>(PBB) | 多溴化二苯<br>醚<br>(PBDE) | 邻苯二甲酸<br>二(2-乙基)<br>己酯<br>(DEHP) | 邻苯二甲丁<br>基苄酯<br>(BBP) | 邻苯二甲酸<br>二酸正丁酯<br>(DBP) | 邻苯二甲酸<br>二异丁酯<br>(DIBP) |
| **电气外壳<br>(Electrical Enclosures)** | X | O | O | O | O | O | O | O | O | O |
| **紧固件和弹簧<br>(Fasteners)** | X | O | O | O | O | O | O | O | O | O |
| **电缆组件<br>(Cable Assembly)** | X | O | O | O | O | O | O | O | O | O |
| **印刷电路板组装<br>(PCBAs)** | X | O | O | O | O | O | O | O | O | O |
| **机械零件(Mechanical Parts)** | O | O | O | O | O | O | O | O | O | O |
| **塑料和橡胶零件<br>(Plastic & Rubber Parts)** | O | O | O | O | O | O | O | O | O | O |
| **金属零件<br>(Metal Parts)** | X | O | O | O | O | 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 (indicates that the content of the toxic and hazardous substance in all the Homogeneous Materials of the part is below the concentration limit requirement as described in GB/T 26572).

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 (indicates that the content of the toxic and hazardous substance in at least one Homogeneous Material of the part exceeds the concentration limit requirement as described in GB/T 26572).