PCB PIEZOTRONICS
AN AMPHENOL COMPANY

Model 422E35

In-line charge converter, 1 mV/pC, +/-2.5V output, -5% frequency 5 Hz, for high temp sensors

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

The Model 422E In-Line Charge Converter

Operating Guide with Enclosed Warranty Information

3425 Walden Avenue, Depew, New York 14043-2495

Phone ***716 684-0001***

Fax ***716 684-0987***

E-Mail ***electronics@pcb.com***

Toll Free Line ***1-800-828-8840***

24 Hour Sensor Line ***716 684-0001***

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introduction

The 422E series in-line charge converters are designed to convert the high impedance of a 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 charge-mode piezoelectric sensors.

description

The 422E 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 422E series to the transducer with low-noise cable (003A) 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 422E should be minimized.*

operation

To operate, simply connect the input of the 422E to the transducer using low-noise (003A) 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 422E contains a high-gain, low-noise amplifier connected in a charge amplifier configuration. The charge output of the transducer is transferred to the feedback capacitor of the amplifier to develop a voltage which may be calculated using the following equation.

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

where:

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

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

Example: *A 357A12 (3 pC/g) is used with a 422E02 (10 mV/pC). Calculate the output in mV/g.*

Answer: *10 mV/pC x 3 pC/g = 30 mV/g*

TEDS functionality

422E units with a "T" prefix incorporate TEDS (Transducer Electronic Data Sheet) technology. Using a TEDS capable signal conditioner, or TEDS reader, the user is able to read calibration data stored in the sensor. Some systems allow the user to also write user data and calibration information to the 422E. All data is formatted in accordance with IEEE 1451.4.

special considerations

High source capacitance may degrade the performance of the 422E (source capacitance is the input capacitance defined as transducer capacitance + cable capacitance). In particular, noise may increase and high frequency response may decrease if source capacitance exceeds the recommended level. In some cases, low frequency oscillation of the output may occur. The maximum recommended level in pF's is determined using the following formula:

maximum recommended source capacitance = 10,000/422E sensitivity in mV/pC

For example, the level for a 422E02/E12 would be 10,000/10 pF = 1,000 pF, and the level for a 422E03/E13 would be 10,000 pF. If PCB 003 type low noise cable is used, these values correspond to 10 meters and 100 meters of length respectively.

422E series models for use with high temperature sensors

The 422E35 (1 mV/pC) and 422E36 (10 mV/pC) 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 10kΩ.

***Note**: Because of the special circuitry required, the 422E35 and 422E36 have somewhat higher noise and longer turn on time than the equivalent units designed for use with sensors with high insulation resistance (the 422E03 and 422E02 respectively). 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.*

422E series models for use in radioactive environments

The 422E65 (1mV/pC) and 422E66 (10mV/pC) were designed to offer resistance to the effects of radiation exposure up to 1 Mrad Integrated Gamma Flux or 10^{10} N/cm^2 of Integrated Neutron Flux. They are also designed to operate with lower insulation values which piezoelectric sensors may exhibit when subjected to the high temperatures that generally accompany high levels of radioactivity.

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.

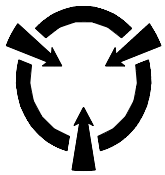
warning 2 – ESD sensitivity

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

3425 Walden Avenue, Depew, NY 14043-2495

Phone *716 684-0001* ***Fax*** *716 684-0987* ***E-Mail*** *electronics@PCB.com*

PCB *www.PCB.com* ***IMI*** *www.IMI-Sensors.com* ***Key*** *www.KeyTransducers.com*

ISO 9001 Certified

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Model Number	IN-LINE CHARGE CONVERTER	Revision: F
422E35		ECN #: 45760

Performance	ENGLISH	SI	
Sensitivity(± 2 %)(Charge Conversion)	1 mV/pC	1 mV/pC	
Input Range	± 2500 pC	± 2500 pC	
Low Frequency Response(-5 %)	5 Hz	5 Hz	[2]
High Frequency Response(2.2 mA)	30 kHz	30 kHz	[3]
High Frequency Response(4 mA)	60 kHz	60 kHz	[3]
High Frequency Response(20 mA)	100 kHz	100 kHz	[3]
Non-Linearity	≤ 1.0 % FS	≤ 1.0 % FS	
Environmental			
Temperature Range(Operating)	-65 to +250 °F	-54 to +121 °C	
Temperature Response(Sensitivity Deviation)	<2 %	<2 %	
Maximum Shock	1000 g pk	9810 m/s² pk	
Humidity Range	100 %	100 %	
Electrical			
Excitation Voltage	+18 to 28 VDC	+18 to 28 VDC	
Output Bias Voltage	+12.00 to 15.00 VDC	+12.00 to 15.00 VDC	
Output Voltage(at specified measurement range)	± 2.5 V	± 2.5 V	
Constant Current Excitation	2.2 to 20 mA	2.2 to 20 mA	
Output Impedance	<10 Ohm	<10 Ohm	
Settling Time	<6 min	<6 min	
Output Polarity	Inverted	Inverted	
Maximum Input Voltage	30 V	30 V	
Broadband Electrical Noise(1 to 10,000 Hz)	14.0 µV	-97 dB	[1]
Spectral Noise(1 Hz)	8.90 µV/√Hz	-101 dB	[1]
Spectral Noise(10 Hz)	0.85 µV/√Hz	-121 dB	[1]
Spectral Noise(100 Hz)	0.31 µV/√Hz	-130 dB	[1]
Spectral Noise(1 kHz)	0.17 µV/√Hz	-135 dB	[1]
Spectral Noise(10 kHz)	0.07 µV/√Hz	-143 dB	[1]
Capacitance(Maximum allowable at input)	20,000 pF	20,000 pF	
Resistance(Minimum required at input)	10,000 Ohm	10,000 Ohm	
Source Capacitance Loading	<0.0005 %/pF	<0.0005 %/pF	
Physical			
Housing Material	Stainless Steel	Stainless Steel	
Sealing	Welded	Welded	
Electrical Connector(Input)	10-32 Coaxial Jack	10-32 Coaxial Jack	
Electrical Connector(Output)	BNC Jack	BNC Jack	
Size (Diameter x Length)	0.52 in x 3.4 in	13 mm x 86 mm	
Weight	1.1 oz	31 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.

TLD - TEDS Capable of Digital Memory and Communication Compliant with IEEE 1451.4

Temperature Range(Operating)	-40 to +185 °F	-40 to +85 °C

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 ±10% of the specified frequency.
[3]Above stated frequency, the amplifier becomes slew rate limited.
[4]See PCB Declaration of Conformance PS024 for details.

Entered: LK	Engineer: CPH	Sales: ML	Approved: DY	Spec Number:
Date: 8/10/2016	Date: 8/10/2016	Date: 8/10/2016	Date: 8/10/2016	17785

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

422-5010-95

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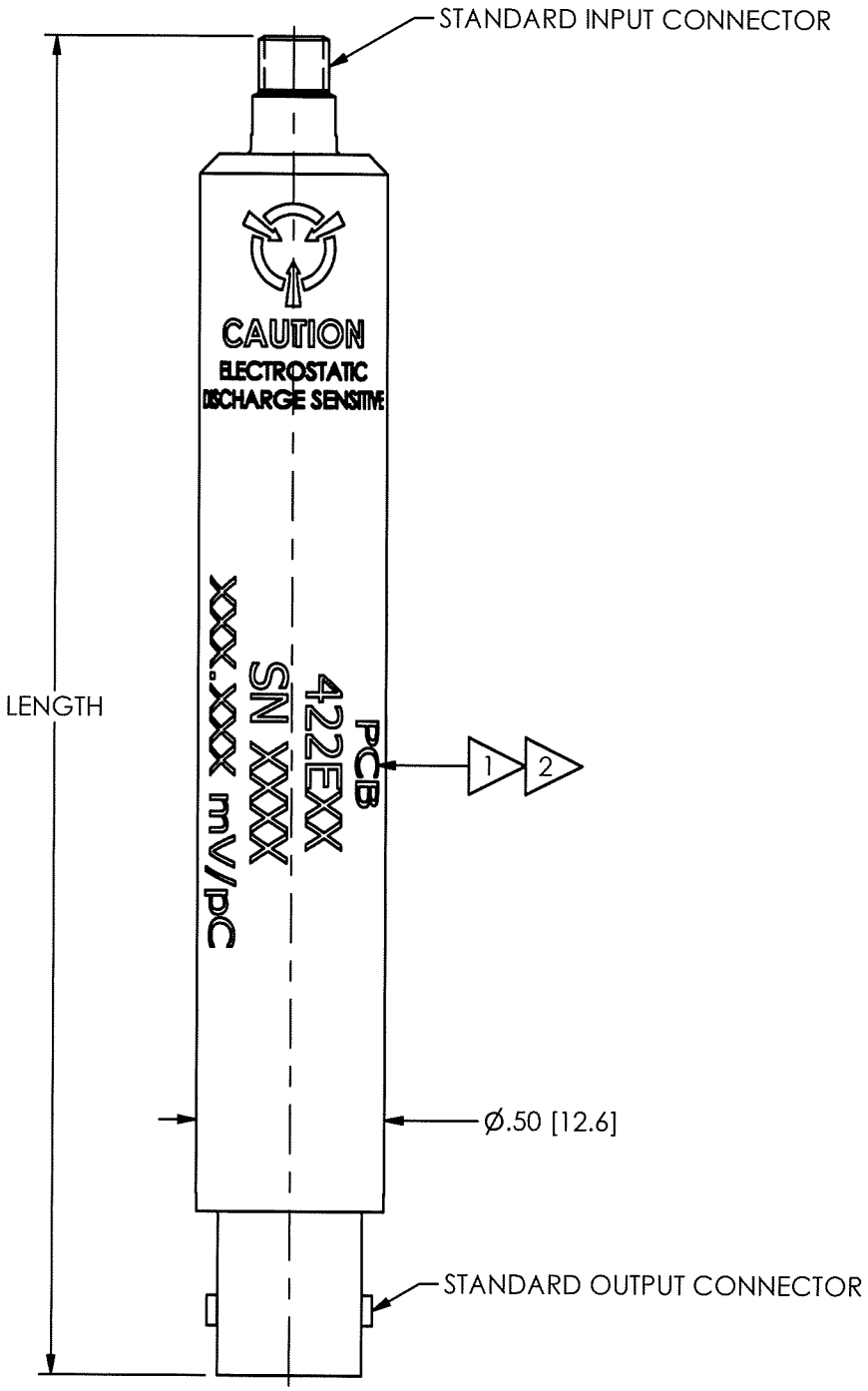
REVISIONS		
REV	DESCRIPTION	DIN
L	REMOVED ITAR STAMP	37190



AVAILABLE CONNECTOR OPTIONS:

STANDARD MODEL NUMBER
INPUT: 10-32 MICRO DOT JACK
OUTPUT: BNC JACK
LENGTH: 3.4 [85]

MODEL NO./A
INPUT: 10-32 MICRO-DOT JACK
OUTPUT: 10-32 MICRO-DOT JACK
LENGTH: 3.0 [76]

MODEL NO./C
INPUT: 10-32 MICRO-DOT JACK
OUTPUT: BNC PLUG
LENGTH: 3.2 [81]

MODEL NO./D
INPUT: BNC JACK
OUTPUT: BNC JACK
LENGTH: 4.2 [107]

2 ETCH WITH "IN ← → OUT" TO INDICATE PROPER ORIENTATION.

1 ETCH WITH NORMAL SENSITIVITY, AS IT APPEARS ON SPEC SHEET.

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:		DRAWN		CHECKED		ENGINEER	
DIMENSIONS IN INCHES	DIMENSIONS IN MILLIMETERS [IN BRACKETS]	SMB	10/7/11	EcB	10/7/11	BAM	10/7/11
DECIMALS XX ±.03 XXX ±.010	DECIMALS X ±0.8 XX ±0.25	TITLE					
ANGLES ± 2 DEGREES	ANGLES ± 2 DEGREES	OUTLINE DRAWING MODEL 422E SERIES IN-LINE CHARGE AMPLIFIER					
FILLETS AND RADII .003 - .005	FILLETS AND RADII 0.07 - 0.13						

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

CODE IDENT. NO. 52681	DWG. NO. 422-5010-95
SCALE: 2X	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

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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 Part Name	有毒和危险品 Toxic and Hazardous Substances or Elements									
Part	铅 (Pb)	水银 (Hg)	镉 (Cd)	六价 铬 (Cr(VI)	多溴化 苯 (PBB)	多溴化二苯 醚 (PBDE)	邻苯二甲酸 二(2-乙基) 己酯 (DEHP)	邻苯二甲丁 基苄酯 (BBP)	邻苯二甲酸 二酸正丁酯 (DBP)	邻苯二甲酸 二异丁酯 (DIBP)
电气外壳 (Electrical Enclosures)	X	O	O	O	O	O	O	O	O	O
紧固件和弹簧 (Fasteners)	X	O	O	O	O	O	O	O	O	O
电缆组件 (Cable Assembly)	X	O	O	O	O	O	O	O	O	O
印刷电路板组装 (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 (Plastic & Rubber Parts)	O	O	O	O	O	O	O	O	O	O
金属零件 (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).