



Model 134A24

Tourmaline ICP® pressure bar, 1000 psi, 5 mV/psi, 0.2 microsecond rise

Installation and Operating Manual

This manual contains the 402A installation and operating manuals that comprise a Model 134A24 Tourmaline ICP® pressure bar, 1000 psi, 5 mV/psi, 0.2 microsecond rise time kit.

**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**



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 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

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

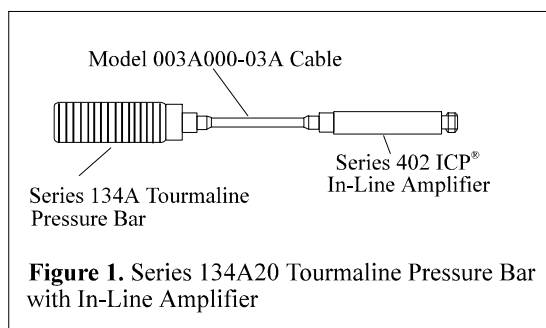
PCB for a complete statement of our warranty. Expendable items, such as batteries and mounting hardware, are not covered by warranty. Mechanical damage to equipment due to improper use is not covered by warranty. Electronic circuitry failure caused by the introduction of unregulated or improper excitation 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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3425 Walden Ave.
Depew, NY 14043 USA
Toll-free: (800) 828-8840
24-hour SensorLineSM: (716) 684-0001
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1.0 INTRODUCTION

Series 134A20 Tourmaline Pressure Bar with In-Line Amplifier consists of a Series 134A Tourmaline Pressure Bar connected to a three-inch, low-noise cable that connects into Series 402 In-Line Source Follower Voltage Amplifier. See Figure 1.



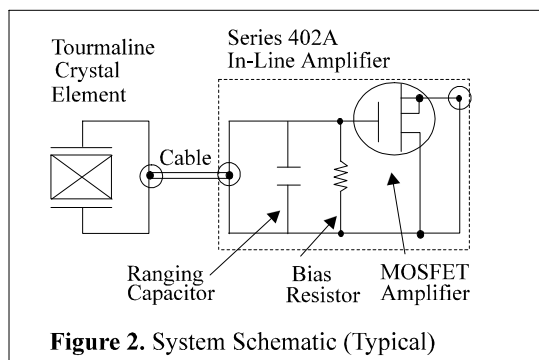
The Tourmaline Pressure Bars is a high-pressure, fast rise time, suppressed-resonance blast sensor ideal for single-shot, high-frequency measurements of incident or reflected shock wave pressures found in studies of plasma physics and hyper-sonics. Ranges up to 20,000 psi are available.

The Series 134A20 is typically powered by a PCB Series 480 ICP® Power Conditioner (constant current) or equivalent. Power and signal is conducted over a single-conductor coaxial cable with the shield serving as a signal return. Output from the power conditioner is usually fed into a high-speed readout instrument, such as a digital oscilloscope.

2.0 DESCRIPTION

The Series 134A20 Tourmaline Pressure Bar with In-Line Amplifier consists of three components attached together and calibrated as a system. The Series 134A Tourmaline Pressure Bar senses and transduces a pressure/shock wave into a high-impedance, electrostatic charge. This charge is sent through the three-inch, low-noise cable into the Series 402A In-Line Amplifier, where it is converted into a low-impedance voltage with less than 100 ohms output impedance. See Figure 2.

The circuit in the in-line amplifier consists of a MOSFET input IC with a very high trans-conductance, resulting in a voltage gain that is very close to unity. The source terminal "follows" the gate voltage instantaneously, without a shift in phase (i.e., the amplifier is non-inverting).



2.1 SYSTEM OUTPUT

The system output of Series 134A20 is a low-impedance output governed by the following equation:

$$V = \frac{Q}{C1 + C2 + C3}$$

where:

- V = voltage sensitivity of system (V/psi)
- Q = charge output of Tourmaline Bar (pC/psi), Model 134A
- C1 = capacitance of Tourmaline Bar (pF), Series 134A
- C2 = capacitance of three-inch cable (pF), Model 003A000-03
- C3 = capacitance of input of in-line amplifier (pF), Series 402A

A system calibration is supplied with Series 134A20 that shows the system output in mV/psi.

3.0 INSTALLATION

See the Installation Drawing included in the back of this manual for a description of the Tourmaline Bar and its installation. *Install in a gas medium where the measurement is to be taken. The sensor can not be normally used in a liquid medium.*

Connect the Series 134A20 Tourmaline Pressure Bar with In-Line Amplifier to a PCB power conditioner. Connect the output of the power conditioner to an appropriate readout instrument.

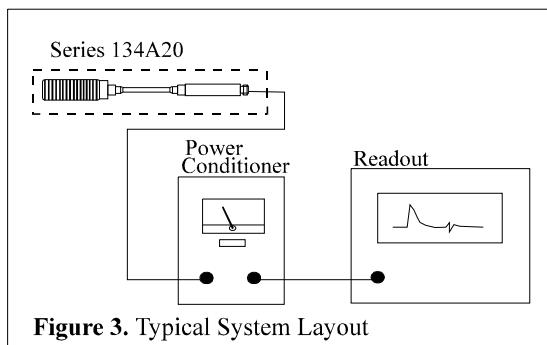


Figure 3. Typical System Layout

Tie the three-inch, low-noise cable to a rigid structure to prevent excessive motion and noise. Allow for strain relief.

Caution

If the tourmaline pressure bar or the three-inch cable become disconnected from the in-line amplifier, take caution to momentarily electrically short out the cable and tourmaline pressure bar before reconnecting the cable to the in-line amplifier. This prevents any unusual high charge buildup from damaging the input stage of the in-line amplifier.

Black vinyl tape is supplied on the sensing end of the tourmaline bar to dampen heat transfer into the sensing crystal. This tape can be removed and replaced if damaged.

4.0 OPERATION

Switch on the (PCB) power conditioner and observe the bias monitoring voltmeter (or LED) on the front panel.

If the indicator reads proper bias (green area on the meter, approximately 11 volts), the connections from the Series 402A In-Line Amplifier are correct and the in-line amplifier is operational. If the meter reads in the red or yellow areas, the system is shorted or open. The short or open circuit may be in the in-line amplifier, the cable connecting the in-line amplifier to the power conditioner, or in the power conditioner.

Allow the system to stabilize for a minute. A signal drift may occur when connecting the power conditioner to the readout instrument. This should stabilize as components in the power conditioner and readout instrument charge.

If long cables between the Series 134A20 and the power conditioner are used, impedance matching of the long cable and increase of the constant current in the power conditioner may be required because of the high-speed response of the sensor. Check with PCB if there are questions.

5.0 CALIBRATION

The tourmaline pressure bar must be calibrated *dynamically*. The tourmaline pressure bar does not measure static pressures. In addition, application of high static pressure to the tourmaline bar may cause damage.

Two methods are used at PCB to calibrate the Series 134A20: a shock tube and a hydraulic pulse tester. The shock tube is used primarily to check the sub-microsecond response of the tourmaline pressure bar.

The hydraulic pulse tester is used to generate a known, short-duration pressure pulse at five different pressure levels to determine the average sensitivity of the sensor.

Recalibration services are offered by PCB. In addition, the shock tube and hydraulic pulse calibrator are offered as standard products by PCB.

6.0 USE OF CHARGE MODE TOURMALINE PRESSURE BAR

The tourmaline pressure bar is a charge output piezoelectric sensor that can be used without the in-line source follower amplifier for certain applications. Calibration information is supplied showing (charge) output sensitivity of the tourmaline bar alone, along with its crystal capacitance.

Note that the Series 402A In-Line Amplifier features a frequency response of greater than 1 MHz. A charge amplifier used with the tourmaline pressure bar may limit the upper frequency response of the system.

Connecting the Series 134A Tourmaline Pressure Bar directly to a readout instrument without the use of the Series 402A In-Line Amplifier or other impedance-converting device can be done with some limitations. The input impedance of the readout instrument may be significantly low to create a very high-pass filtering effect. This can affect measurement of pulse duration or amplitude of a slow-rising pulse. Also, the voltage sensitivity of the output of the tourmaline bar into the readout instrument is affected by the cable capacitance and input capacitance of the readout instrument.

Contact the factory with any questions regarding use of the sensor in the charge output mode.

6.1 USE OF THE IN-LINE AMPLIFIER

The Series 402A In-Line Amplifier is used to convert the high-impedance output of the tourmaline pressure bar into a low-impedance output. The in-line amplifier may also be used as a unity gain amplifier for checking system frequency response. A signal generator is connected to the input of the in-line amplifier and fed through the system.

7.0 MAINTENANCE AND REPAIR

The electrical connectors on the tourmaline pressure bar, the input of the in-line amplifier, and the three-inch, low-noise cable must be kept clean and dry, especially if they are operating in a dusty or wet environment. This is to prevent drift due to low insulation resistance. Also, note the following precautions:



1. Do not exceed maximum levels.

2. Constant temperatures around the tourmaline bar should be limited to 150°F. Short-term exposure to higher temperatures, such as that found in a blast wave, do not cause damage.

3. Use only PCB power conditioners or approved alternative.

4. Current to the in-line amplifier must be limited to not more than 20 mA to avoid damage.

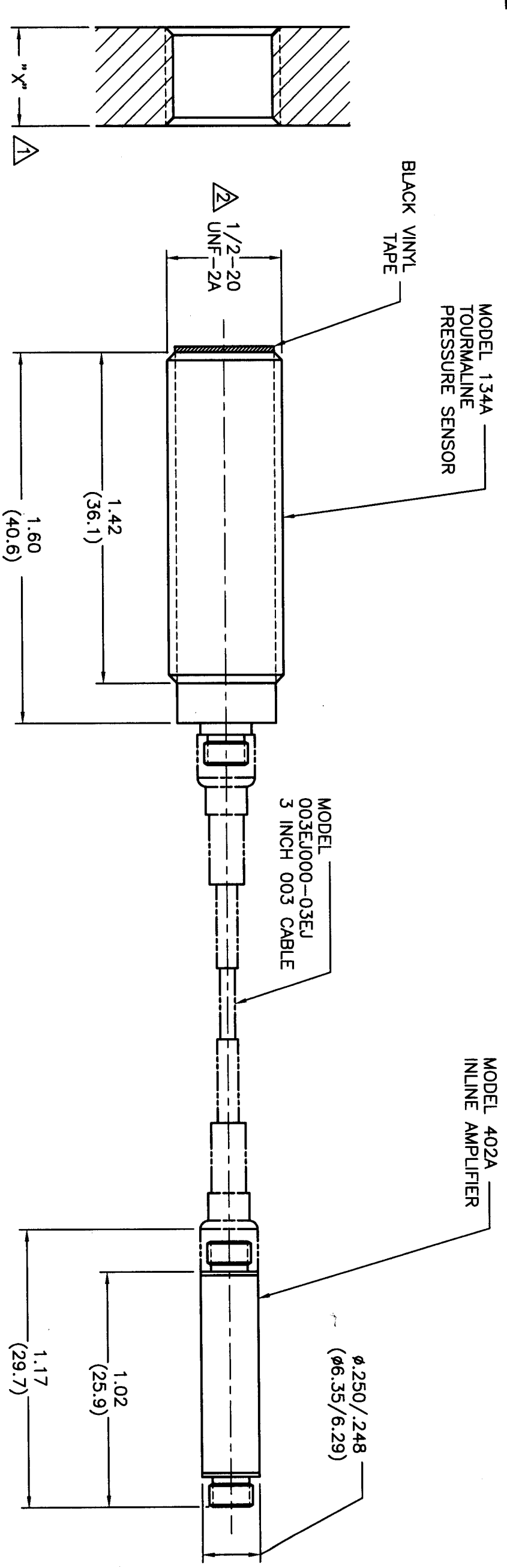
5. If the tourmaline pressure bar and in-line amplifier are to be left outside overnight or in humid or rainy environments, they should be coated with silicone oil and covered.

Model Number 134A24	ICP® PRESSURE SENSOR			Revision: H ECN #: 18856										
Performance Measurement Range (for ± 5V output) Useful Overrange (for ± 10V output) Sensitivity (± 15 %) Maximum Pressure (static) Resolution Resonant Frequency Rise Time (Reflected) Low Frequency Response (-5 %) Non-Linearity	ENGLISH 1 kpsi 2 kpsi 5 mV/psi 15 kpsi 20 mpsi ≥ 1500 kHz ≤ 0.2 μ sec 0.25 Hz ≤ 2 % FS	SI 6895 kPa 13,790 kPa 0.73 mV/kPa 103425 kPa 0.14 kPa ≥ 1500 kHz ≤ 0.2 μ sec 0.25 Hz ≤ 2 % FS	[1] [2] [3]	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 N - Negative Output Polarity										
Environmental Temperature Range (Operating) Maximum Flash Temperature	+32 to +120 °F 5000 °F	0 to +49 °C 2760 °C		NOTES: [1] For +10 volt output, minimum 24 VDC supply voltage required. Negative 10 volt output may be limited by output bias. [2] Calibrated as a system using (3 inch) type 003 cable and 402A series in-line amplifier. [3] Zero-based, least-squares, straight line method. [4] See PCB Declaration of Conformance PS023 for details.										
Electrical Output Polarity (Positive Pressure) Discharge Time Constant (at room temp) Excitation Voltage Constant Current Excitation Output Impedance Output Bias Voltage	Positive ≥ 1 sec 20 to 30 VDC 2 to 20 mA ≤ 100 ohms 8 to 14 VDC	Positive ≥ 1 sec 20 to 30 VDC 2 to 20 mA ≤ 100 ohms 8 to 14 VDC		SUPPLIED ACCESSORIES: Model 061A30 Spanner Wrench, 2 Pin (1)										
Physical Sensing Element Housing Material Diaphragm Sealing Electrical Connector Weight	Tourmaline Stainless Steel Epoxy Epoxy 10-32 Coaxial Jack 1.4 oz	Tourmaline Stainless Steel Epoxy Epoxy 10-32 Coaxial Jack 39 gm		ICP® Pressure Sensor Specifications <table border="1"> <tr> <td>Entered: <i>BLS</i></td> <td>Engineer: <i>KLG</i></td> <td>Sales: <i>Jmm</i></td> <td>Approved: <i>WSH</i></td> <td>Spec Number:</td> </tr> <tr> <td>Date: <i>12-5-03</i></td> <td>Date: <i>12/5/03</i></td> <td>Date: <i>12/5/03</i></td> <td>Date: <i>12/8/03</i></td> <td>6616</td> </tr> </table>	Entered: <i>BLS</i>	Engineer: <i>KLG</i>	Sales: <i>Jmm</i>	Approved: <i>WSH</i>	Spec Number:	Date: <i>12-5-03</i>	Date: <i>12/5/03</i>	Date: <i>12/5/03</i>	Date: <i>12/8/03</i>	6616
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 [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.	 PCB PIEZOTRONICS™ PRESSURE DIVISION 3425 Walden Avenue, Depew, NY 14043 Phone: 716-684-0001 Fax: 716-686-9129 E-Mail: pressure@pcb.com													

APPLICATION USED ON VAR
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REVISIONS		ECN	DATE	APP'D
ZONE	REV	DESCRIPTION		

14376



MOUNTING HOLE PREPARATION:
 Ø.453 THRU
 TAP 1/2-20 UNF-2B

TEFLON TAPE OR OTHER THREAD SEALANT IS RECOMMENDED
 "X" DIMENSION TO SUIT USER REQUIREMENTS

UNLESS SPECIFIED TOLERANCES		DIMENSIONS IN MILLIMETERS		DRAWN		MFG		DATE	
DIMENSIONS IN INCHES	DECIMALS XX ±.01	DIMENSIONS IN MILLIMETERS	DECIMALS XX ±0.3	CHK'D	DM	ENGR	USE	DATE	
	XXX ±.005		XXX ±0.13	APP'D	REV	DATE	DATE		
	ANGLES ±2 DEGREES		ANGLES ±2 DEGREES	TITLE					
	FILLETS AND RADI		FILLETS AND RADI	INSTALLATION DRAWING					
	.003 - .005		(0.07 - 0.13)	MODEL 134A24					
				PRESSURE SENSOR					
DD012 REV. B 03/13/98				SCALE: 2x		SHEET 1 OF 1			

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