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Model 480E09

1-Channel, battery-powered, ICP® sensor signal conditioner, gain x1, x10, x100, 2mA, BNC input/output connectors.

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





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.

PCB PIEZOTRONICS
AN AMPHENOL COMPANY

Model 480C02 / 480E09
Battery-Powered ICP® Signal Conditioners





Operating Manual with Enclosed Warranty Information

3425 Walden Avenue, Depew, New York 14043-2495

Phone (716) 684-0003

Fax (716) 684-3823

Toll Free Line 1-800-828-8840

MANUAL NUMBER: 19175
MANUAL REVISION: B
ECO: 52841

PCB PIEZOTRONICS
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Introduction

Model 480C02 & model 480E09 are rugged, portable, power sources for ICP® sensors. These models are nearly identical except model 480C02 is unity gain 1:1 only with no adjustment, while model 480E09 has the additional feature of 3-position gain adjustment (1/10/100). They are powered internally by three replaceable batteries and provide constant current excitation to the charge amplifier within ICP® sensors (or to in-line and adaptor style amplifiers) and decouples the sensor output signal from the power. Signal output is a high quality, voltage output compatible with standard readout, recording or acquisition instruments.

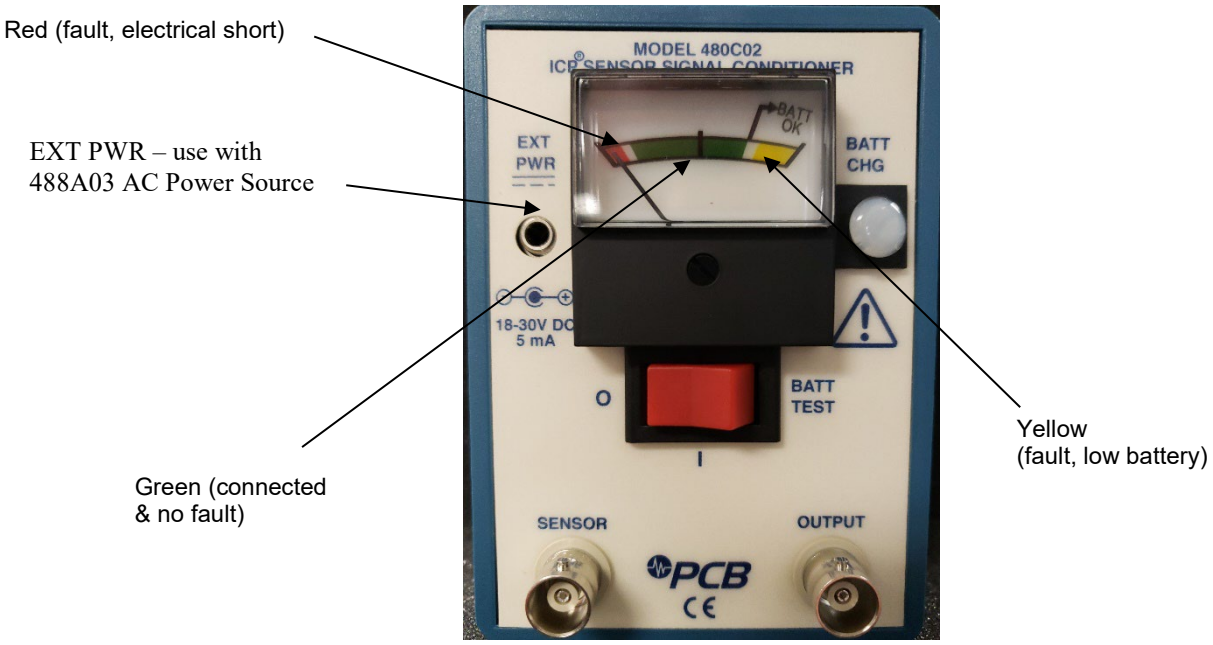


Figure 1: Model 480C02 Signal Conditioner

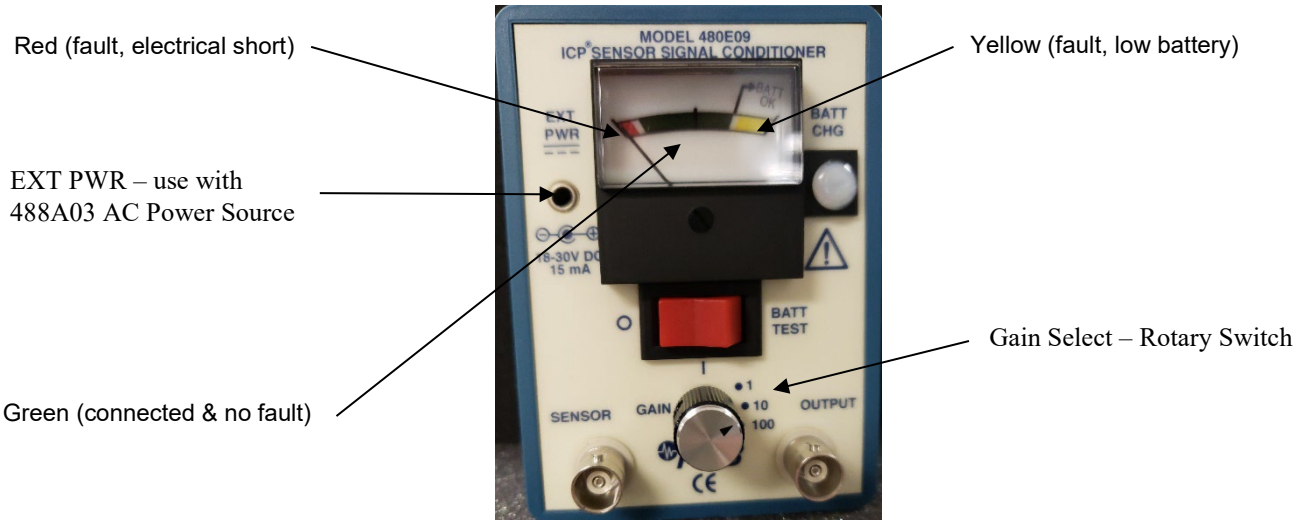


Figure 2: Model 480E09 Signal Conditioner

Description

Models 480C02 / 480E09 contain three, PP3 size, 9 volt batteries connected in series to provide DC power to internal electronics which provide regulation for approximately 2.6 mA of constant current power. Connections include two BNC jacks, one for Sensor (ICP® power/input) and one for Scope (output to scope, data recorder, or DAQ). The front panel meter indicates the voltage output when connected to a sensor and is color coded for various fault conditions, shown in Figure 1 & 2. Optional connections include sockets for EXT PWR and BATT CHG. A central, three-position rocker switch allows off, on and momentary battery test functionality.

Model 480E09 has the additional 3-position gain adjustment that multiplies the signal output through the SCOPE connection. It has 2 additional settings beyond the 480C02, 10x and 100x, shown in Figure 2.

Operation

Internal electronics include a capacitor and resistor that decouples the sensor output signal from the DC power. With no sensor connected, move power switch to “ON” position. The front panel voltmeter measures the battery voltage with full scale set at 27 volts (+27 volts for new batteries), see Figure 1. When an ICP® sensor is connector to the input “XDCR” jack, the meter will indicate approximately mid-scale (+11 volts nominal) if the sensor’s internal amplifier and cables are functioning properly without damage. Some sensors use a 5 volt excitation and in this case the meter will read at the lower edge of the green region.

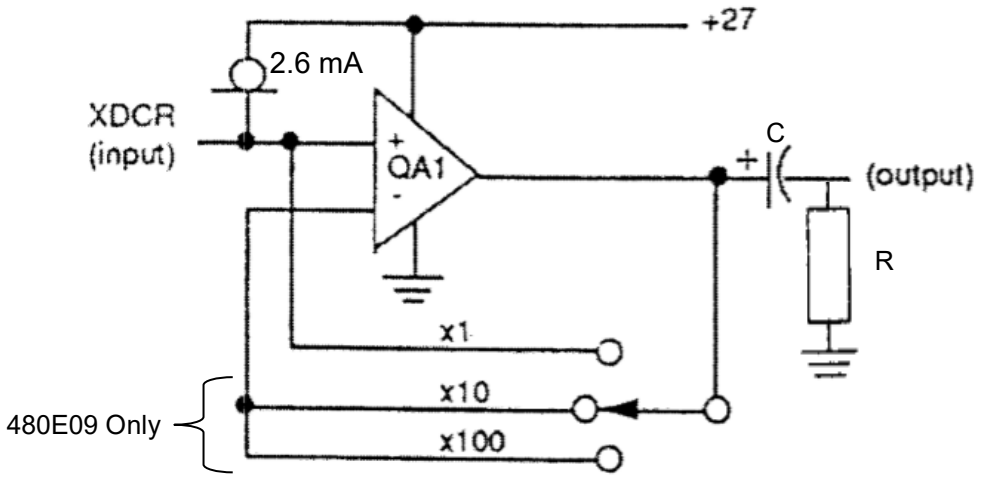


Figure 3: Models 480C02 / 480E09 Signal Conditioner Schematic

If the sensor amplifier and/or cable are damaged to short open, the meter will indicate in the full scale (yellow) area. Should the sensor amplifier and/or cable be damaged to short closed, the meter will indicate zero volts (red area). Immediately after connecting readout instrument, (oscilloscope, meter, recorder, etc.) to the output jack, the 47 μF coupling capacitor will begin charging through the internal resistor and input resistance of the readout instrument. This charging will cause an apparent "drifting" of the output signal until the capacitor is fully charged. Such drifting is considered normal operation.

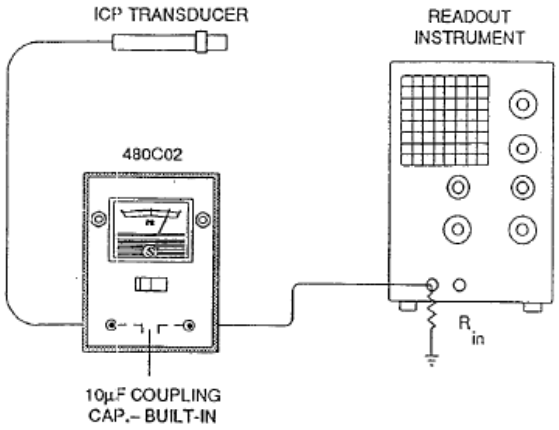


Figure 4: Diagram: AC Coupling

Coupling Time Constant (TC), AC Coupled

The coupling discharge time constant (DTC) is the product of the capacitor (47 μF) and the parallel internal resistor and the input resistance of the readout instrument (See Figure 4, Equation 1).

Equation 1:

$$TC\ (sec) = C_c\ (microfarads) \times R_{in}\ (ohms)$$

DTC (sec)	Frequency (Hz)		
	-5%	-10%	-3 dB
.1	5	3.4	1.6
.5	1	.68	.32
1	.5	.34	.16
5	.1	.07	.03
10	.05	.03	.016

Low Frequency Response Table

$$3dB\ down: F_0 = \frac{0.16}{DTC}$$ Equation 3

$$10\%\ down: F_0 = \frac{0.34}{DTC}$$ Equation 4

$$5\%\ down: F_0 = \frac{0.5}{DTC}$$ Equation 5

The small amount of leakage through the 47μF coupling capacitor will typically result in a +30 mV maximum offset with a 1.0 megaohms readout load. Normally, it is desirable to keep the coupling discharge time constant (DTC) long with respect to the sensor discharge time constant to minimize the effect of the coupling distance time constant on low frequency response. Typical coupling discharge time constants for various values of readout input resistance are shown in Table 1.

DC Coupling for Low-Frequency Response

With the 480C02 / 480E09 connected as shown in Figure 5, the low frequency response of the coupling circuit is determined by the relationship in Equation 2. This requires use of a BNC Tee. Figure 6 below provides a comparison of AC vs DC coupling the same signal.

Equation 2:

$$\text{-3dB Frequency (Hz)} , F_O = \frac{1}{2 \pi RC} = \frac{0.16}{R \text{ (in)} \times 10 \ \mu F}$$

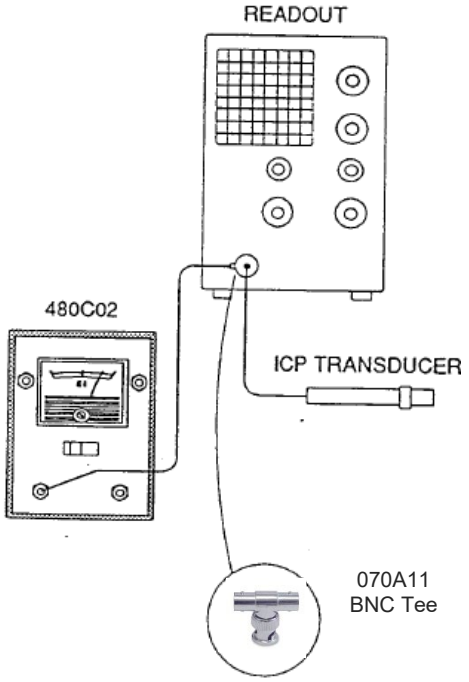


Figure 5: Direct Coupled Mode

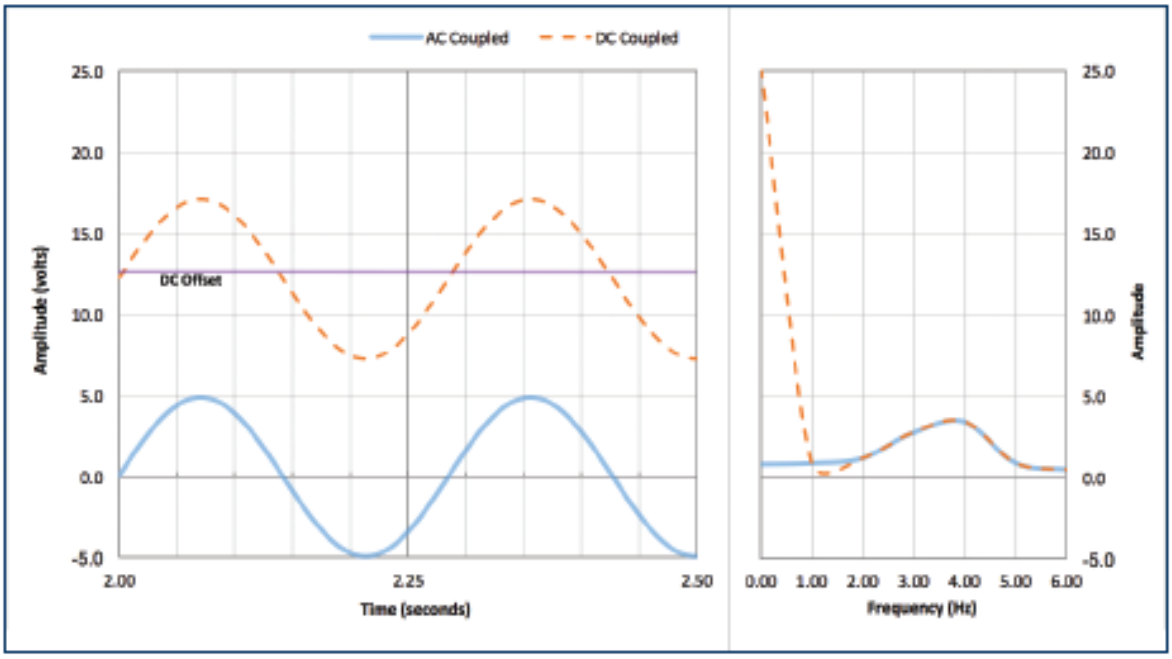


Figure 6: Diagram: AC vs DC Coupling

Performance Limits

Output Voltage Limits

Certain ICP sensors are capable of 10-volt output voltage swing. Models 480C02 / 480E09 with 27 volt supply will allow the positive-going side of the signal to go to +14 volts. The negative signal side is capable of -8 volts assuming a 10 volt turn-on for the sensor. This must be taken into consideration or resulting outputs may show signs of clipping.

Constant Current Limits

When using battery powered signal conditioners, battery life can be a concern. The current output of model 480C02 / 480E09 is fixed at approximately 2.6 mA. This current will adequately handle high-frequency signals in cables up to approximately 100 feet (31 meters) in length. Longer cables can be driven but it sacrifices some high-frequency response. PCB line powered signal conditioners (482 Series / 483 Series) should be considered for cable lengths beyond 100 feet (31 meters) as they provide up to 20 mA of drive current.

Battery Considerations

Battery Test

Models 480C02 / 480E09 incorporate a momentary battery test position in the 3 position switch. When the rocker switch is depressed to the right, the meter switched from the “XDCR” jack to the battery power high-side. Normal circuit operation is not affected by this change and releasing the rocker returns the meter to the transducer fault monitor function. It is recommended to confirm the status of batteries before initiating a test. Replace batteries any time the pointer does not reach the BATT OK position or further when the BATT Test switch is depressed. A slightly low reading will limit the usable output of most sensors but will not cause damage to the model 480C02 or connected sensors.

Battery Life & Replacement

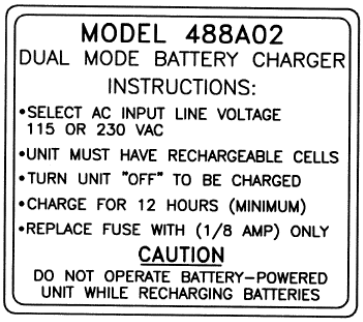
Typical battery life is 100 hours at gain of 1 or 40 hours at gain of 10 or 100 when using high quality alkaline batteries, assuming the unit is turned off when not in use. When a BATT Test fail occurs, find and carefully remove the Philips head screw on the back of model 480C02. The housing will easily separate from the working portion of the unit and expose the batteries. Gently remove each of the battery connectors to avoid damage and remove the batteries. Re-install new PP3, 9-volt batteries in same locations, making sure all are of the same type and same manufacturer. Replace housing and hand-tighten screw on back of unit. It is not recommended to mix type or manufacturer of batteries or damage can occur as batteries rupture or leak. It is recommended to remove batteries from units not in frequent use, to avoid any damage from long-term battery corrosion.

Optional Power Connections

Rechargeable Battery Use & Charging

WARNING, models 480C02 / 480E09 do not ship with rechargeable batteries and PCB external battery chargers are suitable for use with Nickel-Cadmium (Ni-Cad) rechargeable batteries only. **It should not be used with alkaline or other non-rechargeable batteries.**

Use of battery chargers, model 488A02 (110 VAC) or model F488A02 (220 VAC) should only be attempted after installation of suitable batteries. Plug 488A02 charging connector into front panel jack and with unit off, recharge for 14 hours. Charger supplies 10 mA constant current to the rechargeable batteries in the unit. Batteries should not be charged in areas near combustible materials or left unattended. Disconnect all power if any evidence of overheating occurs.



External Power Connection

The external power connector (which mates with a #750 Switchcraft telephone plug) is intended for use when longer battery life is desired. Insertion of the plug into the jack isolates the battery power connection, powering the unit from only the secondary power source. A variety of battery packs were previously available for use with this connection, one being model 073A05. They are still viable for use, but are no longer in production from PCB.

CAUTION: Insert plug into EXT PWR prior to powering ON the external power supply.

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.

Calibration & Service

Aside from battery replacement, no maintenance is required for this unit. The 480C02 contains no field serviceable parts and is not designed for field repair. 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.

PCB will perform calibrations on model 480C02 on request. Typical calibration validates the unit functions within factory new parameters, includes replacement of batteries and a factory calibration certificate.

Return Procedure

To expedite returned instrumentation, contact a factory PCB applications engineer for a RETURN MATERIAL AUTHORIZATION (RMA) NUMBER. When requesting the RMA, please be prepared to provide the model number, serial number, a brief written description of the problem, your company details, and any other pertinent information. We also recommend a copy of this information should be provided in the package with the instrument.

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 **info@pcb.com** or visit our web site at **www.pcb.com**.

Total Customer Satisfaction

PCB, a division of 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, 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 **PCB Hot Line at (716) 684-0003**, and an application specialist will assist you.

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ICP ® is a registered trademark of PCB Piezotronics, Incorporated,
which uniquely identifies PCB sensors that incorporate built-in microelectronics.

Model Number	BATTERY-POWERED SIGNAL CONDITIONER	Revision: V
480E09		ECN #: 45339

Performance	**ENGLISH**	**SI**	
Channels	1	1	
Frequency Range(-5 %)(x1, x10 Gain)	0.15 to 100,000 Hz	0.15 to 100,000 Hz	[6]
Frequency Range(-10 %)(x100 Gain)	0.15 to 50,000 Hz	0.15 to 50,000 Hz	[7]
Voltage Gain(± 2 %)	1:1	1:1	
Voltage Gain(± 2 %)	1:10	1:10	
Voltage Gain(± 2 %)	1:100	1:100	
Fault/Bias Monitor/Meter(± 1 V)(midscale)	13 VDC	13 VDC	
Environmental			
Temperature Range	32 to 120 °F	0 to 50 °C	
Electrical			
Excitation Voltage(To Sensor)	25 to 29 VDC	25 to 29 VDC	[1]
Constant Current Excitation(To Sensor)	2.0 to 3.2 mA	2.0 to 3.2 mA	[2]
Discharge Time Constant	>7 sec	>7 sec	[3][4]
DC Offset(Maximum)	<30 mV	<30 mV	[3]
Spectral Noise(1 Hz)(Gain 1)	.25 µV/√Hz	-132 dB	
Spectral Noise(10 Hz)(Gain 1)	.07 µV/√Hz	-143 dB	
Spectral Noise(100 Hz)(Gain 1)	.05 µV/√Hz	-146 dB	
Spectral Noise(1 kHz)(Gain 1)	.04 µV/√Hz	-148 dB	
Spectral Noise(10 kHz)(Gain 1)	.03 µV/√Hz	-150 dB	
Broadband Electrical Noise(1 to 10,000 Hz)(Gain x1)	3.25 µV rms	-110 dB/rms	
Spectral Noise(1 Hz)(Gain 10)	2.2 µV/√Hz	-113 dB	
Spectral Noise(10 Hz)(Gain 10)	2.0 µV/√Hz	-114 dB	
Spectral Noise(100 Hz)(Gain 10)	1.1 µV/√Hz	-119 dB	
Spectral Noise(1 kHz)(Gain 10)	.55 µV/√Hz	-125 dB	
Spectral Noise(10 kHz)(Gain 10)	.3 µV/√Hz	-130 dB	
Broadband Electrical Noise(1 to 10,000 Hz)(Gain x10)	49 µV/rms	-86 dB/rms	
Spectral Noise(1 Hz)(Gain 100)	20 µV/√Hz	-94 dB	
Spectral Noise(10 Hz)(Gain 100)	19 µV/√Hz	-94 dB	
Spectral Noise(100 Hz)(Gain 100)	12 µV/√Hz	-98 dB	
Spectral Noise(1 kHz)(Gain 100)	5.5 µV/√Hz	-105 dB	
Spectral Noise(10 kHz)(Gain 100)	2 µV/√Hz	-114 dB	
Broadband Electrical Noise(1 to 10,000 Hz)(Gain x100)	569 µV/rms	-65 dB/rms	
Power Required(Standard)	Internal Battery	Internal Battery	
Internal Battery(Type)	9V	9V	
Battery Life(Standard Alkaline)	50 hours	50 hours	
Power Required(Alternate)	DC power	DC power	
DC Power	15 mA	15 mA	[5]
Internal Battery(Quantity)	3	3	
DC Power	18 to 30 VDC	18 to 30 VDC	[5][1]
Physical			
Electrical Connector(Input, sensor)	BNC Jack	BNC Jack	
Electrical Connector(Output, scope)	BNC Jack	BNC Jack	
Electrical Connector(External Power, DC)	3.5 mm Diameter Miniature Jack	3.5 mm Diameter Miniature Jack	
Electrical Connector(Battery Charger)	#722 Switchcraft Jack	#722 Switchcraft Jack	
Size (Depth x Height x Width)	2.4 in x 4.0 in x 2.9 in	6.1 cm x 10 cm x 7.4 cm	
Weight(Including Batteries)	0.7 lb	0.3 kg	

CE[8]

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]Excitation voltage to sensor limited by optional DC power voltage.
[2]Through internal current limiting regulator.
[3]With 1M ohm load.
[4]Un-buffered output, read out device input impedance affects discharge time constant and low frequency response of unit.
[5]Provided by optional external DC power supply.
[6]Low frequency response specified into 1M ohm load.
[7]After Serial Number 24699, previously HFR was 100kHz.
[8]See PCB Declaration of Conformance PS024 for details.

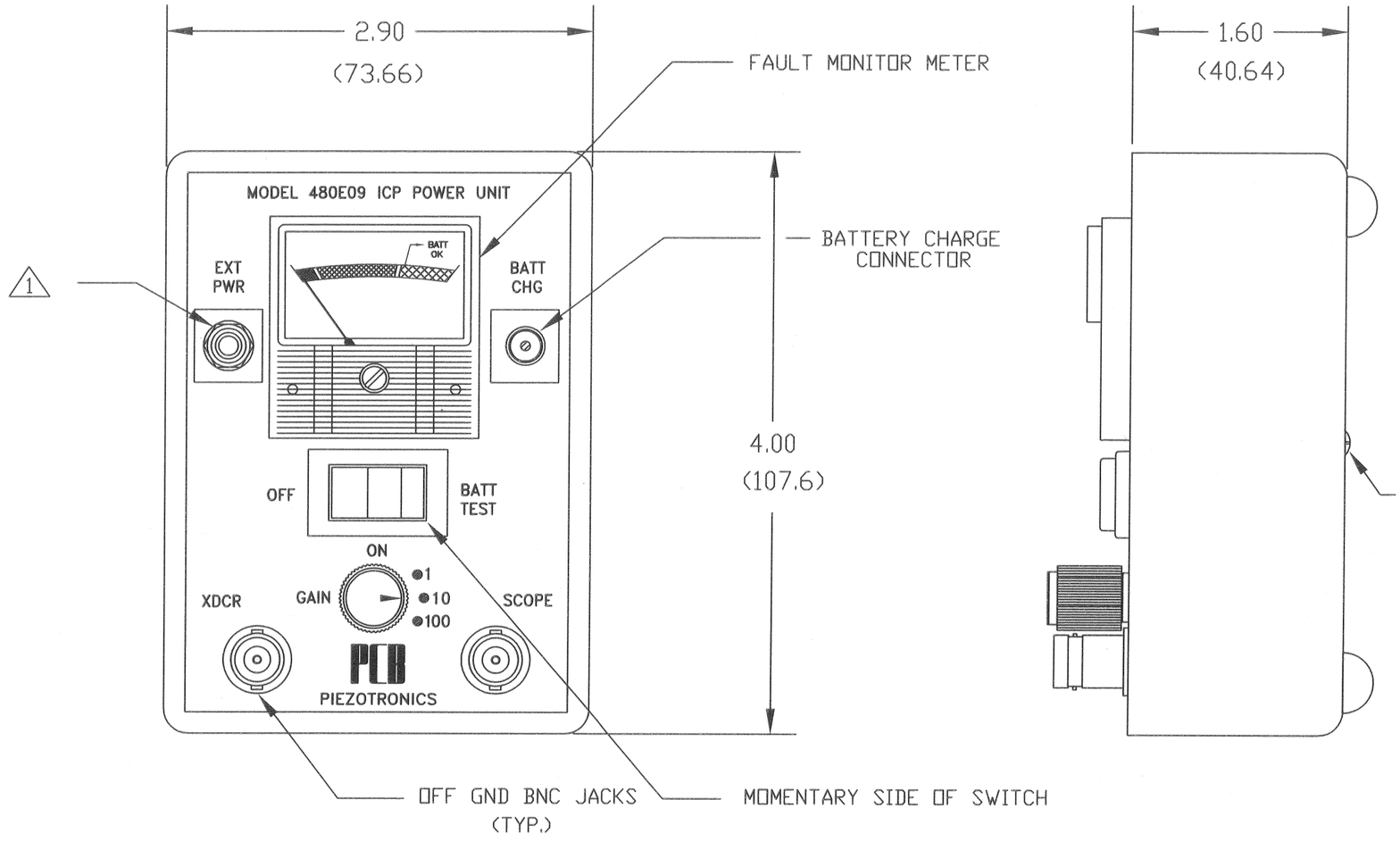
Entered: LK	Engineer: CPH	Sales: ML	Approved: JWH	Spec Number:
Date: 5/23/2016	Date: 5/23/2016	Date: 5/23/2016	Date: 5/23/2016	480-5090-80

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

APPLICATION		
NEXT ASS'Y	USED ON	VAR

480-5090-95

REVISIONS					
ZONE	REV	DESCRIPTION	ECN	DATE	APP'D
	A	CHANGED NOTE	17892	7/7/03	DM 7/7/03



1 FOR USE WITH 488A03 AC POWER SOURCE

UNLESS SPECIFIED TOLERANCES	MATERIAL	DRAWN	TC	7-8-03	MFG	BD	7/10/03
DIMENSIONS ARE IN INCHES DECIMALS XX ±.01 XXX ±.005 ANGLES ±2 DEGREES		CHK'D	DM	7/10/03	ENGR	CMH	7/10/03
FILLETS AND RADII .003 – .005	FINISH	APP'D	RJV	7/14/03			

TITLE: OUTLINE DRAWING MODEL 480E09 ICP POWER UNIT

PCB PIEZOTRONICS, INC.
3425 WALDEN AVE. DEPEW, NEW YORK 14043
PHONE: (716) 684-0001

CODE IDENT. NO.	DWG. NO.	
52681	480-5090-95	
SCALE: FULL	SHEET 1 OF 1	

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