



**Model 646B72**

**4-20 mA Output Accelerometer**

**Installation and Operating Manual**

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

**Toll-free: 800-959-4464**

**24-hour SensorLine: 716-684-0001**

**Fax: 716-684-3823**

**E-mail: [imi@pcb.com](mailto:imi@pcb.com)**

**Web: [www.imi-sensors.com](http://www.imi-sensors.com)**





<b>Service, Repair, and Return Policies and Instructions</b>
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**The information contained in this document supersedes all similar information that may be found elsewhere in this manual.**

**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 ensure 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 SI through 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 ensure 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 **Warranty, Service, Repair, and Return Policies and Instructions** 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.

**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](http://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](http://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:

PCB Piezotronics, Inc.  
3425 Walden Ave.  
Depew, NY14043 USA  
Toll-free: (800) 828-8840  
24-hour SensorLine<sup>SM</sup>: (716) 684-0001  
Website: [www.pcb.com](http://www.pcb.com)  
E-mail: [info@pcb.com](mailto:info@pcb.com)



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	○	○	○	○	○	○
PCB板	X	○	○	○	○	○
电气连接器	○	○	○	○	○	○
压电晶体	X	○	○	○	○	○
环氧	○	○	○	○	○	○
铁氟龙	○	○	○	○	○	○
电子	○	○	○	○	○	○
厚膜基板	○	○	X	○	○	○
电线	○	○	○	○	○	○
电缆	X	○	○	○	○	○
塑料	○	○	○	○	○	○
焊接	X	○	○	○	○	○
铜合金/黄铜	X	○	○	○	○	○
本表格依据 SJ/T 11364 的规定编制。						
○：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.

DOCUMENT NUMBER: 21354

DOCUMENT REVISION: **D**

ECN: 46162



**Model 640/641/645/646 B7 Series Industrial 4-20mA Sensor**



SENSORS AND INSTRUMENTATION FOR MACHINE CONDITION MONITORING

**Operating Guide with Enclosed Warranty Information**

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

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**Toll Free Line 1-800-959-4IMI**

MANUAL NUMBER: 28077  
MANUAL REVISION: B  
ECN NUMBER: 42851

## **Table of Contents**

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<i>Introduction.....</i>	<i>Page 3</i>
<i>General Features</i>	
<i>Dimension Drawing .....</i>	<i>Page 4</i>
<i>Operation and Wiring .....</i>	<i>Page 5</i>
<i>Standard Wiring</i>	
<i>Taking Measurements</i>	
<i>RV Option</i>	
<i>TO Option</i>	
<i>EP Option</i>	
<i>ESD Sensitivity.....</i>	<i>Page 10</i>

## **Warranty/Service**

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<i>Warranty, Service &amp; Return Procedure .....</i>	<i>Page 11</i>
<i>Customer Service.....</i>	<i>Page 12</i>

## Introduction

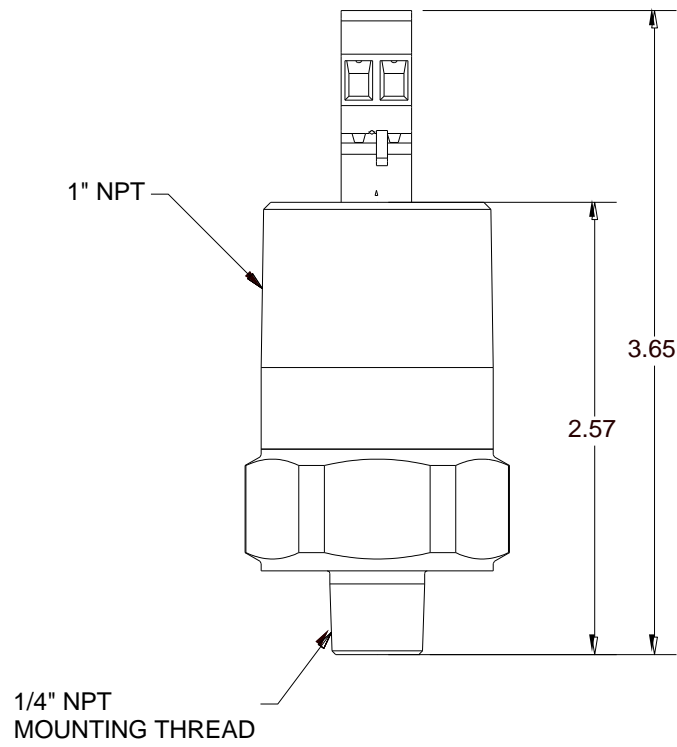
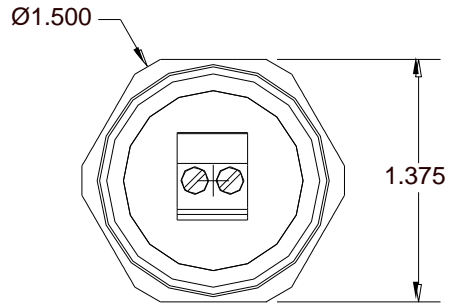
The Model 640/641/645/646 B7 Series Industrial 4-20mA Sensors combine the capabilities of a piezoelectric vibration sensor and a 4-20mA vibration transmitter. The sensor outputs a 4-20mA signal that is proportional to the overall velocity or acceleration of the machinery. Ideal for monitoring the vibration of process equipment such as fans, motors and pumps, the output of the sensor is used for process control or predictive maintenance. There are many options in this series. Please refer to specific specification sheets for further details.

### General Features

- Imbedded Piezoelectric Accelerometer for improved accuracy and frequency response.
- Vibration range can be in Acceleration or Velocity.
- Allows for continuous vibration monitoring of critical applications.
- Reduces sophisticated vibration analysis requirements.
- RV (Raw Vibration) option for conducting frequency analysis and machinery diagnostics.
- TO (Temperature Output) option via an independent 4-20mA loop.
- EP option includes an Explosion Proof capped elbow.
- Readily interfaces to existing process control and predictive maintenance equipment.
- Rugged stainless steel construction for applications in harsh environments.
- Flexible design allows for various custom requirements.



**Dimension Drawing**

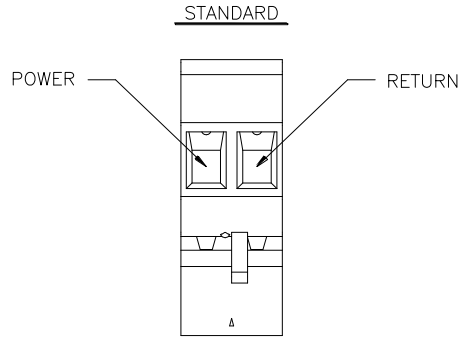


Inch (mm)

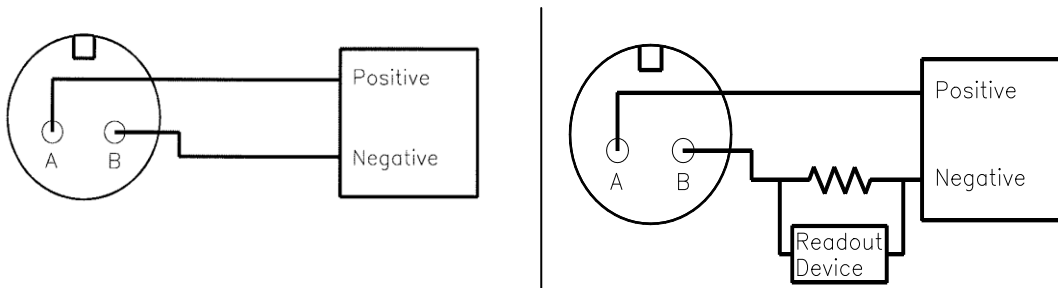
## Operation and Wiring

### Standard Wiring

The Model 640/641/645/646 B7 Series uses plug-in type screw terminal connectors for all input and output connections and operate from a standard 2-wire, 4-20mA loop. Attach the positive (+) input from the power supply to Pin 2 and the negative (-) input from the power supply to Pin 3.



**Figure 1 – wiring: standard connection**



**Figure 2 – wiring: loop powered**

**Figure 3 – wiring: loop powered/DC source**

If using a standard DC power supply, install either an ammeter and/or load resistor in line with the return connection Pin 3.

The resistor will generate a DC voltage that is proportional to current by:

$$V = IR$$

$$\text{If } R = 500\Omega \text{ and } I = 6\text{mA, then } V = 3\text{Vdc}$$

**Note:**

- Resistor value must be less than:  $(V_{supply} - 12) \times 50$ .

### Taking Measurements

When measuring the current output from the unit, use the following formula to calculate the vibration level:

$$\text{Vibration Output} = (\text{Measured Output} - 4\text{mA}) \times (\text{Full Scale Vibration Output} / 16\text{mA})$$

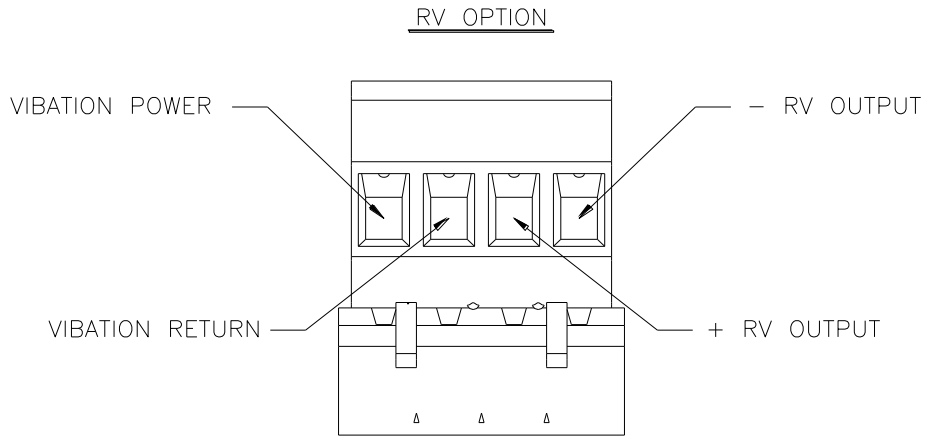
<u>Measured mA</u>	<u>640BX0</u>	<u>640BX1</u>	<u>640BX2</u>
4.00	0.0 ips, pk	0.0 ips, pk	0.0 ips, pk
8.00	0.125 ips, pk	0.25 ips, pk	0.5 ips, pk
12.0	0.25 ips, pk	0.5 ips, pk	1.0 ips, pk
15.75	0.37 ips, pk	0.73 ips, pk	1.47 ips, pk
20	0.5 ips, pk	1.0 ips, pk	2.0 ips, pk

<u>Measured mA</u>	<u>641BX0</u>	<u>641BX1</u>	<u>641BX2</u>
4.00	0.0 ips, rms	0.0 ips, rms	0.0 ips, rms
8.00	0.125 ips, rms	0.25 ips, rms	0.5 ips, rms
12.0	0.25 ips, rms	0.5 ips, rms	1.0 ips, rms
15.75	0.37 ips, rms	0.73 ips, rms	1.47 ips, rms
20	0.5 ips, rms	1.0 ips, rms	2.0 ips, rms

<u>Measured mA</u>	<u>645</u>	<u>646</u>
4.00	0.0 g rms	0.0 g rms
8.00	1.25 g rms	2.50 g rms
12.0	2.50 g rms	5.00 g rms
15.75	3.67 g rms	7.34 g rms
20	5.00 g rms	10.0 g rms

**RV Option**

The RV (raw vibration) option includes a 100mV/g  $\pm 20\%$  additional output. The accelerometer frequency range is 1 Hz-1 kHz, maximum amplitude of 15 g-pk. Data collectors or analyzers can use this vibration signal for further analysis.



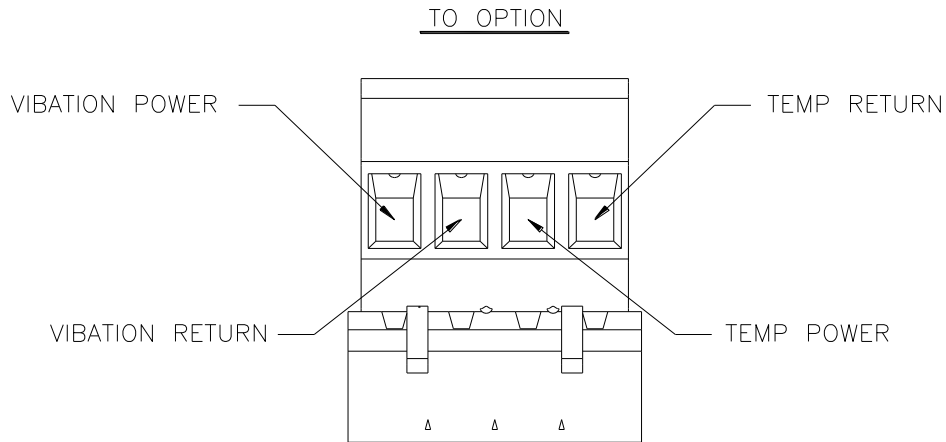
**Figure 3 – RV wiring**

**Note:**

- The Acceleration Signal Negative has to be isolated from any grounding. If this terminal is grounded, the 4-20mA loop will short, causing no output.
- The acceleration output signal is ideally suited for use with portable battery powered data collectors or analyzers.

**TO Option**

The TO (Temperature Output) option includes an additional independent 4-20mA output for temperature measurement. The temperature range is from -40°C to 125°C with an overall accuracy of  $\pm 5\%$ FSO. The imbedded temperature sensor monitors the environment internal to the sensor housing and is situated at approximately mid level.



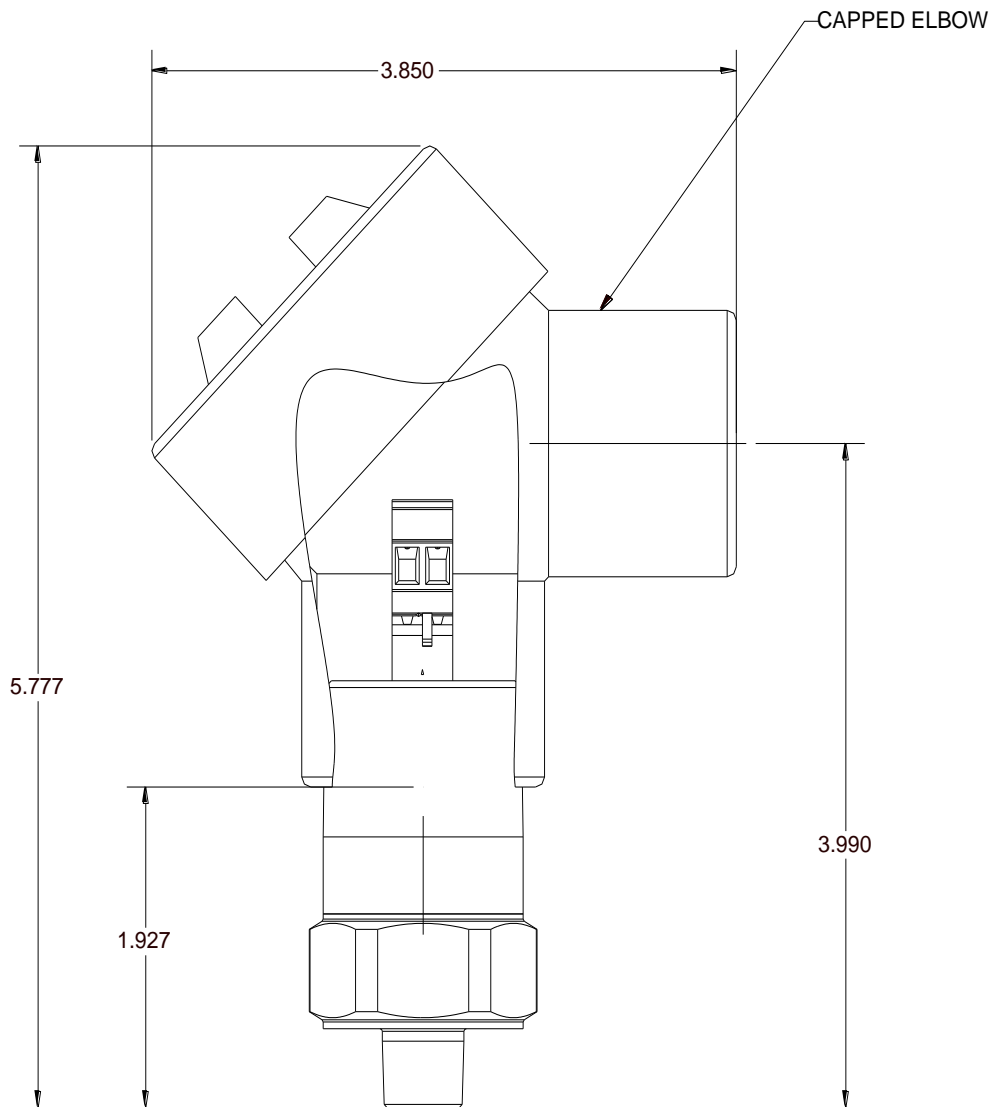
**Figure 4 – TO wiring**

**Note:**

- The same power supply can be used for both 4-20mA loops. Connect both positive terminals directly to the power supply, then use the negative terminals for independent process loops.

**EP Option**

The EP option includes an Explosion Proof capped elbow for applications in rigid or IMC conduit systems where space is limited and access is needed for pulling conductors or maintenance. Standard conduit hub size is 1"NPT.



**Figure 5 – EP option**

## **Warning 1 – ESD sensitivity**

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**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**

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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**

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**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.*

**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**

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**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**

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IMI 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**

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Because of the sophisticated nature of IMI 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 IMI applications engineer concerning the situation as certain problems can often be corrected with simple on-site procedures.

## **Return procedure**

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*To expedite returned instrumentation, contact a factory IMI 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 IMI if none are located in your area.*

Customers outside the U.S. should consult their local IMI distributor for information on returning equipment. For exceptions, please contact the International Sales department at IMI 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 [imi@pcb.com](mailto:imi@pcb.com) or visit our web site at [www.pcb.com](http://www.pcb.com).





## Customer Service

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IMI, a division of PCB Piezotronics, guarantees **Total Customer Satisfaction**. If, at any time, for any reason, you are not completely satisfied with any IMI product, IMI will repair, replace, or exchange it at no charge. You may also choose to have your purchase price refunded.

IMI 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 **IMI Hot Line at (716) 684-0003**, and an application specialist will assist you.



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

Model Number  
646B72

# LOOP POWERED, CURRENT OUTPUT, INDUSTRIAL VIBRATION SENSOR

Revision: A  
ECN #: 27692

	<u>ENGLISH</u>	<u>SI</u>	
<b>Performance</b>			
Measurement Range	0.0 to 10 g rms	0.0 to 98.1 m/s <sup>2</sup> rms	[1]
Output	4-20 mA	4-20 mA	
Frequency Range(± 3 dB)	180 to 60,000 cpm	3 to 1000 Hz	[2][3]
Broadband Resolution	0.05 g rms	0.49 m/s <sup>2</sup> rms	[4]
Non-Linearity	± 1 %	± 1 %	
<b>Environmental</b>			
Temperature Range	-40 to 185 °F	-40 to 85 °C	
<b>Electrical</b>			
Excitation Voltage	12 to 30 VDC	12 to 30 VDC	
Settling Time(within 2% of value)	<15 sec	<15 sec	
Electrical Isolation(Case)	>10 <sup>8</sup> ohm	>10 <sup>8</sup> ohm	
<b>Physical</b>			
Size (Hex x Height)	1.5 in x 3.7 in	38.1 mm x 94 mm	
Weight	19.5 oz	553 gm	
Mounting Thread	1/4 NPT	Not Applicable	
Sensing Element	Ceramic	Ceramic	
Sensing Geometry	Shear	Shear	
Housing Material	Stainless Steel	Stainless Steel	
Electrical Connector	Removable Screw Terminals	Removable Screw Terminals	
Electrical Connection Position	Top	Top	
Electrical Connections(Tab 1)	4-20 mA Pos (+)	4-20 mA Pos (+)	
Electrical Connections(Tab 2)	4-20 mA Neg (-)	4-20 mA Neg (-)	
Screw Terminal Wire Size	12-24 AWG	3.0 - .2mm <sup>2</sup>	

**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.

**EP** - Explosion-proof certified conduit housing with 1" pipe thread

**RV** - Buffered Analog Signal Output - 100 mV/g (±20%)

Electrical Connector	Removable Screw Terminals	Removable Screw Terminals
Electrical Connections(Tab 1)	4-20 mA Pos (+)	4-20 mA Pos (+)
Electrical Connections(Tab 2)	4-20 mA Neg (-)	4-20 mA Neg (-)
Electrical Connections(Tab 3)	Signal Output Pos	Signal Output Pos
Electrical Connections(Tab 4)	Signal Output Neg	Signal Output Neg

**NOTES:**

- [1] Conversion Factor 1g = 9.81 m/s<sup>2</sup>.
- [2] Current will fluctuate at frequencies below 5 Hz.
- [3] 1Hz = 60 cpm (cycles per minute).
- [4] Typical.
- [5] See PCB Declaration of Conformance PS039 for details.

**SUPPLIED ACCESSORIES:**

Model ICS-4 NIST-traceable single-axis amplitude response calibration from 0 cpm (0 Hz) to upper 10% frequency for 4 - 20 mA output vibration sensor (1)



[5]

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.

Entered: JET	Engineer: MJD	Sales: MPM	Approved: NJ	Spec Number:
Date: 11-15-07	Date: 11-12-07	Date: 11-12-07	Date: 11-12-07	35155

**IMI SENSORS**  
A PCB PIEZOTRONICS DIV.  
3425 Walden Avenue, Depew, NY 14043

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Fax: 716-684-3823  
E-Mail: imi@pcb.com

2

1

APPLICATION

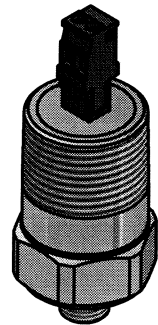
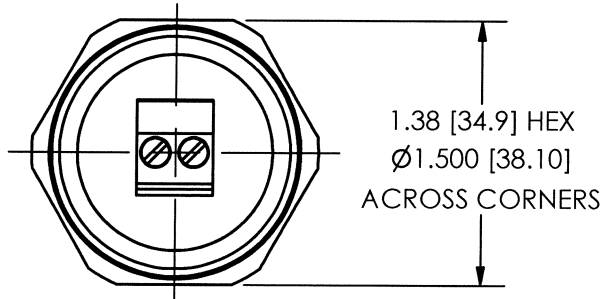
REVISIONS

NEXT ASS'Y	USED ON	VAR

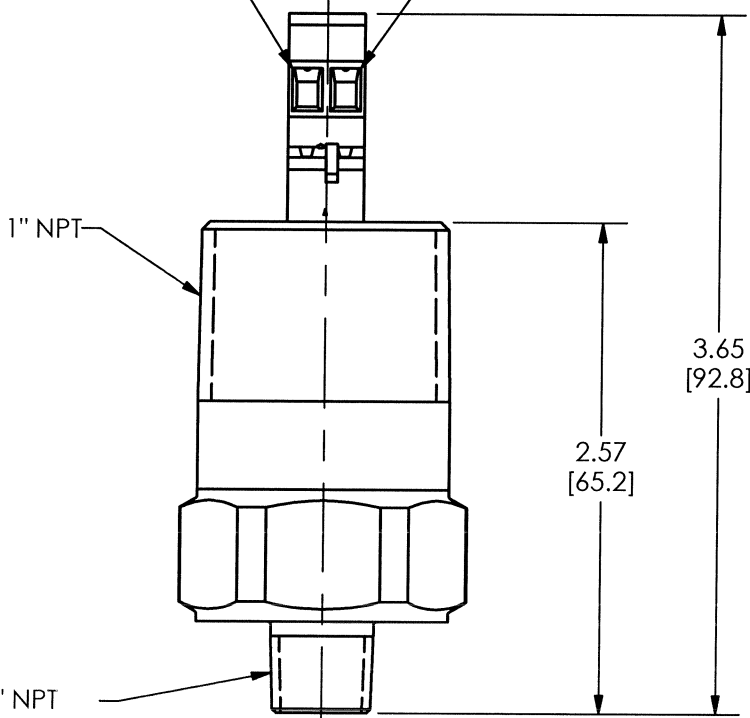
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POS 4-20 mA      NEG 4-20 mA



1/4" NPT MOUNTING THREAD

645B72	0-5 GRAMS, 3Hz-1kHz
646B72	0-10 GRAMS, 3Hz-1kHz
MODEL	DESCRIPTION

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:

DIMENSIONS IN INCHES	DIMENSIONS IN MILLIMETERS [IN BRACKETS]
DECIMALS XX ± .03 XXX ± .010	DECIMALS X ± 0.8 XX ± 0.25
ANGLES ± 2 DEGREES	ANGLES ± 2 DEGREES

FILLETS AND RADII .003 - .005	FILLETS AND RADII [0.07 - 0.13]
-------------------------------	---------------------------------

DRAWN	<i>DFM</i> 8/22/06	MFG	<i>J. XL</i> 8/23/06
CHK'D	<i>ECB</i> 8/22/06	ENGR	<i>MJE</i> 8/14/06
APP'D	<i>DF</i> 8/23/06	SALES	<i>GRM</i> 8/25/06

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

OUTLINE DRAWING  
 MODEL 645B72, 646B72  
 4-20 mA ACCELERATION SENSOR

CODE IDENT. NO. 52681	DWG. NO. 35154
SCALE: FULL	SHEET 1 OF 1

2

1