



**Model 682B03**

**ICP® Vibration Transmitter**

**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)**



**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](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, NY 14043 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)

**682 Series 4-20mA Din Rail ICP<sup>®</sup> Signal Conditioner**

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***Operating Guide with Enclosed Warranty Information***

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**Phone (716) 684-0003**

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

MANUAL NUMBER: 40535  
MANUAL REVISION: B  
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## **Warranty/Service**

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## Introduction

The **682 Series** is a 4-20mA Din Rail Signal Conditioner designed to interface with IMI Sensor's ICP<sup>®</sup> Accelerometer. Acceleration, Velocity, or Displacement can be converted to a 4-20mA signal by simple DIP Switch selection internal to the Din Rail enclosure. An additional standard feature of the **682 Series** is the ability to convert the temperature output from an accelerometer (when equipped) to 4-20mA. Signal Filtering can be easily configured in the field by installing factory calibrated Filter Modules into sockets located inside the enclosure.

### General Features

- External transmitters, signal conditioners, and ICP<sup>®</sup> power supplies can be eliminated by direct connection of the sensor to the Din Rail Signal Conditioner.
- Optional 500Vdc Input to Output Electrical Isolation.
- Selectable 24Vdc Unregulated, 18Vdc regulated, 4mA excitation to power sensor
- 4-20mA Output Signals for Vibration and Temperature.
- Selectable 0-5 or 0-10Vdc Output Signal for Vibration.
- Internal DIP switch selectable vibration ranges include:

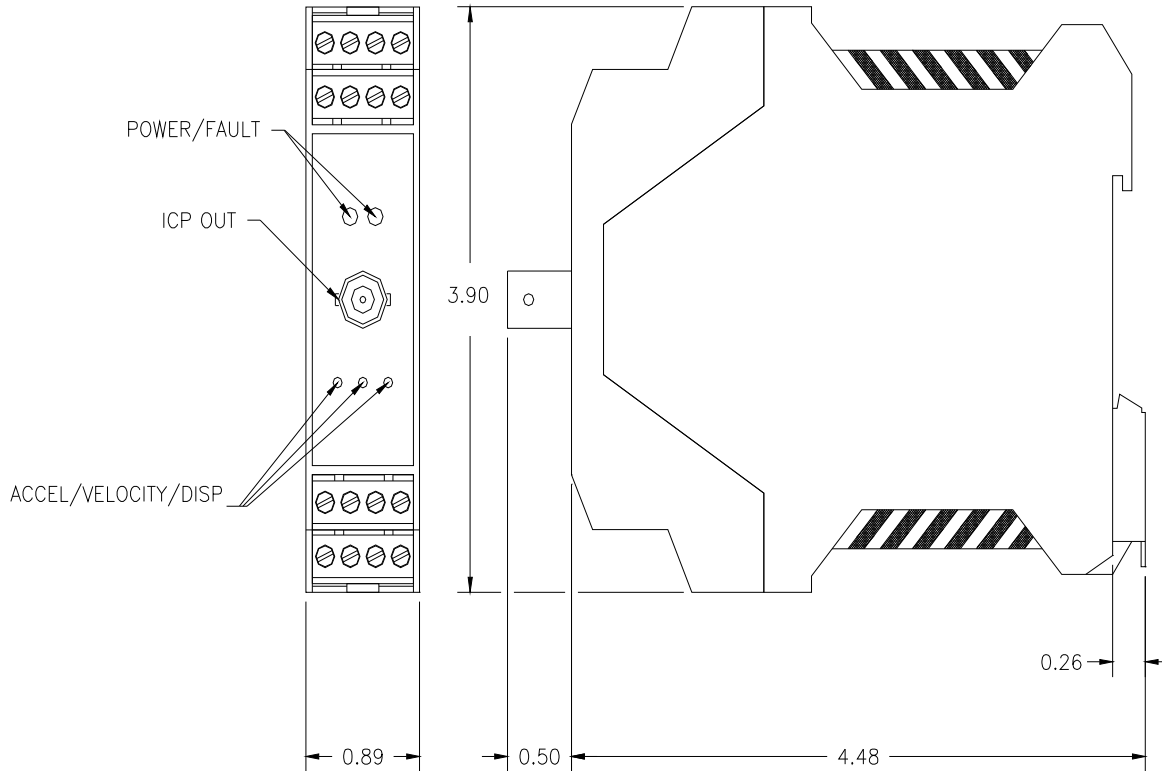
Acceleration (g's)	Velocity (in/sec)	Displacement (mils p-p)
5.00	0.50	10.0
10.00	1.00	20.0
20.00	2.00	40.0

- Internal DIP switch selection for Peak or RMS.
- Utilization of Filter Modules for field configuration of High and Low pass 2-pole filtering.
- Analog output signal connections (RV) for conducting frequency analysis and machinery diagnostics.
- LED indicators for Power, Sensor Fault, Acceleration, Velocity, and Displacement.
- Electronic Sensor Fault Indication via 4-20mA output by providing a 0mA signal.
- Configurable for ICP<sup>®</sup> Sensor Power disable to accommodate existing applications.
- Removable Terminal Blocks for easy wiring.
- 35mm (1.38in.) Din Rail Mount configuration.
- Space saving 22.5mm (0.9in.) wide design.

## Installation and Wiring

### Installation

The **682 Series** is designed to be mounted on a 35mm Din Rail. Do not install in a harsh area where it can be exposed to cleaning fluids or machine oils. IMI Sensors recommends mounting the 682BX3 in a type NEMA 4 enclosure to protect the electronics from contamination.



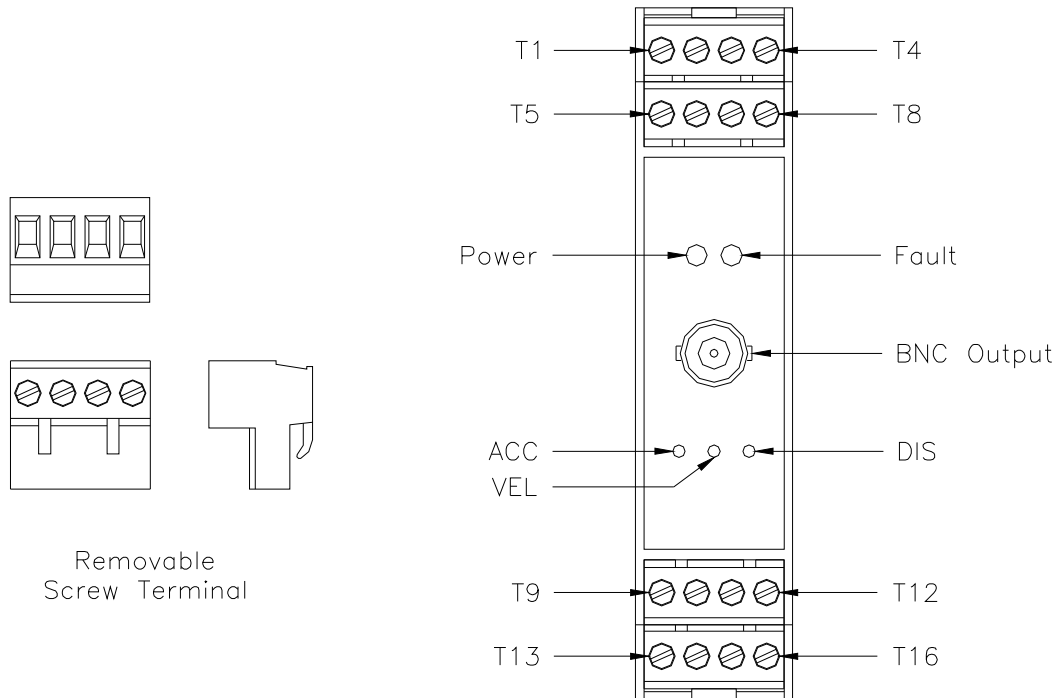
**Dimension Drawing**

## Connector and Pinout Diagram

The **682 Series** uses plug-in type screw terminal connectors for all input and output connections.

Strip off 8mm of insulation from the connection wire ends. Using a screwdriver, remove the terminal block from the enclosure in either the up or down direction, terminate the wire in the correct location. Do not exceed a torque of 0.5Nm. Re-install the terminal block.

This easy to assemble connection method allows devices to be exchanged easily and the electrical connection to be visibly isolated.



**Pin Location Diagram**



### **WARNING**

**AC and DC input signals and power supply voltages could be hazardous. DO NOT connect live wires to screw terminal plugs, and DO NOT insert, remove, or handle screw terminal plugs with live wires connected.**



**Pin Descriptions:**

**DC Power – Pins 1 to 3:**

- Pin 1** +Power
- Pin 2** -Power/Common
- Pin 3** Earth Ground

**ICP<sup>®</sup> Accelerometer – Pins 4 to 6:**

- Pin 4** Shield
- Pin 5** + ICP<sup>®</sup> Accelerometer
- Pin 6** - ICP<sup>®</sup> Accelerometer

**Temperature Sensor – Pins 7 to 8:**

- Pin 7** + Temperature Sensor
- Pin 8** - Temperature Sensor (- ICP<sup>®</sup> Accelerometer)

**Raw Vibration (RV) – Pins 9 to 10, and BNC Jack:**

- Pin 9** + RV
- Pin 10** - RV

**4 to 20mA Temperature Output – Pins 11 to 12:**

- Pin 11** + 4 to 20mA Temperature Output
- Pin 12** - 4 to 20mA Temperature Output

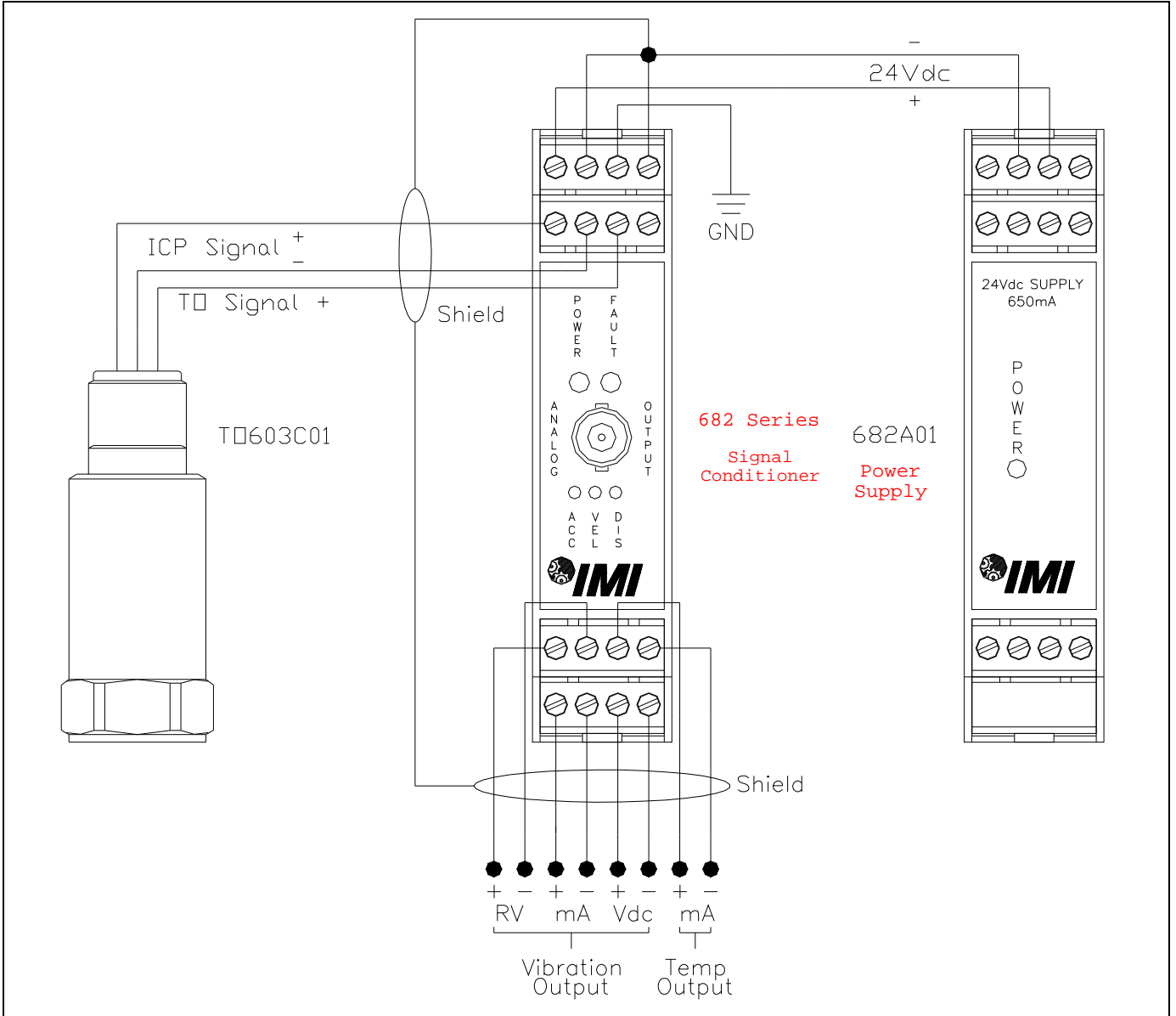
**4 to 20mA Vibration Output – Pins 13 to 14:**

- Pin 13** + 4 to 20mA Vibration Output
- Pin 14** - 4 to 20mA Vibration Output

**0-5/10Vdc Vibration Output – Pins 15 to 16:**

- Pin 15** + 0-5/10Vdc Vibration Output
- Pin 16** - 0-5/10Vdc Vibration Output

**Typical Wiring Diagram**



To Maintain Conformance, Earth Ground, Power Supply Common, and I/O Shields must be connected together.

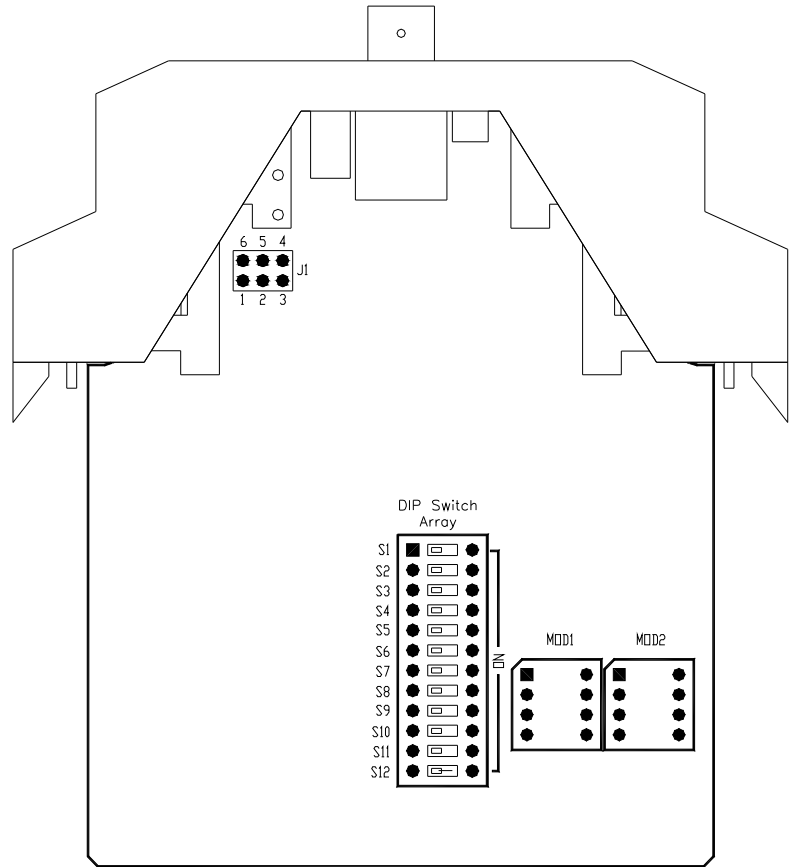
Note: If using the **682 Power Supply**, mount the **682 Signal Conditioner** to the left of the power supply with a recommended minimum separation distance of 4" where applicable.

## Configuring the 682 Series

### Internal PC Board Diagram

The Internal PC Board Diagram shows the location of the internal DIP Switch, Filter Modules, and Sensor Power Select Jumper. The DIP switch is used to configure the **signal conditioner** for various sensor and vibration ranges. The Filter Modules are installed to set the High and Low cutoff frequencies. The Jumper selects unregulated, regulated, or no ICP<sup>®</sup> power to the accelerometer.

The PC Board is accessible through the front of the indicator by removing the Screw Terminal Connectors and disengaging the tabs on the TOP and BOTTOM of the meter with a screwdriver. Once disengaged, the PC Board can be slid out for configuration.



### DIP Switch and Filter Module Descriptions:

- S1 and S2:** Acceleration Mode
- S3 and S4:** Velocity Mode
- S5 and S6:** Displacement Mode
- S7:** RMS
- S8:** Peak
- S9:** 20g, 2ips, 40mils
- S10:** 10g, 1ips, 20mils
- S11:** 5g, 0.5ips, 10mils

**S12:** Off = 0-5Vdc Output, On = 0-10Vdc Output

### Internal DIP Switch Setting

The Internal DIP Switch of the **682 Series** must be configured for the Full Scale Output of the ICP® Sensor connected to it. This is accomplished by removing the front cover and sliding the PC Board out of the Signal Conditioner. Once removed, the DIP switch should be configured per one of the conditions in the following table.

Range Setting	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
<b>5g RMS</b>	ON	ON	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON
<b>5g Peak</b>	ON	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON
<b>10g RMS</b>	ON	ON	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF
<b>10g Peak</b>	ON	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF
<b>20g RMS</b>	ON	ON	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF
<b>20g Peak</b>	ON	ON	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF
<b>0.5 in/sec RMS</b>	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	OFF	OFF	ON
<b>0.5 in/sec Peak</b>	OFF	OFF	ON	ON	OFF	OFF	OFF	ON	OFF	OFF	ON
<b>1.0 in/sec RMS</b>	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	OFF	ON	OFF
<b>1.0 in/sec Peak</b>	OFF	OFF	ON	ON	OFF	OFF	OFF	ON	OFF	ON	OFF
<b>2.0 in/sec RMS</b>	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	ON	OFF	OFF
<b>2.0 in/sec Peak</b>	OFF	OFF	ON	ON	OFF	OFF	OFF	ON	ON	OFF	OFF
<b>10 mils p-p</b>	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF	ON
<b>20 mils p-p</b>	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	ON	OFF
<b>40 mils p-p</b>	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	OFF	OFF

<b>S12</b>	OFF	0-5Vdc Output
<b>S12</b>	ON	0-10Vdc Output

Note: Factory Default Setting is 1.0in/sec Peak, 0-5Vdc Output

### Filter Module Location

The Filter Modules are utilized to set the cutoff frequency of the internal band pass filter circuit. The **682 Series** comes standard with Modules preinstalled. If a different cutoff frequency is desired, the preinstalled module can be removed by simply pulling it out of the MOD socket, and replacing it with a different module. The module is labeled with the type of filter, Low Pass or High Pass, and the cutoff frequency. Module location is as follows:

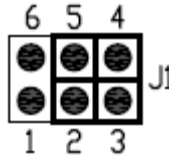
**MOD1:** Low Pass (LP) Filter Module Location  
**MOD2:** High Pass (HP) Filter Module Location

**Warning:** Do not make any adjustments to the internal potentiometers. These potentiometers are used for factory calibration and adjusting them will require return of the **682 Series unit** to the factory for recalibration.

Sensor Power Jumper Configuration:

**Regulated 18Vdc/4mA Power  
(Factory Default)**

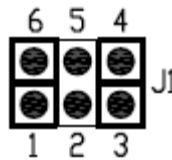
Jumper 2-5 and 3-4



**Unregulated 24Vdc Supply/4mA Power**

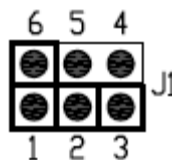
(Constant Current Diode is Internal to **682 Series Signal Conditioner**)

Jumper 1-6 and 3-4



**Sensor Power Disabled  
(No ICP<sup>®</sup> Power to Accelerometer)**

Jumper 1-6 and 2-3



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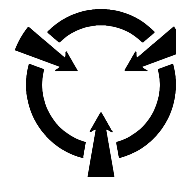
This equipment is designed with user safety in mind; however, the protection provided by the equipment may be impaired if the equipment is used in a manner not specified by PCB Piezotronics, Inc.

## **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.*



**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**

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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.

## Ordering Information

IMI Part Number: **682A X 3**

**Frequency Response/Isolation\***

0	3Hz to 10kHz (Standard)
1	3Hz to 1kHz
2	10Hz to 10kHz
3	10Hz to 1kHz
4	3Hz to 10kHz with 500Vdc I/O Isolation
5	3Hz to 1kHz with 500Vdc I/O Isolation
6	10Hz to 10kHz with 500Vdc I/O Isolation
7	10Hz to 1kHz with 500Vdc I/O Isolation

**Ordering Example:** 682B13

This is a 4-20mA Din Rail ICP<sup>®</sup> Signal Conditioner with the following:  
Frequency Response: 3Hz to 1kHz  
I/O Isolation: None

***\*Additional Options Available – Please Inquire***

## **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, within the warranty period, 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  
**682B03**

# 4-20MA DIN RAIL SIGNAL CONDITIONER/TRANSMITTER

Revision: A  
ECN #: 32835

**ELECTRICAL**

	<b>ENGLISH</b>	<b>SI</b>
Power Supply Voltage	23 - 25 Vdc	23 - 25 Vdc
Power Supply Current	100mA max.	100mA max.
ICP® Input Signal	100mV/g [3]	100mV/g [3]
ICP® Sensor Excitation	18Vdc/4mA, ±1V/±1mA [7], [8]	18Vdc/4mA, ±1V/±1mA [7], [8]
Temperature Sensor Input	0 - 1.2V Full Scale [6]	0 - 1.2V Full Scale [6]
Vibration Output (milliamps)	4-20mA	4-20mA
Zero	4mA ±2% of Span	4mA ±2% of Span
Span	16mA ±5.0%	16mA ±5.0%
Vibration Output (volts)	0-5/10Vdc	0-5/10Vdc
Zero	0Vdc ±2% of Span	0Vdc ±2% of Span
Span	5/10Vdc ±5.0%	5/10Vdc ±5.0%
Temperature Output (milliamps)	4-20mA	4-20mA
Zero	4mA ±2% of Span	4mA ±2% of Span
Span	16mA ±5.0%	16mA ±5.0%
Raw Vibration Output	±1% of Input Vibration	±1% of Input Vibration
Input Channels	1	1
Frequency Response:	3Hz to 10kHz [2],[4],[5]	3Hz to 10kHz [2],[4],[5]
Fault Current Output	<1mA	<1mA

**ENVIRONMENTAL**

Warm Up	<2 minutes	<2 minutes
Operating Temperature Range	32 to 158°F	0 to 70°C
Storage Temperature Range	-40 to 257°F	-40 to 125°C
Relative Humidity	<95% (Non-Condensing)	<95% (Non-Condensing)

**MECHANICAL**

Case Dimension W x H x D:	0.9 x 3.9 x 4.5 in.	22.5 x 99 x 114.5 mm
Weight	6.4 oz. max.	181 grams
Material	Polyamide	Polyamide
Input/Output Electrical Connectors	Removable Screw Terminals	Removable Screw Terminals
Raw Vibration Connector	BNC Jack	BNC Jack
Screw Terminal Wire Size	24 - 14 AWG	0.2 - 2.5 mm <sup>2</sup>
Din Rail Mount	1.38 in.	35mm

**INDICATOR**

Power LED	GREEN	GREEN
Fault LED	RED	RED
Acceleration	GREEN	GREEN
Velocity	GREEN	GREEN
Displacement	GREEN	GREEN

*All specifications are at room temperature unless otherwise specified.*

**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.

N/A

**NOTES:**

- 1) Internal DIP Switch Selection:
  - Acceleration: 5.00g, 10.00g, 20.00g
  - Velocity: 0.50 in/sec, 1.00 in/sec, 2.00 in/sec
  - Displacement: 10.0 mils p-p, 20.0mils p-p, 40.0 mils p-p
  - Peak or RMS
  - 0-5 or 0-10Vdc Output
- 2) Frequency Response Tolerances:
  - Acceleration: -3dB at 3Hz ±0.5Hz, -3dB at 10kHz ±0.5kHz
  - Velocity: -3dB at 3.5Hz ±0.5Hz, -3dB at 10kHz ±0.5kHz
  - Displacement: -3dB at 3.5Hz ±0.5Hz, 1000Hz max.
- 3) Output measurement range is based upon input from a 100mV/g accelerometer and will be scaled inversely proportional to any percentage deviation of this input.
- 4) Output Current/Voltage will fluctuate at frequencies below 5 Hz.
- 5) Attenuation is -40dB/Decade
- 6) Requires an accelerometer with TO option output.
- 7) Jumper selectable for 18Vdc Regulated, 24Vdc Power Supply Voltage, or ICP® Sensor Excitation Disabled.
- 8) 4mA Constant Current Diode is Internal to 682BX3.

**CERTIFICATIONS:**



See PCB Declaration of Conformance PS051 for details.

ICP® is a registered trademark of PCB Group, Inc.

*In the interest of constant product improvement, we reserve the right to change specifications without notice.*

Form DD030 Rev.F 2/23/99

Drawn: LH	Engineer: NF	Sales: EGY	Approved: EB	Spec Number:
Date: 4/29/10	Date: 4/24/10	Date: 4/24/10	Date: 4/26/10	<b>40536</b>



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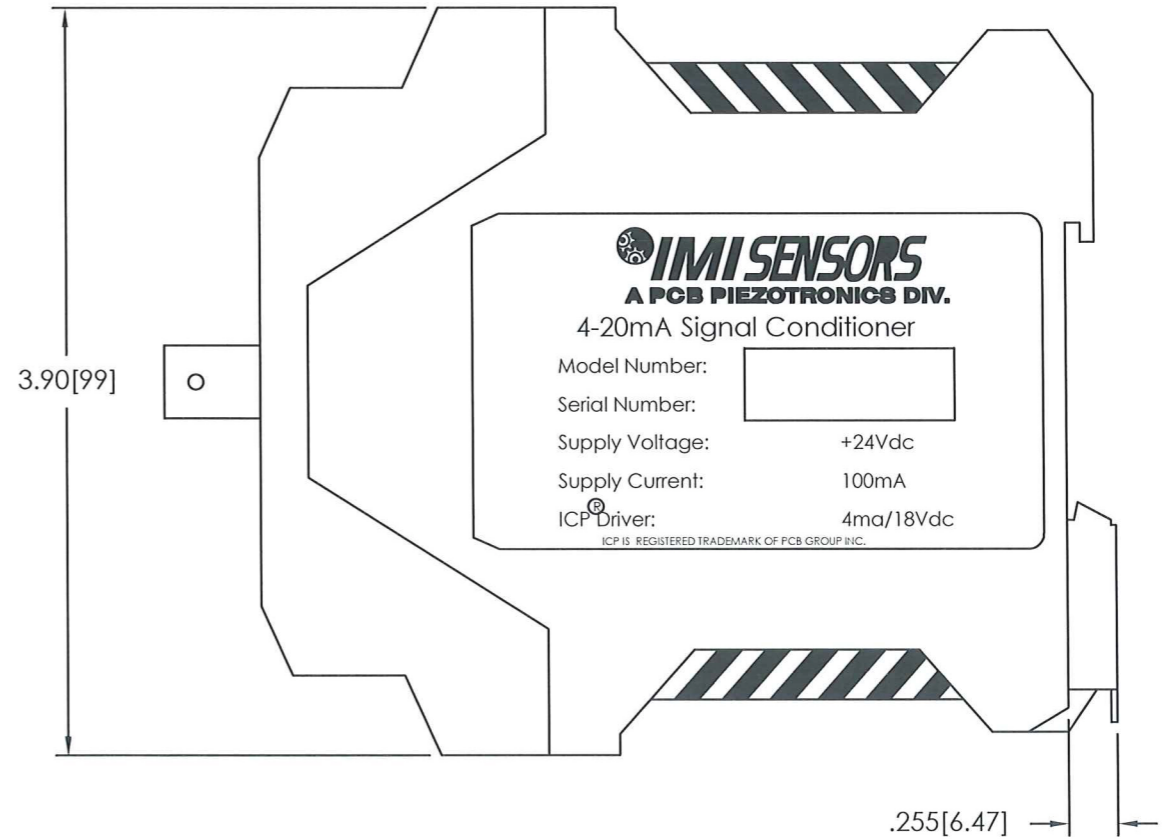
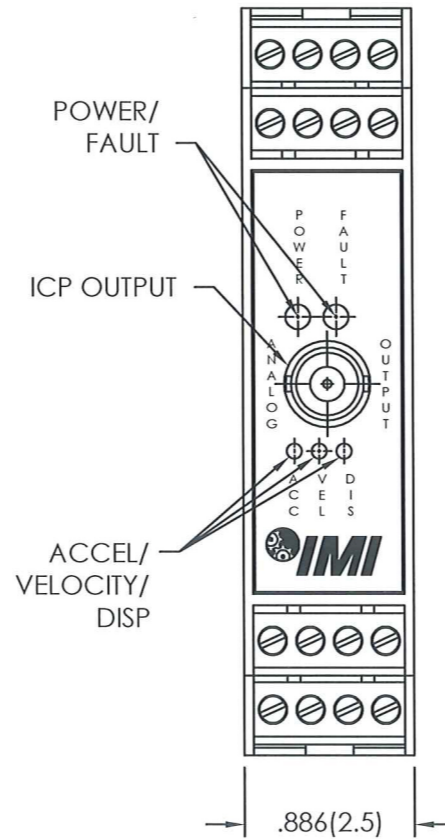
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REVISIONS		
REV	DESCRIPTION	ECO
A	UPDATED DWG TITLE	40321

40537

Terminal Connection	
Input	Output
1 + ] Power	9 + ] Raw Vibration
2 - ] Earth Ground	10 - ] Temperature
3 Shield ] ICP Sensor	11 + ] 4 - 20mA
4 + ] ICP Sensor	12 - ] Vibration
5 - ] + Temp. Sensor	13 + ] 4 - 20mA
6 - ] - Temp. Reference	14 - ] Vibration
7 + ]	15 + ] 0-5/10Vdc
8 - ]	16 - ]

BNC : Raw Vibration Output - Acceleration  
ICP IS REGISTERED TRADEMARK OF PCB GROUP INC.



UNLESS SPECIFIED TOLERANCES		DRAWN	CHECKED	ENGINEER	 <small>3425 WALDEN AVE. DEPEW, NY 14043</small> <small>(716) 684-0001 EMAIL: SALES@PCB.COM</small>		
DIMENSIONS IN INCHES	DIMENSIONS IN MILLIMETERS [IN BRACKETS]	JDM 11/21/12	<i>Jm White</i>	AJG 11/21/12		<table border="1"> <tr> <td>CODE IDENT. NO. 52681</td> <td>DWG. NO. 40537</td> </tr> </table>	CODE IDENT. NO. 52681
CODE IDENT. NO. 52681	DWG. NO. 40537						
DECIMALS XX ±.03 XXX ±.010	DECIMALS X ±0.8 XX ±0.25	TITLE			SCALE: FULL		
ANGLES ±2 DEGREES	ANGLES ±2 DEGREES	OUTLINE DRAWING 4-20 DIN RAIL CONDITIONER			SHEET 1 OF 1		
FILLETS AND RADII .003 - .005	FILLETS AND RADII [0.07 - 0.13]						