Model 649A03

Bearing Condition Transmitter

Installation and Operating Manual

**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

PCB PIEZOTRONICS INC.
A PCB GROUP COMPANY

Warranty, Service, Repair, and Return Policies and Instructions

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 traceablility 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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DOCUMENT NUMBER: 21354
DOCUMENT REVISION: B
ECN: 17900

IMI SENSORS
A PCB PIEZOTRONICS DIV.

SENSORS AND INSTRUMENTATION FOR MACHINE CONDITION MONITORING

Model 649A03 Series Industrial 4-20mA Bearing Condition Transmitter

CE

Operating Guide with Enclosed Warranty Information

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MANUAL NUMBER: 45611
MANUAL REVISION: NR
ECN NUMBER: 38356

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Introduction

The 649A03 Bearing Condition Transmitter is a USB Programmable loop powered device with 4-20mA output, all contained in typical vibration sensor housing. It is specifically designed to provide early warning of typical ball/rolling element bearing faults such as cracked races, spalling, brinelling and looseness. It has five modes of detection that are user selectable by a simple software program through a PC's USB port. The options include **RMS acceleration, True Peak acceleration, Compensated Peak acceleration** using bearing diameter and speed to normalize output, **Crest Factor**, and **Crest factor Plus**(based on original combination of the peak, RMS, and crest factor) for improved detection on variable speed machinery. A structure diagram of the transmitter and test results are discussed.

Machinery and mechanical systems face potential failure when the ability to function normally is compromised due to worn components or when operation conditions diverge from normal. Continuous monitoring of vibration levels helps avoid expensive unplanned shutdowns by detecting machinery faults before they become catastrophic events. It is known that machinery vibration changes when problems such as worn bearings occur. Bearings are needed whenever one part of a machine slides against another, and can be classified as either sliding or rolling contact bearings. For rolling contact bearing condition monitoring, The Rolling/Ball bearing Condition Transmitter, a new field programmable and cost-effective sensor has been designed. The sensors are constructed with a two pin independent polarity connector and can work directly with PLC, DCS, or SCADA, and other plant information systems. All parameters and configurations of the sensor are USB programmable through a PC.

Two groups of methods are widely adopted for the determination of rolling bearing health and the presence of faults. Although not always possible, the best results are obtained when both methodologies are adopted.

The first group of methods, which are diagnostics orientated, is based on the separation and analysis of discrete components of certain frequencies which make up excited oscillations in the bearing. The diagnostic features are frequency components of the spectrum and characteristics of the signal pulse shaped associated with the characteristic frequencies of the bearings. These are the pulse peak value (usually harmonic amplitude), the ratio of the harmonic energy to the noise level, and the amplitude of spectrum components at the pulse repetition frequency. To analyze these parameters, use is made of vibration signal spectra, spectra of AM-envelopers of narrow band high frequency components of the vibration signal in a range of 0.1 to 40 kHz and vibration time waveforms.

The second group of methods is based on the determination of the technical condition of the bearing as a whole. In the case of loss of serviceability, it is paramount to determine the necessity of bearing replacement (i.e. determine its health). The cause of the failure may be determined later, if required, by visual inspection of the bearing. The condition of the bearing is evaluated by the degree of development of degradation; a process that may be separated into four known stages. The following is a list of possible diagnostic parameters (RMS and Peak of acceleration, characteristics of amplitude distribution, moment characteristics (dispersion, excess), correlation and regression variances ,amplitude discriminates, various parameters with use of Peak(Crest) Factor and its combination with RMS and Peak of vibration and comparison of vibration parameters in various frequency bands. One important property of the field applicable methods is a strong ability to separate current process characteristics, such as speed and loading, from bearing defects. The RMS, Shock Pulse, Crest Factor, Kurtosis, High Frequency Resonance Technique (HERT), Spike Energy™ , gSE, HFD, etc., are the main methods of bearing conditions related to the second group. Several popular methods for determining bearing conditions are listed below.

- Real or true PK of Acceleration and HFD
- True RMS of Acceleration
- Crest (peak) factor CF = A_{pk}/A_{rms} (trend is required)
- Shock pulse method (rpm is required)
- W_{1X} (A_{pk}/A_{rms}) + W_2 x A_{rms}
- Enveloping with Spectrum Analyses, Cepstrum and others
- K – factor K= $A_{pk\,x}\,A_{rms}$ and other high order moments (rpm is required)
- Strum factor $K_0/Kt = A_{pk0}xA_{rms0}/A_{pkt}$ x A_{rmst}
- Kurtosis (rpm is required)
- Modulation deepness of envelop signal (rpm is required)

The 649A03 product uses the first five methods listed above. When programming the sensor, the user selects the method most closely matched to his application. Factory application assistance is always available 24/7.

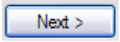
The Bearing Condition Transmitter can be programmed by the user by using the 600A21 programming kit for the 2-pin Mil Style connector. The kit contains the 070A89 programmer cable as well as the software on a CD. The 600A2X kit contains the same plus and extra cable adapter (model 042M17) for use with integral cable models as well as the terminal block style connector used in conjunction with a 90 °conduit e lbow for hazardous areas. The latest copy of this software is also available as a free download via the IMI Website (www.imi-sensors.com). The software must be installed on the computer before connecting the programming cable to sensor.

Program Installation

Copy the Files: Insert the software disk provided into the CD drive. Create a new directory on the computer and copy the entire contents of the disk to the directory created. Be sure to remember where this new file is located, because you will need to browse to it once the device is first connected.

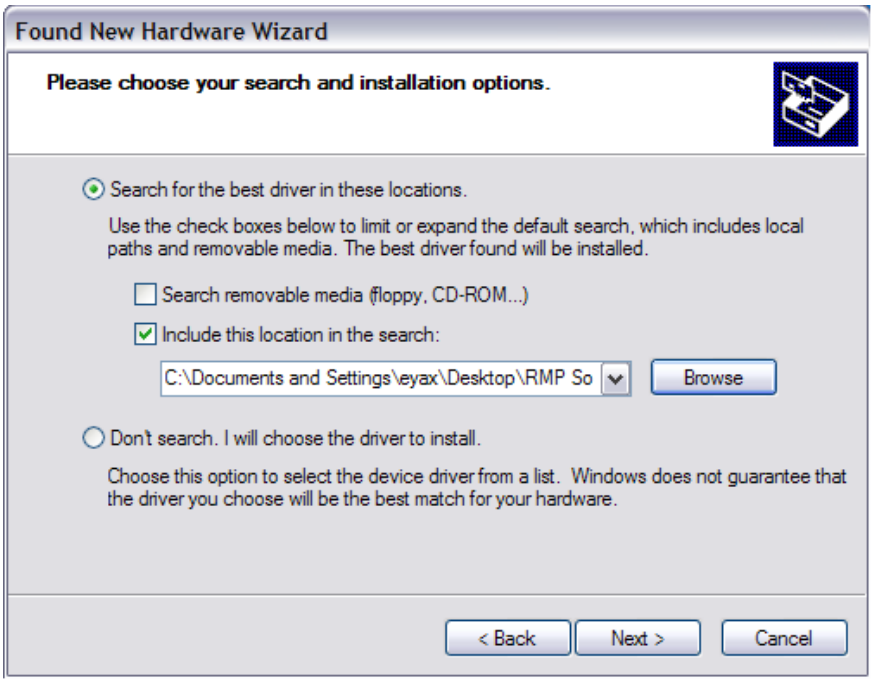
Install the Drivers and Software: *NOTE: If the computer does not find the new hardware automatically as described below, the drivers can also be installed by either using the "Add Hardware" function in the Control Panel or by gong to System, Hardware, Device Manager in the Control Panel.* Please contact IMI if you need further assistance.

NOTE: It is important to connect the USB Programmer in the sequence described for proper operation. Connect the Model 070A89 USB Programmer first to the 2-pin MIL connector on the Series 649A and then to the USB connection on the computer. If the switch has a terminal block connector or integral cable, use the Model 042M17 adapter cable with the USB Programmer. After a few seconds, you will be prompted with the following message. Note: In some cases, you may not get this message but get the one that follows it below.

Select "Yes, this time only" and click 

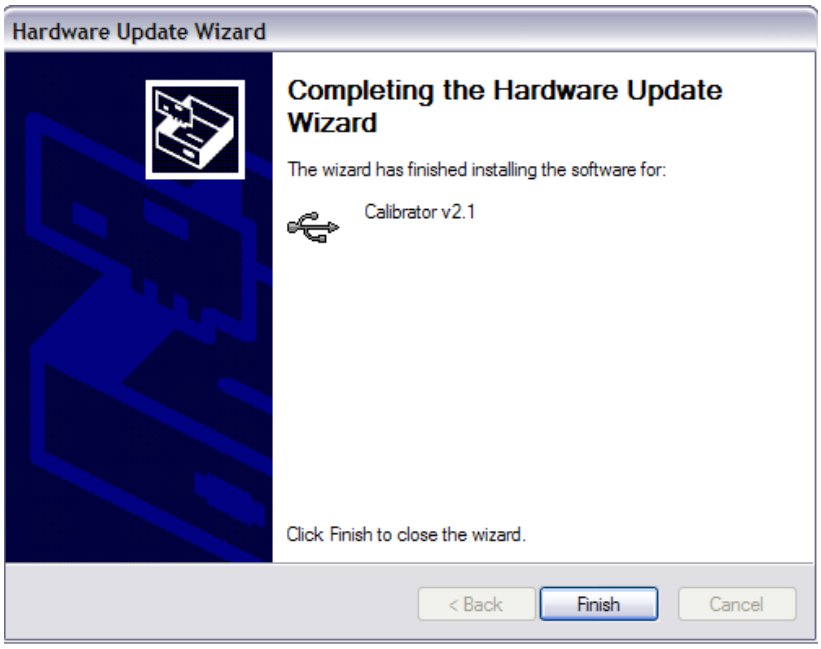
The following screen should appear, select “Install from a list or specific location” and click Next >

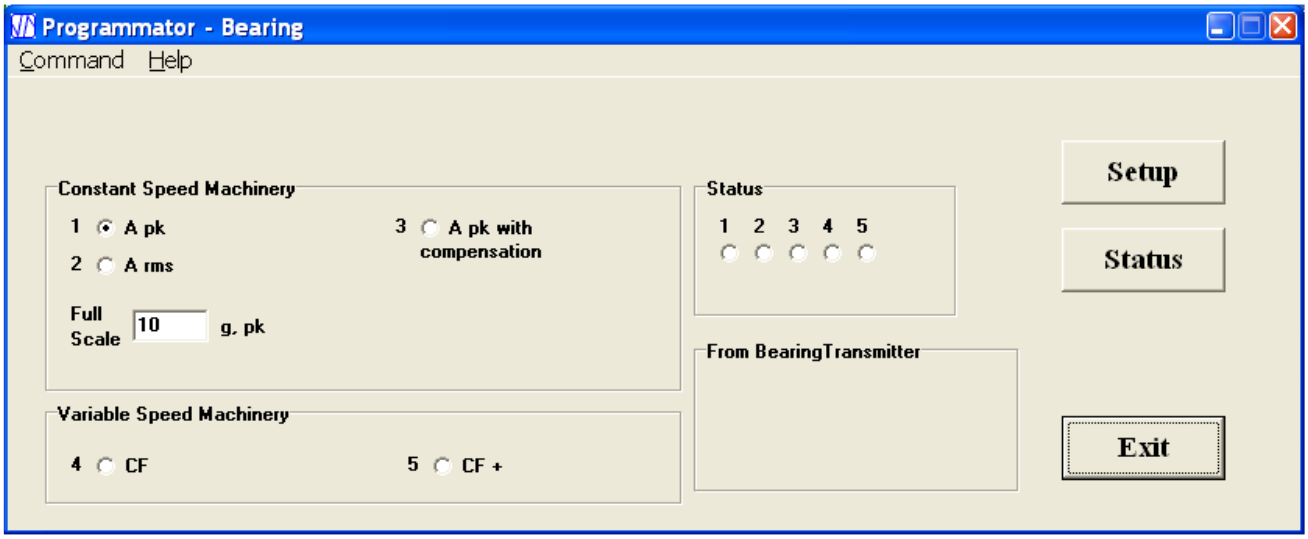
At the next screen prompt, select the option to “Include this location in the search”, and click Browse to select the “Calibrator1Driver” folder that is a subfolder of the “Software for 649AXX” folder that you created when you copied the files. Click Next >



When the following screen appears; click “Continue Anyway”

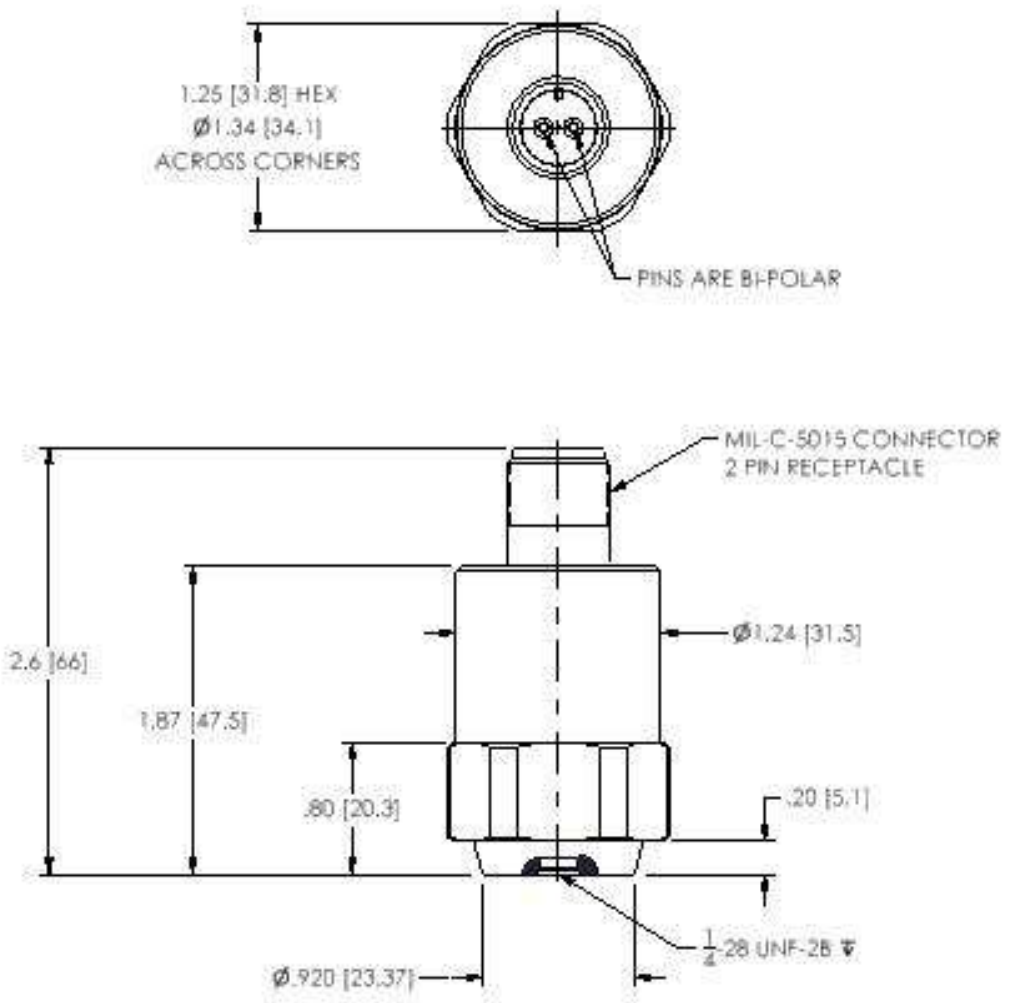
The drivers will now be properly installed and you should get the following screen. Click “Finish”. The software is now ready to use.





A 649 Series Programming Screen similar to the one above will be displayed. The data in the "STATUS" window indicates the current programming settings of the Series 649 Sensor. The left side of the screen provides the choices for programming the sensor and consists of 2 sections. The top left section is used to program constant speed machinery and includes the following selections: True Peak of acceleration (A pk), True RMS of acceleration (A rms), which are both user programmable from 2-50 g. The third choice is True Peak of acceleration with compensation (A pk with compensation) which is a modified shock pulse method for non-resonance measurements. This selection will call for the user to enter the bearing diameter as well as the rotation speed. The bottom section is used for "Variable Speed Machinery" and includes Crest (peak) factor which is the ratio of Acceleration peak and Acceleration RMS and is represented as sensor output in mA equal to the CF. The Crest Factor Plus (CFR+) is a combination of the Peak, RMS and Crest Factor is modified known technology for improving bearing defect detection on variable speed machinery. The output is useful for detecting high level defects. The CF+ algorithm recognizes when defects get severe enough to increase RPM output (acting to reduce the value of CF ratio) and compensates for it. Once the proper mode is selected from the above and entered into the program through 070A89 programming cable by selecting the set up button.

Dimension Drawing



Inch (mm)

Operation and Wiring

Standard Wiring

The Model 649A Series operates from a standard 2-wire, 4-20mA loop. If using a loop powered unit, attach the positive (+) input from the power supply to Pin A or **Red** wire on the sensor and the negative (-) input from the power supply to Pin B or **Blue** wire of the sensor.

Figure 1 – wiring: loop powered source

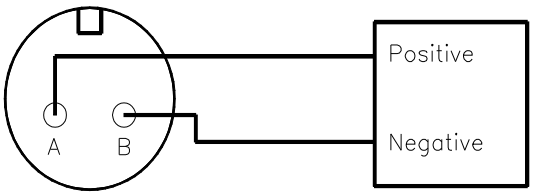
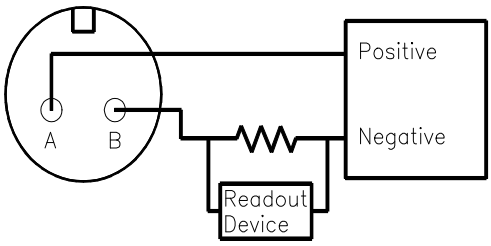


Figure 2 – wiring: loop powered/DC



If using a standard DC power supply, install either an ammeter and/or load resistor in line with the output, Pin B or **Blue** wire.

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

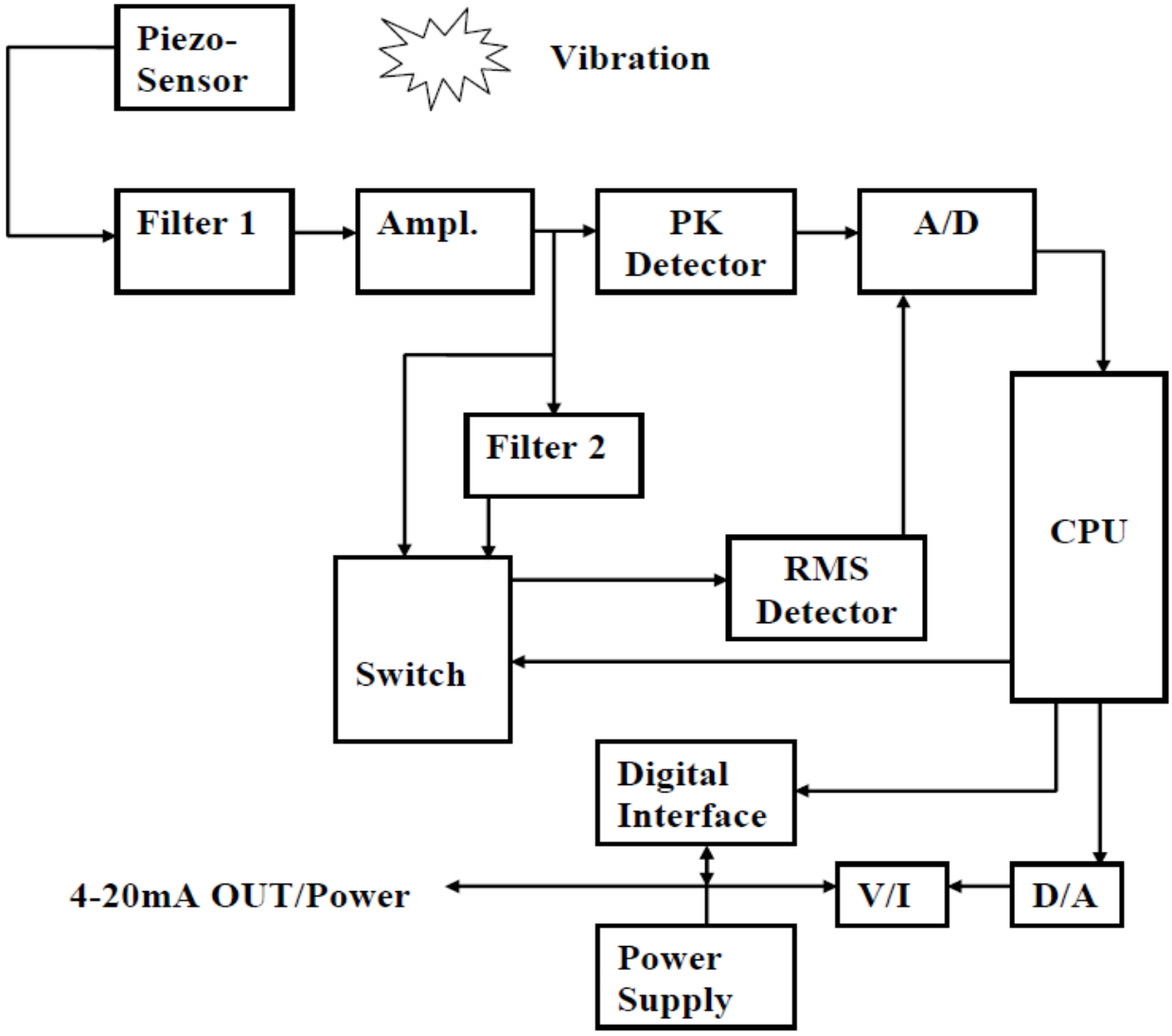
$$V = IR$$

$$If\ R = 500\ ohms\ and\ I = 6\ mA, then\ V = 3\ VDC$$

Note:

- Resistor value must be less than: (Vsupply – 12) x 50.
- For integral cable sensors: RED wire is positive, BLUE wire is negative.

Block Diagram



Simplified block diagram of the bearing Condition Transmitter is shown above.
The Bearing Condition Transmitter includes an embedded accelerometer (piezo-sensor) that generates a voltage output that is proportional to the shock and vibration sensed on the machine bearing. The output of the sensor is passed through a band pass filter (250 Hz to 10+ kHz) and coupled through an amplifier to a high speed peak detector and thru another band filter (2.5 kHz to 10+kHz) or directly to a true RMS detector.

The PK detector and RMS detector monitor the continuous vibration signal and hold the highest values seen within the sample window. The PK and RMS values are passed through the analog-to-digital convertor (A/D) to the CPU. The sensor output is a 4-20 mA current proportional to measured parameter based on the USB programmed settings.

Installation

When choosing a mounting method, consider closely the advantages and disadvantages of each technique. Typical mounting types are stud, direct adhesive, adhesive mounting base and magnetic mounting base. Since the frequency response is limited to 1 kHz on the 640/641, any of the four methods can be used without seriously affecting the data values. The mounting method might affect some of the 649 series because of the increased frequency response.

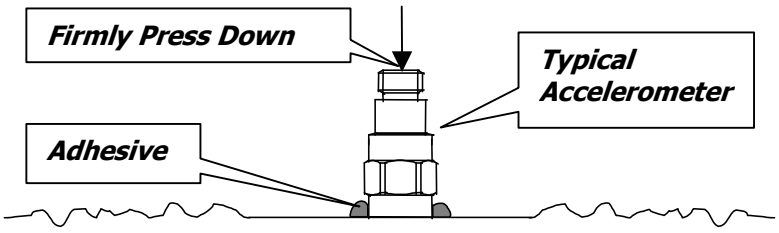
Direct Adhesive Mount Procedure

For restrictions of space or for convenience, most sensors (with the exception of integral stud models) can be adhesive-mounted directly to the machine surface.

STEP 1 Prepare a smooth, flat mounting surface. A minimum surface finish of 63 µin [0,00016 mm] generally works best.

STEP 2 Place a small portion of adhesive on the underside of the sensor. Firmly press down on the top of the assembly to displace any adhesive. Be aware that excessive amounts of adhesive can make sensor removal difficult.

Figure 5 – direct adhesive mounting



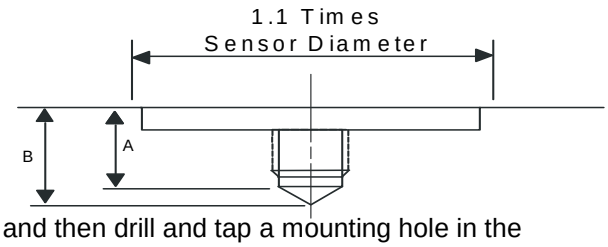
Standard Stud Mount Procedure

This mounting technique requires smooth, flat contact surfaces for proper operation and is recommended for permanent and/or secure installations. Stud mounting is also recommended when testing at high frequencies.

Note: DO NOT attempt mounting on curved, rough or uneven surfaces, as the potential for misalignment and limited contact surface may significantly reduce the sensor's upper operating frequency range.

Figure 6 – mounting surface preparation

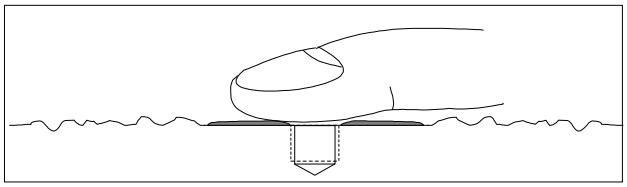
	1/4-28 Stud	***1/4-28 Captive Screw***
A (in)	*0.250*	*0.250*
B (in)	*0.350*	*0.350*
Torque (ft-lb)	*2 to 5*	*2 to 5*



STEP 1 ***First***, prepare a smooth, flat mounting surface, and then drill and tap a mounting hole in the center of this area as shown in Figure 6. A precision-machined mounting surface with a minimum finish of 63 µin [0,00016 mm] is recommended. (If it is not possible to properly prepare the machine surface, consider using an adhesive mounting pad as a possible alternative.) Inspect the area, checking that there are no burrs or other foreign particles interfering with the contact surface.

STEP 2 ***Wipe*** clean the mounting surface and spread on a light film of grease, oil or similar coupling fluid prior to installation.

Figure 7 – mounting surface lubrication



Adding a coupling fluid improves vibration transmissibility by filling small voids in the mounting surface and increasing the mounting stiffness. For semi-permanent mounting, substitute epoxy or another type of adhesive.

STEP 3 HAND-tighten the sensor/mounting stud to the machine, and then secure the sensor with a torque wrench to the mounting surface by applying the recommended mounting torque (see enclosed specification data sheet for proper mounting torque). It is important to use a torque wrench during this step. **Under-torquing the sensor may not adequately couple the device; over-torquing may result in stud failure and possibly permanent damage.**

Adhesive Stud Mount Procedure

Adhesive mounting is often used for temporary installation or when the machine surface cannot be adequately prepared for stud mounting. Adhesives like hot glue or wax work well for temporary mounts; two-part epoxies and quick-bonding gels provide a more permanent mount.

Note: Adhesively mounted sensors often exhibit a reduction in high-frequency range. Generally, smooth surfaces and stiff adhesives provide the best frequency response. Contact the factory for recommended epoxies.

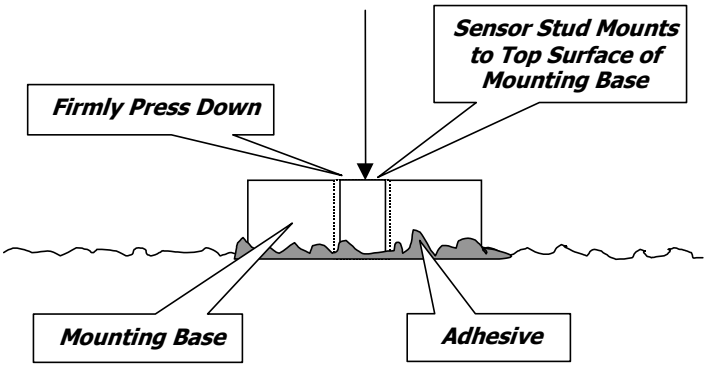
This method involves attaching a base to the machine surface, then securing the sensor to the base. This allows for easy removal of the accelerometer.

STEP 1 ***Prepare*** a smooth, flat mounting surface. A minimum surface finish of 63 µin [0,00016 mm] generally works best.

STEP 2 Stud-mount the sensor to the appropriate adhesive mounting base according to the guidelines set forth in Steps 2 and 3 of the *Standard Stud Mount Procedure*.

STEP 3 ***Place*** a small portion of adhesive on the underside of the mounting base. Firmly press down on the assembly to displace any extra adhesive remaining under the base.

Figure 8 – mounting base: adhesive installation



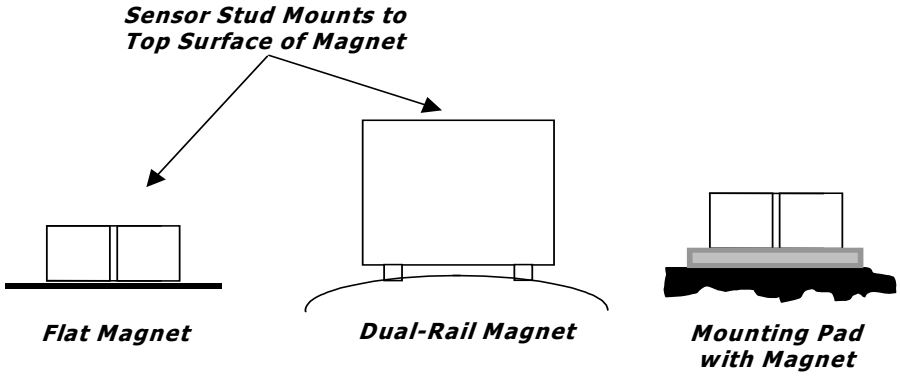
Magnetic Mount Procedure

Magnetic mounting provides a convenient means for making portable measurements and is commonly used for machinery monitoring and other portable or trending applications.

***Note**: The correct magnet choice and an adequately prepared mounting surface is critical for obtaining reliable measurements, especially at high frequencies. Poor installations can cause as much as a 50% drop in the sensor frequency range.*

Not every magnet is suitable for all applications. For example, rare earth magnets are commonly used because of their high strength. Flat magnets work well on smooth, flat surfaces, while dual-rail magnets are required for curved surfaces. In the case of non-magnetic or rough surfaces, it is recommended that the user first weld, epoxy or otherwise adhere a steel mounting pad to the test surface. This provides a smooth and repeatable location for mounting.

Figure 9 – magnet types



ALL SURFACES SHOULD BE FLAT AND SMOOTH

STEP 1 After choosing the correct magnet type, inspect the unit, verifying that the mounting surfaces are flat and smooth.

STEP 2 Stud-mount the accelerometer to the appropriate magnet according to the guidelines set forth in Steps 2 and 3 of the Standard Stud Mount Procedure.

STEP 3 Prepare a smooth, flat mounting surface. A minimum surface finish of 63 µin [0.00016 mm] generally works best. After cleaning the surface and checking for burrs, wipe on a light film of silicone grease, machine oil or similar-type coupling fluid.

STEP 4 Mount the magnet/sensor assembly to the prepared test surface by gently "rocking" or "sliding" it into place.

Note: Magnetically mounting accelerometers carelessly has the potential to generate very high (and very damaging) g levels. To prevent damage, install the assembly gently. If unsure, please contact the factory for assistance.

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.*

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

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

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

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

Customer Service

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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Model Number	Preliminary BEARING CONDITION TRANSMITTER	Revision: NR
649A03		ECN #: 37104

Performance	ENGLISH	SI	
Output(Loop power)	4-20 mA	4-20 mA	
Sampling Time	1 sec	1 sec	
Measurement Range(with HPF 250 Hz)	0-2 to 0-50 g pk	0-2 to 0-50 g pk	[1][2]
(with HPF 2500 Hz)	0-2 to 0-50 RMS	0-2 to 0-50 RMS	[1][2]
(Compensation pk)	1 to 16	1 to 16	[1]
Crest Factor(with HPF 250 Hz)	1 to 16	1 to 16	[1]
Crest Factor Plus	1 to 16	1 to 16	[1]
Bearing Diameter	1.57 to 39.37 in	40 to 1000 mm	
Bearing Rotation Speed	600 to 3600 RPM	10 to 60 Hz	
Linearity(Loop powered)	10 %	10 %	
Environmental			
Temperature Range	-40 to 212 °F	-40 to 100 °C	
Storage Temperature Range	-40 to 257 °F	-40 to 125 °C	
Electrical			
Excitation Voltage	15 to 30 VDC	15 to 30 VDC	
Load Resistance	50(Vs-15) ohm	50(Vs-15) ohm	
Electrical Isolation	>10^8 ohm	>10^8 ohm	
Physical			
Size (Height x Hex)	2.60 in x 1.25 in	66 mm x 32 mm	
Weight	6 oz	170 gm	
Mounting Thread	1/4 - 28 UNF	1/4 - 28 UNF	
Mounting Torque	3 to 5 ft-lb	4 to 7 N-m	
Sensing Element	Piezoelectric Accelerometer	Piezoelectric Accelerometer	
Housing Material	Stainless Steel	Stainless Steel	
Sealing	Welded Hermetic	Welded Hermetic	
Electrical Connector	MIL-C-5015	MIL-C-5015	
Electrical Connection Position	Top	Top	
Electrical Connections(Pin A)	4-20 mA Pos (+)	4-20 mA Pos (+)	
(Pin B)	4-20 mA Neg (-)	4-20 mA Neg (-)	
Overload Limit (Shock)	5000 g pk	49,050 m/s² pk	

CE [3]

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.

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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
Supplied Accessory : Model M081A61 Mounting Stud 1/4-28 to M6 X 1 (1)

NOTES:

[1] Customer programmable parameters
[2] With 0.1g Step
[3] See PCB Declaration of Conformance PS039 or PS053 for details.

SUPPLIED ACCESSORIES:

Model 081A41 Mounting stud 1/4-28 socket head set screw brass tip stainless steel 5/8" long (1)

Entered:	Engineer:	Sales:	Approved:	Spec Number:
Date: 11-10-11	Date: 10-13-11	Date: 11-10-11	Date: 10-31-11	45609

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

Phone: 800-959-4464
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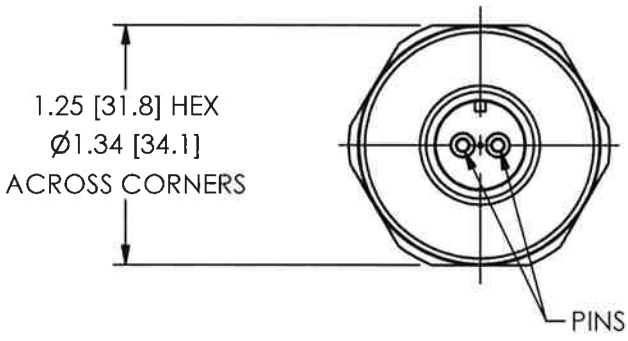
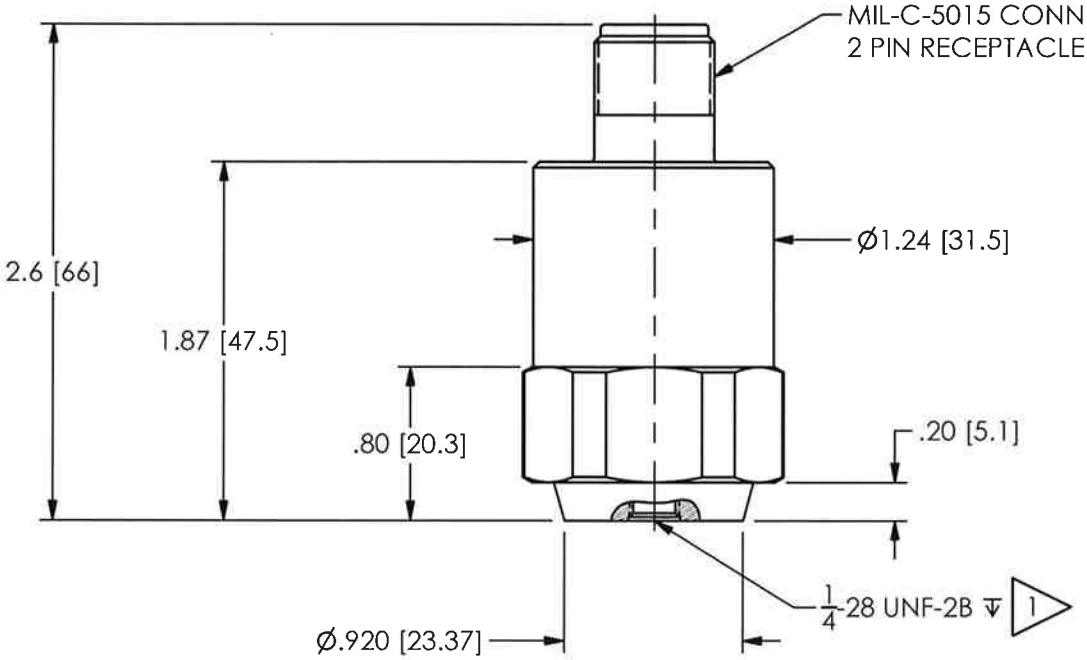
E-Mail: imi@pcb.com

45610

REVISIONS		
REV	DESCRIPTION	ECO
A	CORRECT MODEL NUMBER IN TITLE	33352





1 MODEL 081A40 MOUNTING STUD SUPPLIED AS STANDARD. FOR M PREFIXES (M649A03) MODEL M081A61 (M6 X 1.0 TO $\frac{1}{4}$-28) MOUNTING STUD REPLACES 081A40.

UNLESS OTHERWISE SPECIFIED TOLERANCES ARE:		DRAWN	CHECKED	ENGINEER
DIMENSIONS IN INCHES	DIMENSIONS IN MILLIMETERS [IN BRACKETS]	EJH 7/6/10	ECB 7/6/10	JJD 7/6/10
DECIMALS XX ±.03 XXX ±.010	DECIMALS X ±0.8 XX ±0.25	TITLE: OUTLINE DRAWING MODEL 649A03 BEARING FAULT PROTECTOR		
ANGLES ± 2 DEGREES	ANGLES ± 2 DEGREES			
FILLETS AND RADII .003 - .005	FILLETS AND RADII 0.07 - 0.13			

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(716) 684-0001 E-MAIL: sales@pcb.com

CODE IDENT. NO. 52681	DWG. NO. 45610
SCALE: FULL	SHEET 1 OF 1