IMI SENSORS

A PCB PIEZOTRONICS DIV.

Model 649A03

Bearing Fault Detector PLUS

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
Web: www.imi-sensors.com

Total Customer Satisfaction

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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:

PCB Piezotronics, Inc.
3425 Walden Ave.
Depew, NY 14043 USA
Toll-free: (800) 828-8840
24-hour SensorLine^{SM}: (716) 684-0001
Website: www.pcb.com
E-mail: info@pcb.com

IMI SENSORS
A PCB PIEZOTRONICS DIV.

649AX3 Series Industrial 4-20mA
Bearing Fault Detector PLUS

CE

Operating Guide with Enclosed Warranty Information

3425 Walden Avenue, Depew, New York 14043-2495

Phone (716) 684-0003

Fax (716) 684-3823

Toll Free Line 1-800-959-4IMI

Table of Contents

Warranty/Servicing

Introduction

The 649A03 Bearing Fault Detector PLUS 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.

Outputs

1. **True Peak Acceleration**

   Details: This is the highest acceleration value captured within the sampling window. The acceleration signal used for this output is high pass filtered at 250 Hz.

   Best Uses: This is the best and most commonly used method for early detection of bearing wear for fixed speed machinery. The peak capture and high pass filtering provide values that strongly correlate to the severity of cracks, spalling, or brinelling. The short pulse cause by these faults has low energy compared to the overall broadband vibration, and therefore would typically get lost in a traditional RMS measurement.

2. **RMS Acceleration**

   Details: This is the arithmetic average of all values captured within the sampling window. The acceleration signal used for this output is high pass filtered at 2500 Hz.

   Best Uses: RMS Acceleration can be used when it is preferred to run a bearing close to failure before raising an alarm. It is also helpful for processes which involve violent impacting and high amplitude short pulses that can transfer through the machinery to the bearing. Using the RMS Acceleration in this case avoids false trips caused by these high energy but short duration vibrations. The True Peak Acceleration output may increase greatly with one of these impacts, but the RMS Acceleration will not significantly increase.

3. **Crest Factor**

Details: This is the ratio of True Peak to RMS Acceleration. Therefore this value increases as the amplitude of high frequency impacts in the bearing increase compared to the amplitude of broadband overall vibration. The output is a unit-less severity scale from 1 to 16. Refer to *Table 1* for a guide that relates the output value to the bearing condition
The acceleration signals used for this output are high pass filtered at 250 Hz.

Best Uses: Crest Factor is better suited for variable speed machinery because the ratio of Peak to RMS acceleration should not vary much at different speeds. This is due to the fact that both will increase as speed increases; however, only True Peak Acceleration will increase if the fault severity increases in the early stages of bearing failure. Please note that once the bearing condition is poor enough, the fault vibrations will actually start to cause the RMS Acceleration value to increase, and therefore the Crest Factor starts to decrease as the condition gets worse. Trending this Crest Factor value can capture that decrease and still provide accurate awareness of the bearing condition. If you are not able to trend these values or would like a similar output that always increases as bearing condition worsens, consider using the Crest Factor + output described below.

4. **Compensated Peak Acceleration (Peak Acceleration with Correction)**

Details: This is a normalized ratio of the acceleration of impacts within the bearing to the linear speed of the rolling element passing over a defect. This uses the speed and diameter of the bearing that were programmed into the sensor to determine the linear velocity of the rolling element. The output is a unit-less severity scale from 1 to 16. Refer to *Table 1* for a guide that relates the output value to the bearing condition.
The acceleration signals used for this output are high pass filtered at 250 Hz.

Best Uses: Compensated Peak Acceleration is most helpful for when the user has various size and speed machinery for which they would like to monitor the rolling element bearings. By normalizing the output using the shock pulse method described above, the values will be similar for machines with the same bearing condition, even if these machines vary greatly in size and speed. Therefore a single alarm limit can be set in the control system for all monitored bearings across different pieces of machinery.

5. **Crest Factor +**

Details: This is similar to Crest Factor plus, but the output has been adjusted such that the value always increases as the bearing condition gets worse. This uses a sum of Crest Factor, RMS Acceleration, and True Peak Acceleration. These are weighted differently such that the sum of the three always increases as bearing condition gets worse, even if 1 value decreases. This primarily corrects for the fact that Crest Factor decreases when the fault is very severe. By adding RMS Acceleration into the equation, the decreasing Crest Factor is counteracted by the increasing RMS Acceleration as bearing condition is very poor. The output is a unit-less severity scale from 1 to 16. Refer to *Table 1* for a guide that relates the output value to the bearing condition. The acceleration signals used for this output are high pass filtered at 250 Hz.

Best Uses: Crest Factor + is best suited for variable speed machinery when trending is not possible or not desired. The value will always increase over the entire life cycle of the bearing as its condition worsens. This allows the user to simply set an alarm value for the severity scale and not worry about keeping historical data for trend monitoring.

Scaled Output (1-16)	Bearing Condition
1 to 5	Good
6 to 1	Satisfactory
12 to 15	Unsatisfactory
Above 15	Unacceptable

**Table 1 – Bearing Condition Guide for
Crest Factor, Compensated Peak Acceleration, and Crest Factor +**

The Bearing Fault Detector Plus 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 elbow 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

Installing the Software and USB Driver: Insert the software CD provided into the CD drive. The Software will start the installation automatically if your PC is set to auto-install applications. If not, browse the CD and click on Setup.exe, this will start the installation process. The default installation directory is C:\PCB\600A21 it is recommended to use the default setting.

The Installer will first install the PCB 600A21 Programmer Kit application and then the Silicon Labs USBXpress device driver. This device driver is required for the programmer software to communicate with the 070A89 USB dongle included in the programmer kit.

The following screens will be displayed when the installer starts. Click the Next button to proceed from step to step.
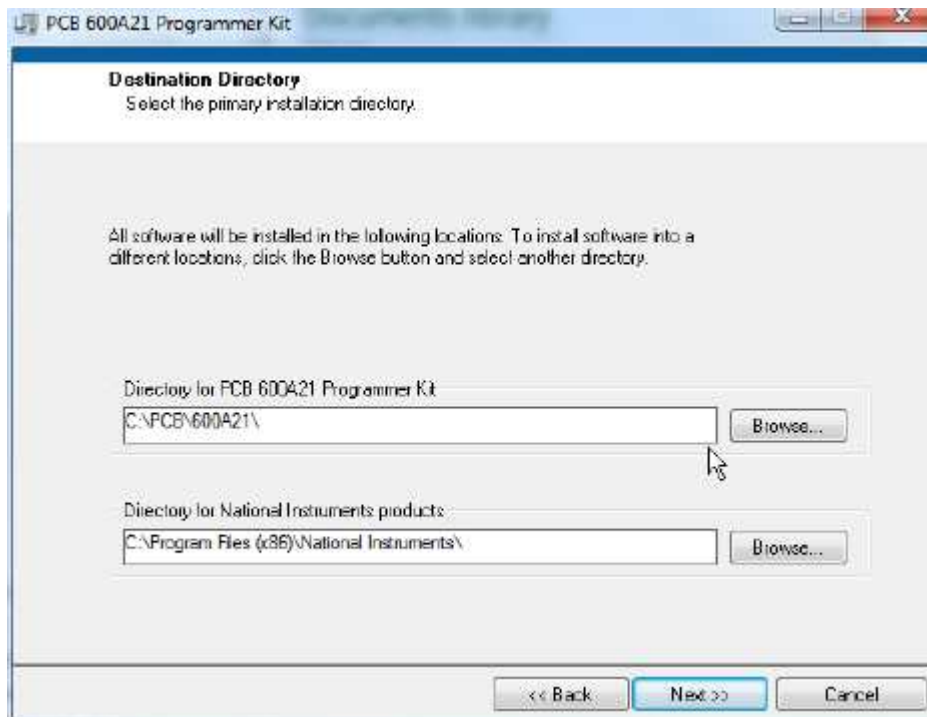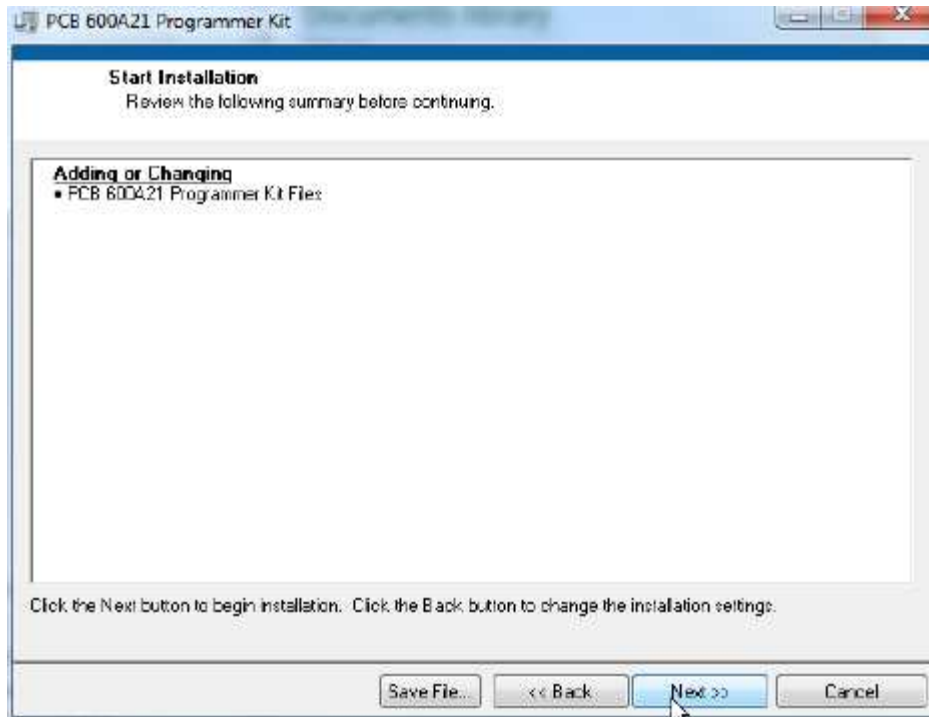

Figure 1 – 600A21 Install location screen

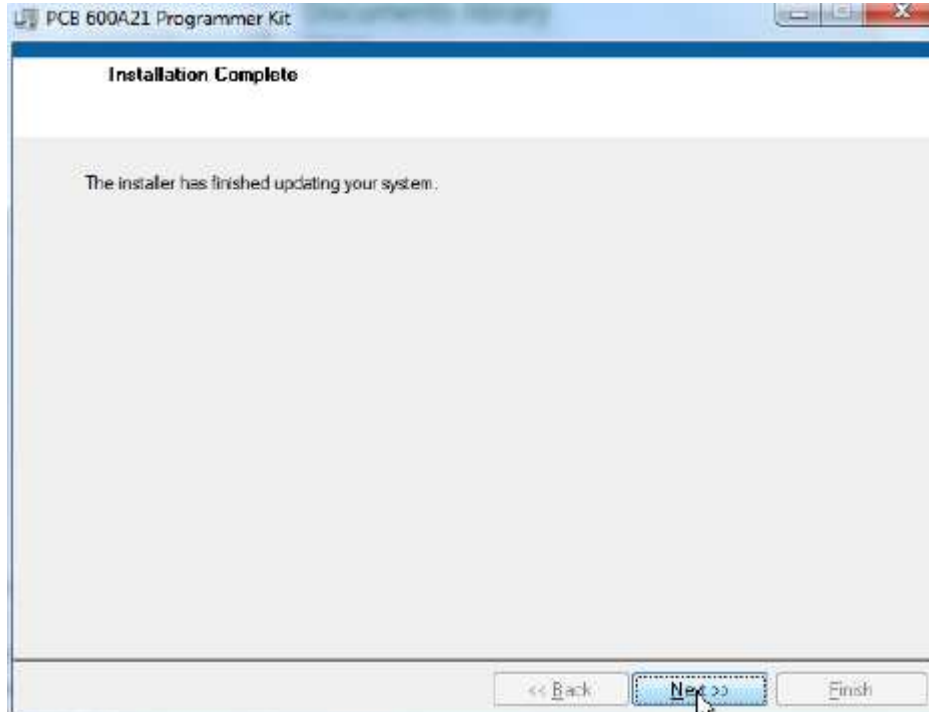**Figure 2 – 600A21 Installation verification screen**

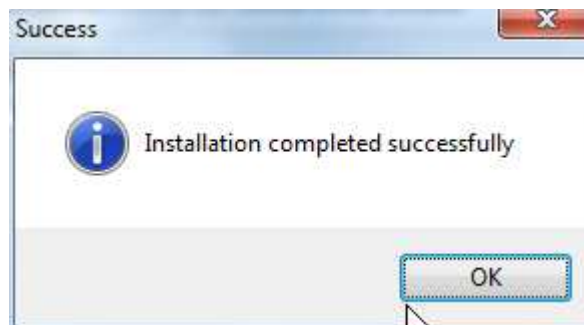**Figure 3 – 600A21 Installation complete screen**

After the 600A21 Programmer application installation completes the USB driver installer will start automatically. The initial USB installer will look similar to the one below.

Figure 4 – USBXpress driver installation screen

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

When the USB driver installation completes the following screen will be displayed.

Figure 4 – USBXpress driver installation complete screen

Running the 600A21 Software

Connect the 070A89 Dongle to a USB port on the PC and then run the 600A21 Programmer application from the **Start | All Programs | PCB 600A21** menu item

Initially the screen will appear as in **Error! Reference source not found.** with a yellow bar and status indicating 'Initializing…' followed by the message: "Connecting to USB Dongle…".
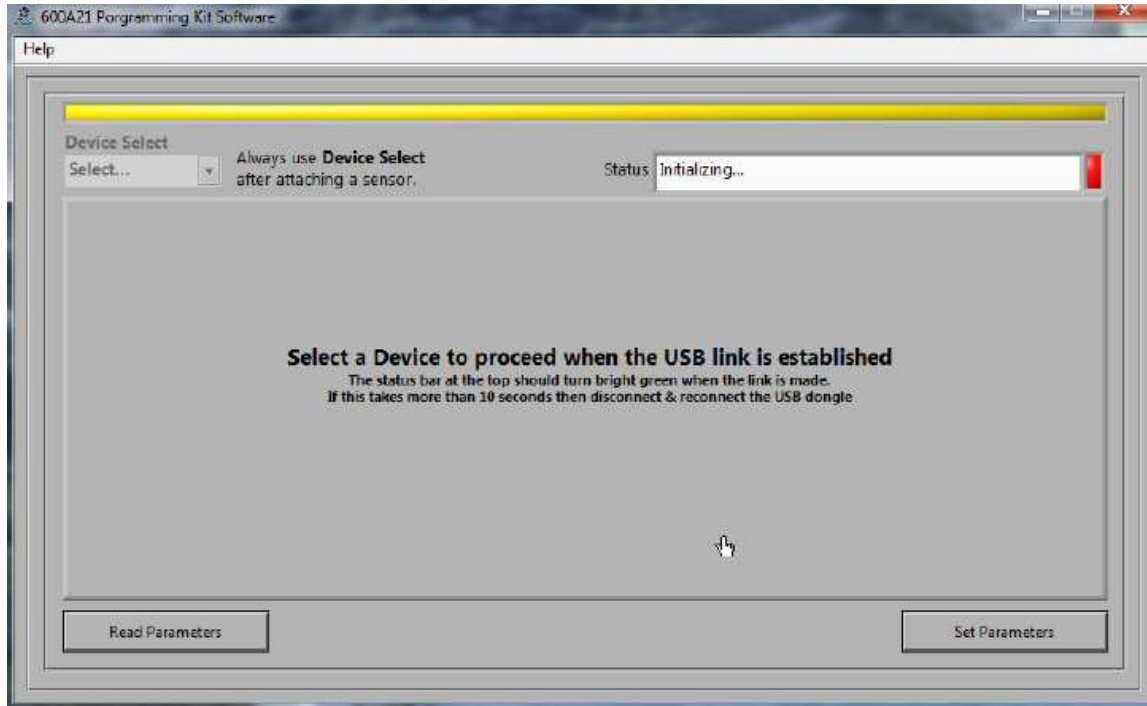

Figure 5 – 600A21 software without 070A89 USB dongle connection

Once the connection is made the bar at the top of the screen will turn green and the status will indicate "USB Connection Success - Select a device" (Figure 6). If the software and dongle fail to connect, remove and reinsert the USB dongle.
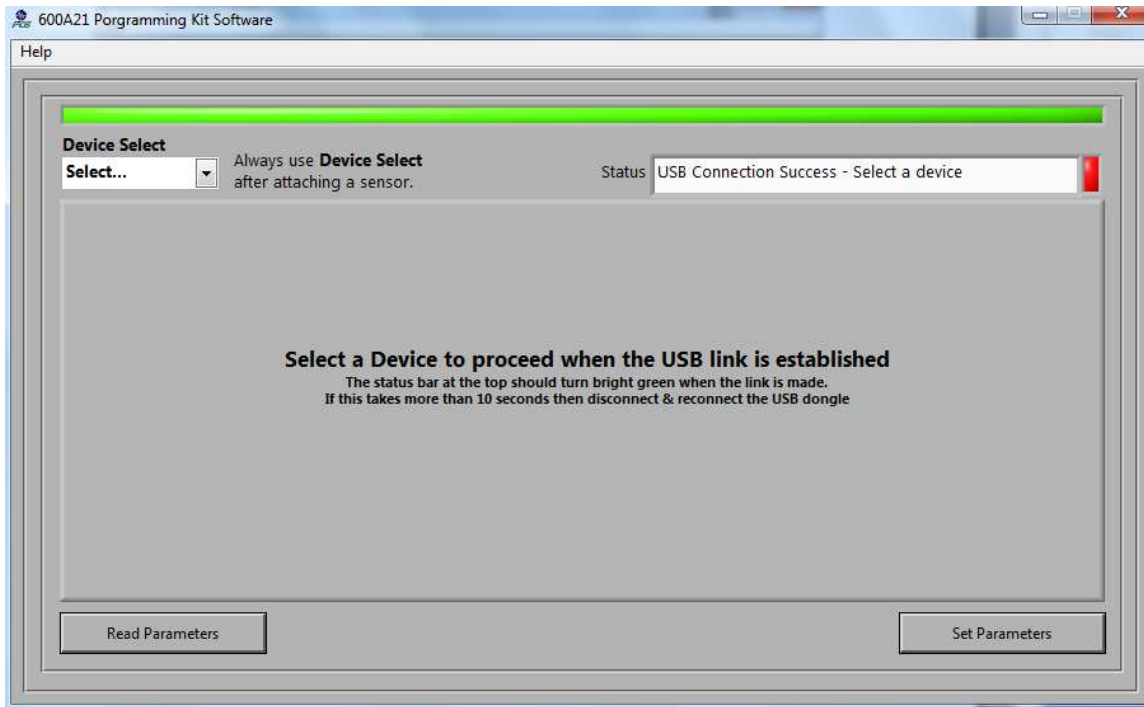
Figure 6 – 600A21 software with 070A89 USB dongle connection

To select a device click on the Device Select pull down menu (Figure 7) and select the device you'd like to program, in this case, 649A03.
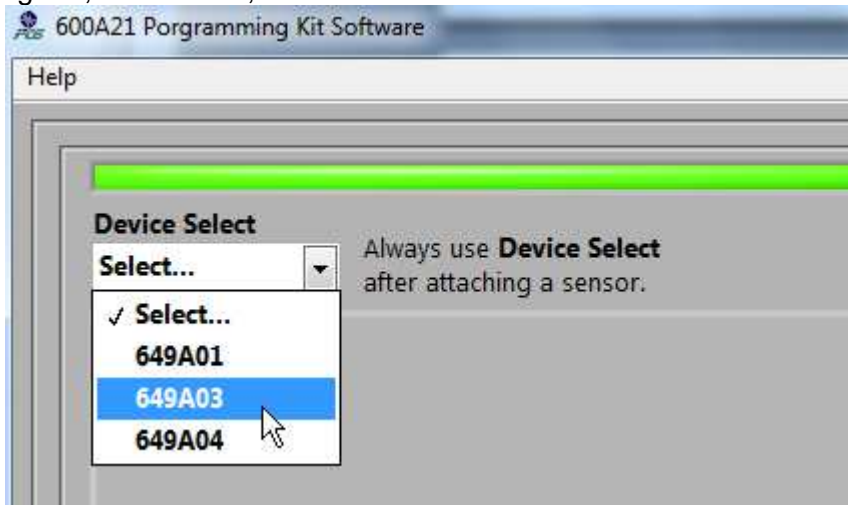

Figure 7 – 600A21 Device Selection

Once selected the software prompt you to connect the cable to the selected device. When the sensor is connected click OK to proceed. While the software is establishing communication with the sensor the status will display 'Checking Status…' and the colored indicator box next to the status will alternate between red and yellow, this will take ~15 seconds. Once communication is established the indicator box will turn green and the software will read the sensors current settings and data (**Error! Reference source not found.**). The fields presented in the main body of the screen will be specific to the selected sensor.

649A03 Setting & Data fields

The 649A03 screen has 3 sections;
- **649A03 Sensor Data** – This section, located on the left of the screen, displays the current vibration levels in g's Peak, g's RMS and HF g's RMS (2.5 kHz High pass filtered g's RMS)
- **Actual 649A03 Mode** – this section, in the middle of the screen, shows the Mode the sensor is currently programed to and any associated settings.
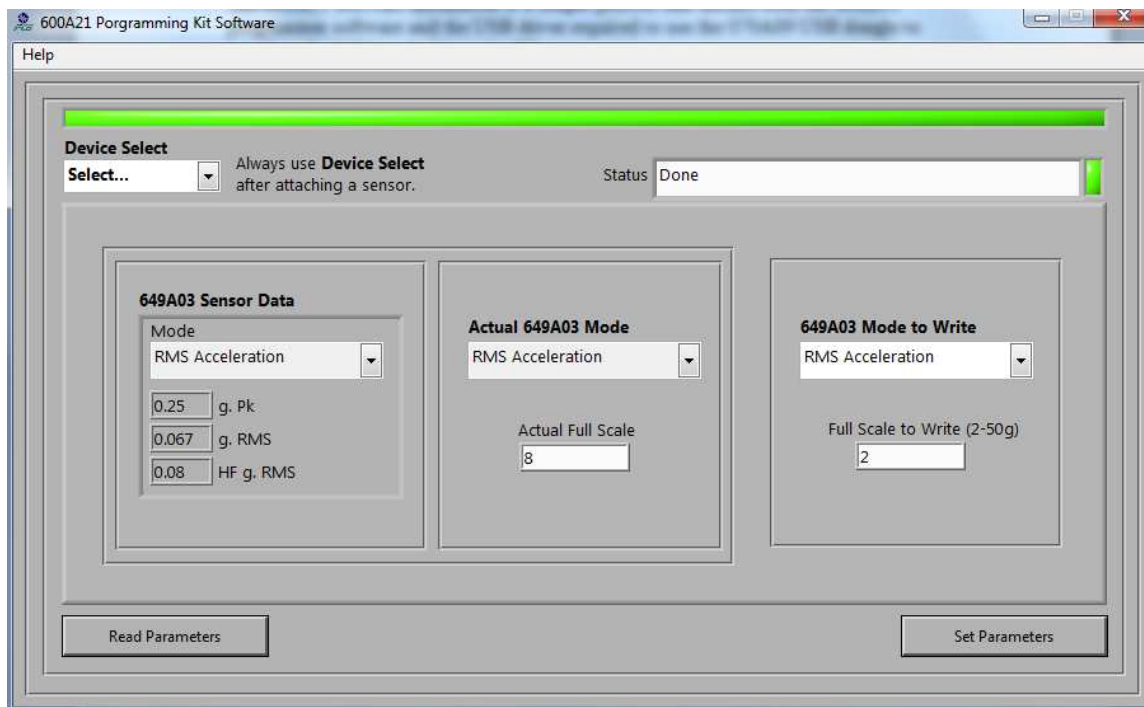- **649A03 Mode to Write** – this section, on the right, presents the options for programming the device.

Figure 9 – 600A21 649A03 Successful Parameter Read

Figure 8 displays the programming options which include settings for both constant and variable speed machinery.

Constant Speed Machinery options include:
- Peak Acceleration (True Peak of acceleration) - programmable full scale 2-50 g.
- RMS Acceleration (True RMS of acceleration) - programmable full scale 2-50 g.
- Peak Accel with Correction (Compensated Peak) - This is a modified shock pulse method for non-resonance measurements. This selection will call for the user to enter the bearing diameter and the rotation speed.

Variable Speed Machinery options include:
- Crest Factor - This is the ratio of Acceleration peak and Acceleration RMS and is represented as sensor output in mA equal to the CF.
- Crest Factor Plus – This is a combination of Peak, RMS and Crest Factor. It is a technology for improving bearing defect detection on variable speed machinery.
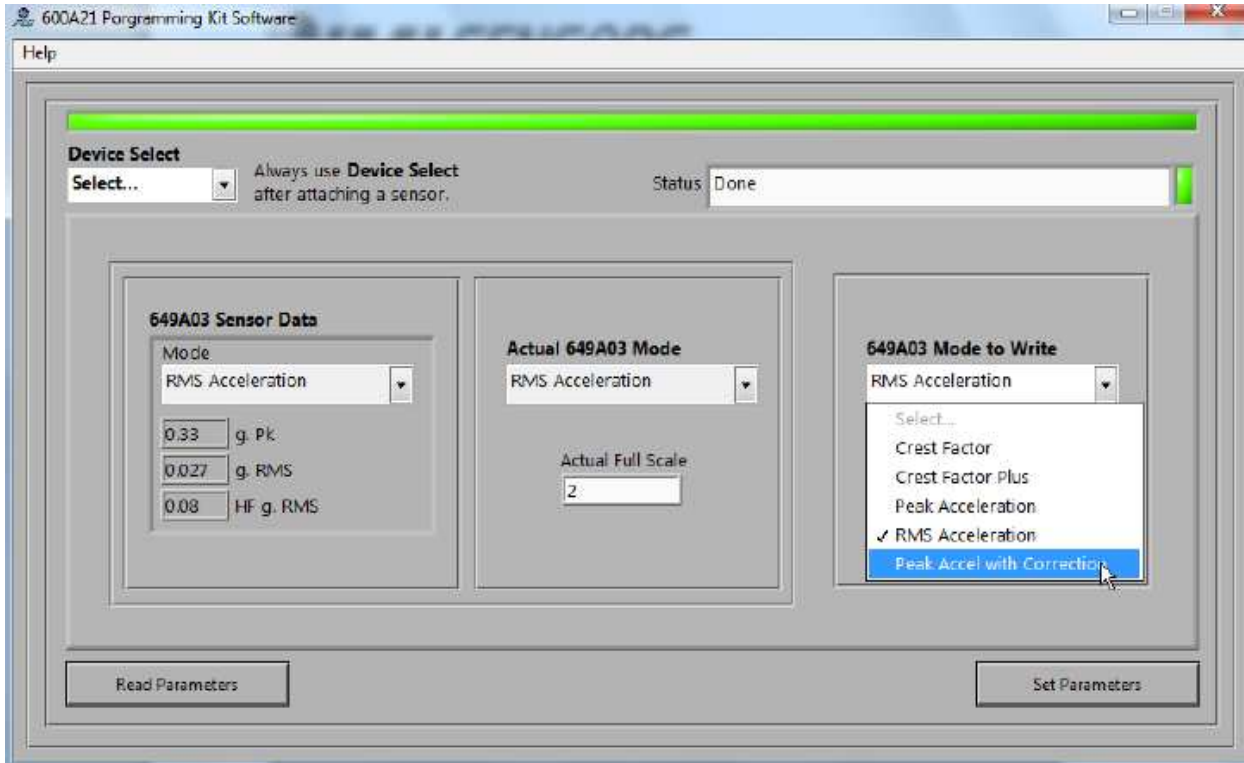
Figure 8 –649A03 Mode Selection

Menu Bar Items

The menu bar has 1 item, **Help**, which has 2 sub-items;
- **Log Communication** – selecting this option creates the text file **600A21 Comms.txt** in the same directory where the application is located. This file will be helpful to PCB technical support if communication problems occur.
- **About**… Selection this option causes a dialog box to appear with the software application version information.

Setting and Reading Settings

To set the sensor settings do the following:
- Select the mode (Figure 8) using the 649A03 Mode to Write field
- Enter any parameters required for the selected mode (Figure 9)
    - full scale for Peak or RMS Acceleration
    - bearing diameter and the rotation speed for Peak Accel with correction
- Click the **Set Parameters** button – This causes the settings to be sent to the sensor and then read back and displayed in the Actual 649A03 indicators. The 649A03 Sensor Date indicators are also updated after this action.

To Read the current sensor setting and data click the **Read Parameters** button

Note: These operations take ~45 seconds.
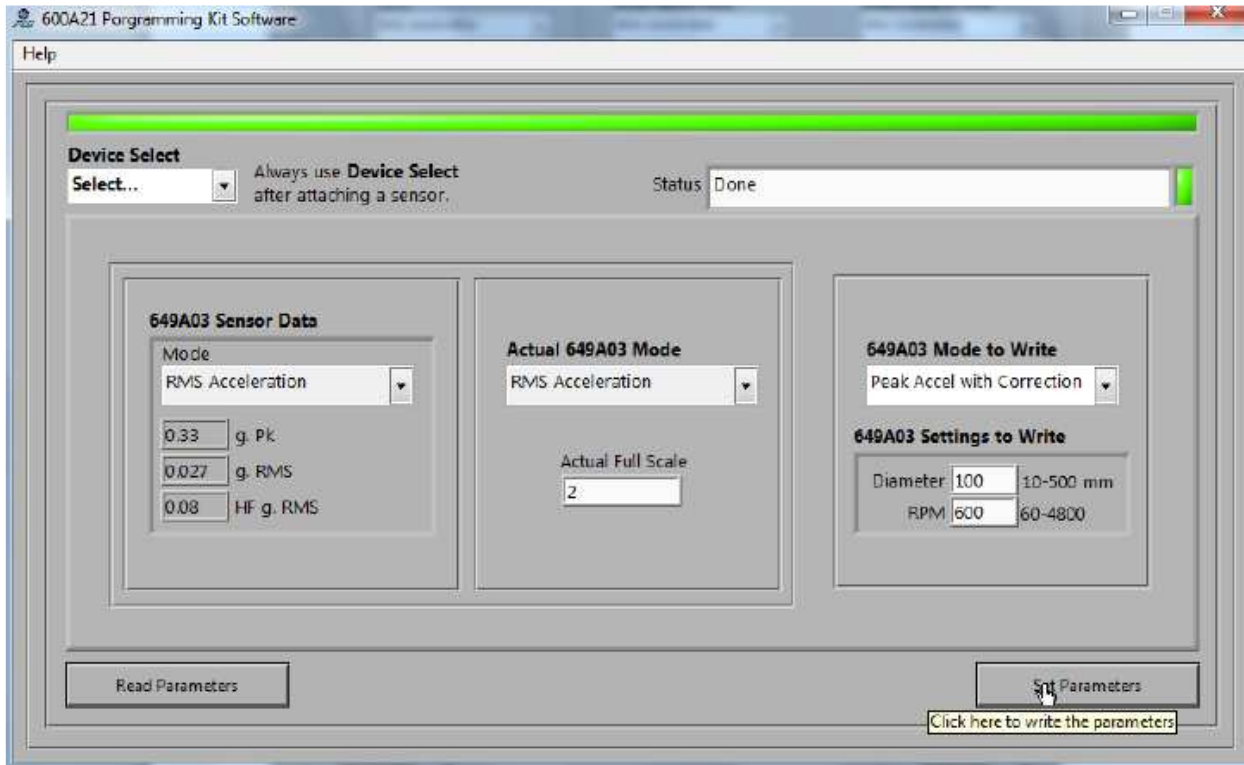
Figure 9 –649A03 Peak Acceleration with Correction Mode Parameters

Figure 10 shows the 649A03 screen after setting new parameters.

Figure 10 –649A03 Peak Acceleration with Correction Mode after Parameters are set
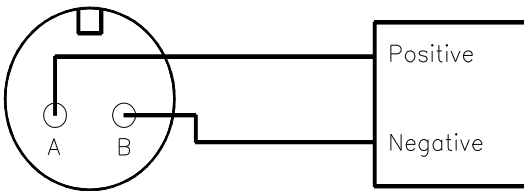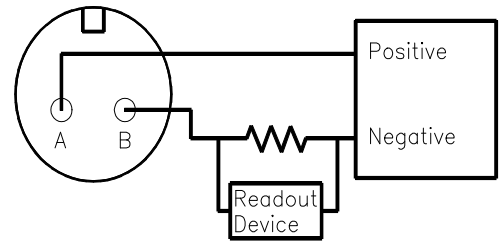
Operation and Wiring

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:
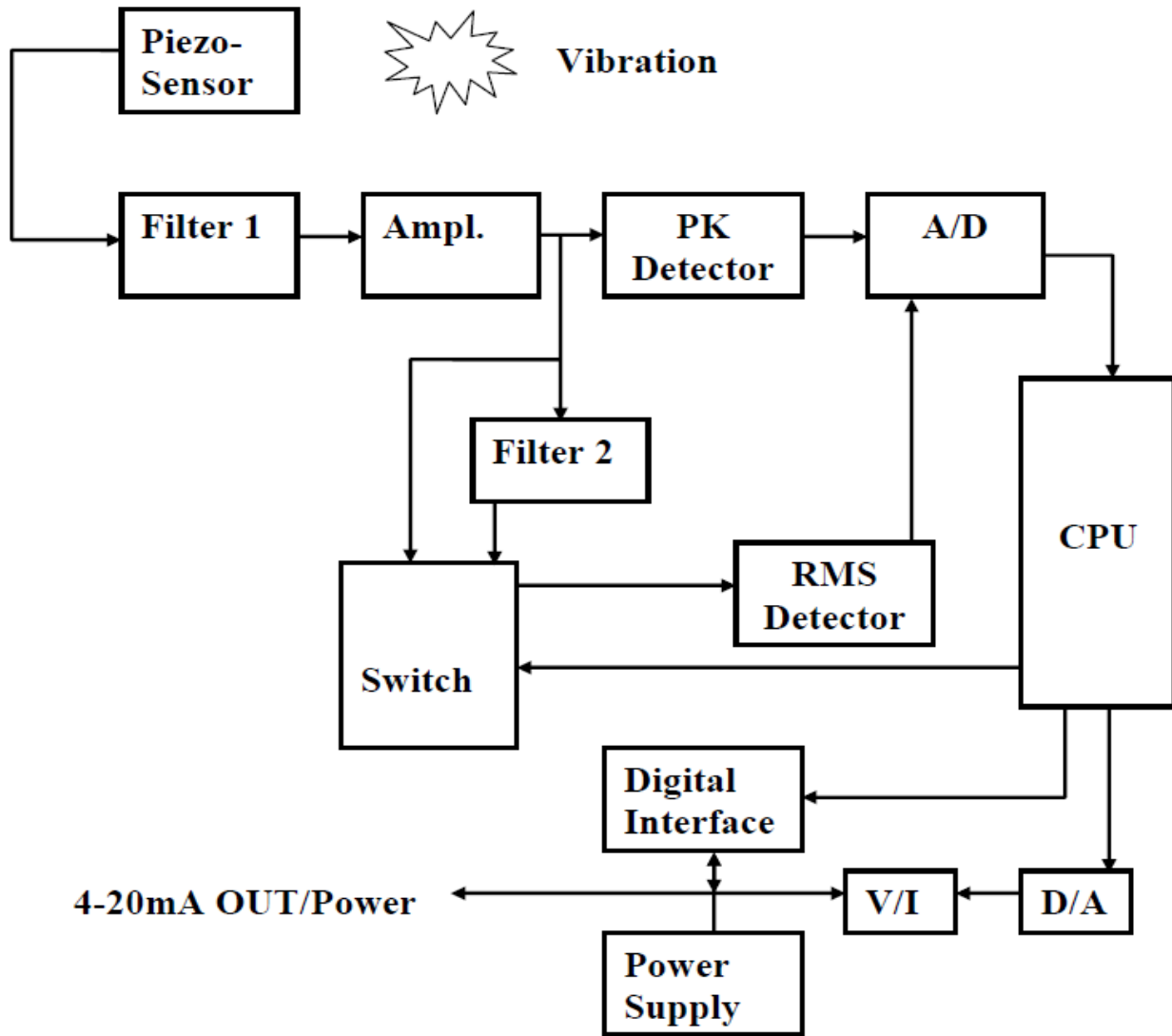
$$V = IR$$

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

Note:

- Resistor value must be less than: (Vsupply – 12) x 50.

- For integral cable sensors: RED wire is positive, BLUE wire is negative.

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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. Stud mounting is highly recommended for model 649A03 since it has a frequency response upwards of 10 kHz and most of the output signals are directly related to High Frequency Energy.

Note: For a complete list of product specifications, see the "Specification Sheet" and "Outline Drawing" at the end of this Manual

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
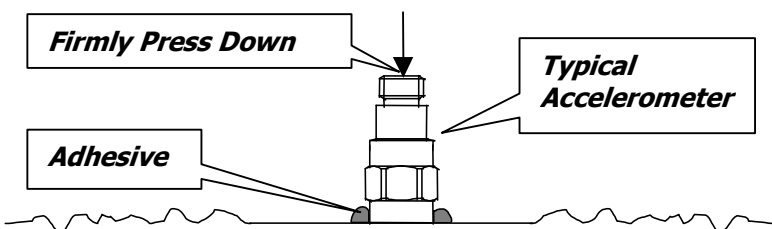
Standard Stud Mount Procedure

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
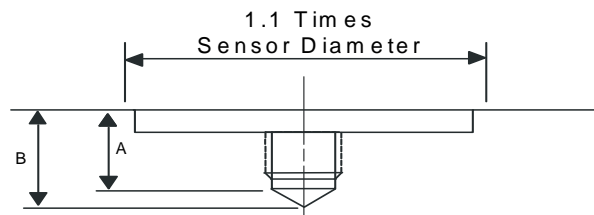
STEP 1 *First*, prepare a smooth, flat mounting surface, and then drill and tap a mounting hole in the center of this area as shown in Figure 6. A precision-machined mounting surface with a minimum finish of 63 µin [0,00016 mm] is recommended. (If it is not possible to properly prepare the machine surface, 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
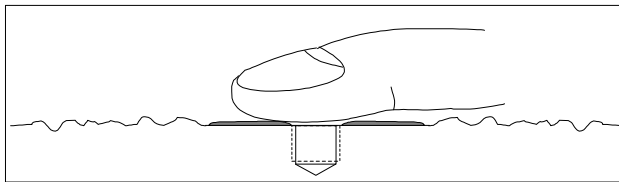
Adding a coupling fluid improves vibration transmissibility by filling small voids in the mounting surface and increasing the mounting stiffness. For semi-permanent mounting, substitute epoxy or another type of adhesive.

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
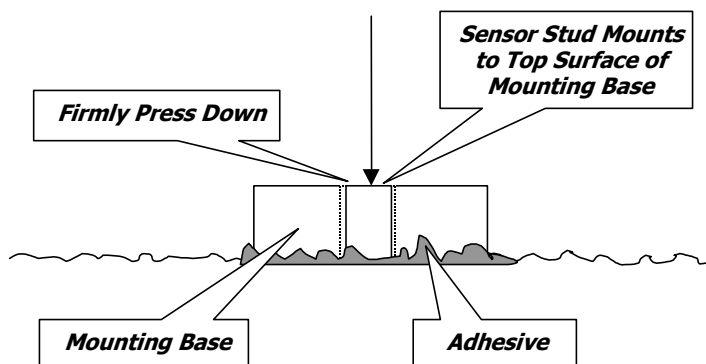
Magnetic Mount Procedure

Magnetic mounting provides a convenient means for making portable measurements and is commonly used for machinery monitoring and other portable or trending applications.
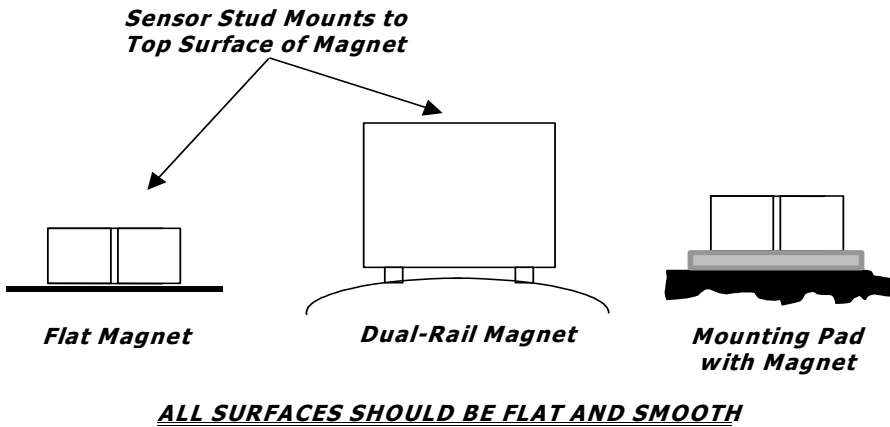
Note: The correct magnet choice and an adequately prepared mounting surface is critical for obtaining reliable measurements, especially at high frequencies. Poor installations can cause as much as a 50% drop in the sensor frequency range.

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

Sensor Stud Mounts to Top Surface of Magnet

Flat Magnet   **Dual-Rail Magnet**   **Mounting Pad with Magnet**

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.
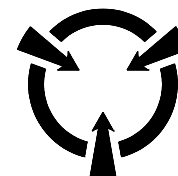
Caution 1 – ESD sensitivity

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:

CAUTION
ELECTROSTATIC
DISCHARGE SENSITIVE

- *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.

Model Number **649A03**	**BEARING FAULT DETECTOR PLUS**	Revision: C
		ECN #: 42229

Performance	ENGLISH	SI	
Output(Loop power)	4-20 mA	4-20 mA	
Sampling Time	1 sec	1 sec	
Measurement Range(HPF 250 Hz)	0-2 to 0-50 g pk	0-2 to 0-50 g pk	[1][2]
Measurement Range(HPF 2500 Hz)	0-2 to 0-50 RMS	0-2 to 0-50 RMS	[1][2]
Compensated Peak(HPF 250 Hz)	1 to 16	1 to 16	
Crest Factor(HPF 250 Hz)	1 to 16	1 to 16	[1]
Crest Factor Plus(HPF 250 Hz)	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	5.7 oz	162 gm	[3]
Mounting Thread	1/4 - 28 UNF	1/4 - 28 UNF	
Mounting Torque	3 to 5 ft-lb	4 to 7 Nm	
Sensing Element	Piezoelectric Accelerometer	Piezoelectric Accelerometer	
Housing Material	Stainless Steel	Stainless Steel	
Sealing	Welded Hermetic	Welded Hermetic	
Electrical Connector	2-Pin MIL-C-5015	2-Pin MIL-C-5015	
Electrical Connection Position	Top	Top	
Electrical Connections(Pin A)	4-20 mA Pos (+)	4-20 mA Pos (+)	
Electrical Connections(Pin B)	4-20 mA Neg (-)	4-20 mA Neg (-)	
Overload Limit (Shock)	5000 g pk	49,050 m/s² pk	

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] Typical.
[4] See PCB Declaration of Conformance PS124 for details.

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

Entered: AP	Engineer: LAB	Sales: SA	Approved: NJF	Spec Number:
Date: 1/14/2014	Date: 1/14/2014	Date: 1/14/2014	Date: 1/14/2014	**45609**

CE [4]

All specifications are at room temperature unless otherwise specified.
In the interest of constant product improvement, we reserve the right to change specifications without notice.

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

Phone: 800-959-4464
Fax: 716-684-3823
E-Mail: imi@pcb.com

REVISIONS

REV	DESCRIPTION	DIN
B	TITLE WAS: BEARING FAULT PROTECTOR	42229

1.25 [31.8] HEX
Ø1.34 [34.1]
ACROSS CORNERS

PINS ARE BI-POLAR

MIL-C-5015 CONNECTOR
2 PIN RECEPTACLE

Ø1.24 [31.5]

2.6 [66]

1.87 [47.5]

.80 [20.3]

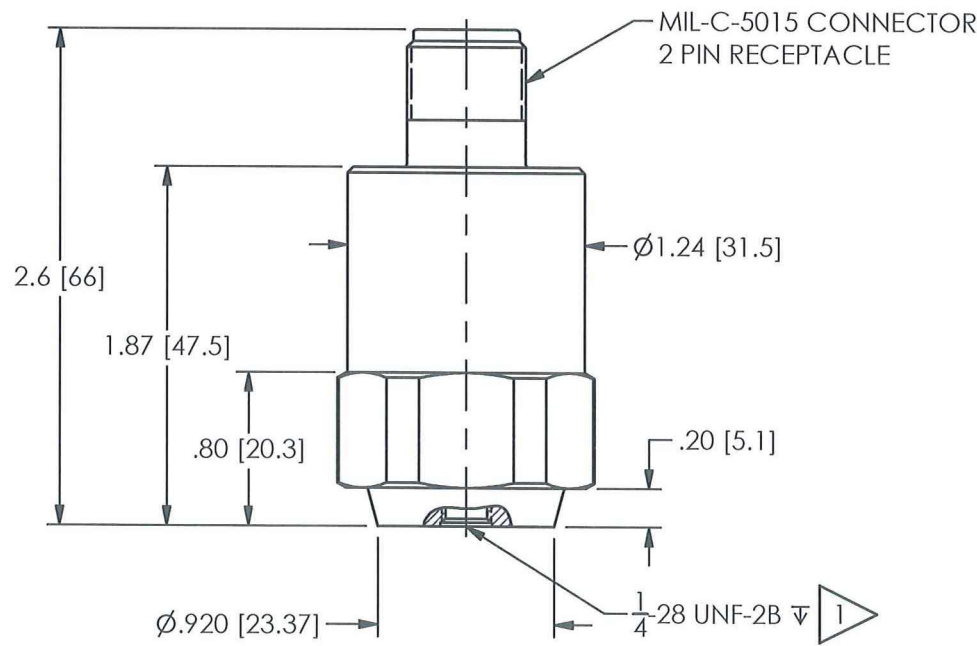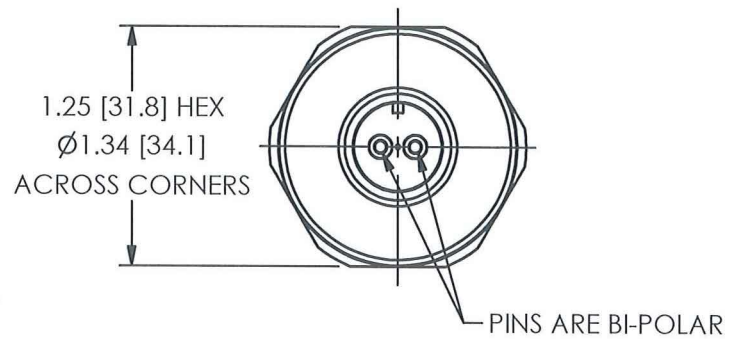.20 [5.1]

Ø.920 [23.37]

$\frac{1}{4}$-28 UNF-2B ▽ ⟩1⟩

⟩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]	AF	1/9/14	AF	1/9/14	LAB	1/9/14
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						

TITLE

OUTLINE DRAWING
MODEL 649A03
BEARING FAULT DETECTOR PLUS

PCB PIEZOTRONICS
3425 WALDEN AVE. DEPEW, NY 14043
(716) 684-0001 E-MAIL: sales@pcb.com

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