



Model TLD288D01
Mechanical Impedance Sensor
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



Repair and Maintenance

PCB guarantees Total Customer Satisfaction through its “Lifetime Warranty Plus” on all Platinum Stock Products sold by PCB and through its limited warranties on all other PCB Stock, Standard and Special products. Due to the sophisticated nature of our sensors and associated instrumentation, **field servicing and repair is not recommended and, if attempted, will void the factory warranty.**

Beyond routine calibration and battery replacements where applicable, our products require no user maintenance. Clean electrical connectors, housings, and mounting surfaces with solutions and techniques that will not harm the material of construction. Observe caution when using liquids near devices that are not hermetically sealed. Such devices should only be wiped with a dampened cloth—never saturated or submerged.

In the event that equipment becomes damaged or ceases to operate, our Application Engineers are here to support your troubleshooting efforts 24 hours a day, 7 days a week. Call or email with model and serial number as well as a brief description of the problem.

Calibration

Routine calibration of sensors and associated instrumentation is necessary to maintain measurement accuracy. We recommend calibrating on an annual basis, after exposure to any extreme environmental influence, or prior to any critical test.

PCB Piezotronics is an ISO-9001 certified company whose calibration services are accredited by A2LA to ISO/IEC 17025, with full traceability to SI through N.I.S.T. In addition to our standard calibration services, we also offer specialized tests, including: sensitivity at elevated or cryogenic temperatures, phase response, extended high or low frequency response, extended range, leak testing, hydrostatic pressure testing, and others. For more information, contact your local PCB Piezotronics distributor, sales representative, or factory customer service representative.

Returning Equipment

If factory repair is required, our representatives will provide you with a Return Material Authorization (RMA) number, which we use to reference any information you have already provided and expedite the repair process. This number should be clearly marked on the outside of all returned package(s) and on any packing list(s) accompanying the shipment.

Contact Information

PCB Piezotronics, Inc.
3425 Walden Ave.
Depew, NY14043 USA
Toll-free: (800) 828-8840
24-hour SensorLine: (716) 684-0001
General inquiries: info@pcb.com
Repair inquiries: rma@pcb.com

For a complete list of distributors, global offices and sales representatives, visit our website, www.pcb.com.

Safety Considerations

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the precautions required to avoid injury. While our equipment is designed with user safety in mind, the protection provided by the equipment may be impaired if equipment is used in a manner not specified by this manual.

Discontinue use and contact our 24-Hour Sensorline if:

- Assistance is needed to safely operate equipment
- Damage is visible or suspected
- Equipment fails or malfunctions

For complete equipment ratings, refer to the enclosed specification sheet for your product.

Definition of Terms and Symbols

The following symbols may be used in this manual:



DANGER

Indicates an immediate hazardous situation, which, if not avoided, may result in death or serious injury.

**CAUTION**

Refers to hazards that could damage the instrument.

**NOTE**

Indicates tips, recommendations and important information. The notes simplify processes and contain additional information on particular operating steps.

The following symbols may be found on the equipment described in this manual:



This symbol on the unit indicates that high voltage may be present. Use standard safety precautions to avoid personal contact with this voltage.



This symbol on the unit indicates that the user should refer to the operating instructions located in the manual.



This symbol indicates safety, earth ground.



PCB工业监视和测量设备 - 中国RoHS2公布表

PCB Industrial Monitoring and Measuring Equipment - China RoHS 2 Disclosure Table

部件名称	有害物质					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
住房	0	0	0	0	0	0
PCB板	X	0	0	0	0	0
电气连接器	0	0	0	0	0	0
压电晶体	X	0	0	0	0	0
环氧	0	0	0	0	0	0
铁氟龙	0	0	0	0	0	0
电子	0	0	0	0	0	0
厚膜基板	0	0	X	0	0	0
电线	0	0	0	0	0	0
电缆	X	0	0	0	0	0
塑料	0	0	0	0	0	0
焊接	X	0	0	0	0	0
铜合金/黄铜	X	0	0	0	0	0
本表格依据 SJ/T 11364 的规定编制。						
0：表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。						
X：表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。						
铅是欧洲RoHS指令2011/65/ EU附件三和附件四目前由于允许的豁免。						

CHINA RoHS COMPLIANCE

Component Name	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Chromium VI Compounds (Cr(VI))	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
Housing	O	O	O	O	O	O
PCB Board	X	O	O	O	O	O
Electrical Connectors	O	O	O	O	O	O
Piezoelectric Crystals	X	O	O	O	O	O
Epoxy	O	O	O	O	O	O
Teflon	O	O	O	O	O	O
Electronics	O	O	O	O	O	O
Thick Film Substrate	O	O	X	O	O	O
Wires	O	O	O	O	O	O
Cables	X	O	O	O	O	O
Plastic	O	O	O	O	O	O
Solder	X	O	O	O	O	O
Copper Alloy/Brass	X	O	O	O	O	O

This table is prepared in accordance with the provisions of SJ/T 11364.

O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

X: Indicates that said hazardous substance contained in at least one of the homogeneous materials for this part is above the limit requirement of GB/T 26572.

Lead is present due to allowed exemption in Annex III or Annex IV of the European RoHS Directive 2011/65/EU.

Table of Contents

Model 288D01

Table of Contents/Appendix	i
1.0 Introduction	1
2.0 Description	1
3.0 Installation	1
4.0 Operation	1
5.0 Maintenance and Repair	1

Appendix

General Operating Guide for use with Piezoelectric ICP® Accelerometers
(Installation, Mounting, Cabling)

Specification Sheet

Installation Drawing

General Signal Conditioning Guide
(Voltage/Charge Amplifiers, Transducer Powering, Cable Driving, Low-Frequency Response)

Supplement to Mounting Accelerometers

Standard Cables

Accessories

Prefix Guide

Warranty, Calibration and Service

Certificate for Free Stinger

Excitation Stinger Data Sheet

Quick Mount Adhesive Kit Data Sheet

Supplied Accessories

Model 081B05 Mounting Stud (2)

Model 080A Adhesive Mounting Base (1)

NIST-Traceable Calibration Certificate

1.0 Introduction

Mechanical structures characteristically transfer motion and force; their product is defined as mechanical energy. By imparting motion and force to a specimen through the impedance head (also known as a driving point sensor) and evaluating the data, a better understanding of the behavior of the test object is achieved.

The term “mechanical impedance” is quite important in analyzing structures and is generally defined as Force divided by Velocity:

$$\text{Mechanical Impedance} = \frac{\text{Force}}{\text{Velocity}}$$

More commonly, however, the input force-to-output motion relationship is viewed at driving points as Acceleration divided by Force. This is properly defined as an inertance frequency response function.

Connection between a stinger or shaker armature and the test specimen is made via the 10-32 tapped holes provided at either end of the Model 288D01.

2.0 Description

Refer to the Installation Drawing provided in this manual for the exact dimensions of the Model 288D01. This unit is designed to maximize stiffness and natural frequency and to minimize mass compensation, cross talk, and transverse sensitivity. The impedance head is engineered to minimize the strain sensitivity of the accelerometer and to reduce the acceleration sensitivity of the force gauge.

The built-in microelectronic amplifiers convert the high-impedance signals generated by the quartz-element force gauge and the ceramic-element accelerometer to low-impedance voltage signals.

If you wish to learn more about sensors with built-in microelectronic circuitry, known as ICP® sensors, consult PCB’s “General Operating Guide for use with Piezoelectric ICP® Accelerometers,” a brochure (included in this manual) outlining the technical specifics associated with piezoelectric sensors. Topics covered include charge versus voltage mode systems, sensor time constants, effect of discharge time constant on low frequency response, and power requirements.

3.0 Installation

For details regarding mounting hole preparation and other installation guidance, consult the Installation Drawing provided in this manual.

It is important to make certain that the mating surfaces at both ends of the Model 288D01 are very flat. While ground surfaces are preferable, satisfactory surfaces may be obtained by other machining techniques, such as turning, milling and spotfacing.

The clearly labeled end of the force sensor should be attached to the test object. Usually, the driving point sensor is connected to the test structure through an adhesive mounting base. The base is typically bonded with an extremely stiff “dental cement” type adhesive. If the sensor is stud mounted, however, tighten to the recommended mounting torque as listed on the Installation Drawing.

NOTE: Ensure that the Model 288D01 is installed properly with the connector end attaching to the stinger. This is unlike the previous versions of impedance heads (Model 288B01 and earlier), which were installed with the connectors closest to the structure interface.

Connect the stinger or shaker armature to the other end. A stinger is a thin, flexible rod that helps ensure that only uniaxial force is applied to the test structure. For more information on stingers, refer to the Excitation Stinger Data Sheet included in this manual.

Caution

When torquing on the sensor, be careful not to damage the connectors with the torque wrench.

NOTE: To avoid any phase shift between force and reference acceleration at higher frequencies, provide a rigid mount between the sensor and the test structure by using a stud or suitably stiff adhesive.

4.0 Operation

Connect the force and acceleration connectors to the respective ICP® signal conditioners using Model 002A Coaxial Cable (or its equivalent). Check to ensure that cable connections are tight.

Most PCB signal conditioners employ a fault-monitoring voltmeter incorporated into the front panel to monitor sensor bias voltage. Normal operation of sensor amplifiers is indicated by a mid-scale reading on this meter.



The outputs of the signal conditioners may be connected directly to the analyzer since the output impedance of the sensor is less than 250 ohms.

5.0 Maintenance and Repair

The sealed construction of the Model 288D01 precludes field maintenance. Should problems occur, contact the factory for instructions on returning the unit for repair or replacement.

MANUAL NUMBER: 18296

MANUAL REVISION: NR

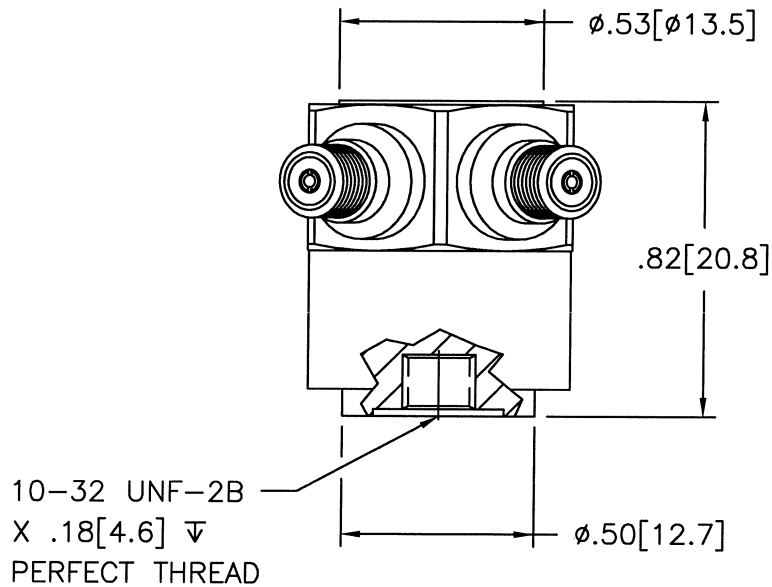
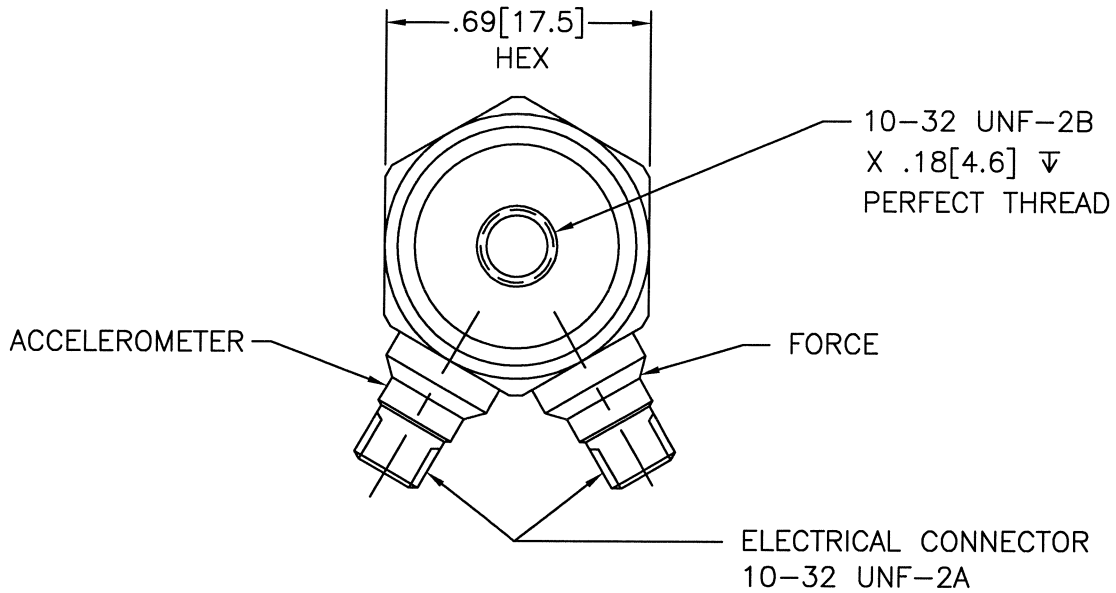
Model Number 288D01		MECHANICAL IMPEDANCE SENSOR		Revision: J ECN #: 47357											
Performance				OPTIONAL VERSIONS											
Sensitivity(± 10 %)(Acceleration)	ENGLISH 100 mV/g	SI 10.2 mV/(m/s ²)		Optional versions have identical specifications and accessories as listed for the standard model except where noted below. More than one option may be used.											
Sensitivity(± 10 %)(Force)	100 mV/lb	22.4 mV/N		TLA - TEDS LMS International - Free Format											
Measurement Range(Acceleration)	± 50 g pk	± 490.5 m/s ² pk		TLB - TEDS LMS International - Automotive Format											
Measurement Range(Force)	± 50 lbf pk	± 222.4 N pk		TLC - TEDS LMS International - Aeronautical Format											
Frequency Range(± 5 %)(Acceleration)	1 to 5000 Hz	1 to 5000 Hz		TLD - TEDS Capable of Digital Memory and Communication Compliant with IEEE 1451.4											
Frequency Range(± 10 %)(Acceleration)	0.7 to 7000 Hz	0.7 to 7000 Hz		Output Bias Voltage	8 to 15 VDC 8 to 15 VDC										
Rise Time(Force)	<10 µ sec	<10 µ sec	[1]												
Resonant Frequency(Mounted)	≥ 20 kHz	≥ 20 kHz													
Resonant Frequency(Unmounted; no load)	>40 kHz	>40 kHz													
Phase Response(± 5 °)	4 to 5000 Hz	4 to 5000 Hz													
Broadband Resolution(1 to 10,000 Hz)	0.002 g rms	0.02 m/s ² rms	[1]												
Broadband Resolution	0.002 lb	0.0089 N	[1]												
Non-Linearity	± 1 %	± 1 %	[2]												
Transverse Sensitivity(to Acceleration)	≤ 5 %	≤ 5 %													
Maximum Force	500 lb	2224 N													
Environmental															
Temperature Range(Operating)	-15 to +200 °F	-26 to +95 °C													
Temperature Response(on Acceleration)	≤ 0.05 %/°F	≤ 0.09 %/°C	[1]												
Temperature Response(on Force)	≤ 0.03 %/°F	≤ 0.05 %/°C	[1]												
Base Strain Sensitivity	≤ 0.0007 g/µε	≤ 0.007 (m/s ²)/µε	[1]												
Maximum Shock	3000 g pk	29,430 m/s ² pk		NOTES:											
Electrical				[1] Typical.											
Excitation Voltage	22 to 30 VDC	22 to 30 VDC		[2] Zero-based, least-squares, straight line method.											
Constant Current Excitation	2 to 20 mA	2 to 20 mA		[3] See PCB Declaration of Conformance PS023 for details.											
Discharge Time Constant(Acceleration)	0.4 to 1.5 sec	0.4 to 1.5 sec													
Discharge Time Constant(Force)	≥ 60 sec	≥ 60 sec													
Output Bias Voltage	8 to 14 VDC	8 to 14 VDC													
Output Impedance	<250 Ohm	<250 Ohm													
Output Polarity(Acceleration)	Positive	Positive													
Output Polarity(Force)	Positive	Positive													
Spectral Noise(1 Hz)	200 µg/√Hz	1962 (µm/sec ²)/√Hz	[1]												
Spectral Noise(10 Hz)	50 µg/√Hz	490.5 (µm/sec ²)/√Hz	[1]												
Spectral Noise(100 Hz)	10 µg/√Hz	98.1 (µm/sec ²)/√Hz	[1]												
Spectral Noise(1 kHz)	3 µg/√Hz	29.4 (µm/sec ²)/√Hz	[1]												
Physical															
Sensing Element(Acceleration)	Ceramic	Ceramic													
Sensing Element(Force)	Quartz	Quartz													
Sensing Geometry(Acceleration)	Shear	Shear													
Sensing Geometry(Force)	Compression	Compression													
Housing Material	Titanium	Titanium													
Sealing	Welded Hermetic	Welded Hermetic													
Size (Hex x Height)	11/16 in x 0.820 in	11/16 in x 20.83 mm													
Weight	0.68 oz	19.2 gm	[1]												
Electrical Connector(Acceleration)	10-32 Coaxial Jack	10-32 Coaxial Jack		SUPPLIED ACCESSORIES:											
Electrical Connector(Force)	10-32 Coaxial Jack	10-32 Coaxial Jack		Model 080A Adhesive Mounting Base (1)											
Mounting Thread(both ends)	10-32 Female	10-32 Female		Model 081B05 Mounting Stud (10-32 to 10-32) (2)											
Mounting Torque	10 to 20 in-lb	1.1 to 2.2 Nm		Model HCS-3 NIST Traceable Calibration of Series 288 impedance head (1)											
End Plate Mass(Force)	0.16 oz	4.8 gm	[1]	Model M081B05 Mounting Stud 10-32 to M6 X 0.75 (2)											
Stiffness	2.0 lb/µin	0.35 kN/µm	[1]												
<table border="1" style="width:100%"> <tr> <td>Entered: LK</td> <td>Engineer: BAM</td> <td>Sales: KWW</td> <td>Approved: BAM</td> <td>Spec Number:</td> </tr> <tr> <td>Date: 10/16/2017</td> <td>Date: 10/16/2017</td> <td>Date: 10/16/2017</td> <td>Date: 10/16/2017</td> <td>6084</td> </tr> </table>						Entered: LK	Engineer: BAM	Sales: KWW	Approved: BAM	Spec Number:	Date: 10/16/2017	Date: 10/16/2017	Date: 10/16/2017	Date: 10/16/2017	6084
Entered: LK	Engineer: BAM	Sales: KWW	Approved: BAM	Spec Number:											
Date: 10/16/2017	Date: 10/16/2017	Date: 10/16/2017	Date: 10/16/2017	6084											
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 30%;">  <p>All specifications are at room temperature unless otherwise specified. In the interest of constant product improvement, we reserve the right to change specifications without notice. ICP® is a registered trademark of PCB Group, Inc.</p> </div> <div style="width: 40%; text-align: center;">  <p>3425 Walden Avenue, Depew, NY 14043</p> </div> <div style="width: 20%; text-align: right;"> <p>Phone: 716-684-0001 Fax: 716-684-0987 E-Mail: info@pcb.com</p> </div> </div>															

6082

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APPLICATION		
NEXT ASS'Y	USED ON	VAR

REVISIONS				
REV	DESCRIPTION	ECN	DATE	APP'D
C	REVISED PER ECN	14696	2/8/02	DM2/05
D	REVISED PER ECN	22111	5/27/05	EB JMT



1.) SEE SHEET 2 FOR MOUNTING HOLE PREPARATION.

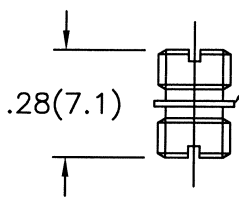
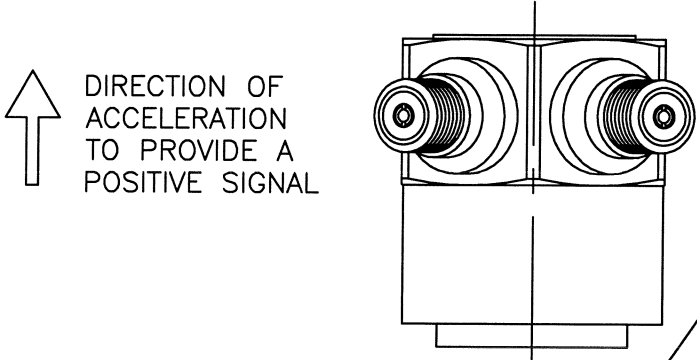
UNLESS SPECIFIED TOLERANCES		DRAWN	<i>JMT</i>	MFG	<i>RJA</i>	<i>9/2/05</i>	 3425 WALDEN AVE. DEPEW, NY 14043 (716) 684-0001 EMAIL: SALES@PCB.COM
DIMENSIONS IN INCHES	DIMENSIONS IN MILLIMETERS [IN BRACKETS]	CHK'D	<i>ECB</i>	ENGR	<i>JMS</i>	<i>9/24/05</i>	
DECIMALS XX ±.03 XXX ±.010	DECIMALS X ±0.8 XX ±0.25	APP'D	<i>WS</i>	SALES	<i>WJL</i>	<i>2/24/05</i>	
ANGLES ±2 DEGREES	ANGLES ±2 DEGREES	TITLE	INSTALLATION DRAWING MODEL 288D01 SERIES IMPEDANCE HEAD				
FILLET AND RADII .003 - .005	FILLET AND RADII [0.07 - 0.13]	DD011 REV. C 01/21/03	CODE IDENT. NO. 52681		DWG. NO. 6082		SCALE: 2X
						SHEET 1 OF 2	

6082

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APPLICATION		
NEXT ASS'Y	USED ON	VAR

REVISIONS				
REV	DESCRIPTION	ECN	DATE	APP'D
	-SEE SHEET ONE-			



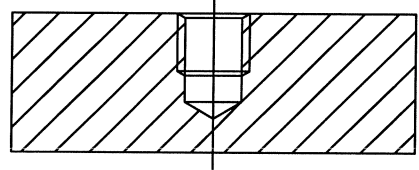
MODEL 081B05
MOUNTING STUD
10-32 UNF-2A
TYPICAL EACH END
(2 SUPPLIED)

MODEL M081B05
METRIC MOUNTING STUD
10-32 UNF-2A TO
M6 X 0.75-6g
(2 SUPPLIED)

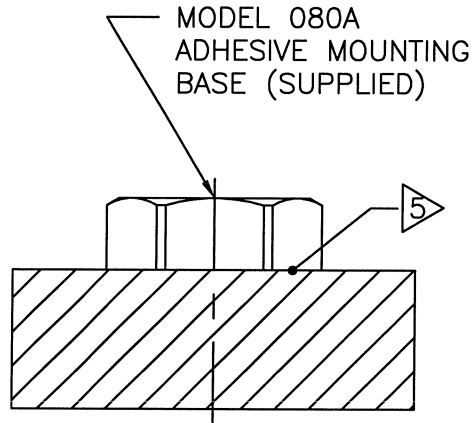
MOUNTING HOLE PREPARATION:

081B05 STUD:
 $\phi .159[\phi 4.04]$ $\nabla 1$
 X .23[5.8] ∇ MIN.
 10-32 UNF-2B
 X .15[3.8] ∇ MIN.

M081B05 STUD:
 $\phi .209[\phi 5.3]$
 X .30[7.6] ∇ MIN.
 M6 X 0.75-6H
 X .20[5.1] ∇ MIN.



TYPICAL STUD INSTALLATION



TYPICAL ADHESIVE INSTALLATION

- $\nabla 5$ APPLY A THIN LAYER OF EPOXY, DENTAL CEMENT, OR SIMILAR ADHESIVE.
- 4.) FOR BEST RESULTS, PLACE A THIN LAYER OF SILICONE GREASE ON SENSOR INTERFACE PRIOR TO MOUNTING.
- 3.) RECOMMENDED SENSOR MOUNTING TORQUE 10-20 INCH POUNDS [113-225 NEWTON CENTIMETERS].
- $\nabla 2$ MOUNTING SURFACE SHOULD BE FLAT TO WITHIN .001[0.03] TIR OVER $\phi .50[\phi 12.7]$ WITH A MINIMUM 63/[1,6/] FINISH FOR BEST RESULTS.
- $\nabla 1$ DRILL PERPENDICULAR TO MOUNTING SURFACE TO WITHIN $\pm 1^\circ$.

UNLESS SPECIFIED TOLERANCES		DRAWN <i>JRM</i> 9/26/05		MFG <i>RJA</i> 7/29/05		 3425 WALDEN AVE. DEPEW, NY 14043 (716) 684-0001 EMAIL: SALES@PCB.COM	
DIMENSIONS IN INCHES	DIMENSIONS IN MILLIMETERS [IN BRACKETS]	CHK'D <i>ECB</i> 9/26/05	ENGR <i>SMB</i> 9/26/05	SALES <i>WJL</i> 9/26/05	CODE IDENT. NO. 52681		
DECIMALS XX $\pm .03$ XXX $\pm .010$	DECIMALS X ± 0.8 XX ± 0.25	APP'D <i>JRM</i> 9/26/05	TITLE INSTALLATION DRAWING MODEL 288D01 SERIES IMPEDANCE HEAD		SCALE: 2X SHEET 2 OF 2		
ANGLES ± 2 DEGREES	ANGLES ± 2 DEGREES	FILLETS AND RADII .003 - .005		FILLETS AND RADII [0.07 - 0.13]		DD011 REV. C 01/21/03	