MINIATURE 2 GRAM

QUARTZ ACCELEROMETER

Series 303A

PIEZOTRONICS

with built-in microelectronics & 10 mV/g sensitivity

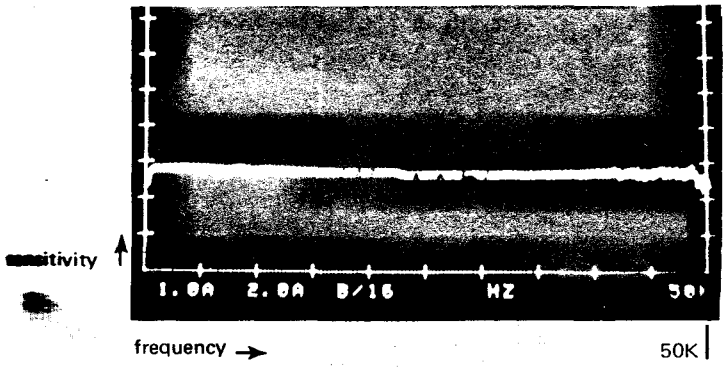
Measure shock and vibration in applications requiring small size, low mass or very high frequency response.

Series 303A Quartz Accelerometers function to transfer shock and vibratory motion into high-level, low-impedance (100 ohm) voltage signals compatible with readout, recording or analyzing instruments. These tiny sensitive (10 mV/g) sensors operate reliably over wide amplitude and frequency ranges under adverse environmental conditions.

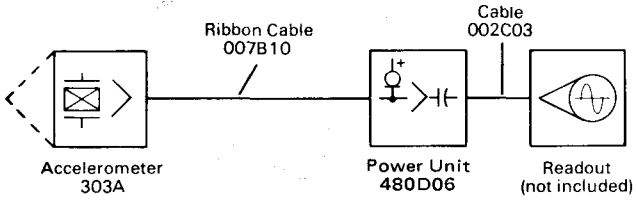
They are structured with permanently polarized compression-mode quartz elements and a microelectronic amplifier housed in a lightweight metal case. Three different case and connector configurations give you a choice in mounting and cabling. The built-in electronics operate over a coaxial or two-conductor cable; one lead conducts both signal and power. Solder terminal versions are normally supplied with a ribbon wire cable (10 ft. long; Model 007B10) attached. Model 303A02 requires Model 002G coaxial cable with a Micro 5-44 connector on one end.

Test results of the behavior of the Model 303A are presented below. Note especially the sharp clean signals free of cable noise and the exceptionally high frequency response. Because of the low mass, Series 303A sensors measure motion of many light structures without appreciably changing the structure or behavior of the test object during the measuring transaction.

Frequency Response (mounted)

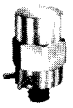


TYPICAL SYSTEM: Model GK303A Accelerometer Kit

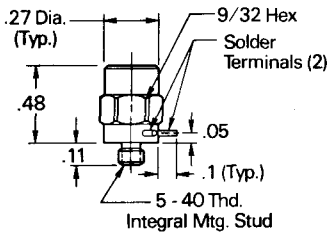


Note: Coaxial shielded for Model 303A02 only:
002G10, 10 ft. long; 5-44 thd. plug to 10-32 thd. plug.
002G"X" specify length "X" feet.

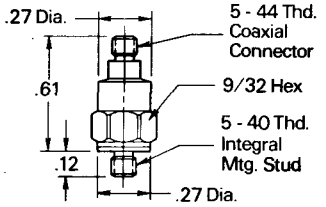
303A



Supplied with attached 10' ribbon wire terminating in 10-32 Micro connector

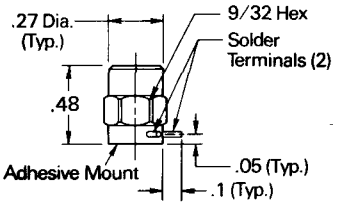


303A02



303A03

Supplied with attached 10' ribbon wire terminating in 10-32 Micro connector



SPECIFICATIONS: Model No.		303A & 303A03
Range (for ±5 output)	g	±500
Resolution	g	0.01
Sensitivity (nominal)	mV/g	10
Resonant Frequency (mounted)	kHz	70
Frequency Range (±5%)	Hz	1 to 10000
Discharge Time Constant	sec	1
Linearity	%	1
Output Impedance	ohm	100
Output Bias (nominal)	V	11
Overload Recovery	microsec	10
Transverse Sensitivity (max.)	%	5
Strain Sensitivity	g/μin/in	0.05
Temperature Coefficient	%/°F	0.03
Temperature Range (operational to +250°F)	°F	−40 to +200
Vibration	g	±1000
Shock (protected)	g	2000
Size (hex. x height)	in	0.28 x 0.48
Weight (approx.)	gm	2
Connector (solder terminals)		2
Case Material		s.s.
Seal		epoxy
Excitation Voltage	V	+18 to 24
Excitation Current (constant)	mA	2 to 20

Notes:

Model 303A02 has a 5-44 micro-connector. Other specifications are the same.

Options include 080A15 adhesive mounting base, 080A16 three-axis mounting adaptor (10-32 thread) and triaxial Model 303A06.

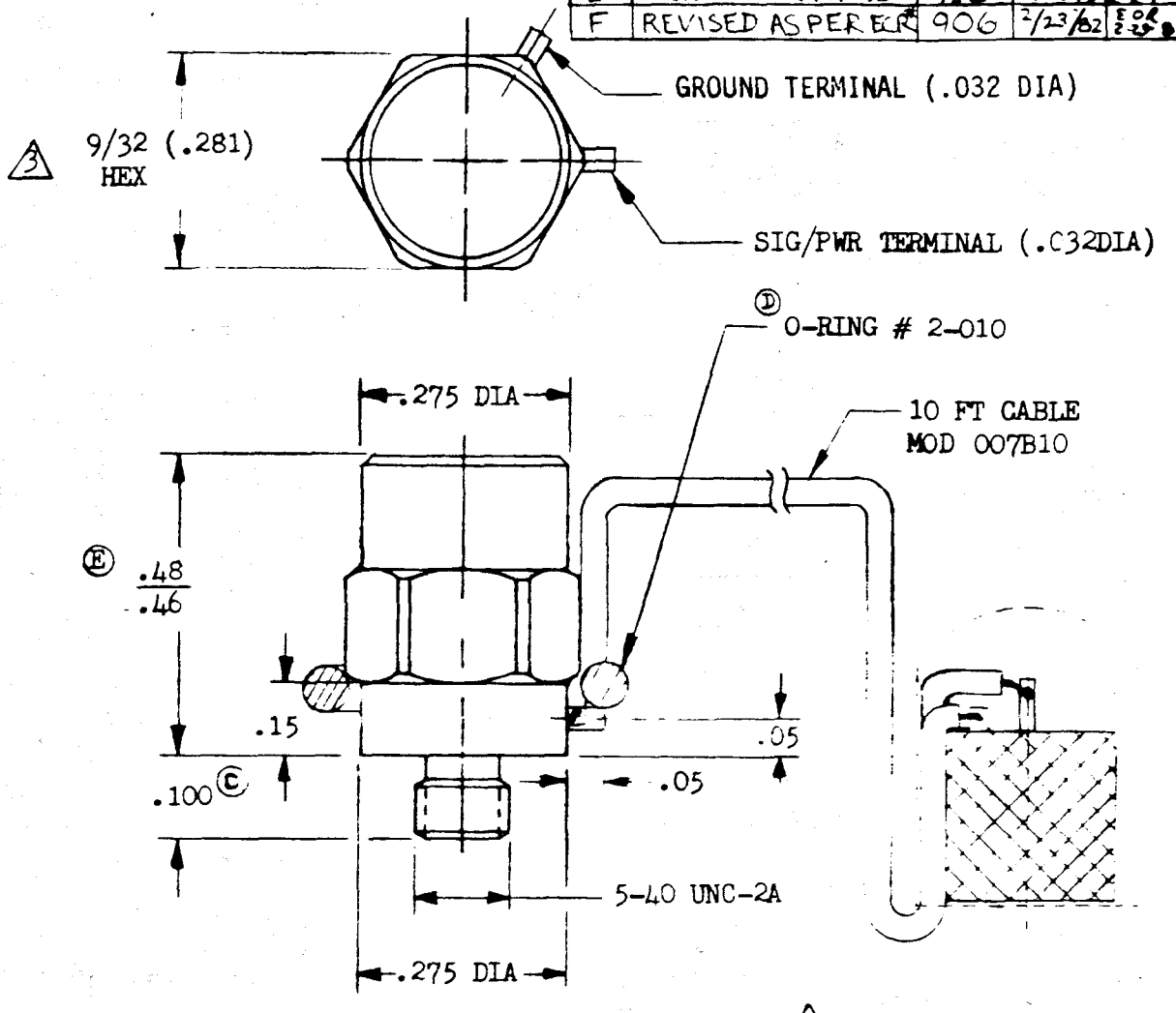
PCB PIEZOTRONICS, INC. 3425 WALDEN AVENUE DEPEW, NEW YORK 14043-2495 TELEPHONE 716-684-0001 TWX. 710-263-1371

303-1010-90

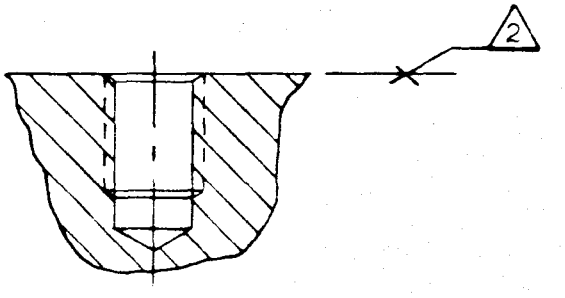
APPLICATION			
QTY.	NEXT ASSY.	USED ON	VAR

G REV. AS PER ECR# 1083

REVISIONS				
SYM.	DESCRIPTION	EO	DATE	APP'D
A	MOD 303A WAS 303A04		3-16-76	
B	.15 WAS .10	25	11/76	
C	.100 WAS .110	126	7/77	
D	ADDED CABLE & O RING	408	5/11/79	
E	.48/.46 WAS .40/.45	452	9/6/79	
F	REVISED AS PER ECR#	906	2/23/82	



MOUNTING HOLE PREPARATION:
DRILL #38 (.101 DIA) 1
X .200 DEEP
TAP 5-40 UNC-2B
X .150 DEPTH PERF THD.



3 RECOMMENDED MOUNTING TORQUE ON 9/32 HEX 4 - 5 IN LBS

2 MOUNTING SURFACE MUST BE FLAT WITHIN .001 TIR (9/32 DIA MIN) WITH A 63√ FIN.

1 DRILL PERPENDICULAR TO MOUNTING SURFACE TO WITHIN ±1°

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES. TOLERANCES: FRACTIONS ± 1/64, DECIMALS XX ± .01, XXX ± .005, ANGLES ± 1/2 DEG. BREAK SHARP EDGES .003 - .005	MATERIAL	DRAWN E.OR. 10-27-75	MFG.		pcb piezotronics, inc. BUFFALO, NEW YORK 14225
		CHECKED OK	ENGR.	10-75	
	HEAT TREAT	APP'D	RELEASE NO.		
	EXCEPT AS NOTED FIN √	TITLE INSTALLATION DRAWING MODEL 303A MINATURE ACCELEROMETER			CODE IDENT. NO. DWG. NO. 303-1010-90
					SCALE 4 X SHEET 1 OF 1

OPERATING GUIDE
SERIES 303A
HIGH FREQUENCY ICP
QUARTZ ACCELEROMETERS

1.0 INTRODUCTION

The Series 303A Miniature ICP (Integrated Circuit Piezoelectric) Accelerometers are designed specifically for high frequency response. The miniature size of this series makes chem ideal for vibration and shock measurements where low mass is important.

A tiny built-in impedance converter transforms the high impedance voltage signal from the crystals to a low impedance signal at a 10mV/g level. A single co-axial cable or twisted pair connects the 303 to the power unit for simplicity of operation. The low impedance output allows driving of long cables (low noise cables are not necessary) up to 1000 ft. without appreciable signal loss and/or distortion.

See Guide G0001 for a more complete treatment of the ICP concept.

2.0 DESCRIPTION

The 303A Series consists of 3 models, the Models 303A, 303A02, and 303A03.

The 303A (See Figure 1) features a 5-40 integral stud mount and radially mounted solder terminals. This is the general purpose model and is recommended for most applications.

The 303A02 (See Figure 2) has the same stud mount but features a 5-44 Micro coaxial connector, top mounted.

This version is useful where there is no room for radial leads and where lowest mass is not important.

The Model 303A03 (See Figure 3) is designed for adhesive mounting and has the same radial solder terminals as the Model 303A. This model has the lowest mass of the 3.

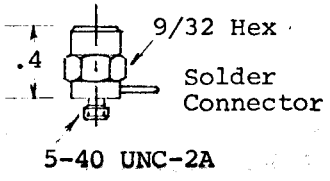


FIGURE 1
MODEL 303A

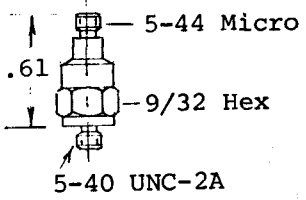


FIGURE 2
MODEL 303A02

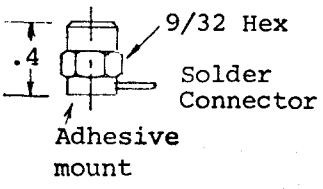


FIGURE 3
MODEL 303A03

The 3 models described here are similar internally, i.e., they all contain the same self generating quartz element coupled to a FET input IC impedance converter.

Refer to the installation drawing for your specific model, included as part of this manual, for a detailed dimensional outline.

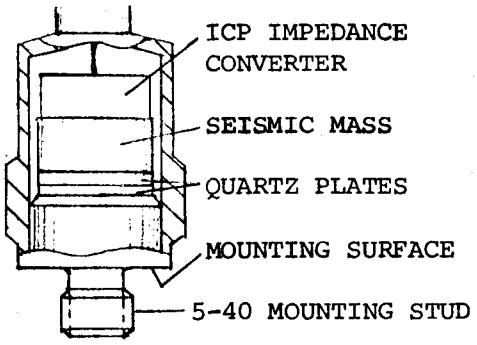
2.1 THEORY OF OPERATION

A change in acceleration into the base of the accelerometer exerts a force on the seismic mass, thru the crystals resulting in an electrostatic charge ($\triangle q$), exactly proportional to the change in input acceleration. (Refer to Figure 4A)

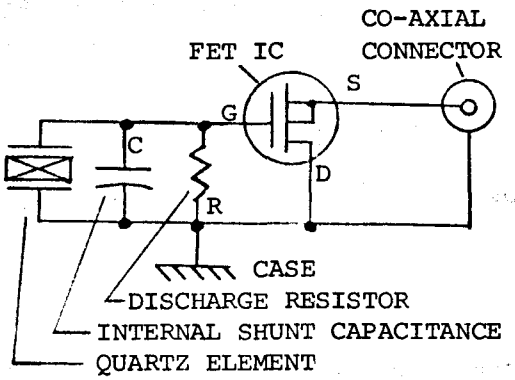
This charge ($\triangle q$) is collected in the crystal shunt capacitance (C), resulting in a voltage ($\triangle V$), in accordance with the electrostatic equation.

$$\triangle V = \frac{\triangle q}{C} \qquad \text{(Eq. 1)}$$

This voltage is impressed across the gate of the FET source follower, (See Fig. 4B) resulting in the same voltage change at the source terminal, but at a much lower impedance level. This signal at the source terminal is added to a D.C. bias voltage of approx. +11 volts. The signal is separated from the bias voltage in the PCB power units.



(A) CROSS SECTION (MOD 303A02)



(b) SCHEMATIC

FIGURE 4
SERIES 303

The discharge resistor across the element serves a dual function. It refers the gate to drain potential, providing proper bias for the amplifier and it provides a discharge path for spurious thermally induced charges generated by the piezo-electric element.

The discharge time constant (TC) is the product of shunt capacitance (C) and discharge resistance (R).

(Eq. 2)

TC (Seconds) = R (Ohms) x C (Farads)

The TC establishes the low frequency response in accordance with the following relationship:

Where: $fo = \frac{.16}{TC}$ **(Eq. 3)**

fo = Lower -3db Frequency Hz
TC = Discharge Time Constant as defined in Equation 2.

The discharge TC of the Series 303 is approximately 1 Sec, thereby providing a lower cut-off (-3db) freq. of .16 Sec.

The outer shell of these units is at electrical ground potential. In most situations, this will not cause noise problems because of the low impedance output of the built-in amplifier.

Should electrical isolation be absolutely necessary, consult the factory for advice since, in every case, high frequency response is compromised somewhat by off-grounding techniques.

3.0 INSTALLATION

Because of the miniature size and high frequency use of the Series 303, it is extremely important that the units be properly mounted.

Good high frequency transmissability into the base of the 303 is dependent upon intimate contact between the base and the mounting surface.

3.1 INSTALLATION, MODS 303A and 303A02

For the Models 303A and 303A02, prepare the tapped hole and mounting surface as shown in the appropriate installation drawing.

The mating surface, in contact with the accel. base must be machined smooth and flat as possible. Surface grinding, while not always possible, is ideal, however, spot facing with a sharp tool, ground flat is also acceptable.

A light film of silicone grease between mating surfaces will enhance transmissability of high frequencies for these two models.

For more permanent installations, a thin layer of epoxy between mating surfaces

will ensure good high frequency performance without fear of the accelerometer becoming loose during use.

NOTE: To avoid twisting off the integral mounting stud during removal, do not allow epoxy to enter the thread area of the stud. Check mating surfaces for burrs and other particles before mounting.

3.1.1 MOUNTING TORQUE

Because of the small size, the 5-40 mounting stud can be easily twisted off with excessive mounting torque.

Do not exceed the recommended mounting torque of 5 in. lbs.

If a torque wrench is not available, torque unit on with slightly greater than hand tightness, using a very small wrench.

3.2 INSTALLATION, MODEL 303A03

The Model 303A03 is designed for adhesive mounting. Prepare a flat mounting surface using a grinding or spot-facing operation if possible. Since the adhesive can make up for slight surface imperfections, surface preparation for this model is not quite as critical as with the stud mount models.

Generally a good machine finish of 125 or better is sufficient. Check mating surfaces for burrs and other particles before applying adhesive to either surface.

A small amount of Eastman 910 ® or other adhesive as well as many other commercially available epoxies will suffice for mounting. Use any adhesive sparingly to facilitate removal.

Use care during removal to avoid damage to accelerometer. To remove, apply steadily increasing torque on 9/32 hex until bond breaks loose. Do not strike accel. to break bond.

3.3 INSTALLING THE CABLE

A Model 002G10 Co-Axial Cable is normally supplied with the Model 303A02. This cable has a special Micro-miniature 5-44 connector on one end (to mate with the 303A02) and a standard 10-32 Micro coaxial connector at the other end (to mate with power unit).

Snug up the threaded lock rings at the accel. tightly by hand. When securing the cable, allow a flexing loop and tie the cable to rigid structure close to the accelerometer.

To install the cable to the Models 303A and 303A03, use very fine wire (30 AWG stranded, twisted pair is recommended) and solder with low temp. eutectic tin-lead solder with light (less than 15 watt) soldering iron. Use minimal heat on terminals so as to avoid overheating.

As with the other two models, secure cables to surrounding rigid structures to avoid excessive cable motion.

Refer to Figure 5 for definition of polarity of electrical connections for Models 303A and 303A03.

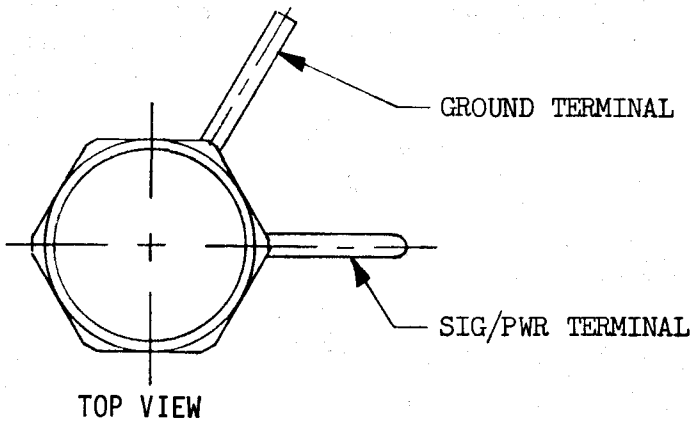


FIGURE 5
ELECTRICAL TERMINALS
MODEL 303A and 303A03

The positive (center) lead from the power unit connector labeled "Xducer" is connected to the sig/pwr terminal as defined in Figure 5 and the ground return (outer shell) of this connector is connected to the ground terminal of the accelerometer. An 070A09 Solder Connector Adaptor will facilitate connection to the power unit.

4.0 OPERATION

A simplified accelerometer/power unit schematic is shown in Figure 6.

After installing the accelerometer, connect the cable to the power unit and

tighten retaining nut securely to provide a good ground return.

Switch power unit on and observe bias monitoring volt meter. (All PCB power units incorporate this meter at the front panel). When supplied with power through a 2 to 20mA constant current source, as shown in Figure 6, the amplifier will nromally display an 11 volt bias level at the source (or output) terminal. The output signal is superimposed upon this D.C. bias level and is de-coupled by the 10uF capacitor. The bias meter will indicate an approximate mid-scale (green) reading for normal source follower operation and cable continuity. A full scale (Yellow) meter reading indicates a faulty internal amplifier or an open cable or cable connection. A zero voltage (red) reading indicates a shorted cable or cable connection. In this manner, this meter is actually used as a go, no-go system fault indicator.

If it is desired to build the power unit rather than use one of the PCB Models, a Motorola Series MCL1300 constant current diode is recommended for the constant current element. The MCL1304 is a nominal 4mA diode and the MCL1302 is a nominal 2mA diode.

Up to 5 MCL1304's can be placed in parallel to provide 20mA for long cable driving capability. Do not exceed 20mA and under no circumstances should voltage be placed across the electrical connector without current limiting diodes or other current limiting protection. To do so will destroy the built-in source follower amplifier.

The "scope" jack of the power unit is connected directly to readout instruments such as oscilloscopes, recorders, A.C. meters, etc.

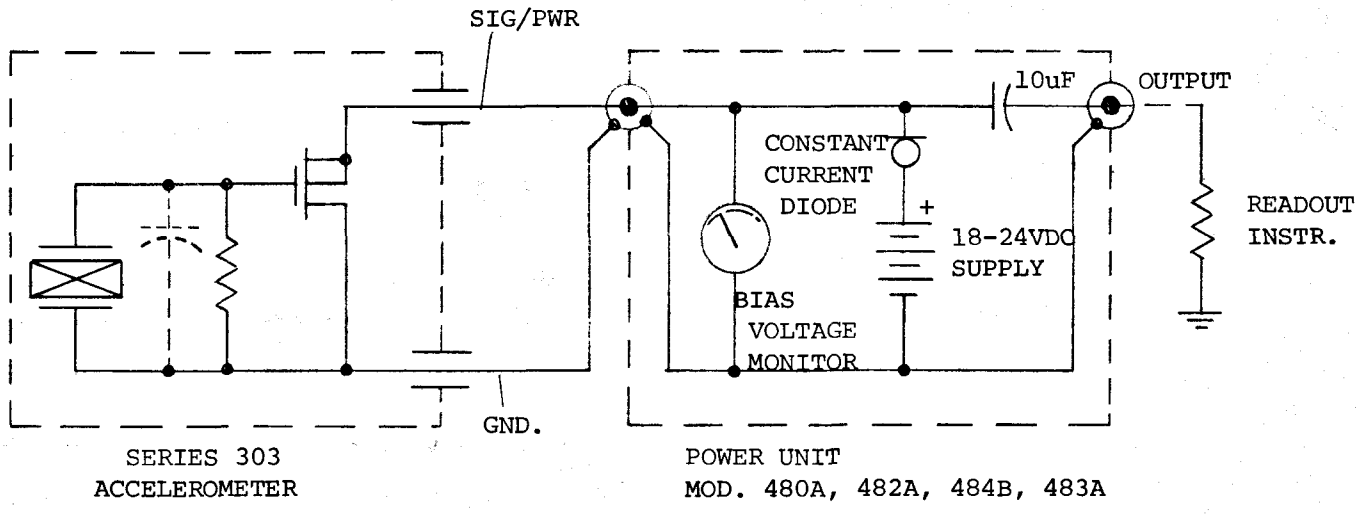


FIGURE 6
SYSTEM SCHEMATIC

5.0 POLARITY

Unless otherwise specified, the 303 Series will produce positive going output voltage for positive acceleration into the mounting base (toward the top of the unit).

Reverse polarity is available on special order.

6.0 CALIBRATION

Calibration of these units is performed at PCB by use of a NBS traceable reference system over the frequency range of 30Hz to 10,000 Hz. The reference sensitivity is measured at 100 Hz per ISA RP 37.2. PCB offers re-calibration service for a nominal charge. Contact the factory for details.

7.0 MAINTENANCE AND REPAIR

Because of the miniature size and sealed construction, field repair is generally precluded. Return damaged or defective units to the factory for inspection and subsequent repair quotation. (See note 7 below.)

CAUTION:

1. Observe maximum shock levels stated in specification. Do not exceed.

2. Do not overtorque when mounting.

3. Do not subject units to temps. above 250°F.

4. Do not apply voltage to unit without constant current protection.

5. Do not apply more than 20mA of current.

6. Do not exceed 30 volts supply voltage.

7. Units are epoxy sealed, consequently, it is possible that after long periods of storage in humid environments moisture could enter. If unit fails to turn on or has a shortened time constant, bake out in 250°F oven for several hours.

PCB

PIEZOTRONICS

CALIBRATION DATA

ICP ACCELEROMETER (per ISA-RP 37.2)

Model No. 303A

Serial No. 15480

By P. Jasmuszy

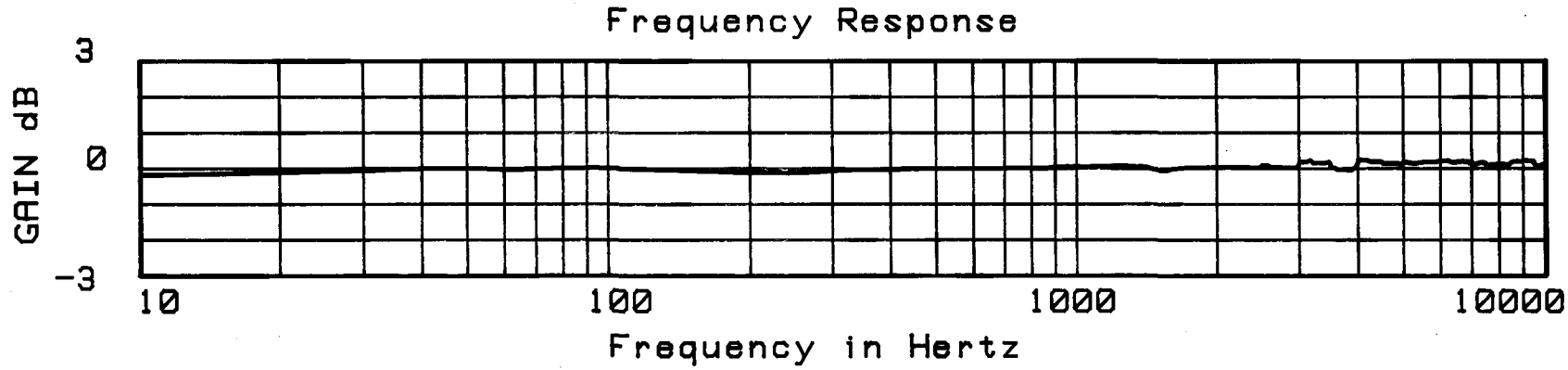
185 Date 2/19/88

Voltage sensitivity:	10.60	mV/g	Resonant Frequency:	78	kHz
Transverse sensitivity:	1.0	%	Time constant:	0 .5	s
Resolution:	0.01	g	Maximum temperature:	250	°F
Output bias level:	11.5	V	Range:	500	± g

The Calibration procedure of PCB Piezotronics is in compliance with MIL-STD-45662.

Freq. Hz	10	15	30	50	100	300	500	1000	3000	5000	7000	10000
Deviation %	-2.5	-1.7	-.7	0.0	0.0	-.7	0.0	.7	2.1	2.0	1.5	1.5

Calibration traceable to NBS through project no. 737/236905



PCB PIEZOTRONICS, INC. 3425 Walden Avenue Depew, New York 14043-2495