OG3056M9
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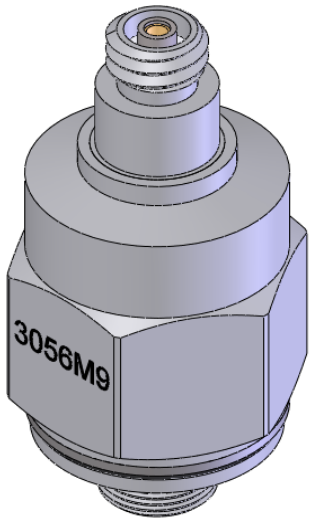
REV C, ECN 7932, 10-12-11

OPERATING GUIDE

SERIES 3056M9

IEPE ACCELEROMETER, 50 mV/g

HERMETICALLY SEALED AND CASE ISOLATED



NOTE:
Series 3056M9 features hermetically sealed construction and electrically isolated case for "off-ground" performance. Hermeticity is obtained by all-welded construction and glass-to-metal sealed connector. Case material is titanium. Case ground isolation is by an electrically isolated threaded insert located in the base of the instrument. Signal ground return is electrically isolated from the mounting surface.

This guide contains:
1) Operating instructions, Series 3056M9.
2) Outline/installation drawing, Series 3056M9
3) Specifications, Series 3056M9
4) Paper, "Low Impedance Voltage Mode (IEPE) Theory and Operation

NOTE: IEPE is an acronym for Integrated Electronics Piezoelectric types of low impedance voltage mode sensors with built-in amplifiers operating from constant current sources over two wires. **IEPE** instruments are compatible with most other manufacturers' comparable systems.

SPECIFICATIONS
MODEL SERIES 3056M9 IEPE ACCELEROMETERS WITH TEDS

SPECIFICATION	VALUE	UNITS
PHYSICAL		
WEIGHT	10.0	grams
SIZE, HEX x HEIGHT	.50 x 1.07	inches
MOUNTING PROVISION	M6 X 1.0 Thread	
CONNECTOR, TOP MOUNTED	10-32 coaxial	
MATERIAL, BASE, CAP & CONNECTOR	titanium	
SEISMIC ELEMENT TYPE	ceramic, planar shear	
PERFORMANCE		
SENSITIVITY, ± 5% [1]	50	mV/g
RANGE F.S. FOR ± 5 VOLTS OUTPUT	±100	g
FREQUENCY RANGE, ± 5%	1.0 to 1000	Hz
RESONANT FREQUENCY	>32	kHz
EQUIVALENT ELECTRICAL NOISE FLOOR	0 .001	g rms
LINEARITY [2]	±2	% F.S.
TRANSVERSE SENSITIVITY, MAX.	5	%
ENVIRONMENTAL		
MAXIMUM VIBRATION/SHOCK	500/3000	± g/g pk
TEMPERATURE RANGE, operational	-60 to +250	°F
SEAL, HERMETIC	Glass-to-metal and TIG welded	
ELECTRICAL		
SUPPLY CURRENT [3]	2 to 20	mA
COMPLIANCE VOLTAGE	+18 to +30	Vdc
OUTPUT IMPEDANCE, TYP.	150	Ω
BIAS VOLTAGE, +10.5 VOLTS NOM.	+11 to +13	Vdc
DISCHARGE TIME CONSTANT	0.5 to 1.5	sec
OUTPUT SIGNAL POLARITY FOR ACCELERATION TOWARD TOP	positive	
ELECTRICAL ISOLATION, min CASE GROUND TO MOUNTING SURFACE	10	MΩ

[1] Measured at 100 Hz, 1 g rms per ISA RP 37.2.
[2] Measured using zero-based best straight line method, % of F.S. or any lesser range.
[3] Do not apply power to this device without current limiting, 20 mA MAX. To do so will destroy the integral IC.

OPERATING INSTRUCTIONS MODEL SERIES 3056M9 IEPE ACCELEROMETER

INTRODUCTION

The Dytran Model Series 3056M9 is a 50 mV/g accelerometer.

The accelerometer features Integrated Electronics Piezo Electric (IEPE) operation. The self generating seismic element, utilizing piezoceramic crystals in planar shear mode, convert acceleration to an analogous electrostatic charge mode signal. This very high impedance signal is fed to the gate of a tiny on-board IC JFET charge amplifier which drops the output impedance level ten orders of magnitude allowing this instrument to drive long cables without appreciable effect on sensitivity and frequency response.

Simple constant current type power units supply power to operate the integral charge amplifier and separate the signal from the DC bias of the internal amplifier. Coaxial cables or even twisted pair wire may be used to connect accelerometer to power units. Power and signal are conducted over the same two-wire cable.

Model series 3056M9 also features signal ground isolation from the mounting surface to avoid annoying ground loops and hermetic sealing for normal operation in moist and dirty environments.

DESCRIPTION

Figure 1, following, is a representative cross section of series 3056M9.

The seismic masses, made from a very dense tungsten alloy, and are tightly preloaded against the ceramic crystals by means of a special preload screw. This is so there isabsolutely no relative motion between mass, crystals and base keeping the non-linearity and the natural frequency high.

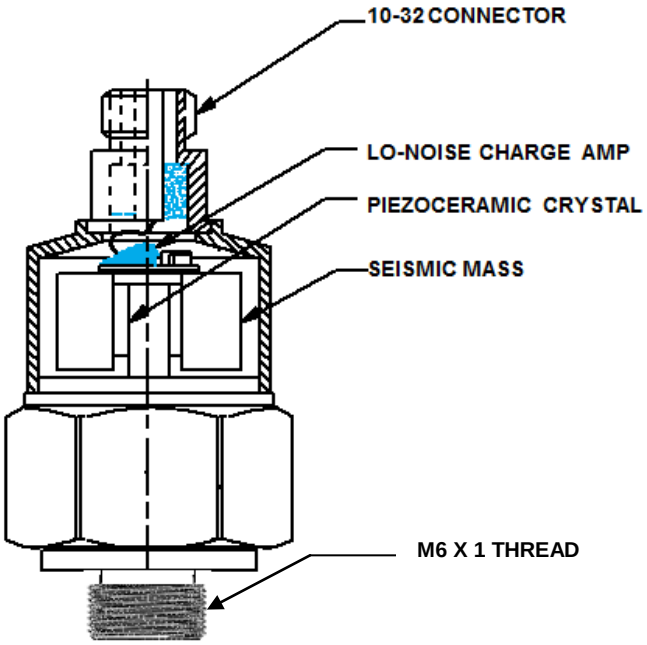


Figure 1-Cross section, 3056M9

The force from acceleration (vibration or shock) acting upon the mounting base, is transferred to the seismic mass through the crystals, stressing the crystals in shear mode and producing an electrostatic charge signal analogous to the input acceleration. This charge is impressed across the gate of the JFET IC charge amplifier.

Because the IC is a 2-wire IEPE charge amplifier, the dynamic voltage signal is impressed across the input terminal which is the same terminal into which the constant current from the power unit is applied. (See Figure 2 below)

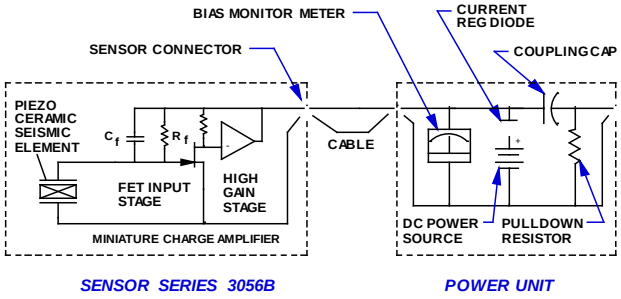


Figure 2 - Electro-mechanical schematic, accelerometer and power unit system.

When constant current from the IEPE power unit is applied to the accelerometer amplifier input terminal, the amplifier "turns on" at approx. +12 Volts DC quiescent bias level. When the accelerometer senses acceleration, the resultant signal is superimposed upon this bias voltage.

In the power unit, in its simplest form, a capacitor blocks the DC bias and allows the dynamic signal voltage to be separated and brought out to an "output" jack on the power unit. At this point the signal may be connected directly to almost any type of readout instrument such as DVM's, oscilloscopes, data collectors, spectrum analyzers, etc. The approximate 100 Ohm output impedance of the signal allows the driving of long cables without adverse effects on sensitivity or frequency response.

Referring to figure 2, the feedback resistor R in conjunction with shunt capacitance C, forms a first order high-pass filter which sets the low frequency response of the accelerometer in accordance with the following equation:

$$f_{-3db} = \frac{.16}{RC} \qquad \text{(Equation 1)}$$

where:

f_{-3db} = lower -3db frequency (Hz)

R = resistance value R (Ω)

C = total shunt capacitance C (Farads)

RC = discharge time constant TC (seconds)

Equation 1 above, defines the frequency at which the accelerometer sensitivity will be 3db down when compared to the reference sensitivity measured at 100 Hz.

The discharge time constant for series 3056M9 is 0.5 seconds, yielding a lower -3db frequency of 0.3 Hz, from equation 1.

As rule of thumb, the lower -5% frequency is three times the -3db frequency.

INSTALLATION

(Refer to Outline/Installation drawing 127-3056M9) To install Model 3056M9, is necessary to prepare (or find) a flat mounting area of approximately 0.5 inch diameter. Ideally, the mounting surface should be flat to .001 in. TIR. The flat mounting surface ensures intimate contact between accelerometer base and mounting surface for best high frequency transmissibility, thus accuracy.

At the center of the mounting area, drill and tap a M6 X 1 (.200 inches deep) mounting port in accordance with instructions on drawing 127-3056M9. Clean the area to remove all traces of machining chips, burrs, etc.

Spread a light coating of silicone grease, or other lubricant, on either of the mating surfaces and thread the accelerometer/stud combination into the tapped hole by hand, until the accelerometer base seats against the mounting surface. Check to see that the mating surfaces are meeting properly, i.e., that they are meeting flush and that there is not an angle formed between the two surfaces indicating that they are not co-planar. If this condition is observed, torquing the accelerometer down will strain the base causing possible poor frequency response and even erroneous reference sensitivity. Inspect the perpendicularity of the tapped hole.

If the hand tight meeting between the two surfaces is satisfactory, torque the 3056M9 to the mating surface with 15 to 20 lb-inches of torque, preferably measuring the torque with a torque wrench torquing on the hex surface only.

Proper torque will ensure the best high frequency performance from the instrument as well as repeatability of sensitivity when mounting and remounting.

Connect the cable (typically Models 6010AXX or 6011AXX) to the accelerometer snugging up the threaded lock ring tightly by hand.

> **NOTE:** Do not use a pliers or vise grips on the knurled lock ring. This could damage the connector of the 3056M9 and/or the cable connector.

To avoid stressing the cables which could lead to early failure, especially under larger excursions of the test object, it is good practice to tie the cable down to a fixed surface near the mounting area at a point approximately one inch from the accelerometer.

If there is excessive motion between the accelerometer and the nearest tie point, allow a strain

loop of cable to let relative motion occur without stressing the cable.

Connect the other end of the cable to the "Sensor" jack of the IEPE power unit/data collector. You are now ready to receive input data from the sensor.

CAUTIONS

1) Do not store or use the 3056M9 above +250 °F. To do so can damage the IC amplifier.

2) Do not allow cables to vibrate unrestrained. This will eventually destroy the cable and could lead to system inaccuracies.

3) Avoid dropping or striking the accelerometer, especially against rigid materials such as concrete and metals. While Model 3056M9 is intrinsically protected against shock induced overloads, the very high overloads induced by dropping can do permanent damage to the IC amplifier or to the mechanical structure of the accelerometer. This type of damage is not covered by the warranty.

MAINTENANCE AND REPAIR

The welded construction of the model 3056M9 precludes field repair.

Should the electrical connector become contaminated with moisture, oil, grease, etc., the entire instrument may be immersed in degreasing solvents to remove the contaminants. After degreasing, place the instrument in a 200 to 250 degree F oven for one hour to remove all traces of the solvent.

Should a problem be encountered with the operation of the instrument, contact the factory for trouble shooting advice. Often our service engineers may point out something which may have been overlooked and which may save the expense and time of returning the 3056M9 to the factory.

If the instrument must be returned, the service department will issue you a Returned Materials Authorization (RMA) number to aid in tracking the repair through the system. Do not send the instrument back without first obtaining an RMA number. At this time you will be advised of the preferred shipping method.

A short note describing the problem, included with the returned instrument, will aid in trouble shooting at the factory and will be appreciated.

We will not proceed with a non-warranty repair without first calling to notify you of the expected charges. There is no charge for evaluation of the unit.