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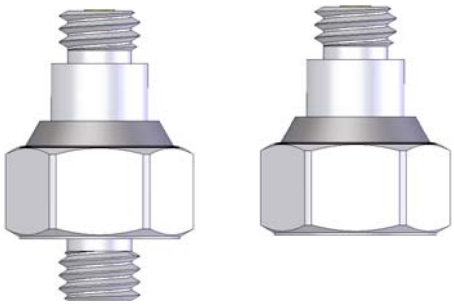
OG3049E.DOC
Rev B 17 APR 06

OPERATING GUIDE

MINIATURE 3049E SERIES IEPE ACCELEROMETERS

10 mV/g AND 100 mV/g

HERMETICALLY SEALED AND CASE ISOLATED



NOTE:
Series 3049E Series 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. Signal ground return is electrically isolated from the mounting surface.

This guide contains:
1) Operating Instructions, Series 3049E Series.
2) Outline/installation drawing, Series 3049E Series
3) Specifications, Series 3049E Series
4) Paper, "Low Impedance Voltage Mode (LIVM) Theory and Operation"

NOTE: IEPE is an acronym for **I**ntegrated **E**lectronics **P**iezo**e**lectric 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 3049E Series IEPE ACCELEROMETERS

SPECIFICATION		VALUE	UNITS
PHYSICAL			
WEIGHT	3049E, 3049E2	3.3	grams
	3049E1, 304E3	3.1	grams
SIZE, HEX x HEIGHT (all models)		.39 x .54	inches
MOUNTING PROVISION	3049E, 3049E2	10-32 integral stud x .15	inch
	3049E1, 3049E3	adhesive	
CONNECTOR, TOP MOUNTED		10-32	coaxial
MATERIAL, BASE, CAP & CONNECTOR		titanium alloy	
SEISMIC ELEMENT TYPE		ceramic, annular shear	

PERFORMANCE	**3049E**	**3049E1**	**3049E2**	**3049E3**	
SENSITIVITY, ± 5% [1]	10	10	100	100	mV/g
RANGE F.S. FOR ± 5 VOLTS OUTPUT	± 500	±500	±50	±50	g
FREQUENCY RANGE, ± 5% (all models)			1 to 10,000		Hz
RESONANT FREQUENCY, NOM. (all models)			35		kHz
EQUIVALENT ELECTRICAL NOISE	.002	.002	.001	.001	grms
BASE STRAIN SENSITIVITY	.004	.004	.004	.004	eq g/με
LINEARITY [2] (all models)			±2		% F.S.
TRANSVERSE SENSITIVITY, MAX. (all models)			5		%

ENVIRONMENTAL		**3049E**	**3049E1**	**3049E2**	**3049E3**	
MAXIMUM VIBRATION		600	600	200	200	g pk
MAXIMUM SHOCK (all models)				5000		g pk
TEMPERATURE RANGE	min	-60	-60	-60	-60	°F
	max	250	250	212	212	°F
SEAL, HERMETIC (all models)				glass-to-metal/welded		
COEFFICIENT OF THERMAL SENSITIVITY				.06		%°F

ELECTRICAL		
SUPPLY CURRENT [3]	2 to 20	mA
COMPLIANCE VOLTAGE RANGE	+18 to +30	Volts
OUTPUT IMPEDANCE, TYP.	100	Ω
BIAS VOLTAGE.	+11 to +13	Vdc
DISCHARGE TIME CONSTANT, MIN.	0.5	Sec
OUTPUT SIGNAL POLARITY FOR ACCELERATION TOWARD TOP	positive	
ELECTRICAL ISOLATION, MIN CASE GROUND TO MOUNTING SURFACE	10	MΩ

Accessories supplied: none

[1] Measured at 100 Hz, 1 grms 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 amplifier.


DYTRAN
INSTRUMENTS, INC.

OPERATING INSTRUCTIONS MODEL SERIES 3049E SERIES
IEPE ACCELEROMETERS

INTRODUCTION

The Dytran Model 3049E Series consists of four accelerometers, differing in sensitivity and mounting configuration. Stud mount versions are Model 3049E (10mV/g), and 3049E2 (100mV/g). Adhesive mount versions are Model 3049E1 (10mV/g) and 3049E3 (100mV/g).

These accelerometers are for IEPE operation. The self-generating seismic element, utilizing piezoceramic crystals in annular shear mode, convert acceleration to an analogous electrostatic charge mode signal. This very high impedance signal is fed to the input of a miniature on-board IC JFET charge amplifier that drops the output impedance level ten orders of magnitude, allowing this instrument to drive long cables without an 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 at the output 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.

The 3049E Series 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

The seismic mass, made from a very dense tungsten alloy, is carefully mated to the ceramic sensing element, ensuring low non-linearity and high natural frequency.

Because the IC is a 2-wire IEPE charge amplifier, the dynamic output voltage signal is impressed across the connector of the sensor which is the same point into which the constant current from the power unit is applied. (See Figure 1 below)

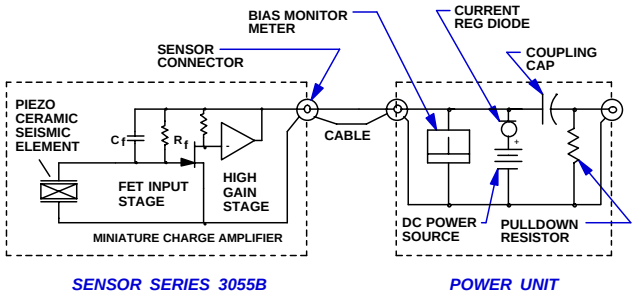


Figure 1-Electro-mechanical schematic, accelerometer and power unit system.

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 low output impedance of the signal allows the driving of long cables without adverse effects on sensitivity or frequency response.

Referring to Figure 1, the feedback resistor Rf in conjunction with shunt capacitance Cf, forms a first order high-pass filter which sets the low frequency response of the accelerometer in accordance with the following equation:

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

where:

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

R = resistance value R (Ohms)

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 all Models 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 or 1 Hz.

INSTALLATION

(Refer to Outline/Installation drawing 127-3049E) To install Model 3049E series accelerometers, it 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.

To install the adhesive mounted 3049E1 or 3049E3, clean the mounting surfaces with solvent if necessary to remove all traces of oils and other impurities including burrs or any matter which could preclude intimate contact between mating surfaces.

Apply a light coating of cynoacrylate adhesive (or other type of suitable adhesive) to either mounting surface, position the accelerometer in the desired cable orientation and press the accelerometer firmly onto the mounting surface and hold for several seconds.

To install the stud mounted 3049E or 3049E2 accelerometers, drill and tap a 10-32 mounting hole with enough thread depth to accommodate the integral stud. 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 3049E or 3049E2 accelerometer to the mating surface with 15 to 20 lb-inch 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. Excessive torque could damage the ground isolation base.

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 3049E Series 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 Dytran power unit (Models 4102C, 4103C, 4110C, 4114B1, etc.) and switch the power on.

Observe the monitor voltmeter located at the front panel of each of the power units. If the meter reads in the mid-scale region, (labeled "Normal"), this tells you that the cables, accelerometer and power unit are functioning normally and you should be able to proceed with the measurement.

Check for shorts in the cables and connectors if the meter reads in the "Short" region. Check for open cables or connections if the meter reads in the "Open" area. In this manner, the meter becomes a trouble shooting tool for the measurement system.

HIGH FREQUENCY RESPONSE

All piezoelectric accelerometers are basically rigid spring mass systems, i.e., second order systems with essentially zero damping. As a result, these instruments will exhibit a rising characteristic as the resonance is approached. A filter incorporated into Model 3049E Series compensates for this rise.

The frequency at which the sensitivity may increase or decrease by 5% is approximately 10,000 Hz, the frequency to which the 3049E Series series is calibrated. The accelerometer is usable above this frequency but to use it above 10,000 Hz, it must be calibrated at the specific frequencies of intended use because sensitivity deviations will increase drastically as you greatly exceed this high frequency calibration limit. Consult the factory for special calibrations required above 10kHz.

CAUTIONS

1) Do not store or use the 3049E Series above 250 degrees 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 3049E Series is 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 series 3049E Series precludes field repair.

Should the mounting surface become distorted, nicked and otherwise distressed, it can be redressed by **CAREFULLY** wiping on a new sheet of 400 grit emery paper on top of a clean surface plate (3049E1 and 3049E3 only). We stress "carefully" because if not done properly, this procedure can do more harm than good. Press the surface firmly against the paper and draw directly toward you in several short precise strokes making sure that the surface remains in full contact with the paper and does not "rock". Rotate the accelerometer 90 degrees and repeat the procedure. When you observe the bottom surface it should appear perfectly flat with straight marks across it. If you cannot achieve flatness with several attempts, return the instrument to the factory for 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°F to 250°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 3049E Series to the factory.

If the instrument must be returned, the service department will issue you a **R**eturned **M**aterials **A**uthorization (**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.