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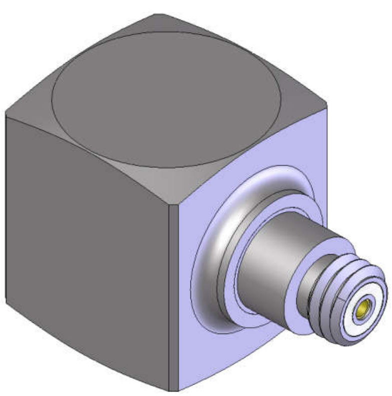
OPERATING GUIDE

SERIES 3214A

IEPE ACCELEROMETERS, 10, 100 & 500 mV/g

HERMETICALLY SEALED



NOTE:
Series 3214A features hermetically sealed construction. Hermeticity is obtained by all-welded construction and glass-to-metal sealed connector. Case material is titanium.

This guide contains:
1) Operating instructions, Series 3214A.
2) Outline/installation drawing, Series 3214A
3) Specifications, Series 3214A

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 other comparable systems labeled **LIVM**™

OPERATING INSTRUCTIONS MODEL SERIES 3214A
IEPE ACCELEROMETERS

INTRODUCTION

The Dytran Series 3214A consists of three accelerometers, differing only in sensitivity and range. Model 3214A1 is 10 mV/g, Model 3214A2 is 100 mV/g, Model 3214A3 is 500 mV/g.

These accelerometers features **I**ntegrated **E**lectronics **P**iezoelectric (**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 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.

DESCRIPTION

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

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

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)

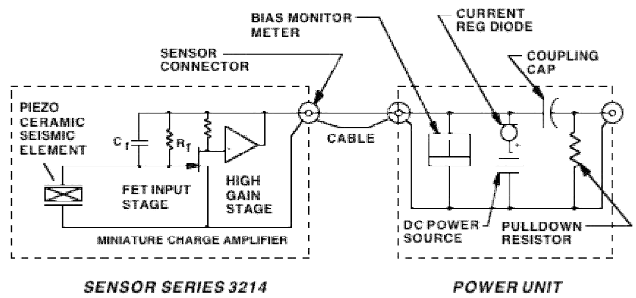


Figure 1-Electro-mechanical schematic, accelerometer and power unit system.

When constant current from the IEPE power unit is applied to the accelerometer amplifier input terminal, the amplifier "turns on" at approx. +10 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 1, 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:

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

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, nom., 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

To install Model 3214A, 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 10-32 mounting hole. Clean the area to remove all traces of machining chips, burrs, etc.

Next, thread the Model 6200 mounting stud into the base of the 3214A. The stud should enter easily and thread in up to the raised collar of the stud by hand. This collar prevents the stud from bottoming inside the tapped hole in the 3214A where it could possibly cause stresses in the base structure which could, in turn, cause anomalous behavior of the accelerometer at higher frequencies.

After seating the stud, 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 3214A 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. 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 3214A 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 4102, 4103, 4110, 4114, 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 3214A compensates for this rise.

The frequency at which the sensitivity may increases or decrease by 5% is approximately 10,000 Hz, the frequency to which the 3214A 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 3214A 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 3214A 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 3214A 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. 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 3214A 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.