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OPERATING GUIDE

MODEL 3056C

CHARGE MODE ACCELEROMETER, 15 pC/G

HERMETICALLY SEALED AND BASE ISOLATED

NOTE:

Series 3056C 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, Model 3056C.
- 2) Outline/installation drawing, Model 3056C
- 3) Specifications, Model 3056C

OPERATING INSTRUCTIONS MODEL 3056C CHARGE MODE ACCELEROMETER

INTRODUCTION

The Dytran Model 3056C is a super light weigh charge mode accelerometer with 15 pC/G sensitivity.

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 center pin of a radially mounted 10-32 connector mounted to the hex base of the accelerometer.

Dytran in-line IEPE charge amplifiers (4750, 4705) convert the charge mode signal to a low impedance voltage mode signal. Coaxial cables or twisted pair wire may be used to connect charge amplifiers to constant current power units. Power and signal are conducted over the same two-wire cable from in-line amplifier to power unit.

Model 3056C may also be used with conventional laboratory type charge amplifiers.

Model series 3056C 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, below, is a representative cross section of series 3056C.

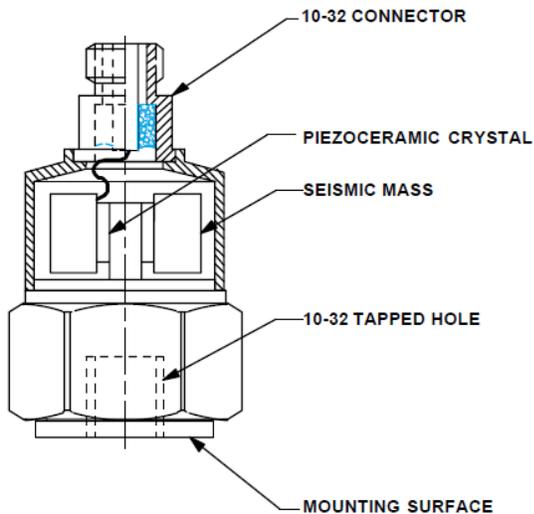


Figure 1-Cross section, series 3056C

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, to a flat crystal support, under hundreds of pounds of force. This is so there is absolutely no relative motion between mass, crystals and base 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 mass through the crystals, stressing the crystals in shear mode and producing an electrostatic charge signal analogous to the input acceleration.

Charge mode accelerometers are intended to be used, for the most part, with a very high input impedance amplifier called a charge amplifier. The charge amplifier is essentially a very high gain inverting amplifier with capacitive feedback. See figure 2 below.

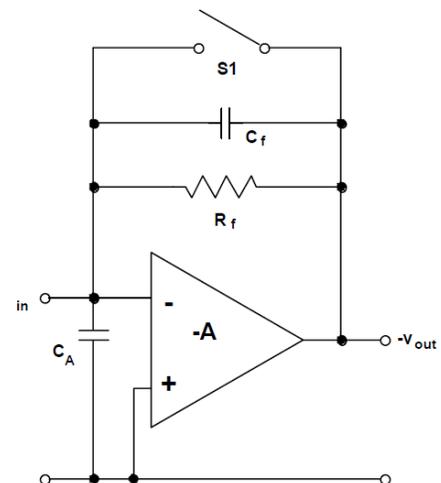


Figure 2-Functional schematic, the charge amplifier

CHARGE AMPLIFIER, BASIC THEORY

A charge amplifier is a special high gain, high input impedance inverting voltage amplifier with capacitive feedback. The amplifier is usually an operational amplifier (op-amp) with near infinite voltage gain.

Referring to Figure 2, the input charge q_{in} is applied to the summing junction (inverting input) of the charge amplifier and is distributed to the input capacitance of the amplifier C_A and the feedback capacitor C_f . We may write the equation:

$$q_{in} = q_A + q_f \quad \text{Eq 1}$$

Using the electrostatic equation $q = CV$ and substituting in equation 1:

$$q_{in} = v_A C_A + v_f C_f \quad \text{Eq 2}$$

Using equation 2 and making the appropriate substitutions and solving for the output voltage of the amplifier in terms of input charge, amplifier loop gain, and input and feedback capacitance we have:

$$V_{out} = \frac{-q_{in}}{C_A / A + C_f (A + 1)} = \frac{-q_{in}}{C_f (1 + 1 / A)} \times \frac{1}{1 + C_A / C_f (A + 1)} \quad \text{Eq 3}$$

where A is the open loop gain of the op-amp.

Now, letting gain A approach infinity, we have:

$$V_{out} = \frac{-q_{in}}{C_f} \quad \text{Eq 4}$$

This result (Eq 4) shows clearly that the transfer function (gain) of a charge amplifier is a function only of the value of the feedback capacitor C_f . Notice that input capacitance C_A has no effect on the sensitivity of the charge amplifier. This means that cable capacitance, for example, has no effect on the sensitivity, a significant find when switching cable lengths and types.

INSTALLATION

(Refer to Outline/Installation drawing 127-3056C) To install Model 3056C, 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 port in accordance with instructions on drawing 127-3056C. Clean the area to remove all traces of machining chips, burrs, etc.

Next, thread the Mod. 6200 mounting stud into the base of the 3056C. 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 3056C 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 3056C 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 lo-noise Models 6013AXX or 6019AXX) 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 3056C 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 charge amplifier. Consult the operating manual for the particular charge amplifier employed for instructions on its use.

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 resonant frequency is approached.

The frequency at which the sensitivity may increase or decrease by 5% is approximately 5,000 Hz, the frequency to which the 3056C series is calibrated. The accelerometer is usable above this frequency but to use it above 5,000 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 5kHz.

CAUTIONS

- 1) Do not store or use the 3056C above 375 degrees F.
- 2) Do not allow cables to vibrate unrestrained. This will eventually destroy the cable and could lead to system inaccuracies and noise.
- 3) Avoid dropping or striking the accelerometer, especially against rigid materials such as concrete and metals. While Model 3056C is intrinsically immune to shock induced overloads, the very high trauma induced by dropping can do permanent damage 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 3056C 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.

Since charge mode accelerometers are high impedance devices, it is essential that the connector insulation be kept at a high level. 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 3056C 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.