Interfacing Piezo to the signatureACE® System

Piezoelectric transducers like IMCO, HELM Load Plugs, or load probes, or Kistler piezo load sensors or accelerometers require a different technique than strain gages. The piezo device is a self-generating sensor that produces energy that is proportional to deformation of the piezo element.

Note that I used the word ENERGY - not current or voltage. The piezo device will produce a certain amount of energy when it is squeezed, but will also extract the same amount of energy when it is released. What is required to properly see the output of a piezo device is a "Charge Amplifier" which can be formed by connecting a capacitor across the + and - Signal inputs of the TEC™ module.

There is some belief that a piezo device is "Rate Sensitive" - i.e. they produce a greater output when squeezed quickly than they do if squeezed slowly. In fact they don't. It is the leakage of the charge amplifier that creates the "rate sensitivity", not the sensor. A high quality charge amplifier shows little difference related to "rate of change".

The signatureACE® input is superior to most front ends due to its low leakage, and high amplification, enabling the use of large capacitive loads to store the charge from the sensor. When a piezo device is connected to the TEC™ unit, some external components are required as illustrated below.

First the piezo signal must be centralized in the common mode range of the input amplifier. As shown below, the connection shown from –"Excitation" to "-Signal" accomplishes this. MAKE SURE the SA2000™ inputs used for piezo devices are set to 5-volt excitation BEFORE hooking the sensors up. **Failure to do this can result in system damage.**

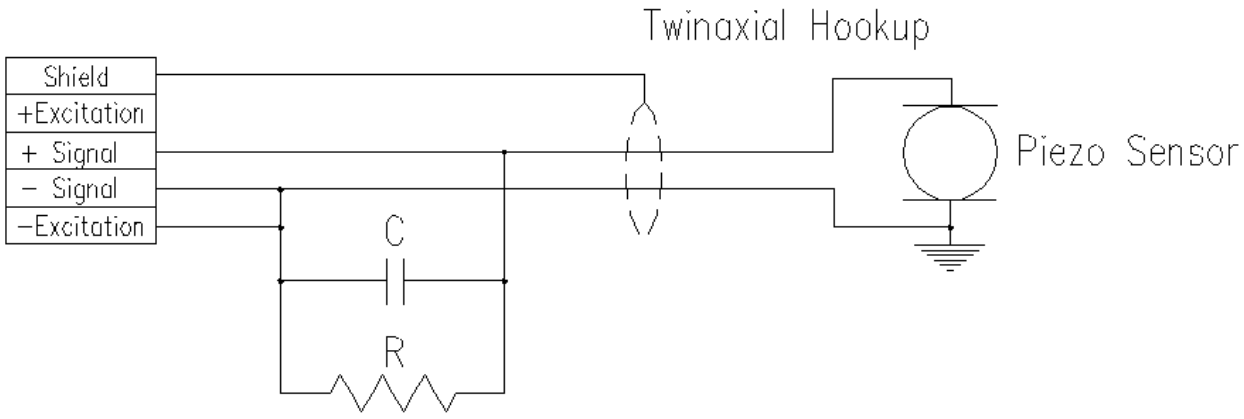

Figure # 1 - Piezo Twinaxial Sensor Interfacing (Preferred)

The 1 meg-ohm resistor "R" acts as a "Drain" to maintain the sensor at zero potential statically. The piezo sensor is then connected to the +/- Signal inputs as shown, and the gain of the channel is adjusted by shunting the input with the capacitor "C".

What we're looking for is to limit the signal level to either +/- 2.5 volts in LO Range, or +/- 0.005 volts in HI range (selected by the jumper at the channel input). In general it's better to run HI range, as this minimizes the "sag" in the signature at lower speeds. "C" Capacitor values in the 1 - 10 mfd. range are normally required.

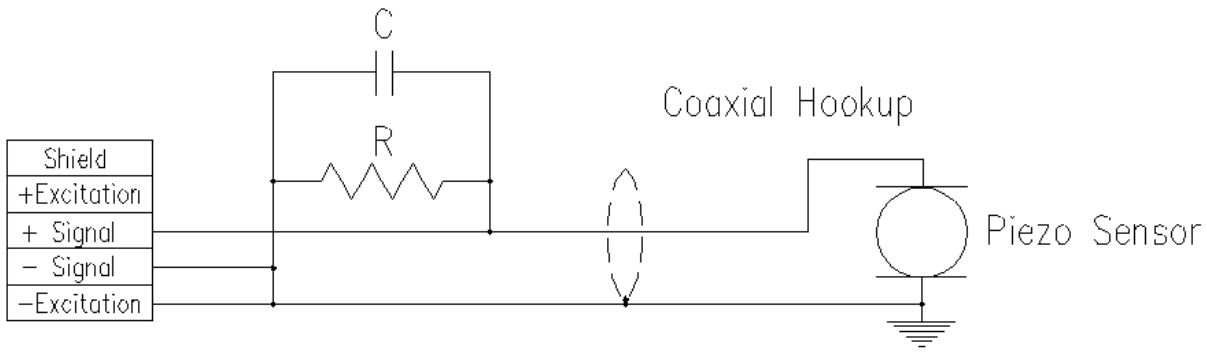

Figure # 2 - Piezo Coaxial Sensor Interfacing

The illustration above at Fig #16 features a “Twinax” or two-conductor shielded configuration such as would be used with InSitu Strip™ type sensors. If you purchase from other sources, a coaxial hookup will probably be supplied. It’s connected as shown in Fig #17.

If your machine always runs fast then you could use the LO range (fine for 200 S.P.M. and up), use capacitors in the 0.02 - 0.047 range to start, and trim to suit. If you flattop, use a bigger capacitor.

If "sag" is a problem, try increasing the value of the 1 meg-ohm resistor. Some channels of the SA2000™ will have less leakage current, and can be used with values as high as 10 meg-ohms, other channels can't. You'll have to find this out for yourself. The 1 meg-ohm value works for every channel. Use a good quality capacitor - polyester type to limit leakage. **Don't use electrolytic or Tantalum capacitors**.

Basic Tuning -

Start in HI (1000X gain) range, with a 1 meg-ohm resistor, and a 2 mfd. Capacitor connected as shown. If the signature is too big - i.e. flat-tops, increase the size of the capacitor. There’s no maximum value. If it gets REALLY big, then you may consider switching to LO gain, and starting again with a 0.05 Mfd Capacitor. Using a calibration factor of “1” set the signature so it’s about 1500 counts high.

IF there’s evidence of vertical drift in the signature then reduce the size of the resistor. You’ll find that the size of the signature won’t change much, but the “sag” on horizontal portions will increase with smaller resistor values. If the signature is stable, but “saggy” - i.e. an elevated portion of the signature that should be horizontal actually slopes down - you can try larger values of resistor, 3.3 meg-ohm or so, is normally as big as you can go. If you lose the signature altogether and just get a flat line, then the resistor is too big, and the leakage current has “wound up” the capacitor off scale.

Signature Technologies, Inc. • 13375 Stemmons Frwy., #320 • Dallas, Texas 75234 USA
Telephone: (972) 488-9777 • Fax: (972) 488-2924
www.signaturetechnologies.com