AN106

ACCELEROMETER WIRE TERMINATION

INTRODUCTION

Accelerometers used for high shock applications generally use wires which are very small in diameter. Sometimes these wires are not much larger than thread. The small size causes problems when the accelerometer must be interfaced to a recorder in high shock environments. If the wires are soldered directly to the recorder's analog board, the fragile wires will usually break under high shock due to movement.

Another problem encountered when using an accelerometer in a high shock environment is the high frequency ringing, generally up around 1 to 2 MHz. This can sometimes occur if a sensor goes into resonance when excited by an event, such as, a projectile impacting a concrete or steal target. The sensor in this mode of operation can produce outputs of several volts at these frequencies, which saturate the inputs of the recorder. Adding an external single-pole low-pass filter between the sensor and the inputs of the recorder can reduce this unwanted high frequency signal.

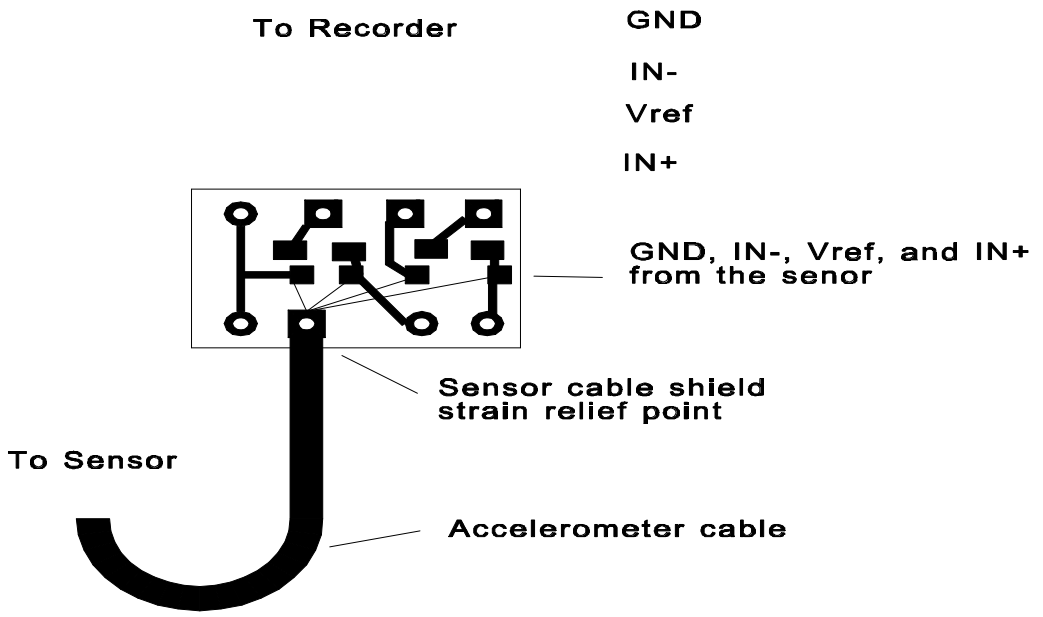

Figure 1. Accelerometer Termination Board

PACKAGING PROCEDURE

This application note describes one method used in mounting the accelerometer wires to the recorder for increased survivability, and shows where an external filter can be added between the sensor and the recorder's inputs to filter out unwanted signals.

The solution to the wire breakage problem is a rather simple one. Accelerometer wires break due to movement and their small physical size. If wires are made stationary, there is a reduced probability of a wire breaking. A way to accomplish this is by epoxying the wires directly to the recorder, which provides the necessary physical support. The problem with this approach is when

the need arises to change the sensor. With the wires glued to the recorder, it is sometimes difficult to remove each wire and damage might occur to the recorder's circuit board. A better solution is epoxying the wires to a separate board, and then attaching this board to the recorder with larger jumper wires.

This board is called an Accelerometer Termination Board, shown in Figure 1, which can be supplied by IES. The shielded cable that surrounds the accelerometer wires is soldered to the board and used as a strain relief. If the accelerometer cable is pulled, no loading occurs directly on the fragile wires inside the cable. The accelerometer wires are then soldered to the termination pads on the board. The whole area is epoxied to protect the wires from movement and breakage under high shock.

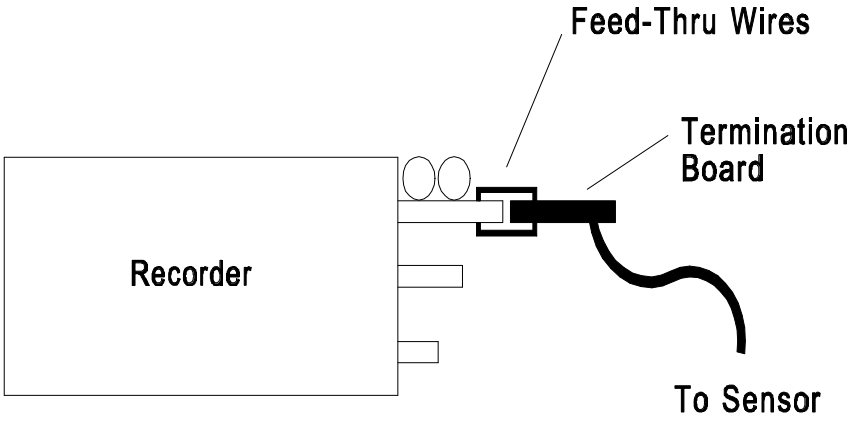

Figure 2. Recorder/Termination Board Placement

The accelerometer termination board can be mounted directly to the amplifier board on the recorder, as shown in Figure 2, with large wires, such as, 1/4 watt resistor leads. The termination board can also be mounted remotely, using larger gage, insulated wires, as interconnects.

WARNING. If the termination board is mounted directly on top of the recorder's analog board, a layer of Teflon tape should be placed between the amplifier and termination boards to prevent the solder pads of both boards from sticking to each other. This could result in a lifted or damaged pad on either board when removing the termination board from the recorder.

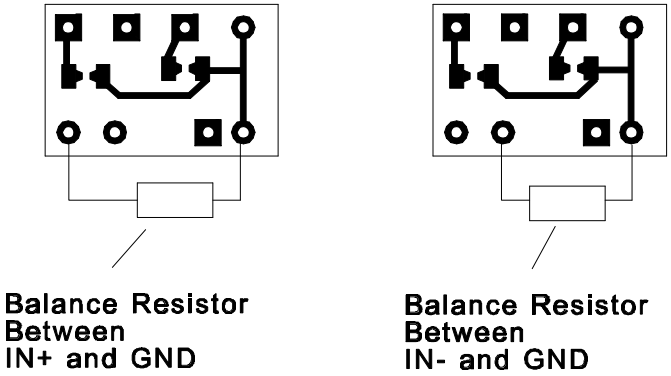

Figure 3. Balance Resistor Placement

Another advantage of using the termination board is when a balance resistor is needed for the accelerometer. Sometimes the resistive bridge sensor being used, requires balancing. If the bias resistor installed on the recorder does not give the correct DC bias voltage required for the test, a balance resistor must be installed across one leg of the sensor's bridge. This resister can be placed on the termination board as shown in Figure 3. If the balance resister installed between IN+ and Ground does not change the output bias voltage, then simply try the resistor between IN- and Ground. One or the other will work.

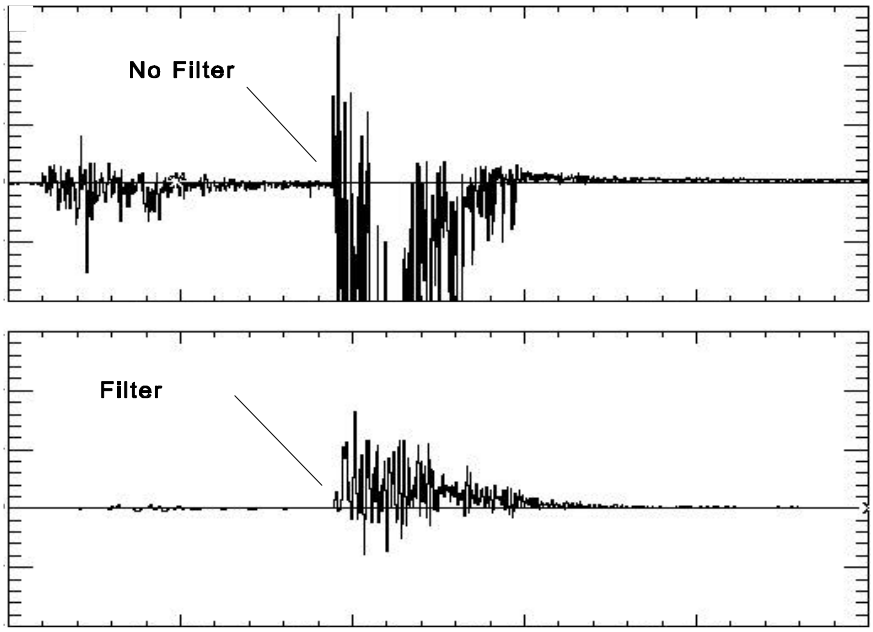

Figure 4. Filtered/Unfiltered Data

FILTERING OUT UNWANTED SIGNALS

It is beneficial to filter out high frequencies when the test environment drives the sensor into resonance. This event can cause higher than normal output voltages from the sensor and saturate the recorder's inputs, resulting in data dropouts. Figure 4 shows the effects of this problem. There are several methods to help reduce this problem if it occurs.

1. Use a sensor that will fit your application and has the HIGHEST resonant frequency specification. The higher the value, the harder it is to excite the sensor into resonance.

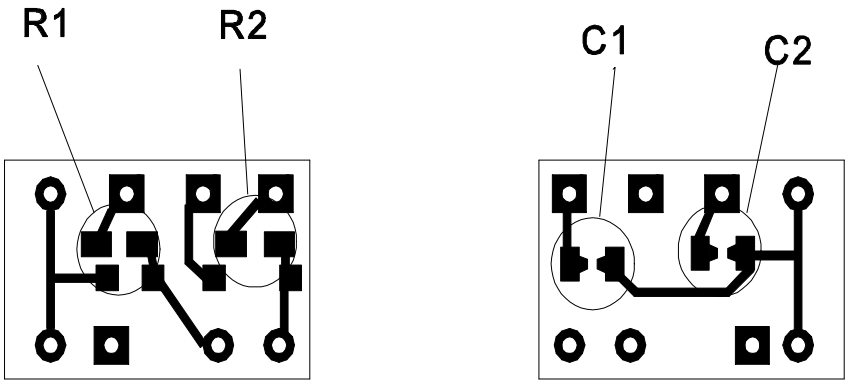

Figure 5. Filter Components

2. Use a electrical low-pass filter between the sensor and the inputs (IN+ and IN-) of the recorder. This reduces the high frequency signal from the sensor, which goes into the inputs. A pair of one-pole filters can be placed directly on the Accelerometer Termination Board, shown in Figure 5. Two resistor/capacitor pairs are required, one pair for IN+ and the other pair for IN-. It is important that R1 = R2, and C1 = C2. Select C1=C2=100pF and don't let each resistor exceed 100K ohms. It is good practice to set the cut-off frequency for at least the same value as the internal 4-pole filter of the recorder, but lower values can be selected. IMPORTANT NOTE: IF NO FILTER IS DESIRED, PLACE A JUMPER WHERE R1 AND R2 WOULD NORMALLY BE PLACED. The formula for the filter is:

FILTER FREQUENCY = 1/(2*Π*R*C)

3. Use a mechanical filter between the sensor's body and the mounting point on the test fixture. This can dampen the high frequency ringing from being transmitted from the test item to the sensor.

CONCLUSION

The Accelerometer Termination Board provides a convenient way of stabilizing the small wires of the sensor. It also provides a mounting platform for filter components.