Accelerometer Application Note

Output Sensitivity

The output sensitivity is the rated output, measured in mV/g, of the accelerometer that is set during manufacturing. The standard setting is 100 mV/g for industrial accelerometers having internal electronics such as those offered by Metrix. This means that for 1g of vibration at any frequency within the operating limits of the accelerometer, the output voltage will be 100 mV.

The operating limits of the accelerometer are defined by the low and high frequency cut-offs of the accelerometer; however the resonant frequency is also a factor. The specified operating amplitude range is usually 0 to 50g.

A good quality accelerometer has a low "noise floor" (low output when no vibration is present) and low cross-axis sensitivity (minimum effect by vibration in any axis except its sensitive axis). Standard accelerometers measure in one direction only. A high-performance accelerometer is measured by its rated deviation from 100 mV/g sensitivity over a frequency range. This is referred to as "frequency response" or pass band. A frequency response of ±5% is considered very good for an industrial accelerometer. The specified frequency response usually increases towards the low and high limits of its specified frequency range.

Operating Near Resonance

The output sensitivity of an accelerometer becomes both high and non-linear as you approach its resonant frequency. Newer accelerometer designs have limited maximum amplitudes at resonance so it is possible to use an accelerometer near this frequency region. A few years ago, this was not the case. Users were always cautioned to avoid the resonant frequency range. The new designs allow industrial accelerometers to be brought to the marketplace at a lower cost.

Overload and Ski-slope

It is usually impossible to overload an accelerometer with daily measurements in most industrial applications. This is due to the wide dynamic range (usually ±50g) of the accelerometers.

However, if you excite the resonance of an accelerometer, overloading is possible. This means there is a high frequency excitation force present. A few conditions that can cause this problem are:

1. Steam or compressed air is being vented near the accelerometer mounting point
2. An operator takes measurements on a heavily loaded gear box that is exhibiting even slight gear meshing "noise"
3. A loose accelerometer, due to improper installation
4. Severe cavitation in a pump (in rare situations) that causes high frequency turbulence

These characteristics are easily detected using a portable vibration analyzer to observe the spectrum of the vibration signal. The signal should be analyzed using a minimum range of 40 kHz.

If overloading does occur, the peaks of the signal reach a voltage operating limit and begin to flatten off. This can also be identified with a portable vibration analyzer to observe the time wave of the vibration signal. The flattening is referred to as clipping and may only be seen on either the positive or the negative peaks of the signal, not necessarily both. The clipping is seen as low frequency by a vibration measurement circuit and vibration spectrum analyzer. Suddenly, there are errors in the measurement. The vibration

APPLICATION NOTES

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spectrum analyzer shows a very high low-frequency amplitude which slopes down rather quickly as frequency increases. This is the "ski-slope" problem. There are other causes of ski-slope but this is a common one. Instability in the bias voltage of the accelerometer will also produce a ski-slope effect. Such instability may be caused by a loose accelerometer cable or by an unstable supply voltage to the associated measurement channel electronics.

Turn-on Time

Another measure of quality for industrial accelerometers is the length of time it takes to turn on when its bias voltage is applied. This is important for accelerometers being used where they are not powered all the time. For example, consider accelerometers connected to a switch box. The switch box is measured periodically by a portable instrument, so the accelerometers are only powered when switched to the portable instrument. If the accelerometer takes a long time to stabilize after power is applied, errors can occur in the data collected by the portable instrument. Accelerometers should turn on and become stable within a fraction of a second.

Industrial accelerometers are commonly supplied with a constant current source at a voltage level of 24 Vdc. The built-in electronics establish the operating bias voltage, usually 10 to 12 Vdc. A first level of trouble shooting an operating accelerometer is to measure the voltage at the connection to the measurement channel electronics. If everything is good, the bias voltage will be stable at 10 to 12 Vdc. If the voltage is low (0 to 3 Vdc), this usually indicates a fault within the accelerometer. If the voltage is high (24 Vdc), the trouble can most likely be traced to an open cable connection.

Accelerometers can be expected to operate for 10 to 12 years but may last even longer. They are equipped with solid-state electronics and have no moving parts to wear out. If an accelerometer is dropped, it should be checked before installing because its sensing element (crystal) may be broken by severe shock.

Installation

Accelerometers require a good mechanical connection between its base and the mating surface of the machine. Care should be taken when preparing the mounting point. Follow the directions in the Installation Manual or call Metrix for mounting assistance. Be sure to use a thin layer of silicon grease at the mounting point. Accelerometers are hermetically sealed so they will function well in most conditions. For moist environments, put a small dab of silicon grease on the end of the connector before inserting it into the mating connector of the accelerometer. This will displace air and prevent moisture from developing at this electrical juncture.