Technical note series:
The Basics of Vibration Measurement – A Very Practical Approach

Accelerometer Cable lengths – IEPE accelerometers

In this article we will review the issues of accelerometer cable lengths and potential noise issues and signal degradation with a focus on IEPE (integrated electronics piezoelectric) accelerometers where the internal electronics of the accelerometer is typically powered by the built in IEPE signal source within the data acquisition hardware.

An IEPE accelerometer uses a DC voltage and constant current supply to establish a bias voltage around which the AC signal output swings, typically this swing voltage is ±5VAC (or 5000mV). As this power is sent down the same cable as the signal output there are potential issues caused when cable lengths increase.

As the cable gets longer the capacitance builds up, this is an inherent feature of cables and not really something that can be avoided, a typical accelerometer cable capacitance is approximately 100pF/m (about 30pF/ft), there may be slight variations but not significant enough to make a real difference. The build up of capacitance effectively works as a low pass filter which starts to affect the higher frequency content of a signal.

The formula to calculate this is:

$$f_{max} = \frac{10^9}{2\pi CV/(I_c - 1)}$$

Where: fmax is maximum frequency
C = Cable capacitance
V = Voltage swing
Ic = IEPE supply source current

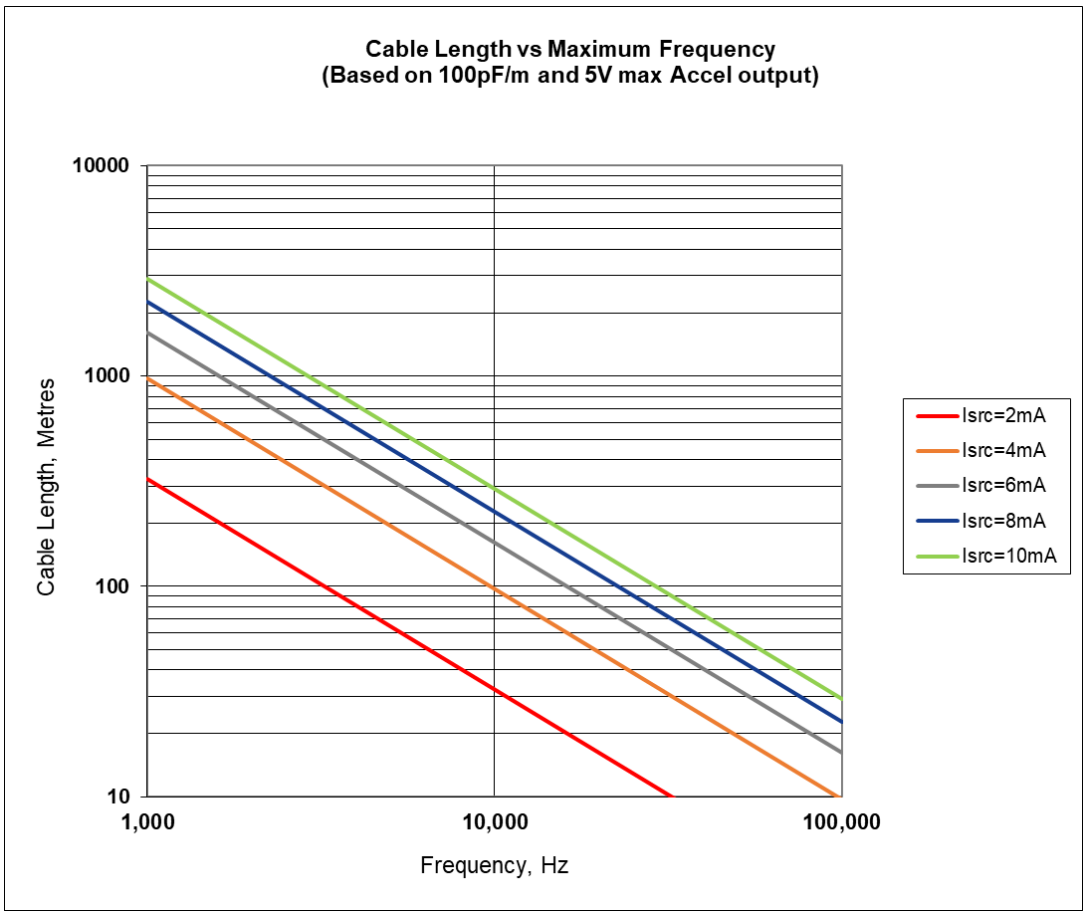
As capacitance is dictated by cable length and voltage swing is almost always 5V the only variable that can be changed to affect the fmax frequency is the IEPE supply source current. Most DAQ systems will supply either 2mA or 4mA as standard and many do not have the ability to change this, so cable length can have a significant effect on your ability to measure higher frequencies.

Kemo offers an online calculator to assist you when trying to determine if this is an issue that will affect your particular application visit https://kemo.com/technical-library/

As an example, if IEPE supply source current is 2mA, Voltage swing is 5V and capacitance is 100pF/m the maximum frequency is just 10kHz for a 32m cable, which is relatively short, if the IEPE supply source current is increased to 4mA the cable length increases to 95m for an fmax of 10kHz.

Knowledge of the IEPE supply source current from your chosen equipment is critical to understanding how the cable length will affect your results.

To summarise these conditions a graph comparing different IEPE supply source current



Many applications will suffer this issue if engineers do not pay attention to the details of IEPE supply current and cable length, if you need any support please contact Kemo to discuss how our IEPE signal conditioning systems 3X-I, 9X-I and DR1000 can solve your issues with variable IEPE signal source current.

Of course there are many other issues of possible noise interference which are associated with longer cables, however that is a topic for a another day.

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