



Practical considerations in using IEPE accelerometers with modern data acquisition systems

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Introduction

- ▶ Sensor manufacturers have offered high quality signal conditioning amplifiers for years
- ▶ Accelerometer makers in particular offer amplifiers for piezoelectric charge (PE) and piezoelectric voltage (IEPE) accelerometers
- ▶ Highly flexible, allowing almost any combination of input and output scale factors
- ▶ Output intended for use with a downstream data acquisition system

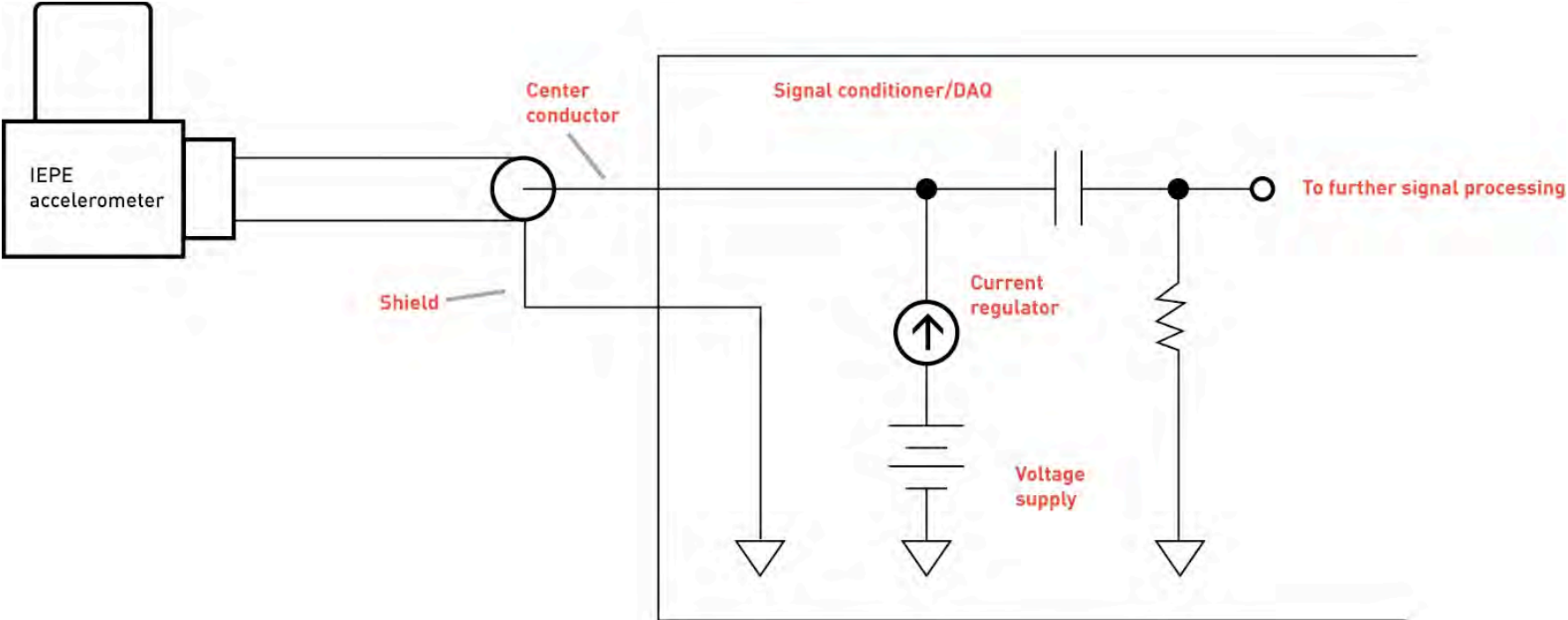


Introduction

- ▶ Historically, accelerometer manufacturers have not offered a data acquisition product, being satisfied with a signal conditioning offering
- ▶ With the rapid rise in popularity of IEPE accelerometers, several DAQ system vendors now offer IEPE accelerometer signal conditioning integrated into their systems
- ▶ A convenient, cost effective approach, but there are factors to consider when using these IEPE/DAQ systems, to ensure the quality of measurement is at the level required
- ▶ We will examine these factors one at a time



IEPE signal conditioning

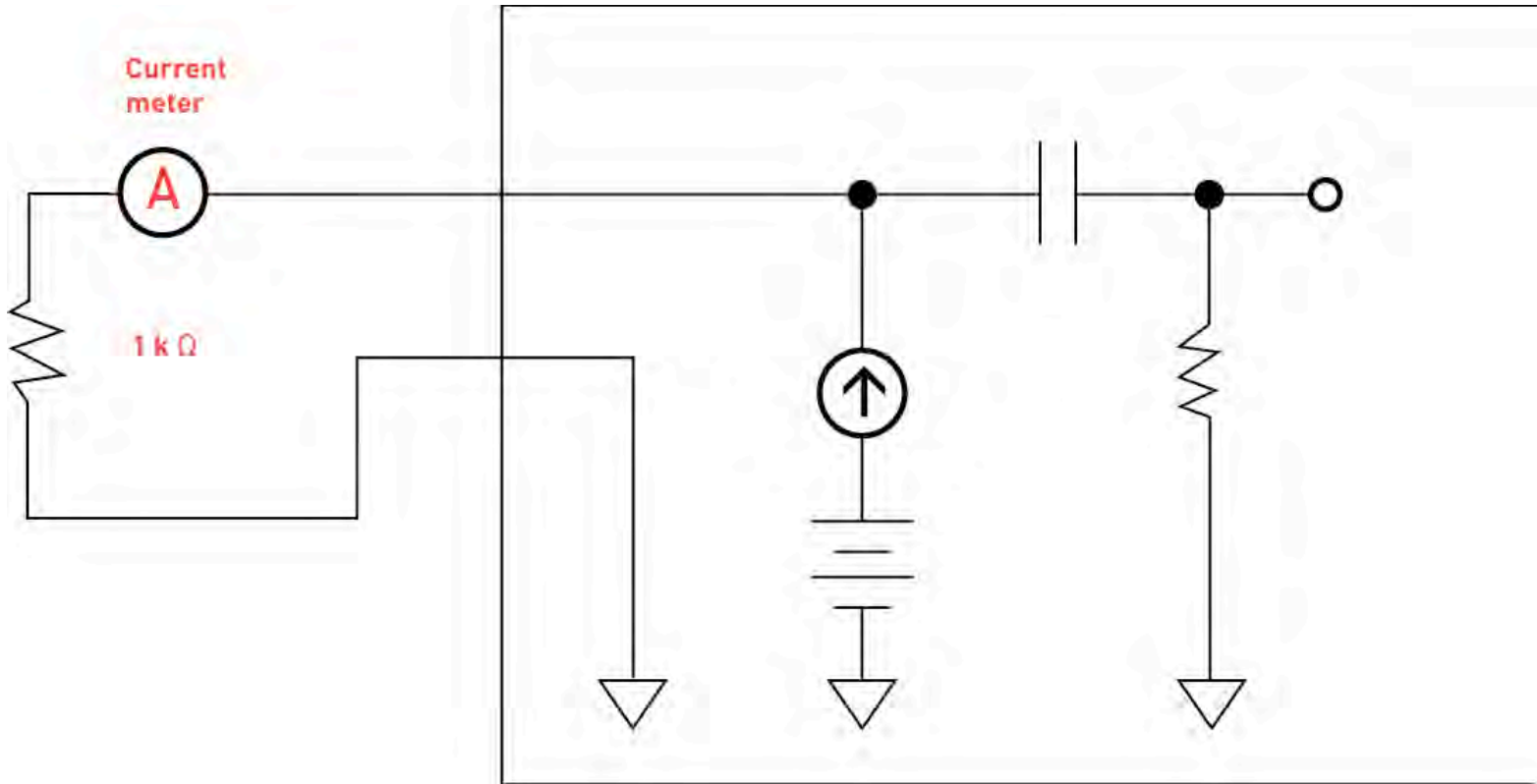




Power requirements - current

- ▶ Always refer to accelerometer's datasheet for power requirements, as there is no "standard" IEPE power
- ▶ Current requirements are often specified as a range, with minimum often being 2 mA, maximum sometimes as high as 20 mA
- ▶ The user must ensure the IEPE signal conditioner/DAQ can supply the minimum current required by the accelerometer
- ▶ Current supply capability of DAQ should be specified in datasheet – if not, it can be measured


Power requirements - current





Power requirements - current

- ▶ Note that more current than the specified minimum may be required, if application involves long cable lengths, and/or high amplitude, high frequency vibrations

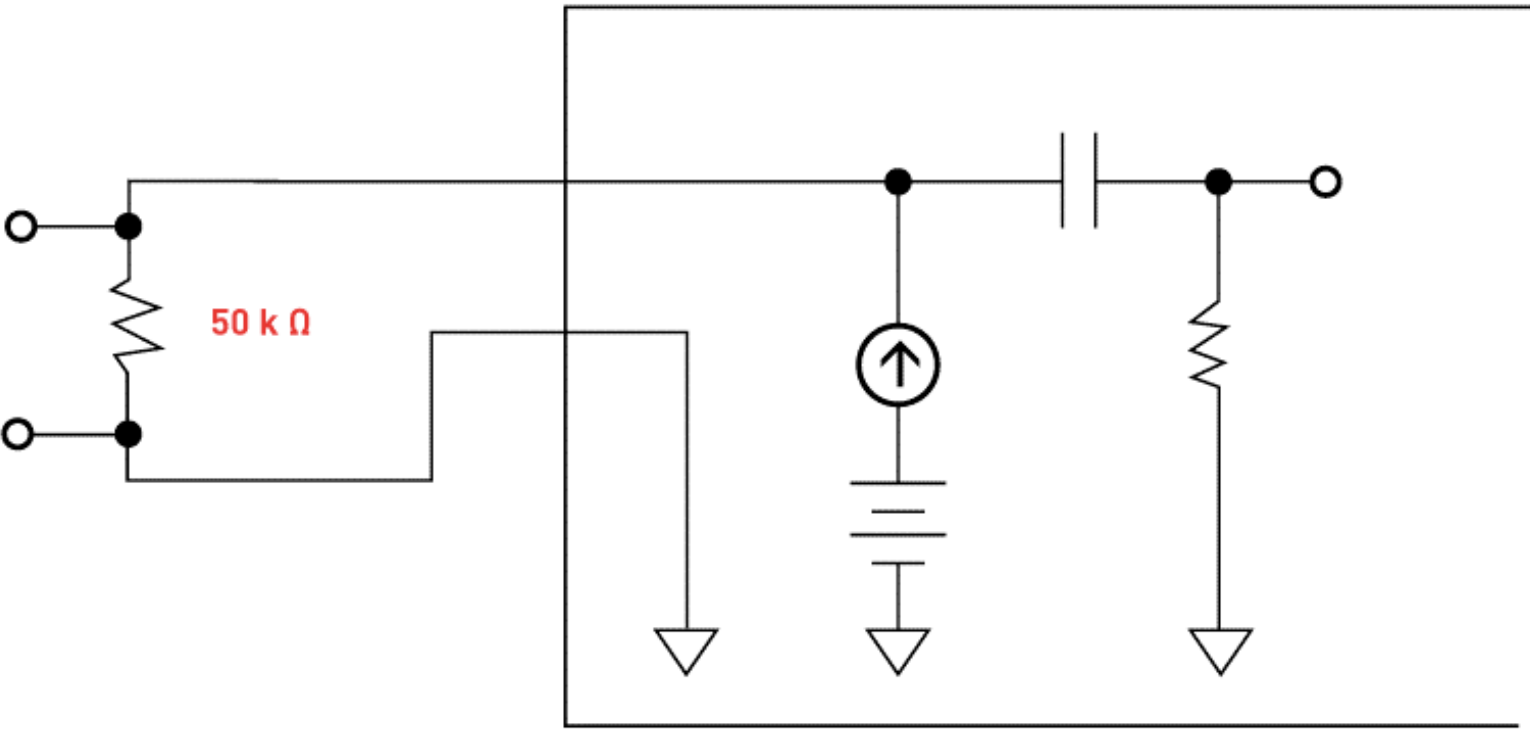


Power requirements – compliance voltage

- ▶ Accelerometer also requires a voltage in order to transmit a signal in a distortion free manner
- ▶ Known as the compliance voltage, it is the maximum voltage available from the constant current source
- ▶ As with the current, it is specified as a range, with minimum often being 18 Vdc, maximum as high as 30 Vdc
- ▶ User must ensure their IEPE signal conditioner/DAQ can supply minimum compliance voltage required by the accelerometer
- ▶ If not specified by the DAQ supplier, approximate value can be measured



Power requirements – compliance voltage





Power requirements – compliance voltage

- ▶ In some certain circumstances, it may be permissible to operate an IEPE accelerometer below the required minimum current and voltage
- ▶ Under no circumstances should an accelerometer be operated above specified maximums – doing so risks permanent damage to the sensor



Noise considerations

- ▶ Many IEPE accelerometers have excellent noise performance, the user must ensure the IEPE signal conditioner/DAQ system does not degrade this performance
- ▶ Some lower cost DAQ systems, particularly battery and USB powered units, can exhibit excess noise
- ▶ The culprit is typically a poorly or cheaply designed switching DC-to-DC converter in the power supply
- ▶ Not much the user can do about these, other than to be aware and avoid



Frequency response – high frequency

- ▶ Frequency response of IEPE accelerometers are usually well specified, user must consider what affect the IEPE signal conditioner/DAQ has on this response
- ▶ High frequency response is dependent on maximum acceleration, length (or capacitance) of cable and current available from DAQ system
- ▶ This dependency can be expressed as:

$$f_{\max} = I / 2paSLC$$



Frequency response – high frequency

$$f_{\max} = I / 2paSLC$$

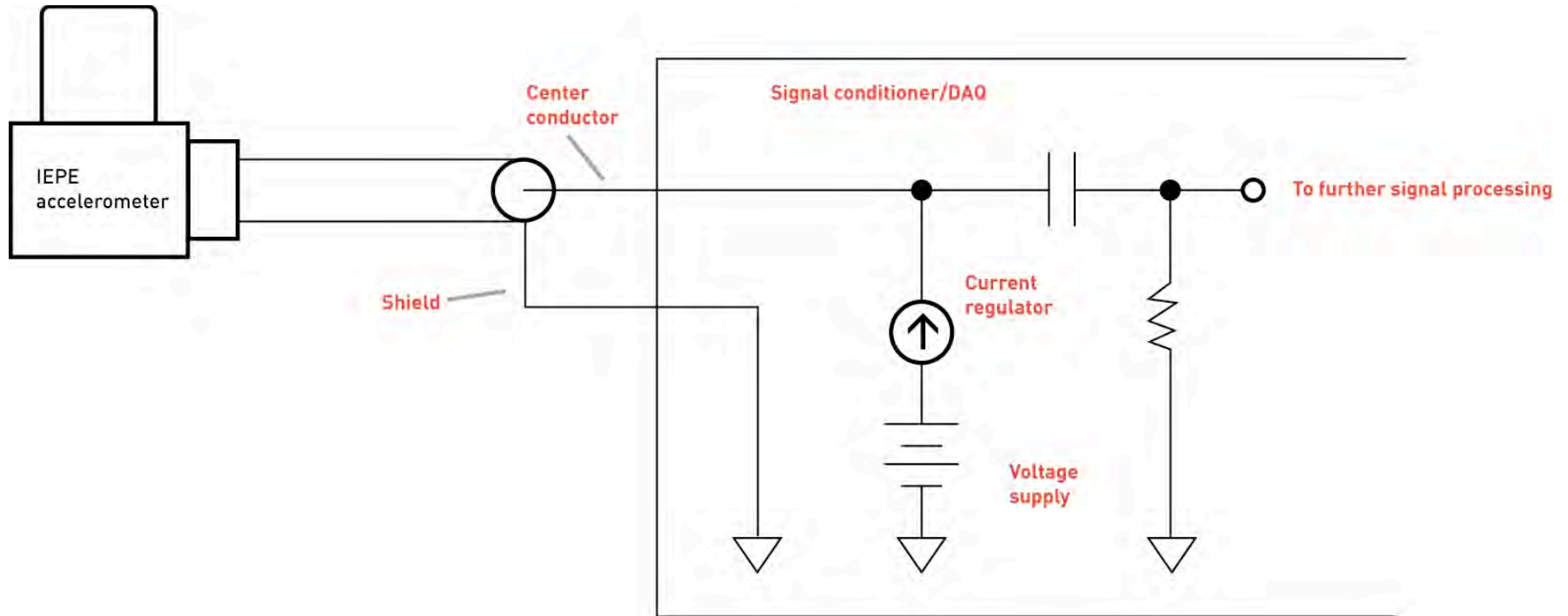
- ▶ Long cables (increased capacitance) will reduce system bandwidth
- ▶ If required to measure high amplitude accelerations and/or accelerations at high frequency, user must ensure the IEPE signal conditioning/DAQ system can supply sufficient current to achieve the system bandwidth required for the measurement



Frequency response – low frequency

- ▶ IEPE accelerometers output a DC bias voltage when properly powered, with the AC dynamic signal riding on this bias
- ▶ This DC bias must be stripped off in order for the dynamic signal to be further processed
- ▶ A simple RC network is typically used to do that, setting a low frequency cut off in the signal conditioner/DAQ system
- ▶ User must ensure this low frequency cut off is low enough for the measurement they are trying to make

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Conclusion

- ▶ Ensure signal conditioner/DAQ supplies required current for the accelerometer
- ▶ Ensure signal conditioner/DAQ supplies required compliance voltage for the accelerometer
- ▶ Consider noise performance of signal conditioner/DAQ
- ▶ Consider high frequency response of the system, in particular ensuring signal conditioner/DAQ supplies adequate current in addition to minimum required
- ▶ Consider low frequency response of the system



Questions?



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