IEPE Standard

Most modern accelerometers feature a built-in preamplifier. It transforms the high impedance charge output of the piezo-ceramics into a low impedance voltage signal which can be transmitted over longer distances. Metra uses the well-established IEPE standard for electronic accelerometers ensuring compatibility with equipment of other manufacturers. IEPE stands for "Integrated Electronics Piezo Electric". Other proprietary names for the same principle are LIVM, ICP®, CCLD, Isotron®, Deltatron®, Piezotron® and others.

Principle

The built-in circuit is powered by a constant current source (see Figure 4). This constant current source may be part of the instrument or a separate unit. The vibration signal is transmitted back to the supply as a modulated bias voltage. Both supply current and voltage output are transmitted via the same coaxial cable which can be as long as several hundred meters. The capacitor CC removes the sensor bias voltage from the instrument input providing a zero-based AC signal. Since the output impedance of the IEPE signal is typically 100 .. 300 Ohms, special low-noise sensor cable is not required. Standard low -cost coaxial cables are sufficient.

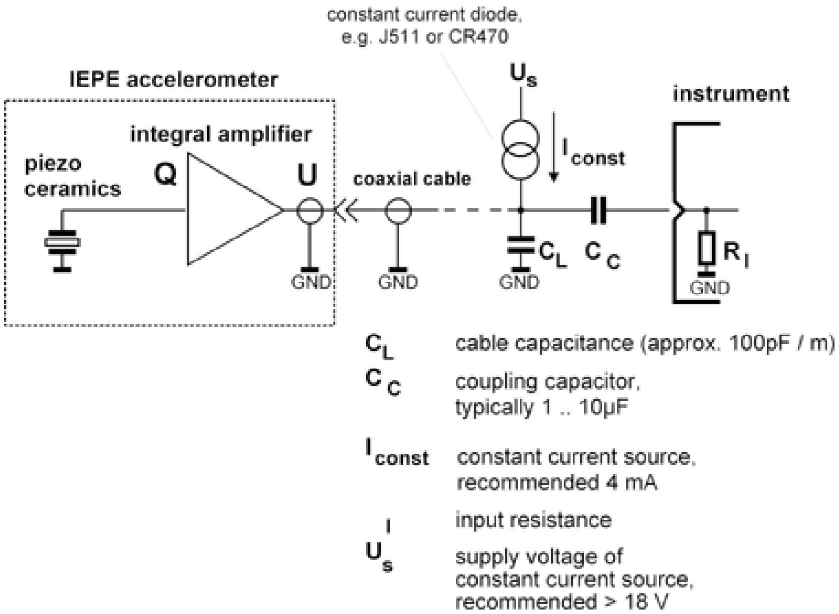

Figure 4: IEPE principle

The constant current may vary between 2 and 20 mA (Do not confuse with 4 to 20 mA standard!). The lower the constant current the higher the output impedance and, therefore, the susceptibility to EMI. A constant current value of 4 mA is a good compromise in most cases.

The bias voltage, i.e. the DC output voltage of the sensor without excitation, is typically between 12 and 14 V. It varies with supply current and temperature. The output signal of the sensor oscillates around this bias voltage. It can never become negative. The upper limit is set by the supply voltage of the constant current source. This supply or compliance voltage should be between 24 and 30 V. The lower limit is determined by the built-in amplifier. Metra guarantees an output span of > ± 5 V. Figure 5 illustrates the dynamic range of an IEPE compatible sensor.

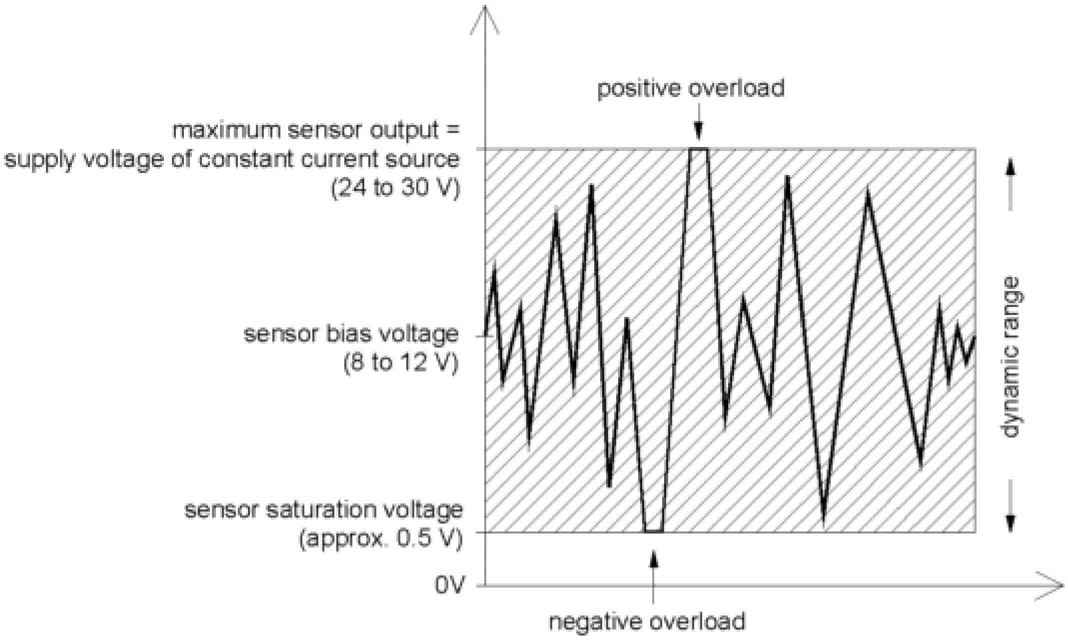

Figure 5: Dynamic range of IEPE transducers

Frequency Performance

The lower frequency limit of Metra´s transducers with integrated electronics is 0.3 Hz for most shear and bender accelerometers and 3 Hz for compression sensors. The upper frequency limit mainly depends on the mechanical properties of the sensor. In case of longer cables, their capacitance should be considered. Typical coaxial cables supplied by Metra have a capacitance of approximately 100 pF/m.

The nomogram in Figure 6 shows the maximum output span of an IEPE transducer over the frequency range for different cable capacitances and supply currents. With increasing cable capacitance the output span becomes lower. The reason for this influence is the reduced slew rate of the built-in amplifier at higher load capacitances. With very long cables the full output span of ± 6 V can only be reached at frequencies up to a few hundred Hertz. For a cable capacitance up to 10 nF (100 m standard coaxial cable) and 4 mA supply current the reduction of the output span can be neglected.

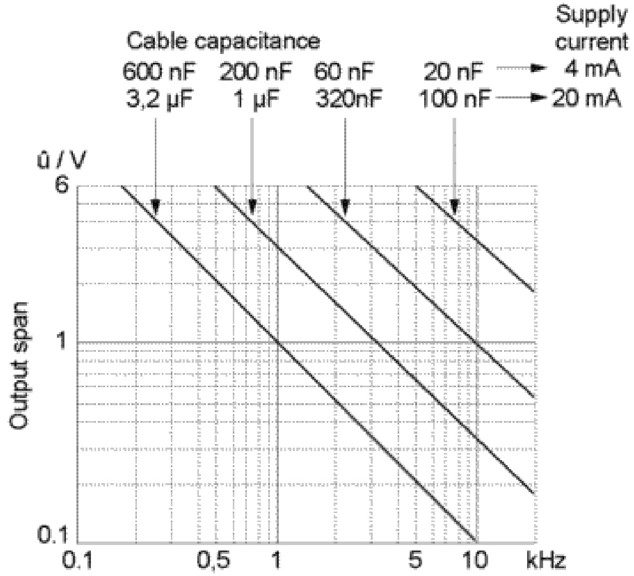

Figure 6: Output span of IEPE accelerometers for different cable capacitances and supply currents

Figure 7 shows the typical frequency response of the sensor electronics under the influence of different cable capacitances and supply currents. At higher capacitances the upper frequency limit drops due to the low pass filter formed by the output resistance and the cable capacitance. At 4 mA the cable capacitance can be up to 50 nF (500 m standard coaxial cable) without reduction of the upper frequency limit.

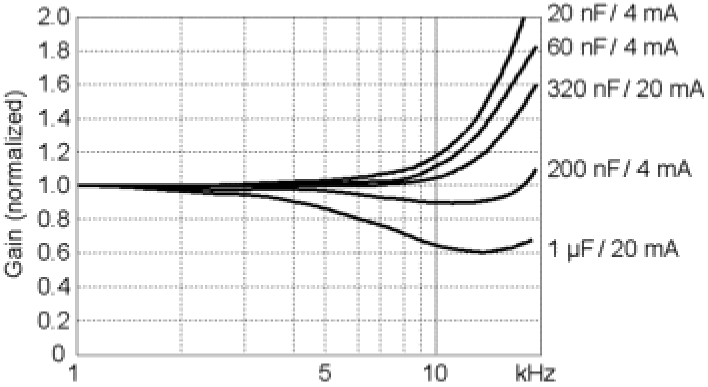

Figure 7: Frequency response of IEPE accelerometers for different cable capacitances and supply currents

Today in most applications IEPE accelerometers are preferred. However, charge mode accelerometers can be superior in some cases. The following table shows advantages and drawbacks of both sensor types.

	IEPE Sensors	Charge Mode Sensors
Advantage	Fixed sensitivity regardless of cable length and cable quality Low-impedance output can be transmitted over long cables in harsh environments Inexpensive signal conditioners and cables Intrinsic self-test function Withstands better harsh conditions like dirt and humidity	No power supply required - ideal for battery powered equipment No noise, highest resolution Wide dynamic range Higher operating temperatures Smaller sensors possible
Disadvantage	Constant current excitation required (reduces battery operating hours) Inherent noise source Upper operating temperature limited to <120 °C	Limited cable length (< 10 m) Special low noise cable required Charge amplifier required