CONDITIONING

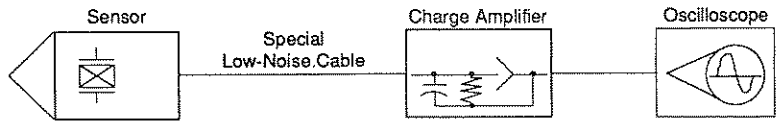
Electronic signal and power conditioning structures govern or modify the functional transfer behavior of sensor systems...

Interacting with neighboring instruments through energy transferring transactions, electronic signal conditioners function to transfer a sensor's electrical output into a communicable signal compatible with recorders or analyzers. Sometimes called modifying transducers, they amplify, attenuate, filter, standardize, limit, debias, clamp, check, calibrate, isolate, reject, convert, compensate, drive or monitor.

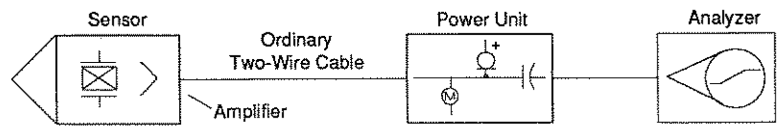
Power conditioners function to transfer raw electrical power into regulated voltages or currents for exciting sensors and powering amplifiers.

In the piezoelectric systems illustrated, a charge or voltage-type isolation amplifier with an ultra-high (10 000 000 000 ohms) input impedance and a relatively low output impedance (10 ohms) is required for a valid low-frequency measuring transaction. If directly connected, the charge signal from the crystal would quickly leak away through the input resistance of the analyzer.

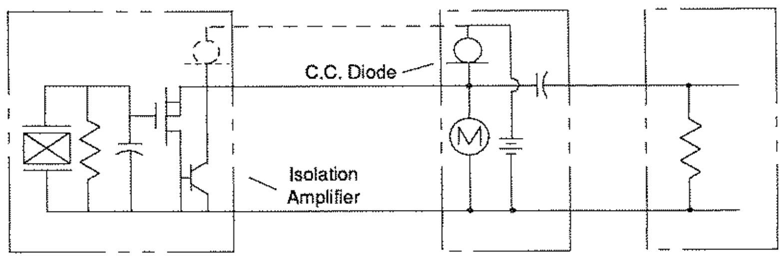
Both charge and voltage-type amplifiers employ a capacitor to convert charge into voltage according to the law of electrostatics: $E = Q/C$. They differ primarily in the location of this capacitor. External charge amplifiers offer control of the capacitor discharge time, whereas, ICP voltage-mode sensors seal the troublesome ultra-high impedance amplifier and cable components within the sensor case.

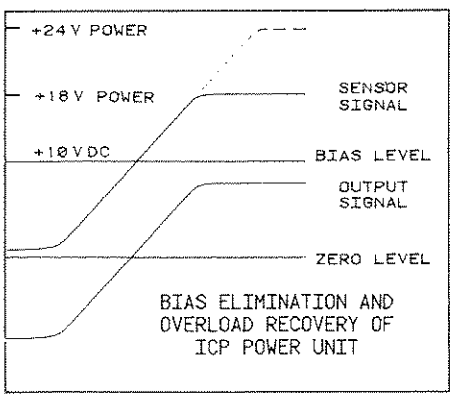


Conventional Charge-Mode System

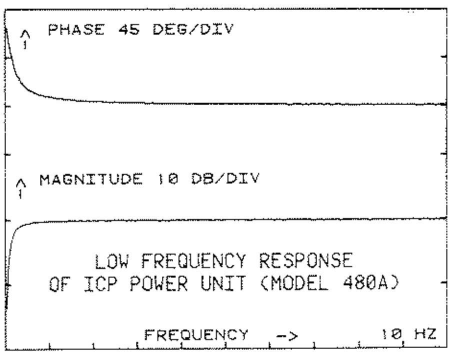


Modern ICP* Voltage-Mode System



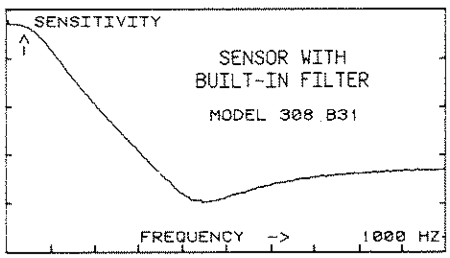


Basic ICP (integrated-circuit-piezoelectric) conditioners power the sensor over the signal lead, debias the output signal and indicate faults. The meter indicates red for short circuits and yellow for open circuits. Exciting the sensor with constant current power permits two-wire operation over coaxial or ordinary cable. The power supply voltage limits the positive-going signal excursion, which has been extended to over 10 volts in the newer models. Some commercial analyzers now feature built-in ICP conditioners.



The low frequency, quasi-static behavior of ICP systems is determined by the sensor discharge circuit and by AC coupling circuits in the conditioner or analyzer. Both of these circuits behave the same. They function as high-pass filters to block the transfer of DC signal components, allowing unattended drift free AC operation.

The high-frequency response of ICP sensor systems depends upon the behavior of the sensor's mechanical structure and electronic low-pass filters in the sensor, conditioner or analyzer. The frequency response of an accelerometer with a built-in charge-driven filter located ahead of any amplifier is illustrated.



Because of the automatic rezeroing action of the discharge circuit eliminating static signal components, piezoelectric sensors generally measure relative to the initial level for transient events and relative to the average signal level for repetitive phenomena. Sometimes the slow action of these circuits is mistaken for zero drift by impatient operators. Certain situations usually require special or modified signal conditioners, such as: (1) driving long cables with shock or blast signals, (2) monitoring zero-based repetitive events, (3) rejecting ground-loop noise, (4) operating in hazardous environments, (5) testing transfer behavior at very low frequencies and (6) operating at very high temperature.

* Integrated-Circuit-Piezoelectric