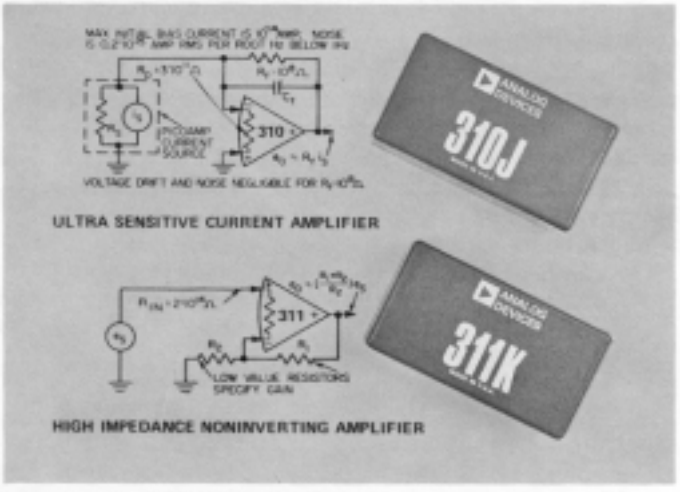
Ultra Low Bias Current Varactor Bridge Operational Amplifiers

Models 310, 311

FEATURES
Guaranteed Low Bias: 10^{-14} A max
Low Voltage Drift: 10μV/°C max (310K, 311K)
Versatility: Noninverting, model 31IJ/K
Inverting, model 310J/K
High Input Impedance: 10^{14} Ω(311J, 311K)

APPLICATIONS
Femto-ammeter
Electrometer
Long-Time Integrator
Small-Rate Differentiator
Flame Current Detector
Phototube Amplifier
Log Compressor
pH Meter



GENERAL DESCRIPTION

The models 310 and 311 are operational amplifiers with extremely low input bias currents and high input impedances. As such, they are applicable to a large number of *electrometer* amplifier applications which have traditionally been fulfilled (not without difficulty) by vacuum electrometer tubes. These specialized requirements are characterized by extremely high source impedances or where infinitesimal currents must be measured or amplified. Because of varactor bridge inputs, the all solid state 310 and 311 amplifiers are ideally suited to this type of requirement. Voltage drifts are small, noise is minimized, and the cost is low. In principles the operation of varactor bridge amplifiers is similar to that of vibrating reed electrometers (parametric), but also includes the inherent advantages of solid state design.

VOLTAGE SOURCE OR CURRENT SOURCE?

Model 310 - The model 310 is designed such that the high quality signal input is the *inverting* input terminal, and is most appropriate for measurements of *current* signals. This type of signal source is common to gas chromatograph flame detectors, photomultiplier tubes, radiation detectors, etc. The inverting model 310 is also useful for logarithmic compression over an extremely wide dynamic range and in the construction of very-long-time-constant integrators or differentiators. Input signals from picoamps to milliamps may be accommodated with femtoamp current resolution.

Model 311 - The311 is similar to the 310 but the high quality input is the positive or *non-inverting* input. It is primarily intended for measurement of voltages from very high source impedances. Such sources are found in the glass electrodes of pH cells and other scientific measurement apparatus. Another such source is charge stored on the plates of a capacitor, as is found in long-time track-and-hold applications.

Table 1. Comparison of Electrometer Types

TYPE	VARACTOR BRIDGE	VIBRATING CAPACITOR	MOSFET	ELECTROMETER TUBES
I-Stability	good	excellent	good	good
V-Stability	excellent	excellent	fair	poor
Bandwidth	narrow	narrow	wide	wide
Overload Protection	easy	easy	difficult	—
CMR	excellent	excellent	fair	poor
Microphonics	fair	fair	good	poor
Warm-up	fast	fast	fast	slow
Size	small	large	small	large
Price	low	high	medium	medium

The chart above shows the relative advantages of various electrometer types. The best performance possible is given by the vibrating reed electrometer. it should be remembered, however, that this is a large, expensive laboratory instrument not generally suitable for instrument construction.

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