

Abstract

A low-leakage transimpedance amplifier front-end converts picoampere-level sensor currents into voltage while remaining immune to humidity-driven leakage and kilovolt transients. The circuit uses: an operational amplifier (110) with a parallel feedback resistor and capacitor to set gain and integration time; a driven guard conductor (120) that surrounds the high-impedance input and also drives the inner shield of a triaxial cable (150), thereby suppressing cable and PCB leakage; a milled creepage-increasing slot (180) around the input pad plus a transient-voltage-suppressor diode (170) that clamps surges; and an on-board charge-pump converter (160) enclosed by the guard ring so that its switching ripple cannot couple into the measurement node. A microcontroller can momentarily disable the guard to verify integrity and applies a stored humidity-offset map to correct baseline drift. The arrangement enables stable picoampere measurement on a cost-effective two-layer PCB suitable for field air-quality monitors.