

Switching preamp improves a-d converter sensitivity

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The low-signal resolution of even the best analog-to-digital converters, including those equipped to eliminate input-offset disturbances, is limited by the noise generated at the inputs. But the resolution, and thus the true sensitivity, of a converter can be inexpensively improved by an order of magnitude if a switched, differential amplifier is employed at the input to precancel offset errors without affecting the normal conversion process.

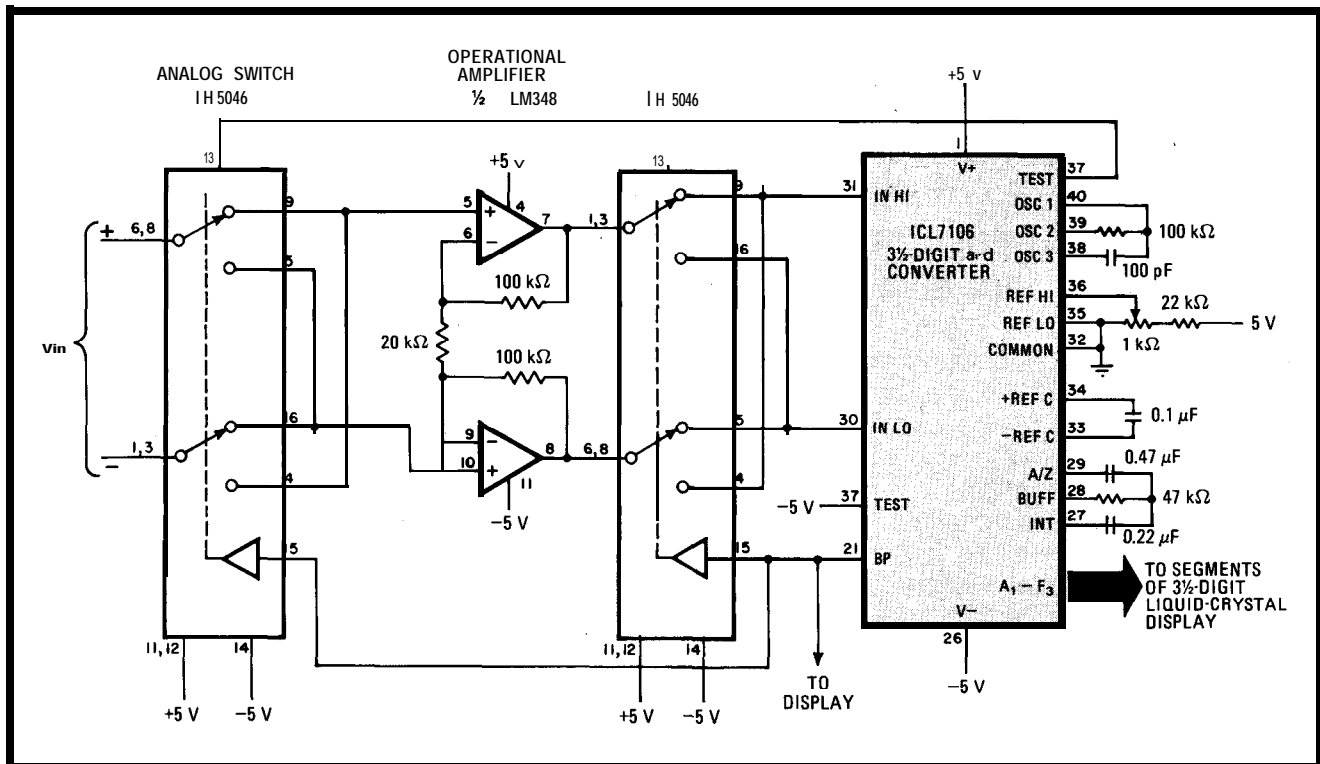
The technique is illustrated for Intersil's ICL7106 3½-digit autozero converter/display driver, which normally handles signals over the range of 100 millivolts to 2 volts. In such a converter, the small input noise voltage trapped on the autozero capacitor during a conversion sets the aforementioned lower signal-handling limit. The noise (which is caused by the equivalent noise resistance at the input, not a component of the signal) can be minimized to a great degree with preamplifiers having low offset voltage, but this can be a rather

expensive solution to the problem.

As shown, an alternative approach is to use the liquid-crystal-display backplane (BP) drive output of the ICL7106 to synchronously switch one half of the low-cost LM348 quad operational amplifier via analog switches so that, over a switching cycle, the input of the converter sees no instantaneous change in the magnitude or polarity of sample voltage V_{in} . Offset voltages, including that of the op amp, on the other hand, are virtually canceled because an equal but opposite noise component (average value is near zero) is applied to the IN HI (and IN LO) ports of the converter over a given interval. In this case, the switching (BP) signal is set at 45 kilohertz, but this can be varied by suitable selection of the RC components at pins 38 and 39 of the ICL7106. In this configuration, excellent performance is obtained for input signals ranging from 1 to 20 mv full scale.

Most dual (matched) op amps will be suitable for the switching task, but it is important that both the positive and negative slew rates of the device be reasonably close. Op amps having significant crossover distortion (such as the LM 124/324) should not be used.

The CD4053 or the Intersil IH5046 will serve well as the analog switches. In the case of the 4053, 1% devices will be required. Only one double-pole, double-throw switch is contained in each 5046, however, and so two of these devices would be required. □



Precancelled. Switching the signal-handling op amp at supersonic rate virtually eliminates input-offset errors of converter, thereby improving sensitivity. Converter's input sees no instantaneous change in V_{in} during switching cycle, and normal conversion process is not affected. But offset voltage at input is alternately fed to (+) and (-) ports; thus equivalent noise voltage over cycle is near zero.