

# Low-power op amp reduces cable costs

The extremely high source impedance of a pH probe ( $10^{12}\Omega$ ) often mandates the use of low-loss Teflon cable between the probe and its meter electronics. Such cable costs several dollars per foot. As an alternative, you can buffer the probe with a MAX406 low-power op amp that allows the use of ordinary, less-expensive coaxial cable instead. The resulting system (Figure 1) includes a general-purpose pH electrode, a buffer circuit, and a simple LCD-meter circuit based on a 3<sup>1</sup>/<sub>2</sub>-digit, integrating-type A/D converter (IC2).

If desired, you can install the op amp and its power supply (a small lithium battery) within the probe housing. The entire probe-interface circuit consumes less

than 1.5 $\mu$ A, and operates for thousands of hours on the DL1620B lithium cell shown.

The resistive divider R1/R2, whose output is midway between the 3V battery's terminals, provides a reference potential for the pH probe. This potential, connected via the coax shield to pin 32 of IC2, also establishes a common-mode reference for the A/D converter. (Pin 32 is generally 3V below the converter's V<sup>+</sup> level at pin 1.) Potentiometer R3 introduces an adjustable 700mV offset. By shifting the probe's  $\pm$ 700mV output range to one of 0 to 1400mV, this offset provides an output compatible with the intended display range of 0 to 14 pH.

(Circle 4)

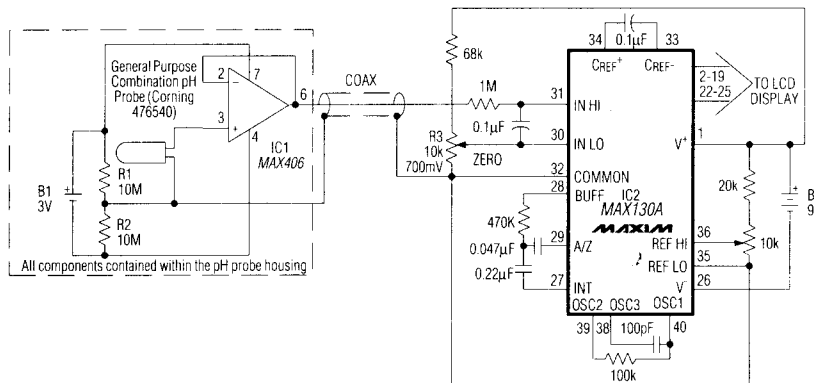


Figure 1. Adding a low-power op amp buffer (IC1) to the output of a high-impedance pH probe allows use of ordinary coaxial cable in place of the expensive Teflon cable otherwise required.