LETTERS

Write to Letters, Radio-Electronics, 500-B Bi-County Blv

MULTILAYER SOLUTION

I am an electronics technician in the Navy, currently working as an instructor in the Navy's miniature/micro-miniature (2M) electronic repair program. I read the letter from V. Deeoh, titled "Multilayer Woes," that appeared in the *Ask R-E* column in the June issue of **Radio-Electronics**. The repair is possible. In fact, as I write this letter, I have five students in various stages of performing such a repair. It requires the use of various dental tools and a stereo-zoom microscope. It also requires a large amount of skill and patience. Of course, the damage would have to be isolated before the repair could be attempted.

ET1(SW) BRIAN K. FOWLER
Norfolk, VA

ELECTRONIC COMPASS CORRECTIONS

The "Electronic Compass" article (**Radio-Electronics**, June 1991) caught my attention, since I would like to build a device to measure magnetic field strengths in the order of Earth's and less. I thought that I might even use part of the compass circuitry—until I discovered what looks like a fatal flaw.

The article says that the Hall Effect sensors have a nominal 2.5-volt output that varies up or down about 1.3 mV per Gauss, depending on the field direction. Actually, that isn't stated clearly, but is implied and sounds reasonable. Thus, the inputs to resistors R1 and R2 will ideally be identical at 2.5 volts in the east-west orientation. By my concept of ideal op-amps, the voltage at pin 3 of IC2-a is entirely dependent upon the divider R4-R2, and the voltage from IC4 will be about 2.38 V. In an ideal op-amp, the voltage at pin 2 will be the same. The only way that can happen with both sensors at 2.5 volts is for pin 1 to be at zero volts, but the text says the voltage will be between 2 and 3 volts and the rest of the circuit depends upon it being in that range.

Next, I built that part of the circuit using adjustable supplies to replace the sensors. As my theory predicted, the output at pin 1 is near zero (actually 0.052 V) when equal voltages are applied to R1 and R2. I have found out from past tests of LM324's that they don't actually go to zero output. Mine are always 50 mV or so positive, and they are also quite nonlinear in gain in that region. I once attempted to use an LM324 as a differential amplifier with inputs quite similar to the compass circuit (differing by only millivolts). I gave it up primarily because of the nonlinear gain with near zero output voltage.

The text says that the gain of IC2-b is 100, but the resistors used with it give a gain of only 10. Also, the parts list is mixed up for the IC listing.

Something is seriously wrong. My lab tests agree with my theory, yet the published circuit apparently works. Please explain.

KENNETH E. STONE
Cherryvale, KS

Mr. Stone's analysis of circuit operation is correct. The circuit will operate as published if the quiescent output voltage of IC4 is greater than that of IC3. That will cause pin 1 of IC2 to assume a positive value and operate with linear circuit gain.

In order to force the output of IC2 pin 1 to assume a voltage level between 2 and 3 volts, R4 should be deleted from the circuit. That will cause pins 3, 2, and 1 to assume a nominal voltage of 2.5 volts. The voltage gain of IC2-b is 10, as determined by the values of resistors R6 and R5. The identification of the IC's specified in the parts list is incorrect. IC2 is LM324N, while IC3 and IC4 are the Hall sensors.

ANTHONY J. CARISTI

PROFITS OR PROGRESS?

Forty years ago, the first computer filled a large room, weighted 30 tons, and needed 19,000 vacuum tubes in order to function. Today, a desktop computer with silicon chips instead of tubes can do anything the 20-ton dinosaur did, and do it better. That's progress!

If we had the same kind of progress