

Case of the Deep-Fried Resistors



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I was working at LeCroy Corp. in Beaverton, Ore., when I was asked to do a test on some recently developed probes. The instructions were to "cover them with thermal blanket before testing." I had 10 to do, so I didn't wait long for them to warm up, maybe a minute or two. I proceeded to test all 10 probes and calibrate them. They all appeared fine.

I was surprised when I was told they were all failing a subsequent test. The failure mode was DC offset. When a differential probe has nothing on its two inputs, the output should be zero. I asked my friend, John Addis, who designed the probes: "What is going on here?" He told me the first two resistors were as good as any on the market, but they still had matching issues. I thought about this for a bit. John mentioned that Agilent had a circuit in this area that pulled away bias currents.

The night before I started to try solving the problem, our dinner at home was steak and a mixture of cheeses, dipped in a deep fryer. It gave me an idea.

I talked with John the next day and said: "If we can't buy any better resistors, maybe we can make them better." I took the deep fryer from our kitchen and brought it to work. We tried water and alcohol first, but the HP 34401 was showing faint leakage.

We made a trip to the local grocery store for some mineral oil. That worked well. So using a thermocouple and a Variac, we stabilized the oil at 55C. We developed a process that used Pomona tweezers to pick up the 0805 resistor, and let the meter stabilize on 6 1/2 digit slow mode, and then engage a null-to-zero reading. After a minute in the oil, the meter was reading the relative temperature coefficient. The sample was then binned according to its drift.

Before we developed this process, the probes would exhibit many divisions of offset from turn-on to 10 minutes. After I installed some thermally matched parts, I tested a probe, zeroed it, and stuck it in the burn-in chamber. We let it stabilize, and then we quickly powered it up. Wow, rock solid flat line, right where it should be. I then stuck the UUT in our employee freezer. Once again, right on zero. We started matching parts and supplying kits to assemblers.

When the build process moved to corporate headquarters, I heard some negative comments about the deep-fried solution. However, sometimes engineers must use whatever tools are available in order to stamp out their problems.

Steve Lindberg has loved electronics since he received his first Weller soldering gun when he was 12. He has 35 years of experience in test, debug, and design.

This entry was submitted by Steve Lindberg and edited by Rob Spiegel.

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