ALBERT HELFRICK • EMBRY-RIDDLE AERONAUTICAL UNIVERSITY

The Ex-scope-ist

Many years ago, in my college days, I was an intern at a large computer manufacturer. I worked in a repair and refurbishing shop, where I analyzed and typically repaired electromechanical "business machines" and installed updates and engineering improvements. In the corner of this shop was the instrument-repair facility for the repair of service equipment, such as voltmeters, pulse generators, and—most important for the new all-electronic digital computers—oscilloscopes.

On occasion, I would help the instrument-repair technician tackle an unusually difficult repair. I had been an amateur radio operator since I was 11 years old, had worked for a TV-repair shop before I was old enough to drive the shop's truck, and was adept at fixing electronic equipment.

One day, the technician at the repair shop was exceedingly puzzled, and I asked whether I could help. He had just performed a complete calibration of a perfectly good operating oscilloscope and was ready to ship the unit back to the field. Inexplicably, however, it developed a constant offset of some 50 mV or so.

Those old vacuum-tube oscilloscopes had numerous dc-coupled stages of differential amplifiers to provide the several hundred volts to deflect the electron beam of the CRT. To have a ground potential that resulted in positioning the beam in the center of the screen, all the cascaded amplifiers had to have nearly 0V offset voltage. Some of the amplifiers had adjustments, and some required reasonably matched vacuum tubes.

Using another oscilloscope, the technician carefully probed the vertical amplifiers, working his way back from the deflection plates stage by stage, but he could not find the source of the constant offset. He then disconnected one stage from another and finally worked his way to the input stage, where he still detected an offset.

"There is nothing left," he lamented. "I have only the front-panel connector and the input attenuator in the circuit, and I still see an offset."

I immediately recognized the problem. "Your oscilloscope is possessed! It needs to be exorcised," I declared.

Ready to accept any explanation, he asked, "How can we exorcise it?"

"Put the scope on the cart and pull it away from the workbench," I replied. "We need to heat the scope to drive out the devil."

I grabbed the technician's heat gun and started to wave the hot air around the oscilloscope. "Oh wadda, oh wadda goo, oh wadda goo Siam," I chanted as I waved the heat gun around the sides and top of the oscilloscope, making sure to bathe the front panel with plenty of air. I then told the technician to power up the oscilloscope and see whether I had exorcised the evil spirit.

He powered the unit back up and, with a shriek of disbelief, remarked, "It's gone! There is no offset!" After a few minutes, he finally regained his senses. "How did you *really* do that?" he asked.

I replied with a question of my own: "What is the last thing you do before you ship a scope back to the field?"

"I clean it up and put it in a plastic bag," he replied.

"How do you clean it?" I asked.

"I use a spray cleaner and wipe it dry with a rag."

"Do you spray the front panel?" I asked.

"Yes," he replied.

"Do you cover the input connector to ensure that you don't get any cleaner in the connector?" I asked. I knew that, if he hadn't, he would have created a battery.

"Oh, I see," he said. "Two dissimilar metals, such as the inner conductor and the outer conductor of the input connector, would make a battery. I owe you lunch. Let's go."EDN

Albert Helfrick is a professor in the electrical and systems engineering department at Embry-Riddle Aeronautical University (Daytona Beach, FL).

DANIEL VASCONCELLOS