MAC'S SERVICE SHOP

Electronic Geriatrics

By John T. Frye, W9EGV, KHD4167

BARNEY, returning from lunch, held the door of the service shop open for a frail, stooped man making a shuffling exit. The latter thanked him with a tired smile and then turned around creakily in the doorway to say in the cracked voice of age, "Do the best you can, Mac. I'll expect no miracles. That little set's pretty old—but then so am I!" The old man's lips were still curled in a sardonic smile as he turned around and left.

"It must be tough, getting old," Barney mused as he plugged in his soldering iron.

"Yep," Mac agreed, starting to remove the back of the small portable TV set the last customer had brought in. "Age takes its toll of both men and electronic gear. Did you ever stop to think that you and I are, in a way, in the electronic geriatrics field?"

"Come again?"

"Geriatrics is that branch of medicine dealing with the problems and diseases of old age and aging people. Here in the shop we're concerned with the problems and component failures that occur in aging electronic equipment. Much of our work, like that of the doctor, is concerned with diagnosis; and, like him, we employ a wide variety of techniques to pinpoint the cause of the symptoms our 'patients' display."

Black Boxes and Surgery. "Both the doctor and the technician often employ the 'black-box' approach. The doctor introduces various drugs and dyes into his patient and then traces their course through the body with X-ray or other means and measures the quantity and quality of these substances showing up at the various body outputs. From this, he deduces the level of functioning of various body organs. We do the same thing and call it 'signal injection' and 'signal tracing.' If we cannot pinpoint the difficulty with this black-box method, both of us resort to exploratory surgery.

"Yes, every day you and I perform surgery—some minor and some radical—there on the bench. The surgeon removes obstructing gallstones, kidney stones, emboli, and intestinal masses. We seek out and correct open circuits that block current flow. Doctors give a transfusion of whole blood to anemic patients. We give an electron transfusion by replacing a depleted battery. The doctor is likely to give a 'shot' of cortisone into a sore and inflamed joint. We give a 'shot' of contact cleaner from an aerosol can to smooth out an erratic control or tuner. We, too, perform 'transplants' that are sometimes rejected. Any technician who has substituted for an unobtainable exact duplicate power transformer and has seen the replacement start to smoke and has smelled the unmistakable odor of scorched insulation and shellac knows exactly what I mean."

"Yeah," Barney interrupted, getting into the metaphorical spirit, "and don't forget our patients also need proper nutrition and exercise. Try feeding 60-hertz equipment on 25 hertz, and you've got electronic dyspepsia no Alka-Seltzer will cure; or let a hi-fi or TV set sit around idle in a damp basement for a few months, and it is ready for a trip here to our hospital."

Factors Hastening Aging. "Several factors hasten the aging process of electronic equipment," Mac said. "You've just mentioned dampness which, accompanied by dust, invites arcs in high-voltage circuits, arcs that soon form a carbonized path to bleed away current and overload high-voltage rectifiers and flyback transformers and lead to the breakdown of these components. Heat is another aging element. It melts the seals on capacitors, allowing moisture to enter and cause these units to have a high dc leakage. Heat raises the ambient temperature of transformers, resistors, transistors, IC's, and other components above their rated temperature and contributes to their premature failure. Heat also has a bad effect on many pc boards, rendering them brittle and causing them to warp and crack and break the printed conductors etched in them.

"Incidentally," he said, tossing a plastic slide rule over to Barney, "here's a *Circuit & Conductor Calculator* put out by the G.T. Schjeldahl (pronounced 'Shell Doll') Company of Northfield, Minnesota. With it you can calculate the temperature rise above 20° C. ambient for various currents through an etched conductor of a given thickness and a given width. You can also determine the ohms/1000 ft for a conductor of that width and thickness. Schjeldahl, a major manufacturer of flexible printed circuits such as those used under the dashboards of modern cars, is giving these calculators away free, as long as they last, to people who write for them on company letterheads. Hey, why are you grinning like a Chessie cat?"

"I was just thinking you hadn't mentioned the thing that ages electronic equipment faster than anything else I know; namely, kids! How many times do we get TV sets or hi-fi's in here in which the little monsters have run pencils through both speaker grilles and cones? How many times have we fished pennies, bobby pins, bubble gum, and crayons out from under stuck turntables? We both know how hard kids are on TV tuners and tonearms. They spin the former like a roulette wheel and wrestle with the latter when it is trying to go through its change cycle. I'm trying to forget the TV sets that come in with the knobs broken off or lost, the transistor radios that have been dropped into the bathtub or the ocean, and the tape recorders that have had Cokes spilled through their innards. Some of the things kids do to abuse electronic equipment is enough to make a strong man cry."

"Spoken like a confirmed bachelor!" Mac said, smiling. "However, I've got to admit I've noticed a tremendous difference in how long radios, TV sets, hi-fi's, and tape recorders last in different households; and the homes in which electronic equipment seems to need a minimum of service are invariably those in which there are no children or ones in which the parents have the small-fry under firm control. But let's change to a more pleasant subject. Suppose we try to write a prescription for long life of electronic gear."

Prescription for Long Life. "Operate the equipment from a proper power source. When operating on ac, that

means making sure both the frequency and the voltage are as specified. When operating on dc, that means making sure you use the proper batteries *properly installed*. And when the equipment is not going to be used for a while, get those batteries out of there, no matter how 'leak-proof' they are claimed to be. What we see here in the shop reveals the danger of placing too much blind faith in that claim.

"Protect the equipment from temperature extremes. That means not leaving it on the dash or on the deck behind the rear seat of a closed car sitting in the sun, not locating it near a heat register or radiator or above a cookstove or oven, not failing to see it has ample ventilation when operating, and not placing it directly in the recurrent blasts of cold air from an adjacent air conditioner. Rapid temperature cycling is possibly even harder on electronic equipment than is a sustained elevation of temperature.

"Treat electronic apparatus gently. Just because the impact-resistant case of your transistor radio does not break when you drop it doesn't mean the radio has not suffered 'internal injuries.' Such a jar often breaks the speaker loose from its moorings or the tuning capacitor loose from the pc board. The board itself may be cracked by the violent flexing resulting from the jar. In this case, the bright edges of the conductor fracture may maintain current flow across the break for a few weeks until those edges become oxidized; then the radio 'just quits playing for no reason at all.' Finally, don't let children abuse electronic equipment. Teach them to change TV channels gently, to let the automatic record changer do its thing without interference, and to shut the equipment off when they are not paying attention to it."

"Leaving the TV set down for a week or so when it conks out may get the point across to the rambunctious kids," Barney suggested. "Let 'em miss a few episodes of Bat Man."

"Now let's not get carried away," Mac demurred. "After all, *we* have to make a living, and the Supreme Court has handed down decisions against cruel and inhuman punishment. There's one more thing: if you want to keep your TV set or hi-fi from having a 'stroke,' it's still an excellent idea to pull the line plugs during a thunderstorm. A nearby bolt can induce a surge of voltage into the power lines that can leap across the open on-off switch contacts and do all kinds of havoc before you hear the thunder clap."

"We *are* extending the potential life of electronic equipment, though," Barney pointed out. "Using solid state cuts down on the damaging heat such equipment produces internally. Transistors and IC's, properly protected from overloads and transients, have a very long life—so long, in fact, that it has never been measured accurately. Solid-state components are much more resistant to mechanical damage than are tubes. And you, with your long gray beard, know much better than I the improvements that have extended the life of other electronic components."

"Thanks a bunch for that 'long gray beard' crack," Mac replied. "You're right, though, in that no Johnnie-come-lately in electronics can fully appreciate the accuracy and reliability engineered into modern resistors, capacitors, coils, and transformers. I still remember those triple-section 8 µf wet electrolytic capacitors the size of a large fruit can that, after the little black nipple of an expansion seal had rotted, spilled electrolyte all over your bench every time you turned the chassis on edge. The first 'dry' electrolytics were not much better. The essential electrolytic moisture readily evaporated from the square or rectangular paraffin-coated cardboard cases and left the capacitors really dry—and useless. Heat quickly melted the sealing wax from the ends of cardboard cases of paper tubular capacitors and let in the moisture. To get away from this, some manufacturers potted paper units in tar and placed them in metal cases riveted or bolted to the chassis. For a period we had metal-cased paper capacitors and cardboard cased electrolytics!

"Resistors were not nearly so accurate, reliable, and compact as the ones we have today. Carbon units were all about two inches long and 3/16" in diameter, with no insulation. With age, they made great excursions in resistance. The only way you could get stability in resistance was to go to wirewound units. Candohm made metal-encased, wirewound bleeder resistors that were riveted to the chassis to provide heat-sinking. This was better in theory than in practice, in my experience. After a radio containing these resistors was out a couple of years or so, most of the sections of the bleeder resistor were bridged with individual wirewound units."

"I'd like to throw in just one more thing," Barney said.

"Shoot."

"I've always heard that a doctor who treats himself has a fool for a doctor and a fool for a patient. That goes, doubled in spades, for the fellow who tries to repair modern complicated electronic circuitry without the necessary knowledge and equipment. Nothing can shorten the life of a color TV set faster than some heavy-handed homebrew servicing." ◈

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