R-E's Service Clinic

Lightning protection

Be safe rather than sorry

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THERE'S AN OLD SAYING THAT GOES: "Lightning never strikes twice in the same place; because when it hits the second time, the place isn't there any more". Unfortunately, in solid-state circuitry, this isn't true. We're running into more repeated failures of the same parts due to lightning transients than ever before. This is the bane of designers' and technicians' lives. One harried technician wrote us a pitiful story of having replaced the same IC in a well-known make six times under warranty, and twice after the warranty ran out!

Unfortunately, there isn't any such thing as a true "lightning *arrester*". The only thing these gadgets can do is shunt the current off to ground through a small arc-gap, destroying themselves in the process. In the case of a direct hit, it's just too bad. The current is so tremendous that the place literally isn't there. I've seen a 6-inch square heavy ceramic fuse block, two big fuses, the brass holders, and everything except the ends of the wires completely disintegrated after a lick like this. (This occurred in a radio transmitter atop a mountain.) The cabinet looked as if someone had thrown about 5 pounds of flour in it!

However, for the smaller hits that cause sharp line-transients, we can help things a little. We can't stop them but we can hold the damage down quite a lot. There are devices that will help.

Chassis modifications

One of these is the super-fast action varistor, such as the GE-750 from General Electric, that is connected directly across the AC line where it comes into the chassis. These are specially designed metal-oxide devices and are called *GE-MOV* varistors. In normal operation, they have a very high resistance so that they have no effect on the circuit. When a transient spike comes along, they break down very quickly and become a short circuit across the line ("crowbar" effect). G-E's Application Note on these gives a response-time of less than 50 nanoseconds for the type V130LA1.

That's one; another method recommended by set-makers is the installation of chokes in the AC line. The idea of these is to offer a high resistance to very sudden changes of current, such as a transient spike. Bypass capacitors to ground are also used for the same reason; they provide a low-impedance path to ground for the spikes.

Zenith has a set of recommendations for problems like this. In their 19DC12 and 23DC14 chasses, they tell you to replace the original line chokes (95-2920) with one of higher inductance, 95-2964. In Issue 72-73 of *Tech-Topics*, they also recommend moving some of the low-level leads going to the 9-97 color module—one of the parts that have suffered repeated damage in areas where thunderstorms are frequent. It looks to me as if they are figuring on reducing the chance of the spikes being coupled into the module circuit by interlead capacitance.

Paraphrasing the instruction for this, several leads of the control plug and socket are changed. This requires the use of an 868-2 (Molex HT-1010-2B) pin-extraction tool. For the 19DC12 chassis, here are the changes (Fig. 1) that should be made:

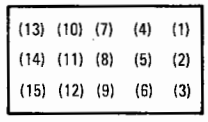

FIG 1

1. Remove the orange wire from pin 4 and place it in the empty pin-10 position.
2. Remove the black wire from pin 13 and place it in pin 4.
3. Remove the green wire from pin 5 and place it in pin 12.
4. Remove the blue wire from pin 6 and place it in pin 13.

(1 and 2 in the original layout are the leads to the AC switch. The leads on 5 and 6 go to the color circuits, and for goodness sake don't forget to change the leads in both plug *and* socket! It would also be a good idea to stick a note on the chassis saying that this modification had been made!)

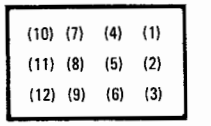

FIG 2

In the 23DC14 control plug (Fig. 2) these changes should be made:
1. Remove the white-green wire from

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pin 4 and place it in the empty pin 7 position.
2. Remove the black wire from pin 10 and place it in pin 4.
3. Remove the green wire from pin 5 and place it in pin 10.
4. Remove the white/black wire from pin 11 and place it in pin 5.
5. Remove the violet wire from pin 6 and place it in pin 11.

Be sure to get the right plug in the 23DC14. This is P203, which is the *12-pin* connector and not the 15-pin "Secondary Control Plug" P204.

Other manufacturers have similar "fixes" for these problems, for they've all run into them. If you have trouble, check with the nearest distributor for the brand and ask them what the factory recommends. If you can't get anything, you might go ahead and add the *GE-MOV* varistor and the bypass capacitors, as well as the chokes in the AC line. I've always been a "belt-plus-suspenders" man; a bit extra can't hurt.

Antennas

Cable systems are usually pretty well protected against lightning. The spikes have to travel through so many things that they dissipate before they get to

you. However, if the set is used with an outside antenna, there are several things that must be done to make it as safe as possible from damage.

For the most important, the mast or tower must be well grounded. Drive at least a 4-foot ground rod and tie or bolt this to the mast. There is a very handy thing available that I wish I had when I was putting up antennas. This is a combined base and ground-rod. It's driven into the ground up to the flange, and the mast simply dropped over the stud on top. Since practically all antennas are well-grounded by the mounting bolts, a properly installed mast makes a very good lightning rod!

The other essential is a good UL approved lightning arrester, which should be mounted on the wall as close as possible to the place where the lead-in enters the house. If this is close to the bottom of the mast, you can use this ground. If it's more than a few feet away, drive *another* ground rod directly below the arrester and run a short heavy ground wire to it.

One more precaution. If a certain location seems to get more than its share of lightning damage, check the grounding of the *AC line* at the point where it enters the house. There should be an 8-foot ground-rod directly under the "service entrance" box. These ground rods are sometimes hard to drive all the way. Some careless workmen have been known to drive them only about 24-inches and hit a rock. Then they cut off the top of the rod and go away! This is *not* sufficient grounding for protection. (Ask me how I know. I did this, and lightning promptly hit the place and scattered the motor of my water-pump all over the basement! The well-casing made a good ground! There is now a full 8 feet of ground rod at my place; I had to drive three of them before I got one all the way in through the rocks but it's there and we haven't had any more of this kind of trouble.)

There is only one really effective way of eliminating lightning damage; pull the line plug and disconnect the antenna! This is quite safe, unless you take a direct hit on the house. If this happens, you will have so many other worries, you'll forget the TV set! **R-E**