COMMUNICATIONS CORNER

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Spikes and cures

COMPUTER CIRCUITS OFTEN ENHANCE communications systems, but they also create new problems of their own. Chief among those problems is susceptibility to transient voltage surges, or what we generally call spikes.

Unlike vacuum tubes, solid-state devices are extremely sensitive to the transient voltage surges that appear on power and signal lines. Unless it is directly struck by lightning, communications gear built from tubes is seldom disturbed by a surge, whether it's picked up by the power lines, the telephone lines, or even an antenna. A lightning arrester usually provides tube gear with sufficient protection from lightning strikes.

But solid-state equipment is another story. A TV set, a CB radio, a ham rig, a commercial VHF transceiver—everyone knows that just one surge can wipe out data memory or stored programming; a particularly bad surge could even destroy the device as a whole. For example, a lightning strike hundreds of feet away could cause a surge in the power lines strong enough to zap a solid-state power supply, or a lightning strike in the next county, or the start-up of an oil burner—which can generate a spike of almost 2000 volts—could cause a glitch in a computerized receiver, transmitter, or control center.

Whether it appears on the power lines, the telephone wires, an antenna, or the electrical system of a motor vehicle, a transient spike can be very dangerous. Because of its shape, a spike contains a great deal of high-frequency energy—which can flow through or around filters from one circuit to another—as well as a high-voltage component. The high-frequency energy could disturb data memory or modify programming, and the high voltage could destroy solid-state components.

Figure 1 shows how transient spikes on the AC power line might appear. The voltage at any instant in time depends on which part of the AC cycle the spike is superimposed on, as well as the direction of the spike. For example, a positive-going spike that occurs at the positive crest of the waveform results in a transient that is the sum of the two signals. Since the spike could range from several hundred to several thousand volts, depending on what generated it, the peak instantaneous voltage could exceed the peak voltage rating of a solid state device easily.

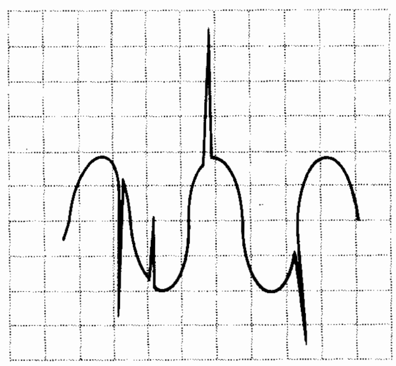

FIG. 1

What makes a spike so insidious is that it lasts for a very short period of time and that it is composed of signals that are often too high to be by safely bypassed by a circuit's normal "interference filter." Also, those high-frequency signals can be capacitively coupled from wire to wire and circuit to circuit because, at high frequencies, a small amount of capacitance provides a low-impedance path for whatever happens to come along.

Spike remedies

A spike is usually best dealt with by a device generically known as a "surge suppressor." A surge suppressor may be built from a bi-directional Zener diode, or more commonly, from one or more MOV's (*M*etal-*O*xide *V*aristors).

A bi-directional Zener simply clips any spike that exceeds a predetermined value, usually 150 to 180 volts. They're effective, but they can't dissipate much power, so if the transient lasts for more than a few microseconds the heat that is generated can destroy the diode.

An MOV, on the other hand, is a resistor whose value decreases sharply when the applied voltage exceeds a predetermined level. MOV's used on AC power lines commonly trip at 150 to 180 volts. Although the MOV does not respond to spikes quite as fast as the Zener diode, it can dissipate more power than a bi-directional Zener. Since MOV's are reliable and inexpensive, they are used in a broad range of suppression devices intended for both power and telephone lines. A MOV can be connected directly across the power line, as shown in Fig. 2-*a*, or from each side to ground, as shown in Fig. 2-*b*.

Modern modems and digital telephones usually have a MOV wired between ground and the

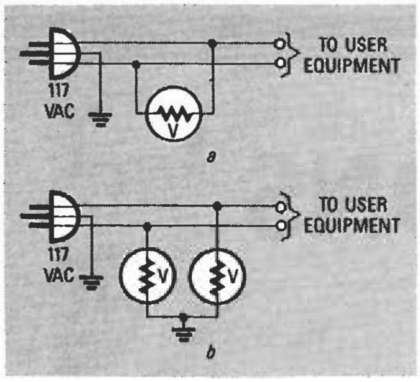

FIG. 2

point where the device connects to the telephone line; that helps prevent transient disturbances generated in the telephone network from entering the sensitive equipment and wreaking all sorts of havoc. Generally, the MOV is connected to the user's side of the ring detector so that the 90-volt ringing signal doesn't affect the MOV. That's done because the MOV is generally rated at 25 to 50 volts in order to protect the signal circuit, which usually operates at a loop voltage of 5- to 10-volts DC.

Power-line interference

Telephone equipment has problems with spikes, but AC power lines have even more problems due to interference from sources other than transient spikes. For example, low-frequency RF interference that cannot be suppressed with a spike suppressor is generated when the electric utility switches a capacitor on or off the power line to maintain the power factor. Further, a ham or CB transmitter can radiate substantial amounts of RF into the power line.

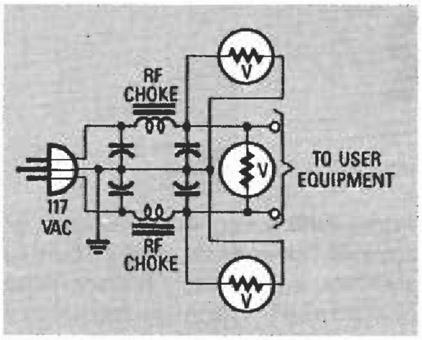

FIG. 3

As a general rule, when a piece of equipment is subject to both transient spikes and RF interference, we use a device that has both transient surge suppression and RF filtering, like the "power line filter" shown in Fig. 3. The MOV's handle the spikes while the RF chokes prevent RF from passing either in to or out of that piece of equipment.

Although much modern communications equipment contains filtering for the types of interference we've been discussing, much older gear was manufactured before the effects of transients and RF hash.

There's no guarantee that filtering of that sort will solve your problems, however. The reason is that transient interference may not be the cause! Verifying the presence of spikes and other interference can be quite difficult because signals like those are often brief.

So, if you have no good ideas about what might be causing seemingly random malfunctions of digital equipment, or if you just want to play it safe, adding a surge/RF suppressor to your equipment may be a good idea. **R-E**

SERVICE QUESTIONS

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INTERMITTENT BRIGHTNESS

Recently the brightness on an RCA CTC92C became erratic. Voltage measurements indicated that the trouble was in the red section of the kine driver module. After replacing Q4, the red bias transistor and C4 (a 4.7 µF electrolytic), the problem cleared up. But, when the parts that I'd removed were checked using an ohmmeter, they tested good. Can you shed a little light on what's happening?—J.N., Dalton IL

I have a feeling that you have not done a thorough job in checking. Component failure in the red-driver circuit shows up as changes in the red gun *only*, and not as a brightness problem.

If the trouble returns (and I don't doubt that it will), look to the luminance section. Something in that section must be malfunctioning, causing a rise and fall in the voltage entering pin 4 of the driver module. That voltage sets the bias of all three outputs, and is also responsible for the brightness level.

SHUTDOWN PROBLEM

The Panasonic NMX-P3A chassis that I've been working on has an overload in the video section, which causes the set to shut down at turn-on. I thought that IC102 was bad. But after changing that IC, I had no picture at all. When the original was placed back in the set, the overload condition returned. Could the replacement have been bad?—P.S., E. Northport, NY

Welcome to the club: You've just experienced one of the worst things that can happen to a repairman—changing a part, only to wind up with a worse problem than you began with. Yes, it is within reason to suspect that the replacement part was defective, but there is always the possibility that you missed a solder joint.

Nevertheless, I agree with your original diagnosis. I've seen IC102 cause the condition that you described. Bear in mind, however, that IC101 contains all the AGC circuits, so look to it as the next most likely trouble spot. But, before anything else, check the AGC controls with an ohmmeter.

CAN'T TUNE CHANNEL 13

I can't get Channel 13 to come in on an Admiral TV (chassis number 28M55) with touch tuning. After sending the tuner out for repairs, I was able to get Channel 13 for about 2 weeks and then it quit again. Can you help me?—B.T., Delta, IA

You are dealing with a varactor tuner, which uses different voltages to tune each channel—the one for 13 being 3 volts higher than the Channel 11 voltage. You stated that you cannot get Channel 13 in any position. Well that eliminates the selector switch and the number 13 potentiometer as possible trouble spots.

If you can't get 20.8 volts on the potentiometer wiper arm, then perhaps the 33-volt supply that feeds all the potentiometers is low. If the voltage is correct, I would talk to my tuner repairman to find out what voltage he's using to pull in Channel 13 (which is obviously not being supplied. **R-E**