SERVICE CLINIC

Which way does current flow?

JACK DARR, SERVICE EDITOR

AT TIMES, WE COME ACROSS SITUATIONS where we need to know the polarity of the voltage at a certain point in a circuit. Finding that polarity presents few problems if we remember some of the basic laws of electronics and current flow. Although there is only one type of current, there are (to cause confusion) two ways to describe it. One way is in terms of electron flow, which describes current by the actual direction that electrons move in a circuit. The other way is in terms of conventional flow. Conventional flow came about because the early experimenters arbitrarily said of their batteries, "This pole is positive and that pole is negative, and current flows from positive to negative."

Actually, those experimenters knew that *something* flowed in a circuit, but they had no idea as to what! The invention of the vacuum tube cleared that up. They found that a stream of electrons flowed from the hot cathode to the anode (plate). Also, they found that electrons had a negative charge. By putting a high positive voltage on the plate, "current" flowed. Stubbornly they insisted that current flowed from plate to cathode! So, that was the "plate current." That didn't cause too much trouble until the invention of the diode and transistor.

When they made up the symbols for semiconductor devices, they hung on to the old conventions. Every junction (in a diode, transistor, etc.) is marked by an arrow and a bar. The convention was to say that current flowed out of the point of the arrow. Actually electrons flow *into* the arrow! Figure 1 shows a sketch I made up that helps me when I get confused. I have three copies of it: one over my bench, one in my wallet and one over the desk where I am now! Electrons flow into the point of the arrow, leaving the device with the polarity shown.

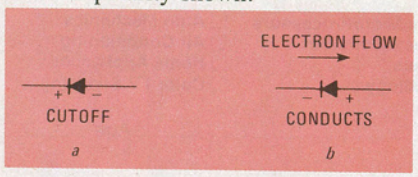

FIG. 1

When you run into any kind of problem where you need to know the polarity of the voltage at a given point, go back through the circuit until you come to a point with a tube, transistor, or other device where you know the current direction for certain.

Here is an example of where that method can be used: A while ago I came across a set with a problem in the automatic-brightness-limiter circuit. In that model, the beam current is monitored by a tap in the high-voltage return circuit. A resistor from the tap to ground develops a voltage that is fed to the automatic-brightness-limiter circuit. You need to know the polarity of that voltage to troubleshoot the circuit, but the schematic doesn't show it. But, by going back to a point in the circuit where the direction of the current flow is known, the polarity can be determined. That point is the CRT, which is just a big tetrode vacuum tube. Figure 2 shows a basic diagram of the circuit.

In that circuit, electrons flow from the "plate" (CRT screen) to ground through the high-voltage tripler and the flyback. The resistor (R_{sense}) to ground develops the control voltage. Electrons flow into the resistor, so that one end has a surplus of electrons and becomes negative. The higher the beam current, the higher that negative voltage. If the beam current increases (thus increasing the brightness of the picture on the CRT screen) more electrons flow and the voltage drop across the resistor increases. That voltage reverse-biases the first video stage, thus reducing the beam-current and maintaining a constant picture-brightness.

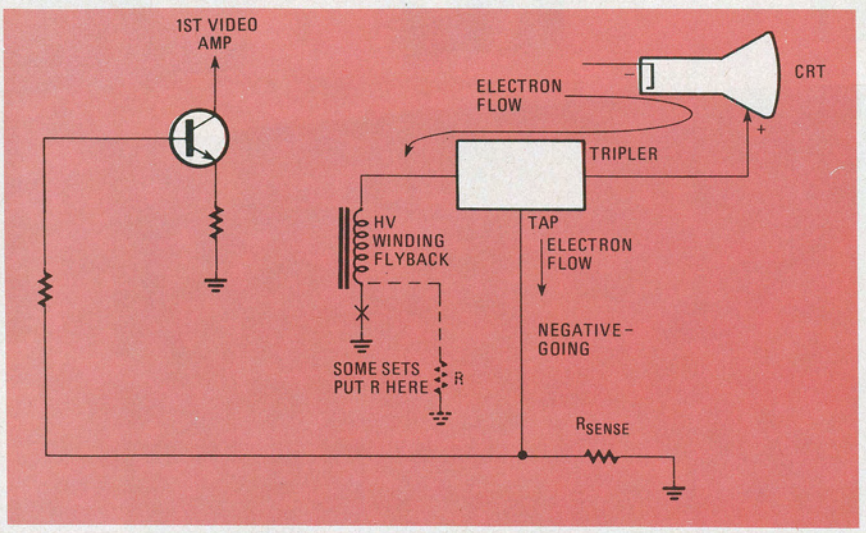

FIG. 2

A word about grounds

The chassis is the common (usually called ground) in practically all TV circuits. Older sets have only one ground. In some new sets, you'll find two. One is the earth ground of the AC power line. The other is an isolated ground, which is the common for all the TV circuits. Incidentally that common is always *hot* with respect to an earth ground. When servicing such a set, an isolation transformer *must* be used because your test instruments are almost always grounded to the AC line. **R-E**

SERVICE QUESTIONS

VTVM METER PEGGED

I asked you why the meter needle pegged to the left on an old Knight VTVM, and you suggested checking resistors (in the meter). I thought I had, but I found a 22K resistor (R33) in the power supply that read over 80K. I replaced it and everything's fine now. Thanks.—*G.R., Key Largo, FL*

GOOD COLOR, WRONG PLACE

I got this set to fix (flood damage) after it had been to another shop. I fixed several