At the Repair Bench – Heathkit® IT-3121Curve Tracer - February 2025

Every now and then, a piece of equipment comes in as an unsolicited repair job, wherein the owner has been directed to me either by a friend, another ham, or via my website, www.ad2cs.com. This was one of those cases, where a friend of a friend sent this guy to me. He shipped an older (circa 1980) Heathkit® IT-3121 Semiconductor Curve Tracer for repair if possible. I sort of chuckled at that last caveat – *"if possible"* – because to my way of thinking, anything is repairable, but it may not always be practical or cost-effective to do so. There is almost always a method by which an older piece of equipment can be made operational again, if the owner wants to spend the *"do-re-mi"* that it would take.

Figure 1 - Heathkit® IT-3121 Curve Tracer

In the situation at hand, this was a piece of test apparatus that would not operate as intended. The specific complaint was that although the pilot light would illuminate, there was no output from this unit when connected to an oscilloscope.

A brief explanation is called for here. This tester is actually a *curve tracer adapter* rather than a full curve tracer in its own right. This device is designed to apply the operational voltages and current to the semiconductor device under test (DUT), and then to process the output into usable input signals for display on an oscilloscope. The oscilloscope connections for both X and Y (horizontal and vertical) are on the rear panel of the IT-3121. The owner's complaint was that he was getting no output to the oscilloscope when the DUT was installed to the banana jacks used as the test jacks on this unit.

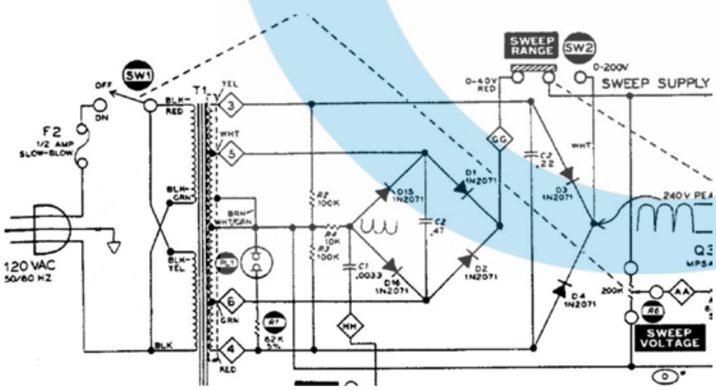

Figure 2 - IT-3121 sweep supply

A quick look at the schematic revealed that the IT-3121 has two separate internal power supplies, one of which is identified as the low-voltage supply, leaving the technician to assume that the opposite supply (*the sweep supply)* is a high-voltage supply. In fact, that supply provides output voltages as high as 200 volts. It also supplies AC to the neon lamp used as the pilot lamp, which tells part of the story of this unit.

The fact that the pilot lamp was working simply meant that the incoming line voltage, the power switch, the main fuse, and the transformer primary winding were all intact, and it indicated that the HV supply secondary was also intact. This shifted my focus to the low-voltage power supply in the search for the problem. Some voltage measurements showed that there were definitely some problems in the low-voltage supply. Specifically, the +5VDC, +15.5VDC, and -16.1VDC supplies were all missing. In fact, the only low-voltage supply that seemed to be present was the -15.5VDC supply.

A look at the schematic in this area (Figure 2) showed some likely candidates, so I set about taking some more measurements. The positive output of the full-wave bridge rectifier (or the collector of transistor Q13) should have measured about +22 volts, but this point in fact measured zero volts, meaning it was grounded. The most likely candidate here was the 200µF/25V axial electrolytic capacitor C5, whose job is to smooth the pulsating rectifier output somewhat. I opened this capacitor circuit, and voltage was restored at the Q13 collector. Replacing that shorted capacitor restored both the +15.5VDC and the +5VDC supplies. I used a 50-volt rated capacitor as the replacement – more about why shortly.

Now for the -16.1VDC supply. In this case, I began by measuring the voltage at the collector of transistor Q15, and once again found it to be 0VDC, indicating that it was grounded and that Zener diode D18 was effectively bypassed. Once again, we were looking at a shorted capacitor, in this case, the culprit was the 50µF/25V axial electrolytic capacitor C9. As before, replacing the shorted capacitor resulted in the -16.1VDC supply coming back to life.

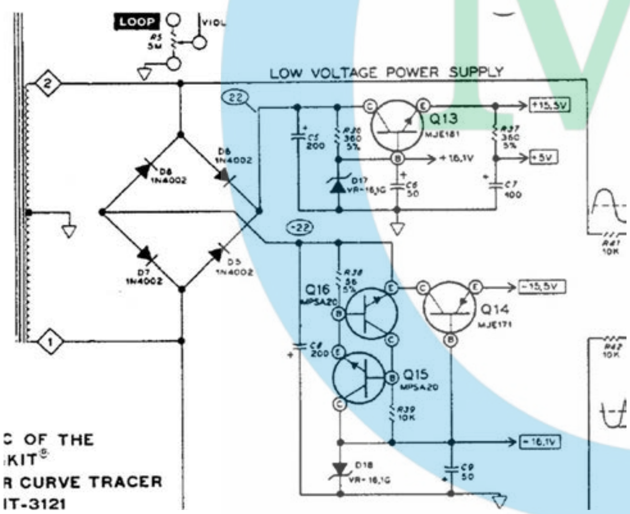

Figure 3 - IT-3121 low-voltage power supply

This entire unit uses only nine polarized capacitors, all aluminum electrolytics. There are four 10µF/25V radial types (C11, C12, C13, and C14) – all in the step generator circuit. The are two of the 200µF/25V axial types, one in each of the two low-voltage power supply sections, the positive supply and the negative supply. There are two of the 50µF/25V axial types, again one in each of the two low-voltage power supply sections, and finally one rated 100µF/35V, placed in the +5VDC part of the positive low-voltage power supply. Based on the age of this unit and therefore the associated ages of these electrolytic capacitors, I decided that it was worth replacing all of them with new.

Note that the 200µF capacitors were rated 25V, and are used in ±22VDC circuits. Depending upon specific component tolerances and actual line voltage levels, these capacitors may have been operated at a point in excess of their rated voltage limits. For this reason, I elected to upgrade these capacitors to 50-volt types instead of the original 25-volt rating. In fact, in all cases, the working voltages of the capacitors were increased, partly due to smaller modern component sizes and my desire to keep to components of the same approximate physical size so that they fit the PCB placements properly.

With all of the capacitors replaced, I did a quick clean-up of the unit, and then I put it through some actual-use testing to verify its functionality. All was as it should have been, so I called this job *“done!”*

This was one of those simple jobs that come in occasionally, and it is one that was extremely easy to diagnose so long as one thinks through the conditions. What works? What doesn’t work? How is that condition verified? Then, finally, what could cause that problem? Think it through, evaluate the schematic, check your thinking with a multimeter, and it’s all over.