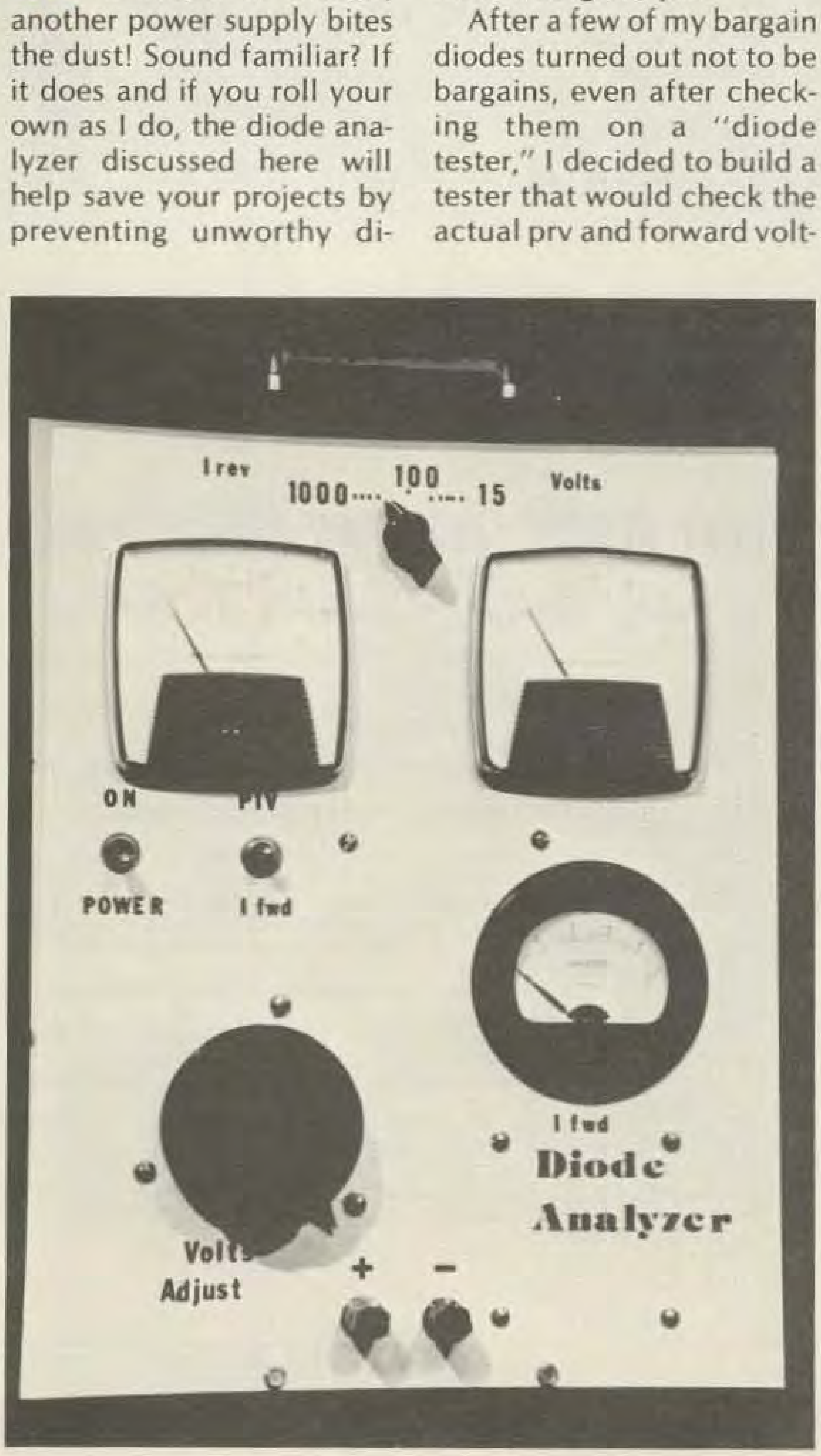
Bob Engle K9QLL
RR 2
Franklin IL 62638

The Cheapskate

—a checker for bargain diodes

With a mighty hum and a cloud of smoke, another power supply bites the dust! Sound familiar? If it does and if you roll your own as I do, the diode analyzer discussed here will help save your projects by preventing unworthy diodes from creeping into an otherwise good job.

After a few of my bargain diodes turned out not to be bargains, even after checking them on a "diode tester," I decided to build a tester that would check the actual prv and forward voltage drop of a diode and to do it with as little cash outlay as possible.



Front panel of the diode analyzer.

The Cheapskate analyzer will provide you with the information you need when selecting or grading bargain-pack diodes. The culls can be used for noncritical applications, one-way wires, etc. And, the good ones can be graded for performance at whatever voltage or current levels are required by the circuit they are to be used in. It requires *no* external meters or connections other than to the diode under test.

Experience has taught me that test jigs and alligator clip leads with 1000 volts or so on them can be an unhappy combination if one gets careless or is in a hurry. This is the reason for the all-in-one-box design.

This device will allow you to test diodes under actual anticipated operating voltages or currents and to match diodes for HV rectifier strings or other purposes.

This article is not a step-by-step, how-to-make it type for the simple reason of economics. It does not make sense to build an expensive device to test bargain semiconductors. Although once built, I would recommend testing any diode that you intend to use, even so-called first-quality ones, as it will prevent some nasty surprises.

The tester (Fig. 1) consists of two variable-voltage supplies and their associated metering and switching circuits.

VT1 is a 0-to-130-volt Variac; a 50-Watt rheostat could be used instead. The idea is to vary the input voltage, so whichever means your scrounging or junk box provides will work.

R1, R2, and R* are limiting resistors and limit the voltage out of the prv test section to agree with the meter scale in use. In my case, this meter (M2) was a 50-μA unit with scales of 100, 15, and 3. So, I set R1, R2, and R* and R4, R5, and R6 for full-scale readings of 1000, 100, and 15 volts at maximum setting of VT1. The meter that you use in your voltmeter circuit will determine the values for these resistors. I would recommend a meter with a 50- or 100-μA movement as best suited for this application. The meters that you have available will depend on the size of your junk box or what's on sale at the local hamfest.

As high-current dc meters are not cheap—even used—the best bet is to use a shunt. My favorite is a 0.001-Ohm shunt used with a 50-μA meter. The shunt is either 11-7/8" of #10 solid copper wire or 7-7/16" of #12 solid copper wire. The series resistor value will depend on the internal resistance of the meter and the desired range of the meter. Just divide the full-scale reading of meter in volts by the current in Amps needed for full-scale deflection. Then subtract the internal resistance of the meter used to find the series resistor value (e.g., 0.025 volts full-scale and 25 Amps. 0.025 V/0.00005 A = 500 Ohms − 300-Ohm meter resistance = 200-Ohm series resistor). For other ranges, remember that the voltage drop for the 0.001-Ohm shunt will be 0.001 volt per Amp of current through the shunt. Use #10 wire for 30 to 50 Amps.

When measuring the internal resistance of meters with sensitive movements, use a series resistor of known value to prevent exceeding the range of the meter under test.

Transformer T1 is a small unit of unknown origin that provides approximately 1000 V ac to D1 and D2, which are 1-kV, 1-Amp units. C1 and C2 are 1-μF 600-volt paper caps. A 1- or 2-μF, 2-kV oil-filled unit would be perfect here but will have to wait until the next hamfest. Do not use a string of high-capacity electrolytics here as it will strain T1 and take quite a time to discharge. M1 is a 50-μA meter from the same junked unit as M2. The meter scale here is unimportant. All that is necessary is to indicate when a few microamps of current begin to flow in order to establish checkpoints when matching diodes.

T1 can be any type of small transformer capable of delivering whatever maximum prv you wish to check. Since current drain is very small, the smaller T1 is physically, the easier it will be to package. R3 is a limiting resistor and should be high enough to limit the shorted output to around 100 μA at T1's maximum output. (Yes, Waldo, diodes do come as dead shorts occasionally and some of us can't guess which end of an unmarked unit is the cathode every time.)

T2 is a 2.5-volt, 10-Amp filament transformer to provide current for the I_{fwd} (forward-voltage drop) test. T2 could be a 5-volt winding on T1. However, I wanted to test high-current rectifiers so I used what I had available. D3 is a 50-volt, 25-Amp stud-mount diode. C3 is 10 μF at 30 volts and M3 is a 5-Amp unit. R7 gives me a full-scale reading of 3 volts on M2.

S3 is a rotary switch. It could easily be a DP3T slide switch if it can handle the necessary voltage. S2 is a DPDT center-off toggle switch, and if you buy only one part this should be it. It should be rated for whatever I_{fwd} you are designing for, and the center-off position is necessary for safety when using the unit. As a matter of fact, a momentary switch is not a bad idea even though operation would then be two-handed.

Construction Hints

1) Do not rush to your local parts house and buy all the parts. First, it would be expensive (the 2-Amp Variac is around $20 to $30) and, second, you will not have the opportunity for a good scrounging session.

2) Do not use chassis ground; use a ground bus instead. This will help prevent shocks.

3) Use a large container so that you will have room for future modifications and additions.

4) Group control functions in a logical arrangement.

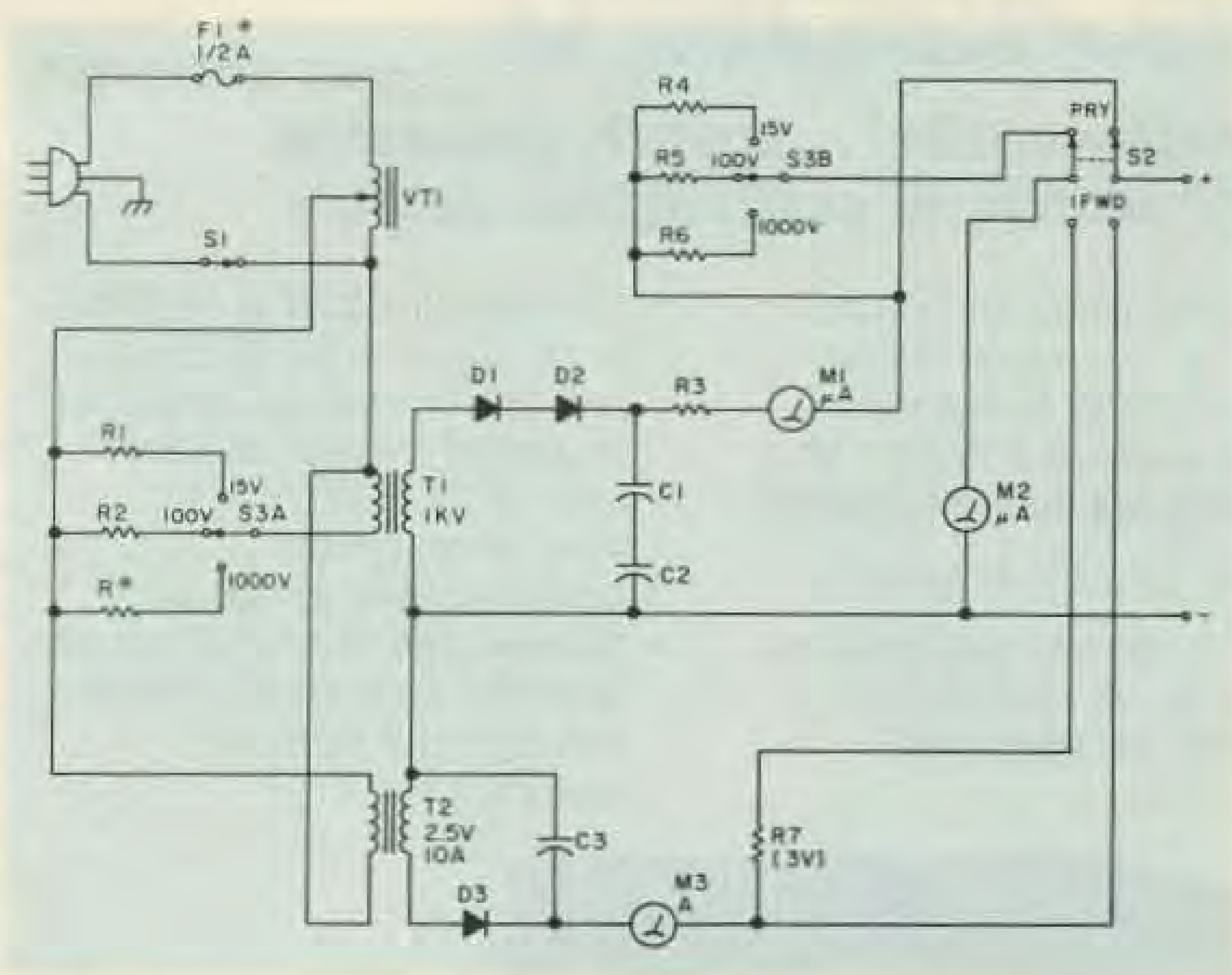


Fig. 1. The diode analyzer schematic diagram.

Operation

For prv test, install a diode (cathode to positive), set volts adjust to minimum, set to lowest prv range, set range switch S2 to prv, turn on power, and advance volts adjust. If M1 goes off scale, reverse the diode connections and try again, advancing volts adjust and S2 range switch until a point is found where a very rapid increase in current occurs for a very small increase in voltage. This is the breakdown or zener point for the diode under test. The voltage, at the breakdown point, is the prv of the diode. Rate the diode well under the actual prv, especially in power-supply circuits.

If the diode under test shows a steady rise in current for an increase in voltage, discard it or use it in a noncritical use. It will become very apparent after testing your first handful of bargain diodes why they were priced so low.

For testing the forward-voltage drop (I_{fwd} test), turn off power, reverse the diode connections (cathode to negative), set volts adjust to minimum, switch to I_{fwd}, turn on power, and advance volts adjust until M3 indicates proper I_{fwd} for the diode under test. M2 will show the voltage drop across the diode. For a good silicon diode, this will be 0.4 to 0.8 volts, depending on the temperature and specific type of diode. Remember that the diode will be dissipating I × V power, so don't take too long for this test. It is possible to destroy the diode rather quickly.

If you test zener diodes, remember that the current will be limited by R3 to a very low value. However, the zener point will show up very clearly because M2 will rise to the zener voltage and refuse to go higher with an increase in the setting of volts adjust. M1 may go off scale under these conditions, so if you test zeners often, a shunt and switch could be added or a separate circuit could be added for testing zeners only.

This project has been well worth the time spent in construction and design. It provides a very worthwhile addition to my bench and has provided an extra bonus in that I use it as a source of low-current voltage and for checking leakage of unmarked capacitors. Last, but not least, I now know that when I install a diode in a project that its specs will meet the requirements of the circuit in which it is installed. ■