Load Tester for Batteries and Power Supplies

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For years, I've used an old automobile headlight to test batteries and power supplies. Actually, it's the high-beam filament – this is the bulb that was replaced when the low-beam filament burned out. It draws about 5 amps, and has an obvious indicator that everything is working. A battery that can keep it bright for several hours will stand up to a day of roving.

I've also used the light to test power supplies, with mixed results. It draws too much current for small ones and not enough for larger ones. For higher currents, I add some big resistors – now I've got hot resistors and lights all over, and sometimes the clip leads overheat, or slip off and cause more excitement.

Recently I was thumbing through an electronics magazine and came across an "Ideas for Design" circuit[1] for a dummy load for power supplies. Many of these ideas are questionable, but this circuit was pretty simple, so I could figure out how it works. It used some fancy parts, coincidentally made by the company that employs the designer, to keep the battery drain low. A few quick calculations suggested that the same circuit with cheap, readily available parts (i.e., the kind in my junk box) would work just as well, but a 9-volt battery would only last a week instead of a year. Since this kind of gadget is only used occasionally, battery life is not a problem.

The schematic is shown in Figure 1. The op amp, U1, compares the voltage drop across R13 to the voltage set by the pot, R10, and controls the drive to the power FET to keep a constant current through R13. The voltage reference, U2, provides a stable 2.5-volt reference voltage over temperature and battery life; it works like a zener diode, only better and cheaper. None of the component values are particularly critical, but power is a consideration. It is important that R13 be a hefty resistor, since the power it dissipates is I^2R — 10 watts at 10 amps, 22.5 watts at 15 amps, etc. R11 can be used to set the maximum current. Q1 dissipates the rest of the power (I times 12 volts), so it needs a good heatsink, while R13 uses the box for a heatsink. I used a 10-turn pot for R10, for finer adjustment. For testing at low currents, the negative lead (RETURN) may be connected to add R14 into the circuit.
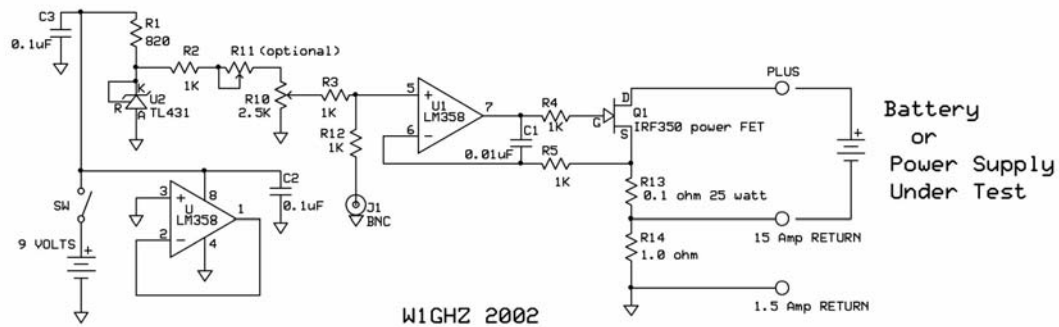
LOAD TESTER FOR BATTERIES AND POWER SUPPLIES

A common 9-volt battery powers the unit, so it doesn't care about grounding – it works fine with positive and negative supplies. Battery life should be 50-100 hours of operation. If that is a problem, micropower op amps (U1) and voltage references (U2) are available to reduce battery drain.

The circuit is simple enough to breadboard or dead-bug, but those never get put together well enough to work reliably. I chose to put it on a PC board – it fit in a spare corner of another board that I was sending off to ExpressPCB (www.expresspcb.com). Since their MiniBoard service is a fixed size board, I make sure to fill all of the space with something. The board layout files are on my website, www.w1ghz.org.

When I got the boards back, I dug out the rest of the parts, plus a big heatsink and a used aluminum box big enough to hold the heatsink – the PC board is a tiny in comparison. Figure 2 is a photo of the finished unit.

The unit provides a constant-current load, good for testing batteries. I adjust the pot for the desired test current, then flip the switch on and off to see how much the voltage droops under load. With a good battery, the droop might be less than 0.1 volt, while a dying battery might droop several volts.   Then I can test the battery under load for hours, checking the voltage occasionally – when it starts dropping faster, the battery is nearly drained. I tested all my rover batteries this way and found a couple of weak ones, which probably would have died in the middle of a 10 GHz contest ("why does my frequency keep jumping?").
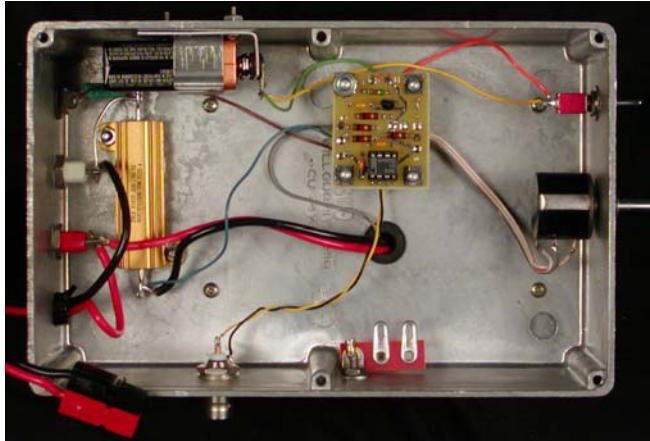
The load is also good for testing power supplies; I usually buy them surplus or at flea markets. A regulated voltage should not change significantly with current, and the current can be adjusted slowly to check current limiting in a power supply. More important is the transient response – a power supply should respond fast enough for CW keying and SSB peaks without overshoot or ringing. I look at the output voltage with an oscilloscope while flipping the switch on and off; for a severe test, I connect a pulse generator to the BNC connector and give the power supply a workout.
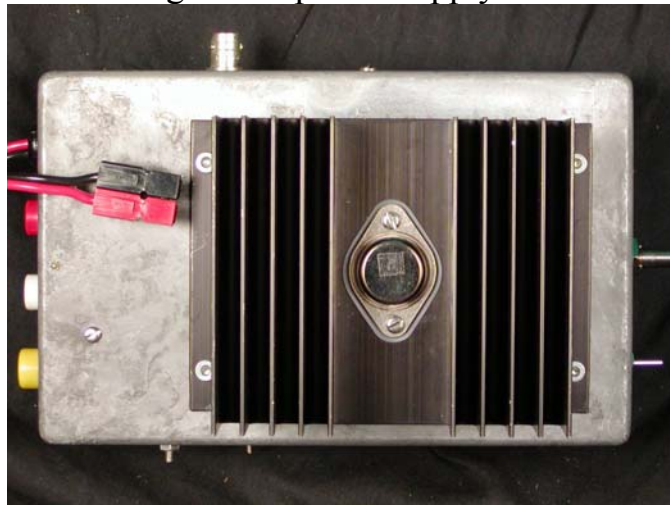
Testing isn't limited to 12 volts; the load will work from about 3 volts to as high as the power FET will stand. I recently used it to test some 48-volt supplies.

In summary, this is a handy, useful gadget that is simple to use and easy to build with common parts. What more can you want?

1. Guy, J., "Resistive Dummy Load Draws Constant Current From 1.2 To 50V, *Electronic Design*, 16 April 2001, P. 99.