Quality DC Power – Cheap

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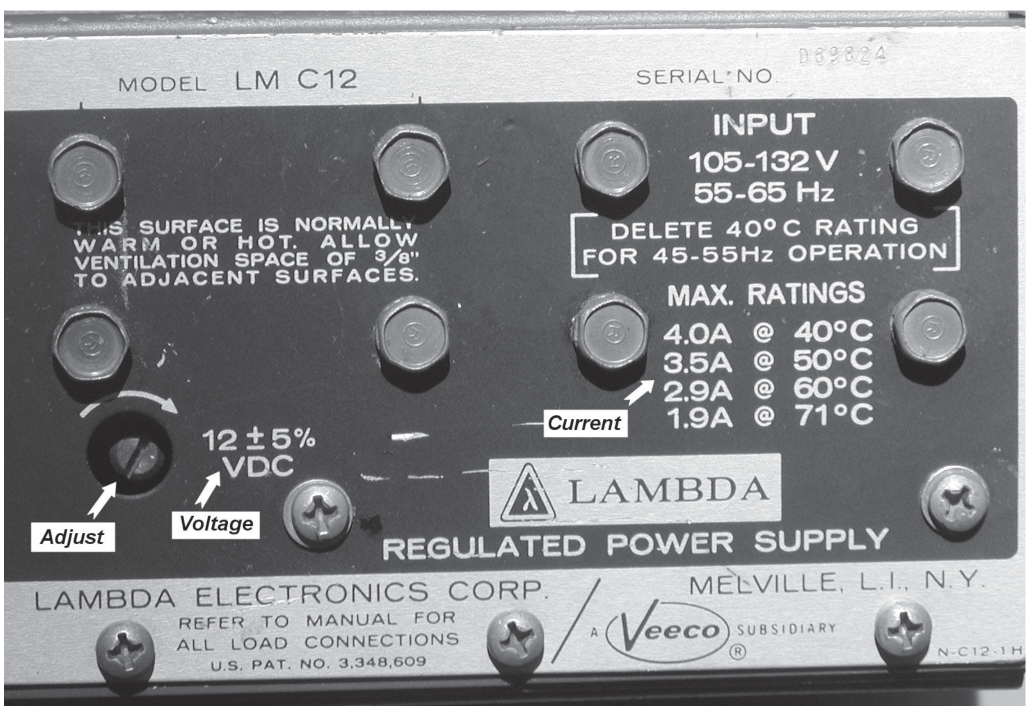
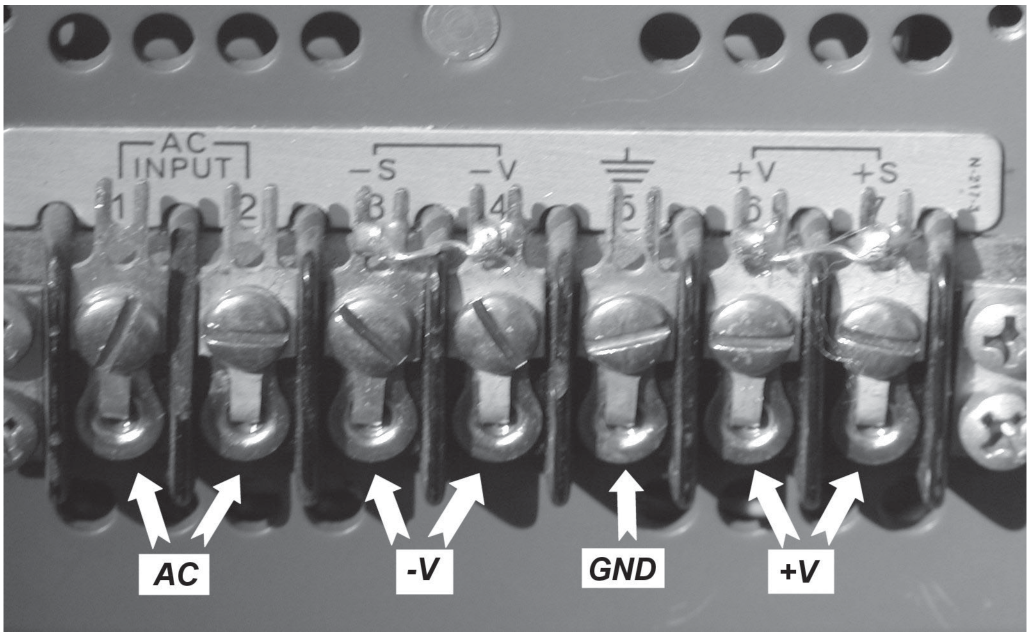
Most of our ham electronic devices are powered from "12 volts" DC, (in reality, more like 13.6 volts for best operation). This is ideal for automotive use, but keeping a big 12-volt battery in the shack is inconvenient. Instead, we use power supplies, but never seem to have enough of them – I know one ham who powers his whole station from several nice Astron 35-amp power supplies, but has nothing available over at his workbench. Also, we often need other voltages – as we try to use surplus microwave equipment, +28 volts and –12 volts are common requirements, while ex-telephone equipment often requires –24 or –48 volts. New power supplies are rather expensive, so we could build our own, but there are alternatives that are often cheaper than the parts we'd end up buying.

When an equipment manufacturer needs an odd voltage in a rack of equipment, he often adds a "rack power supply" – usually a metal box with a few terminals but no lights or meters. Tons of these have been used, and lots of them show up at surplus dealers and swap meets. I've never paid more than $20 for one. My favorite brand is Lambda, because they put the voltage and current right on the box, as shown in the front photo, instead of just a cryptic model number found on some brands. I'm sure you've seen these: a gray metal brick with ventilating holes all over. Most of them have a screwdriver adjustment marked "XX volts ± 5%." You can probably figure out the code! I've seen them for voltages anywhere from 5 to 48 volts, and most of them will adjust more than 5% — both 12 and 15 volt models will adjust to 13.6 volts. The output voltage is floating, so it can be either positive or negative.



The current is usually listed as a function of temperature: some Amps at 40ºC, then lower currents at higher temperatures up to 75ºC. Most of us don't enjoy operating when the shack temperature is upwards of 40ºC, so the highest current is usable, but higher temperatures could be found in remote operations, for instance, at a beacon location, or portable in Texas.

Hookup is pretty simple: all connections go to a barrier strip on the back end, like the one shown in the photo.



The AC line cord goes to terminals 1 and 2, and the green wire goes to case ground, terminal 5. The +S and –S terminals are for remote sensing, and possibly for connecting supplies in parallel, but for normal operation, just connect +S to +V and –S to –V. Then +V, terminal 6, is the positive side of the output, and –V, terminal 4, is the negative side. Either may be grounded, or both may be left floating. Spade terminals from your local auto store are neater than twisting wires around the screws.

I usually add a few small enhancements, like rubber feet on the bottom to improve airflow, and a bit of plastic over the barrier strip to keep fingers and metal clear of the AC line terminals. The cases have a number of tapped holes which make these easy to add. I also add disc capacitors from the output terminals to ground, to keep RF out, and an LED on the output (use a series resistor of about 100 ohms per volt) so I can tell at a glance if I have power. Troubleshooting is so much easier with visual indicators!

Occasionally, I find one of these supplies with an overvoltage protection module – a small attachment with two wires connected to the output voltage terminals and a small adjustment pot. If the output voltage gets too high, the module simply shorts the output and keeps it shorted until power is removed, then resets itself. Adjust it to fire a few volts above the desired output voltage. If you use the module and don't have an LED indicator to tell you the output voltage is gone, your only warning that the module has fired will be the aroma of hot electronics – most of us are quite familiar with the odor!

Performance

I have perhaps a dozen Lambda power supplies in my shack powering various things, with available output currents from 1 to 16 amps. Another went into "temporary" use in someone's 10 GHz rig about 6 years ago, driven by an inverter for battery operation. All have been reliable – the only failure was when a hookup wire slipped out of my hand and flew cleanly through one of the vent holes to hit one of the terminals on a big filter capacitor. Another supply was sensitive to RF while sitting next to the 6-meter amplifier, so I swapped it for a different model and use it in another location further away.

Before I actually use a power supply to power something more expensive, I test it for a while at full load current, then switch the current on and off several times quickly to simulate CW keying while looking for transient spikes on the output voltage with an oscilloscope. Transients from the Lambda supplies are small, typically under 100 millivolts. (Astron supplies are also pretty good, but some other brands aren't.) A good load for testing is an automobile headlight bulb – usually the low-beam filament fails but not the high beam, so the bad bulb is still good for testing. A typical bulb draws about 5 amps at 12 volts, but the starting current for a cold bulb is much higher until it heats up, so it provides a stringent test for a power supply.

A quality power supply should also survive the "screwdriver test" without any damage – just put a big screwdriver right across the output terminals a few times (wear safety glasses for this test).

Repair and modification

These are simple linear power supplies with fine 1970's technology. Most of the parts are transistors, diodes, resistors, and capacitors (no ICs) on a single-sided PC board, and similar models use the same board with slightly different resistor values. I was able to repair the supply I damaged by comparing voltages and resistances with another supply of different ratings – replacing two 15-cent transistors did the trick. Another supply had low output voltage when I got it; one of the zener diodes had lower voltage than the comparison supply, and replacing it cured the problem.

Switching Power Supplies

These old supplies have linear regulators and real transformers, so they are solid and relatively big and heavy. More modern power supplies use switching regulators, and provide a lot more power per pound. A well-designed switching power supply is every bit as good as a linear supply, but not all of them are suitable for ham use. Often, it is because they were designed for a different use; sometimes, the manufacturer cut too many corners. Some of the problems to look for:

- RF noise: switching regulators generate lots of hash, and your receiver will tell you if it isn't properly filtered.
- Response time: the feedback loop that controls the output voltage takes some amount of time to respond to changes in load current. If the response time isn't right for sudden changes, like CW keying or voice peaks, the voltage may droop or spike. Load testing with the auto headlight can check this.

- Minimum load: many switching power supplies require a minimum load current to operate properly. On supplies with multiple output voltages, one particular output must be loaded; for instance, many PC power supplies require a minimum current of several amps on the 5-volt output.
- Buzzing: some switching power supplies generate enough audible noise to drive you out of the room!
- RF susceptibility: particularly if you operate HF. Modern switching regulators operate at several hundred KHz, not too far from 160 meters.

I prefer linear power supplies, but some recent switching power supplies designed for ham use are small, light, and quite reasonably priced. QST reviewed[1] some of them recently.

Summary

Don't just walk past that pile of gray bricks at the next flea market – one of them might be just what you need to get some other surplus treasure going. For a small price (they are gray bricks, not gold) and not much work, you can have all the DC power you need.

1. Bottiglieri, J., AA1GW, "QST Compares: Switching Power Supplies," QST, January 2000, p. 70.