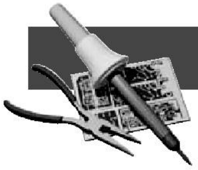

Phil Salas, AD5X

High Power DC Load for Power Supply and Battery Evaluation

Wonder if that power supply really puts out under load? Here's how to find out.

How often have you wished that you had some sort of high power dc load you could use to help evaluate different dc power supplies and batteries? I've frequently had this need, especially since I'm always looking at new switching power supplies and battery packs for portable operation. In the past, I was forced to use HF, VHF or QRP radios for my evaluation loads, but this tends to be inconvenient and offers limited choices. Because of the availability of low cost high power resistors, I decided the time had come to bite the bullet and build a flexible dc test load fixture.

DC Load Fixture Design

My design objective was to build a fixture that would provide multiple current loads, up to that of a typical 100 W HF transceiver. Of course, it needed to be built with readily available components. The schematic (Figure 1), and the associated parts list, details my final design. This dc load fixture has the following characteristics:

- Switch selectable 3, 7, 10, 14, 17, 21 and 24 A steps.
- LED display of current steps selected.
- Capability to monitor dc and ac.
- Fan cooled.
- Compact.

Putting it All Together

I used 12-gauge wire for the dc input, and 16-gauge wire connecting the common dc input to the individual switches. You should fan out the 16-gauge wires from the common dc input to minimize

Table 1
List of Materials

Qty	*Description*	*Source/Part Number*	*Price Ea*
1	10 Ω, 25 W resistor	Mouser 280-CR25-10-RC	$1.09
1	8.2 Ω, 25 W resistor	Mouser 280-CR25-8.2-RC	$1.09
3	2 Ω, 100 W resistor	Mouser 71-HL100-06Z-2.0	$6.64
3	Mounting hardware	Mouser 71-102-100W	$1.25
1	7×5×3″ mini-box	Mouser 563-CU-2108B	$8.70
2	2 terminal strip	Mouser 158-1002	$0.25
1	5 terminal strip	Mouser 158-1005	$0.54
7	#6 solder lug	Mouser 534-914	$0.14
8	0.187 female term.	Mouser 159-1641	$0.09
4	SPST 10 A switch	Mouser 540-RRA22H3FBRNN	$0.90
1	2 pin plug	Mouser 538-0306-2023	$0.20
1	2 pin receptacle	Mouser 538-03-06-1023	$0.19
2	Female contact	Mouser 538-02-06-1103	$0.19
2	Male contact	Mouser 538-02-06-2103	$0.19
1	Black "Powerpole"	Mouser 571-538942	$0.64
1	Red "Powerpole"	Mouser 571-5389-4	$0.64
2	"Powerpole" contact	Mouser 571-53892-4	$0.44
1	Red tip jack	Mouser 530-105-0802-1	$0.60
1	Black tip jack	Mouser 530-105-0803-1	$0.60
1	⅜″ grommet	Mouser 5167-210	$0.07
4	3k mcd green LED	All Electronics LED-57	$2.85
4	620 Ω, ¼ W resistor	All Electronics 620	10/$0.50
1	12 V, 40 mm fan	All Electronincs CF-184	$2.50
1	BNC panel mount	All Electronics BNC-19	$1.25
1	1 µF capacitor	All Electronics RMC-316	3/$1.00

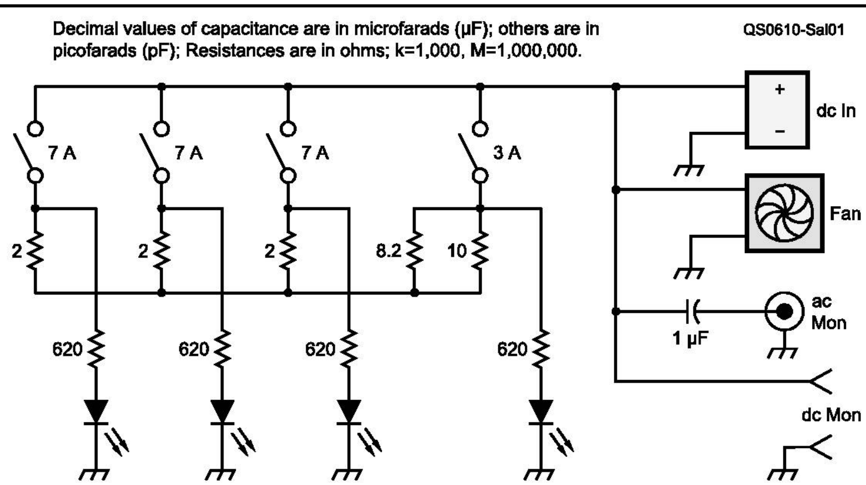

Figure 1 — Schematic diagram of test fixture. Note that all controls have corresponding indicators. A 30 A in-line or panel-mount fuse may be added.

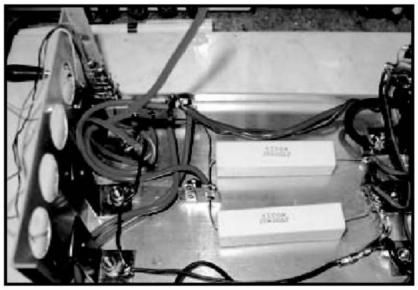

Figure 2 — Internal view showing wiring before switches and 2 Ω resistors are installed.

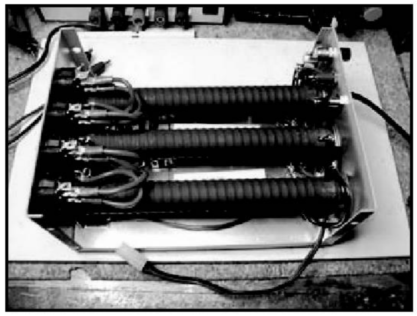

Figure 3 — Internal view showing final internal wiring.

Figure 4 — View of fan mounting arrangement on one side of the aluminum box.

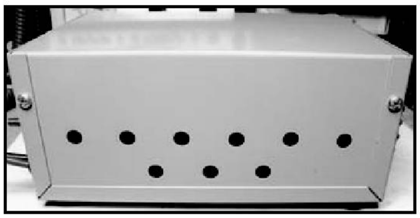

Figure 5 — Detailed view of ventilation holes on the opposite side of the box.

Figure 6 — Front panel view showing control and indicator layout.

Figure 7 — Rear panel with connectors.

voltage drops in the 16-gauge wiring. Other than this suggestion, the wiring is not particularly critical.

From a physical and mechanical standpoint, I wanted to keep the dc load fixture as compact as possible. Therefore, I used a 5 × 7 × 3 inch aluminum box to house the dc load. This box is not long enough to fully contain the power resistor mounting screws, so I let these screws extend through the back of the box. Except for the fan, I mounted all parts on the main part of the box, as shown in Figures 2 and 3. I connectorized the fan power cable so that the cover could be separated from the main assembly if desired. For ventilation, I punched nine ¼ inch air holes into the side of the cover opposite the fan and oriented the fan so that it pulls air through the unit. The fan is wired so that it is always on whenever there is a dc input. Figures 4 and 5 show the fan mounting and ventilation holes. Figure 6 shows the positioning of the switches and LEDs.

I mounted the LEDs vertically as shown so as to be able to mentally add the enabled current drains at a glance. I located the dc and ac monitoring connectors on the rear of the unit. The ac connector, a BNC bulkhead jack, is meant for connecting to an oscilloscope to look at noise and ripple on the dc from the power supply under evaluation. It also can be used to observe dc power supply transient response to sudden changes in current. While most, if not all, oscilloscopes can handle a dc input, I felt that adding a 1 µF dc blocking capacitor was a safe thing to do because of the possibility of high current if this jack was inadvertently shorted (bad coax cable or other problem). Figure 7 shows the dc input cable and the dc and ac monitoring jacks. I decided not to fuse the unit since the unit is just a resistor bank, and I felt there was not really anything that could short internally. You may wish to add a fuse to be extra safe. Finally, I labeled everything using a Casio labeler and "black on clear" labeling tape.

Parts Substitution

I used the small (0.063 inch contact) Molex connectors for the fan cable. Obviously, any connector, or direct wiring with no connector, can be used. And any switch capable of handling more than 7 A dc can be substituted for the rocker switches called out. Wiring can be directly connected to the switch instead of using the female terminals. You can also use less expensive red LEDs, or eliminate the LEDs and associated resistors if you wish. I called out a generic connector made by AMP that is compatible with the usual Anderson PowerPole connectors. This and the other parts are available from Mouser Electronics. You can obviously use a regular Anderson PowerPole or any other dc connector you may have standardized on.

Testing Capabilities

Aside from permitting you to evaluate battery capacity, this dc load fixture can also be used to evaluate power supplies under different load conditions and during transients. In other words, you can suddenly increase or decrease the current drain on the dc power supply by switching resistors in and out. With a dc voltmeter connected to the dc monitoring jacks, you can look at load regulation under varying current drain conditions. With an oscilloscope, you can look at the power supply transient response to sudden changes in current, as well as ripple and noise on the dc input as a function of current drain.

Conclusion

I've described a very useful high current dc load fixture that can be used for evaluating dc power supplies under various load conditions. It can also be used to determine battery ampere-hour capacity. The components necessary are readily available and inexpensive. If you do much work in the dc area, you may want to consider building one of these units.

Phil Salas, AD5X, is an electrical engineer, now fully retired after working 33 years in the telecommunications industry. Phil has been an active ham since he was first licensed in 1964 at the age of 15. And it was because of his ham radio interests that he pursued an engineering career, obtaining BSEE and MSEE degrees along the way. Phil enjoys HF CW DXing, ragchewing, portable and QRP operation and building ham radio related gadgets. He lives with his wife Debbie, N5UPT, and daughter Stephanie, AC5NF. Phil can be reached at **ad5x@arrl.net**.