

High Power DC Load for Power Supply and Battery Evaluation Phil Salas – AD5X

Introduction

How often have you wished that you had some sort of high power DC load so you could 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. Typically, I use HF or VHF or QRP radios for my evaluation loads, but this tends to be inconvenient and limited. However, because of the relatively inexpensive cost of high power resistors, I decided the time had come to bite-the-bullet and build a flexible DC load fixture.

DC Load Fixture Design

My design objective was to build a fixture which would provide multiple current loads, up to that of a typical 100-watt HF transceiver. And, of course, it needed to be built with readily-available components. The schematic shown below, 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 amp steps
- LED read-out of current steps selected
- DC and AC monitoring capability
- Fan cooled
- Compact

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 voltage drops in the 16-gauge wiring. But other than this suggestion, I'll leave the wiring up to you.

From a physical/mechanical standpoint, I wanted to keep the DC load fixture as compact as possible. Therefore, I used a 5x7x3 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 photo "PartialInside" and photo "FinalInside". I connectorized the fan power cable so that the cover could be separated from the main assembly if desired. For ventilation, I punched nine 1/4-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. Photos "Fan" and "Vents" show the fan mounting and ventilation holes. Photo "Front" 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, as well as 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 μ f 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). Photo “Back” 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. However, you may wish to add a fuse if you desire. Finally, I labeled everything using a Casio labeler and “black on clear” labeling tape.

Parts Substitution

I used the small (0.063 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-amps DC can be substituted for the rocker switches called out, and 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. And finally, I called out a PowerPole equivalent connector made by AMP (fully compatible with Anderson PowerPole connectors) so that you can order this, along with the other parts from Mouser Electronics. However, you can obviously use a regular Anderson PowerPole, or any other DC connector you may have standardized on.

Testing Capabilities

Besides permitting you to evaluate battery capacity, this DC load fixture can also be used for evaluating power supplies under different load conditions, as well as sudden transient conditions. 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

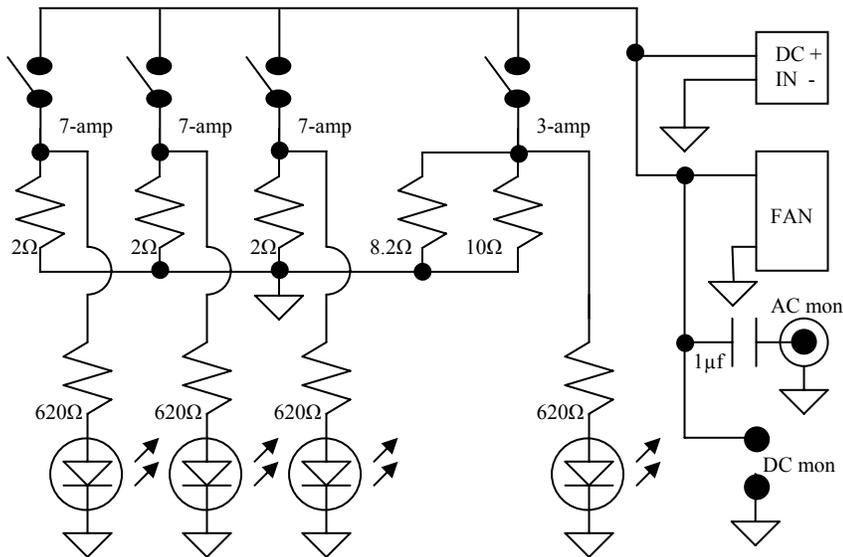
I’ve described a very useful high current DC load fixture which can be used for evaluating DC power supplies under various load conditions, as well as battery amp-hour capacity. The components necessary are readily available and inexpensive. If you do much work in the DC area, you may want to consider 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 and ragchewing, portable and QRP operation, and building ham radio related gadgets. He lives with his XYL Debbie N5UPT, and daughter Stephanie AC5NF. Phil can be reached at ad5x@arrl.net if you have any questions or comments.

Table 1 – List of Materials

<u>QTY</u>	<u>Description</u>	<u>Source/Part Number</u>	<u>Price Ea.</u>
1	10 Ω 25W resistor	Mouser 280-CR25-RC	\$1.09
1	8.2 Ω 25W resistor	Mouser 280-CR25-8.2	\$1.09
3	2 Ω 100W resistor	Mouser 71-HL100-06Z-2.0	\$6.64

3	Mounting hardware	Mouser 71-102-100W	\$1.25
1	7x5x3" 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
3	#6 solder lug	Mouser 534-914	\$0.14
8	0.187 female term.	Mouser 159-1641	\$0.09
4	SPST 10A 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
4	#6 solder lug	Mouser 534-914	\$0.14
1	3/8" grommet	Mouser 5167-210	\$0.07
4	3K mcd Grn LED	All Electronics LED-57	\$2.85
4	620Ω 1/4W resistor	All Electronics 620	10/\$0.50
1	12V 40mm fan	All Electronics CF-184	\$2.50
1	BNC panel mount	All Electronics BNC-19	\$1.25
1	1μf capacitor	All Electronics RMC-316	3/\$1.00
Miscl. 12-gauge wire, 16-gauge wire, #6 hardware			



Schematic – DC Load



Wiring w/o switches and 2Ω resistors



Final internal wiring



Fan Mounting



Ventilation holes



Front panel



Rear panel