Review: The Gamma Research HPS-1a Power Supply

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Introduction

I'm always looking for smaller and lighter equipment for my portable HF package, so when I saw Dave Ingram's comments on the compact HPS-1a power supply in the March 2006 issue of CQ, I decided to purchase one of these units. Four days later, UPS left a tiny box on my front porch. As I picked it up, I was trying to remember what small item I'd ordered. When I saw the "Gamma Research" return address on the box, I was stunned. The shipping box for this power supply is smaller than most switching power supplies currently available!

The Gamma HPS-1a Power Supply

Fred Graham K3GQ, the designer of the HPS-1a, is a professional power supply designer. He recognized that amateur radio operation is typically low duty cycle, and therefore a power supply only needs to handle high current during peak moments. Taking this into consideration, Fred designed the HPS-1a to be a tiny power supply which would handle normal QSOs when used with a typical 100-watt transceiver at the low duty cycles normally encountered in ham transmissions . Let's first look at the HPS-1a specs. They are quite impressive.

Input Voltage:	100-250VAC, 50-60 Hz, 2-amps maximum
Output Voltage:	13.8VDC $\pm$5%
Output Current:	22-amps at 25% duty cycle, 5-amps continuous
Dimensions:	3.37"W x 1.55"H x 5.25"D
Weight:	1.25 pounds

The HPS-1a is packaged very attractively. Gamma uses Pem nuts and flat head stainless steel hardware to make the unit look good and to enhance its structural strength.

So how does Gamma Research accomplish the high current at low duty cycles? They combined a 5-amp switching power supply with five farads (you heard me right!) of output capacitance, consisting of five 25-farad capacitors in series. So the peak current required by your 100-watt radio is supplied by the 5-farad capacitor bank, and the capacitor bank is re-charged during the longer low current duty-cycle time periods. Great idea! And this idea is good enough that Gamma has a patent pending on the technology used.

Performance

So how well does the HPS-1a actually perform? I ran a series of tests using my Icom IC-706MKIIG transceiver. First let's discuss my measuring test set-up and the operating parameters of my transceiver.

I first determined the peak current necessary for 100-watts output by connecting the transceiver to a MFJ-4225 power supply and watching the very fast-acting analog current meter. The peak current shown during CW operation matched the key-down current as indicated on both the MFJ-4225 current meter and an in-line West Mountain Radio Super-Whattmeter. For measuring transmit power, I used a MFJ-267 SWR/Power Meter/Dummy Load. The MFJ-267 power meter is a powered peak-reading power meter. Finally, I used a Radio Shack digital voltmeter for measuring static voltages, and a Hitachi V-355 oscilloscope to measure instantaneous voltage drops during transceiver operation.

I determined that my IC-706MKIIG draws a peak current of 18 amps at 100 watts output. The receive current drain is typically 1.6 amps. And the key-up current drain when in the semi break-in mode is 3.4 amps. When operating QSK (full break-in), the key-up current drain is obviously the receive current drain of 1.6 amps. The idle current drain when operating SSB is 3.4 amps. This occurs when the PTT button is pushed, but you are not speaking. I found it interesting that the analog meter on the MFJ-4225 would kick up to 18 amps with every "dit" and "dah", but when using SSB, the analog current meter would generally indicate less than 10 amps. However, the MFJ-267 peak reading power meter did show 100-watts output power, as did the IC-706MKIIG bar-graph output meter (speech processing was enabled). I could whistle into the microphone and get the analog power meter to indicate 18 amps. Finally, I wanted to note that the operating voltage spec of the IC-706MKIIG is 13.8 volts ±15%, or 11.75-15.87 volts. I checked operation of my IC-706MKIIG and it worked fine down to 11-volts (0.75 volts below the low voltage spec limit). Now knowing all the parameters, I substituted the HPS-1a power supply for the MFJ-4225 and started my tests.

First, I found that the nominal output voltage of my HPS-1a was 13.6 volts. This is obviously well within the ±5% spec of the HPS-1a. Next I did the SSB testing. With speech processing enabled, I observed a 1.2-volt maximum voltage drop during speech peaks. This put the lowest voltage available to the IC-706MKIIG at 12.4 volts during SSB operation.

Next came CW testing. For this testing, I sent about a minute of a typical QSO, starting with CQ. This produced some interesting results. Using semi break-in CW operation, I found that I would find myself with a 2-volt drop after a few seconds of operation. If I dropped my CW keying speed to less than about 15 WPM, the voltage drop increased to about 2.5-volts. In either case, the voltage drop is greater than the spec'd lower voltage range of the transceiver, though my IC-706MKIIG did work well at both levels. Around 10 WPM however, the voltage drop increased to 3-volts, and my IC-706MKIIG began to have problems. The reason for the speed dependant voltage drops is due to the length of the "dits" and "dahs" at lower speeds, which extends the discharge-before-recharge time of the output capacitor bank. However, there are two solutions to this problem. First, I found that reducing my CW transmit power 80 watts kept the voltage drop to below 2-volts for speeds of 10 WPM and higher. And second, if you operate QSK (full break-in) you will also keep the voltage drop to less than 2-volts above 10 WPM at the full 100-watt output level of the IC-706MKIIG. This is because the key-up current drain in QSK is almost 2-amps less than in semi break-in.

So to summarize, when operating SSB (with or without speech processing) you can operate at the full 100-watt output level of the IC-706MKIIG. When operating CW however, you need to keep your CW speed above 10 WPM and either operate QSK to achieve 100-watts output, or lower your transmit power to 80 watts if using semi break-in. Of course, your mileage may vary depending on the characteristics of your particular transceiver. According to Gamma, there are direct reports of the HPS-1a working perfectly with the TS-570, TS-2000, TS-870 and several of the Yaesu 100 watt radios. This makes this power supply attractive for permanent home installations as well. Especially if you are driving an amplifier at something less than 100 watts.

Finally, I wanted to see how "quiet" the HPS-1a is. First, I saw less than 20 microvolts of noise and ripple on the DC output. This makes sense, as you wouldn't expect much AC ripple and noise to get by the 5-farad capacitor bank! Next, I listened for any switching power supply noise across the HF bands. I used a 20-foot long-wire antenna connected directly to the back of the IC-706MKIIG, which was located just a few inches from the HPS-1a. I could find no noticeable receive noise on any of the HF bands. Oh – and the internal fan, which runs continuously, generates virtually no audio noise. Bottom line is that this is one quiet power supply!

A few Cautions and One Complaint

There are a couple of things you should keep in mind when using this power supply. First, since the HPS-1a output includes a 5-farad capacitor bank, you could conceivably see currents in the hundreds of amps for a few milliseconds if you were to accidentally short circuit the output. This is why it is a good idea to use a fused set of DC cables between the HPS-1a and your transceiver, just as you should when connecting your radio to a high capacity battery.

Another thing to be aware of is that it takes quite awhile for that huge capacitor bank to discharge. This means the "off" doesn't occur very fast. There are equalizing resistors across the capacitors, which also act as bleeder resistors. But remember, we're talking about 5-farads of capacitance! Therefore, make sure you disconnect the power supply from a radio if you are working on the radio to ensure you don't accidentally short the power supply output.

And my complaint? I wish the output connector was an Anderson Powerpole. But that's just me. Gamma does provide a matching Molex plug for you, and this plug is also available from any Radio Shack store (RS274-151). Of course, the first thing I did was to make a Powerpole adapter cable!

Conclusion

The HPS-1a is designed to be a small light weight power supply that is perfect for portable operation with your 100-watt transceiver. As such, the design involved tradeoffs between output power, capacitor charge, and overall weight and size of the package. If you pay attention to the issues and solutions discussed in this article, the HPS-1a will serve you quite well. And because this power supply is so small and light, it can become the universal power supply for both your QRO and QRP portable operations.

Is this really a power supply for a 100-watt Transceiver? You bet it is!!

Backside showing the 20-amp Molex DC output connector. Gamma provides a matching plug (also available at Radio Shack).

Inside view showing the 5-amp switching power supply in the front, and the capacitor bank assembly along the back.

View showing the five 25-farad capacitors and equalizing resistors.

<u>UPDATE</u>

I just had to go ahead and add an Anderson Powerpole connector interface to my HPS-1a. I decided to just use a six-inch pendant cable, because after all, I had a Molex-to-Powerpole adapter cable before anyway.

The first thing to do is to remove the existing Molex connector. The easiest way to do this is to first cutting off the red and black wires flush with the back of the Molex connector. Then push the Molex connector back into the power supply and remove it. Next, apply heat with a soldering iron to the capacitor pc board and remove the red and black power wires that originally went to the Molex connector. Use a solder sucker to remove the solder from the holes in the pc board. NOw cut out a 0.8x1.4x0.032” thick aluminum plate and drilled it as shown in Figure 1 below (I bought a piece of sheet aluminum from my local ACE Hardware Store).

Using the holes in the aluminum plate as guides, mark the chassis of the HPS -1a. Then drill and tap #4 holes for the mounting screws. You can use #4 clearance holes if you wish, and then use #4 nuts and lockwashers for mounting the aluminum plate. Before mounting the aluminum plate, however, you need to use a nibbling tool to nibble out the original Molex mounting hole so that it clears the ¼” grommet in the new mounting plate.

Insert the ¼” grommet and mount the aluminum plate. Terminate one end of a 12 -gauge DC cable with a Powerpole connector. Pass the unterminated end of this calbe through the rubber grommet, and then strip ¼” from the ends of the two wires. Insert the wires into the pc board (red closest to the center of the power supply) from the top side and solder in place. Add a small tie -wrap to the cable on the inside of the power supply just to make sure you can’t pull the cable out!

That’s it. You now have a super compact power supply for your portable operation that includes the “standard” Anderson Powerpole connector for the DC interface.

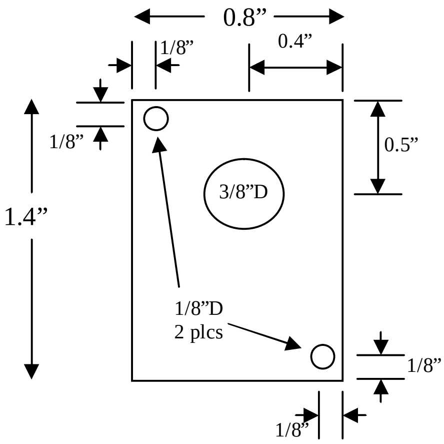
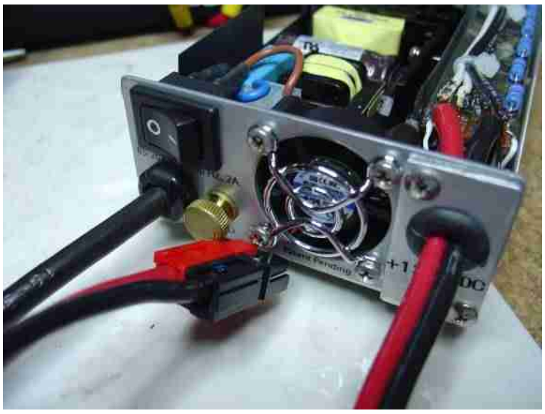


Figure 1: Rear Mounting Plate

New rear plate and pendant cable

Pendant cable internal connection

Powerpole pendant cable



Close-up