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OVERVIEW

If you are an amateur radio operator, Short Wave Listener (SWL) or involved in any number of other areas of communications, sooner or later you will have a need for a high current, well-regulated 12 to 15 volt DC power supply. It may be that you have removed your all band, 100-watt "Super Band Banger" rig from the car for the winter and need a power source to handle that transmit load. Or perhaps you have your station all setup with emergency battery backup and require a much shorter recharge cycle to get your batteries ready for the next black out. Whatever your reason, if you have a use for such a supply ranging in output current from 25 to over 40 amps this idea may be the one for you. If you have priced such a supply, you will find the cost is in the range $200 to $300 (US$). Discussed here will be a way to cut that cost by a factor of 10!

HOW DO WE GET THERE?

Developing a power supply providing 15 VDC or less, at the currents discussed is more of a search and find mission than it is a high tech one. If you are one of the newer members of our amateur radio family or new to needing a high current power or charging system, this relatively straight forward project should not stretch your technical skills and more importantly it will not stretch your budget either! The task at hand is to look through your "junk box" or visit your local "Radio Goodies" store or perhaps better yet, a computer store that sells old equipment and used parts. You will be looking for used but working Personal Computer power supplies. The ones I found were purchased at a "Good Will" store, still mounted in three scrapped out "AT Chassis" for $5 (US$) each—see Photo-1. In this case I not only obtained the three wanted supplies, that were all alike but I also acquired the cases, power switches, AC power cords, etc. The cost was low enough to allow the purchase of two additional units to keep as spares or for other service. You can also use the old PC cabinet for mounting multiple supplies if you desire.

ABOUT COMPUTER POWER SUPPLIES

It may be worth a few minutes of your time, for those of you who may not have had any exposure to a typical PC power supply, to grasp a general understanding of their inner workings without us going into any great detail. The power supplies I am discussing are enclosed in a metal case about 5 x 6 x 7 inches (13 x 15 x 18 cm) containing their own cooling fan, circuit breaker, power switch (case mounted or on short wire leads to the case) and a standard computer 3 pin IEC power connector. The power ratings of these supplies vary greatly from as low as 135 watts to over 300 watts. This wattage rating expresses the total power output of the supply. You will be searching for supplies no smaller than 200 watts with bigger being better with only one caveat discussed a bit later.

The PC power supplies described will normally provide four output voltages which are + 12 VDC, -12 VDC, +5 VDC and -5 VDC. The two minus voltages are usually rated at about 1 amp or less each and are of no practical value for our use here and you may just disregard them. The plus 12 VDC will have an output current rating of anywhere from 7 to 14 amps DC. The 5 VDC output rating will range between 20 and 40 amps depending on the output wattage rating of the supply.

The units used for my supply were manufactured in Taiwan by "KPI ", with a power output rating of 250 watts which turns out to be a very conservative rating for this particular supply. The +12 VDC is rated at 10 amps with the + 5 VDC rating at 25 amps! These two power outputs loaded to their full rating will add up to an output power availability of 245 watts, very near its posted rating. As shown, we have +5 VDC

and +12 VDC and several options and a few restrictions for their use in assembling this new supply to suit our needs.

One important point with reference to these computer power supplies is that they are "switching" power supplies not the more conventional "linear" type supplies so many of us may be more familiar with. There are several distinct advantages of switching supplies over the older linear types. Mainly they are more efficient and run cooler. However, there are also a few things to be cautious about or have knowledge of when using these supplies. The first item comes under the **CAUTION** flag. Switching power supplies take the AC line voltage (100 to 240 VAC, sometimes requiring a jumper to be removed for the higher line voltages) rectify it and charge high value capacitors to ***a high voltage in the range of 250 to 400 VDC***. These high primary voltages do present a dangerous lethal shock hazard and caution must be used if you decide to remove the protective cover over the supply and poke around inside. If you do decide to do so ***always discharge*** the large high voltage capacitors within. **Always!!**

One disadvantage of switching type supplies, in particular the older units, is their requirement for a minimum load on their output terminals. This will be in the range of 2 to 4 amps on the +5 volt output and from 0 to 2 amps on the 12 volt output. Many supplies require this minimum load on the +5 volts only. This may present a problem depending on the type of service you intend to place your supply into. One quick, simple fix is to place a 1 or 2 ohm, 25-watt load resistor across the +5 volt output. Although you are wasting from 12.5 to 25 watts of power, this will settle the supply down and allow it to provide a stable, well regulated output on both the +5 and +12 volt outputs. This is also a good technique to use when first testing your new supplies. An additional load resistor may be necessary on the +12 volt output, if so required, depending on the supply in question. This is the caveat mentioned earlier, but will usually not present a big problem. The two GE receivers in my rack draw enough power alone, on the 12-volt bus, to provide this load. I felt however it was necessary that you be made aware of this factor when dealing with switchers. Without this load present at "**power on**" the output voltages will not come up.

PUTTING THE SUPPLY TO WORK

At this point you have three options for the use of the supply outputs. First, if your load is at or less than the 12 volt maximum rating you may connect your equipment to the black and yellow leads supplying the voltage to the four pin Molex-type connectors coming from the supply. For higher power equipment, parallel several or all of the black leads together and do the same with the yellow leads to minimize your voltage drops. Connect your load to these new junctions. All wires of the same color are the same voltage. All black wires are common ground or reference point for all voltages. More on this "ground" connection a bit later. There is a long cable coming from the supply containing about twelve wires. This cable formally connected to the motherboard in the PC. This may be used as a source of your power. The color codes remain the same.

Your second means of utilizing this low cost power is to connect the +5 VDC outputs of three separate supplies together in series. This will provide you with +15 VDC at 25 amps on up to the maximum rating of the supplies you have acquired. If this +15 volts is beyond the working voltage range of your equipment, once again you have two options. One simple solution is to place one or two 50 amp stud diodes, with a heat sink, in series with the +15 VDC output. This will reduce the output voltage to 14.3 or 13.6 VDC respectively. It will also provide isolation between the supplies and any standby batteries you may have in your system. 13.6 to 13.8 VDC is also an excellent float charge voltage to keep your sealed lead acid batteries well charged without overcharging. An alternate to the added diode method is to remove the covers on the three supplies and look for the +5 V voltage adjustment. Most all computer supplies provide at least a +5 VDC adjustment. Many provide a +12 VDC adjustment as well. Once again "**Use Caution**" when you have the supply uncovered. In particular while AC primary power is applied. Locate the +5 VDC adjustment pot and set each supply output to from 4 to 4.5 volts which will provide a combined output between 12 and 13.5 VDC or as required for your needs.

Your last option is to use both the first and second choices above. Except for the common ground connections (black leads) each of the supply voltages are independent and isolated from each other. As

an example, I power my two GE Master transmitters using the high current series connected 5 volt supplies. I power each receiver independently with the 12 volt outputs of two of the supplies and use the third 12 volt output for other monitor and scanning receivers with lots of 12 volt power to spare.

A few closing thoughts: Although there may be a few variations by certain manufacturers, the standard color coding of these PC power supplies is as follows: (See L-1)

Table L-1

COLOR	VOLTAGE	COMMENTS
RED	+5 VDC	All red wires common to each other
YELLOW	+12 VDC	All yellow wires common to each other
WHITE	-5 VDC	Not Used
BLUE	-12 VDC	Not Used
BLACK	Common Grd.	All black wired common to each other
ORANGE	+5v Signal Wire*	Power Good Lead, connect to +5 VDC

Note: Most PC Power Supplies have an ORANGE wire that provides the "**Power Good**" signal back to the supply. Tie this wire to the +5 VDC leads. Not all supplies have this feature, however, the supply will provide no output voltages without seeing a positive going 5 v signal on this line.

Switching power supplies have several unique properties. Among these is their ability to "Power Share" between supplies. This means that although the +5 volts may be rated at 25 amps, it will be capable of supplying a larger output current that if the +12 volt supply is lightly loaded. You cannot push things too far due to the limits of the power components within the supply. There is a fair amount of leeway in most supplies however.

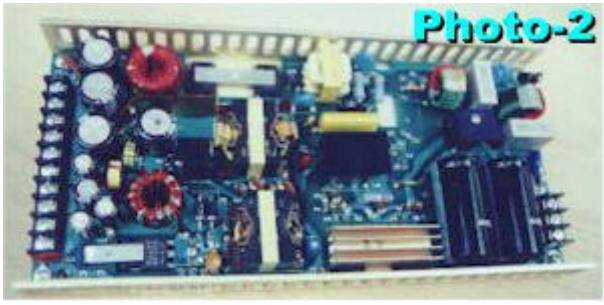
If a switching supply is overloaded or short-circuited, it will shut down. Its out voltage will drop to zero. Do not attempt to improve the filtering of the output power by adding an additional, large filter capacitor across the output. When the supply first begins to come up it will see that large cap as a short circuit and shut the supply down. Adding an additional capacitor will not only create a problem you will find it is not necessary!

It is suggested, if you are using more than one supply, (the three in series for example) connect all primary main power input circuits together so they are all powered on at the same time. Also, although the switching power supplies suggested here are quite efficient while operating they will draw a large surge for the first several cycles of primary power after you turn on the AC power. Be sure your AC main supplying the primary power is not overloaded with other heavy current equipment. After they are switched on however, the three supplies in series will draw about 1100 watts maximum under full load.

One last caution. Many power supplies connect all of the "black" wires, DC common, to earth (3rd wire ground). If this is so with the supplies you have on hand, you must open up the supply and cut the trace or traces that tie this DC common point to ground so the outputs are all floating. This will ONLY have to be done to the second and third supplies. The first supply will have its Black DC Common lead connected to ground in most installations and need not be touched.

If you have considered simply connecting the three 12 VDC outputs together in parallel you must diode isolate the positive lead in each supply before connecting them together. Although this will work fine and provide higher output currents, the output voltage will drop to 11.3 VDC. This can be reduced somewhat through the use of barrier diodes, but the output will now be approximately 11.6 volts. If the +12 VDC is adjustable in your supplies this will not present a problem simply readjust the pot to compensate for the

series diode voltage drop.



As an alternative to using standard PC power supplies there are many open frame, high current, +5 and +12 VDC supplies available (see Photo-2) at very reasonable prices on the used and surplus market. In fact there are several listed now in the ***antenneX*** **Classified Clearing House** (CCH) listing under power supplies. Remember please "**USE CAUTION**" when you have your fingers inside these switching supplies. Although their output voltages are very tame there is a "***Tiger in The Cage with Lethal Teeth***"! **-30-**

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