

The hAmTX Power Supplay

by Paulo Ferreira CT2ILQ
paf@dei.isep.ipp.pt

The need for a power supply

When a ham buys (or makes) a radio he usually needs a power supply for it. A cheap alternative to buy one is to adapt a computer power supply. I just said the magic word, cheap. Hams like cheap things because that way they can buy more radios, or wire for antennas, or CW keys, or any other things they like. And a computer power supply can be bought in many places of the world, where one cannot find other radio related items. But a computer power supply is very different from a radio power supply, so we need to check the differences and see what can be done.



The Normal and the modified PSU

A typical PC compatible power supply is usually a switch-mode power supply with at least one fan. So one can expect RF noise and some acoustic noise. The RF noise can be ignored if the objective is to feed a VHF/UHF FM rig, and (some) modern PC power supplies have reasonably quiet fans.

Moving Closer

There are several documents on the internet that give information about transforming one PC PSU in one radio PSU. They have several shortcomings, they are for older AT style PSUs, they usually need changes in the internal circuit of power supply, or in alternative they can supply only small currents.

But, in the recent times there is a new kind of PC power supplies called ATX12V and they are interesting, very interesting. In a simple way, old style AT PSUs had a strong +5V output, and a reasonable +12V output. The ATX standard brought different connectors and a +3.3V output. The ATX12V standard comes from the need of low voltages and strong currents for the actual processors. The motherboard manufacturers place voltage converters on the motherboard and feed the voltage converters at +12V. So its easy to find PSUs with a capacity of between 15 and 25 Amperes on the +12V line (without circuit changes).

The minimum

The trouble is not the maximum current, but the minimum current because switch-mode PSUs have a minimum current limit, if their load is lower than the minimum, they can be damaged (or they shutdown if they are protected).

But the resolution of this problem is simple, we just need to place some resistors on the outputs that have a minimum current requirement. Usually the +3.3v, +5V and +12V outputs have a minimum current requirement. The resistors must have the correct wattage, preferably with a safe margin. Some of the more recent power supplies only have a minimum current requirement on the +12V line, so they are very nice for our needs.

How to proceed

1) Get the ATX12V power supply design guide.

2) Choose the ATX power supply to buy.
 Items to check:

The PSU must have a power switch.

The manufacturer has a page on the Internet?

Does the page has the full specifications?

Is the PSU a "big fan" (120 mm) type PSU?

What are the maximum currents?

What are the minimum currents?

What are the outputs with a minimum current requirements?

Calculations

So lets suppose we have a power supply with a minimum current of 0.5 A on the +12Volts output only. So we need a resistor of $12/0.5= 24$ Ohms maximum. A good approximation would be a 22 Ohm resistor. The power dissipated would be $12V*0.5A= 6$ Watts so a good compromise would be a 22 Ohm resistor of 15 Watt at least.

If the power supply has a minimum current on other outputs we need to calculate the resistors for the other outputs using the same method.

Opening the power supply

You may get an electrical shock even if the PSU is disconnected from the mains, so be careful, or you may not need to follow the next steps. One measure of caution that may not work, but may diminish the danger, is to leave the PSU disconnected one full day before opening it.

List of wires and colors

Black Wires - Ground - connect to ground (Ground Output)

Green Wire - Connect to one black (to place the power supply always on)

Grey - Power Ok - unconnected

Purple - +5V standby - unconnected

White - -5v (not used in recent motherboards) unconnected

Blue - -12V unconnected

Orange Wires (+3.3v) - leave opened (no connection)

Red Wires (+5v) - leave opened (no connection)

Yellow Wires (+12Volts) - connect to Positive Output

Resistors to connect

As only the +12V output has a minimum current requirement we only place one load resistor (previously calculated) between the yellow and black wires. The resistor (or resistors) should be placed inside the PSU to benefit from the PSU fan.

Practical resume:

Black = Ground = Connect to Black wire of the radio

Yellow = 12 Volts = Connect to Red wire of the radio

Place the Resistor between Yellow and Black

Orange = +3.3V = Leave open (unconnected)

(Place a resistor between Orange and Black if needed, if the +3.3V Output has a minimum current requirement)

Red = +5V = Leave open (unconnected)

(Place a resistor between Red and Black if needed, if the +5V Output has a minimum current requirement)

Green = connect to Black

All the other wires are unconnected

Practical experience:

I got one power supply (460W nominal with a big 120mm fan) and modified it. Acoustically it is very quiet. Electrically with a VHF/UHF FM rig the RF noise is not detectable. So to operate a VHF rig the PSU is suitable.

One good thing about it (and many others) is an adjustable resistor inside to control the output voltage and that way I could adjust the output voltage up to 13.5 Volts instead of usual 12Volts (with a lot of care because of the deadly voltages inside of the power supply).

To test the RF noise I compared the PSU with a linear PSU, and with a Gel-Cell battery, using one hf radio on several amateur bands, and a 20 meter horizontal long wire antenna.

On the first test, inside the house, the PC modified PSU was a noisier than the linear PSU but not much worse, and the battery was comparable to the linear supply.

Then outside, I placed the radio under the antenna and yes, the "computer" PSU, is usable on VHF and UHF FM, but on HF gives a lot of noise. Surprise, the linear PSU also makes noise, and the battery is very quiet, because almost all the QRM I hear is from the coaxial cable routing from the inside to the outside of the house.



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It runs parallel to the satellite receiver cables and that should be the cause of all that QRM... So I need to reroute the antenna cables.

Meanwhile I have a good PSU to use with a typical 50W FM VHF/UHF radio.

Things to try in the future:

The PSU is not suitable for HF use. Could the PSU be improved with additional filters? I have not placed any filter on the output but there is space for the filter inside the PSU box if the fan is moved to the outside.

Links and documentation:

Atx12V Specification:

http://www.enhanceusa.com/documents/ATX12V_v2.01.pdf

Other specifications:

http://www.enhanceusa.com/support_tech.htm

Basic Modification Examples:

<http://www.antennex.com/preview/archive3/powers.htm>

<http://www.qsl.net/aa3sj/Pages/PC-Supply.html>

<http://www.mattsrcstuff.com/PCPS.htm>

<http://www.qsl.net/vk2ep/news/dec2001.doc>

St. Louis switcher

<http://www2.arrl.org/members-only/tis/info/pdf/0205035.pdf>

<http://www.qsl.net/wj5o/project.htm>

<http://www.njgrp.org/qhbextra/6/6d.html>

http://207.195.94.13/sart/radio_library/switcher-supply.pdf

Advanced ones:

Very complete:

<http://www.grp4u.de/docs/en/powersupply/index.htm>

Nice modification

<http://www.qsl.net/vk4ba/projects/index.html>

ATX power supply example

http://pavouk.comp.cz/hw/en_atxps.html

Changing an ATX PSU to 12-24V input (input!):

<http://www.acs.comcen.com.au/atxps.html>

Data sheets and tech pubs:

<http://www.fairchildsemi.com/ds/TL/TL494.pdf>

<http://www.fairchildsemi.com/ds/KA/KA7500B.pdf>

<http://www.antentop.org/> mirror: www.antentop.boom.ru

The hAmTX Power Supply

<http://focus.ti.com/docs/prod/folders/print/tl494.html>

Nice Articles about switched power supply repair (on a slot machine tech magazine !!)

[http://slot-tech-](http://slot-tech-ftp.serveftp.com:8080/magazine/february02.pdf)

<ftp.serveftp.com:8080/magazine/february02.pdf>

[http://slot-tech-](http://slot-tech-ftp.serveftp.com:8080/magazine/march02.pdf)

<ftp.serveftp.com:8080/magazine/march02.pdf>

Modifying a PC power Supply for Lab use:

<http://web2.murraystate.edu/andy.batts/ps/powersupply.htm>



Final version (for now) with fan outside of the box



Inside View