The North Queensland
Amateur Radio Convention 2013
Charters Towers

HOME BREW ACTIVITY

Converting a computer ATX switch mode power supply for radio shack or home use.

In this project, which it is expected that both YLs and YMs will participate, we will be converting an ATX computer power supply (PSU) to run on its own and provide the PSU with handy 12v and 5v output terminals. The builder will need to decide on the following items -
. colours of indicator LEDs   . types of output terminals   . necessity of having a load resistor on 5v rail   . layout of wiring
If you are having trouble deciding these things - phone a friend ! Firstly though, this safety messages is necessary ..

**This project uses a device that employs _lethal_ voltages under normal working conditions.
Any work on the device will be done with the device disconnected from the mains and
the filter capacitors discharged with a load.**

Never assume that this has already been done. Always do it yourself, or watch someone do it for you.

Extra parts needed
- choice of terminals for 12v output
- choice of terminals for 5v output
- if no 5v rail load resistor in PSU - a 10W 10ohm resistor
- LED of your choice for Power On indicator
- LED of your choice for Power Ready indicator
- 2 x 1k ohm resistors for LEDs
- A toggle switch
- Some heat shrink tubing or self fusing tape
- a working ATX computer power supply

Tools needed
- Side cutters
- Stepped hole borer and power drill
- Hot Air source to shrink heat shrink
- Pliers
- Star Screwdriver
- Crimpers
- Soldering Iron and Solder

Fig 1 . TaDa ! a working ATX computer power supply.

Before opening the beastie you need to make sure it is safe. The mains filter capacitors can hold enough charge at a high enough voltage that can kill you <u>many</u> times. With the PSU unplugged from the mains, plug a load, say - a spare computer hard drive as your discharging load - into one of the four way power connectors, then short the green wire to one of the black wires to enable the PSU to fire up momentarily and dissipate any stored charge.
Always treat the PSU with care. Complacency is a killer !

Fig 2 . Inside the PSU

Oooh ! There's a lot of wires ! Don't worry, you will be using most and will be cutting a few away. The layout might differ between different models of PSU but the wiring colours have been standardised by Mr Intel.

This particular model PSU does not come with a switch on the mains circuit. If your PSU is the same please note that even when you turn off the PSU with the installed toggle switch, the PSU will still be active. Unplugging the PSU from the mains circuit is the only way to turn the PSU off completely. Of course, if you have to work on the innards of the PSU then go back to Fig 1.

Now, where are you going to put those extra components ? For this type of PSU, the toggle switch, LED indicators and load resistor sit well on the same side as the mains input socket while, if you are employing binding posts then the output terminals are well mounted on the surface where the wires come out. If you are employing in line sockets then they will just be on the wires.

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Fig 3 . Main Motherboard Connector

Ok, now it is time to sort out the grain from the chaff....
Required Wires - colours and function
Black   - zero volts (negative)
Orange   - +3.3v dc
Red   - +5v dc
Yellow   - +12v dc
Green   - Turn PSU On (when connected to zero volts)
Brown   - Volt Sense
Grey   - Power OK / Power available indicator (5v dc)
Purple   - Power available / Standby power (5v dc)
Not Required Wires - colours and function
Blue   - minus 12v
White   - minus 5v

Aha ! Now it is time to do something destructive !
- With a pair of side cutters, cut the wires off the connector.
- Draw those cut off wires back inside the PSU case.
- Isolate the green wire and one black wire and knot together
- Isolate one red wire and one black wire and knot together
- Isolate the purple wire and one black wire and knot together
- Isolate the grey wire and one black wire and knot together
- Isolate the brown wire, the orange wire and one red wire
    and knot together
- Shove the unused black, red and yellow wires back outside
    the PSU case
- Isolate the Blue and White wires and tie together. Apply heat shrink tube or self fusing tape to the ends of the wires.
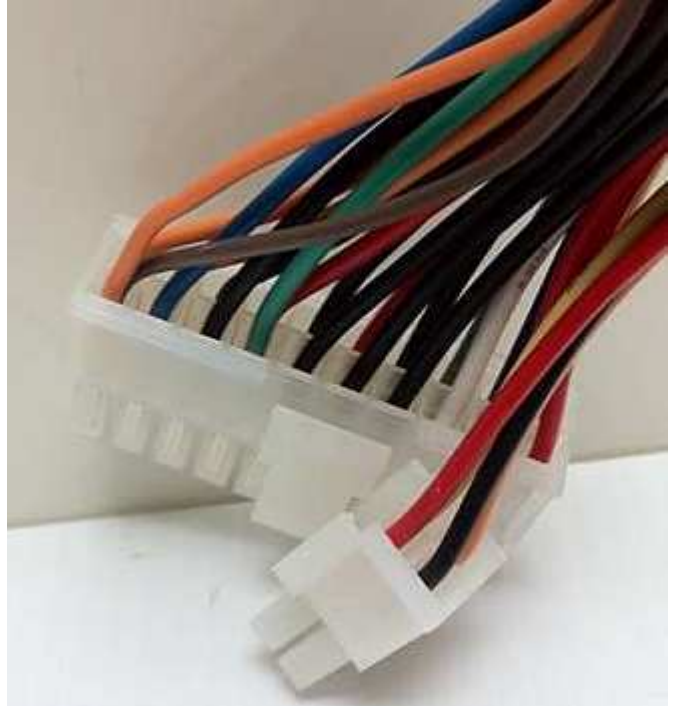
Fig 4 . Suggested Component Placement

Decision time - where to put the LEDs, switch and load resistor.
Here is a suggested placement for the components. Everything mounted low so that it clears the cooling fan.
Copper tie wire for the load resistor.
Once you have your holes drilled and components mounted it is time to start soldering.
If you are using heat shrink tube, then now is the time to put short lengths onto wires ready for placement and shrinking.
If you are using self fusing tape then have it ready.
Strip a small bit of insulation off the wires, pre-tin with solder, then ...
- solder green and black wires to toggle switch terminals
- solder purple and black wires onto Power Available LED
- solder grey and black wires onto Power On LED
- solder the red and black wires onto the load resistor
Here comes the curly question - does your power supply sense 3.3v or 5v to make sure all is well ?
Try firstly .. - solder the orange and brown wires together. Now, either shrink the tube over all the solder joints or wrap self fusing tape around all the solder joints.

Fig 5. Not sure which is what on a LED ? The Cathode (negative terminal) is normally indicated by the shorter wire coming out of the LED. You have to watch out though, sometimes the wires are clipped equal length or clipped wrong. Double check - look for the big part inside the LED - that's the wire to solder the black wire to !
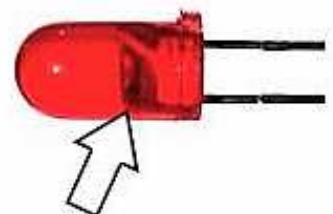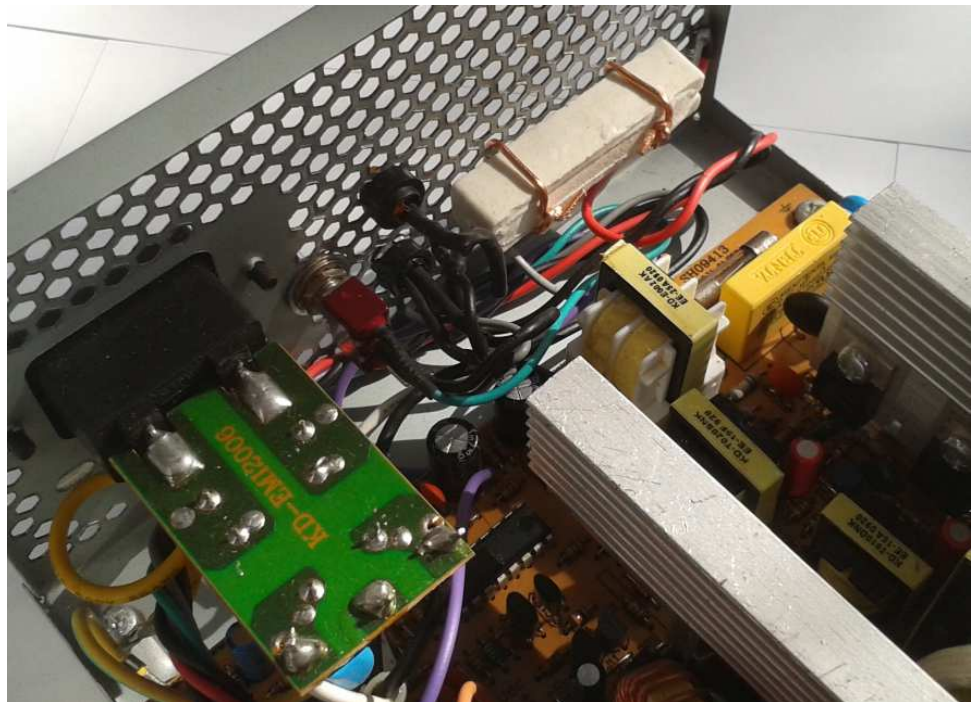
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Test Time !
Put the PSU case back together, ensuring all your modifications are clear of mains components and nothing is pinched.
Previously, you shoved some spare wires to the outside of the PSU case. You still have other external wires with 4 terminal connectors on them. OK, for the wires you shoved out of the case …
Match each 12v yellow wire to a black wire and knot together. Match each 5v red wire to a black wire and knot together.
Now, grab that discharging load (old computer hard drive) and plug it into one of the leads with the 4 terminal connectors on it.
Make sure all switches are off. Plug a mains lead into the PSU. Turn on the switches. The discharging load should spin up.

If not - check the following …
. Does the fan come on ?   . Is there any voltage on output wires, even if it is not right ?   . Was the PSU working before mods ?
Another thing that might be out of whack - remember when you were told to join the brown and orange wires together ?
It is possible that your PSU needs the brown and red wires joined together. It is also possible that you might have an ultra modern ATX PSU and that you will have some thinner orange and brown remote sensing wires floating about. Connect the thin orange wire to the thick orange wire and the thing brown wire to the thick brown wire. If they exist, also connect the thin red wire to the thick red wire and the thin yellow wire to the thick yellow wire.

Once everything is sorted and the discharging load spins up ok, turn off the mains and discharge the PSU with the discharging load. Now it is time to work on the output wires.

Fig 6. Output Terminals
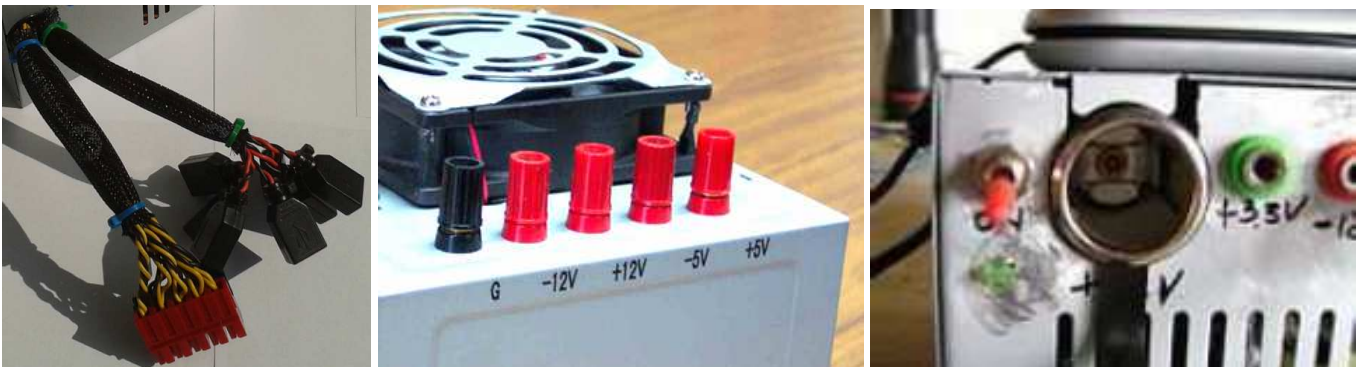
Here are a few suggestions - inline Anderson 30A for 12v, inline USB for 5v - Binding posts for all - hack a cigi socket .
You will choose what best suits your needs. Whatever you choose, make sure that any panel mounted hardware has
good clearance to the PSU board and mains circuitry !
Finally - drag any left over outside wires back into the case, knot them together then apply heat shrink tube or self fusing tape to the ends of each individual wire. Then reassemble your converted PSU.

Fig 7. The completed item
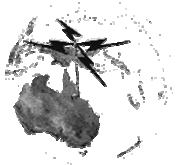
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Fig 7 shows a converted PSU set up to provide 12v dc through 30A Anderson Connectors and 5v dc through inline USB sockets. Imagine being able to charge 7 USB devices and run a mobile rig or charge handhelds in 12v charging cradles at the same time ? As is, the PSU is fine for shack use, however if you use it in the home you might need to put it in a box - ensuring of course that ventilation is maintained.

Now for some tech tables -

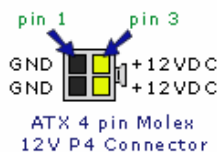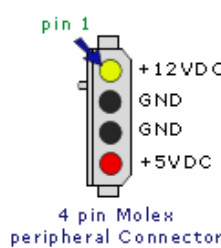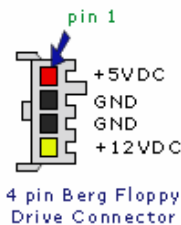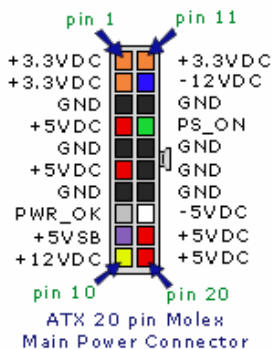| Model (Rated Output)	145W	200W	235W	250W	275W	300W	350W	400W	425W	475W
+3.3 V		14	13	13	14	14	28	40	40	45
+5 V	18	22	22	25	30	30	32	40	40	40
+12 V	4.2	10	8	10	10	12	15	15	15	18
-5 V	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
-12 V	0.5	1.0	0.5	0.5	1.0	1.0	0.8	1.0	1.0	2.0
+5 VSB *	0.2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.5
+3.3V and +5V Max Combined Wattage **		135 W	125 W	150 W	150 W	150 W	215 W	300 W	300 W	300 W

Representative ATX 12 V. Power Supply Ratings (amps)

Power supplies vary in ratings by manufacturer and date of manufacture -- consequently, the power supply you have on hand may not exactly match the output ratings listed below. A power supply rated at 200 watts will be similar, but probably have slightly different amperage figures. It has been noticed that the supplies of later manufacture tend to list higher current levels than earlier, but also list maximum combined output. Please keep in mind that the table below is approximate and is to be considered as a guideline only.

* Standby voltage -- most system boards on recently manufactured computers will be constantly powered thru standby to allow for Wake on LAN startup.

** A little applied algebra will show that the total wattage (watts = volts x amps) produced would be considerably above the rated wattage of the power supply. However, recent manufacture power supplies will have a maximum wattage rating for the 3.3v and 5v lines combined. Even though you may draw up to the rated wattage from one voltage, you will not be able to draw maximum rated wattage from both lines simultaneously.

ATX Supply Output Lead Pinouts
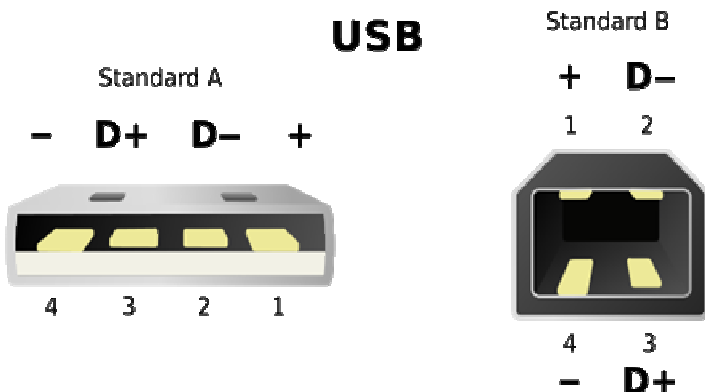
USB connectors - Pin configuration - Standard A/B, viewed looking into face/end of plug