SCHMIDT CONSULTING

ATX Bench Power Supply

Tom Schmidt

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tom@tschmidt.com
http://www.tschmidt.com

PC ATX power supplies provide 3.3, 5, and +/-12 volt outputs making them ideal as a poor man's bench supply. The use of a nifty breakout board makes the conversion extremely simple. Anyone who has been involved with electronics for any length of time probably has several old PC supplies kicking around. This is a great way to put an old supply back to work.

While on eBay I stumbled on an ATX power supply breakout board. It had never occurred to me to repurpose an old PC power supply, rather than just scraping the entire machine.

ATX Power Supply Standard

The ATX PC specification has been around for years. For our purposes the important portion of the specification is the power supply. It provides 4 voltage rails: +3.3, +5 and +/-12 volts and uses standardized connectors. The first three outputs are high current, at least 10 amps in even the lowest wattage rated supply, more than enough for typical breadboard projects. The -12 volt rail has a much lower rating; my supply a Bestec ATX-250-12Z out of an old HP desktop is rated at .8 amps. That is enough to provide the -12 volt rail for most analog projects or a limited amount of 24 volt power when teamed with the +12 volt output.

The supply has an always on 5 volt source and remote power control accomplished by grounding the Power on pin of the connector. That makes it easy to control the supply without having to switch AC mains voltage.

The motherboard DC connector is 24 pins. Early versions of the specification used a 20 pin connector; the good news is the 20 pin connector is a proper subset of the 24 pin version, so even ancient supplies will work. As power demands have increased the specification added a 4 pin 12 volt connector to directly feed the CPU. There are also flying leads to power multiple SATA and/or PATA drives with +5 and +12 volts.

From the eBay description it sounded like the board was an unassembled kit, but it arrived fully assembled. There are several versions of the PCB artwork. I chose the one that requires a wire from each banana jack to the PCB because the jacks are spaced wider apart. I wanted to add a LED for each voltage rail so that gave me enough room to mount the LEDs. The board that arrived was a different artwork. It has pads under each jack, so no need to use wires. Unfortunately the jacks are closer together so there is not enough room to mount the LEDs as I had intended. Price on eBay is less than $10 shipped to the US. In digging into this found lots of variants of this concept for example ones from Dangerous Prototypes and Sparkfun.

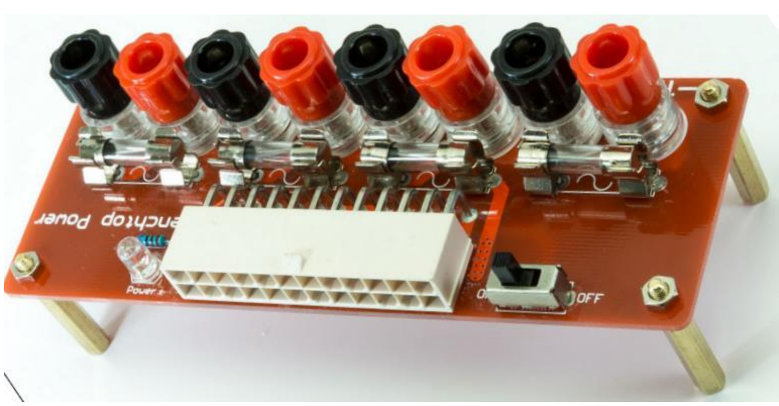


Figure 1 ATX Power Supply Breakout Board

Breakout Board Modification

I made several minor modifications to the breakout board to improve functionality as a bench supply.

DC Rail LEDs

I added a green LED and associated current limiting resistor at each of the four pairs of banana jacks. This is a handy reminder voltage is present, fuse is not blown and it discharges the supply when power is turned off. Located the LEDs and resistors under the board wired to each pair of binding posts.

Power On LED

The board came with a power on LED; I removed it because I added a LED to each voltage rail.

AC LED

I connected an amber LED and current limiting resistor to the 5V standby rail as a reminder the supply is plugged into the mains. This LED is on even when the supply is turned off. The LED is located in the space previously used for the Power LED.

Banana Jacks

The binding posts that came with the breakout board are okay but not the greatest; they are a pretty tight fit for banana plugs and do not have a drilled pin hole. I had some nice brass ones laying around so replaced the stock jacks. I used a yellow one for the -12 volt supply to differentiate it from the positive outputs. As a purest I hate using red for a negative supply.

Mounting standoffs

The board came with four metal spacers, female thread at one end and male thread and nut at the other. To mount the board need to use four M3 screws that are not included. I used some M3 nylon screws I had laying around from other projects.

Power Supply Modification

As with the breakout board made several minor modifications to the power supply itself.

Minimum Load Resistor

ATX power supplies typically require a minimum load to maintain regulation. In my case the 3.3 and 5 volt rails are fine without a load but the +12 output is low, at 11.6 volts. A 120ma load on the 5 volt rail brought it up to 12 volts. Increasing the load to 1.5 amps increased the 12 volt rail to 12.3 volts. I connected a 10 ohm 5 watt resistor to the 5 volt rail and ty-wrapped the resistor to the rear of the chassis in the air stream. This draws 500 ma resulting in a 2.5Watt load. Hate to waste the power but didn't want the outputs bouncing around under various load conditions.

Floating vs Grounded DC Common

As built ATX power supplies bond DC common to chassis and hence to Earth via the IEC mains power connector. For most projects this is fine but for some having a grounded supply is not desirable. The supply connects DC common to ground via a couple of PCB mounting screws. To isolate the supply I added an insulated washer between the PCB and chassis at each of the four mounting locations.

Normally the supply is operated with DC common connected to the power supply chassis. For times when it is not I added a 150nf cap and 100k resistor from DC common to chassis to bypass high frequency noise and provide a DC path to bleed of any static charge.

The breakout board has plenty of clearance around each of the standoffs so DC common is not inadvertently connected to chassis.

I attached a green flying lead to the chassis. The other end is connected to one of the black DC common binding posts if a grounded supply is desired.

Unused Connectors

I debated what to do with the unused drive and CPU connectors, ultimately decided to remove them to reduce clutter. Cut them off where they attach to the PCB. I used 5 volt and ground from one of the PATA connectors to feed the load resistor.

Fan Direction

ATX supplies exhaust hot air toward the rear of the PC toward the IEC mains connector. When used as a bench supply this means hot air gets blown toward the user. I rotated the fan so it is an intake blowing air through the supply and away from the user. This moves the blades closer to the grill guard. As an extra safeguard sandwiched scrap of fiberglass window screen between the fan and chassis.

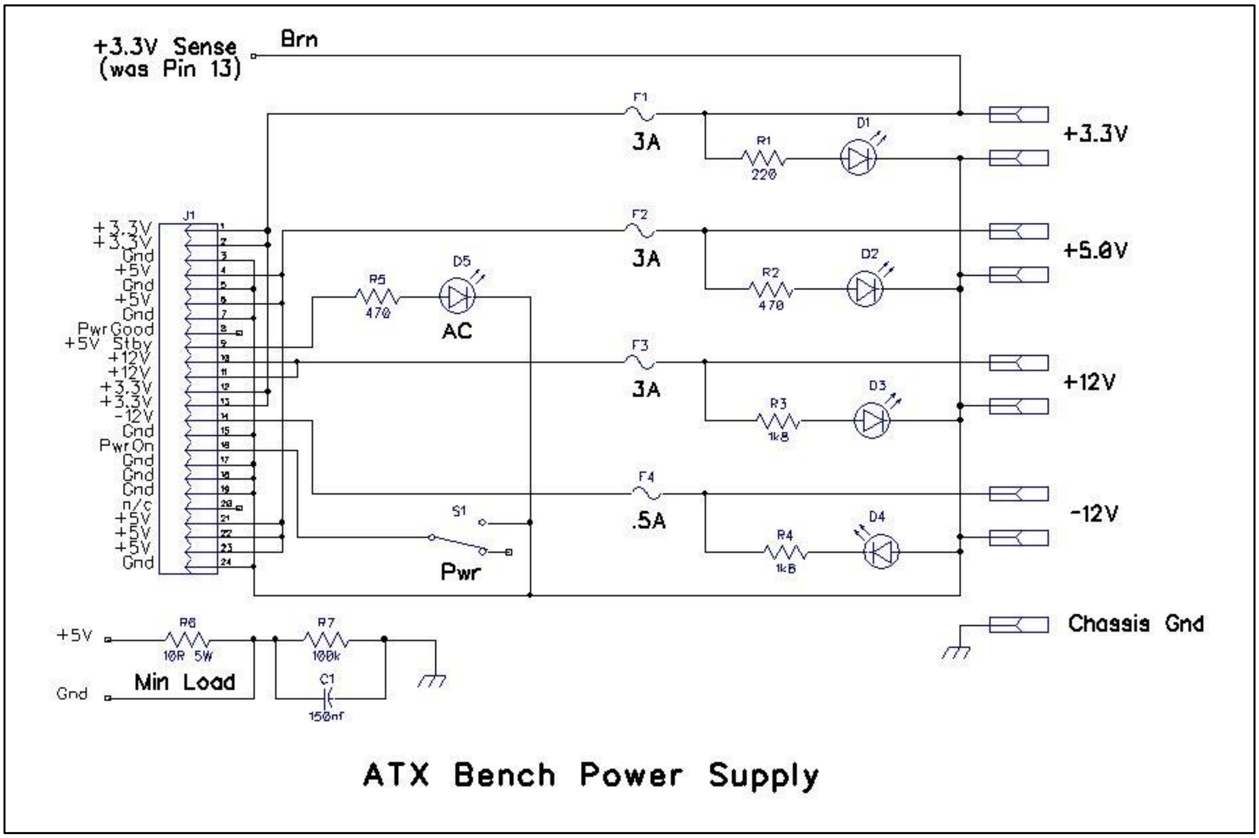
3.3 Volt Remote Sensing

The 3.3V sense lead (brown) is normally connected to Pin 13 of the ATX connector, paralleling one of the 3.3V power leads. To compensate for voltage drop across the fuse and PCB trace I removed the sense lead from the connector and attached it to the 3.3V binding post. Note this compensates for voltage drop on the 3.3V source but not the common ground shared by all the supplies. If the fuse blows the supply detects the fault and shuts down.

Schematic

Schematic is a composite showing the PCB and the modifications I've implemented.

The minimum load resistor is wired to 5 volt/ground wires from a PATA connector and located within the supply, not on the breakout board itself. A 100k resistor and 150nF cap bypass DC common to chassis ground.



Assembly

I drilled 4 mounting holes in the top cover of the supply to mount the breakout board. The cover has ventilation slots on the top. The breakout board is mounted forward of the ventilation slots. While the case was open removed the unneeded connectors, reversed the fan, placed insulating washers under each of the PCB mounting locations and mounted the power resistor using wires from the PATA connector.

I crimped terminals to a short length of green wire and attached it to the chassis. This is left disconnected if I want an isolated supply or attached to one of the binding posts (more typical) if I want a grounded supply.

To finish it off attached a foot at each bottom corner of the supply.

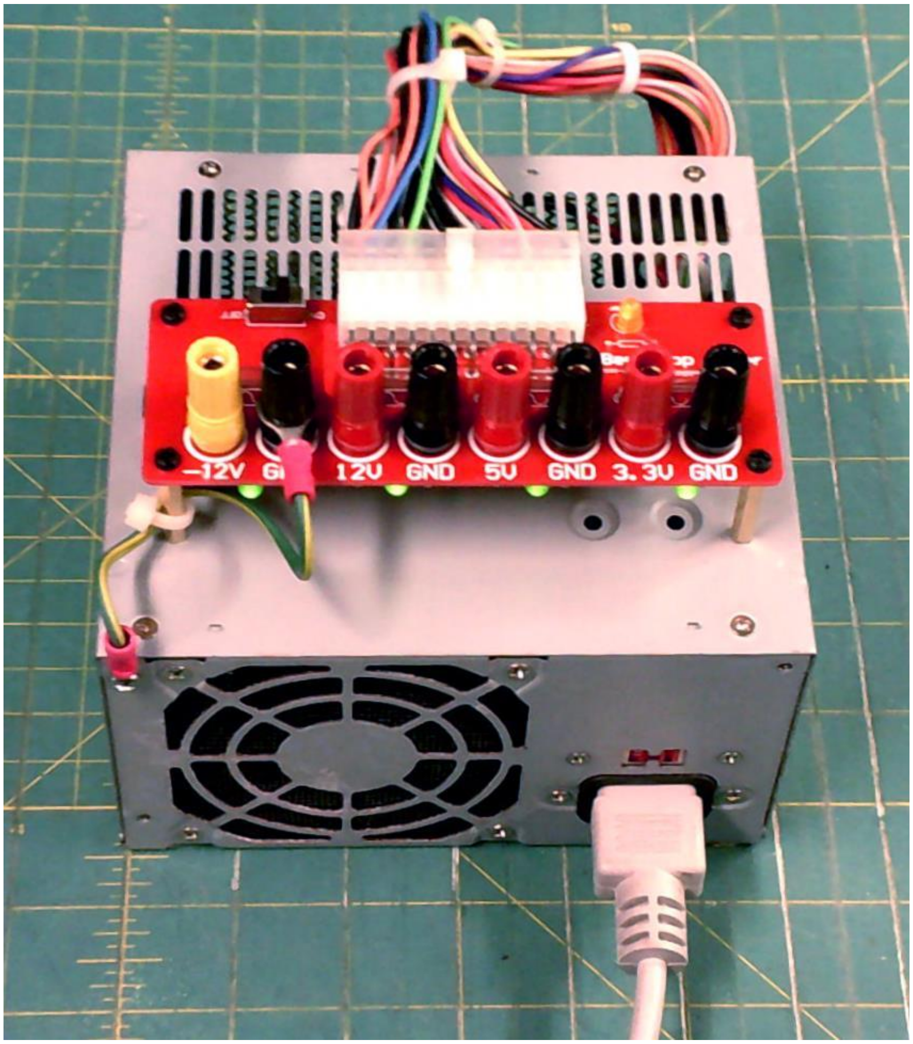


Figure 2 Finished Bench Supply

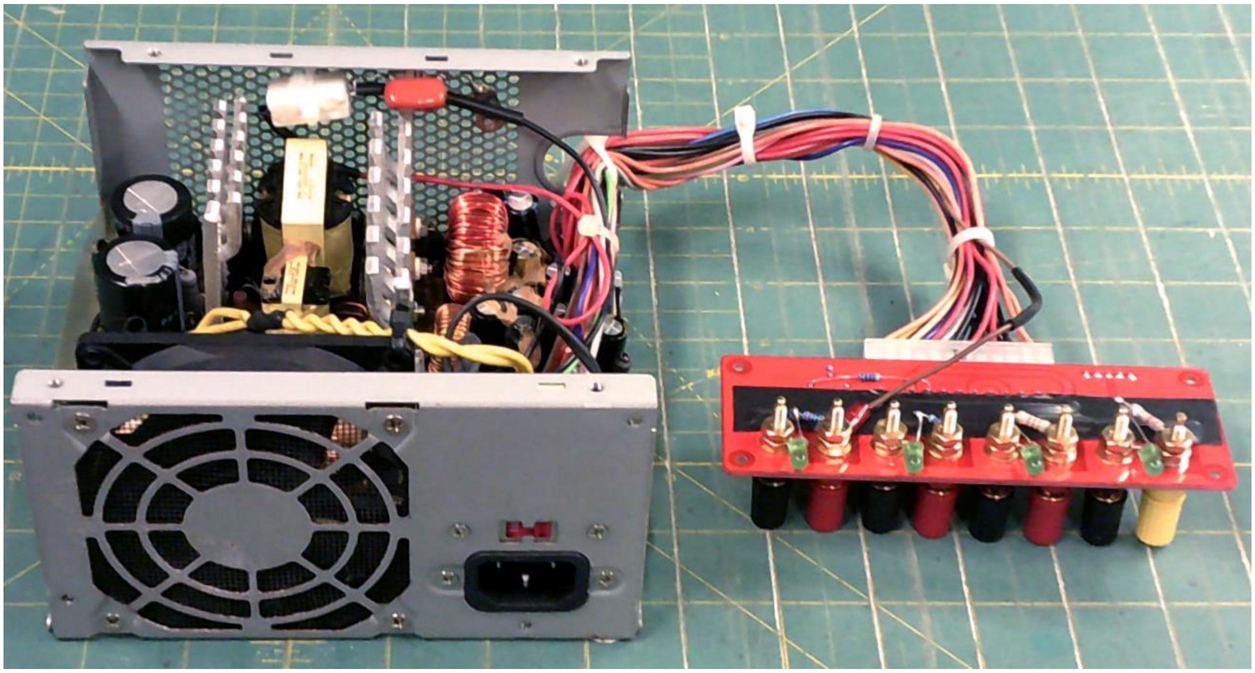


Figure 3 Internals

Fuses vs Polyswitch

I'm a big fan of polyswitches because they reset automatically after an overload. I considered using them in place of the 5x20mm fuses that came with the breakout board but decided to stay with fuses for a couple of reasons. Polyswitches are fairly slow to respond and once soldered to the board it is not practical to swap in a different value. One of the advantages of ATX supplies is the tremendous amount of power they are able to deliver. But that is also a disadvantage while debugging low power prototypes wired with fine gauge wire. In case of a short the wire ends up acting as the fuse. Staying with fuses allows me to install the appropriate value depending on the particular project I'm working on.

As delivered the breakout board came with 10 amp fuses. That is rather large for my projects and the -12 volt power supply rail is only rated at .8 Amps. I substituted 3 Amp fuses for the three main voltages and ½ Amp for -12 volt. Being in the US I rarely use 5x20mm fuses so ordered an assortment of fuses to keep spares on hand.

Accessories

I do a fair amount of USB and 12 volt automotive work so made up an adapter for each.

Figure 4 5V USB Adapter

For USB I stripped the buck converter out of a cheap eBay USB car charger. The problem with these cheap chargers is they do not meet rated current spec and run very hot. I gave up on the eBay cheapies and ended up buying a bunch of quality Anker car chargers. Once the buck converter and unnecessary hardware were removed added a resistor so the LED still works and ran 18 AWG red and black leads out of the housing attached to banana plugs. This gives me a source of virtually unlimited USB power. Well behaved USB devices will detect D+ and D- are tied together and know they are connected to a USB power device and limit maximum draw to 1.5 amps. Since I removed the buck converter need to be careful and only connect the modified adapter to the 5 volt supply, or risk letting out the magic smoke from the device I’m testing.

Figure 5 12V Outlet

The other adapter is a motorcycle accessory socket with a couple of banana plugs.   When attached to the 12 volt rail it provides a convenient way to power automotive accessories.

Conclusion

Supply is a great addition to my bench. Wish I had thought about building one years ago.