Mongo's* Simple Sega G80 Vector Mods (Electrohome G08-803)

*actually stolen from various other authors

DISCLAIMER: Working on monitors can be dangerous. You are dealing with high voltage equipment, as well as a potential risk of implosion of a picture tube. I take no responsibility for damage to yourself, others, or your equipment. If you are unfamiliar with high voltage systems DO NOT put yourself in danger. Get someone qualified to work on it and watch them and learn.

Sega Vector games are becoming increasingly rare. This is usually blamed on the notorious reputation of the Electrohome G08 monitor to catch fire. Although the very early versions of this monitor did earn the reputation legitimately, the majority of the monitors were not prone to this failure. Simply browsing available technical and troubleshooting articles reveals there are three contributing factors to game failure that anyone can correct with little or no troubleshooting knowledge and a minimum of tools. The three are:

1- Deflection Transistors. The Deflection transistors for the G08 are getting VERY difficult to find. Anything that can be done to prolong their life should be done. In the first part of this tutorial, we will enhance the heat transfer ability of the transistors (heat kills electronics) with some simple maintenance, cleaning, and minor modification.

2- Transformer Output. The Transformer used in the Sega G80 games employed several moveable inputs to address a variety of different voltages in foreign countries. The U.S. winding was rated for 110 VAC. Although it is commonly held that 110 VAC is the US standard for voltage that is not the case. Using a multi-meter and measuring voltage at the outlet will yield a voltage closer to 120 VAC (and sometimes higher). This means the output of the transformer is pushing out voltage around 10% higher than the game was designed to take. Although the power to the game boards is regulated, the power supply is working harder than it should and the monitor gets the higher voltage directly. Simply modifying the inputs on the Transformer to a winding equal to 120 VAC will correct this condition.

3- Power Supply. The G80 power supply uses a TIP141 transistor as part of the +5 power circuit. When this transistor fails, it can (and will) spike the power in the +5 line supplying the circuit boards. This results in blown memory and sometimes worse. It is fairly easy to add a switching power supply to the +5 circuit that does not exhibit this behavior. When a switcher dies, it doesn't spike the circuit boards. You just replace the switcher (cheap and easy) and you are back in business.

Deflection Transistor Maintenance and Modification

So here we go… We will start with the transistor mod. This is written assuming you have a working monitor although there will be some simple tips along the way if you are experiencing periodic screen collapse.

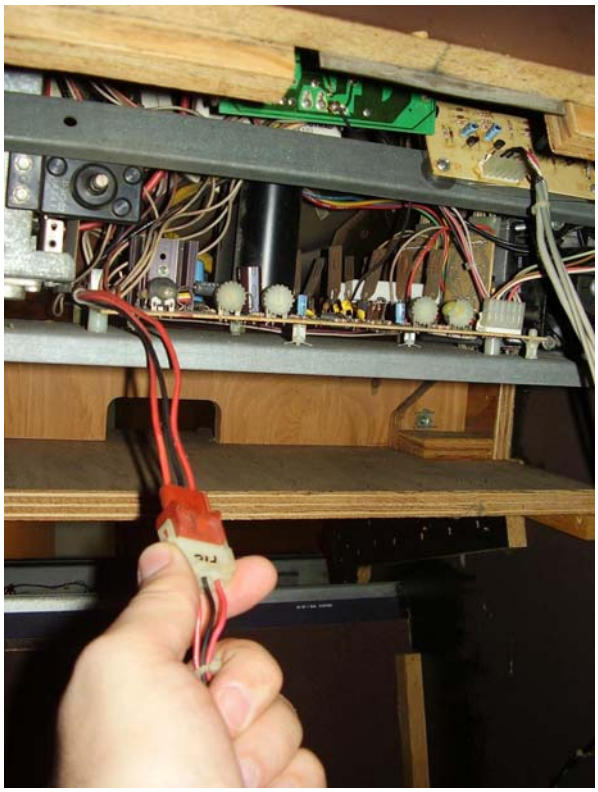
Remove your monitor.

Unlatch your control panel and lower it out of the way or remove it from the game. Lift the bottom of the screen plexi and pull it forward slightly. It should now drop down so you can remove it from the machine and set it aside.

Now remove the black Plastic Bezel by simply sliding it out. It is a snug fit but should not be anchored by anything. Once removed, you will be greeted by the monitor mounting bolts.

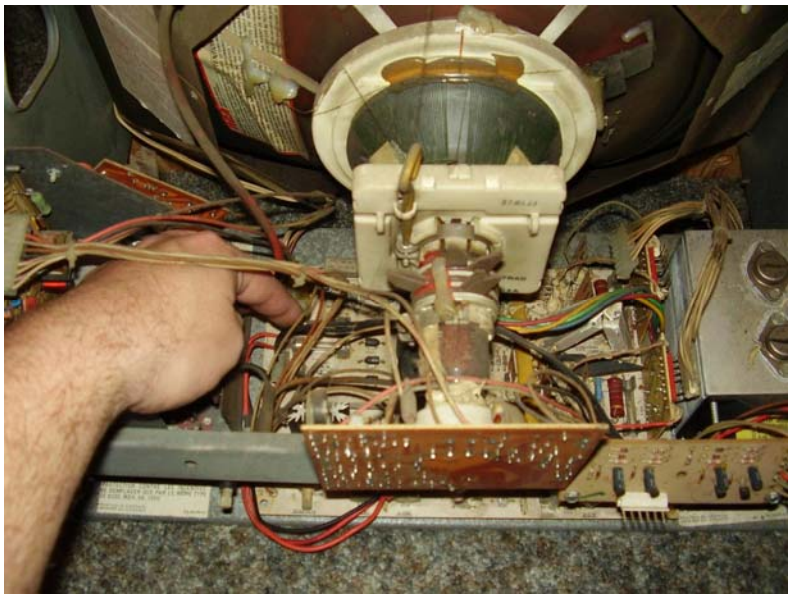
Remove the four bolts at the very TOP and BOTTOM of this picture. Those bolts retain the plywood monitor mount. Not only does this mount have nifty hand holds (top and bottom), the monitor cannot be removed while this is in place. **DO NOT ATTEMPT TO REMOVE THE MONITOR AT THIS TIME AS YOU HAVE NOT DISCONNECTED THE POWER OR INPUT WIRES YET**. There are only two sets of wires on my monitor, power and signal. It is also common to have a ground strap but I like to live dangerously. If yours has any additional wires, they need to be disconnected prior to monitor removal.

The power wire has clips that need to be squeezed together. The input wires on the upper right are just a slip fit usually but that header can be tight. Once the wires are disconnected, grab the hand holds in the plywood mount and slide the monitor out the front of your cabinet.



Once removed, it's now time to get at those transistors!

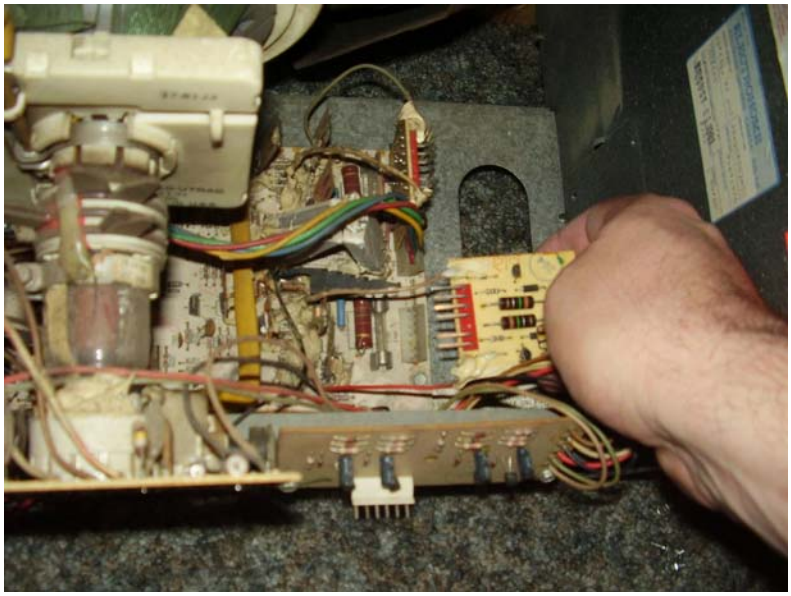
First, you may want to remove the wire harnesses (there are three).
One for the fan power…



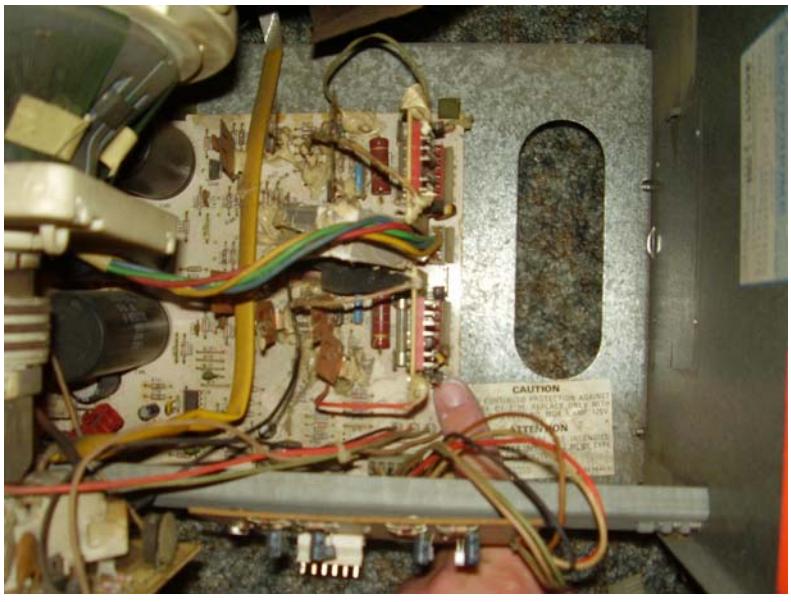
…and two for the deflection transistors.

In order to pull these two harnesses, it may be necessary to hold down the paddle boards* or they will come loose. Not a big deal if that happens but it should be noted that even though the paddle boards remove easily from their headers on the main board, they have jumpers that are soldered in and cannot be removed completely…

***Warning: Some G08 Monitors do not have paddle boards (current limiting boards). This means that you have a G08-801 monitor and the harnesses plug directly into the headers on the deflection board. Time to be on your toes and watch for footnotes!**



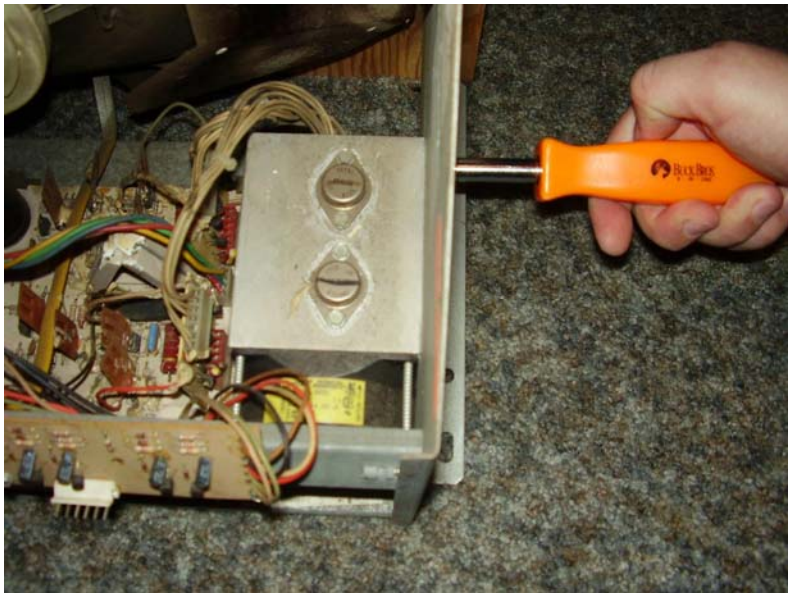
If you are having collapse problems on your monitor, you may have cracks in the solder on the header pins on the paddle board (in the picture above they are red). Another possibility is that you may have bad solder joints on the paddle board header pins, located on the main board.



As you can see, getting to the bottom of these headers will require removal of the entire main board. While there, reflowing solder on ALL joints on all headers is a good idea. Since you have the whole thing apart, you might as well replace all the capacitors with a cap kit (but that is another tutorial).

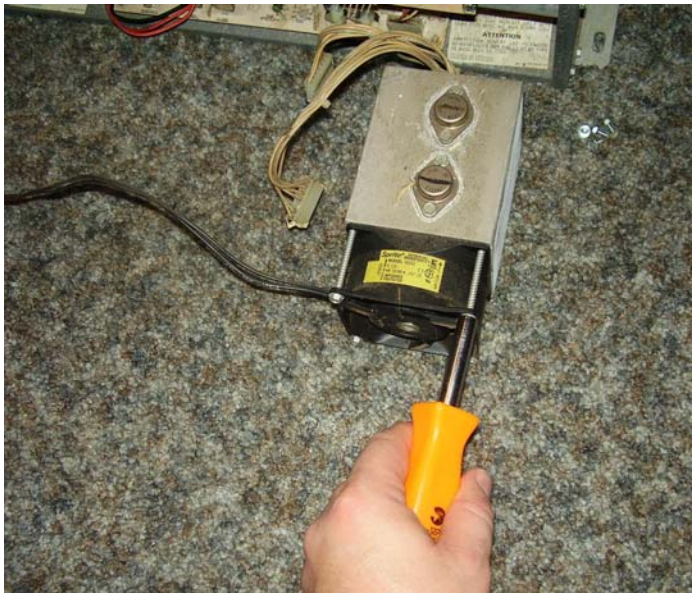
Back to the Transistors!

Once the harnesses are loose, pull the four mounting screws.

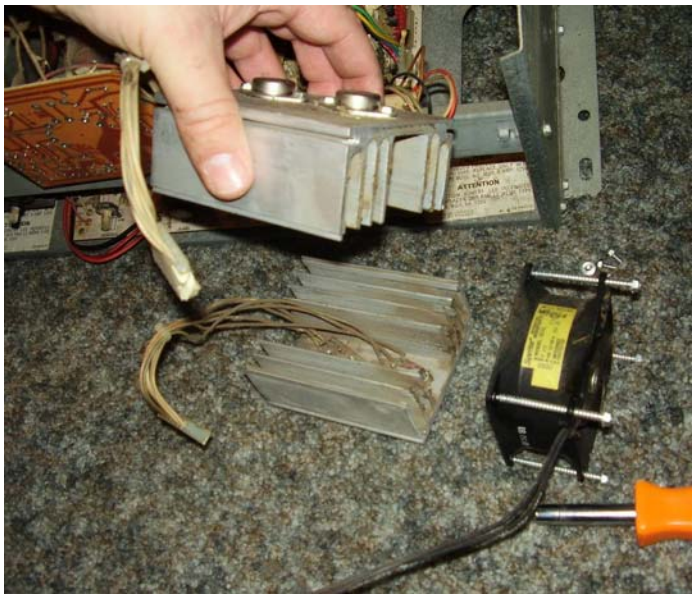


Pull the unit up and out.

Now pull the fan by removing the four end screws.



The unit should now come apart.



Remove the transistors* by removing the two screws holding each one in and pulling firmly on the transistor body.

***Warning: At this point you should notice numbers on the top of your transistors. If they say "2n6529" you have a G08-803 and all the transistors are interchangeable. Throw them in a pile and skip to the next section! If they say "MJ15003" or "MJ15004" you have a G08-801 and they ARE NOT INTERCHANGABLE. Keep track of what socket they came from. Use a Sharpie to label them if need be so you do NOT lose track of them.**

You will notice a crusty white film (dried out thermal compound) and a mica insulator.

Be careful with the insulators as they will break if bent too far and these can be reused. New ones are cheap and plentiful but I don't have any spares and as long as I don't break one, reusing them is not bad.

Once disassembled, it is time for some cleaning. When clean, the mica insulators will usually be clear (if you don't have the tinted version and aren't using thermal pads instead).

You may need a paint brush or a parts brush to get it all.

Once it is all clean we are ready to reassemble. Inspect the sockets for loose wires and the transistors legs for corrosion. Anything that will prevent a clean, tight, connection will cause problems down the road to include periodic screen collapse.

Don't' forget to get the extra dust out of the fan while you are there.

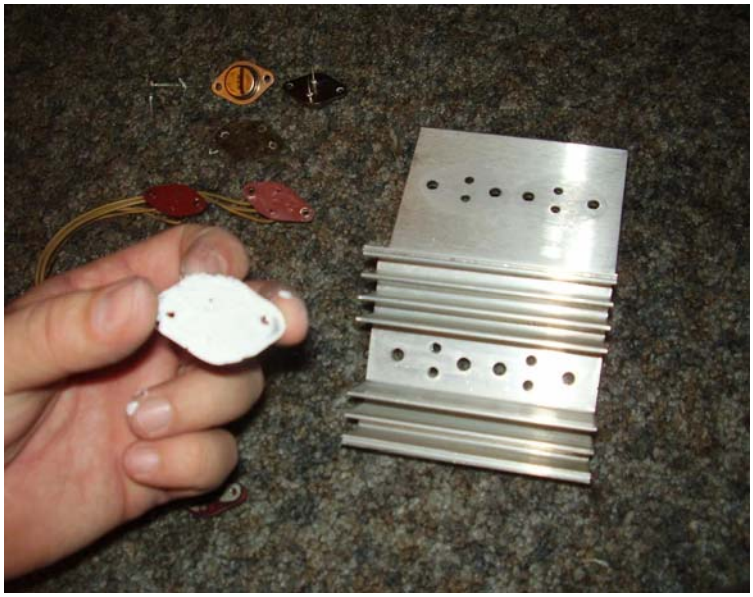
Now comes the mod part. During disassembly you probably noticed that the fan cooled the transistors by moving air through a tunnel comprised of the heat sink fins and the sockets and harnesses. Although this was a good idea the source of the heat (the transistors) were mounted outside of the tunnel and there were obstructions (the harnesses) to the air flow. The harnesses also trap dust and can stop the air altogether over time.

Our idea is better. It will put the source of the heat in the air flow and move the obstructions to the outside of the unit. We start by putting fresh heat sink paste (thermal paste/compound) on our mica insulators.

Just smear a thin layer on there and stick the insulator in place.

The insulator will be a bit of a tight fit at this point but there will be plenty of room for the transistor*.

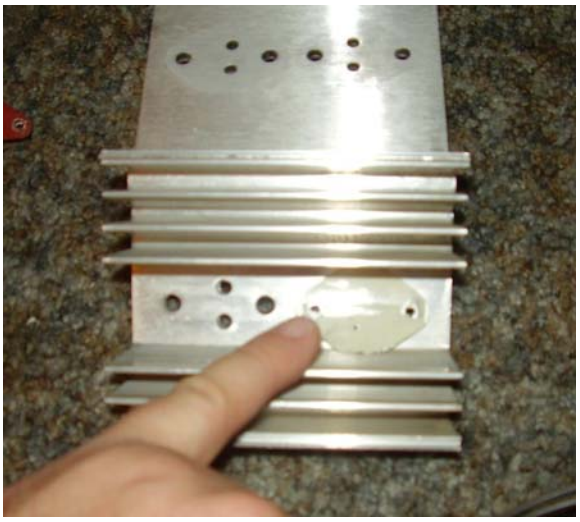
***Warning: DO NOT TRIM THE INSULATORS!**

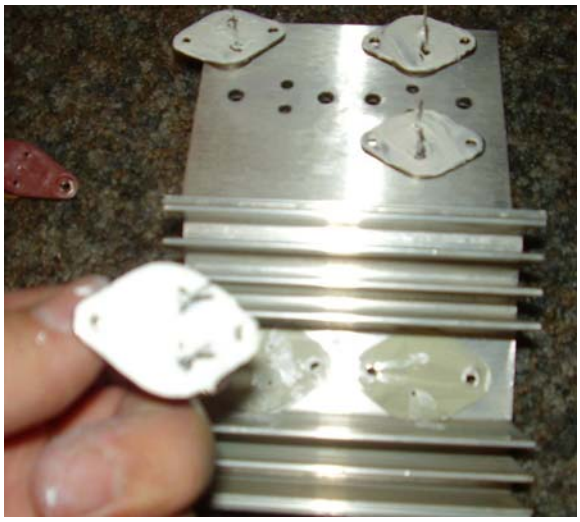


Also make note that the holes for the terminals on the transistors are off-center as are the holes in the insulators. They only go in one way. You CAN put them in backwards but it takes some effort as the sockets are pinned to fit the heat sink only one way as well and the terminal holes will not line up easily.

If everything does not line up relatively effortlessly YOU HAVE SOMETHING IN BACKWARDS.

Now grease the transistors. This will put paste between the heat sink and mica and the mica and transistor. This ensures good heat transfer. You can vary this installation if you wish but there MUST be compound on both sides of the mica when assembly is complete or heat will not transfer properly.





Put the transistor in place and slip on the socket from the back. On this particular monitor*****, all the transistors (2n6529) are identical and interchangeable.

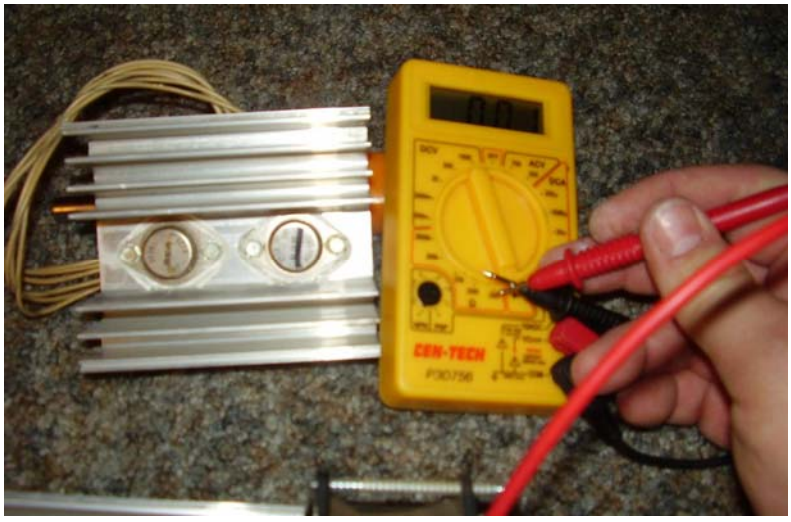
***Warning: If you have the MJ1500X transistors mentioned earlier, you must put them back in the correct sockets at this time**.

If your socket is sitting **FLAT** against the heat sink then you have things lined up right. Just screw the transistor down. Don't apply too much force.

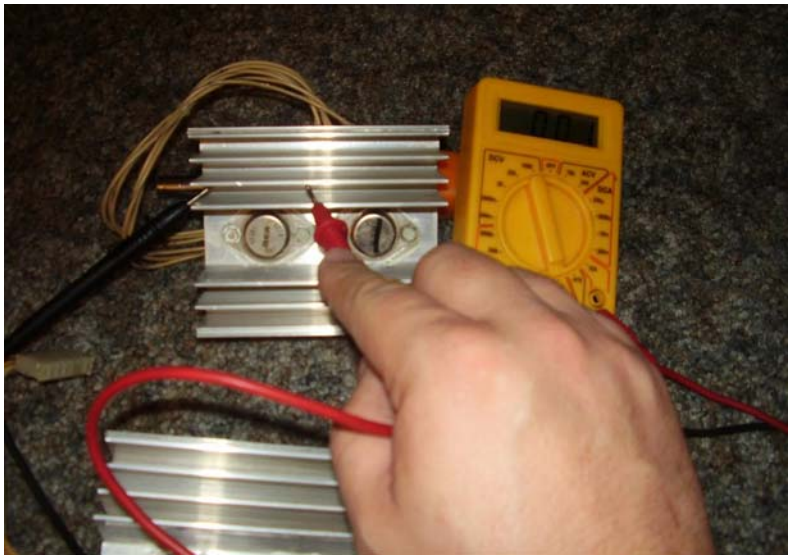
If everything does not line up relatively effortlessly YOU HAVE SOMETHING IN BACKWARDS.

Now, you need to make sure you didn't forget an insulator. Using a meter, set it to diode test (like mine is in the picture) or a resistance setting of your choice. We need to make sure the transistor housings are not in direct contact with the heat sink. Test your meter as shown below. When open (no contact), mine shows a "1" on the screen.

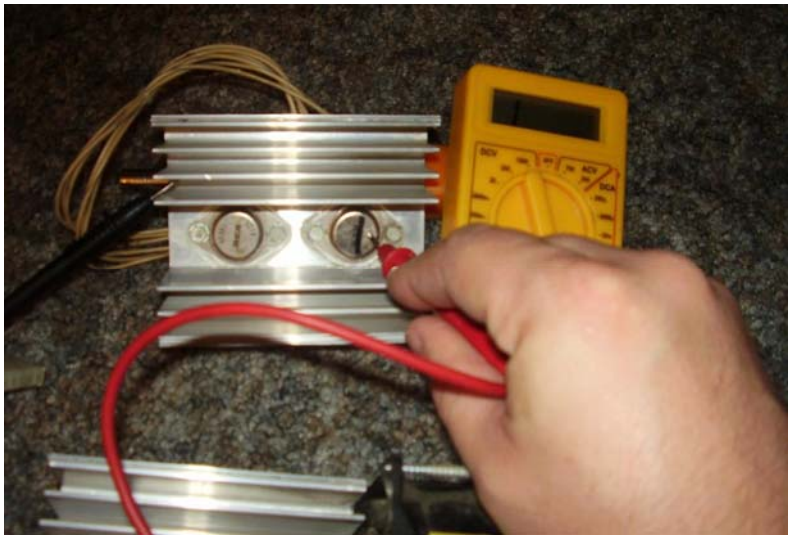
When shorted, it shows a series of zeros and ends in "1". I guess it could use some calibration but what do you expect for $3 at Harbor Freight. I don't really need it to be accurate I just need a reference point that tells me whether it is shorted or not.



Now that I know my meter is working, I just need to verify the transistors are not shorted to the heat sinks.



Just making sure I have a good ground above since I am doing this entire project one handed…



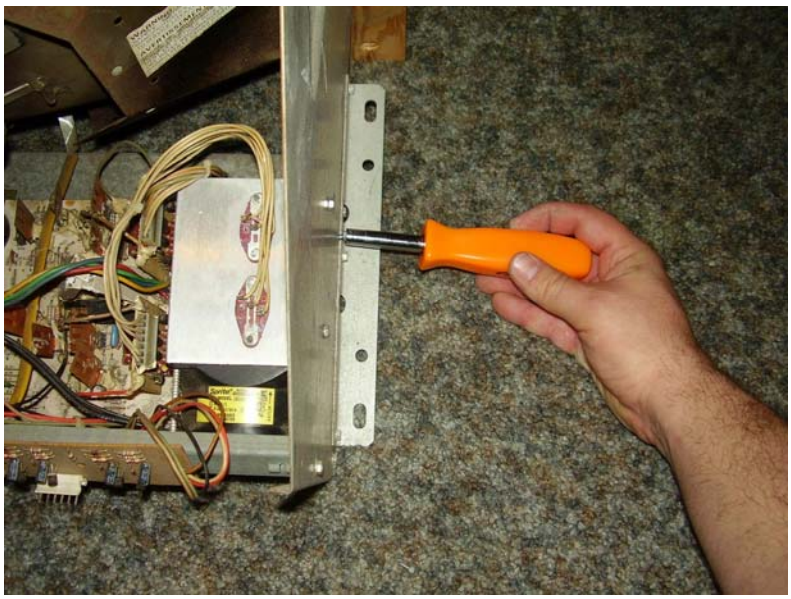
And I am seeing no continuity on my transistors. This means my mica insulators are doing their jobs and most likely none of the transistors are in backwards. Now it is time to put this back together.

I have put it back together after wiping up the excess heat sink compound that I slopped around as it will attract dust. I have also made sure to orient the harnesses in the most advantageous positions for reassembly.

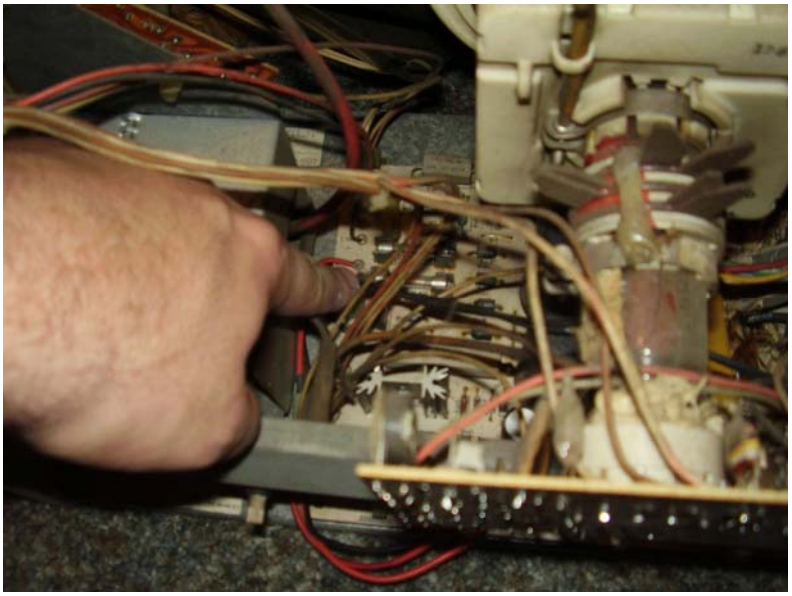
Reinstallation is the reverse of removal.

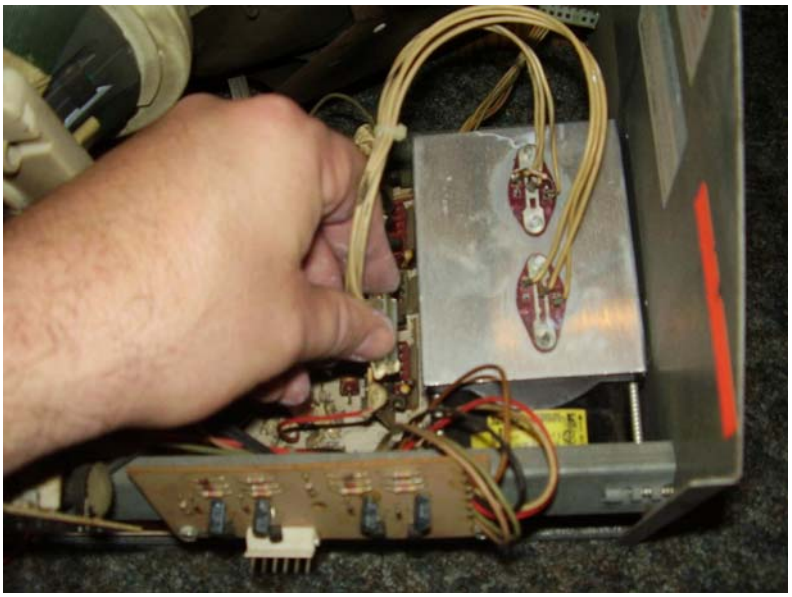
There is a small “stop” punched into the monitor frame that helps you align the unit. It is almost dead center in the picture below.

Just hold the unit against the stop and install the screws.



If you haven't skipped ahead you now need to replace the three harnesses.





The harnesses are keyed and only go on the connector one way. It does not matter which harness goes on which paddle board* or header. Do not abuse the paddle boards at this point as they are not mounted solidly.

*I believe this is true for the G08-801 as well but as I do not have one (or the schematics to one) available to verify this.

You are now all done! Replace the monitor, the four bolts, the power and input harness and you are ready to test. If you start blowing fuses, you probably put in one of the transistors backwards or forgot a mica insulator. Shame on you if this happened! It can only mean you didn't follow directions or skipped the "short" testing. Time to start again…

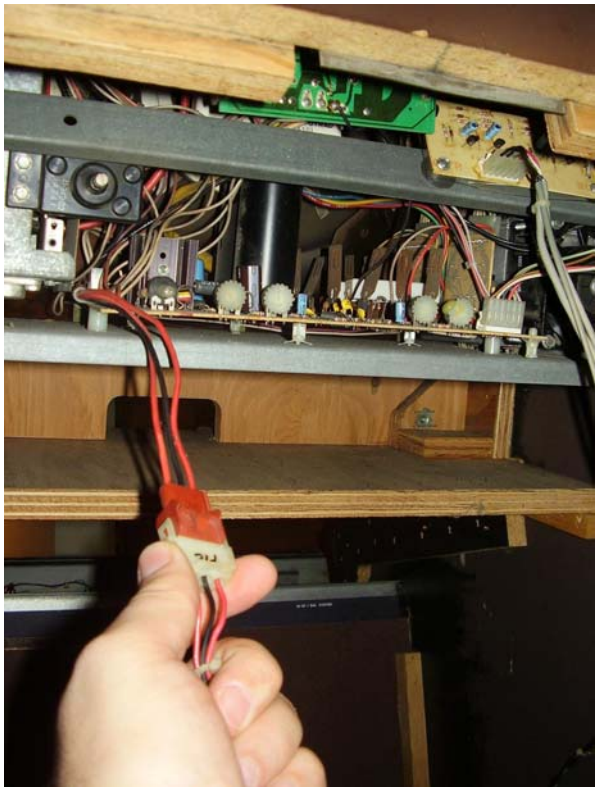
If it did work, CONGRATULATIONS! You are well on your way to a rewarding career in the demanding and high paying field of Arcade Game Technician! *****

***** Only applicable if you have a time machine set to 1980.

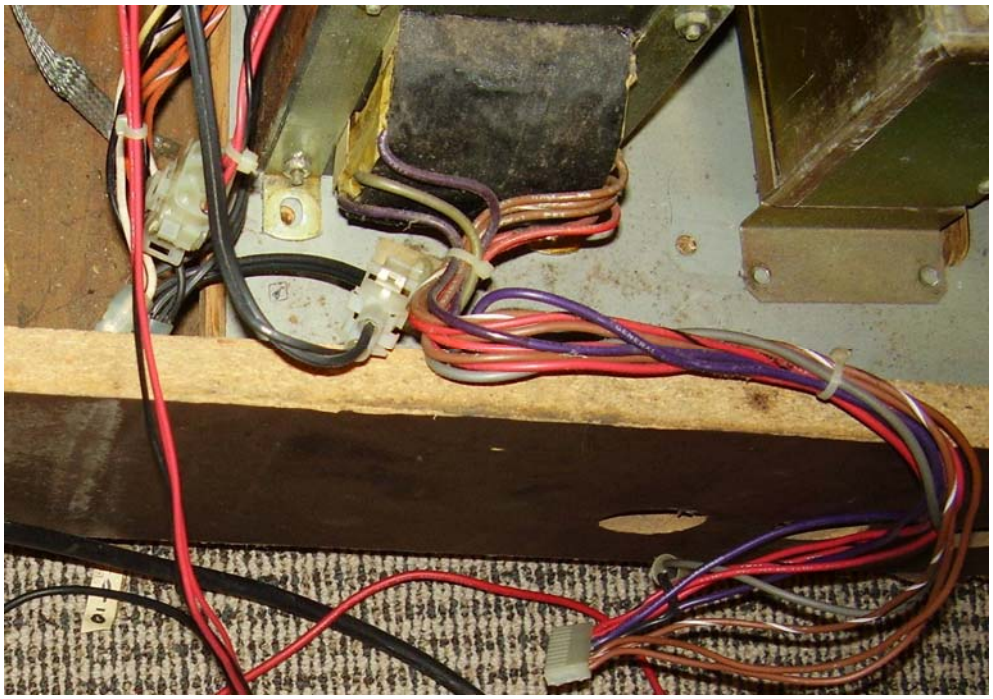
Transformer Modification

This is probably the easiest of the mods and should require no tools although **I strongly suggest that you verify the voltage at the monitor output when done**. In my case, I unplugged the Transformer to Power Supply harness and the monitor power connector before performing the mod.

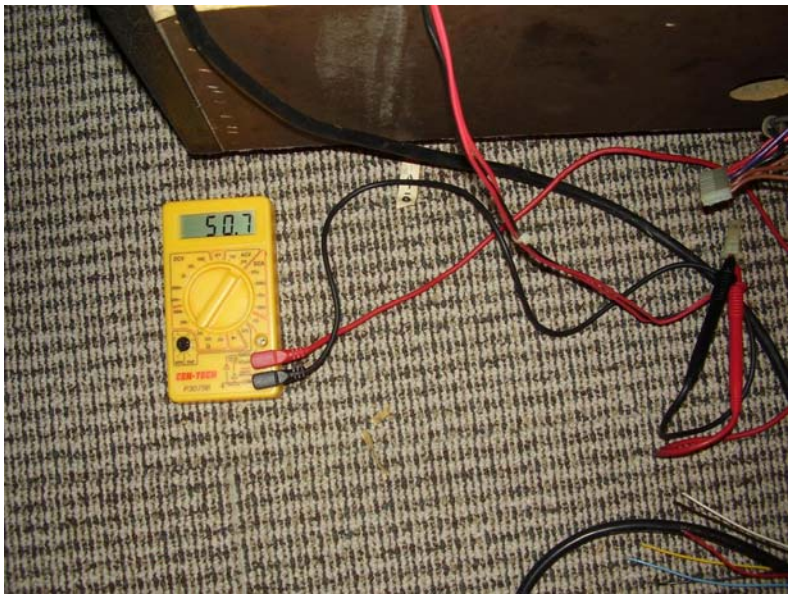
With the game **OFF** and un-plugged from the wall, disconnect the monitor power harness…



…and the AC input connector from the power supply.



Per the schematics, the monitor is designed to take 45 VAC input from the two red wires with the black wire being a ground (common). Set your meter to measure AC Voltage. Put the black lead on the black wire and the red lead on the red wire. Make sure that you do not have your leads on a conductive surface (i.e. metal, water, etc.). Now power on the game and observe the voltage.



As you can see, my voltage is 10% above what it should be. This is due to the transformer being strapped for 110 Volts but getting 120 Volts from my outlet. Transformers generally use the first "tap" as 0VAC and the other taps to set the transformer for the correct input voltage. This is done by subtracting the two taps you are connected to. The manual tells you to use taps 1 and 3. The value of tap 1 is "0" and the value of tap 3 is "110". 110 – 0 = 110VAC. The voltage enters these two taps in the "primary winding" and creates a magnetic field that gets transferred to the "secondary winding" (output side). The trouble is that since we are putting 120VAC into a winding that was calculated to use 110VAC, our field is about 10 percent stronger than anticipated and raises the output by the same percentage. The primary winding is one continuous piece of wire with the first tap being the start of the wire and the last tap being the end. The other two taps are put in at calculated intervals based on the number of windings to adjust the size of the magnetic field. This means that the taps are labeled just for ease of installation and that the use of the 0VAC tap is not necessary for anything other than easy calculation. So let's look at a little quick math. First let's define the taps:

1 = 0VAC

2 = 100VAC

3 = 110VAC

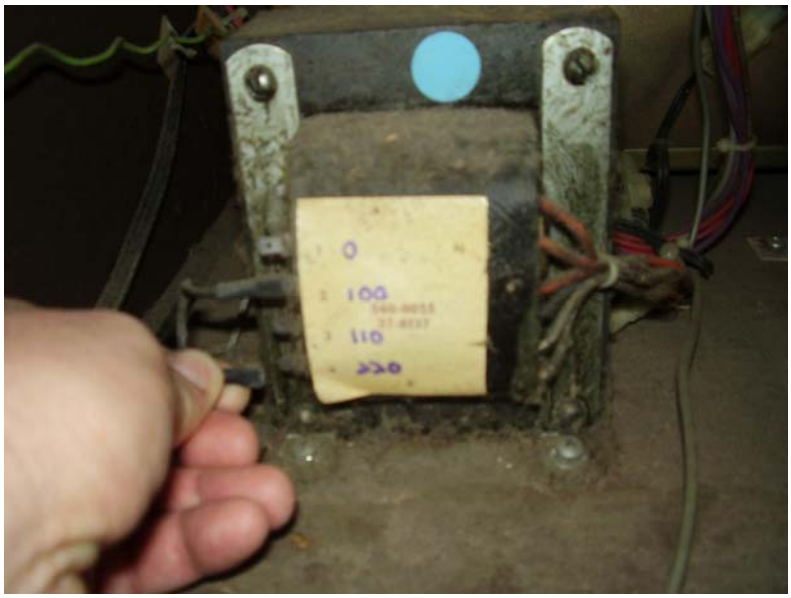
4 = 220VAC (The manual reports this as 220 in the setup section an 230 on the schematic)*****

So… given that the voltage inputs are somewhat arbitrary as the primary winding is simply one continuous length of wire, we know that we do not have to use the 0VAC tap. If your game is stock, it has taps 1 (0VAC) and 3 (110VAC) in use. Let's say we move your inputs to taps 2 (100VAC) and 3 (110VAC). This creates a 10VAC winding (110VAC – 100VAC = 10VAC). This would be BAD! Let's say we moved the input wires to taps 3 (110VAC) and 4 (220VAC). This creates a 110VAC winding (110VAC -220VAC = 110VAC). This puts us right back where we started. But… if we put the input connectors on taps 2 (100VAC) and 4 (220VAC), we have created a 120VAC winding! I was hoping for a 130VAC winding but this is as close as I can get using the transformer that was stock in the game.*****

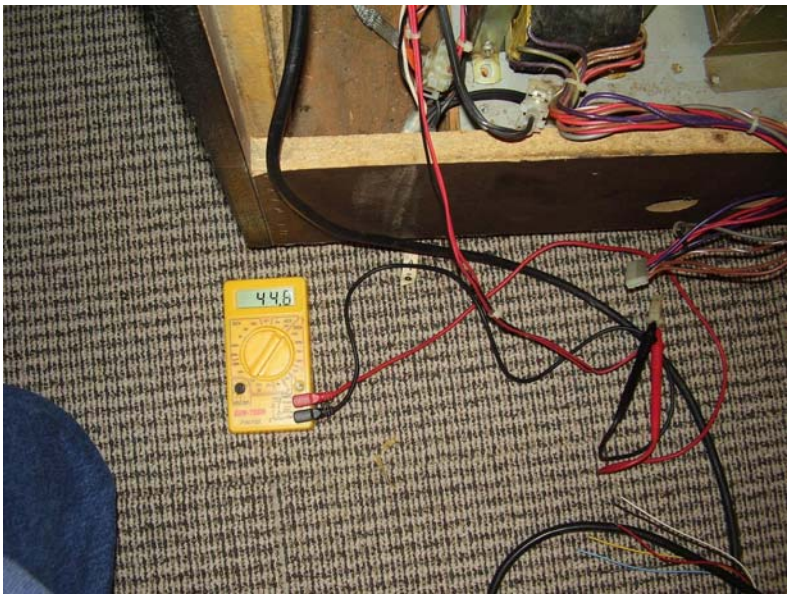
*****These calculations are based on the standard Sega Transformer. I have never seen a different one installed in any of the Sega G80 series games I have owned, or my Star Trek Cockpit, or my dedicated Star Trek. Before attempting this, make certain your machine is not plugged into the wall and that you have your harnesses disconnected as discussed above. ALWAYS VERIFY VOLTAGES/SHORTS when modifying ANY electronic equipment. If you have any doubts about what you are doing… **DON'T DO IT!**

To modify what voltage the game is strapped for, just locate the input side of the transformer. It should look like the picture below (if it does not, stop now). I hand labeled the transformer with each tap's corresponding voltage.

Just wiggle and pull on the connector at tap 1 and move it to tap 2. Then do the same with the connector on tap 3 and move it to tap 4.



Plug the game back in (leaving the monitor power unplugged as well as the power supply) and measure the voltage again. This should put you right back in the ballpark of what voltage your monitor was designed to use (45VAC).



If you got a similar reading to the picture above, unplug your game and replace the monitor harness and power supply connector. You should be done and your monitor should appreciate it!

If you do **NOT** get a similar reading as pictured above, then you can undo what you have done so far (moving two wires) or do the math (assuming you know the values of your taps and can do basic math) and adjust accordingly until you get a better reading.

*****BE CONFIDENT YOU UNDERSTAND WHAT YOU ARE DOING AT THIS POINT*****

Here is why you should verify voltages:

1- If you strap your game for 10VAC (or similar uber low voltage) you will blow a fuse, the breaker in your home, damage your transformer, or set a fire.

2- Strapping it slightly low (100VAC) will increase voltage to the monitor to about 60VAC and cause major damage. It may take a few minutes but it will happen.

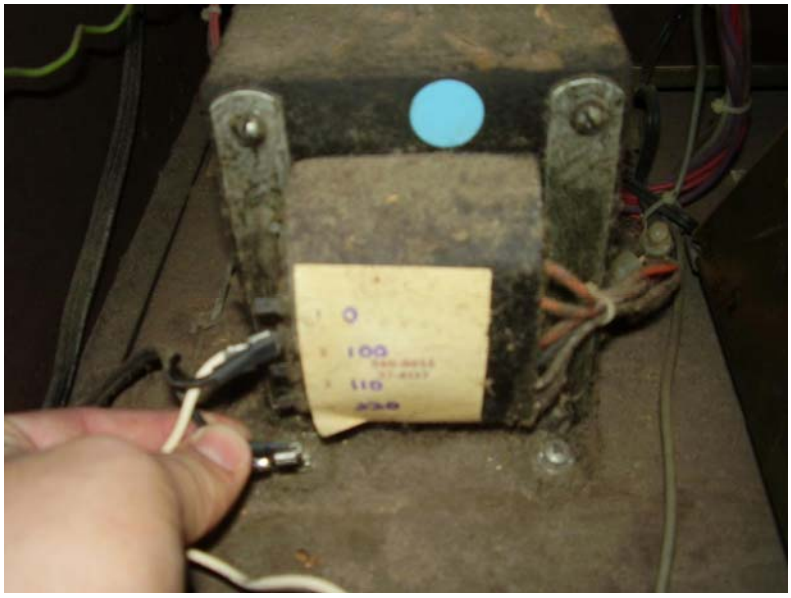
3- If you strap too high (for 220 volts) you will most likely get about 20 VAC on the monitor harness instead of 45VAC. I do not believe any harm can come from this but your game won't work until you straighten it out.

Switching Power Supply Modification

This modification is the most difficult of the three and will require some electrical knowledge*****. I have chosen the least intrusive version of this mod for this tutorial. This means that I will only replace one voltage (+5) and I will be building an adaptor to do it so I do not need to damage anything else in the game to make this happen. I am doing the +5 only as this is the most notorious voltage failure that blows board sets and I have a spare +5 switcher on the shelf. The reason I am using an adaptor (although you are welcome to hard wire yours) is so I can remove the mod whenever necessary. Why would it be necessary you ask? There is nothing wrong with my current power supply aside from the time bomb factor. If my switcher dies, I can easily change back to the linear power supply until I get my hands on another switcher.

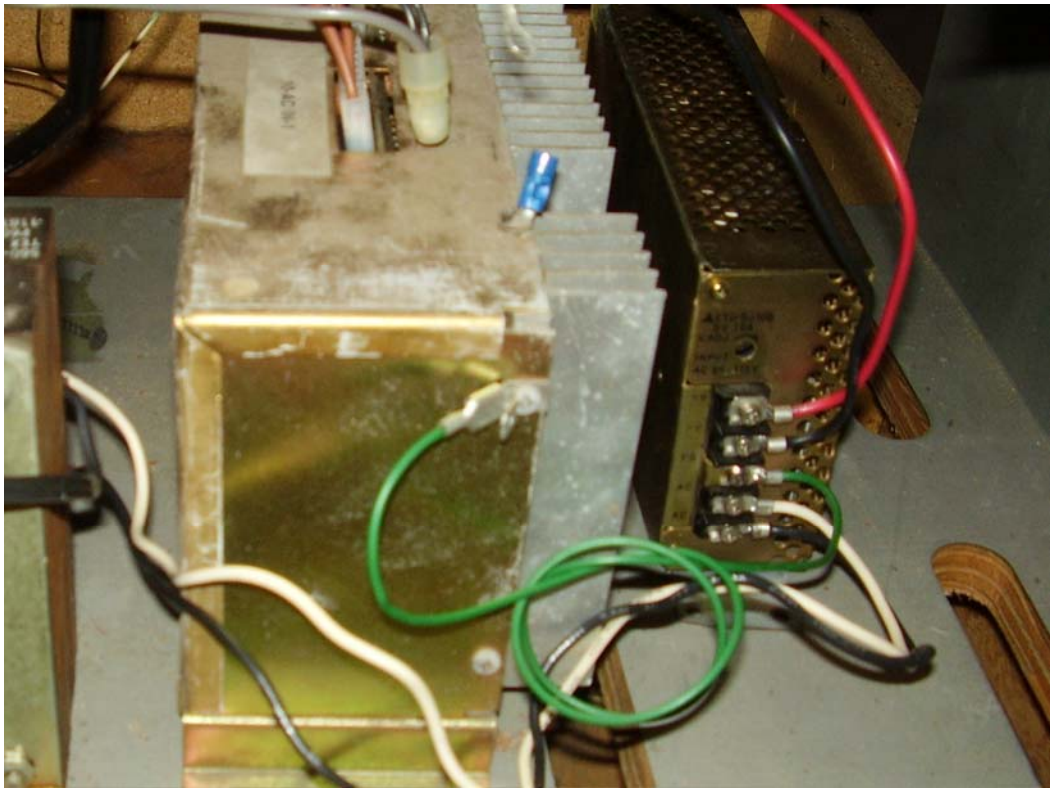
***If you cannot locate/identify by means of a schematic or volt meter your different DC power lines, stop now!**

I am going to start by building an AC harness for my new switcher. As I do not want to cut into any of the existing wires, I am going to put a "piggyback" connector on my switcher harness to allow me to tap into the AC power at the transformer.



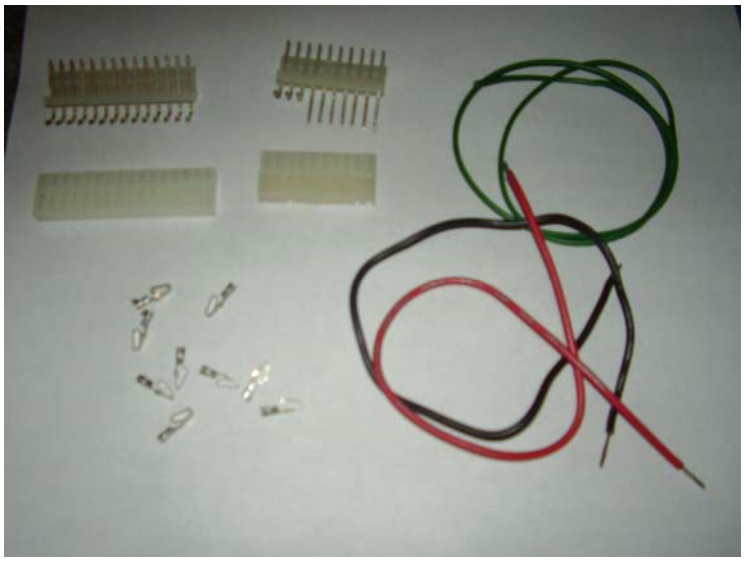
Now that I am tapped in, I test my switcher and see that it is putting out + 5 as expected. In case you haven't noticed, I verify every detail as I go. It is much cheaper for me to take 10 seconds and verify my voltage than it is to spend $150 and three weeks to get my board repaired.

Since I am good there, I need to make sure everything has a good earth ground. Every piece of hardware in the game should read continuity on the metal frames. There are plenty of places to attach a ground line. Pick a spot and do it!



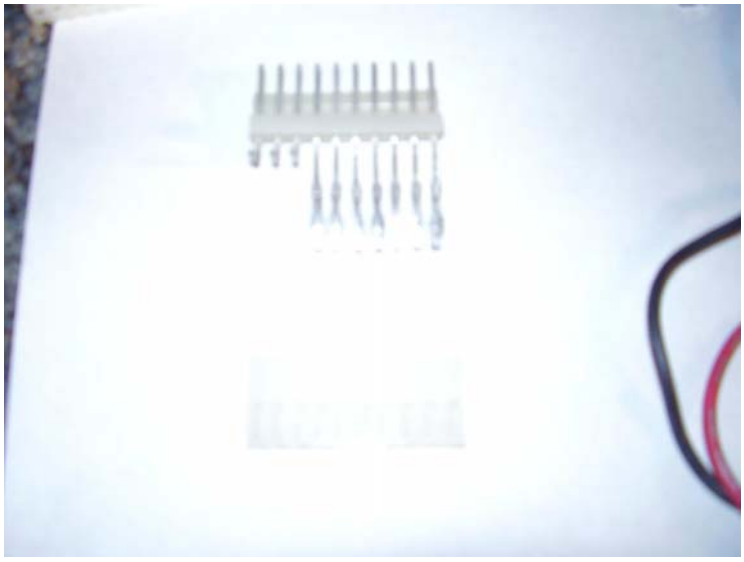
There was a nice tab already installed on the case of the linear power supply. My switcher is pictured on the right. The black and white wires are my AC supply that I piggybacked onto the transformer earlier. The green is a ground. The red and black wires will be going to my adaptor.

Now to build the adaptor. The DC output on the power supply uses a 10 pin straight connector. To tap into this I will use a 10 pin angled header, a 10 female connector, 7 spring pins for the connector, two pieces of wire, some flux and solder.



I simply use pliers to straighten out the first 7 pins of the angled header. This gives me some nice long connectors to work with.

Then I solder on the spring pins for the 7 straightened pins.

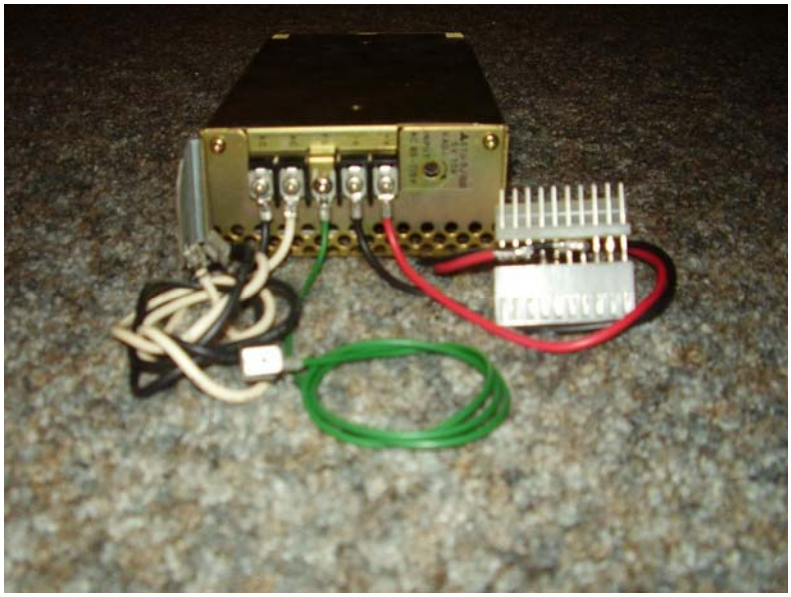


Now the three pins that are still angled are my +5 supply.

YOU CANNOT PUT TWO POWER SUPPLIES TOGETHER
SUPPLYING THE SAME VOLTAGE ON THE SAME CIRCUIT!

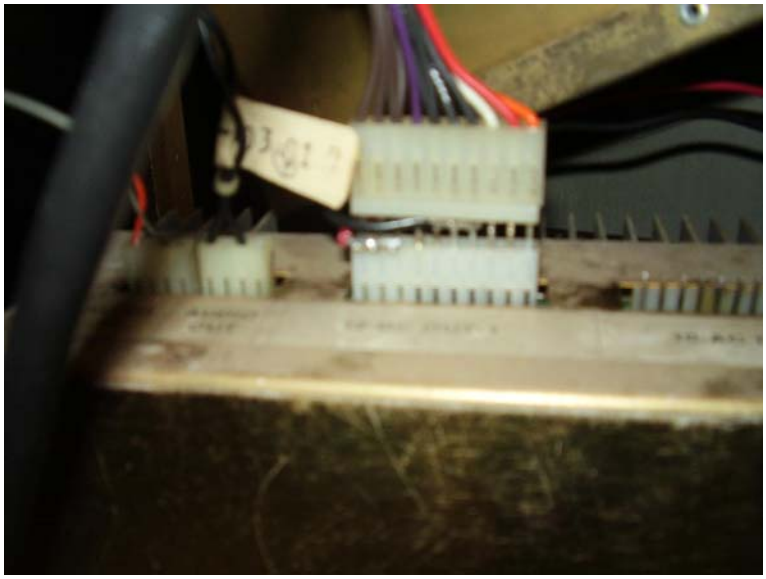
Since they are still angled, they are isolated from the liner power supply. All the other pins will remain connected to the original linear supply. Since both supplies need to share a ground (so they have the same reference point), I am simply going to “tap” into the existing ground using the exposed pins in the adaptor.

Now you need to attach your new wires to the power supply. Make certain that you put the +5 line on the +5 line on the switcher, and your ground wire to the “GND” terminal (sometimes labeled “COM” or “V-“ on the switcher. Here is a picture of the complete adaptor with AC wires, ground, and the adaptor:



On my Star Trek, the three pins on the left were the +5. Notice those pins do not go all the way through to the bottom connector. The next pin was the -5 voltage so I skipped it. The next three pins are my grounds. I stripped about half an inch of each of my DC supply wires and soldered my +5 (red wire) across the isolated +5 pins and my ground (black wire) across the common ground pins. I was very careful to ensure the -5 pin did not get shorted to either my ground or +5 line when soldering.

Now I just need to install my adaptor… The AC input header is removed in the picture below so I could fit my fat head into the cabinet to get a clear shot.



Make sure that everything is as it should be (no shorted wires, everything secure), double check my connections, and power it up! You should immediately measure and adjust (if necessary) the +5 at this point. The load of the game board will need to be compensated for.

Here is the completed unit installed. Wires on the switcher from top to bottom are:

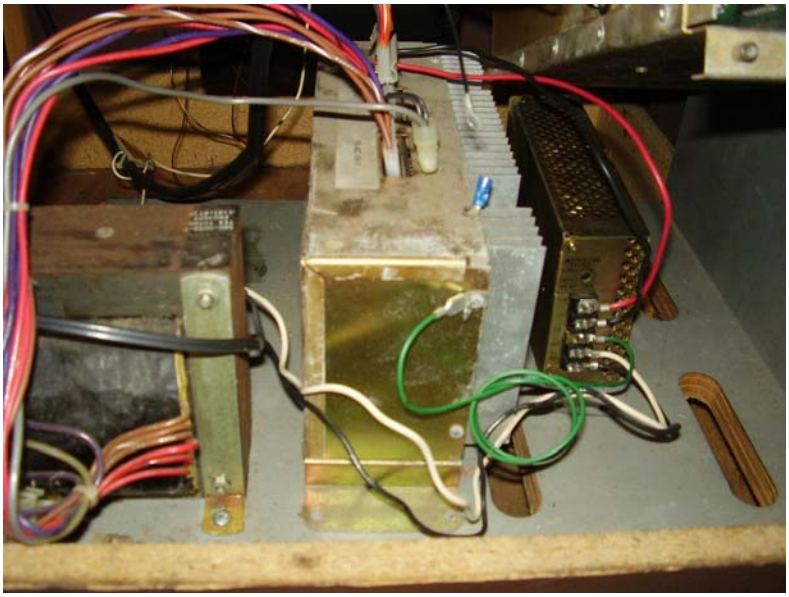
Red=DC +5

Black=DC Ground

Green=Earth Ground

White=AC Neutral

Black=AC Hot



If you have followed my instructions, and not skipped anything or added something, you should still have a working game that will remain so for years to come. Not pictured or really discussed earlier is the fact that the metal cases of all parts should really be grounded to each other. The **switcher**, **linear supply**, **transformer**, and **card cage** all sit on a metal plate. This should be enough to ensure a good ground but there is no reason to take chances. In addition to the mods discussed here, it is important that the monitor frame share a common earth ground with the other parts. When I grounded my switcher to the linear supply, I used another piggyback terminal to ensure I had an easy way to add a monitor ground to my cabinet.