For those interested, I have a number of modifications that I have added to my Astron RS50.

But first, you may ask why?

I repaired an Astron RS 35M for a friend and spent quite a bit more time on it than I would have normally, because the Astron, Pyramid and other similar linear power supplies were all made to a price point, and as such do not have a number of design elements that protect the power supply.

In the case of my friend Dale's power supply, it turned out to be a ceramic capacitor between the Base and Collector of the TIP29 that was leaky, it had a resistance of 6K8 ohms dumping some of the 30 volts supplied from the rectifiers onto the base of the transistor that drives the pass transistors, this higher than usual voltage cause the crowbar circuit to activate, and turned on the SCR. What happens when the SCR is turned on is it puts a direct short across the output of the power supply, which is intended in a over voltage situation to save any equipment attached to the PSU. This protection was working, and saved his IC7300 and IC9700 from damage, however it was cooking everything inside the PSU, which would have eventually cause a major failure of pass transistors, driver transistors and LM723 regulation IC.

The problem with the design is that one needs at least a fuse in the circuit at the output of the rectification stage such that if this situation happens, the short on the output caused by the SCR being turned on, blows the fuse, thereby robbing voltage from the pass transistors and the rest of the circuitry. Dale was smart enough not leave it on and noted the pass transistors were too hot to touch, so saved all other components in the PSU.

Now, on to making a better mouse trap!

First thing I do with any older linear power supply is to remove the pass transistors, because the heat sink compound dries and need replacing. Of course while they are out check them to make sure they are OK. The pass transistors seldom under normal usage will fail, but I replaced all 8 in an RS 50 that were blown due to another problem with the design.
If you want to throw another $10-40 bucks into a PSU, depnding on the size of the PSU, you can upgrade the 2n3771 or on older units the 2n3055 pass transistors with 2n5686 pass transistors, a change I have made on my own Astron RS 50.) The 2n5686 (50A, 80v) is just one of the options, other alternatives are 2n6319 (80A, 100v, HFE=40), 2n6320, 2n6321, BUR50, BUX20, NTE2349 and many more equally grunty transistors.!

Why, because the 2n5686's are a 300w transistor, the 2n3771 is a 200w and the 3055 a 115w transistor, and ALL devices in a PSU are derated as they heat up, HFE goes down, which means the device driving them has to provide more current. The driving device heats up and is derated which means the regulator must provide more current and as it heats up is derated, until it exceeds its capability and dies. Just beefing up that part of the circuit, the 2n3771's (8 of them) are capable of a total of 1600w, the

2n5886's are capable of 2400w. The power supply assuming max voltage of 15v is only 750w under normal conditions, but in the condition Dale's was in would have been dumping a much higher voltage through the Pass transistors, and the total power being dumped in a worst case scenario would be around 1500w, still within the capability of the 2n3771's but too close for my comfort.

Next thing I changed on my RS 50, was the transistor driving the pass transistors. In the RS 50 this is a two stage affair, a TIP29 is driving another 2n3771. I replaced the TIP29 with a TIP41C, again beefing up that stage, the TIP41C is a higher voltage, higher current capable device. I am considering going to a Darlington device a TIP121 with higher HFE, but will look at that later. As I pointed out earlier the number one failure is the LM723, so the less it is strained the longer it will live.

Since my RS 50 was not the RM version with metering, I added a $4 digital volt meter to the output circuit, thus letting me know that I have the correct voltage at the output of the PSU. These are rectangular and require some effort on cutting a hole in the front panel. You can get these inexpensive volt meters in a variety of colors, mine is blue.

Next, because I use a lot of Anderson PowerPoles on equipment I added a dual Anderson PowerPole connector to the front as well as the normal terminal type, giving me total flexibility in how and what I can attach to the PSU. Obviously, this is not necessary, but I do a lot of testing of devices and wanted the flexibility.

Another modification was to bring the voltage adjust potentiometer to the front panel in my case, and in Dales case since he did not have the need to adjust on a regular basis. I used a ten turn pot mounted on the board, drilled a hole in the top panel so that he could access it without having to take the cover off. In my case as the photos show it is mounted on the front panel.

Next, it is a good idea to change out all the electrolytic capacitors, this is cheap insurance against failure. The only one that is spendy is the main smoothing capacitor typically 64,000mfd at 30v, and if this is changed out I suggest going to a higher voltage capability such as 40-60v, these will run around $20-30. If you have an oscilloscope and can look at the voltage on this capacitor you should see very little ripple (ac component) on the DC, in which case it is probably OK and no need to change it YET. If you start hearing a 120Hz hum in the audio of your transceiver, this is the first place to check.

Another problem related to this capacitor is that it stores voltage for many minutes (a good sign that it is OK), the problem is that if you go to work on the PSU immediately after turning it off, you run the risk of blowing all the Pass transistors, because there is still a healthy charge in that capacitor, even though it is off disconncted from the AC mains and apparently completely OFF. I know because I made the mistake.
So how to resolve this, it is quite simple, by adding a LED as a form of diagnostics. I add an LED and resistor which are across the capacitor, so that it is lit all the time there is any charge in the capacitor. It takes some 10+ minutes for the capacitor to drop from the 23v across it when the PSU is turned off, down to a point the RED 2v LED goes out. This tells me two things, the capacitor is good because it retains the charge for a long time, and tells me don't do anything further with the PSU, until the LED is completely out.

Since I mentioned the derating of the semi -conductors previously, I should mention that a simple and easy means of ensuring the pass transistors and components inside the can do not get derated, is to cool them be adding a fan or two. A word on fans: Most DC fans the easiest to add (12v) generate some hash and have sleeve bearings, so it is best to add AC fans that have ball bearings, they last longer and do not generate RF hash.

If you are like me and like diagnostics, another LED&resistor can be added to the front end across the added fuse, such that it lights up only when the fuse has blown. How does that work? Well if the SCR fires, it becomes a short circuit, blows the fuse, the positive end of the LED is at the incoming rectified voltage, and the negative end is now close to ground, hence it indicates the fuse is blown, if the fuse is OK, both ends of the LED are at the same potential, hence it is off. This would have indicated to Dale the SCR was triggered and there had been or was a high voltage situation.

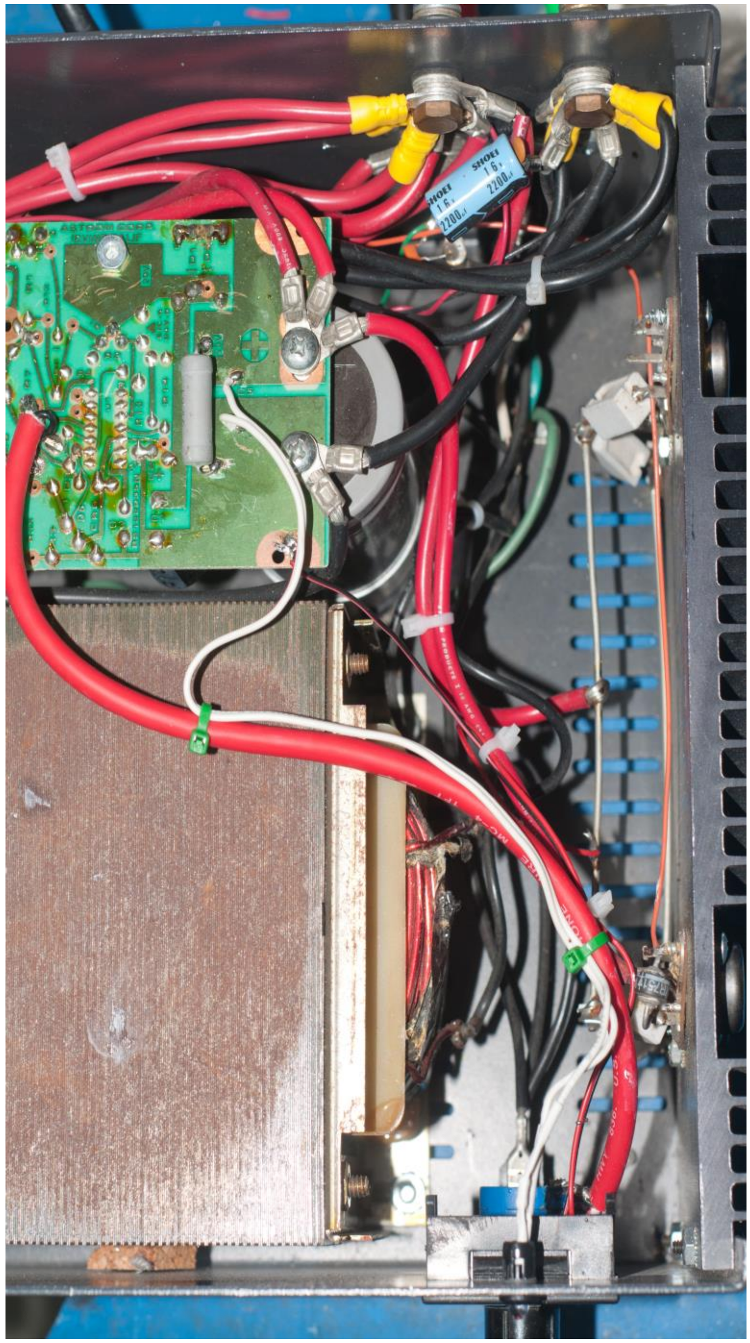
An additional modification I have made is placing a 3k9 5w resistor across the smoothing capacitor. It draws a measly 0.006 amps. while operating, but helps bleed down the capacitor at a faster rate when the supply is turned off. The 3K9 resistor still does not bleed down the Main smoothing capacitor (a 100,000mfd on these 50A supplies, typically 64,000 on the smaller supplies) a fast as I would like, but does so at about 20-25v/sec the reason I have the LED on the front to warn me the capacitor still holds a charge, and do not do anything until it goes out! A good capacitor could take hours if not days to lose its charge without the resistor.
23v/.02a = 1150 secs = 19 mins to be discharged down to about 1.5v and the LED goes out.

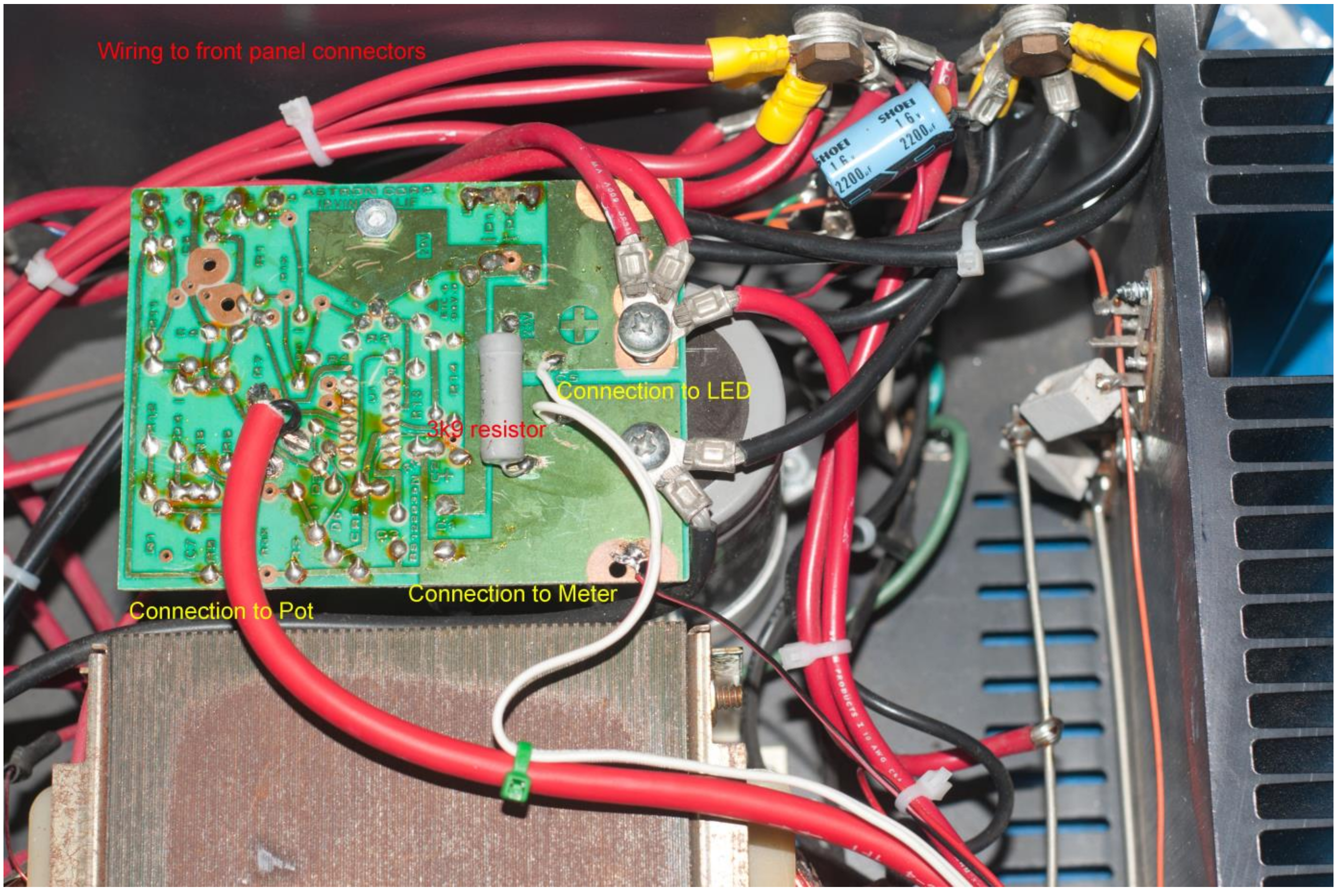
Next, I add a fuse or breaker in the location mentioned previously at the output of the rectification stage. This can be done using other means, but this is the simplest. One could go high tech, adding a heavy duty MSOFET in circuit that gets turns off when the SCR gets turned ON, I am currently designing a better mouse trap that adds an fuse or breaker and SCR right at this stage, with another Integrated circuit (MC3423) that senses OV situation and triggers this front end SCR such that it turns the Power supply circuitry OFF by blowing the fuse or tripping the breaker. I am leaning towards the re-settable breaker if one can be found to fit inside the housing.
The SCR could of course be placed on the AC side and blow the existing fuse in the AC.

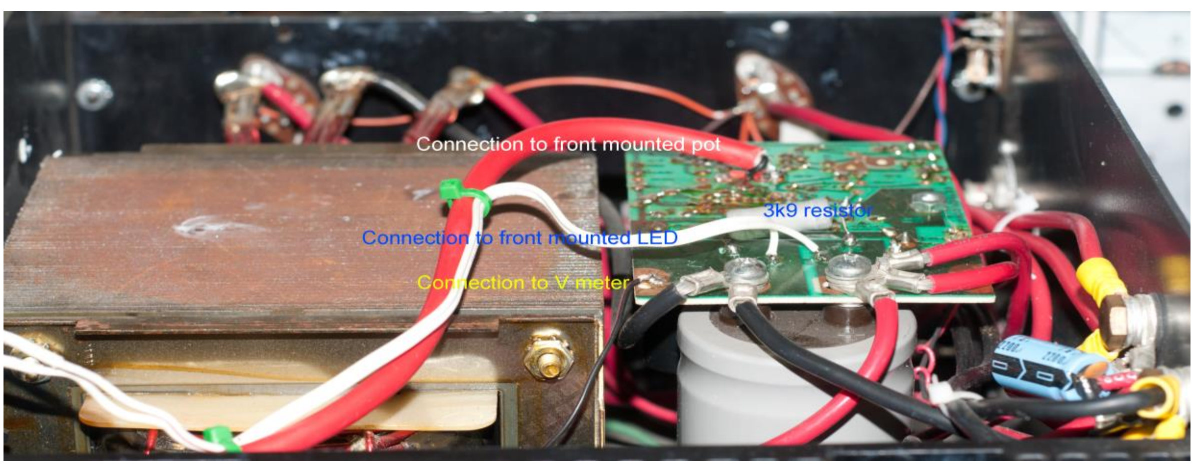
One more thing, if there had been room, I would install and EMI filter on the AC, which would reduce the possibility of EMI/RFI getting into the system via the AC line. Sone of the other Astrons there is room to do so, but not in the 50.

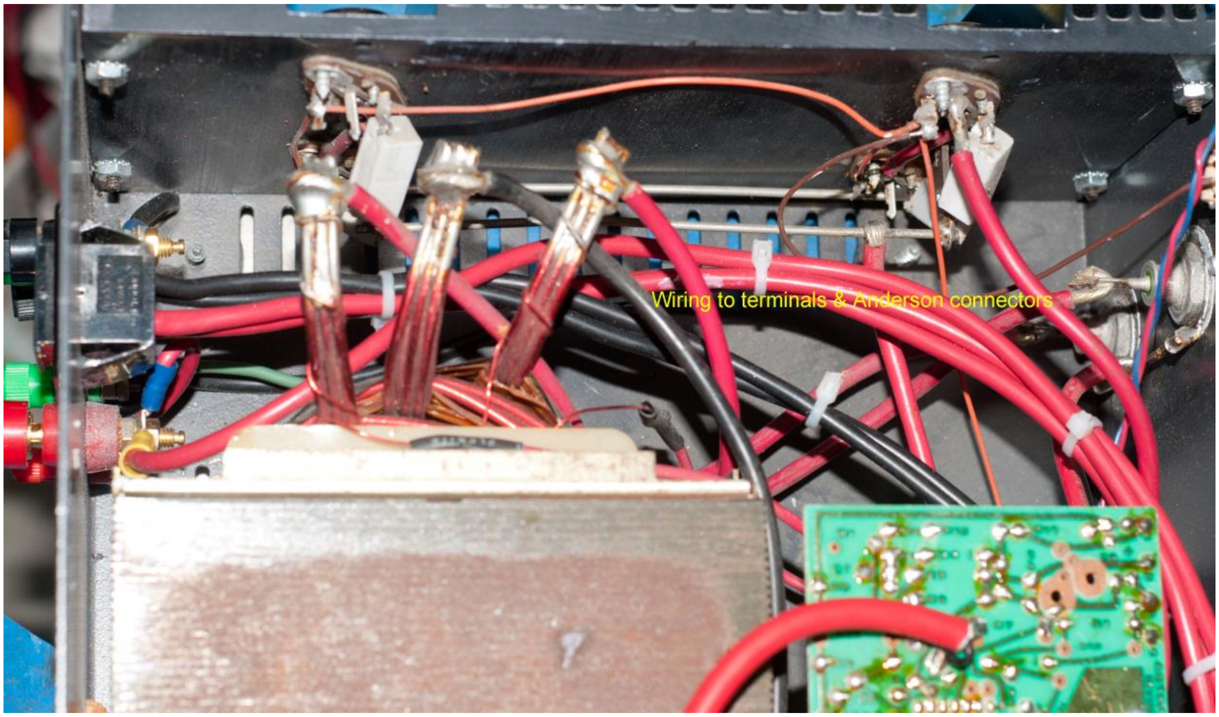
The biggest problem I am facing right now is where and how to locate a 50A fuse, most plastic panel mount fuse holders are only in the 20-30 amp range, trying to locate either a fuse holder or a breaker that will fit back near the 2n3771 driver transistor, as there seems to be some space there and it is right above the rectifiers, maikng it a short distance to run the wire.

Of course there are other things we can do to improve a design, but these suggestions are the simplest and easiest form of improving the design. I hope that some of these suggestions are of help to folks, and help your power supplies last longer.




Wiring to front panel connectors
Connection to LED
3k9 resistor
Connection to Meter
Connection to Pot


Connection to front mounted pot
3k9 resistor
Connection to front mounted LED
Connection to V-meter


Wiring to terminals & Anderson connectors