Voltage Management for Large Boat Anchor Receivers

Last revised: 4/22/2014

One of the vexing problems that face large B/A receiver owners is the problem of current line voltage compared to the original receiver specifications and its effect on receiver operation. Additionally The RFI capacitors and two wire power supplies used can pose a dangerous shock hazard when in general civilian use.

As I live in a rural area and have high line voltage (124-125) that fluctuates as well as occasional fractional second drop outs. So several years ago I conducted a survey on the R390 reflector list about the voltages people had at their location. About half had voltages above 120 volts.

This led to a long discussion of methods used to get the input voltage back to an acceptable and stable level as well as the issue of grounding to prevent GFCI's from tripping. Some used variacs, constant voltage transformers, and dropping resistors. On the Hammarlund SP-600 radios some just used the 130 tap. But what if the radio was moved to a new location? Then except for the CV transformer, one might have to readjust for the new location.

All of these methods work more or less successfully but each has major limitations due to either, size, weight, cost, or effectiveness.

Another problem with the SP-600 and R-388 types of radios is that negative bias voltages are derived from an unregulated power supply. A small change in value to a fixed negative bias value can reduce receiver sensitivity greatly. Bill Orr wrote about this issue with the R-388 in a Ham Radio article years ago.

While the examples here are for the SP 600 series receivers they can easily be ported over to R-390's and other similar receivers.

The SP 600 P.S. problems are like that of gumbo in the south; always good but never the same twice. Hammarlund's variations are such that some bias circuit and some B+ values may not be applicable to your specific receiver. They also used various regulated voltages in different configurations. And complicating this was the use of several different chassis configurations. For more detail see Andy Moorer's SP 600 web page or the D/L the free SP 600 anthology for more details.

My summation is: While the TM11-851 is the most complete publication about SP 600 variations, it is incomplete and has some errors. One needs to do due diligence on every receiver.

Based upon the laws of physics we can't achieve the best reasonably available performance of any B/A receiver without removing all possible variables. Some are happy with a "plug in and pray" mods and many will more or less work. But that isn't my goal.

Up to now most of us haven't given too much attention to receiving tube longevity as they seem readily available at reasonable prices. I believe this lulls us into a false sense of security. While it is probably true that if one only needs 6BA6's and 6BE6's there are probably enough of those available for eons as the military used so many of them.

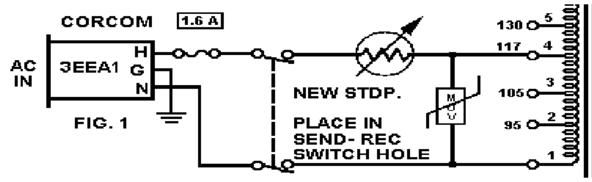
But what about the better tubes we use as substitutes for the 6BA6 such as the 6BZ6, 6JH6, and 6GM6's to name a few of the popular tubes made generally for TV receivers? The last of these were manufactured almost 40 years ago. Also out the millions of tubes that are available most aren't useful to

B/A receivers. Look at the prices asked for 26Z5's or ballast tubes on Ebay and it will give you an idea of future tube prices for those we use. While I have sufficient tubes stocked for my planned needs, stocking up is just a band-aid solution to the real problem.

Tube longevity is based on a number of factors. Filament voltage, its rate of application, stability of the filament voltage, rate of application of the B+, plate dissipation and cooling are the major factors involved. I've attempted to solve as many of these problems in the circuits I designed.

I divided the problems into four parts. First electrical safety and in-rush current protection, Next was solving filament levels and variables. The third part covers the +B supply. The fourth covers bias supply issues.

Fist the revised input circuit in Fig, 1 deals with the safety and RFI problems. The Corcom (or equivalent) provides about 35dB attenuation to RF signals.



It also reduces the shock hazard as it has a leakage value of far less than 500µA. Its ground is permanently attached to the chassis so grounding can't be lost. The new STDP switch opens both AC input to the receiver as current codes require. The CL-80 or CL-90 thermistor reduces input surges and the MOV removes line spikes.

Then there are other issues affecting longevity and performance. According to the RCA tube manuals receiving tubes are rated at 6.3v + 5 per cent. This calculates out to be from 5.985 to 6.615 volts. In addition there is the factor of the rate at which voltage is applied to the filament and tube cooling. Another problem according to the tube manuals is the screen voltages used in receivers. Most tubes list the screen voltage to be + 150 or less. B/A receivers often use values over 100 volts more. I added a +105 volt circuit for screen voltages as that is what Hammarlund used on the R- 620 – its finest.

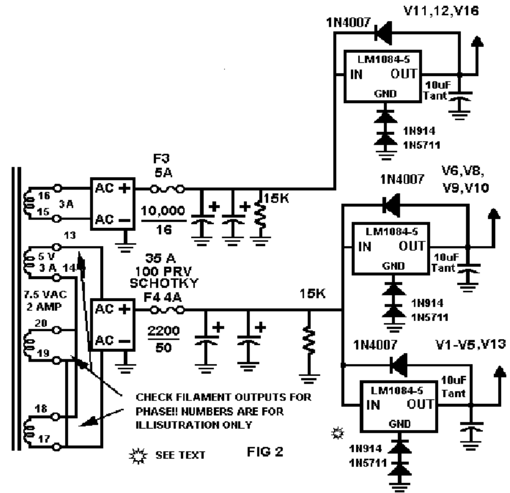
Collins anticipated reduced tube life in the R-390A as the filament voltage is stated to be 6.1 volts on the power transformer.

The rate of filament voltage application is controlled by the CL 80 or CL 90 thermistor in Fig 1. Cooling is easily done with heat dissipating tube shields and/or computer fans.

The two problems left are the filament voltage and its regulation.

The regulated supply that I designed for the SP 600 receivers addresses regulation, stability and will adapt itself to different line voltages automatically and fits inside the receiver. Cost is about $30 for both the filament and B+ circuits. With some modification It can ported over to the R390A. All circuits use 1% metal film .5W resistors as they are the most stable ordinary resistors one can buy and they are considerably cheaper that the original carbon composition units used.

The key to the filament circuit is the LM 1084 LDO 5A regulator. The part I selected was the fixed 5V unit.



Filament Circuit Description

The 7.5v and 5v are paralleled and series wired to provide 12 to 13 vac. The shottky barrier bridge rectifiers provide minimum loss. The high amperage allows for minimal heat sinking requirements. F3 and F4 protects against shorts. After the filter caps the 15K resistor is a bleeder for the caps.

The 1N007 diodes prevent reverse voltage damage to the regulators. The regulators output is raised to about 6.0 volts by the two diode diodes in the ground leg.

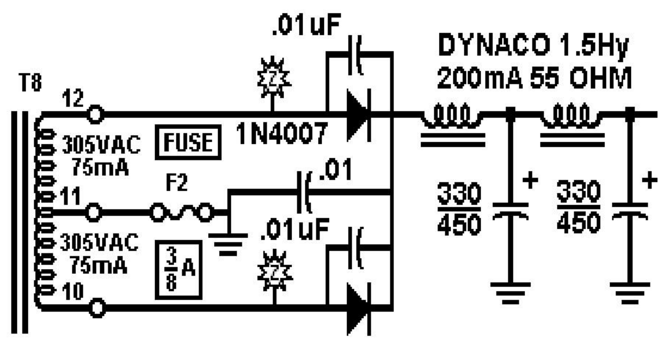
Due to slight component variation with the LM1084 two1N914's may be required to achieve 6.0 volts. The exact voltage is not critical. We just want to be close to the -5% value with stability.

While rated at 5amps the output load of each regulator is limited to about 1.5A. I used three LM 1084-5's to insure maximum regulator life and minimal heat sinking requirements.

Regulated High Voltage Circuit

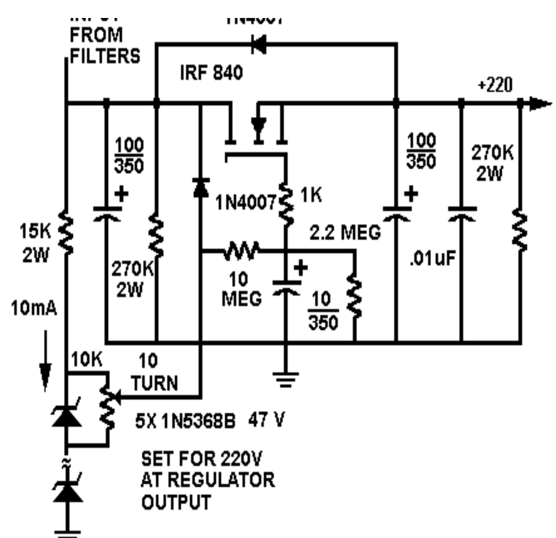
I've divided this circuit into three sections for better clarity.

This is the revised circuit for the +B rectifiers and filters. The filter circuit is changed to a choke input to lower its output voltage.



The original chokes are replaced with Dynaco replacements from Triode Electronics. They are much smaller and lighter. The reduction in inductance is offset by using 11 times the original capacitance value.

This B+ regulator comes from an Audio Express article from 10 years ago.

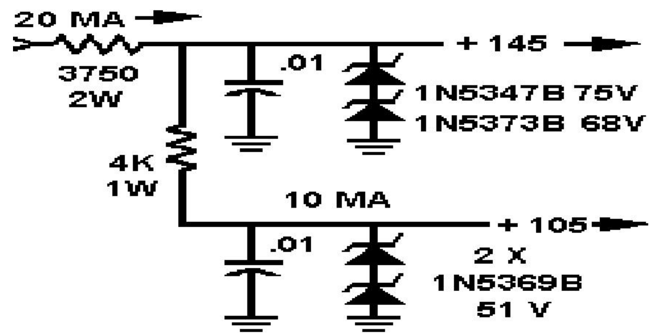


The 15K resister provides about 10mA to the zeners. This is the optimum value for temperature stability. Five were used to insure that 220 volts could be adjusted as the zeners are rated at $\pm$ 5% extra headroom was needed.

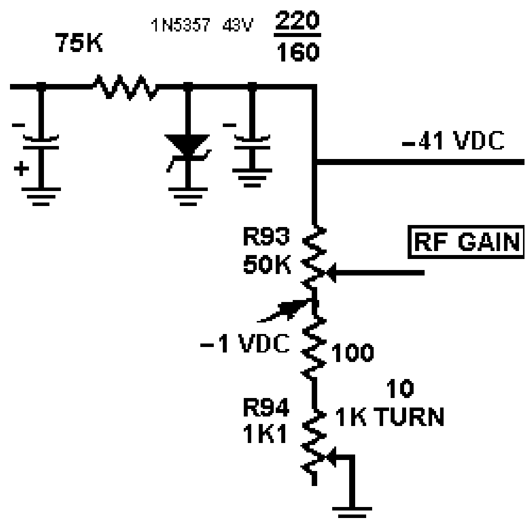
The 100µf electrolytics are mounted as close as possible to the source and drain leads helping insure stability. The 10 meg and 10µF cap forms the RC time delay for a slow B+ rise. A larger cap can be used for an even greater warm-up time.

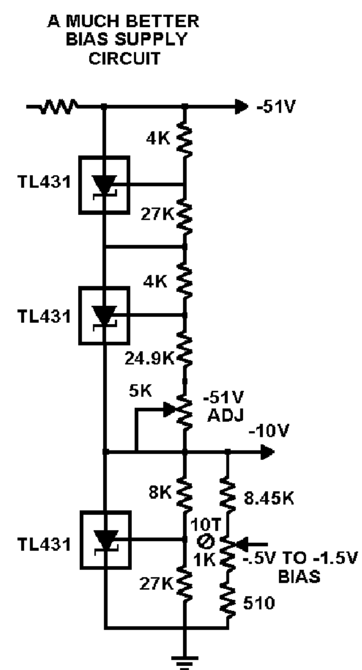
The 270K resistors are used for bleeding off the caps when power is removed. The reverse diode shunts the MOSFET incase B+ input is lost while the final 100µf cap is charged.

The additional regulated B+ voltages needed are derived from zeners fed by the regulated +220. The input resister limits total current to 20 mA with 10 mA going through each set of zeners. The SP 600 model you have may not need these voltage values and you may have to calculate for another value.



Negative bias supplies are poorly designed and they rely on dropping resistor(s) to get the value(s) desired. This is easily remedied with semi-conductors.





The simple one shown just uses a single zener. The circuit with the TL 431 programmable zeners provides superior regulation to simple zeners and the unit cost is almost the same.

The TL 431 output formula is:

$$V_o = \left(1 + \frac{R1}{R2}\right) V_{ref}$$