

Update for Viking II – CDC Upgrades

ER #324 (May/2016) discussed some suggested upgrades to the Viking II – CDC model. In that article, the Hammond 124B and 124D interstage transformers were mentioned as replacements for the original interstage transformer. Only the Hammond 124B circuit was given. If one uses the 124D, appropriate changes to the circuitry will have to be made since this transformer has a 1.5:1 turns ratio, whereas the Hammond 124B has a turns ratio of 3:1. **Further testing shows the Hammond 124D to be preferable because of its lower crossover distortion when driving the 807 grids.**

Clamp Circuit V28 and recommended modifications.

Viking I's and early Viking II's did not have clamp circuits. The Viking II series of production units beginning in June of 1953 contains a revision for a "screen grid regulator," or clamp circuit. Some Viking I's and early Viking II's were later modified to include the clamp circuit, using a kit supplied by E.F. Johnson and other manufacturers, or were simply home-brewed from available schematics.

The clamp circuit shown regulates the final's screen voltage by using a triode configured 6AQ5. HV B+ is tracked by sampling R13's 300V tap via R23. The bottom side of the 1 Meg potentiometer R30 connects to the junction of L6, R24, which senses the grid bias of the finals. If grid drive is reduced or lost, or if the HV rises slightly, this causes the 6AQ5 to conduct more current, dropping more voltage across R28, which in turn reduces the final's screen voltage. IF the SH1 resistor (0.2 ohms) were to open, the clamp circuit would not function properly if the cathode of the 6AQ5 had been returned to chassis ground. Therefore, the cathode of the 6AQ5 is connected to the HV B - rail.

Three modifications are needed here. One is to replace the failure prone R28 with a three resistor group as shown in. A 25k 25 Watt resistor is paralleled with 2, 200k, 3 watt resistors. This grouping creates a larger surface for heat dissipation. 1-1/4" long #16 bus wires connects the resistor group to the terminals of the CW/Phone (AM) switch, SW3. This wire serves to maintain a separation between the resistor group and the switch to allow for better cooling of the resistor group. The second is to replace the 0.1 uF paper capacitor C56 with a 1kV ceramic unit. The third modification is to RF shunt the grid of the 6AQ5A with a 0.001 uF to 0.005 uF 1kV volt ceramic capacitor. This modification prevents rectification and RF modulation of the 6AQ5's plate voltage while transmitting.

The preferable location for this capacitor is at the choke's bias supply side just above the grid choke, with the other lead of the capacitor to the Final's ground bus immediately to the right of the choke. EF Johnson neglected the bias supply when shunting RF.

R13 has fine wire so be careful when making adjustments.

As shown in the HV power supply schematic the R13 tap should be set as close to 300V as possible. RCA and other manufacturers are adamant about the 300V screen voltage maximum. A suggested *starting* position for this tap is shown on the HV power supply schematic. This tap affects the final setting of the clamp plate voltage.

Before the clamp adjustment is made check the value of R35 and replace if out of tolerance. Using the Viking II or Viking II-CDC manual for the clamp circuit setup, adjust R30 for a final plate idle current of 10 mA with no RF excitation. Final screen grid and modulator screen grid voltages are measured while in transmit and in the AM mode, not exceeding 250 mA of plate current.

Improper adjustment of R30 results in a situation such that little or no control grid current results in high final plate currents. This is one indication the final's screen grid voltage is too high. **Note: Do not rely on the final's screen grid voltage reading as defined in the manual, because there is a “threshold” point in this adjustment.** Using the clamp circuit setup set the final's plate idle current for 10 mA with no RF excitation. Some minor juggling between the R13 tap position and the clamp potentiometer R30 setting may be necessary. Operational control grid current will usually indicate 4 to 6 mA for 250 to 300 mA of plate current.

Power Supplies:

For the HV power supply (schematic Figure X), I elected to retain the 5R4's instead of solid-stating, at least until heaven forbid, 5R4's become unavailable. The HV capacitor value was increased to 24.5 uF by paralleling a series string of two, 33 uF electrolytics' with 330k equalizing resistors *across the terminals* of the 8 uF oil-filled C9.

The bias and LV supplies (schematic Figure X and picture Figure X) were solid-stated because I wanted the negative bias voltages to come up quickly, and because the 6AL5 is failure prone. The last thing I wanted to happen was to have the bias voltages fail while transmitting. Dropping resistors and extra capacitive filtering are a necessity when solid-stating in order to keep voltages nominal and to reduce hum.

I also replaced the nichrome shunt resistors with 1 Watt cylindrical ceramic resistors of 0.2 ohms.

Speech Amplifier and Audio Driver Recommendations.

There are many modifications in the public domain for upgrading the speech amplifier and driver. In ER #9 Sheldon Rubin has some Viking II modifications, as well as those articles by Thomas Bonomo in ER's #110 and 111.

Most rebuilders agree the first item to check or to replace is the audio driver transformer T3. The fine-wire windings of the early driver transformers suffered from acid paper corrosion which resulted in either shorted or open windings. Another reason for replacement is the limited bandwidth of the stock transformer.

My preference for the replacement transformer is the Hammond P-124D, or the lower cost P-T156 available from Antique Electronic Supply, <https://www.tubesandmore.com/products/P-T156> .

Changing C2 to a 0.0047 uF 500 V cap lowers the speech amplifier's audio frequency response. The ultimate low frequency response of the total system is determined primarily of course by the response of the modulation transformer and driver transformer. I prefer not to lower the frequency response too much in order to retain some higher frequency components for cutting through noisy conditions.

Adding a 27k 1/4W resistor in series with a 270 pF cap across the gain potentiometer attenuates hiss and supersonics before they reach the driver stage.

I use high impedance dynamic microphones such as the Shure 522, Shure 450, and the Speco MHL-5S. The speech amplifier is biased for accommodation of most microphone output voltages. For D-104 microphones, increase **R1** to 3.3 Megohms to preserve "low-end" response.

Note: One cannot simply replace the first stage amp 6AU6 with a 6AH6 without re-biasing that stage, contrary to some misinformation in the public domain.

Always remove the paper C7 0.001 uF Aerovox, because it is guaranteed this cap will have leakage and show resistances below 100k and attenuates drive voltage.

I also converted the 6AU6 driver stage from a quasi-triode stage to a pentode stage by using Bonomo's suggestion of replacing R37, a 22k, with a 51k and adding a 1 uF voltage stabilizing capacitor at the screen grid. I also raised cathode resistor R31's value to 680 ohms. These component increased the gain of the driver stage and also reduced distortion.

A quality 1:1 or 600:600 ohm audio transformer can be used to drive the last audio stage when using an outboard compressor/limiter.

Modulator Stage Recommendations.

To increase higher frequency audio content reduce the value of C35 with a 2kV rated 0.005 uF ceramic capacitor at T4's primary. C35, a 1.5kV cap, usually suffers the same leakage fate as C7.

C32, L21, and C46 form another low pass filter circuit that inhibits upper frequency response. As K6AD (ER #110) has rightly pointed out, reducing the values of C32 and C46 to 0.0047 uF increases the audio frequency response to a good neighbor compromise of 5.8 kHz. For those wanting a more limited RF bandwidth of 9kHz, C32 and C46 values should be 0.068 uF at 2 kV. (See **RF Chain Recommendations** below).

If you add the soft limiter suggested by Bonomo in ER #111 (as I have), it will save T4 from failure by loading it on negative peaks, reducing the high voltage $V = -L di/dt$ inductive "kickbacks."

As a proactive measure replace the 22 ohm plate cap resistors R33 and 34 with 1 Watt metal oxide types. The carbon composition resistors either break from mechanical flexure and or literally "bake" to death. Cover the mod transformer plate cap leads with heat shrink tubing.

A 300V screen regulator for the modulator tubes is included to further reduce distortion in the audio chain. This regulator is based on a FET as the active device.

RF Chain Recommendations:

One usually finds the tuning points on the CDC will differ slightly from the Viking II. As stated in Part I, "The Viking II-CDC transmitter was basically a Viking II transmitter, but included extra shielding, additional tuning inductance, and a 6 dB audio clipper." There are added inductance values at various stages. L4, the oscillator coil, and L5A, the buffer coil, have slightly different inductances with respect to the stock Viking II. An additional inductance in the PI-Net, L70, which has the same value as L10, was added to increase the inductance for an additional 100 kHz slide down to 1.7 MHz.

In the oscillator section one may find the oscillator cathode current to be too low resulting in low buffer and final grid current. This can be traced to screen grid resistor R19 changing value, so replacement is warranted. A 1 Watt carbon composition resistor or carbon film is necessary since this resistor is part of RF feedback to the crystals. Another problem child is the C29 silver mica which can be replaced with a single 47 pF 1kV ceramic unit. Replacing the medium gain 6AU6 with a higher gain 6AH6 results in more drive at the higher frequencies and I found no need to re-bias the oscillator stage.

Another silver mica that will deteriorate is C25, the buffer-to-final grid coupling capacitor. A single 68 pF 1kv ceramic cap helps here as well. If you are not getting enough final grid current or buffer drive, check R23 for value change. R23 should be replaced with a 47k-51k ½ Watt carbon composition as well.

Another drive related problem can be found with R25. Notice that in stock Vikings, the Drive pot R25 is the only load for the LV power supply when in the AM mode and not transmitting. I added a new 200K resistor in the LV supply to shunt some current away from R25 so that it does not dissipate as much power. Make sure the replacement pot R25 is a true 5 Watt WW resistor. Another option is a circuit consisting of a potentiometer, one extra resistor, and a high voltage (500V) Bi-polar or FET transistor. One such circuit can be found at <http://amfone.net/Amforum/index.php?topic=32895.0> . This circuit is similar to the clamp control circuit.

The Door Knob dc blocking and plate coupling capacitor C31 usually requires replacement because of heating and value changes so I usually replace this cap with a HEC 2000 pF 7.5kV unit.

L21, C32, and C46 form a low-pass splatter filter, but EFJ over compensated here. It is a good idea to examine with a mirror the bottom of the L7 choke as this is where you will find L21. I find that if L21 has a black band at its center, this is an indication of an impending L21 failure. Since you will most likely be replacing C32 and C46, also located at the bottom of L7, go ahead and replace L21. Do **NOT** use a choke with a higher current rating because this choke also acts a “last chance” protection fuse for L7. I used the Murata 11R472C 4.7 uH RF choke available from Mouser as Mouser part number 580-11R472C.

Some authors have promoted high screen voltages (greater than 180V) for the final stage, but I strongly advise against it. Properly setting the R13 tap and the clamp circuit, as described above, will promote tube longevity.

The Control Relay:

My preference is NOT to have to contend with high voltages on the relay PTT control line. I have incorporated an extra relay which controls both the HV relay and the LV to the audio driver stage. In the latter case, I saw no reason to heat the driver tube and T3 transformer when it is not needed.

I located the relay near the accessory plug since this is where the filtered LV is connected and where there is the availability of 6 VAC.

Components marked with a "*" are either new or modified in value.

Voltages marked with a "*" are Keydown in AM or "Phone" mode under the following conditions:

Frequency: 3.880 MHz,

VFO 122 attached,

Osc. Current: 12 mA (Note: The oscillator tube in this rig is a 6AH6).

Buffer Current: 5 mA

Final Grid Current: 5 mA,

Final Plate Current: 280 mA,

Final Screen Voltage: 170V,

Modulator Screen Voltage: 297V,

Resting Modulator Current: 55 mA,

Exciter Frequency Control setting: 3.3-4.5,

Output Min. Max. Coupling Control setting: 4 and 2.3-3.5,

Audio Control setting: 5.5 for 100% Modulation with Hi-Z Dynamic microphones,

HV = 700V,

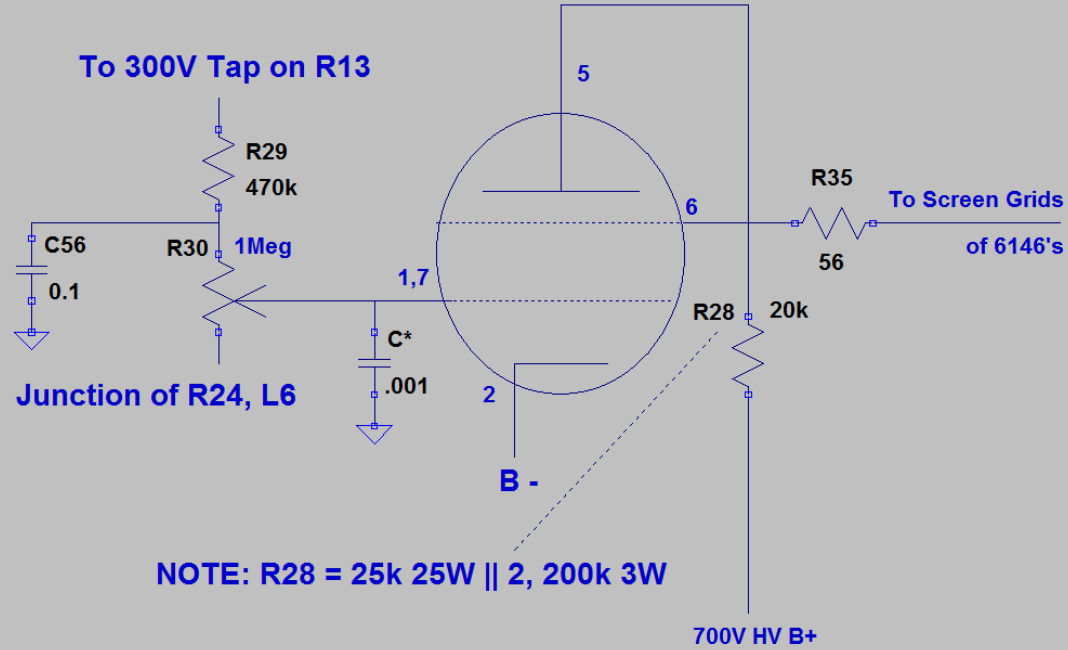
AC input voltage at VHF filters: = 120V,

Resting Carrier Output Power: 110 Watts.

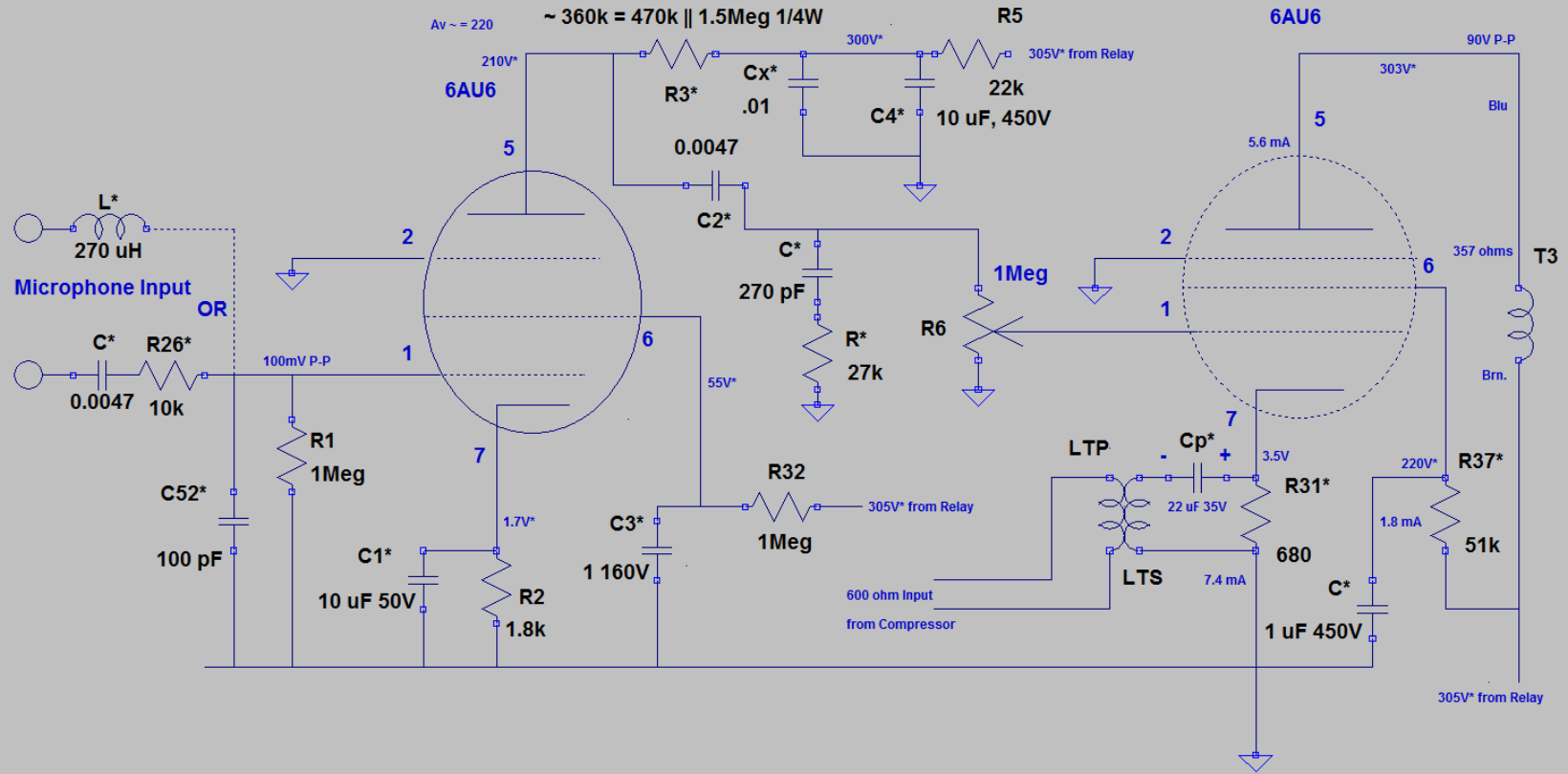
NOTE; Higher modulation percentages can be obtained by reducing output power to ~ 90 Watts.

Viking II-CDC Clamp Circuit

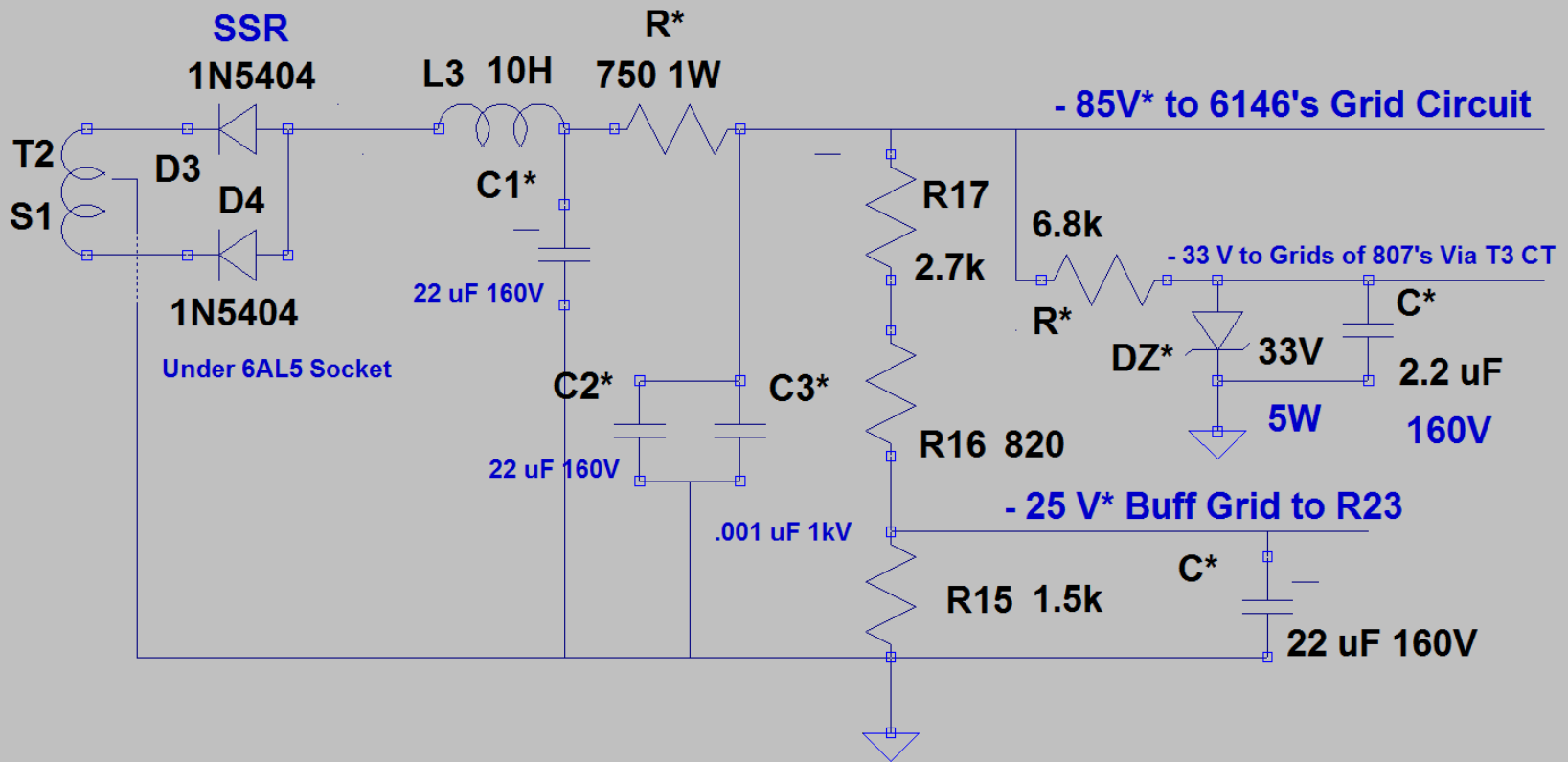
6AQ5A/6005/6HG5



Viking II - Speech Amp and Driver

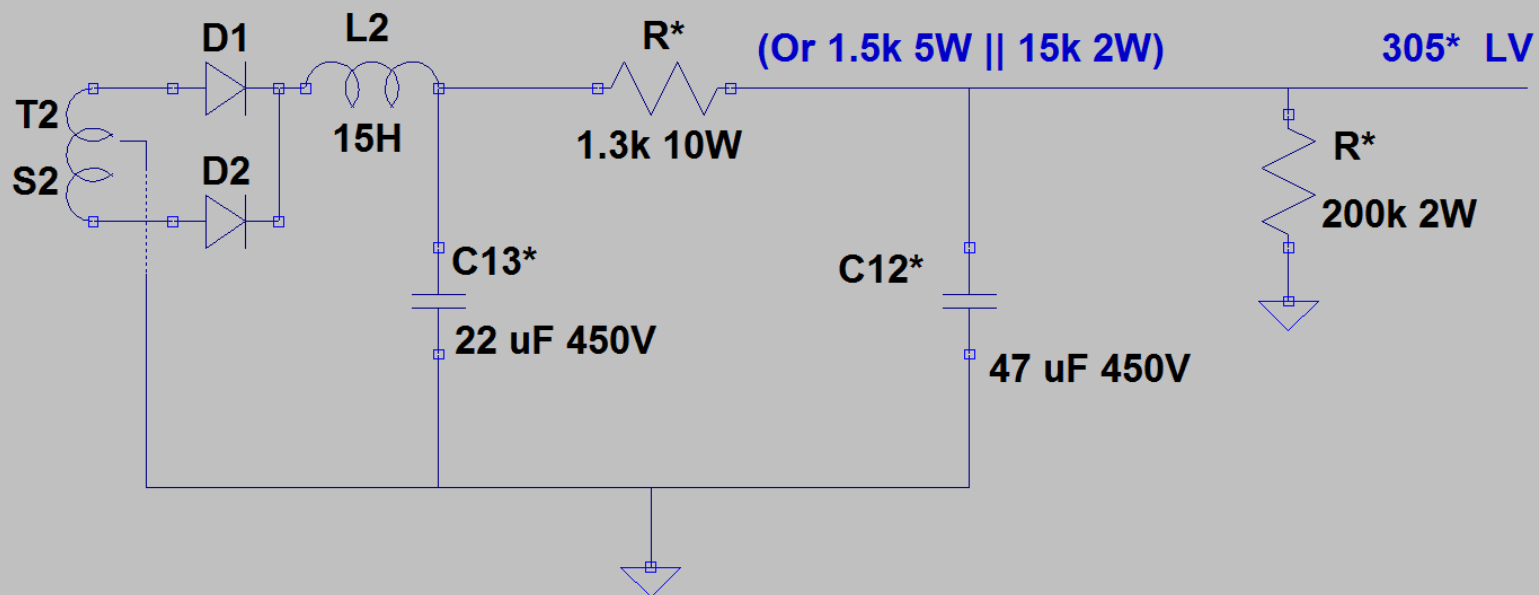


Viking II-CDC Bias Supply

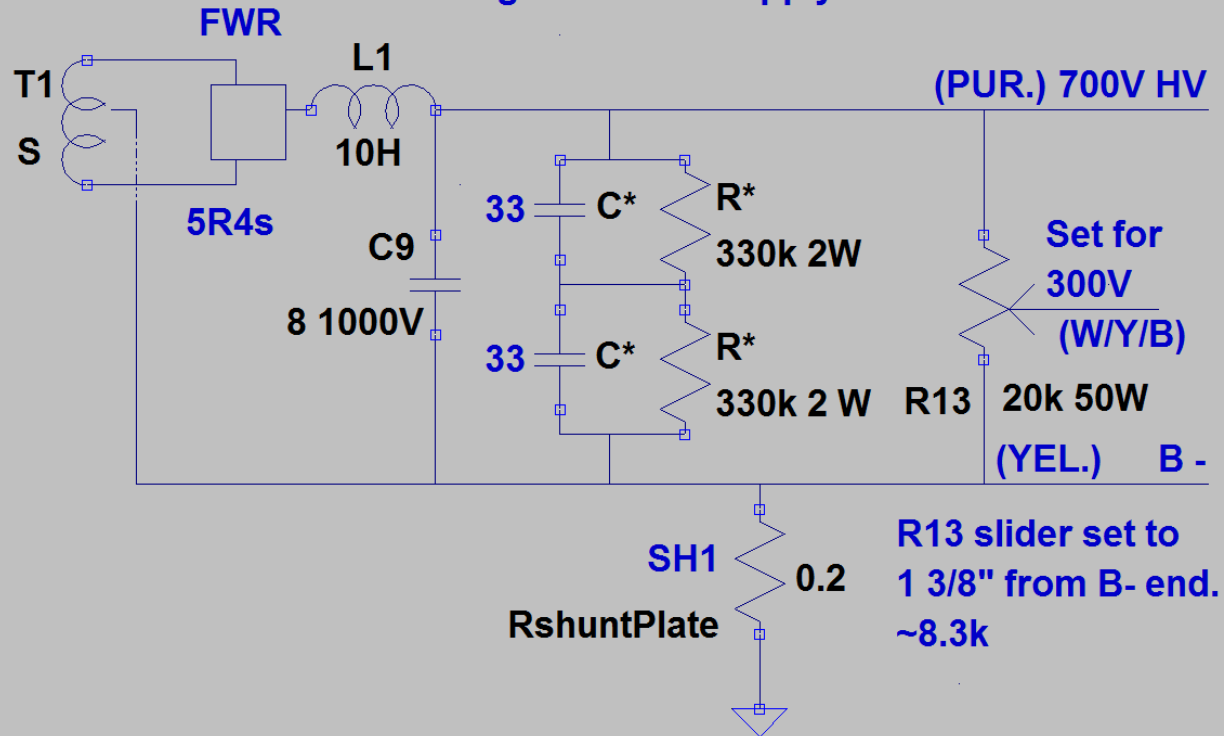


Viking II-CDC LV Supply

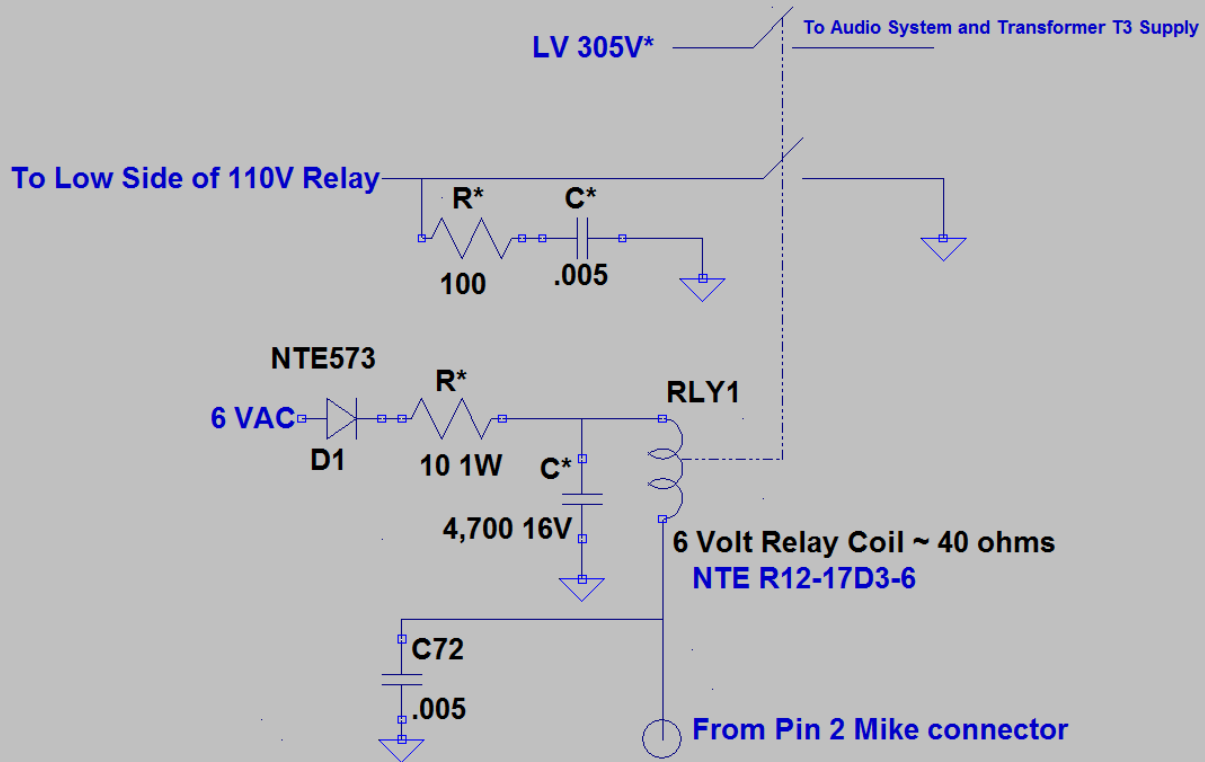
SSR Module or 1N5408's



Viking II-CDC HV Supply

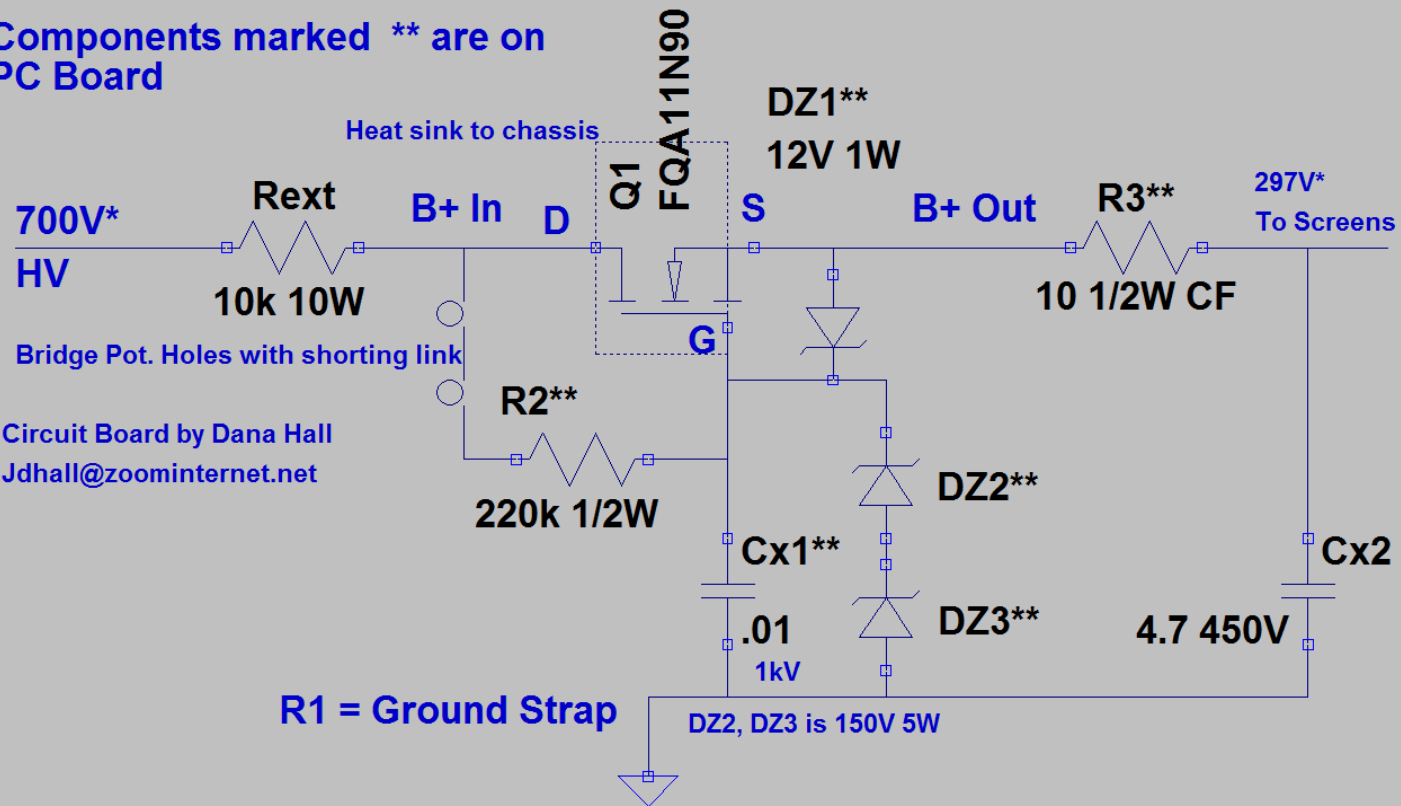


Viking II-CDC Control Relay



Viking II Screen Voltage Regulator

Components marked ** are on PC Board



Circuit Board by Dana Hall
Jdhall@zoominternet.net

