

The Power Supply

At first glance the power supply (PS) may appear to be somewhat complicated, but for a good reason. Refer to Figure 5 (p19). I always like to include a standby mode in my various designs.

However, that can cause a problem when you are working with an RC coupled fixed bias amplifier. You have to be sure the negative grid bias is applied to the output tube grids before the plate & screen voltage arrives. Otherwise, a large cathode current pulse of some duration will occur. This kind of problem is not as serious in a cathode biased power amp. As the cathode current increases, so does the bias so that the circuit is self regulating. I wanted to include this function without resorting to mechanical relays. Nor did I want to use any kind of thyristor which could be a source of interfering RF noise.

The remedy may seem to be simple enough since the positive & negative voltages from the power supply can be readily made to increase at about the same rate. However, that will not solve the problem. The output tube grids are isolated from their bias supply by large value grid resistors while at the same time they are being pulled positive by the driver tubes plate resistors through the coupling capacitors. A large cathode current in the output tubes at turn on is a sure thing & over time will reduce their life.

A solution is possible through the use of a pair of high voltage power FET's, in this case IRF840's. I had originally tried using a single FET but found that at turn-on there was more than 500 volts applied to this part of the circuit. That would not be good for reliability since the IRF840 is rated for 500 volts max from source to drain so that there are now a pair of FET's (Q1 & Q2) in a series connection.

The positive high voltage rise is slowed by the charging of the 22 μ F capacitor C103 through the 47K resistor R116. By connecting a series of four 100 volt Zener Diodes (Z1 to Z4) across C103, the output voltage of the power supply is limited to just under 400 volts. Regulation & ripple reduction resulting from this combination of parts is very good. To help prevent possible RF oscillation by the FET's I have inserted a 1K, 1/2 Watt resistor into each of their Gate leads (R114 & R115).

When the standby switch is closed more than 500 volts is applied to the pair of FET's. It is equally divided by the 100K resistors R111 & R112 so that each FET sees about one-half of the total. However, as C104 charges, the first FET Q1 will absorb a progressively smaller portion of the total voltage drop. A 1M resistor R113 sets the lower limit. By doing this I was able to use a very small heatsink on Q1, in this case a small strip of aluminum extrusion I pulled out of my junk pile. Q2, the other FET absorbs most of the voltage drop during normal operation & is mounted on the Wakefield heatsink.

Sometimes a designer will overlook what may happen when power is switched off. In this circuit, what happens to the charge on capacitors C103 & C104? If you are not careful to provide a discharge path you could destroy both FET's since the excess voltage will be applied to their gates with nowhere to go. That is the function of diodes D9 & D10. C103 & C104 are safely discharged into the load at switch off.

A 0.68 μ F cap removes any remaining noise from the HV supply & provides a high frequency return path for the load. To supply the screen grids of the output tubes I have simply used a 75 volt Zener Diode Z8 to drop the HV down to about 320 volts.

Other aspects of the HV PS are for the most part straight forward. The power transformer is a Hammond 274BX, more than adequate for this application. I have included a Negative Temperature Coefficient (NTC) thermistor in the transformer primary circuit to limit the inrush current at switch on. Eight 1N4007 power diodes (D1 to D8) provide the raw positive & negative DC potentials. All have 510K resistors (R101 to R108) in parallel to ensure that the reverse voltages are equally shared. Both positive & negative leads include current limiting resistors (R119 to R122), since the power transformer was originally meant to be used with a vacuum tube rectifier.

A pair of 100 μ F/ 350 volt caps (C101 & C102) connected in series provides filtering for the positive HV. Voltage across these caps is equalized by a pair of 330K resistors R109 & R110. Current requirements from the negative supply are minimal. That way the limiting resistors R121 & R122 can be increased in order to reduce the ripple at this part of the circuit & reduce the capacity required for filtering. For the amplifier bias supply & the second stage differential amplifier the negative supply is regulated by a series of three 47 volt Zener Diodes (Z5 to Z7) & a common red LED.

The 6.3 volt winding on the 274BX supplies all of the filaments while the 5 volt winding is left to light the pilot light. When the amplifier audio output is 25 watts, the power in from the line is 141 watts or 160 VA. With no signal that drops to 106 watts. In the standby condition the power required is only 38 watts. The Hammond 274BX is rated for 198 VA input to it's primary so there is ample reserve.