PS10 High Voltage Regulator

Our new PS-10 regulator board is versatile in that it can be used for both vacuum tube power amps and preamplifiers. The PS-10 regulator board is a low cost solid state voltage regulator circuit that provides very good load and line regulation resulting in a ripple output that is extremely low.

As with all regulators, it is limited by the power dissipation in the series pass transistor. However, this circuit is very versatile and can be used within a range of 40 volts to 480 volts as long as the input-to-output voltage is carefully balanced with the current requirements (see equation on next page for calculating the mosfet power dissipation). The desired output voltage of the regulator is achieved by properly selecting the total voltage of the zener diode stack. The pass transistor, Q1 can be thought of as a simple source-follower dc amplifier. It increases the load resistance seen by the zener diodes by a factor of beta. In this circuit arrangement the diode stack is required to supply only the gate current for Q1. The net result is that the load regulation and ripple characteristics, of the zener diodes, are improved by a factor of beta. In the case of the PS-10, the beta is very high due to the use of the mosfet. Additionally, C2 reduces the ripple even more and also provides a slow start capability for the PS-10.

Design Notes

Several calculations are required for the design of the PS-10 circuit. These are the resistance and power dissipation of R2, and the power dissipation of Q1. Additionally, the voltage values of the zener diodes must be selected and summed to obtain the approximate regulated output voltage. R2 is designed to supply the zener current to the zener diode string. The resistance value is calculated as follows:

$$\text{Resistance}_{R2} = (V_{B+(min)} - V_Z)/1.1\ I_Z$$

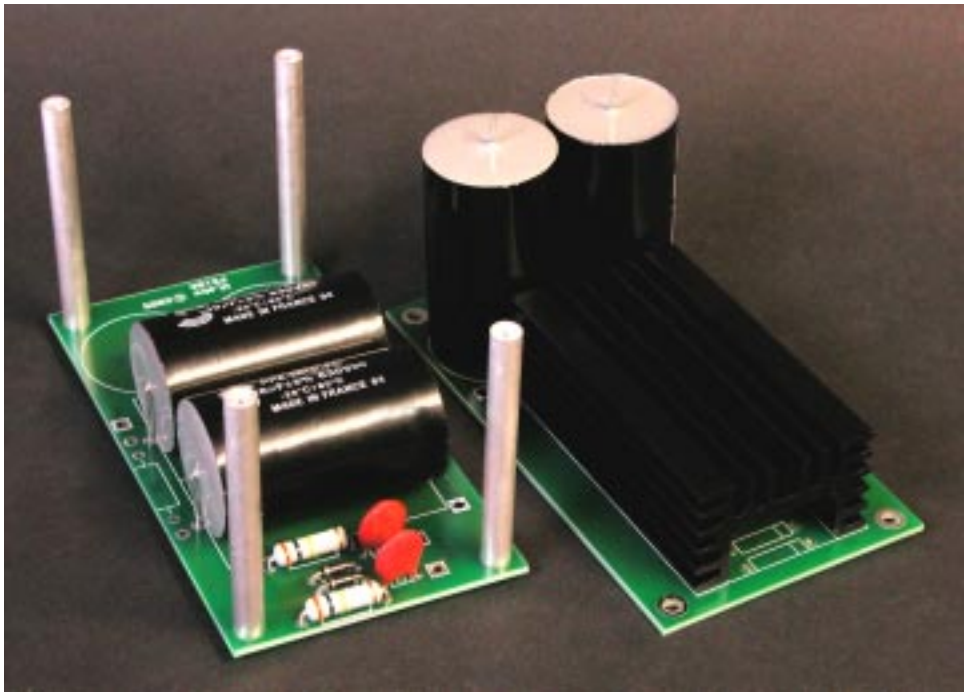
I_Z is the approximate current required for the zener diodes to regulate. This value is approximately 8 to 12 mA for the 5 watt zener diodes in the 50 to 150 volt range. The power dissipation in the resistor can be calculated as follows:

$$P_{R2} = (V_{B+(max)} - V_Z)^2/\text{Resistance}_{R2}$$

The power dissipated in the pass transistor can be calculated with the following equation:

$$P_{Q1} = I_{L(max)} \times V_{DS}$$,where V_{DS} is the input-to-output voltage differential

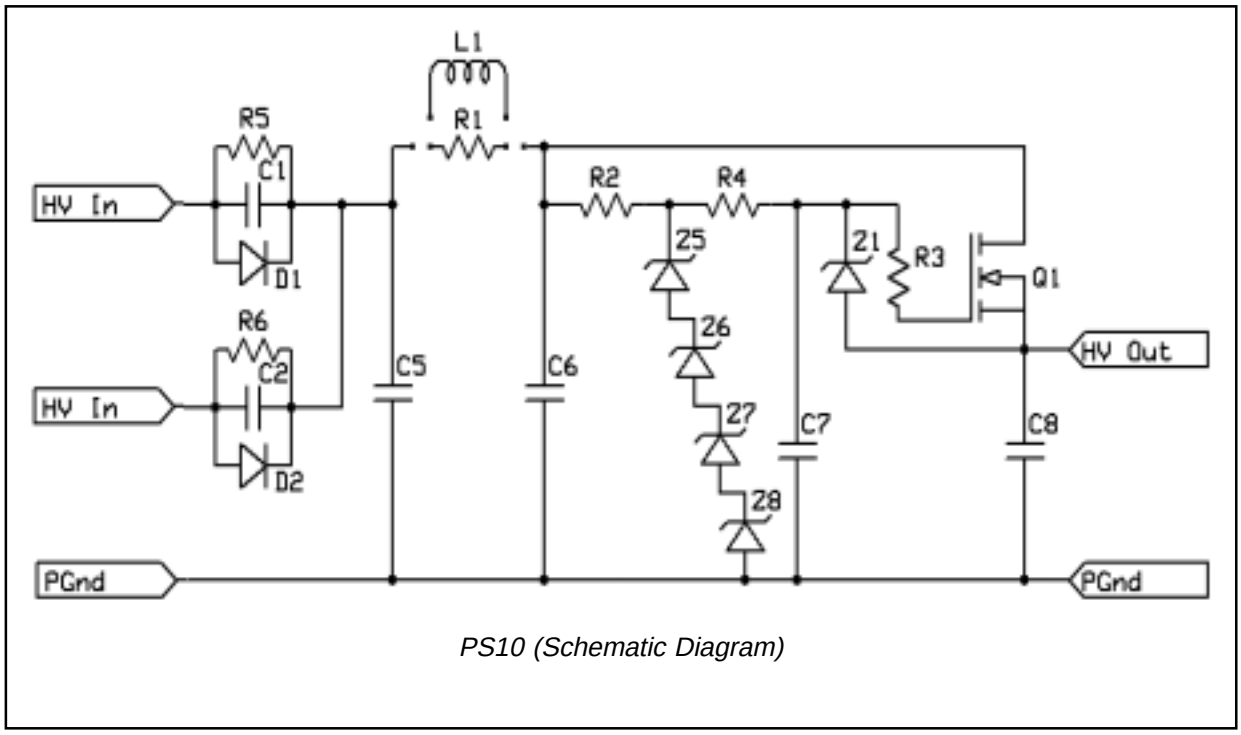
The power dissipation in the mosfet should be kept to approximately 10 watts or less for reliable operation. If more heat must be dissipated, Q1 can be located off the circuit board and mounted on a larger heatsink. The regulated output voltage is obtained by selecting four zener diodes with voltage ratings that sum to the desired output voltage. The final voltage will be the sum of the zener diode string.



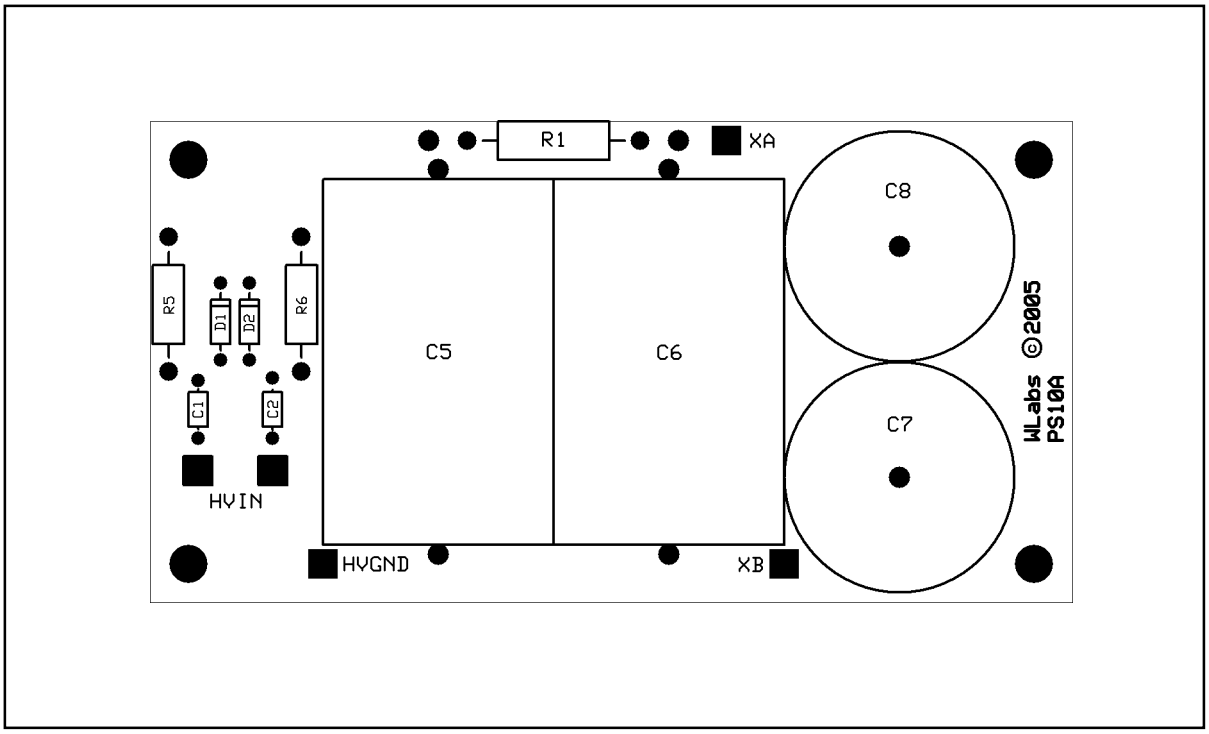
PS-10Voltage Regulator Schematic Diagram

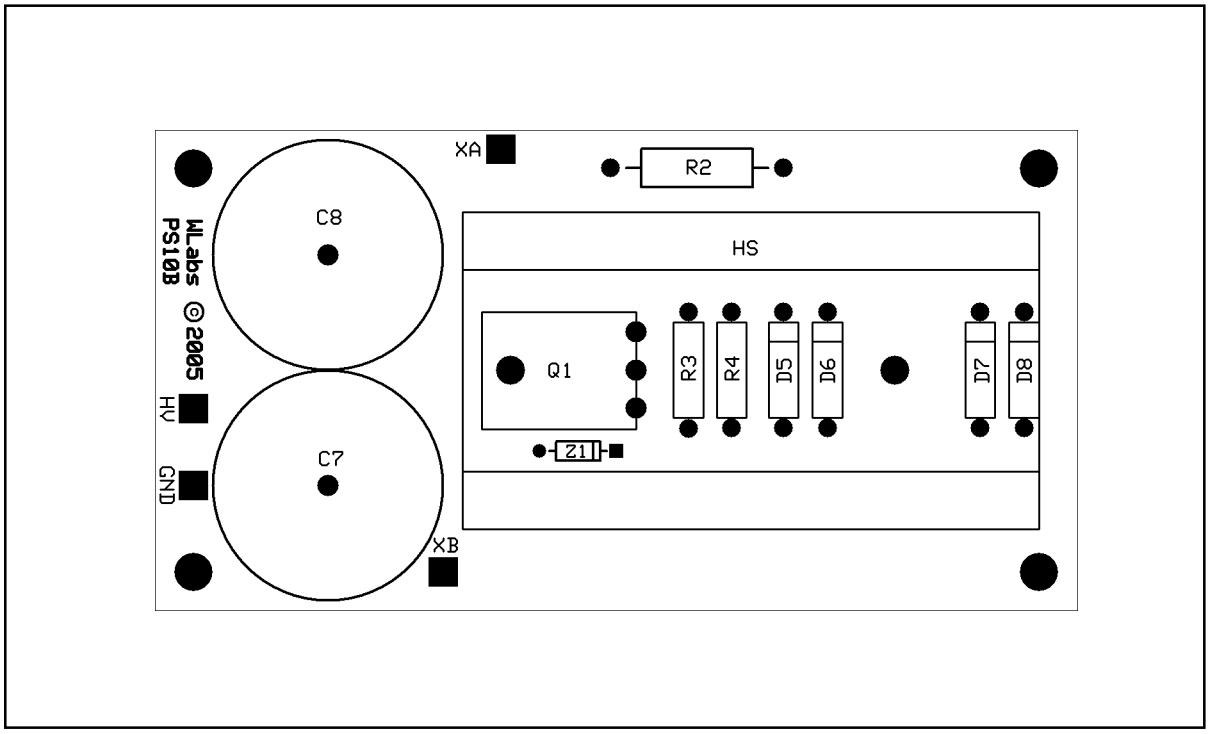
PS-10 Regulator Board Parts List

Resistors		
R1	40 ohm	10W wirewound (or substitute Filter Choke)
R2	3 kohm	2W
R3	100 ohm	1/2W 1% metal film
R4	499k ohm	1/2W 1% metal film
R5, R5	330 kohm	2W (with rectifier option)
Capacitors		
C1, C2	.01uf	Ceramic (with rectifier option)
C5, C6, C7, C8	10uf/600V	Solen Film
C5	.01uf/630V	Ceramic capacitor
Semiconductors		
D1, D2	UF4007	HV Rectifier Diode
Q1	IRFP340	MOSFET 600V 2A (with mtg. hardware)
Z1	1N4742A	12V 1W zener diode
Z5, Z6	Select	5W zener diode
Z7, Z8	Select	5W zener diode
Miscellaneous		
PCB		Printed Circuit Board
HS		Heatsink (x 6)
ST		Standoffs (2" w/hardware)



PS10 (Schematic Diagram)





PS10 (Component Stuffing Diagram)

Recommended Assembly Sequence

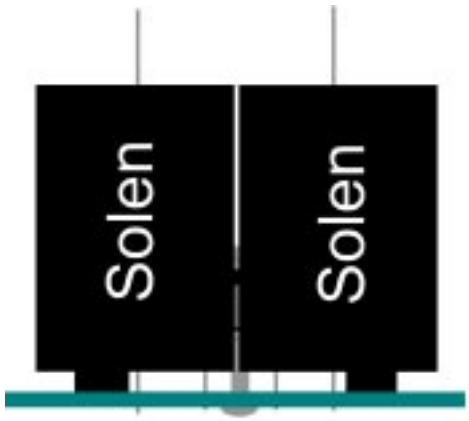
We recommend you follow the assembly sequence outlined below. Before starting check your kit for all components. Each PS10 consists of two circuit boards, one labeled PS10A and the other PS10B. Begin by soldering the components to circuit board PS10A.

1) Install diodes D1 and D2. Note the polarity of the diodes as indicated by the silver band on their body.
2) Install resistors R5 and R6.
3) Install capacitors C1 and C2.
4) If you will not be using an inductor with the PS10, then go ahead and install R1.
5) Install capacitors C5 and C6. Note: the capacitor bodies of C5 and C6 should be mounted such that they are touching the circuit board.

Solder the components to PS10B.

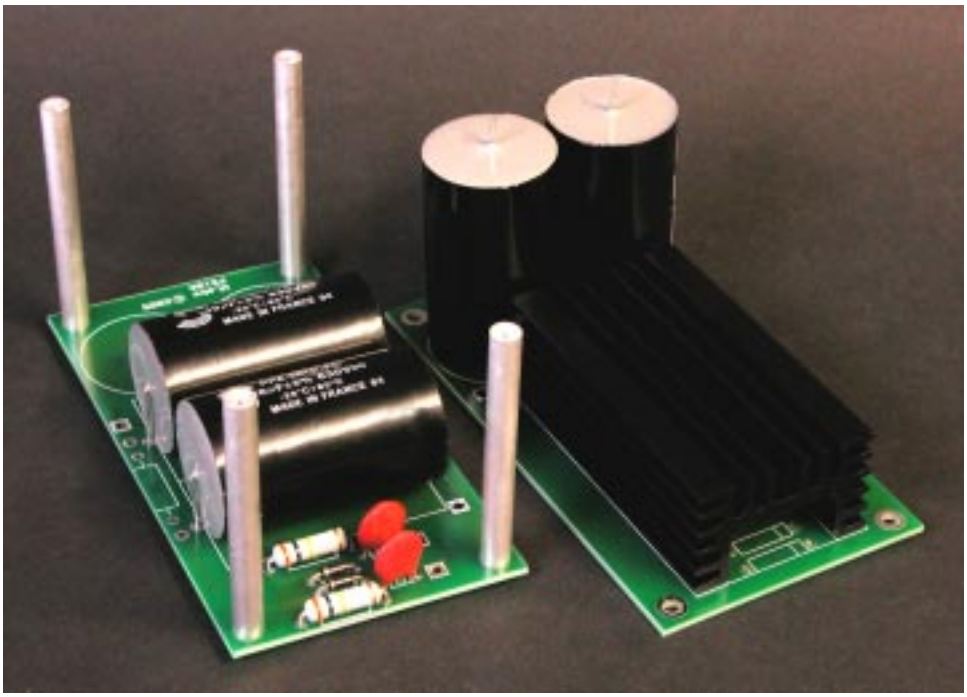
1) Install resistors R2, R3 and R4. These resistors should be mounted with about an 1/8" clearance between their body and the circuit board.
2) Install diode Z1. Note the polarity of the diode as indicated by the silver band on its body.
3) Install diodes D5 thru D8. These diodes should be mounted with about an 1/8" clearance between their body and the circuit board.
2) Install Q1 and attach the heatsink as shown in the figure below. The leads of Q1 should be bent right at the body - do so carefully. Use the supplied hardware to attach Q1 to the heatsink and the heatsink to the circuit board as shown. Do not tighten the nuts such that the circuit board flexes.

5) Install one end of capacitors C7 and C8 to PS10B. There should be a gap of approximately 2 tenths of an inch between the capacitor body and the circuit board as shown in the figure below.



Recommended Assembly Sequence

6) Install the long two inch metal standoffs. Your PS10A and PS10B should now look like the photo below.



7) You can now join the two circuit boards together securing with the provided hardware. Solder the other two leads of capacitors 7 and 8.

8) Each circuit board has a pad marked 'XA' and 'XB'. You should now solder a wire between the pads marked 'XA' on each and solder a wire between the pads marked 'XB' on each board. This completes the assembly of the PS10.

PS10 Checkout and Test

Inspect all solder joints under a bright light. Look for voids, bad joints and solder bridges.

The high voltage taps of your power transformer should be soldered to the pads marked 'HVIN' on PS10A. The ground should be soldered to the pad marked 'HVGND' on PS10A.

If you have purchased the PS10 without the rectifier diodes, you would connected the DC voltage of your power supply as follows: Ground goes to the pad marked 'HVGND' on PS10A. Positive (+) voltage would be soldered to one of the uppermost solder pads of either R5 or R6 on PS10A.

Power-up the PS10 before connecting to your circuit. Check the B+ voltage with a voltmeter to insure correct operation.

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