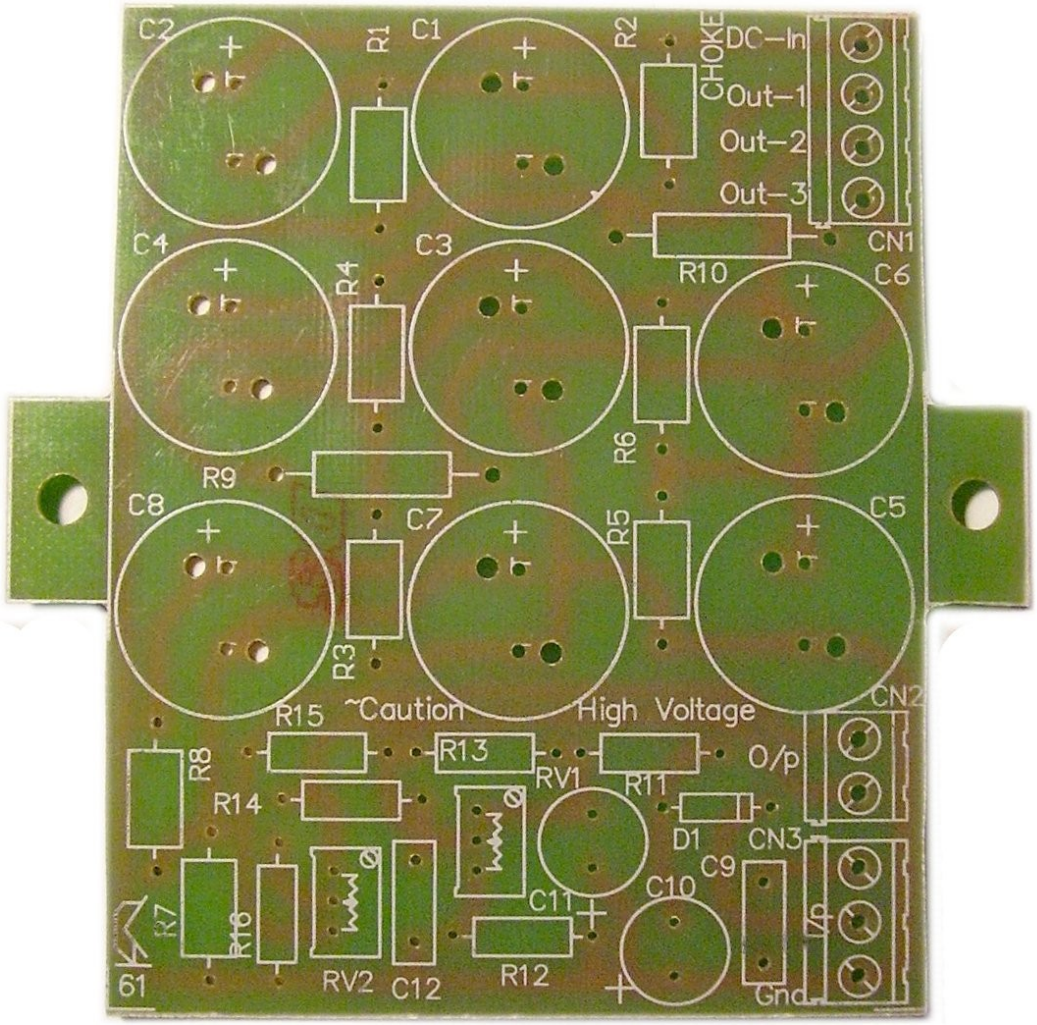
Power Supply Board

by *Classic Valve Design*

for the

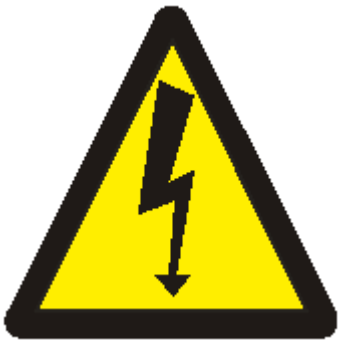
Dynaco® Mark-III

with “failsafe” bias and balance



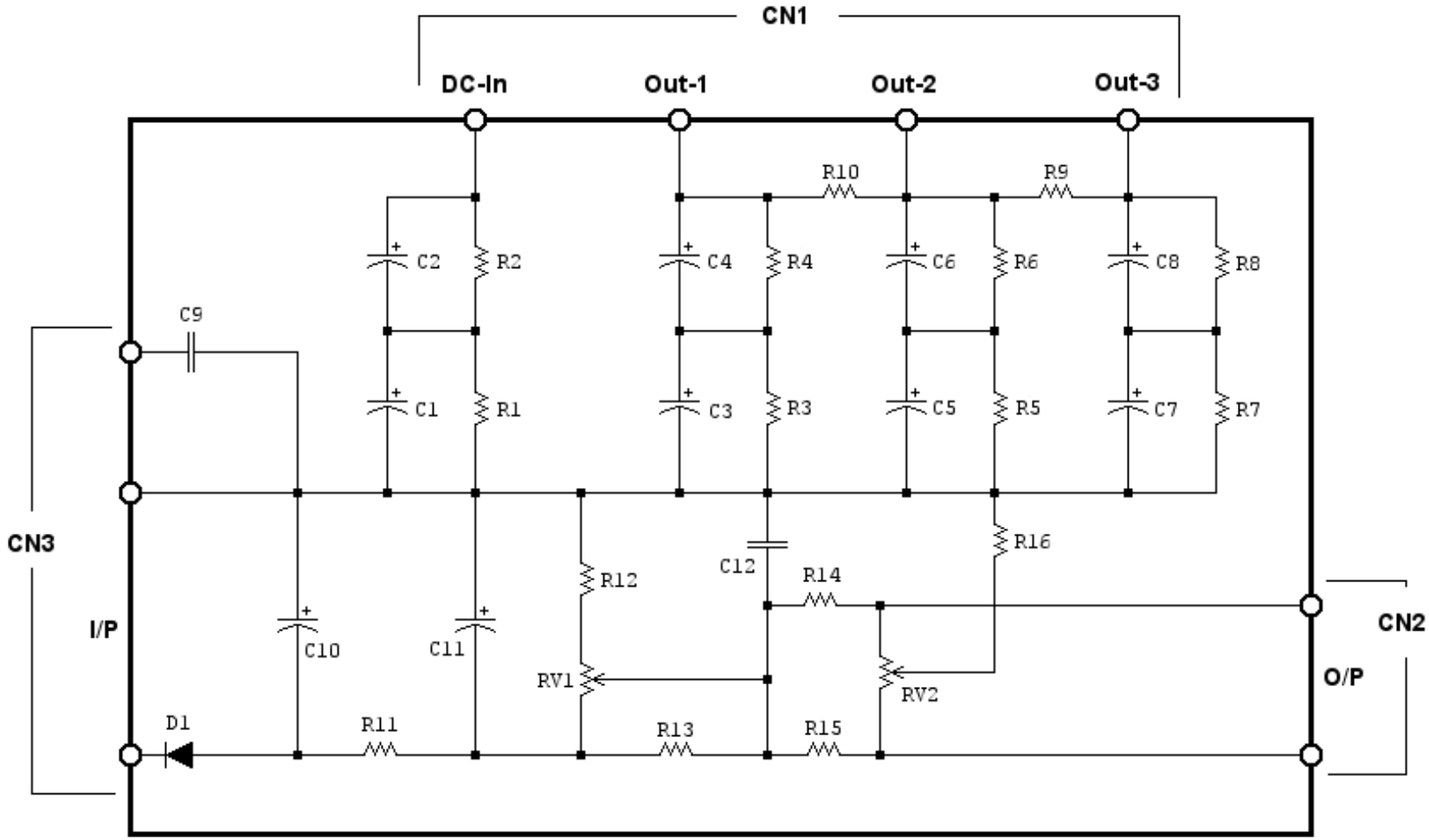
Classic Valve Design assumes no responsibility for circuit or user damage from the use or misuse of these boards or any other product. We simply provide these on an AS-IS basis with workmanship quality as the only thing guaranteed at this time.

This product is designed for and use around **LETHAL VOLTAGES**. We assume the user has a reasonably competent grasp of line operated electronics at the time of sale.



This power supply board allows you the opportunity to add a bias balance control to your Dynaco Mark 3, making output tube biasing a breeze and frees you from the need to buy tubes in matched pairs.

Notice we have used the term *failsafe* bias, this is referring to the way the bias and balance pots are wired to deliver the required bias voltages. On the original Dynaco circuit, if the bias pot wiper “lifts” (the most common failure mode of a potentiometer), the output tubes lose bias, go into full conduction and are often destroyed (sometimes taking the output and/or power transformers with them). In this power supply, if any potentiometer wiper lifts, the output tubes will receive full negative bias voltage to their grids and simply cut off.


CN1
DC-In
Out-1
Out-2
Out-3
R10
R9
C2
R2
C4
R4
C6
R6
C8
R8
C9
C1
R1
C3
R3
C5
R5
C7
R7
CN3
R16
C12
R12
R14
I/P
CN2
C10
C11
RV1
RV2
O/P
D1
R11
R13
R15

Parts List

Capacitors:

C1, C2: 82uF, 350V or 400V for 5U4/5AR4/GZ34 rectifier.
33uF, 350V or 400V for 5R4 rectifier. (See text)
C3 - C8: 82uF, 350V or 400V.
C9: 22n, 400V film type.
C10, C11: 47uF, 100V Electrolytic.
C12: 220n, 250V film type.

Resistors:

R1 - R8: 220K, 1 watt
R9: 47K, 2 watt
R10: 6.8K, 2 watt
R11: 2.2K, ½ watt for KT88 (stock MK-III). 4.7K, ½ watt for EL34.
R12 - R15: 10K, ½ watt.
R16: 150K, ½ watt.
RV1: 10K, ½ watt trimmer (or use original bias pot).
RV2: 100K, ½ watt trimmer.

Semiconductors:

D1: 1N4007

Misc:

CN1: 4-position terminal block, 5mm or 5.08mm pin spacing
(or 2 x 2-position)
CN2: 2-position terminal block, 5mm or 5.08mm pin spacing
CN3: 3-position terminal block, 5mm or 5.08mm pin spacing
Mounting hardware.

Circuit Notes

A **safety note** about the capacitors: The exposed tops of C2, C4, C6, C8, C10 are **HOT** at ½ the rectified and filtered high voltage power supply voltage and should not be touched. The application of “circle stickers” found in stationary stores can be used to insulate these capacitor tops.

Likewise, because of the -V bias supply, the exposed tops of bias capacitors C11 and C12 are at full negative bias voltage (up to -80V). Again application of “circle stickers” found in stationary stores can be used to insulate these capacitor tops.

Please take care to make sure the capacitor's polarity is respected as outlined on the PCB and as per above schematic – reversed polarized electrolytics have a tendency to ***EXPLODE***, spewing hot electrolyte all over the place!

C1 and C2 are the capacitors that the rectifier sees. The GZ34/5AR4 and the 5U4 variants will have no problem with 82uF, because the capacitor values are halved as they are stacked to increase voltage handling. So 2 x 82uF at 350V becomes 41uF at 700V in this circuit. The 5R4 variants aren't very happy with much above 15uF (though I haven't cooked one with 22uF in practise... yet). So 2 x 33uF will equal 16.5uF.

Why haven't we stated 100uF like other popular aftermarket power supply boards? Size! There's a lot of stuff to fit on this board and *the electrolytics in the high voltage section can be no more than 20mm in diameter by 25mm high.* 100uF high voltage caps are out there (Nichicon is one that comes to mind) that fit that bill, but are not usually stocked by suppliers that sell to DIY'ers. The largest stocked in our search was 82uF, so we ran with that. Pads for a lead spacing of 7.5mm or 10mm (including snap-in types) are provided.

By frequent request of our clients, here are some sample part numbers that will fit this unit. Since our commercial account is with Digikey, we will supply these numbers. This is in NO WAY a recommendation of one supplier over another. Parts not mentioned are easily fit and aren't too size specific.

Capacitors:

C1, C2: 82uF, 350V or 400V. Digikey 565-1468-ND or P13557-ND.
33uF, 350V or 400V for 5R4. Digikey 565-1464-ND, 565-1452-ND, P13562-ND, P13552-ND or P13544-ND.

C3 - C8: 82uF, 350V or 400V. Digikey 565-1468-ND or P13557-ND.

(above types chosen for size, lead spacing and operation of 10,000 hours at 105ºC)

C9: 22n, 400V film type. Digikey 495-1305-ND.

C10, C11: 47uF, 100V Electrolytic. Digikey 493-1663-ND.

C12: 220n, 250V film type. Digikey P14656-ND.

Resistors:

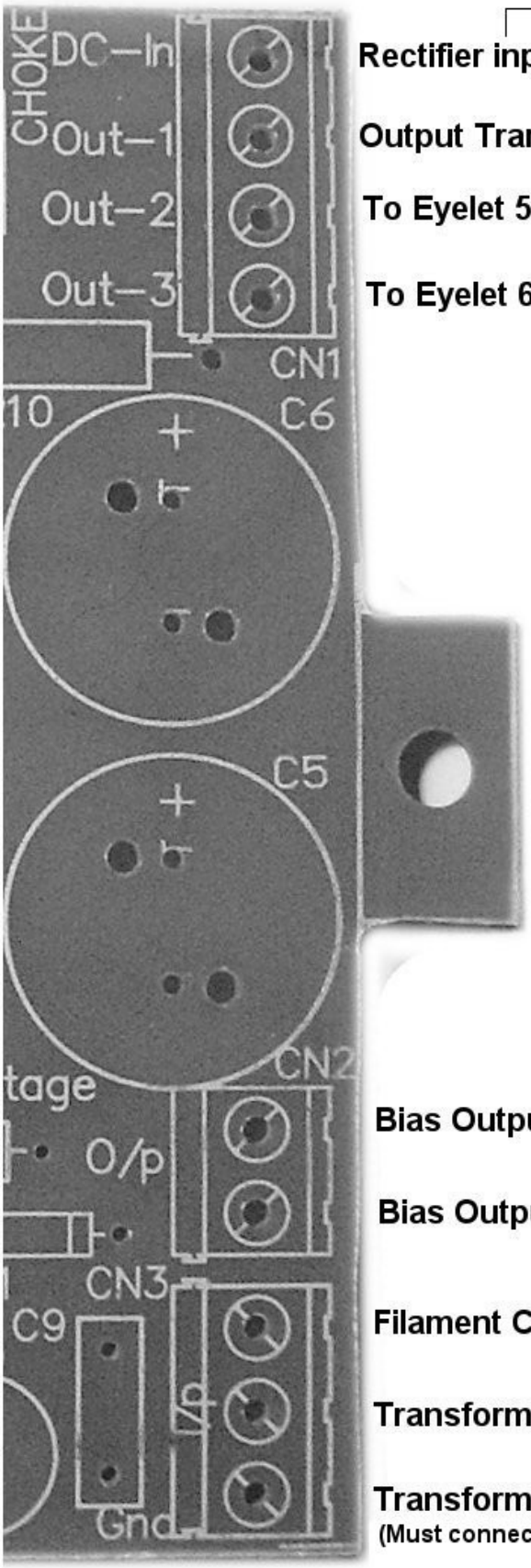
RV1: 10K, ½ watt trimmer. Bourns 3299W series. Digikey 3299W-103LF-ND.

RV2: 100K, ½ watt trimmer. Bourns 3299W series. Digikey 3299W-104LF-ND.

Hooking Up to the Circuitry

Once the board is installed, you can begin hooking up the wiring from the top via the easy to use connectors.

- The output from the GZ34/5AR4 rectifier goes to the ***DC-in*** on ***CN1***.
- The choke goes beteen ***DC-IN*** and ***OUT-1*** on ***CN1***.
- Attach the bias tap to the centre connection of ***CN3***.
- Attach the power transformer's HV centre tap to the ***Gnd*** on ***CN3*** and also run a wire from the second ***Gnd*** hole to the chassis star ground. If you (or someone else) have modified your MK-III to use a floating or other isolated ground system, attach the power transformer's HV centre tap to the ***Gnd*** and ground to your circuit as per your modifications.
- Attach the transformer filament centre tap to the first connection on ***CN3***.
- Connect the centre tap of the output transformer to the ***Out-1*** on ***CN1***.
- Connect wire from eyelet #5 on the driver board to ***Out-2*** on ***CN1***.
- Connect wire from eyelet #6 on the driver board to ***Out-3*** on ***CN1***.
- Finally, connect either bias outputs from ***CN2*** to eyelet #2 on the driver board, if you are using the original Dynaco driver. See the next section on conversion to balanced.



Rectifier input

Choke goes across these terminals

Output Transformer

To Eyelet 5

To Eyelet 6

Bias Output #1

(See Text)

Bias Output #2

Filament Centre Tap

Transformer Bias Tap

Transformer Centre Tap/GND

(Must connect to Eyelet 11 and chassis)

Converting the MK-III for Bias Balance Control

This procedure is in two steps, changing the KT88 cathode circuitry and modifying the driver board (this step isn't necessary if you are using a driver with split bias connections).

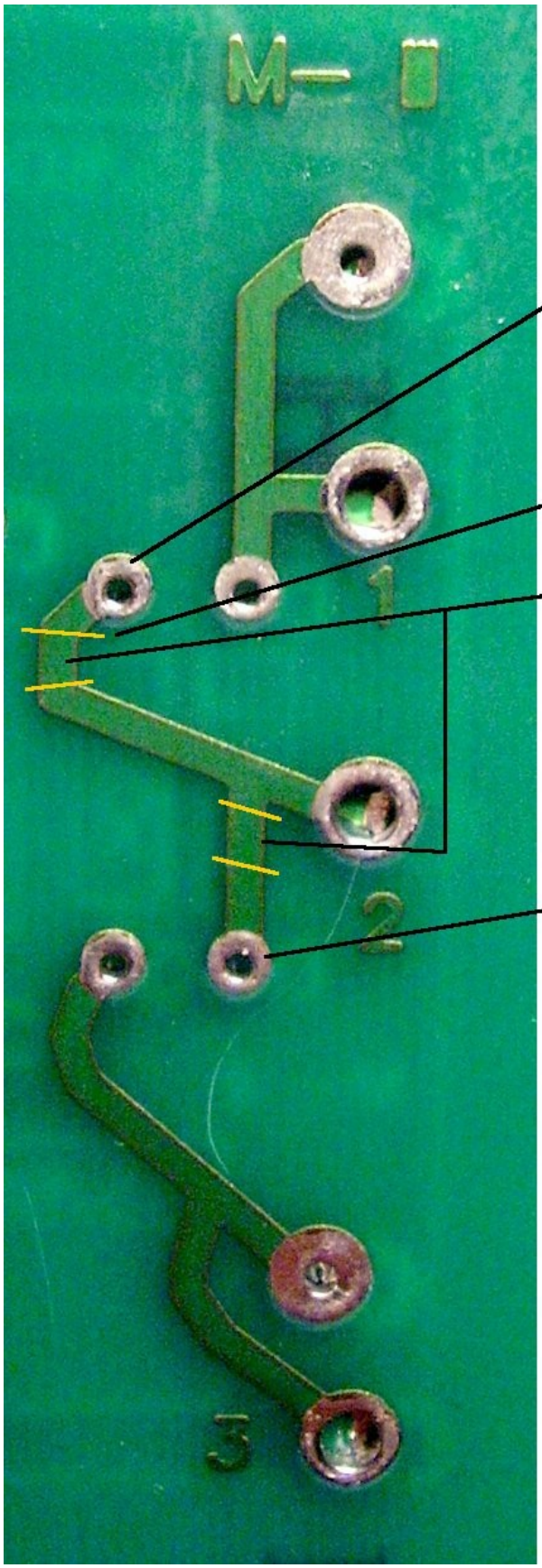
Step 1 – Modifying the KT88 Cathodes:

In order to monitor the bias in each KT88, we need to have a resistor on each KT88 cathode. We need to remove the existing 11.2 ohm resistor and the bridge between the two output tubes. We will use 10 ohm resistors on each cathode.

- Locate the 11.2 ohm resistor near one KT88 output tube socket. Remove it and replace it with one of the 10 ohm resistors.
- Locate the wire that goes between the two output tubes. Remove it.
- Solder another 10 ohm resistor the remaining KT88 pin 8 to chassis lug on the mounting rings.
- If you (or someone else) have modified your MK-III to use a floating or other isolated ground system, tie the ground side of the 10 ohm resistors to a terminal strip and run a wire to the ground terminal on the power supply board.

Step 2 – Modifying the Driver PCB:

Simplest to show this as a picture on the next page:



3) Attach bias #1 wire here.

1) Cut along yellow lines with a razor knife.

2) Heat trace with soldering iron and lift off the board.

4) Attach bias #2 wire here.

First Power Up and Biasing

Before first power up, ***remove your GZ34/5AR4 rectifier*** from the circuit. We want to test first that there is negative bias where there should be before applying B+ to the KT88 tubes.

- Connect a voltmeter on a setting to handle up to -80VDC to any left channel KT88 grid (pin 5) and electrical ground.
- Set **RV1** and **RV2** to midway.
- Turn on your MK-III.
- A negative voltage should register immediately, as it's a SS rectified circuit. If it does not, go through your component mounting and wiring thoroughly!
- Adjust **RV2** for MAXIMUM negative voltage reading.
- Turn off your MK-III and replace the pulled rectifier tube. You are now ready for live biasing.

Biasing and Balancing

1) Connect a voltmeter on a setting to handle up to 2VDC across either KT88 cathode 10 ohm resistor.
2) Turn on your MK-III.
3) As your MK-III warms up, you will see the voltage come up. If this cathode voltage creeps above 800mV (0.8V or 80mA for that tube) at this time, immediately turn off your MK-III and repeat “First Power Up” to look for the problem. If none is found, your tube grids may be on their way out (unable to restrict current flow enough).
4) After about three minutes warm up time, adjust **RV2** for a bias reading of 700mV. This corresponds to 70mA current through that tube.
5) Now remove the negative voltmeter lead from electrical ground side of the 10 ohm resistor and place it on the cathode of the other KT88 (Pin 8).
6) Adjust **RV1** for a reading of 0VDC (anything within 10mV (0.01V) is just fine).
7) Repeat steps 4-6.

Congratulations! Your MK-III is now ready for service! :-)

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