

This procedure is for one channel. It must be repeated for each channel.

### **Recommendations**

Prior to installing the JFETs (which are normally conducting) set the resistance across each of the pots to zero (0) to ensure that the JFETs (and therefore the output MOSFETs) will not be conducting when you first power the circuit. This is critical. Verify by checking the resistance across the 1k5 resistors in parallel with the pots. It should be '0'. It would be wise to mark the direction to increase the resistance (CW or CCW) on the PCB for reference later.

Use a dim bulb tester with an appropriate bulb and/or a variable transformer for the first power up along with a 0A5 fuse. Slowly increase the voltage and check the rails with no load. Verify that all the pots increase the Vgs (voltage to the gates of the output MOSFETs) by measuring across the 1k5 resistors. If everything looks good, you should remove the DBT and increase the fuse value to roughly ½ of the intended bias current or to the next value above your intended bias current (so you can get the initial settings and checks done).

For all the remaining settings and checks, do not use a DBT and ensure that the AC voltage remains consistent at the line voltage you'll be using (or remove the variable transformer). The PSU is not regulated.

For each of the checks and settings following, the polarity of the voltage is not critical. However, it is recommended for checking the offset that the DMM probes be oriented normally with the GND test point connected to the common or "black" probe on the DMM and the 0+ or 0- test point connected to the measurement or "red" probe on the DMM. This will allow you to remain consistent with your CW or CCW turning of the pots as you incrementally adjust the bias.

For all measurements, the DMM should be set appropriately to measure DC Voltage. Offset targets will ultimately be <20mV DC. Voltages to determine final bias current will typically be less than 100mV. When checking / setting the initial Vgs, you can expect a little over 10V when measuring the offset. Auto-ranging meters are a bonus.

## Initial Settings and Checks

Goals:

Gently turn on each 'bank' of the output MOSFETs

Get familiar with how each of the pots affects the  $V_{gs}$  => Bias current and how the N and P channel MOSFETs balance the offset as they both turn on.

- Connect a DMM across the +9140 1k5 resistor ( $V_{gs}$ )
- Connect a DMM to GND and O+ aka "At 0+" (Offset)
- Connect a DMM across a +9140 source resistor, R7 or R8 (Bias Current)
- Turn the +9140 pot, and you should see the  $V_{gs}$  rise. Then, you should also see the offset start to decrease.
- Adjust the pot until the offset is <2VDC
  - The  $V_{gs}$  should be approximately 3.5-4VDC.
  - The voltage across the source resistor should be < 50mV
- Connect a DMM across the -140 1k5 resistor ( $V_{gs}$ )
- Connect a DMM across GND and O- (Offset)
- Connect a DMM across a -140 source resistor, R1 or R2 (Bias Current)
- Turn the -140 pot, and you should see the  $V_{gs}$  rise. Then, you should also see the offset start to decrease.
- Adjust the pot until the offset is <2VDC
  - The  $V_{gs}$  should be approximately 3.5-4VDC
  - The voltage across the source resistor should be < 50mV
- Connect a DMM across the +140 1k5 resistor ( $V_{gs}$ )
- Connect a DMM across GND and O+ (Offset)
- Connect a DMM across a +140 source resistor, R5 or R6 (Bias Current)
- Turn the +140 pot, until you see the offset move consistently and the  $V_{gs}$  is approximately 3.5-4VDC. The voltage across the source resistor should be < 50mV
- Connect a DMM across the -9140 1k5 resistor ( $V_{gs}$ )
- Connect a DMM across GND and O- (Offset)
- Connect a DMM across a -9140 source resistor, R3, or R4 (Bias Current)
- Turn the -9140 pot, until you see the offset move slightly and the  $V_{gs}$  is approximately 3.5-4VDC. The voltage across the source resistor should be < 50mV

At this point, there should be a  $V_{GS}$  of around 3.5-4VDC on all quadrants and the output MOSFETs should have just begun to turn on.

If you were using a lower value fuse, now is the time to increase the fuse value to a rating just above your full bias current.

## **Set Rough Bias and Null Offset**

Get the bias roughed in and gain familiarity with the process for nulling the offset.

- Connect a DMM across the +9140 1k5 resistor ( $V_{gs}$ ) – Just for monitoring
- Connect a DMM across the GND and O+ (Offset)
- Connect a DMM across a +9140 source resistor, R7 or R8 (Bias Current)
- (Optional) If you have enough DMMs, you can also connect a DMM across:
  - the +140 1k5 resistor ( $V_{gs}$ )
  - a +140 source resistor, R5 or R6 (Bias Current)
- Turn the +9140 pot one turn in each direction and observe all DMMs.
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You should now have an understanding of:

- Which direction increases/decreases the  $V_{gs}$  => Increases the Bias Current through corresponding output MOSFETs.
- That the +9140 (P-Channel for the Positive Phase) and +140 (N-Channel for the Positive Phase) are acting in tandem.
  - Increasing the bias current through one, also increases the bias current through the other (and vice versa).
  - That the current through the +9140 MOSFETs is slightly higher than that of the +140 MOSFETs. This is because the +9140 have a constant current.
  - Balancing the current through each will null the DC offset.
- Set the bias current to roughly  $\frac{1}{2}$  of your desired final result and null the offset to within 25mV.
- Connect a DMM across the GND and O- (Offset)
- Connect a DMM across a -140 source resistor, R1 or R2 (Bias Current). Additional DMMs are optional similar to above.
- Using the -9140 and -140 pots, set the bias current to about  $\frac{1}{2}$  the desired target and null the offset to within 25mV

## **Set Final Bias and Null the Offset**

Increase the bias gradually until you reach your target nulling the offset at each slight increase. The bias current and offset remain fairly stable.

It is important to do the final settings with the amplifier fully assembled with all panels installed. The amp should be at temperature equilibrium with good ventilation. The bias current will drop as quickly as the top panel is removed. Observant DIYers will know exactly which pot to nudge before they lift the panel. You will “chase your tail” if you lift the panel, look at the DMM, and try to hit a moving target on the DMM. It is best to let the values stabilize at temp, ensure the direction of change needed, lift the panel, make a slight turn on the pot, and place the top panel back into place and observe.