

Dentron MLA-2500 GI7B Modification Procedure

by N3OC

February 2013

Overview

This document provides some additional detail and a few corrections to the excellent conversion information by W4ZT (sk) and W4EMF. I have done two of these so far, and learn a little more each time.

This is a semi-advanced project. DO NOT attempt this unless you are familiar with working around high voltage devices! **Amplifiers contain LETHAL voltages. By following this procedure, you do so at your own exclusive risk, and agree to hold N3OC, W4ZT, W4EMF, K4POZ, AA4PG and any others that have contributed to this body of knowledge harmless.**

CAUTION – Even when off, the MLA-2500 has line voltage throughout the chassis. Dentron used a single-pole on/off switch, which disconnects only one side of the AC line. The other side is still present, including on the metering board (for the fan circuit).

As of this writing, the best source of sockets is from K4POZ, and the best source of GI7B tubes is probably on eBay. You will need a supply of tubes, a couple sockets, a 12v 4a filament transformer (Hammond 166N12) and various other small components to complete the project. A complete parts list is part of this document.

You will also need some basic metalworking skills, a drill, and a dremel tool or a chassis nibbler to do some of the chassis cutting.

My amp resulted in 1000 watts out for 1600 watts DC input, for an efficiency of 65%, which seems reasonable. 300ma grid current for 100w input, and 850ma plate current. I would not run it this hard for any period of time, however. The tubes can handle it, but the rest of the amp is a little fragile. That's the price you pay for its compact package.

There were several variations of the MLA-2500, and the schematic does not accurately reflect each revision or change. Don't be surprised if you find something slightly different than shown on the schematic in the original manual!

Power Supply Modifications - replace capacitor board with a new board with low-profile capacitors to allow room for 12v filament transformer, mount filament transformer and glitch resistor.

There are two options for mounting the new capacitors. One is to make a new breadboard to mount them on, and install this board vertically. This requires cutting and notching the chassis, and building some L brackets to mount the board.

The second option worked up by AA4PG is to mount the new capacitors in the old holes. There is just barely enough room for the new low-profile caps to fit in the old holes, and still allow room for the filament transformer to fit above them. You can obtain electrolytic capacitor clamps and use the old mounting holes, or you can mount them on a breadboard with the proper spacing to fit in the old holes, and mount the breadboard to the bottom of the chassis with nuts and bolts, allowing the capacitors to stick up through the holes.

See AA4PG's write up of this at this link:

<http://cahabatechnology.com/aa4pg/mla2500.pdf>

I think I prefer this second method since you don't have to cut the chassis, however I had already committed to the first method so that is what I have done and what I describe here.

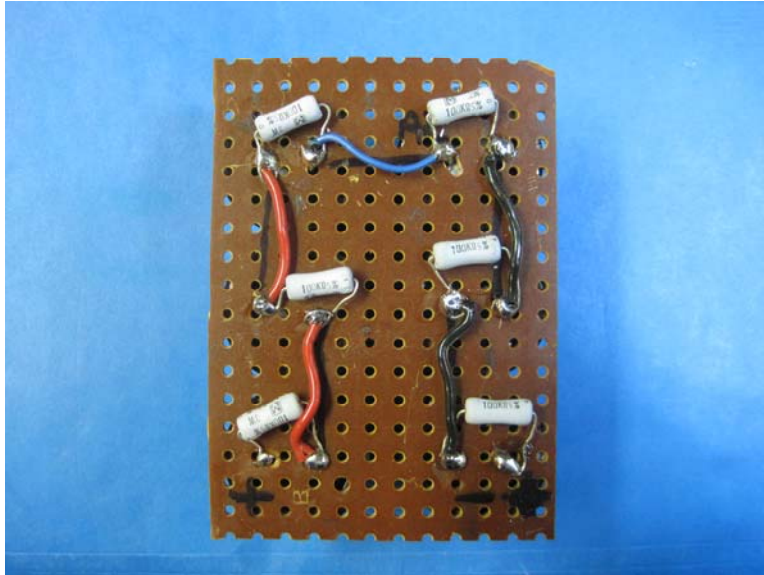
1. Construct a new capacitor board approximately 3" X 4.5" with six 390uf 450v low-profile electrolytic capacitors.



Capacitor Board – Component Side

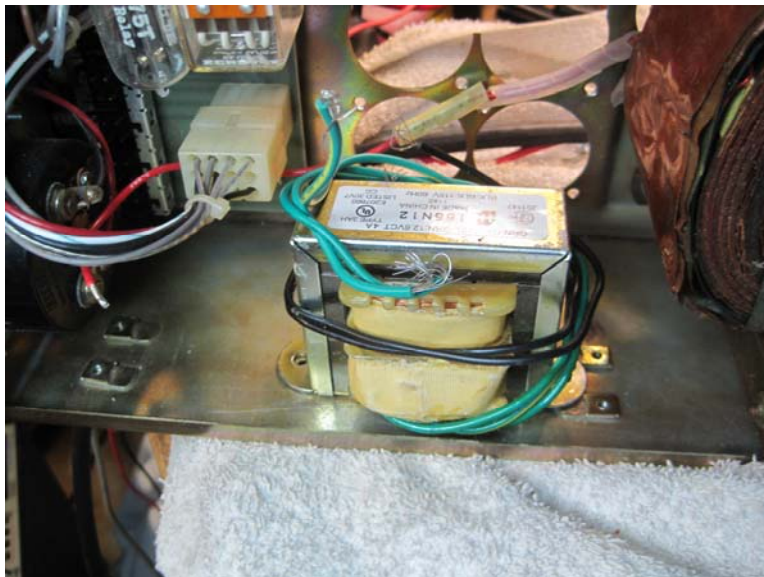
2. Tag the wires going to the existing capacitor section:
 - a. Red Hi-voltage AC wire going to transformer
 - b. Red B+ wire going to tubes
 - c. Red B+ wire going to diode board
 - d. White wire going to plate shunt
 - e. Two white wires going to diode board (B-) and plate meter circuit.
3. Unsolder all wires going to capacitors, saving bleeder resistors to use with new capacitor board.
4. Mount the bleeder resistors and jumpers on new capacitor board. The leads on the old bleeder resistors are very short, so you have to be a little innovative

squeezing them in. Otherwise, you can use new resistors to make things easier. I was able to re-use my old ones.



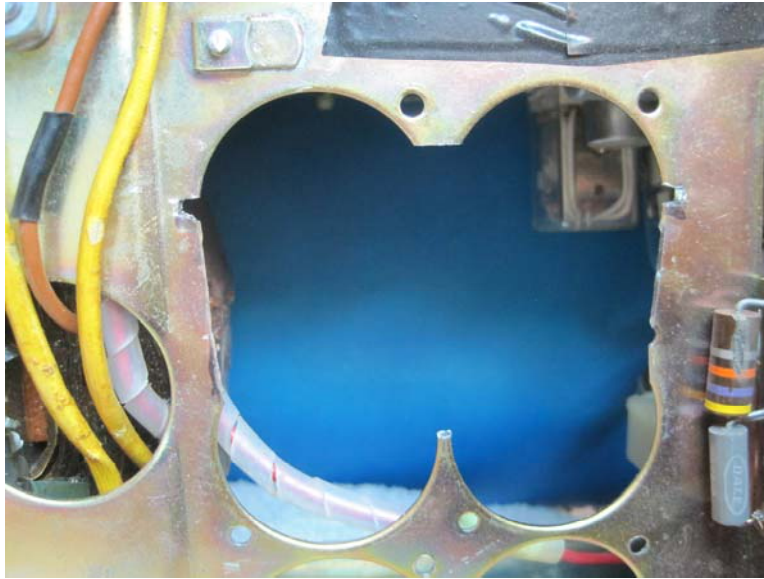
Capacitor Board – Wiring Side

5. Carefully drill out rivets and remove old capacitors. Easier done from the top, but you will need an extra-long drill bit. Can be done from the bottom with more difficulty. If someone already replaced the caps, they might be nuts & bolts.
6. Vacuum out all metal shavings now.
7. Mount filament transformer so you can see where new capacitor board has to squeeze in. Use pan head #4 or #6 screws and counter sink the chassis a little so they are as flush as possible on the outside to let the cover mount correctly. Vacuum out the metal shavings again.



Filament Transformer Mounting Location

8. Optionally, it may be beneficial to test your new capacitor board now before committing to cutting the chassis. If you want to, solder the tagged leads from step 2 to the new board dangling below the chassis, and very carefully power up the amplifier and see if the power supply operates as expected. (I always use a long stick to turn on the power switch from a distance when doing hi voltage tests on amplifiers.) Check for 2200v on the plate meter, and observe that the bleeder resistors work correctly. Allow the voltage to totally bleed off before continuing!
9. Determine where and how to mount capacitor board. It will need to be sunk a little below the chassis because it is a hair too tall. Mark and notch chassis to cut a slot with a Dremel tool where the old capacitor holes were. Slide the board into this notch so the top of the board is at or slightly below the top of the chassis sides and mount it from underneath with small L-brackets. Cut away enough material to allow the capacitors themselves to come down.



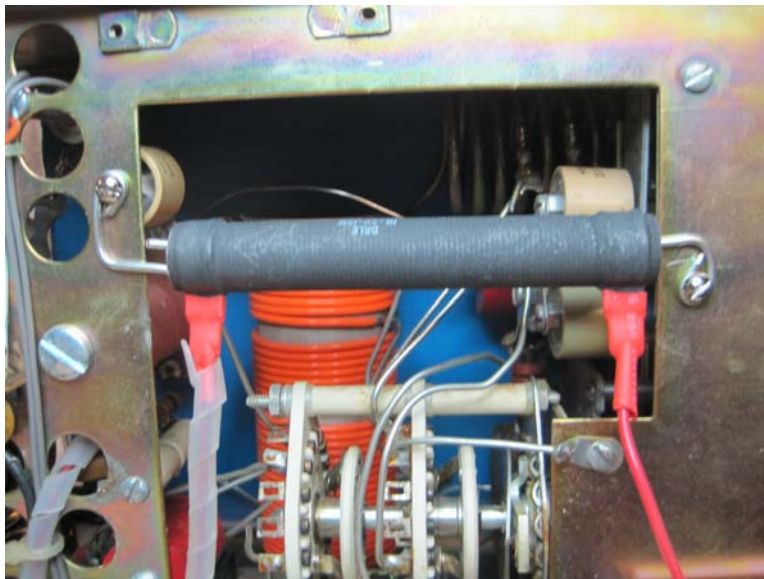
Notches & Chassis Cuts for Filter Board – Note Notches in the Sides

10. Before the final mounting of the capacitor board, fish out the HI-V AC wire that goes to the middle of the capacitor string from the bottom of the chassis to the top of the chassis, as it is likely the middle of your new capacitor string will be at the top. It will probably need to be extended a short amount to reach the top of the new capacitor board.
11. Mount the new capacitor board, and reconnect all the wires tagged in step two to the appropriate locations on the new board.
12. You might want to consider threading a #4 threaded rod through the top of the filter board, the original Dentron control board, and the chassis middle bulkhead to lock the tops of the circuit boards in place. Put a nut with a lock washer on each side of the board and tighten into the proper position.



Threaded Rod Holding Filter Board and Control Board To Chassis Bulkhead

13. This is a good time to install the glitch resistor, since you are working with the B+ wiring. Install a 25 ohm 50 watt resistor between the B+ output of the filter board, and the plate choke input. Even though we have installed the glitch (fault current limiting) resistor, the remaining required safety components (C2 & D2) to finish this are not added until the shunt and metering section of the mod.



Glitch Resistor Installation Location

14. Optionally, test the new capacitor board once it is mounted, as outlined in step 8, observing all high voltage precautions. This is a good chance to check for arcing.
15. Connect the primary of the new filament transformer to the 110vac side of the AC power circuits at terminal 2 & 3 of the voltage selector panel at the rear of the amplifier.

16. Test the filament transformer for proper operation by observing 13.0vac at the output of the secondary, observing all high-voltage precautions.
17. This concludes the power supply modifications. Proceed to the RF deck modifications.

RF Deck Modifications – fixing 80m and 160m tuning

1. You may wish to consider fixing the lack of loading on 160m and 80m at this time. This seems to be a design issue with many amplifiers that will tune on 80 and 160 with the tuning capacitors maxed out, and struggle at best to produce decent output. Or you can defer this step until you finish your conversion and do this with the 617B tubes. The issues in the tank circuit on 160 are most likely Q-related, and I have not completely worked this out yet. Most MLA-2500's I have seen do not work very well on 160. Every one I have seen did not agree with the schematic in the area of the switched in capacitance for "C2" on 160. There are several variations. Some have 4 X 500pf red doorknobs (2 for 160 and 2 for 80 that are also switched in) and some have smaller values. The smaller values seem more correct. The one I am currently working on has 4 X 500pf and seems to like only 1 X 500pf the best.
2. To test the plate circuit resonance, connect a 1800 ohm resistor between the plate choke RF side to ground, leaving the tubes connected. (This simulates the output impedance of the tubes). Then connect an antenna analyzer to the RF **output** jack on the back of the amplifier.
3. **DO NOT PLUG THE AMP IN!** Clip lead 12vdc from a separate power supply to the antenna relay to engage it.
4. Set the tuning controls as close as you can to the band you want to test, and put the antenna analyzer on that frequency. Tune the plate and load controls for minimum SWR on the analyzer. You should be able to achieve a perfect 1:1 SWR. This indicates the plate circuit is now resonant on that frequency and that your test setup is working correctly.
5. Once you determine your test setup is working correctly, change to 160m and try to tune the plate circuit for minimum SWR. If it matches well, you are OK. If not, you will need to adjust the values of the parallel capacitance switched in by the bandswitch.
6. Try the same test on 80m, both at 3800 and 3500. You will likely find it is pretty good at 3800, but has the same problems tuning at 3500 that it does on 160m. This is what we need to fix.
7. The plate tank circuit needs more parallel C on those two bands to get it to resonate without the load control at max.
8. On the rear of the plate tune air variable (C7), you will see an aluminum L-bracket with several doorknob caps on it. We want to increase the ones that are switched in for 80 and 160 by the band switch (C8 & C9).
9. C9 (160m) is normally 3 X 100pf. I removed all three of those and changed mine to one 200pf doorknob and one 170pf doorknob for a total of 370pf.
10. C8 (80m) is normally one 100pf. I added a second 100pf 5kv doorknob in parallel to it to increase C8 to 200pf. Be very careful when messing with these as

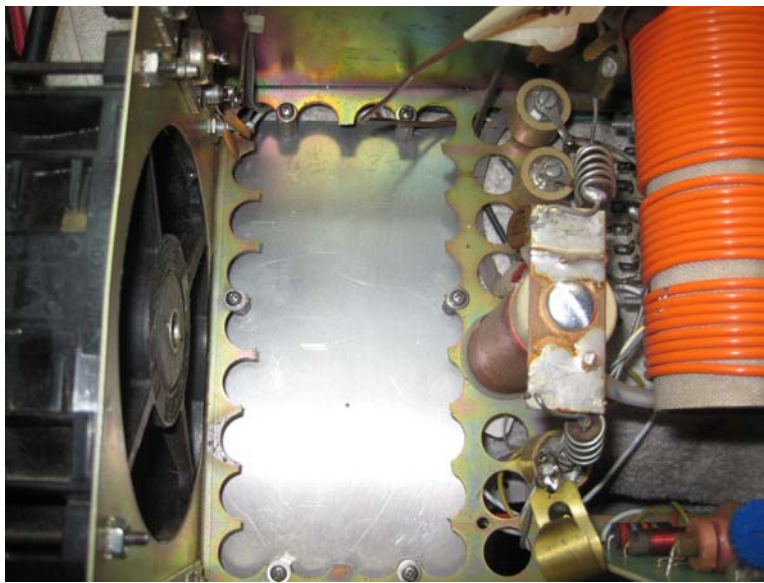
- it is easy to break the solder tab off the band switch. If you have to manipulate the L bracket to change these, unsolder both C8 & C9 from the band switch first to avoid stressing it.
11. After increasing C8 & C9, retest the plate resonance with the antenna analyzer setup and verify you can properly tune 3500 and 1800 to near-perfect SWR.
 12. Note that the frequency won't read out correctly any more on the plate tune adjustment for these bands, but it will be more at mid range instead which seems to me what you want it to be.
 13. Re-check this again after you do the GI7B conversion. I had too much C on 160 and 80 was good.
 14. Remember to remove the 2k resistor and disconnect your antenna analyzer from the RF output of the amp! (I hate to admit I fried one MFJ-259B but amazingly I was able to repair it after it smoked...)

RF Deck Modifications – changing the tube sockets to GI7B sockets

1. You can either cut away the chassis and mount the GI7B tube sockets on a metal plate (subchassis), and suspend this plate slightly below chassis level on standoffs, or you can attempt to mount the tube sockets in the original 8875 holes. For the first two conversions I did, I cut away the chassis and mounted the plate below the existing chassis. This works fine, but it is a big pain to access the tube socket terminals to work on them as they are covered by the plate. AA4PG has worked out a way to disassemble the K4POZ socket and sandwich it between the old chassis and use the original tube holes. This means you don't have to cut the chassis (but you do have to drill some holes) and more importantly you have free access to the bottom of the tubes. I now prefer AA4PG's method. You only have to drill four holes and find some commonly available hardware.
2. If you choose to use the plate method, follow the steps beginning at step 4.
3. If you choose to use the original holes and not cut the chassis, follow the steps beginning at step 12.
4. You will need two GI7B sockets and a metal plate to mount them on. The metal plate is approximately 6.75" X 3.5".
5. The GI7B is too tall with its cauliflower-head heat sink to mount on top of the original chassis. Instead, it will mount on the metal plate which will then hover below the original chassis height on reverse standoffs.
6. The first step will be to unsolder and tag the wiring to the old tube sockets.
Unsolder and tag the following wires:
 - a. Large yellow – old 6.3v filament.
 - b. Green – to 6.3v amperite relay timer. Reconnect to large yellow wire and dress out of the way of the RF deck. The old filament winding will only run the amperite relay now.
 - c. Black coax – RF input. Keep it on the terminal strip so we can re-use it.
 - d. Yellow – bias from RFC4 on bias board. Keep it on the terminal strip so we can re-use it.
 - e. Wht/blu – grid meter. Unsolder it and the plate shunt resistor from the terminal strip. These pull out of the RF deck area and move to a new

terminal strip that will be mounted on the chassis underneath the meter switch board. (See metering section below.)

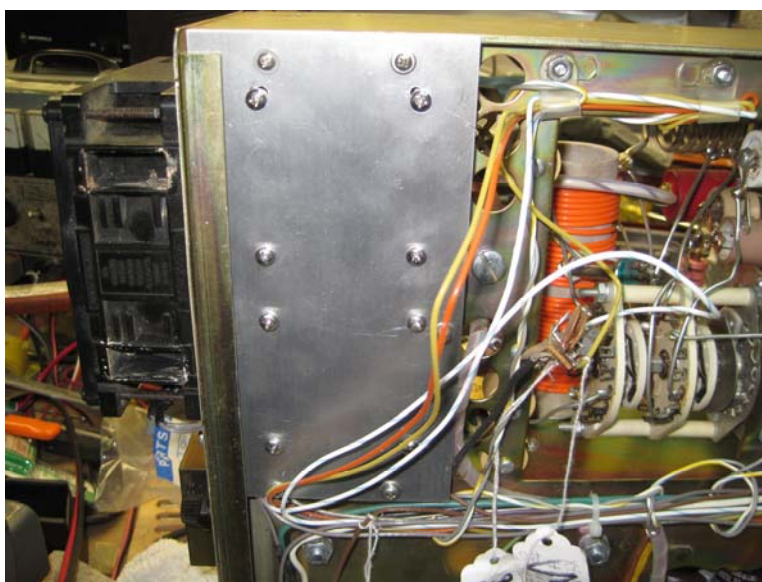
- f. Brown wire to zener diode. Pull out of RF deck area. This wire goes to the new adjustable bias board later.
7. Then cut out the existing chassis and sockets, making a large enough area for both tube sockets to clear, but also leaving enough material for the standoffs to the metal plate to attach to the original chassis. It will take several Dremel tool cutter blades to make all the cuts. When the cutter's diameter is reduced due to wear, make the cuts inside the rear bottom lip. The cutouts will be through the middle of the punched out circles in the last row in the rear and last row on either side. In the front, it will be the middle of the circles on the second row from the front (the first row contains the plate choke and we want to keep that).



Chassis Cuts for 6I7B Sockets with Bottom Plate Installed

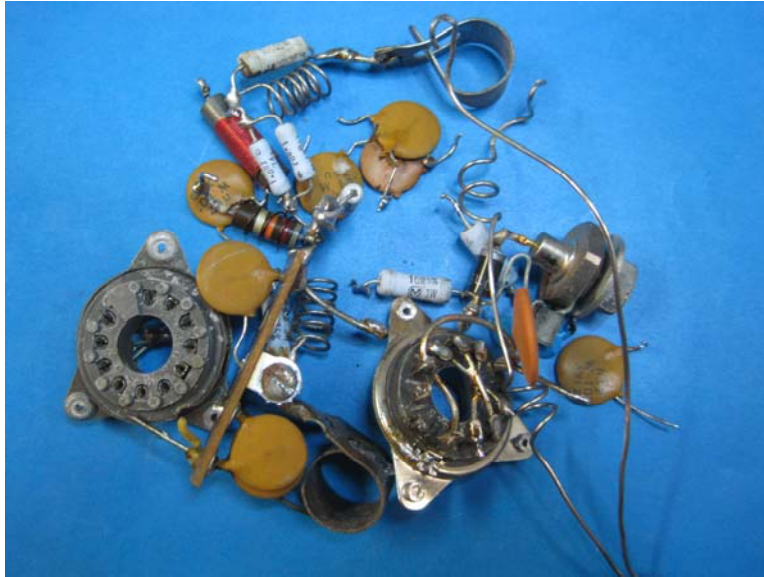
8. Fit the metal plate and temporarily secure with electrical tape from the bottom. It should fit with its rear edge inside the rear lip of the original chassis and slid all the way to the rear to contact the back of the chassis. Set the tubes and sockets in place on it to check for fit. Expand the cutouts if needed. When you are satisfied the tubes and sockets will fit, smooth the edges of the cuts on the chassis and vacuum out all the dust.
9. You will have to relocate the power sensor directional coupler and the T/R relay. Move these out of the way now to help fit the tube sockets, mark the input and output side and mark where the brown wire to the meter attaches. Unsolder and tag the leads to the T/R relay, and remove the relay. Unsolder the RF out lines from the power sensor and mark the board as to which side is in, and which is out. The Tx Output SO-239 will come off with the board. Save the standoffs. Leave the brown power out lead connected and temporarily swing the board out of the way. Remove the SO-239 and re-mount it by itself on the rear chassis.
10. Put the tubes in the sockets, and set them in place on top of the metal plate and move them around to obtain proper clearance. Make sure the top cover of the

amplifier will have enough clearance (it will be close). Mark and drill 1/8" mounting holes in both the chassis and metal plate. Use the one remaining original hole at the rear center as the first hole and put a spacer and nut in it to align the other holes while you drill and mark them. Mount the plate using 7/16" (1/2" spacers trimmed down a little) and 6-32 or 4-40 screws and nuts. Then mark and mount the sockets after double-checking your clearances with the plate mounted. Depending on your type of socket, face the terminals towards each other at the center, and allow them to overlap with each other a little as they are connected in parallel anyway and can just be soldered together. (Make sure the plates don't get too close to each other though.)



Bottom Plate Installed, Showing Mounting Screws for Tube Sockets

11. Continue with step 27. (Skip the sections below on the AA4PG method if you are using the plate.)
12. AA4PG method: You can't really hurt anything by giving this a try. It will be easier to work on your amp if you do it this way. If you mess it up, the other way just cuts out the chassis anyway so you haven't got anything to loose by trying this. I found it works quite well.
13. Completely remove all components surrounding the old tube sockets, and tag the brn, org, wht/blu, yell, grn and filament wires as in step 6 above. Save the old parts for re-use where applicable.



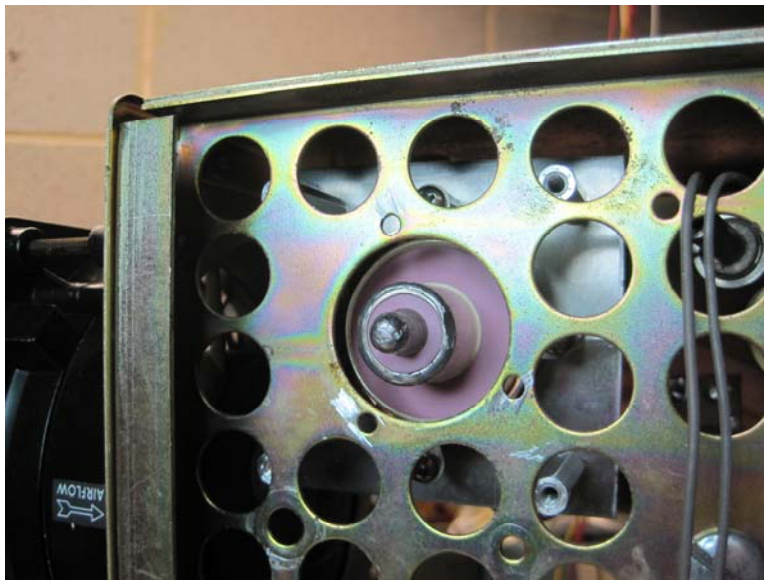
Old Components Removed from RF Deck

14. Pull back the old filament wire (double solid wire in yellow canvas sleeving) and green wires and connect to each other with a butt splice. Run extra lengths of wire along wiring harness bundle to take up the slack. This will connect the old filament voltage to the Amperite delay relay.
15. Cut off the socket rivets from the bottom with a dremel cutter wheel. Punch out the rivets with a punch and hammer from the bottom.
16. Remove the old tube sockets.
17. Carefully disassemble the K4POZ tube sockets. Remove the screws, $\frac{1}{2}$ " spacers and circuit board from the bottom. On the top section change the long $1\frac{1}{2}$ " #6 screw that goes all the way through the 1" spacer to a shorter $\frac{1}{2}$ " #6 screw and put the 1" spacers back on with the $\frac{1}{2}$ " #6 screws from the top.



Top Half of Socket with New Short Screws

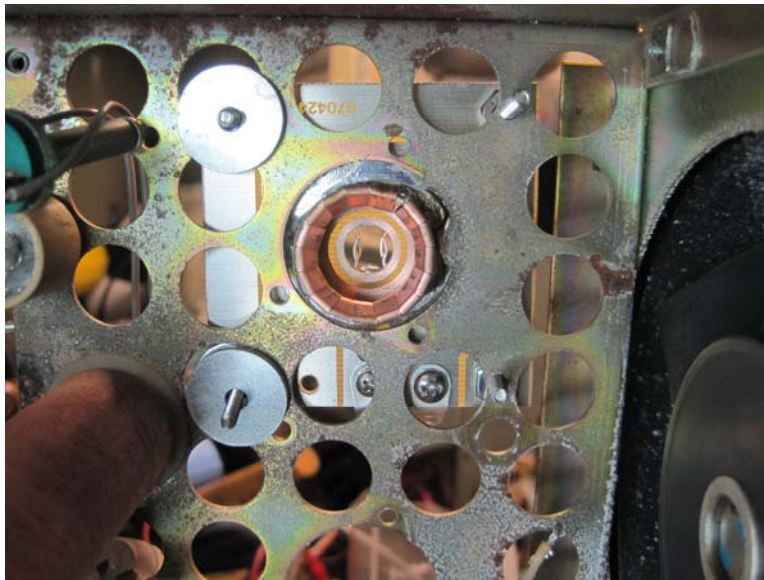
18. Remove deflector shield from old muffin fan to free up room for the 6I7B tubes.
19. Move thermal sensor $\frac{1}{2}$ " forward to make room for the tubes (or just unscrew it for now and move it later).
20. This is where things get a little tricky. Put a 6I7B in the top half of the socket, and hold it and the top half of the socket centered in the old 8875 hole. From the bottom you will find that most of the holes do not line up with a solid part of the chassis. Some are right over the holes in the original chassis. You will need to fabricate some rails to patch up the chassis so the tube sockets have something to mount all four holes to. Alternatively, you can use the two holes that do line up with chassis material, and put a small fender washer over the top of the holes that do not line up, and fill the gap with spacer washers. I found using the fender washers to bridge the gap was much easier and faster than building a rail.



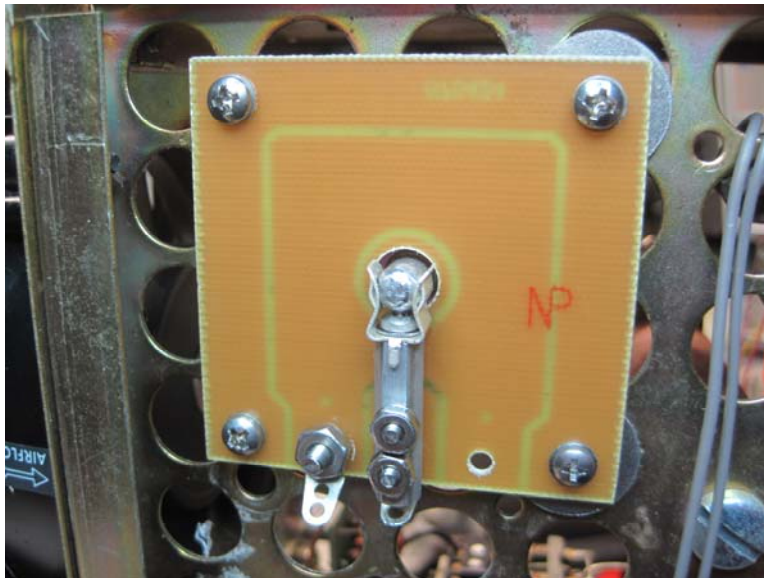
Top Half of Socket Held Over Chassis

21. The total thickness of the K4POZ socket's space between the bottom and top half was around 4mm, the thickness of the nut and two washers that you removed. The Dentron chassis is about 1.5mm thick, so these new "rails" need to be made of a material around 2.5mm or 3/32" thick. This is 12ga steel or 10ga aluminum. There is a little room for play here, as long as you don't exceed the distance that the filament pin of the tube will no longer contact the socket pin. Fabricate two "rails" along the entire length of the RF deck area for both the front and rear sides of the tube sockets, and mount to the Dentron chassis. If you don't use the rails, use a #8 nut as a spacer to fill the gap that the rail would have filled, on the top of the circuit board at each screw hole.
22. If you use the rails, cut away any area of the rail that will intrude on the part of the circuit board that will mount against them that could touch the cathode (marked K) plating on the tube socket PC board.
23. With the rails mounted to the chassis, carefully line up the PC board so that the cathode ring is exactly centered and mark the holes to drill from the bottom. The

- holes will continue through the main chassis and the screw will go in the 1" spacer that is part of the top section of the socket. The rear holes will line up with chassis material and be OK. The front holes will be right over a hole in the main chassis, and will need a few stacked up washers to take up the 1.5mm thickness of the chassis. If you don't use the rails, line up the PC board and mark and drill the two holes that do line up (the rear ones). Start small, and work your way up to a 9/64" hole.
24. Reverse the cathode lug on one of the tube sockets so when they face each other, they can be soldered directly together. Bends all lugs so they face down instead of the up.
 25. Cut 1/8" off the bottom of TWO of the 1" spacers on the top section of the socket with a dremel tool, to allow for the thickness of the fender washers on the front two screws where there is no chassis support.
 26. When all looks good, mount both tube sockets with 3/4" #6 screws into the top section of the socket. Remember to take up the slack of any mounting screws that ended up in a hole of the original chassis. If you are not using rails, use a #8 nut as a spacer on the rear holes that do have chassis material, and use two #6 washers and a 1/8" fender washer on the front holes, and a have fender washers on the top to cover the hole. It is difficult to hold all this hardware in place, it takes 6 hands, but can be done. Put the bottom PC board on first, making sure none of the spacing hardware falls off. Add two 1/8" fender washers to the top of the front holes, and screw on the top section of the socket.

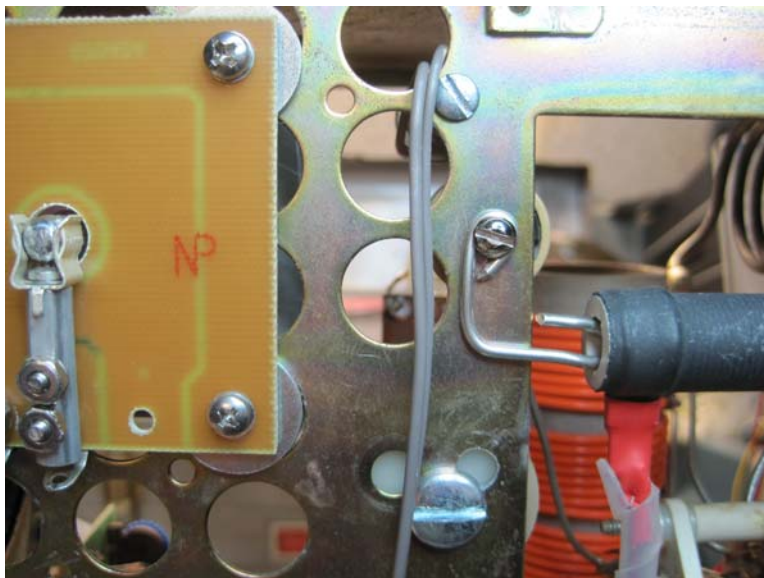


Bottom Half of Socket in Position with Fender Washers (View from Top)



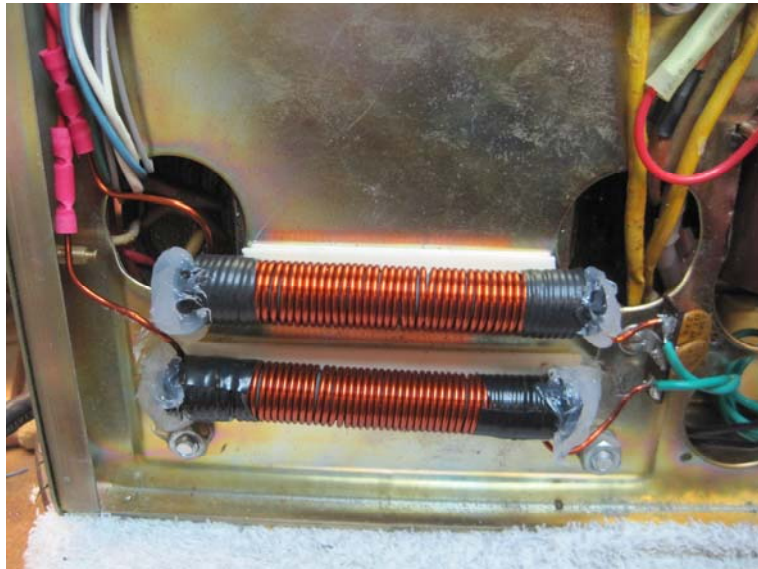
Completed Socket Mounting with Fender Washers (no rails)

27. Ohm out the cathode and the filament to ground to make sure none of the rails shorted the cathode to ground because you didn't remove enough material and it shorted on the PC board. This is important – if this goes to ground while the amp is turned on, you will go to maximum plate current and melt down fairly quickly if you don't recognize that condition and leave the amp on for more than a couple minutes.
28. Move the plate choke forward about 1/4" to give more clearance between it and the edge of the tube socket. You want it equal distance between the edge of the tube socket and the orange wire on L2. It needs a 1/4" hole so be sure you drill it in several smaller steps, and vacuum out the shavings when you are done.

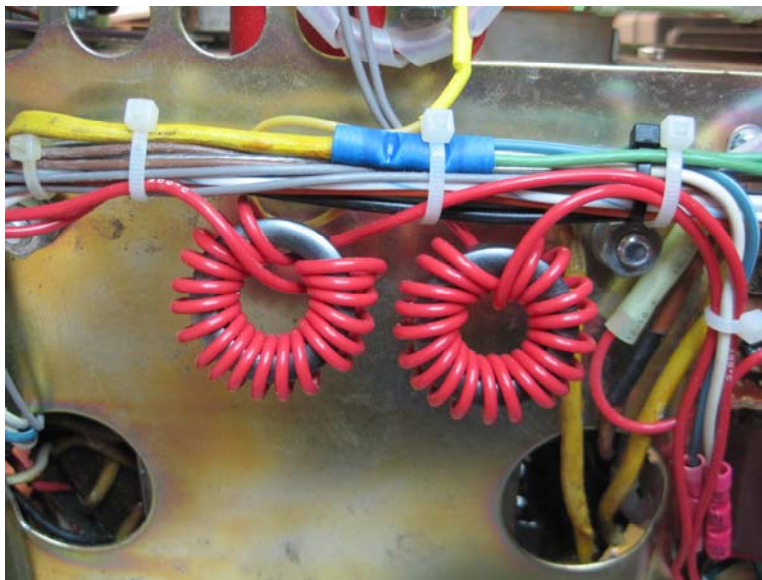


New Plate Choke and Thermal Switch Mounting Locations

29. Mount the filament choke along side the metal plate (see picture). You can do a winding on two ferrite rods, or use AA4PG's method with two Amidon FT114-43 torroids with 20 turns #16 wire each as the filament chokes. I suggest two single windings on two rods using two Amidon filament choke kits. I had hum and some other problems with the torroids so I removed them and went with the rods.

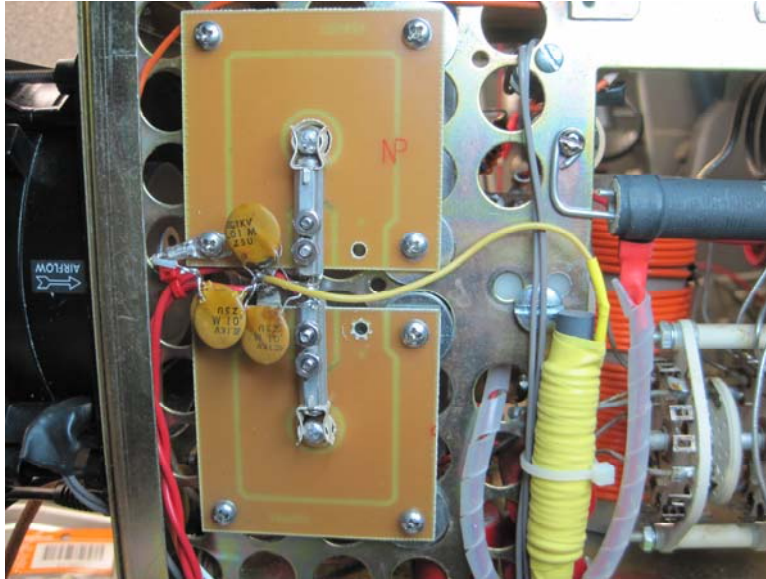


Filament Choke using Amidon Rods



Filament Choke using Torroids

30. Fish the new filament wires into the socket and connect along with the filament bypass caps (.01uf each socket). Fish the bias, grid meter and RF input wires into the sockets and connect.

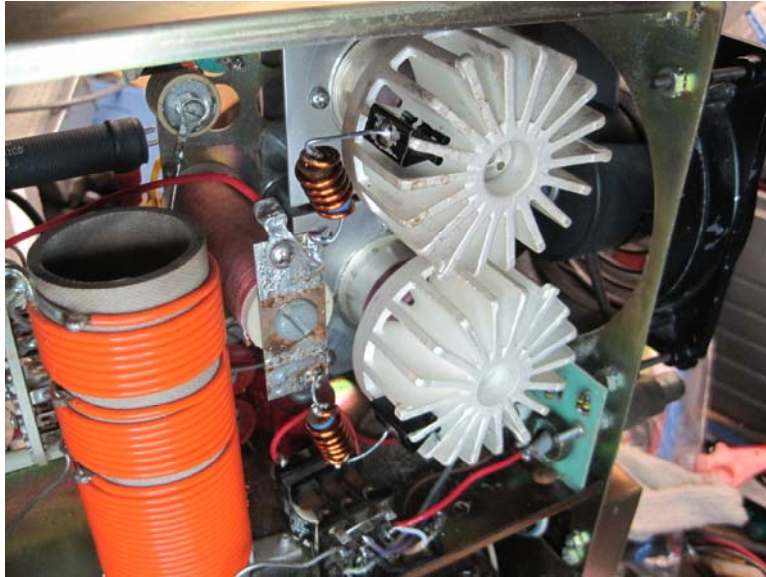


Completed Socket Wiring and B- Choke

31. Once the filament, bias and RF in wires are fished above the new plate, remount the plate and mount one of the sockets. I chose to mount the outboard socket first. Reverse the cathode pin to the other side on one of the sockets, so their two terminals will be a mirror image and be able to be soldered on top of each other. Make all the wiring connections to one socket so there is room to work. Then the second socket can be added and simply solder it's terminals in parallel to the first socket, which is already wired up. Also consider removing a little of the top plate material from both sockets where they face each other, above the terminal strips, to allow access to the two terminal lugs to solder the second socket's lugs on top of the first one when you do the final mounting of the second (inboard) socket.

Remount Power Sensor Board and Install New Antenna Relay

1. Move the 100ohm RF input resistor and the small black RF input coax out of the way.
2. Remount the power sensor board on a small L-bracket and attach it closer to the SO-239 output connector to allow room for the GI7B tubes and the antenna relay. Remove the adjustment potentiometer and replace with a fixed resistor since there is not enough room for the pot any more.



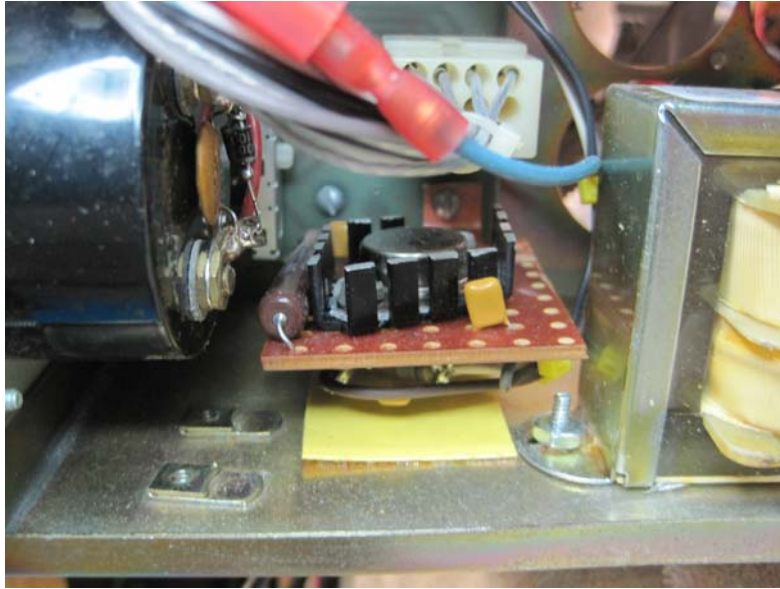
Relocated Power Sensor Board and Antenna Relay

3. Obtain a 12vdc 3PDT relay with 10A contacts in the smallest possible package you can find. Alternatively, you can use separate SPST relays and wire three of their coils together.
4. Attach the new antenna relay to the side wall so it will clear the GI7B tube heat sink. Space is tight, so you will have to play around with the locations of the relay and the power sensor to get the best clearance you can.
5. Reconnect the relay coil leads. The clear wire is +12V and the brown wire is from the PTT jack on the rear of the amplifier. I did not see the need to use the TIP-32C keying transistor but you can if you wish.
6. Wire the violet wire to the control relay coil to be grounded by one of the antenna relay contacts when it is keyed. This allows the antenna relay to make before the tubes are turned on to help prevent hot switching. On the original Dentron schematic, both were keyed together.
7. Wire the RF paths from the input and output RF jacks, the power sensor output, and the GI7B input coax as shown in the schematic.
8. Test the relays by applying 12v from a bench power supply. Connect +12V to the clear lead, and the power supply ground to chassis ground. Key the antenna relay by grounding the relay key jack on the back of the chassis with a clip lead to chassis ground. The antenna relay should key and the red transmit lamp should come on, and then look at the control board relay to make sure it is keying too. Ohm out the RF paths to make sure you have those correct with the relay keyed and unkeyed.

Bias Modifications

1. Build bias board shown in drawing. I used a 30v 1 watt zener and a pass transistor. Be sure to heat sink the pass transistor as the GI7Bs draw around 1 amp of bias current. See schematic for a bias board schematic using a NTE-388 transistor, and a 27 or 30 volt zener.

2. Mount the bias board between the plate meter and the filament transformer, on a small L-bracket mounted to the screw that holds the metering PC board.



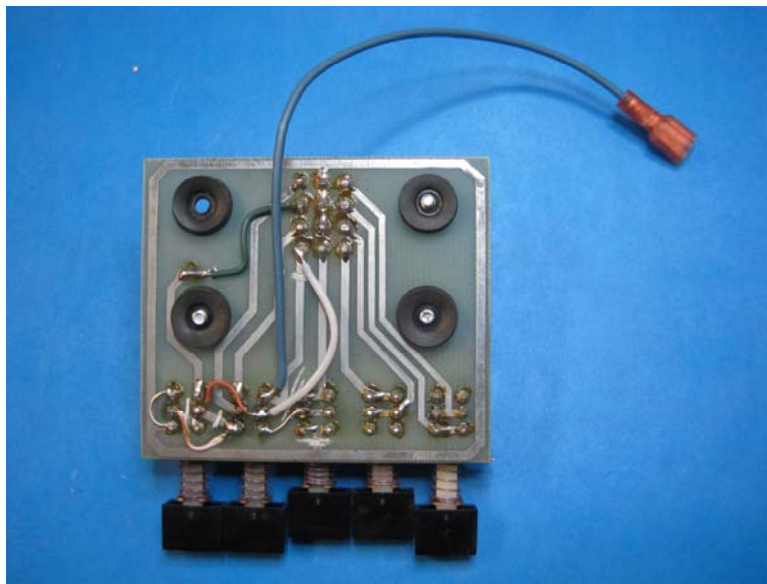
Bias Board

3. Prepare a .05 ohm shunt (use two .1 ohm 2w resistors in parallel) to ground and the ground side of bias board (2x).
4. Connect wht/blu wire (grid meter) to ground side (2x) of bias board.
5. Connect brown wire (B- to tube via control relay) to the hot side (1x) of the bias board.
6. Remove RFC4 from the ALC board. Move the yellow (B-) wire from terminal 4 of the board to the lower solder pad where RFC4 was removed from, connecting it to the top terminal of the fuse. Remember that you constructed a new B- choke, so it is OK to discard RFC4 (or use it as your new B- choke)..
7. Remove the 47K 2W resistor from the plate meter shunt terminal strip and save it for step 8 below. Disconnect the brown wire (unused) and tape it off (now unused, from the control relay NC contact).
8. Run a new wire from the bias board hot side (1x) via the 47k 2W resistor (salvaged from the terminal strip where the brown wire was) to the same position (bottom of where RFC4 was).

Metering Modifications

1. Replace the shunt terminal strip with a slightly larger one (6 position). Obtain a .05 ohm shunt (two .1 ohm 2w resistors in parallel will work) and re-wire the shunts as shown on the schematic. Re-use the original .0462 shunt as the plate shunt (SH1) and use the new .05 ohm as the grid shunt (SH2). The correct values for the .05v meter are .05 ohms, but the .0462 shunt takes account the slight resistance of the wire. Since it is unlikely you will find another .0462 precision resistor, use .05 and it will just have to be close enough. This is the tradeoff when you use very low value shunts and no meter multiplier resistors.

2. Reconnect the B- (white wire) to the plate shunt, and run a new wire from the grid shunt to the bias board ground side (2x) and to the grid metering wire (wht/blue). Note it is probably easier to connect all these wires (grid shunt new wire, grid meter white/blue) on the bias board pass transistor emitter lead on the TO-3 socket.)
3. Rewire the meter board as shown on the schematic. I found it easier to leave the meter + lead on pin 12, and cut the foil going to pin 12 to isolate it, then reconnect it to the plate current common switch. Run a new wire to the plate shunt and connect it to the NO of the plate current switch (same place pin 12 used to go). You can either solder the new wire on as a flying wire, or put a male molex pin on it, cut the foils to one of the unused ground pins (2 or 5) and connect it there, putting a jumper between ground and the remaining grounded pins. Cut the foil between the grid current common and plate current off switch, and re-wire it from the grid current right side common and the plate current off switch right side. This properly connects the meter ground to the low side of the plate shunt instead of chassis ground when in the plate current position. (If it were on chassis ground, it would be going through both shunts and reading too high.)



Metering PC Board with Modifications

4. Some MLA-2500s had a grid shunt wire on pin 6 (wht/blu) and some did not. If yours has the wire, leave it there. If it does not, run a new wire to the grid shunt (connected to emitter of the bias board pass transistor on the TO-3 socket, same place as in the above step) and connect it to pin 6. Then run a jumper on the meter board from pin 6 to the NO pin of the grid meter switch (should be obvious where this jumper goes. See the **corrected** meter switch drawing for the details for all of this. Do not use the original Dentron or W4ZT drawing for the meter switching – it is incorrect and the grid meter will read backwards. Only use the corrected N3OC drawing.
5. If you did all this correctly, the meter circuit is now reconfigured to read the plate and grid current properly without reading the plate current added to the grid

current and visa versa. It will be 1000ma full scale for both plate and grid current. (Some prefer 100ma full scale grid current, but the 6I7B's are a more tolerant than the 8875's were, so I am OK reading 200-300ma on a 1000ma full scale meter.)

6. Complete the fault-current circuit by adding a 1N5408 3A diode across the B-side of the plate shunt to ground, with the anode grounded. Connect a .1uf 50V disc capacitor across this diode. Find the largest disc cap you can but DO NOT go over 50 volts. This is a fault component that we want to short out if the voltage goes to high, but we don't want it to blow open which is why the largest physical size you can find is best. The idea of these two components is that they will handle the fault current flowing through the 25 ohm glitch resistor in the event the plate shunt fails. You will have three devices that might handle the fault current – the plate shunt, the 1N5408 diode, and the .1uf 50v disc cap. Between the three, that ought to handle the fault current (88 amps by the way) until the line fuse blows in the event of a B+ short.

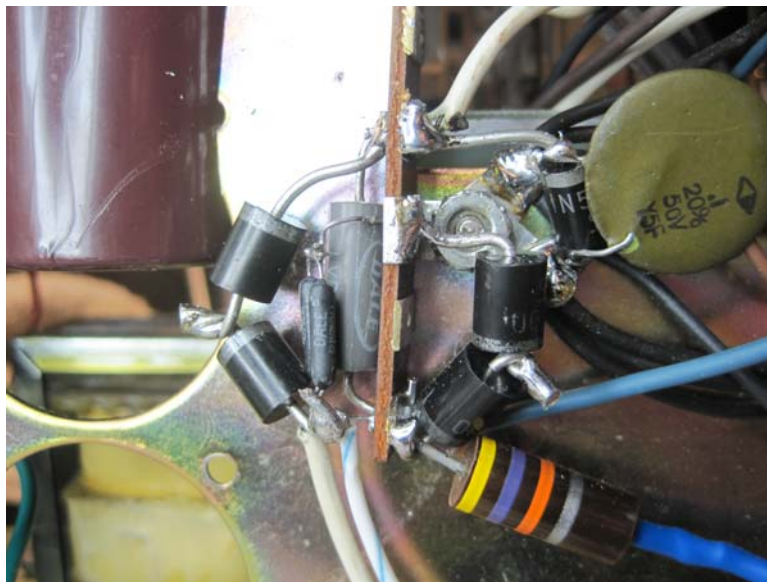


Plate Shunt, Grid Shunt, B+ Fault and Meter Protection

7. TEST and calibrate the meter circuits as follows. Connect a bench adjustable power supply with an ammeter in series with it, with the positive lead going to the chassis, and the minus lead going to the grid shunt. Set the power supply current limit to slightly above one amp if you can. Put the meter circuit in the grid position, and carefully increase the voltage until you see some current flowing. Make sure the meter never hard pegs – it only takes .05 volts to peg it – and increase the current until you see 500ma flowing through the shunt. The grid meter should read approximately 500ma also. Mine read 550ma with the .05 ohm shunt, and that's close enough. I did not see the need to put in the calibration pots because it was pretty darned close.

NOTE: On my final meter calibration, on the grid shunt, 500ma read 650ma on the meter. On the plate shunt, 500ma read 450ma on the meter. So I felt the need

to calibrate the grid shunt a little better. I added a 5 ohm in series with the grid meter (instead of the 330 ohm and the 1k pot shown on the drawing) and that calibrated my grid meter perfectly. I felt the plate was close enough being only 50ma off so I left that alone, and it did not have the 330 ohm resistor nor the 1k pot either.

8. Turn off the power supply, and move it to the plate shunt by connecting the minus lead to the B- and plate metering circuit side of the shunt (white wire) and the positive side of the power supply to the other side of the shunt, at the junction of the plate shunt and the grid shunt. Put the meter in the plate current position, turn on the power supply, and increase the voltage again until you see 500ma of current flowing through the ammeter. The meter should read 500ma also. Mine read 450ma with the standard Dentron .0463 plate shunt, which was close enough for me to not worry about the calibration pots.
9. If you need more info on amplifier metering, google "W8JI amplifier metering" and you will find an excellent write up on how this all works.
10. Finally, install the safety diodes across both shunts, as shown on the schematic and the picture above. I feel that two 6A diodes are sufficient here, as the Dentron shunt voltages are so low since they use very low shunt values, and no meter multiplier resistors.
11. Install two back to back diodes (1A diodes should work fine here) across the meter movement to protect the meter.
12. Recheck the metering with the power supply after you install the diodes to make sure everything works OK.

Install Step-Start Board (optional)

1. Being the MLA-2500 uses a voltage doubler, a step-start is really not necessary and entirely optional. But it does make a smoother turn-on without a big "thunk" when you power the unit up, so feel free to install one if you desire. The Harbach Electronics SS-100 step start board is ideal for this application, and tucks in neatly behind the transformer in the corner where the AC mains come in. I did this on the first couple conversions I did, and have stopped doing as it as I really don't see the need.
2. Make a plastic cover for the step start board out of something like a piece of a for sale or no trespassing sign from Home Depot, cut it out and fold it over the step start board, and tape it closed.
3. Activate the step start board by connecting hole F on the Harbach board to terminal 3 on the Dentron AC primary terminal strip (provides 110v to turn on step start). Then remove R26, bus A & B together, and bus C & D together (we are only going to put the step start in one side of the mains line) and connect A & C to a cut you will make in the mains line from the power on/off switch to the transformer primary (terminal 2 on the Dentron AC primary power strip).

Tuned Input

Your amp will likely benefit from a tuned input if you are using a solid-state exciter, especially one without a tuner. If you are having problems getting full output, and the grid current is low, you probably need a tuned input.

There is just not room to put one inside the MLA-2500. My solution has been to build a switchable tuned input circuit in a box external to the MLA-2500, and connect it to the input with as short a cable as is possible. You want it to be as close to the cathode as you possibly can.

Dentron used to make such a box called a CM-1 or CM-2, but they are very hard to find these days. So if you are having input problems, you will have to build your own.

See the separate document on my web site that describes how to build a tuned input box for your MLA-2500.

Suggested Start Up Checks

1. Of course you could just turn it on with a stick and see if the damn thing blows up. But I prefer to check things out incrementally and carefully. I usually am checking as I do the conversion, up to the point it is so torn apart you can't turn it on any more.
2. Start with checking the filament circuit. Temporarily disconnect one leg of the filament transformer. Ohm out one side of the filament terminal strip to check for continuity to the filament pin on both GI7B sockets. Then ohm out the other side of the filament terminal strip to check for continuity to the cathode ring on the GI7B socket. Next ohm across both sides of the filament terminal strip (with no tubes plugged in) and you should see an open.
3. Now plug in one tube at a time. The GI7B filament is around 4 ohms, so with one tube plugged in you should see 4 ohms, and with both tubes plugged in you should see around 2 ohms.
4. Now disconnect the ohm meter and connect a 12vdc power supply across the filament terminal strip and run the filaments. See that both tubes get warm.
5. When you are satisfied the filament circuits are OK, reconnect the lead of the filament transformer that was unhooked for testing.
6. Put an antenna analyzer on the RF input and key the antenna relay by putting 12vdc on the clear lead, ground the chassis, and key it from the rear jack. Check for reasonable SWR on the RF input to the tube with the antenna analyzer. It won't be perfect, but should be acceptable (2:1 or less).
7. Double check all wiring for errors.
8. Next, put the meter switch in the high voltage position and turn the amp on **OBSERVING ALL HIGH VOLTAGE PRECAUTIONS**. (I turn it on with a stick from a distance!). Check the meter for the correct high voltage (around 2kv).

9. Verify the amperite relay comes on after a couple minutes and the green ready light comes on.
10. Check the grid and plate current meters and verify they are zero which indicates the tube is properly biased off. If you see plate current or the tubes start to get hot with no drive turn it off immediately and double-check all the bias circuits.
11. Key the amp and verify the plate current goes up just a little. I had a 30v zener in mine initially and got 25ma when keyed. It probably needs a 27v or 24v zener for about 50ma when keyed.
12. Measure the DC bias voltage when keyed on the collector of the bias board pass transistor to verify it matches the zener you have installed. Consider tweaking the zener value to obtain around 50ma when keyed with no RF drive. (Mine works fine with 30v so don't worry too much about this.)
13. Apply 30w drive and see if the amp tunes up and makes RF, and test on all bands. It is normal for the tuning to be sort of "dead" on 160, and very touchy on 10m. That is due to the low values of air variables Dentron used, and the large amounts of parallel switched in capacitance on the low bands. The input SWR will not be perfect, but should be around 2:1 and that should work for most rigs. Otherwise, use the rig's tuner.
14. The 6I7Bs do not need normally 100w drive, assuming you removed the 200 ohm swamping resistor from the input. Mine seems to rock and roll with 60-70 watts of drive. Try to keep the plate current below 800ma not so much for the tubes but for the power supply.
15. If you mounted your sockets with the plate subchassis, It may be necessary to trim the rear feet bolts and thin down the nut on the tube side of the amp. They may protrude in to the mounting plate for the tube. Just add some small lock washers on the plastic side of the screw (about 4-5 of them) to shorten it, and grind the bolt down to about 1/2 its original width till the bottom cover will go on correctly. This should not be a problem if you used the fender washers and the original chassis holes.

Troubleshooting

1. Hum on your transmit signal, especially on the low bands - check the filament chokes first. They may not be large enough, or may have coupled other signals in their wires. Twist the wires, and route them away from other wires.
2. Plate current when not keyed and tubes getting hot when not keyed – turn the amp off immediately and troubleshoot the bias circuit! Check for a short to ground at the cathode, which will run the tubes at full current and burn things up in just a few minutes.
3. Poor input SWR – First, check the filament chokes. Then try building and using the tuned input box, especially if you are using a solid-state exciter.
4. Green ready light never comes on – check that the old 6.3V filament winding is still good on the transformer, and check that the Amperite relay is not cracked or has come out of its socket. If those are OK, check the original 12v winding and rectifier diode on the transformer.

5. Not much tuning range on 80 & 160 – this is kind of the nature of the beast. There are several thousand pf of parallel switched in capacitance, and only 500pf of air variable adjustment, which is nothing on 160 meters. See the steps above on adjusting the parallel switched in capacitance on 80 and 160 meters and how to measure the resonance of the tank circuit.

WARC Bands

Be very careful using this amp on the WARC bands. You really need to know the resonant points in your plate choke before you do, otherwise your plate choke might blow up. The compact nature of the MLA-2500 precludes winding with gaps, or using a larger plate choke, so this is a real problem with a 3" plate choke. They are probably going to be somewhat resonant near 12 meters and 17 meters, so be forewarned! My plate choke has it's primary resonance at 24.8 (12 meters!) and it's lesser resonance at 16.5 (OK).

See W8JI's web site for information on how to measure your plate choke resonance. You will need a MFJ-259 antenna analyzer, a light bulb, a dummy load, a coaxial tee, and a rig that is unlocked and can transmit out of the ham bands. I did the mod on my IC-706 to allow it to transmit out of band into a dummy load for this test.

Observing all hi voltage precautions (unplugged, turned off, caps discharged), disconnect the paper clips from the tubes, and remove the wire going to the tank circuit RF output from the top metal bar on the plate choke. That will disconnect everything from the top of the choke. Leave the metal bar on the top, and the parasitic suppressors can just hang loose for now. Leave everything connected from the bottom.

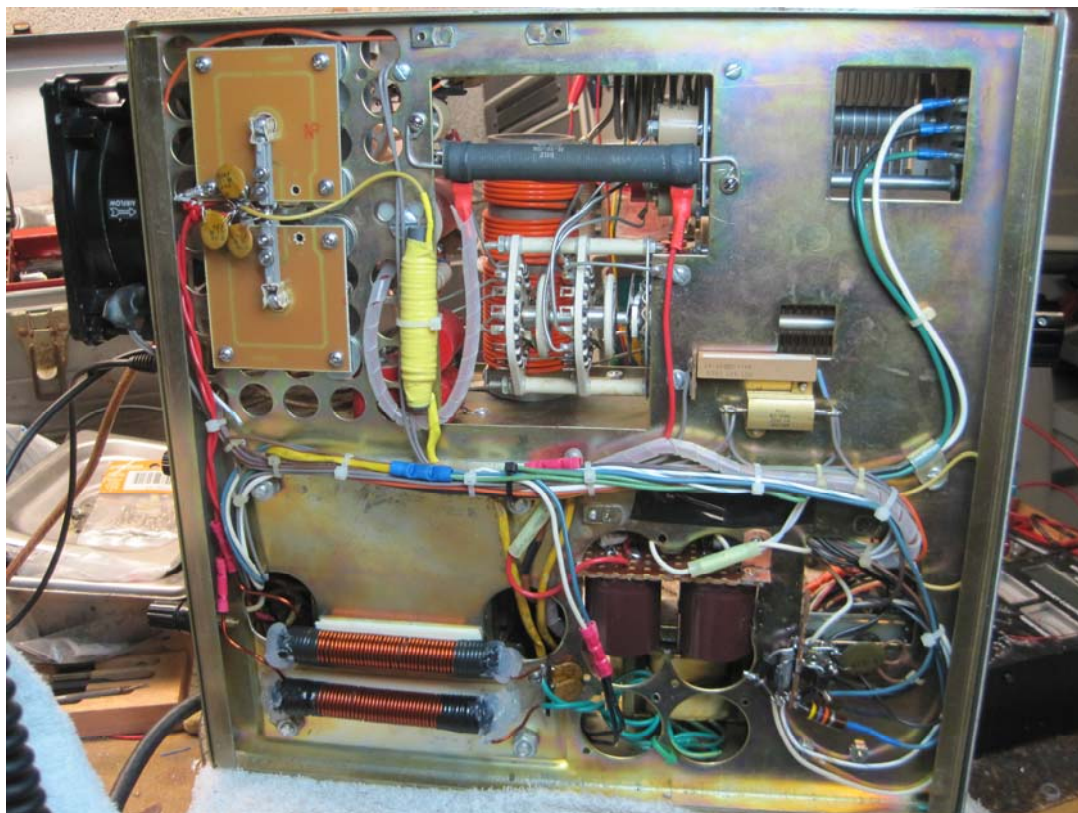
Set up your radio as shown on W8JI's web site. The transmitter goes through the tee to a 50 ohm dummy load, and the output power is set to 10-20 watts. The tee is connected one side to the B+ going to the bottom of the plate choke, and the other side to a 12v light bulb. The other side of the 12v light bulb is temporarily soldered to the top bar on the plate choke via a very short lead. Tune around and look for the bright spots in the light, those are the resonant points. Keep power reduced to the minimum amount to light the lamp, which will increase accuracy. Also nearby metallic and even plastic objects near the choke affect this, which is why you test it in place. And remember we moved it, and there is no good clear spot to put it inside the compact amplifier.

You will probably find, as I have, that the compact plate choke is not good for 12 meters. Having said that, I have used it on the WARC bands, but I usually turn the power way down to the 400 watt range on 12 meters when doing so. 17 meters should be OK.

There is a possibility to move the resonance down a bit, but you generally want 2mhz between a resonant spot in the choke and where you will use the amp. However, if you are diligent about reducing the power, you may be able to get by with a lesser amount. Your mileage may vary here.



Completed Conversion – Top View



Completed Conversion – Bottom View

Parts List

- 2 GI7B tubes - from eBay
- 2 Tube sockets - from K4POZ
- 1 Step start board, Harbach Electronics SS-100 (optional)
- 1 Filament transformer, 12V 4A Hammond 266N12 (Mouser 546-166N12)
- 2 6A 200uh Filament chokes - wind on Amidon ferrite rod kits (Amidon FLC-10)
- 1 B- choke 30uh (approx. 36 turns on 10mm ferrite rod Amidon R61-037-300)
- 6 390uf 450V electrolytic caps 45mm length (save bleeder resistors from original caps) (Mouser 661-EKMM451VNN391MA4)
- 1 Glitch resistor, 25 ohms 50W (Mouser 71-HL50-15N-25)
- 4 1N4002 meter protection diodes (2 for each meter)
- 4 6A100 diodes for shunt safety diodes
- 1 1N5408 diode for B- safety
- 1 .1uf 50v large disc cap for B- safety
- 2 .1 ohm 2w resistors in parallel to make .05 grid shunt (Mouser 71-RW80UR100F)
- 2 1k pot Ig & Ip calibration (optional, not needed)

bias board parts:

- 1 NTE-388 transistor (Mouser 526-NTE388)
- 1 TO-3 socket (Mouser 534-4515)
- 1 TO-3 heat sink (Mouser 532-501603B00 trimmed shorter with dremel tool)
- 1 15k 10w resistor (Mouser 588-20J15KE)
- 1 47ohm 2w resistor (Mouser 756-EMC2-47R0K)
- 1 25-30v 1w zener (30v Mouser 78-1N4751A-TAP)
- 3 .1uf 500v caps bias filtering (re-used old ones in amp or Mouser 80-C330C104KCR)
- 1 .02uf input cap, need voltage (re-used old ones 2 X .01 in amp)
- 3 .01uf 1600v filament & bias bypass caps (re-used old ones in amp)

- 1 B+ bypass cap .001 6kv (Mouser 75-564R60GAS10)
- 2 paper clips for plate connection
- 2 parasitic suppressors, 100 ohm or 62 ohm 2W resistors with 5 turns #16 wire
- 1 TIP-32C keying transistor PNP (optional)
- 1 antenna relay 12v 3PDT

