K5AM k5am home page k5am amplifier page

Raytrack 50 MHz Amplifier; modifications.

Posted on:vhf@w6yx.stanford.edu, 1997 Aug 29.
Revised, 2012 Feb 1.

These are merely very rough notes on recent mods. The notes are in random order. Some plans for work that might be done later are also noted. Comments and suggestions for solutions to the remaining problems will be appreciated. The amp was obtained as back-up for the DM54 Horse Mountain contest site.

A. Power supply

1. Attached handle to top. Replaced diode/capacitor board spacers with fixed-to-board threaded spacers.

2. Replaced each diode string (original 6 x 1N4007, 1 A, 1 kV, 30 A surge) by 10 x 1N5408, 3 A, 1 kV, 200 A surge. More important than the current rating or the total voltage rating may be the peak surge current rating, so step-start may not be needed. The amp arrived with 6 x 1N4005 - only 600 V each. These shorted out during the initial test.

3. Turn on amp in SSB mode. If turned on in CW mode, the primary relay will arc badly.

4. Plan: use CW primary relay for a step start circuit. CW tune-up is not needed if pulse tuning is used. Pulse tuning at 33% duty cycle works well. (Design Notes for "A Luxury Linear" Amplifier, QEX, November, 1996, 13-20.)

5. Deleted 3 x 2.7 ohm 1/2 watt resistors in HV lead in

power supply. Limiting resistor added in RF deck; see note B4 below.

6. Changed 2 x 18 ohm 2 watt resistors in negative lead in power supply to one 10 ohm 10 watt.

7. Removed line cord ground wire from questionable ground at nylon cable clamp and connected to chassis.

8. Plan: Replace sluggish circuit breakers with fast acting fuses.

9. In-rush protection, Keystone Carbon CL-10, 12 amp, Digi-Key KC001L.

B. RF Deck

1. Eliminated cabinet jamming problem (caused by screws which hold feet). Removed feet, attached stick-on feet 1/4 inch high to same spots. Plan: Find 1/2 inch plastic feet with space for nut inside foot.

2. Found one cause of arcing and power supply failure. Noted severe arcing burns between corner of HV shorting interlock device bracket and HV connector hardware. Removed interlock; spring was broken anyway, so it was non-functional. (**Warning:** *Do not remove interlock; this could reduce the number of live 6 meter operators by one, and I need your grid square.*) Plan: Install a good interlock. Always disconnect all cables before opening any amp. Then use a shorting device. My favorite method is to keep my eye on the plate voltage meter while I switch the amp off, watch the meter *decay to zero*, and immediately pull the line plug. The 220 outlet is at the front of the workbench in a prominent place where it cannot be overlooked.

3. Replaced over-long HV connector hardware with proper sized hardware. Cleaned burns from connector.

4. Added HV limit, 20 ohm, 10 watt, on rear panel between tubes. Used 1/2 inch ceramic spacers, nylon hardware, and solder lugs.

5. Replaced parasitic suppressors. Amp arrived with original suppressors missing, and wrong type installed, which burned up in 5 seconds. Used 4 x 0.375 x 0.010 inch brass strips with 68 ohm carbon composition resistors. Amp is absolutely stable and resistors show no signs of overheating.

6. Plan: Move screws on deck which prevent chimneys from seating fully on deck.

7. Replaced steel hardware in plate tank circuit with brass.

8. Removed one blocking capacitor. One is enough, and the parallel connection of two may introduce parasitics.

9. Added 10 ohm 2 watt resistor in lamp ground lead to increase lamp life.

10. Modified grid metering circuit to protect meter from burn-out. Circuit on request.

11. Relay is 12 VAC, incompatible with solid-state control from transceivers. Added DC PTT circuit. Circuit on request.

12. Replaced one chimney.

13. Replaced tubes.

14. Sealed leaks in presurized grid compartment with filament tape and hot glue.

15. Checked meter calibration. Replaced shunt.

16. Plan: Replace bias diodes; 1N5408. QUESTION: Why should the Raytrack have less bias and more idling current than similar amps, such as the SB-220? The Raytrack does very closely meet the Eimac specs for idling current. Why do others get by with less?

17. Added in-rush protection for filaments; Keystone Carbon CL-90, Digi-Key KC009L. This is very easy if amp is wired for 240 V: removed strap at terminal block and attached device in place of strap.

18. Plan: Add filament transformer primary fuse, 2A.

19. Plan: Add cathode fuse, 1 A, in series with relay

contacts.

20. Added 100 ohm 1/2 watt and 0.01 disc in series across relay coil to protect new PTT circuit.

21. Note: output 1250 watts.

C. Grid Metering Mod

NOTES ON RAYTRACK 6M AMP GRID METER CIRCUIT MOD

Mark Mandelkern, K5AM 3 November 1998

1. The purpose of this mod is to prevent grid meter burn-out in the event of tube arcing or PA circuit malfunction.

2. In the schematic on page 2, the grid current flows through the 1 ohm resistor. 5W is of course much more than needed; this sort of overkill is common in meter circuits, since an open resistor would result in instant meter burn-out.

3. The grid meter indicates 400 mA full scale. We calculate with this max, even though we don't run that much grid current.

4. At 400 mA, the shunt develops 0.4 volts. I don't remember measuring the meter resistance or full scale current, but a calculation from the original circuit (with a 0.2 ohm shunt) gives about 80 ohms, assuming a 1 mA meter. To develop 1 mA from the 0.4 volts we need about 400 ohms in the meter line. This means then about 320 ohms for the multiplier.

5. One can easily check the meter calibration after the mod is done, using a bench supply on a COLD amp, with power supply cord and line cord BOTH disconnected. Just run 400 mA through the 1 ohm shunt; no wires in the circuit need be broken during calibration.

6. The change in the plate shunt in the power supply to 10 ohms 10W is important.

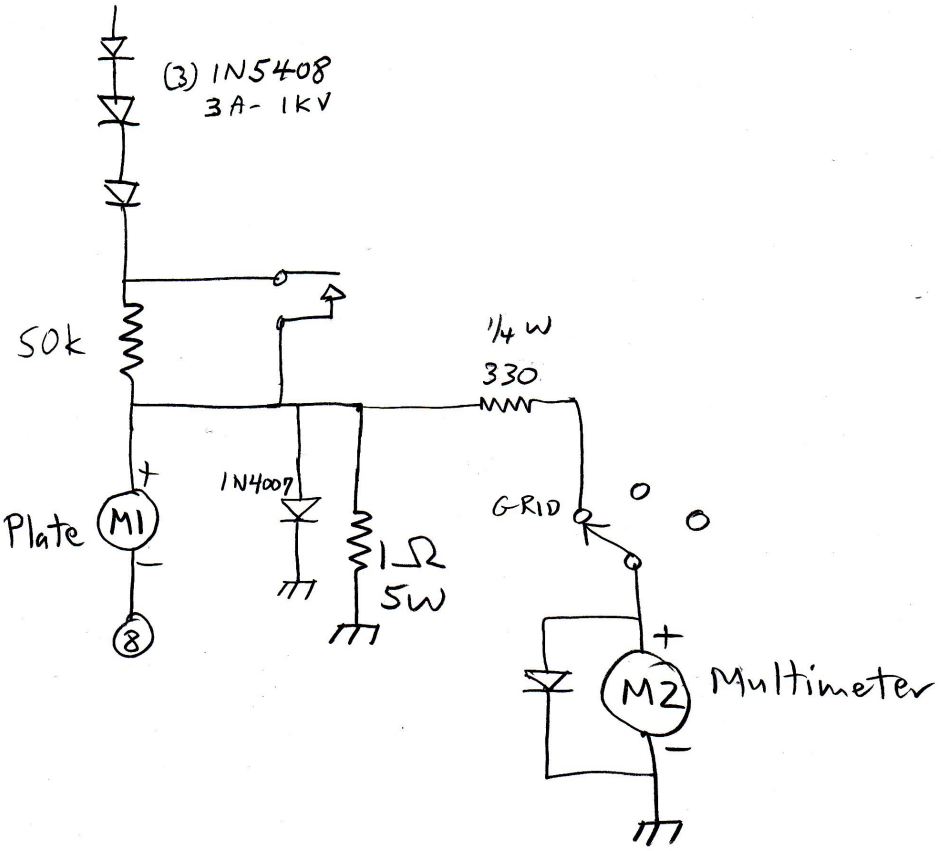
7. The upgrade of the bias diodes is important.

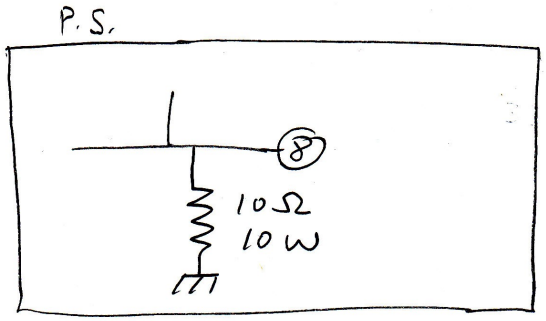
8. The 1N4007 limits the drop in the grid shunt to about 0.7 volts. This limits the meter current to less than 2 times full scale, which it can survive. The scheme can be modified to provide closer limiting, but the diode can start conducting as low as 0.4 volts, so meter error could result.

9. On page 3 is a notebook sketch of the terminal strip mods. Wire colors may vary.

K5AM RayTrack

Grid Meter Mod.





97/8/18 m.m.

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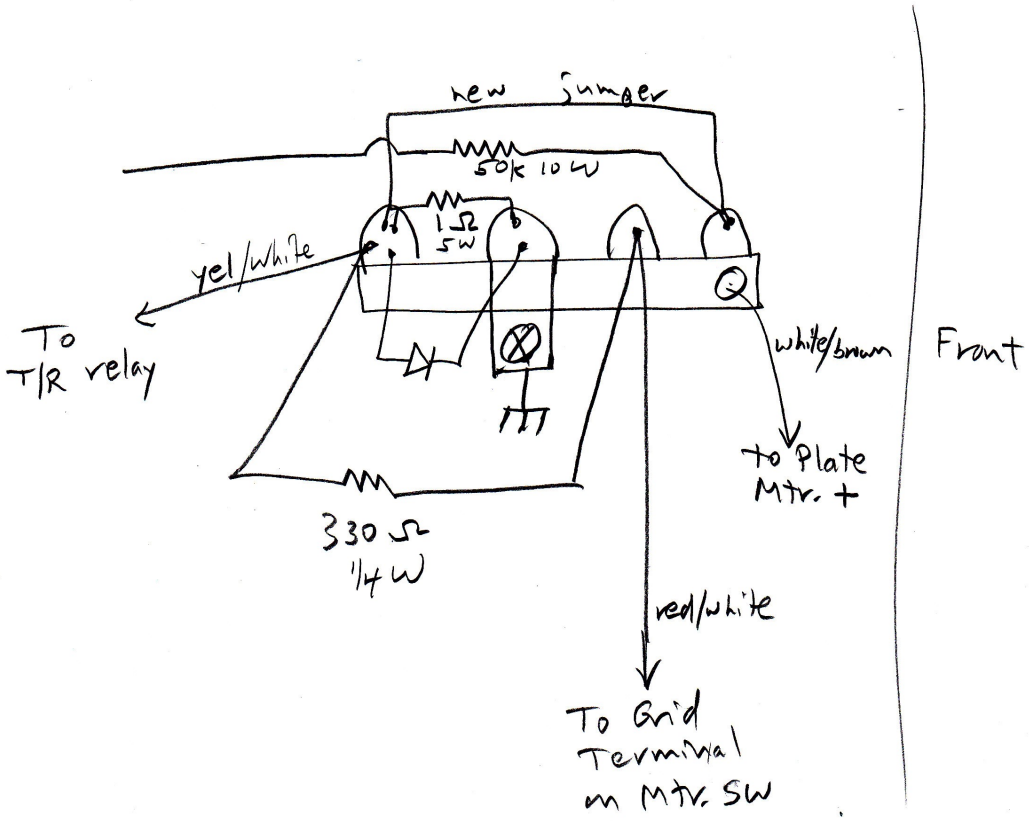
K5AM

RayTrack

Grid Meter Mod.

Bottom View



97/8/18 M.M.

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D. PTT Relay Mod

RayTrack
PTT Mod p.1

Modified Relay Circuit

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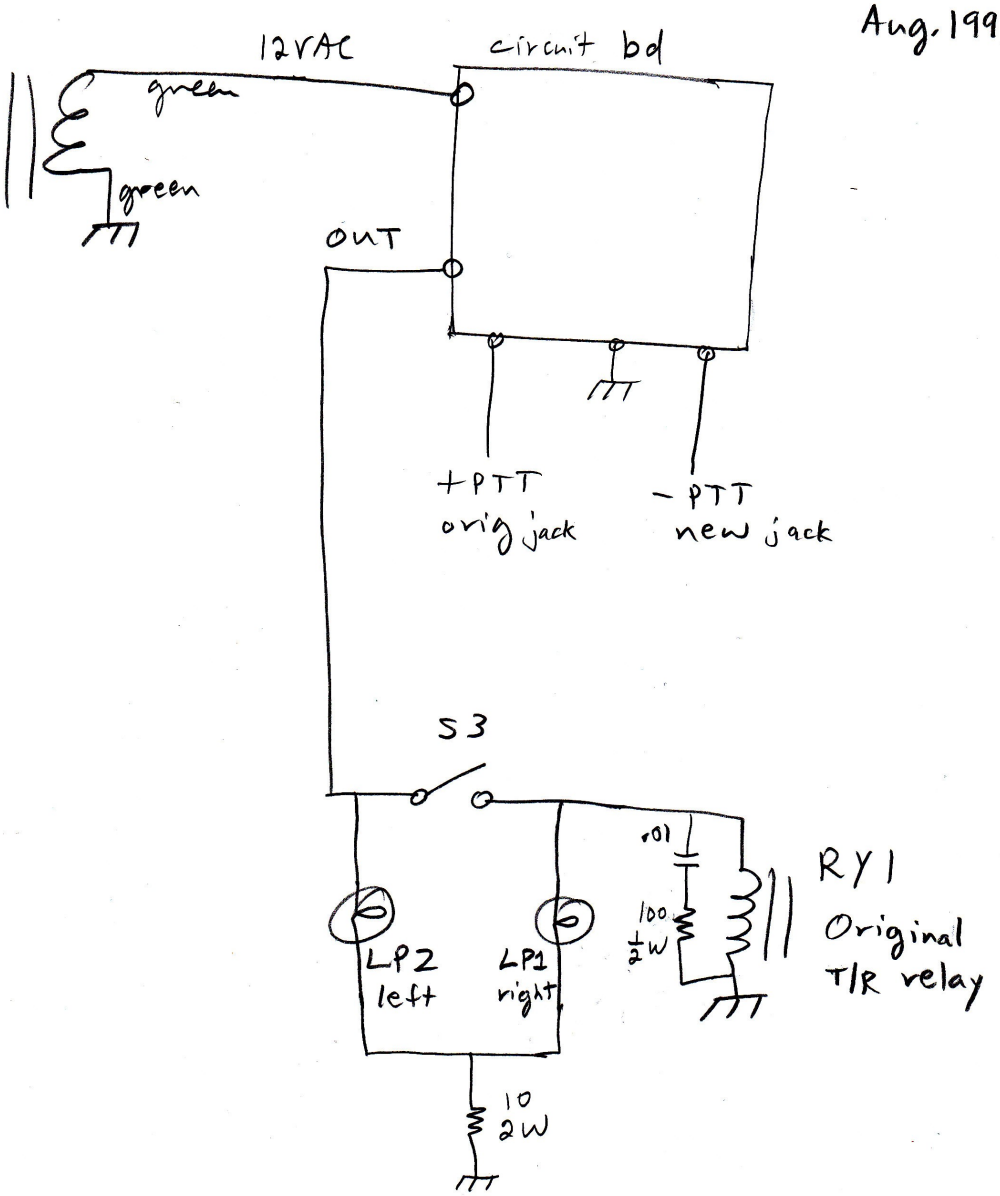

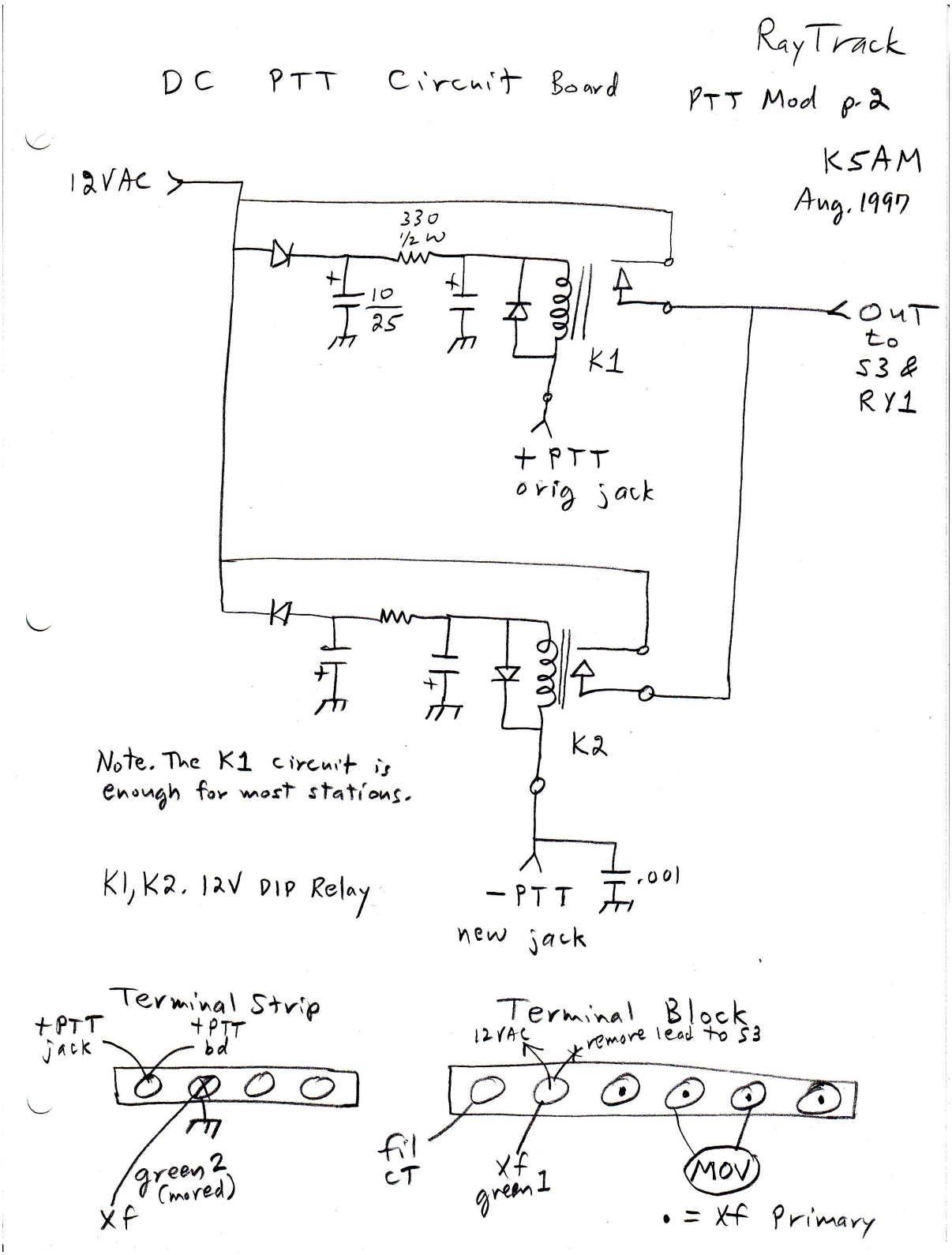
RayTrack
DC PTT Circuit Board
PTT Mod p.2
K5AM
Aug. 1997
12VAC
330
1/2 W
10
25
K1
OUT
to
S3 &
RY1
+PTT
orig jack
K2
Note. The K1 circuit is
enough for most stations.
K1, K2. 12V DIP Relay
-PTT
.001
new jack
Terminal Strip
+PTT
jack
+PTT
bd
green 2
(mored)
Xf
Terminal Block
12VAC
remove lead to S3
fil
CT
Xf
green 1
MOV
• = Xf Primary