Modifying The Heath HA-14 For 6 Meters
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4/22/07

Introduction

The Heathkit HA-14 was one of the few electron tube linear amplifiers intended for mobile use but few were purchased with the 12 volt mobile power supply. Most hams bought the HA-14 for base station use; it was small, lightweight, and ran a healthy "one kilowatt" input with its compact 110 volt A.C. power supply.

I first purchased one in 1993 to serve as a backup for my other amplifier. I found it to be much easier to use than my "big" amp (AL-1200) which requires a long warm-up and careful tuning. The HA-14 gave me a 6 DB boost with instant warm-up and one knob tuning. Given my very favorable experience, I thought I'd purchase another HA-14 and modify it for 6 meters; Ebay accommodated my wishes at a very reasonable price! Note: The HA-14 does convert to 6 meters BUT if you are looking for an easy conversion, buy an SB-200; it requires little physical modification for conversion.

Modification Strategy

The HA-14 is very similar to the Heathkit SB-200 amplifier; both share many identical components including the tubes, a pair of 572-B's. There have been several articles on how to modify the SB-200 for 6 meters. It was my hope that the HA-14 could be modified using these articles. One of the differences is that the HA-14 has the filaments of the tubes is series (for mobile 12 volt use) however, the most unique aspect of the HA-14 design is that it only has a plate tuning control in the PI network; the plate loading is a fixed 350 PF capacitor for all bands. I hoped to modify the 10 meter position and retain the ability to operate 80 through 15 meters. Many weeks of unsuccessful efforts finally convinced me that this was not practical and I would have to convert it to be a single band amplifier. My failure to multi-band the HA-14 was mostly due to the physical layout of components, particularly the plate tuning control which was a great distance from the tubes. My aborted first attempt convinced me that it would be extremely difficult to have a fixed capacitor for the plate loading portion of the PI network because the tuning was extremely sensitive and that lead length in the tuned portions of the amplifier were very critical for 6 meter operation.

Given these factors, the resulting modification strategy was:

1. Settle for single band operation
2. Add an additional variable capacitor for plate loading
3. Minimize lead lengths in tuned circuit components as much as possible

Modification – Additional Parts Required

The list of parts is as follows:

1. A 5 KV variable capacitor physically similar to the existing plate tuning capacitor with a low MINIMUM capacitance (preferably 4 PF or less) and a maximum of about 50 to 70 PF that can fit in the space occupied by the existing band switch elements in the output area of the amplifier (See Figure 3.0). I used one I had in my junk box and I removed two sets of plates from the capacitor with a long-nose pliers. Several capacitors compatible with this

modification are typically listed every week on E-Bay for $10 to $20. New capacitors are listed with surplus retailers at about $30-$40.

2. 3/8 " shaft, panel bushing, and coupler
3. 1 FT. #10 solid copper wire
4. 1 FT. #22 solid copper wire
5. 1 FT. #14 solid copper wire
6. 1 FT. RG-58U
7. 1 FT. aluminum foil (heavy duty)
8. 2-120 PF, 1-140 PF silver mica capacitors

Modification – Parts Removal

Before you begin, test the HA-14 on all bands into a dummy load. Set the exciter to 60 watts and adjust the tuning for maximum output. If your amp and tubes are in good condition, you should have between 450 and 600 watts output. I would not try to convert a poorly performing amplifier (Note: Russian 572B's probably will not work on 6M).

Because it is necessary to install an additional variable capacitor in the

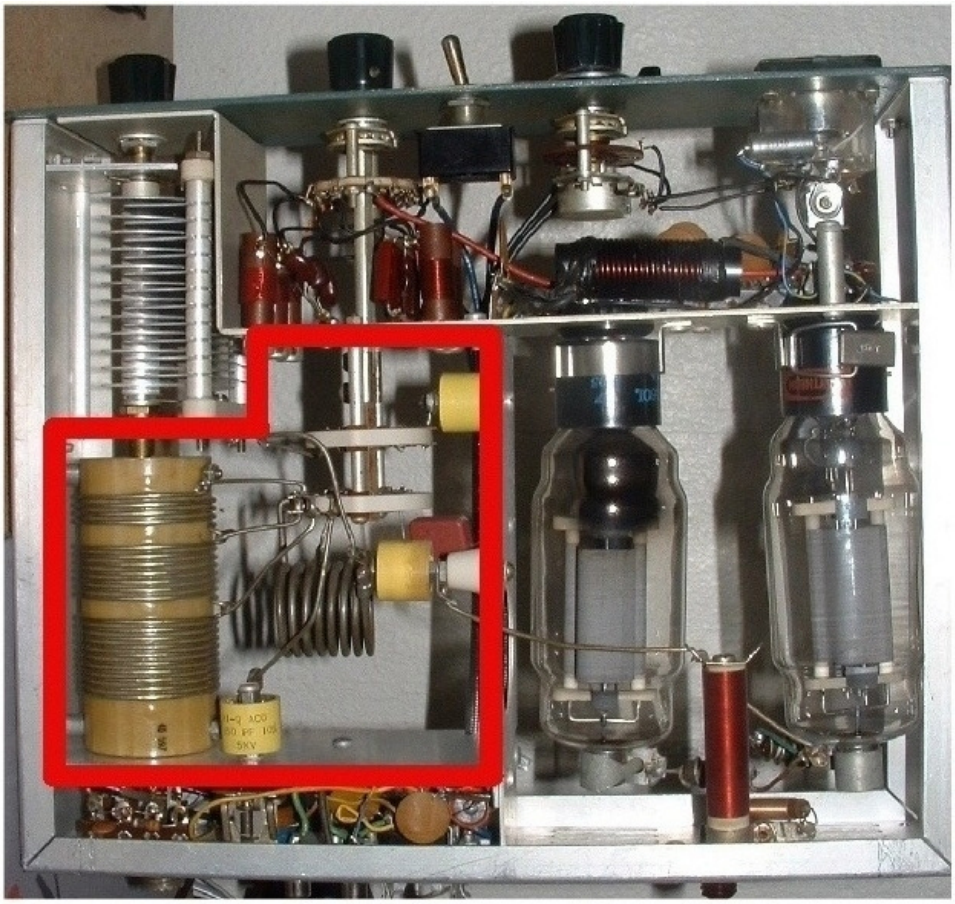

Figure 1.0 Parts Removal

amplifier, the entire band switch must be removed along with all of the components in the PI network portion of the amplifier as outlined in red in Figure 1.0 (except the variable capacitor). The best strategy for removing the band switch is to start by unsoldering all of the PI network coil connections from it, and remove all of the coils and capacitors. At this point the rear portion of the band switch can be removed. Now unsolder all of the wires associated with the input circuits and remove the knob from the front panel. With a bit of manipulation of wires, the band switch can be pushed backwards enough so that the front shaft of the switch will clear the hole in the front panel. Once clear, the switch can be moved up and out of the amplifier. You can opt to remove the input coils from the front of the amplifier however doing so will make it more difficult to return it to 80 through 10 meters if you wish to do so some day. The final components to be removed are the parasitic suppressors on the plate caps of the tubes.

Modification – Parts Mounting

In this modification, the plate tuning capacitor now becomes the plate loading capacitor of the PI network (See Appendix "A" Schematic). The new variable capacitor mounts in the space of the band switch and becomes the plate tuning capacitor. This is advantageous because the wire length from the tubes to the PI network is now considerably shorter.

While the PI network area is open, it is easy to install some of the additional shielding. I put this in to reduce the effect of the pilot light glowing brighter when transmitting but its not a bad idea for added stability. The cable bundle inside a cloth sheath that runs from the rear of the amplifier to the front along the divider between the tube and PI areas will be covered with aluminum foil (See Figures 2 & 3). Installing the foil shield takes a bit of

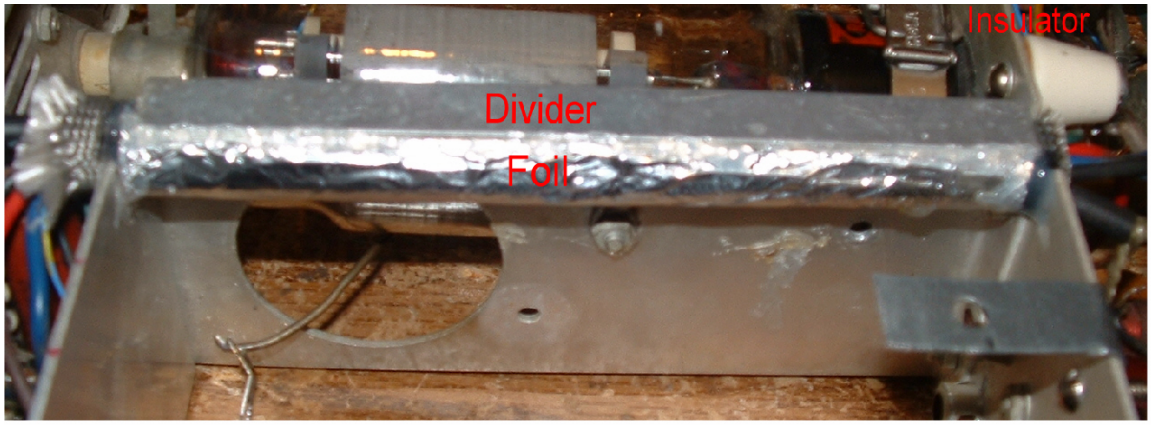

Figure 2.0 Foil Shielding

practice. I folded in half about a 5" length cut to the width of the sheath; then I folded the foil again on one end the width of the divider. This fold is wedged between the divider and sheath. The remaining foil is formed around the sheath and carefully stuffed behind it. Finally, I ran a bead of glue from my glue gun along the seam between the foil and divider and the underside of the sheath.

Now the new variable plate tuning capacitor can be mounted. In my installation, the variable capacitor is attached with a metal strap between it and the front panel divider. Additional support could be had by having a longer strap between the front and real panel dividers. I did not need this but would recommend it if the mounting is not stable (See Figure 3 and Note 3 on the Schematic). You can also see in Figure 3 that I used a panel bushing for the 3/8" shaft and a flexible coupling between the bushing and the capacitor shafts. A straight coupling could have been used but the flexible variety was in my junk box. The details of mounting and capacitor rotation are strictly dependent upon the variable capacitor available.

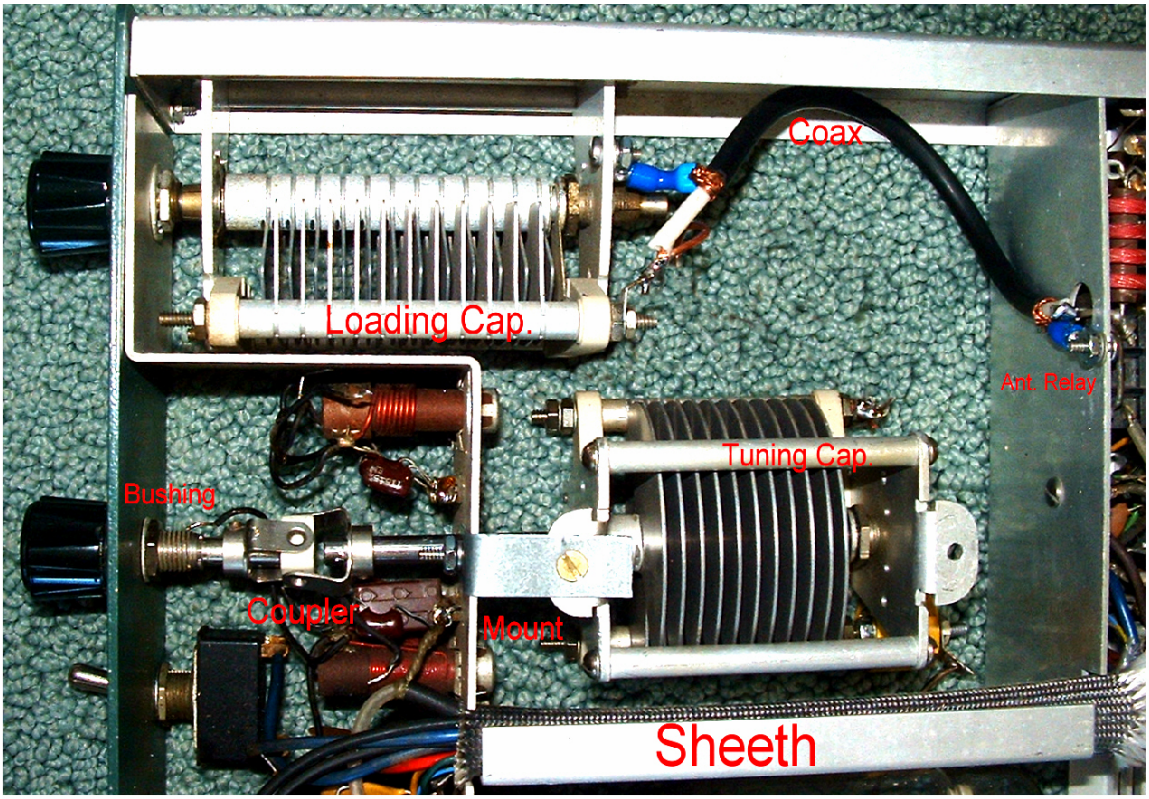

Figure 3 Component Mounting

I relocated the ceramic insulator that held the plate blocking capacitor (Figure 1) to the shield partition near the input circuits (Figure 2.). I used this insulator to hold the new input circuit coil. The plate blocking capacitor (C14 a 1000PF ceramic doorknob), now screws directly on the plate tuning capacitor as shown on Figure 7.0. This minimizes the lead length in this portion of the PI network.

As you can see in Figure 3.0, I installed a short piece of 50 ohm coax from the back of the loading capacitor to the antenna relay wire in the back of the tuning compartment. Note that the shield connections of the coax are as short as possible.

Modifications – Electrical

The electrical modifications are simple compared to the physical modifications. The input circuit needs two fixed capacitors and a single coil space wound with #20 solid wire at ½" diameter. The coil is mounted between the insulator that used to hold the plate blocking capacitor (C-14) and pin 2 of the nearest 572B tubes. Pin 2 is unused and it has a wire that used to connect to the band switch that should be removed (See Note 7 on the schematic, pin 2 also connects to the 140 PF capacitor and C-13). The coax that also used to connect to the band switch now connects to the insulator along with the coil and the 140 PF silver mica capacitor. (See Figure 4.0 and Note 6 on the Schematic)

Figure 4 Input Circuit

The parasitic suppressors (Note 1 on the schematic) have three turns of wire space wound over the resistors. Three turns is one turn too many thus one turn has to be removed or a new coil wound over the resistors. I chose to wind new coils because the new wire was easier to solder. Use #14 solid wire for the coils.

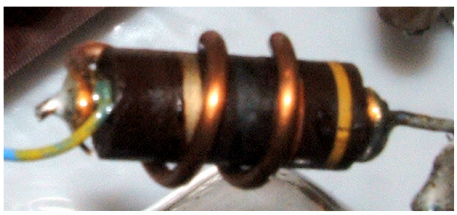

Figure 5.0 Parasitic Suppressor

The output PI network consists of the former tuning variable which is now the loading capacitor (Figure 3 and Note 4 on the Schematic) and the new variable which is the PI tuning capacitor. The coil is connected between the two capacitors. It is space wound with # 10 solid wire for 2 ½ to 3 turns at a 1 ¼" diameter. You should leave just a bit of lead length so that the turns of the coil can be compressed if needed in the tuning procedure. Note in Figure 7 and the very bottom of Figure 6 *the #14 wire jumper between the two capacitors frames. This is a very important connection that makes the difference between 300 and 500 watts output! Without the strap, the ground connection between the capacitors is very long and creates considerable power loss.* Needless to say, this connection should be made as short as possible. Put a 120PF cap across C-15.

Finally, disconnect C-9 from pin 3 of V-1 (See Note 2 of the Schematic).

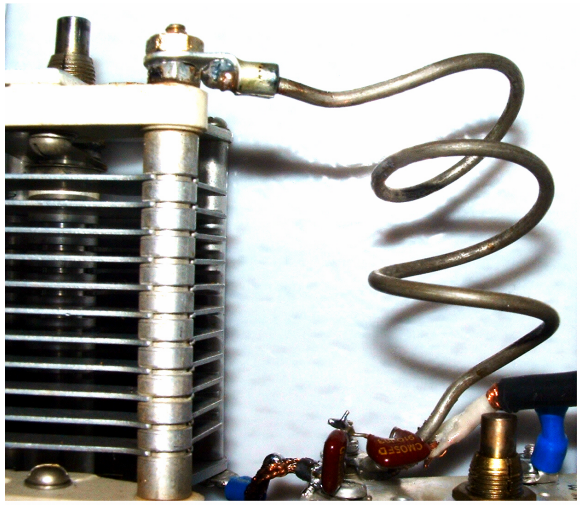

Figure 6 PI Network Coil

Tuning the Amplifier

The amplifier is adjusted using an SWR analyzer such as an MFJ 259B *with the power supply completely disconnected*. The settings are adjusted with the analyzer and then the amplifier is returned to its cabinet for final testing. Making the adjustments would be very difficult without the analyzer. The HA-14 likes to operate with the cabinet on and may be unstable with it off.

Tune-up – Input Circuit

The input circuit is the most difficult to adjust. The best way to do this is with an SWR analyzer attached to the input of the amplifier; be aware that this should be done without the power supply connected to the amplifier . You can wedge a wad of paper between the relay contacts and the rear shield compartment wall to force the relay contacts in the activated position. Temporarily solder a 120 ohm resistor between pin 4 of V-2 and ground. This simulates the input impedance of the tubes when they are operating.

Connect the SWR analyzer to the amplifier INPUT connector on the rear panel and sweep the frequency of the SWR analyzer and set to the lowest SWR. It should be 1.5:1

or less at some frequency on or near 6 meters. If the frequency is too high, compress the coil turns until the lowest SWR is at 50.1 MHZ; conversely spread the turns if the frequency is too low. If the minimum SWR is not less than 1.5:1, then you will have to add or subtract the capacitance of the two input capacitors. I suggest small changes of 10 PF to one of the other. Sweep the frequency again and see if the match is better or worse. This is a trial and error sort of thing that can take a while. Be patient! It may be possible to adjust the input circuit without an SWR analyzer but it would take the patience of a saint and a lot of luck of the Irish to get it right; trust me, I tried it and failed

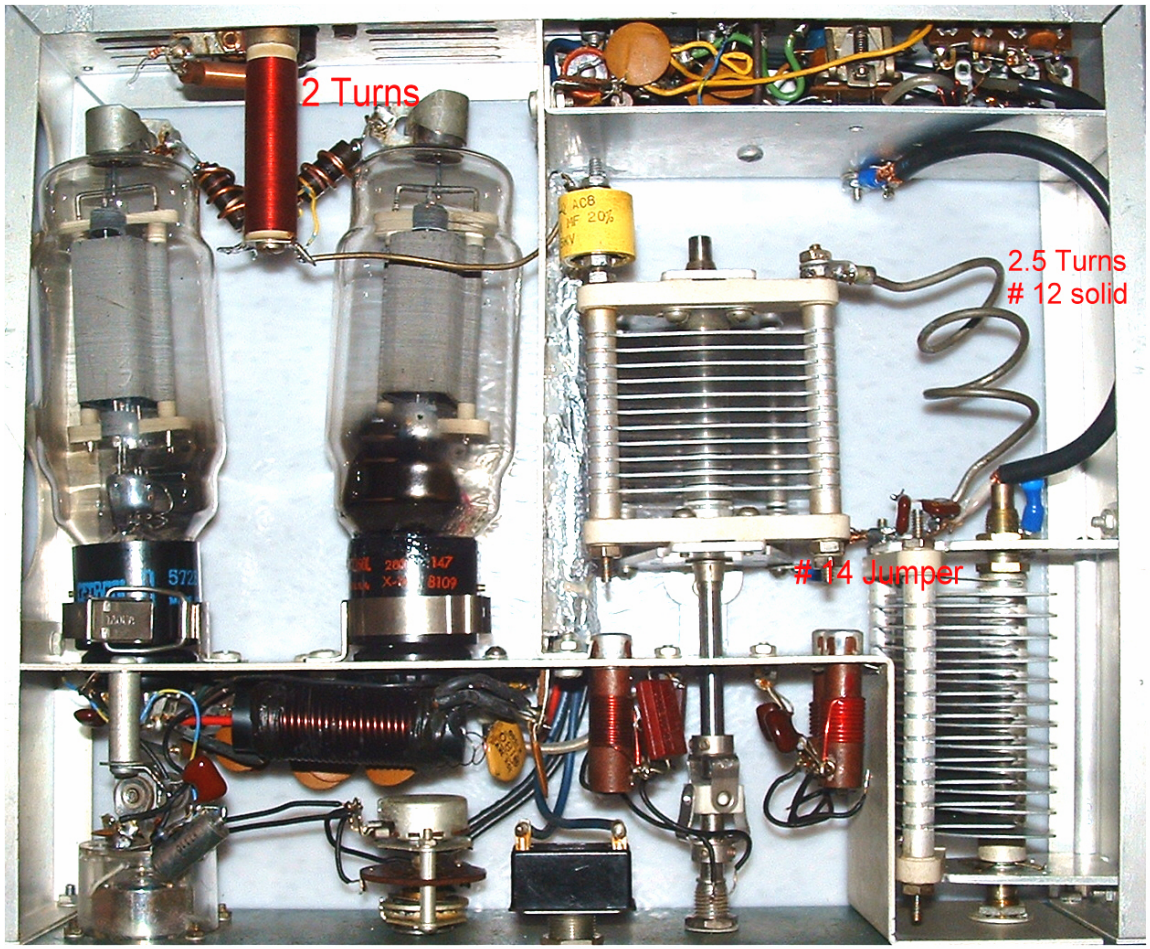

Figure 7 Completed Modifications

Tune-up – Output Circuit

The output circuit is initially adjusted the same way as the input except the SWR analyzer is attached to the OUTPUT of the amplifier. Set the amplifier on the top of the cabinet when making the adjustments. This simulates the effect of having the amplifier in the cabinet for tuning purposes. To simulate the load impedance of the tubes, a 2000 ohm resistor is attached between one of the plate caps and ground. Again, the antenna relay is forced into the activated position. Set the analyzer to 50.1 MHZ and adjust the plate tuning and loading until the SWR is 1:1. Note the meshing of the plate loading capacitor. It should be between half and ¾ meshed when the SWR is 1:1. If it is meshed too little,

spread the turns on the PI network coil slightly further apart and readjust the tuning and loading. Conversely if the loading is meshed too much, compress the turns slightly.

Final Tune-up

Once the input and output circuits are adjusted, remove the two resistors, the paper wedge holding the relay activated, *and put the case back on the amplifier*.

WARNING!!!!!

> The HA-14 high voltage will kill you if you're not careful!! There are no interlocks to prevent you from a lethal shock if you operate the amplifier outside of its cabinet. If you do so, you must be aware of where the high voltage is at all times and never touch anything while the power supply is on. The power supply must be fully discharged before you touch anything. To do so, wait at least 2 minutes then short the plate caps of one of the tubes to the chassis. Their most likely will be a small spark. Do this several times and unplug the power supply and the high voltage connector on the rear of the chassis

Attach your exciter and adjust its power level to 15 watts. Connect the HA-14 to a dummy load and power it up. You should be able to adjust the plate tuning and loading to see 100 to 150 watts output. If you get the proper output, raise the exciter power to 60 watts and re-tune the tuning and loading; you should get 400 to 500 watts output. My HA-14 puts out just over 500 watts with 60 watts of drive, using 30 year old tubes. This is the maximum you should run the amplifier if you like to keep your signal clean and not replace the tubes frequently it will however put out 700 watts with 80 watts of drive. If you do not have the appropriate output, check the input SWR with an SWR bridge and adjust the input circuit as necessary. Remember the lead lengths are critical on 6 meters. My plate tuning capacitor has the plate blocking capacitor (C-14) directly connected to it and the ground connections for the coax are very short. You should also be certain that there is a very short heavy wire connection between the grounded frames of the plate tuning and loading capacitors as shown in Figure 7 and 6. You should also refer to the output you measured on 80-10 meters with the same amount of drive. My HA-14 puts out about the same amount of power (500 watts) on 20 meters as it now does on 6 meters. Low reading on 80-10 and 6 meters would indicate weak tubes.

Additional

I added an RCA (phono) socket to the rear of the amplifier to serve for the antenna relay activation (Seen Note 9 on the Schematic). I also added an additional RCA connector for powering a 12 DC volt computer case fan I place on the top of the amplifier case to draw air through it. The 12 volts DC is derived by a half-wave diode rectifier and a 100 UF capacitor (See Note 8 on Schematic). The fan really makes a difference. The tubes will glow a dull red with 500 watts output. The fan is quiet and keeps the tubes happy.

Good luck with the modification and see you QRO on 6!

73's,
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APPENDIX "A" HA-14 SCHEMATIC