MARS-ALE Application Note

YAESU FT-890 QS/S Relay Modification

DRAFT

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REVISION REQUIREMENTS: None

SCOPE: The scope of this document pertains to a modification of the Yaesu FT-890S/AT transceiver where the Power Amplifier Band Pass Filters (BPF) are not switched until transmit to allow for scanning without excess BPF relay switching.

OVERVIEW

This application note is based on information developed by MARS-ALE SDT member AAR9WI in support of modifying the FT-890S/AT so that its power amplifier transmit filter relays would remain in bypass until transmit thus preventing shortened relay life from MARS-ALE use during scanning. The information here may be applicable to other Yaesu models which use the same or similar design as does the FT-890S/AT.

SCOPE

The scope of this document pertains to a modification of the Yaesu FT-890S/AT transceiver where the Power Amplifier Band Pass Filters (BPF) are not switched until transmit to allow for scanning without excess BPF relay switching.

PROBLEM:

Most HF SSB transceivers provide filtering in the final power amplifier to meet spectral purity requirements when transmitting. Many such transceivers used a switched Band Pass Filter (BPF) where each filter section has a lower and upper frequency range and must be selected prior to transmit.

With regard to Amateur Radio Grade HF transceivers, these BPF sections are usually based on one or more Amateur Radio Bands, for example the FT-890S/AT uses the same BPF section for 10-17.999Mhz (30m and 20m) but then selects another filter section when moving down to 9Mhz or up to 18Mhz as seen in figure 1 below.

Some transceivers select these filters by use of solid state diodes, however as such diodes are both expensive and can introduce Inter Modulation Distortion (IMD) into the signal, relays are more commonly utilized.

The problem with is that these filter sections are selected when the RX frequency is changed and not just at transmit. As such, ALE Scanning over wide space frequencies will cause another BPF section to be selected with just about each frequency change which will shorten the BPF relays life. Many transceivers with the use of SPLIT VFO operation holds off the selection of BPF sections as long as it is only the RX VFO frequency being changed and not the TX VFO frequency, which is one means used by MARS-ALE in its Quiet Scanning/Sounding (QS/S) coding approach. Some make/model transceivers provide for BFP bypass commands over the computer bus, the Harris RF-350 series is such a radio.

However, many transceivers neither support the SPLIT VFO or BYPASS command approach, thus only a hardware modification approach to the problem is left if the radio make/model of interest is to be used for ALE and the BFP relays are not going to be overly switched.

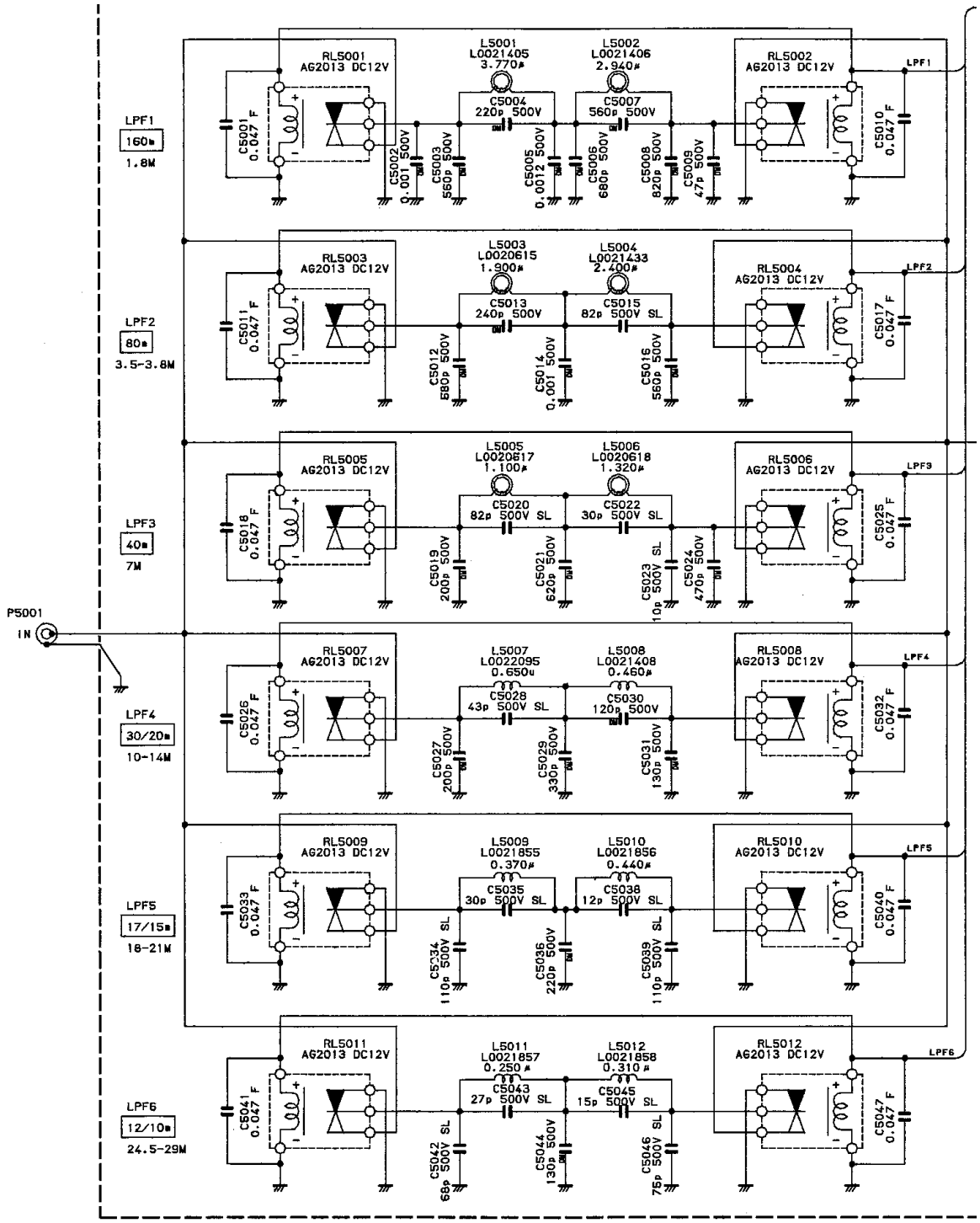

P5001
IN
LPF1
160m
1.8M
LPF2
80m
3.5-3.8M
LPF3
40m
7M
LPF4
30/20m
10-14M
LPF5
17/15m
18-21M
LPF6
12/10m
24.5-29M
RL5001 AG2013 DC12V
RL5002 AG2013 DC12V
RL5003 AG2013 DC12V
RL5004 AG2013 DC12V
RL5005 AG2013 DC12V
RL5006 AG2013 DC12V
RL5007 AG2013 DC12V
RL5008 AG2013 DC12V
RL5009 AG2013 DC12V
RL5010 AG2013 DC12V
RL5011 AG2013 DC12V
RL5012 AG2013 DC12V
L5001 L0021405 3.770μ
L5002 L0021406 2.940μ
L5003 L0020615 1.900μ
L5004 L0021433 2.400μ
L5005 L0020617 1.100μ
L5006 L0020618 1.320μ
L5007 L0022095 0.650u
L5008 L0021408 0.460μ
L5009 L0021855 0.370μ
L5010 L0021856 0.440μ
L5011 L0021857 0.250μ
L5012 L0021858 0.310μ
C5001 0.047 F
C5002 0.001 500V
C5003 560p 500V
C5004 220p 500V
C5005 0.0012 500V
C5006 680p 500V
C5007 560p 500V
C5008 820p 500V
C5009 47p 500V
C5010 0.047 F
C5011 0.047 F
C5012 680p 500V
C5013 240p 500V
C5014 0.001 500V
C5015 82p 500V SL
C5016 560p 500V
C5017 0.047 F
C5018 0.047 F
C5019 200p 500V
C5020 82p 500V SL
C5021 620p 500V
C5022 30p 500V SL
C5023 10p 500V SL
C5024 470p 500V
C5025 0.047 F
C5026 0.047 F
C5027 200p 500V
C5028 43p 500V SL
C5029 330p 500V
C5030 120p 500V
C5031 130p 500V
C5032 0.047 F
C5033 0.047 F
C5034 110p 500V SL
C5035 30p 500V SL
C5036 220p 500V
C5038 12p 500V SL
C5039 110p 500V SL
C5040 0.047 F
C5041 0.047 F
C5042 68p 500V SL
C5043 27p 500V SL
C5044 130p 500V
C5045 15p 500V SL
C5046 75p 500V SL
C5047 0.047 F
LPF1
LPF2
LPF3
LPF4
LPF5
LPF6

Figure 1.

FT-890S/AT BPF RELAY MODIFIATION

In the Yaesu FT-890S/AT the band is decoded by a chip on the Keyer Unit circuit board which supplies nominal 12 volt power to the filter relays for selection of the proper filter section for a given frequency of operation.

After a review of the circuitry, it was learned that the insertion of an isolation relay in the voltage supply line for that chip would allow for enabling or disabling the filter relays. A relay with a 5 volt coil allowed use of the pull-down transistor that turns on the FT-890S/AT XMIT LED on the front panel, this provides the means to activate the filter relays using the Normally Open (NO) contacts of this relay to enable filter relays only when transmitting.

PARTS NEEDED

1 RELAY -

A RadioShack 275-240 was used, however any small SPDT relay with a 5.0 vDC coil that is small enough to fit within the space near the Keyer Unit and beside the speaker should work.

1 DIODE -

A 1N914 was used, however most any diode should work.

FINE WIRE -

4 strands torn off a ribbon cable or similar should be used due to the tight space restrictions, #22 is about the right gauge.

MODIFICATION PROCEDURE

1. Turn the transceiver off and disconnect all cables.

2. Place radio upside-down with the rear facing you. Remove 8 screws (4 bottom and 4 on the sides for 8 total) while pressing down firmly with the correct size screw driver. Then start by removing the bottom cover and prying up on the plastic bumpers on the side opposite the carrying handle. See Figure 2, photos 1 and 2 below.

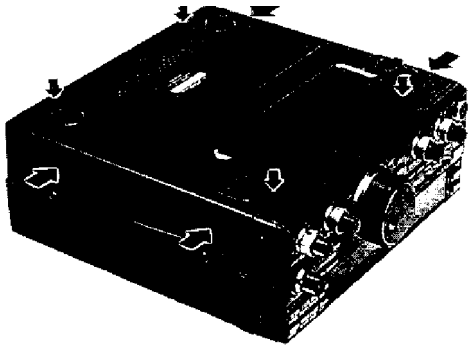


Photo 1

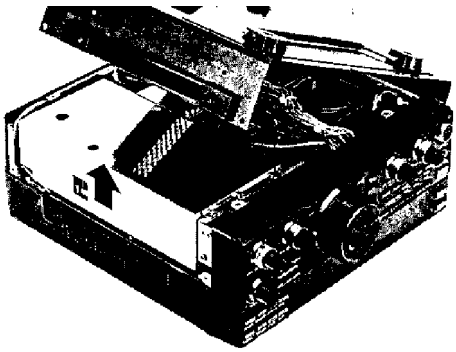


Photo 2

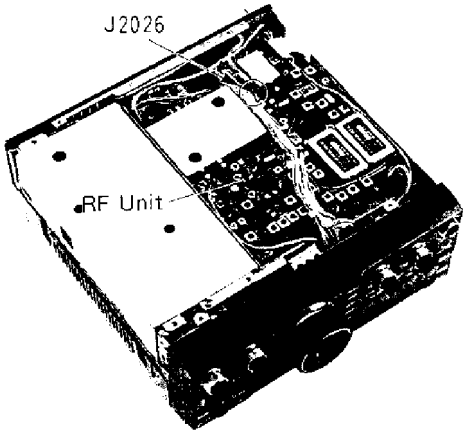


Photo 3

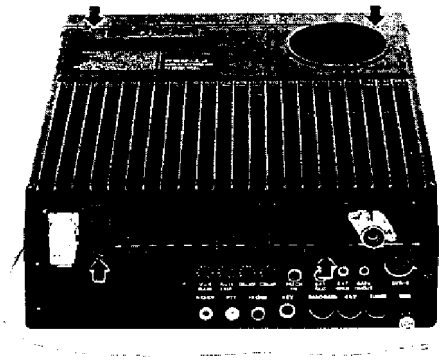


Photo 4

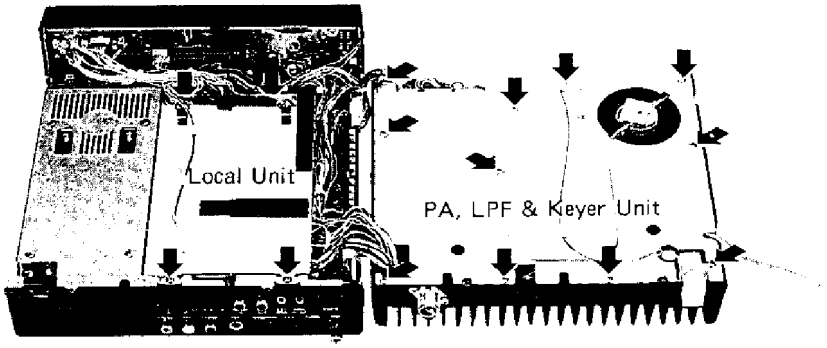


Photo 5

Figure 2.

3. Disconnect the light-blue-banded coaxial cable from J2026 near the rear of the RF Unit. See Figure 2-1, photo 3 above and Figure 2-2 below.

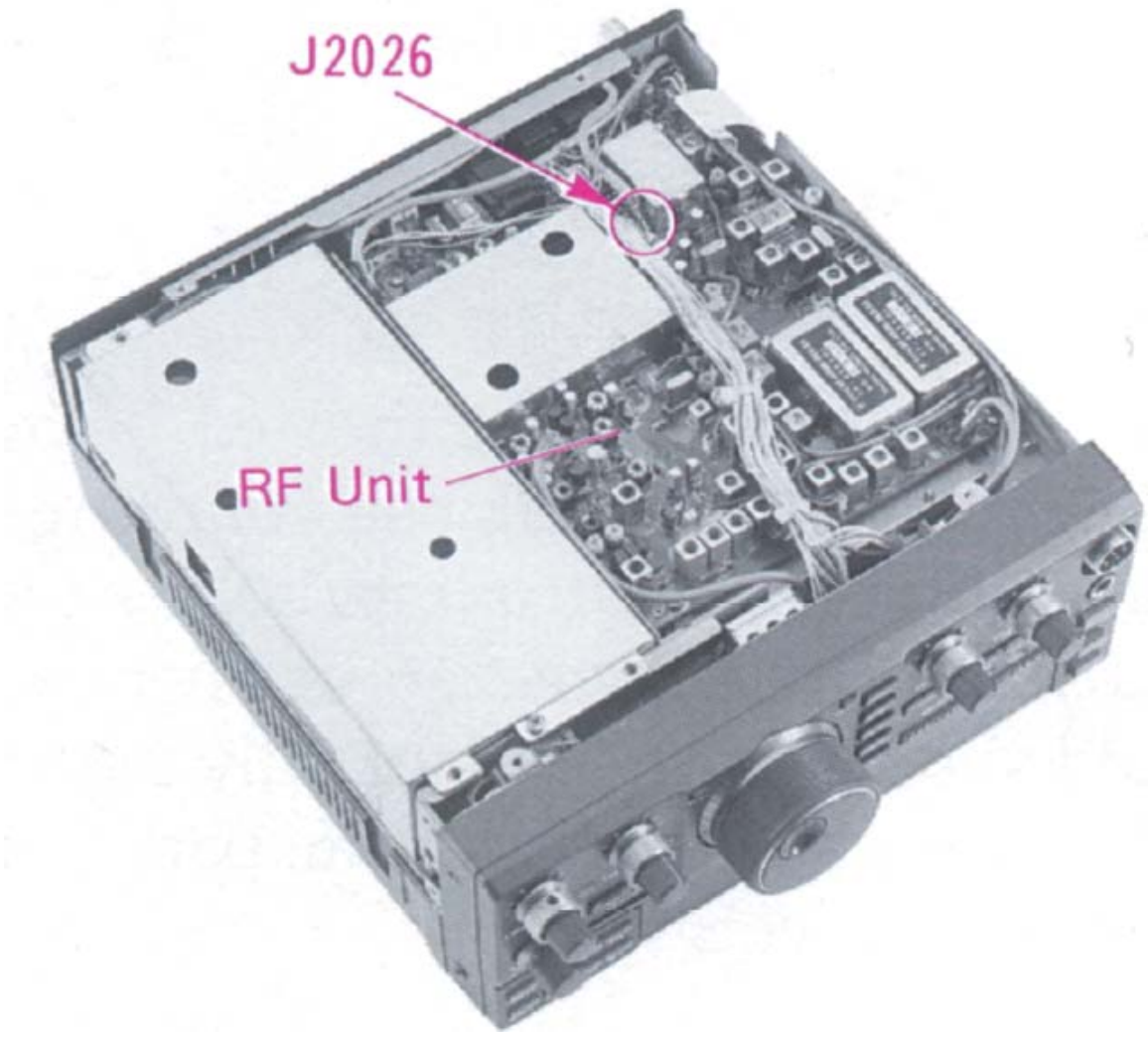


Figure 2-2.

4. Place the transceiver topside-up so the rear panel is facing you. Remove 4 screws (2 at the top and 2 at the rear) see Figure 2-1, photo 4 above. Being careful to feed the coax for J2026 through from the left side of the bottom section, rotate the top section until it lies beside the top section, see Figure 2-1, photo 5 above.

5. Then remove the 11 screws for the shield panel to access the Keyer Unit and be sure to keep count of them!

6. Then un-tape the red and white wires crossing the shield panel and carefully work the wires around the far right corner of the shield panel.

7. Locate the Keyer Unit in upper left of the radio's top section, the component side where most of the devices are mounted, see the board placement in Figure 3-1 below.

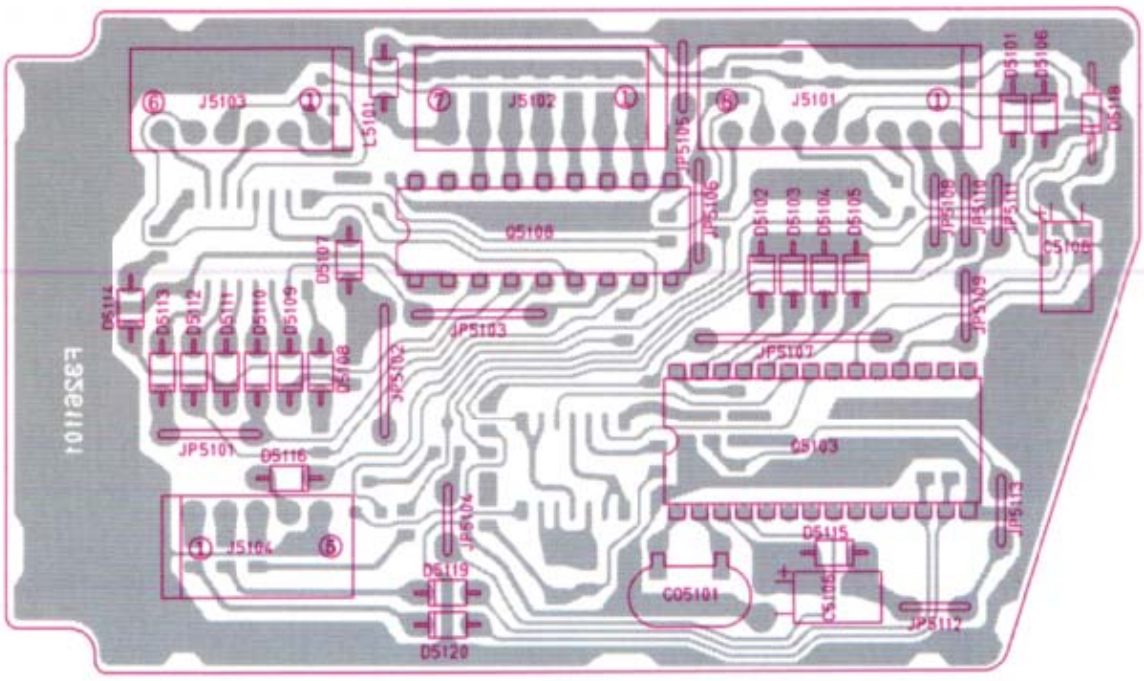


Figure 3-1.

8. Carefully cut jumper JP5106 which is located to the left of Q5108 as seen in Figure 3-2 below and bend two ends away from each other.

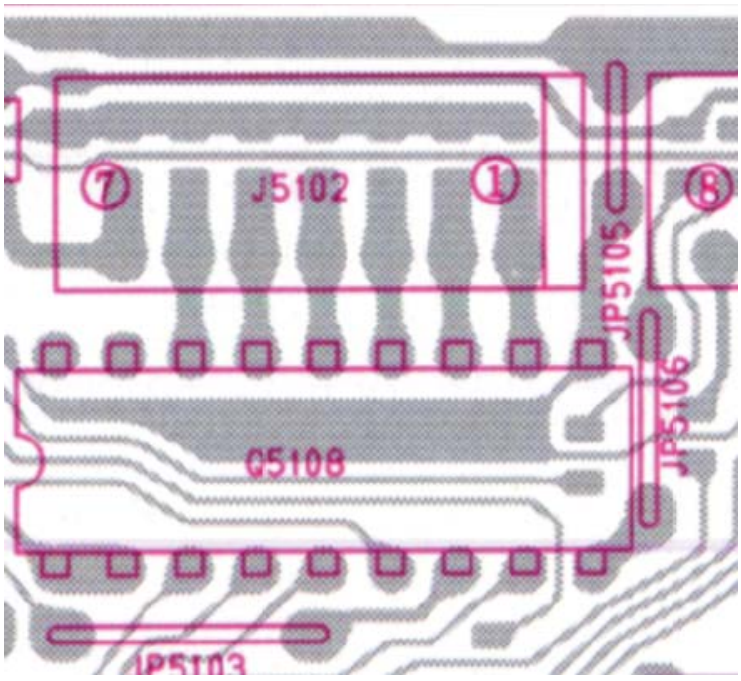


Figure 3-2.

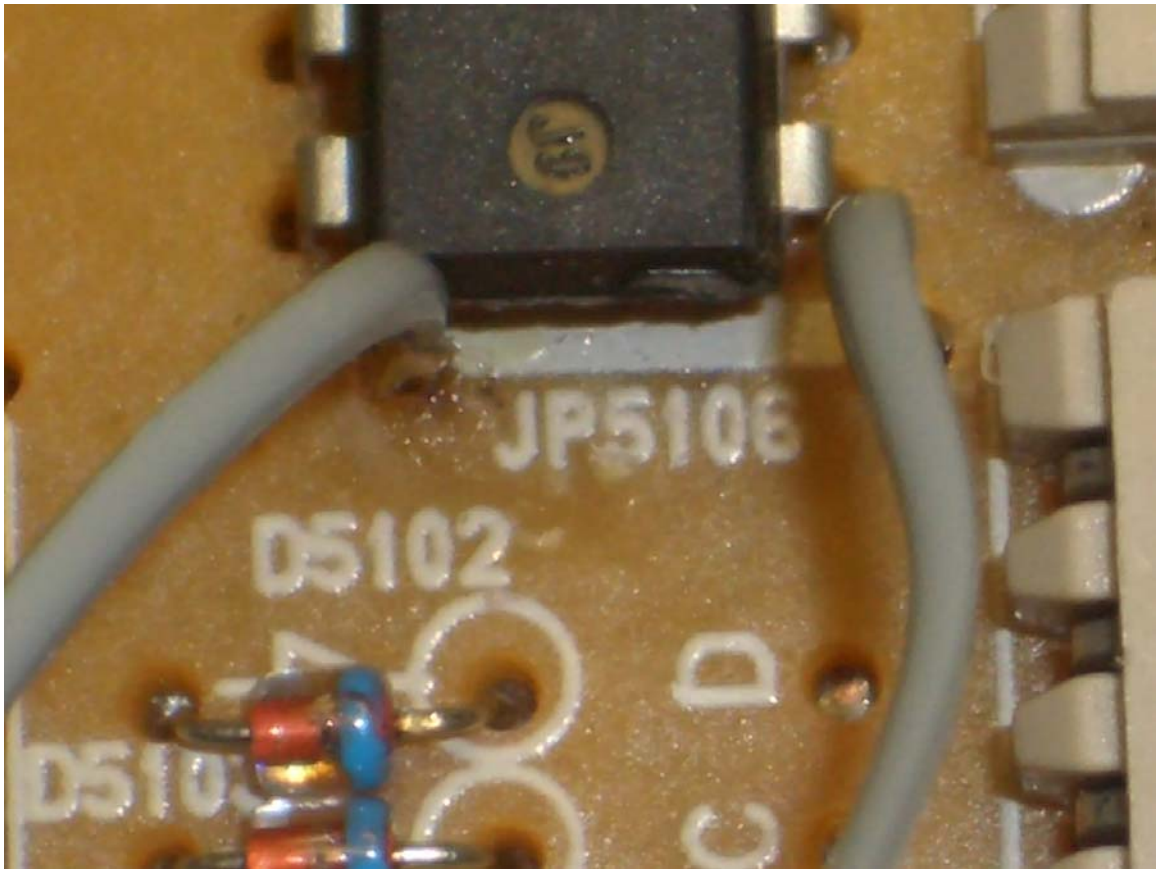


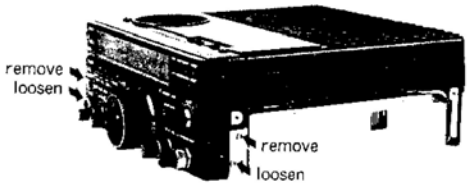
Figure 3-3.

9. Attach wires for new relays Normally Open (NO) contacts to the two sides of the cut jumper as seen in Figure 3-3 above.

10. Attach the diode's cathode to a wire to be attached later to one side of the relay coil.

11. Undo all 4 screws holding front panel to chassis and pull down the front panel as seen in Figure 4 below, carefully arrange it so you can access the bottom of the Display Unit.

Gently pull the front panel away from the chassis (or just fold it down for pilot lamp replacement).



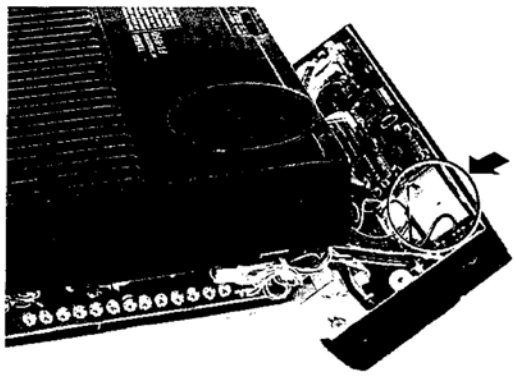


Figure 4.

12. Feed the diode down between chassis and front panel.

13. Attach the anode end of the diode to the 5v terminal of Q3024 (5 volt regulator) on the Display Unit as seen on the component side of the display board in Figure 5-1 and the photo in Figure 5-2 below, this is the toughest part of the modification.

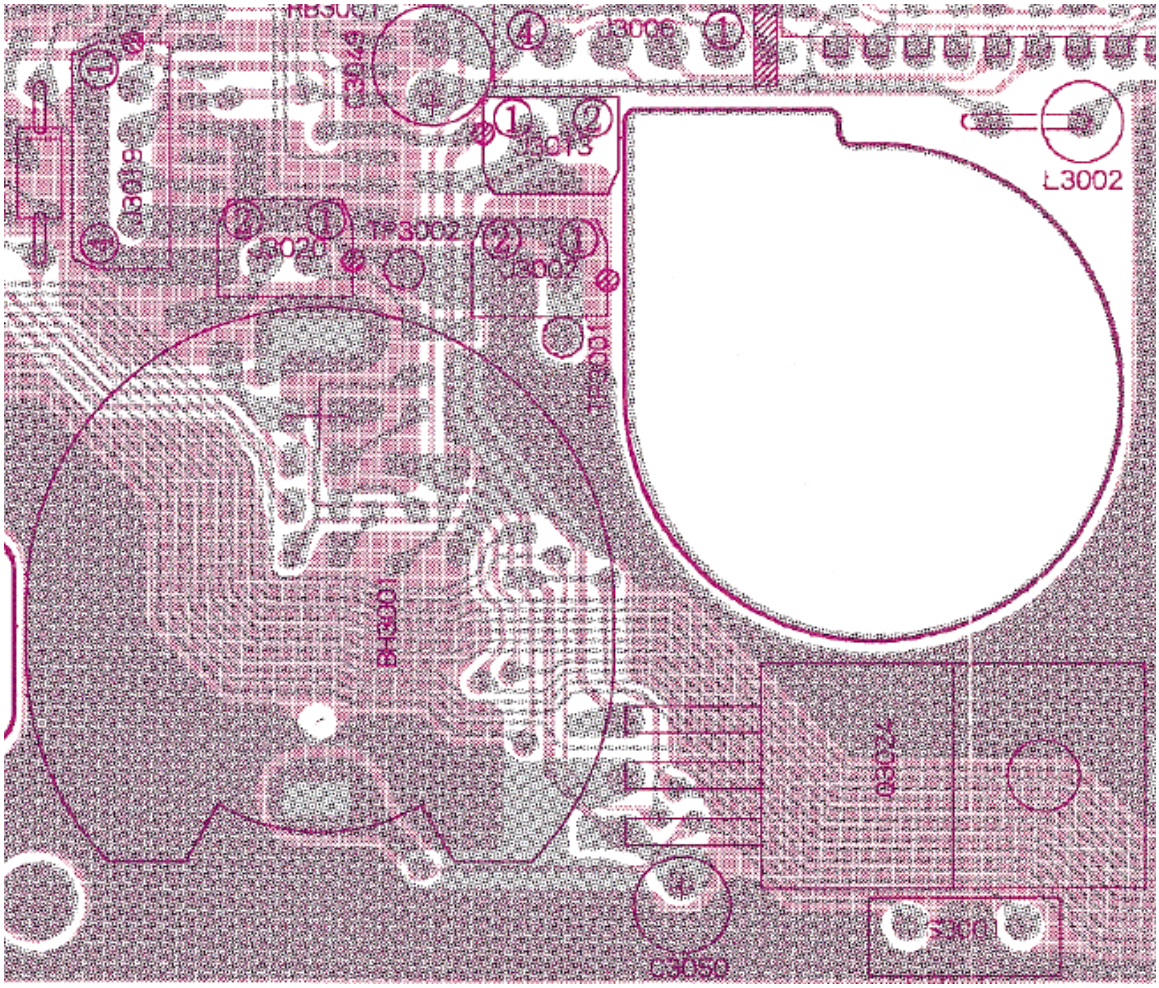


Figure 5-1.

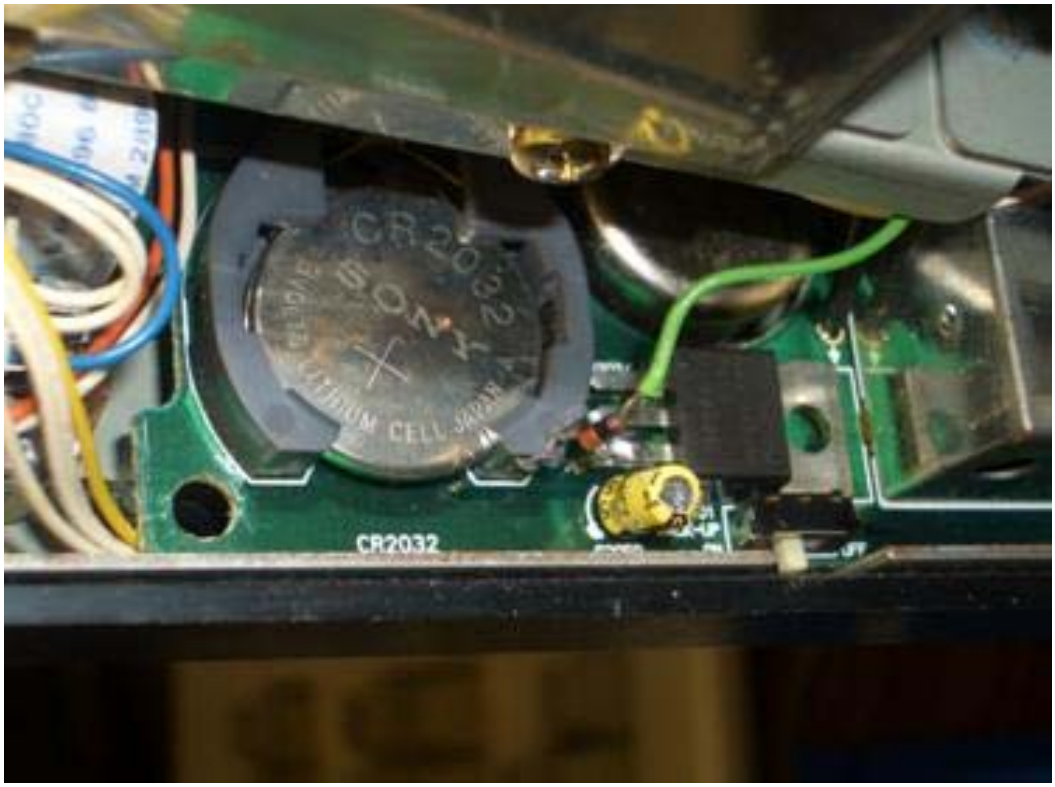


Figure 5-2.

14. Next, attach a wire for the other side of the relay coil to the XMIT LED, D3051 as seen on the component side of the display board Figure 6-1 and the photo in Figure 6-2 below.

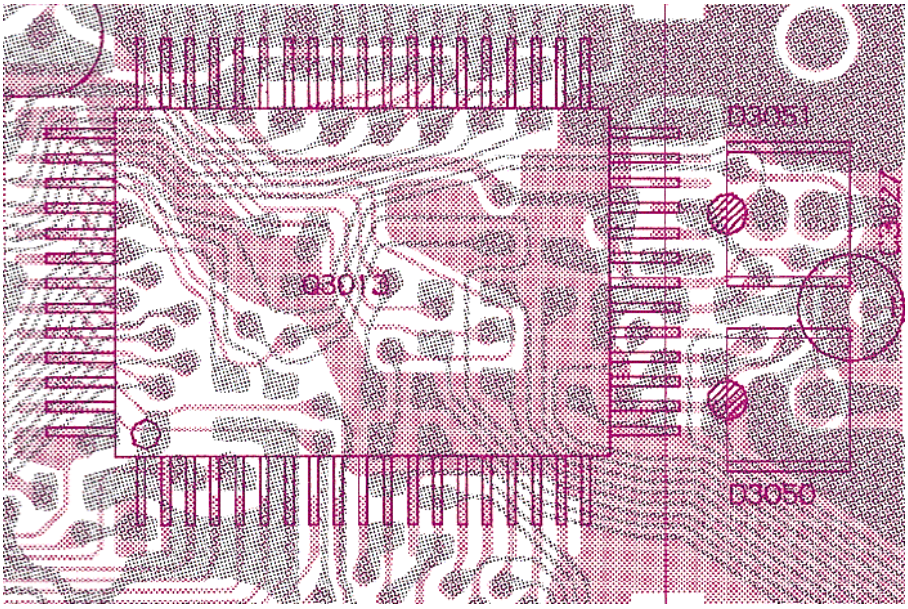


Figure 6-1.

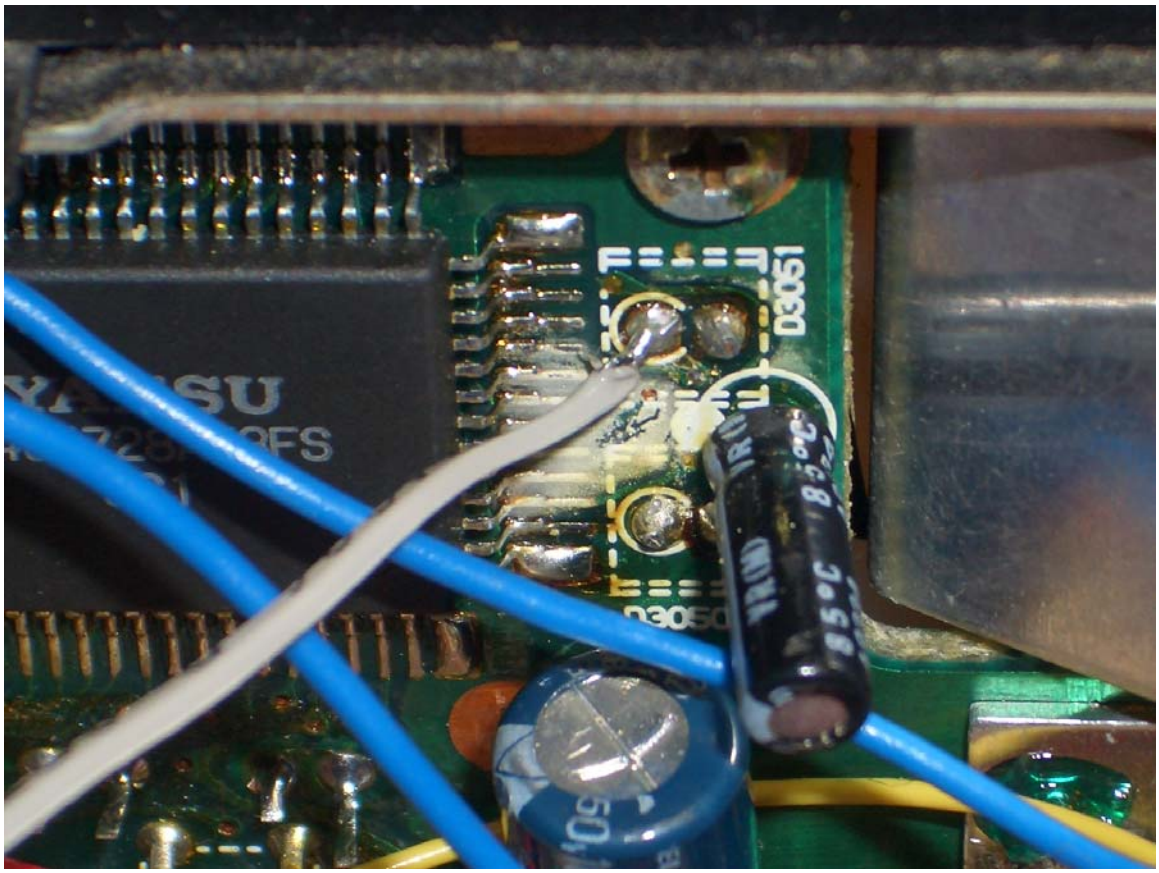


Figure 6-2.

15. Route the coil wires over to the top section and attach them to relay's coil terminals.

16. Attach the wires from cut jumper on the Keyer Unit to the NO contacts on relay.

17. Route the wires, insulate the relay with tape and insert it in the open space to the right of the Keyer Unit. The relay is wedged within a piece of foam in to help keep it in place as seen in Figure 7 below.

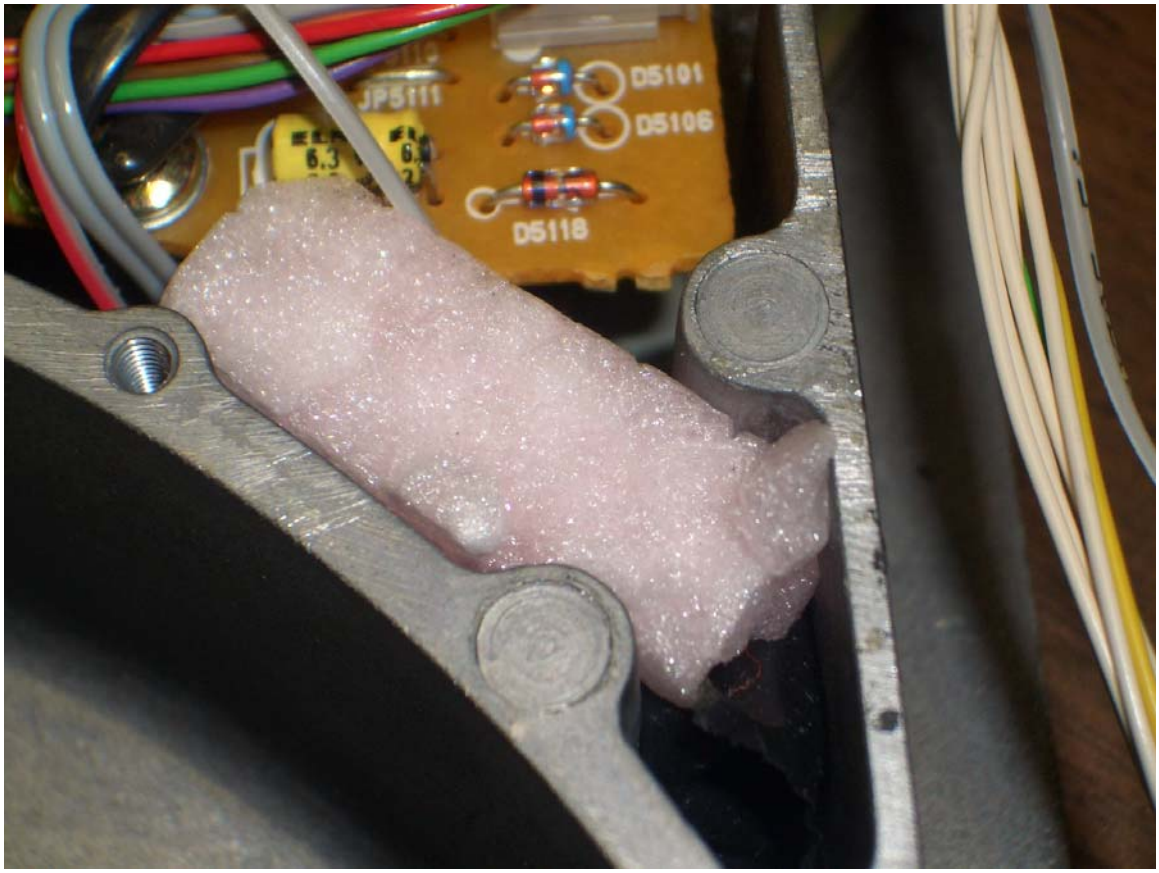


Figure 7.

18. Re-attach the front panel to the chassis and make sure the diode and lead attached to the 5 volt regulator are not shorting to anything.

19. Reverse disassembly procedure. Be sure to get all screws started before tightening any of them when reinstalling shield panel and other sections.

20. Route coax back through lower section and gently pull it through while rotating upper section over lower section. Be careful not to pinch any wires.

21. Don't forget to plug coax back into J2026 as seen in Figure 2-2.

22. Attach a dummy load and power the radio. Either manually using the UP or DOWN band buttons changing through the bands or via use of MARS-ALE and scanning through channels, with the speaker volume on minimum, you should not hear the filter relays activate. Test that they do on transmit by activating the PTT via one or more means and the relays should activate for the given frequency to selection a filter section when PTT is activated. Also check auto-tuner operation first on the dummy load and then an antenna.

23. Finish reassembly.