FLUX RESEARCH

Technical Service Bulletin:
FXR-14

Modifying GE MVS VHF Group 2
150 – 174 MHz for
Amateur Radio Applications
in the 219 – 220 & 222 – 225 MHz Band

A FluX Research project in several phases

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Radio Model #:
GE MVS - NPFH3OSS



Warning:

Please be aware that this document may contain several omissions and or typographical errors, continue reading at your own risk.

Background:

Special thanks to Mohave Amateur Radio Club, K7MPR for providing the radios for experimentation.

The following LBIs may be helpful:

LBI-31919E VHF High band 40 watt MVS maintenance manual
LBI-31920D VHF High band RF board 19D901835G2 (150-174 MHz)
LBI-31921C VHF High band Power Amplifier board 19C851540G2 (150-174 MHz)
LBI-31922D Audio board 19D901870G1
LBI-31924F MDR, MTD, MVS, TMX-8825 System Board 19D901891G1
LBI-31926C Service section for VHF high band combinations
LBI-31927D MVS Operators manual Covers 2 channel, 8 or 16 channel, scan, selective calling (SelCal) and PA operation

LBI-38387B MVS Front cap assembly 19D901913G1 (this is the front panel)
LBI-38465B Remote mount option 19A705306G3
LB-I38899 MVS / MCS / TMX-8712 / TMX-8310 Logic boards 19D901690G11

Phase 0: Preparations

Make sure the radio to be converted is in good working order on its original frequencies before attempting conversion to Amateur Radio use.

Phase 1: Operating Frequency Reprogramming

Option 1: Hack Original GE MVS v3.0 software to allow out of range programming.

Copy MVS.EXE to MVS220.EXE

Using a suitable hex editor such as XVI32, Edit MVS220.EXE and make the following changes:

Hex Address	Original Data	New Data
&H1A328	C0 62	00 60
&H1A33F	C0 65	20 6C
&H1B8E9	C0 62	00 60
&H1B8F1	C0 65	20 6C

This changes the programming range of the software to allow 128 to 225 MHz. Transmit frequencies will show true, Receive frequencies will now have to be programmed minus 90 MHz. I.E. 223.500 MHz RX is programmed as 133.500 MHz.

Option 2: Use alternate firmware on the logic board.

Please refer to the following website:

http://www.dave-page.com/projects.html

This firmware was originally designed to run the 900 MHz GE TMX-9315 in amateur bands, provisions were made to port the code to the GE MVS and one of the bands was 220.

It is also meant to be used with the GE TMX test handset, or a modified GE CF-1000 car phone as the display. It will not drive the stock MVS front panel. There is a handset emulator program that can get the radio programmed and is useful for making link radios where VFO programming is not needed.

The firmware requires a large EPROM with a built in latch buffer. 87C257. Later G11 logic boards have this IC installed and no further modifications are necessary. Early logic boards such as the G5 have the smaller EPROM. This must be replaced for the 87C257 and some modifications are needed to the G5 board as outlined in the documentation.

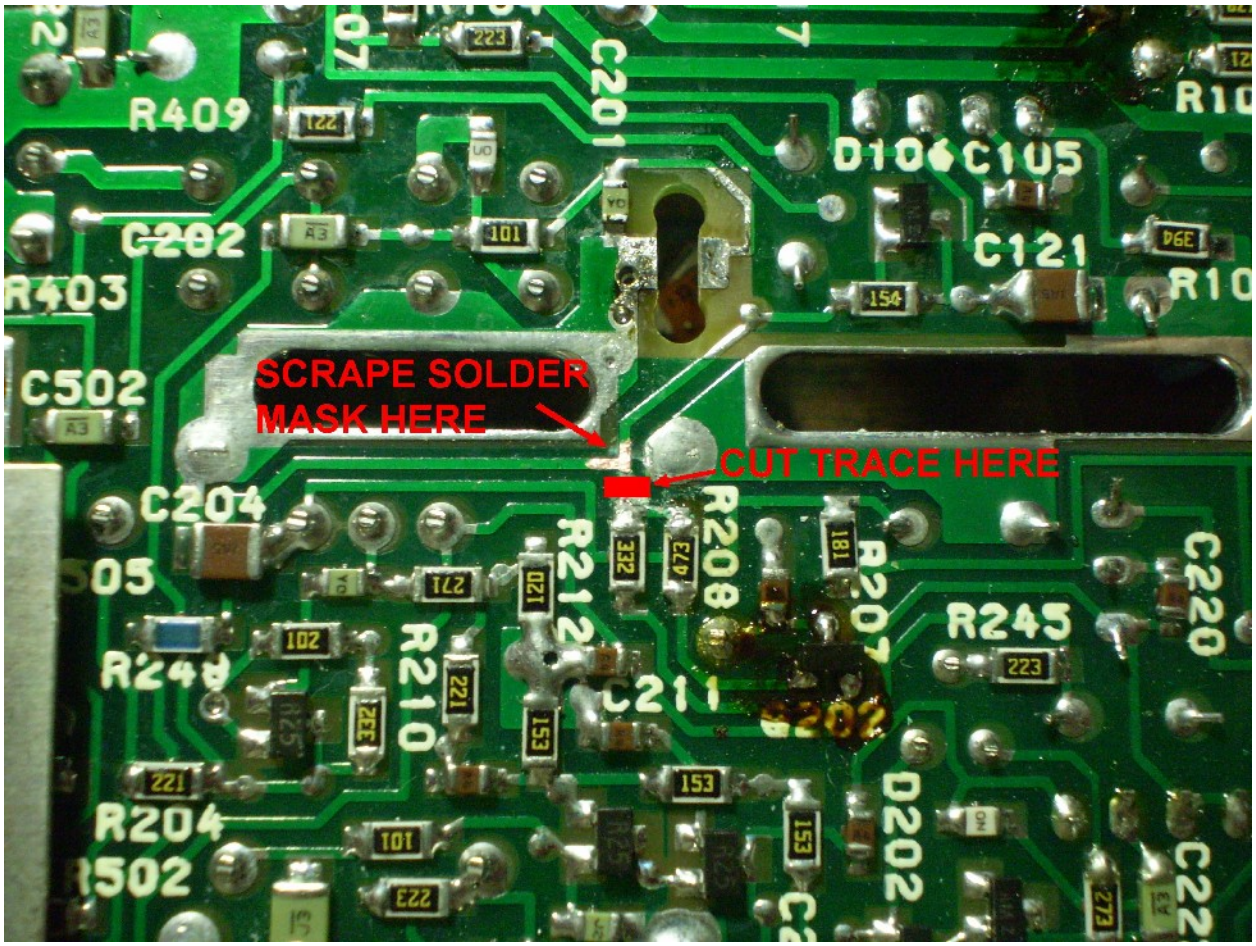
Also note that the author of the firmware recommends using a TMX audio board in the MVS and there may be additional modifications required that are not documented.

For testing program the radio to the following:

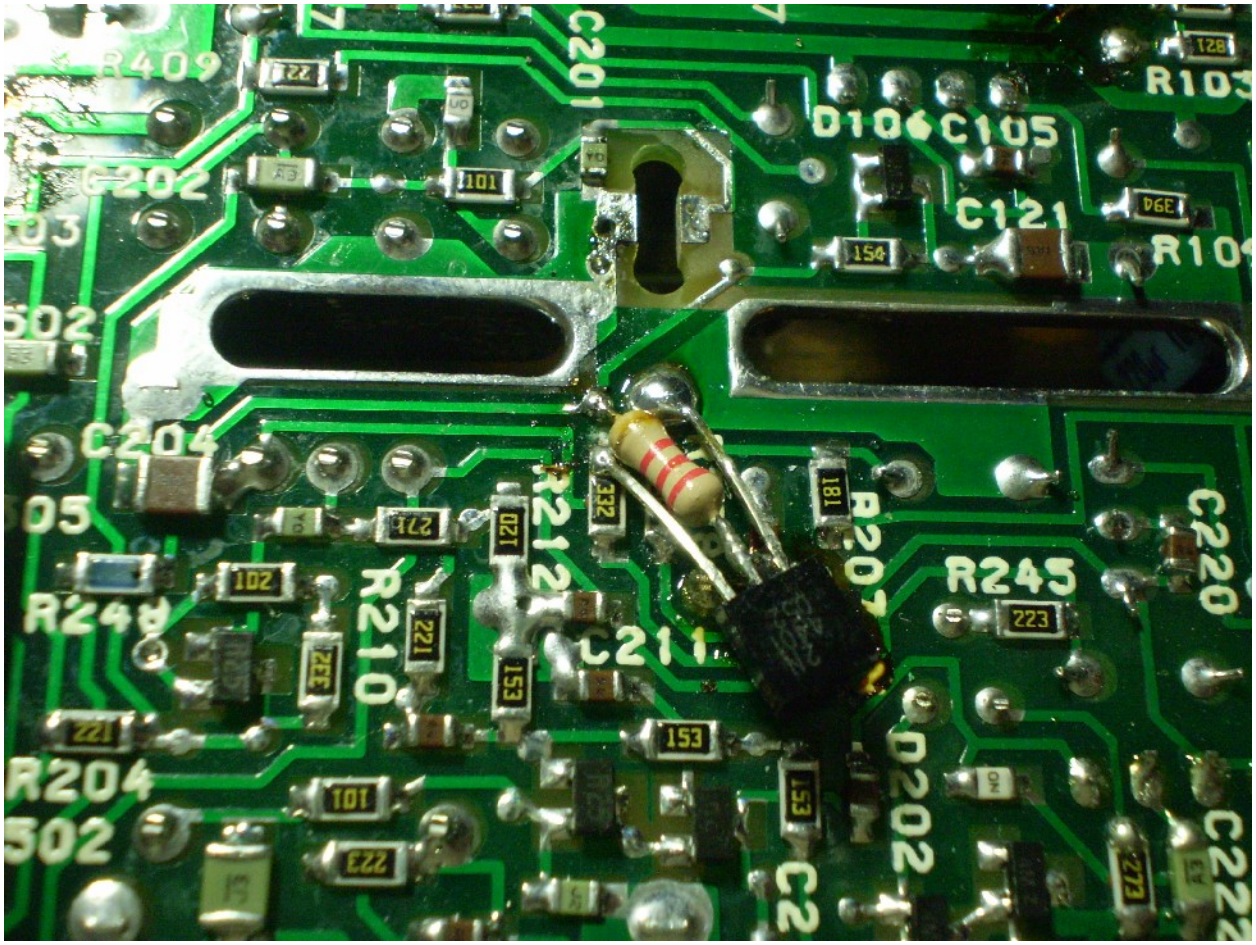
Channel 1 – 223.500 MHz Simplex
Channel 2 – 224.800 MHz Simplex

Phase 2: VCO

Cut the trace on the RF board, feeding the DPTT signal to R208 and R209 after the trace that goes to R248. Scrape solder mask and expose the copper trace that is the original DPTT signal.



Install a logic inverter consisting of a NPN transistor with 2.2-10K resistor on the base lead. Solder emitter to ground, base resistor to the bare trace and collector to R208 and R209 junction.



Installed VCO Inverter Transistor

This effectively makes the VCO band select backwards so the VCO runs in the 222 MHz range on TX and around 178 MHz on RX.

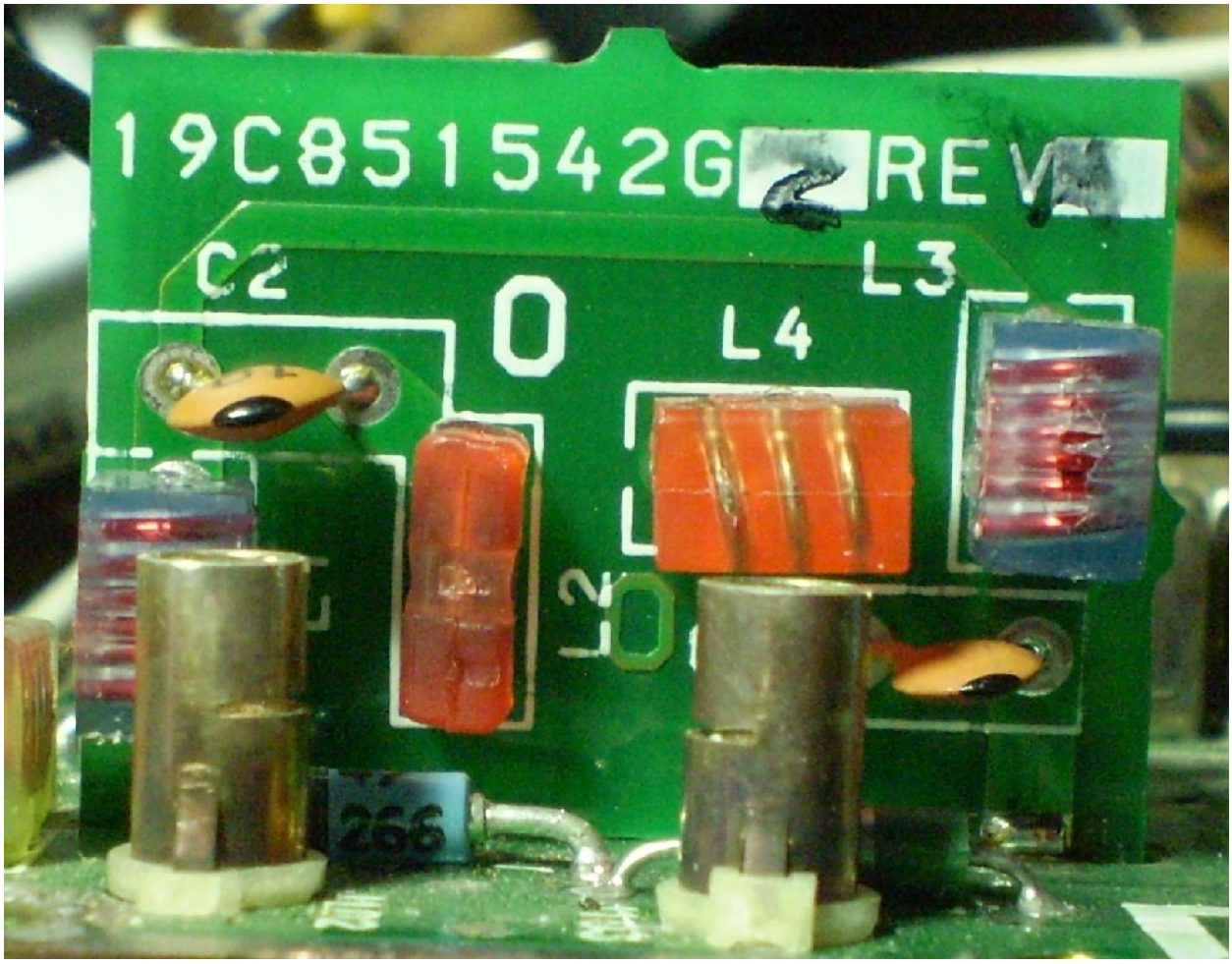
Set the radio to receive on 224.80 MHz. Adjust R218 for 6.5 VDC as measured on test point J201.

Phase 3: Low Pass Filter

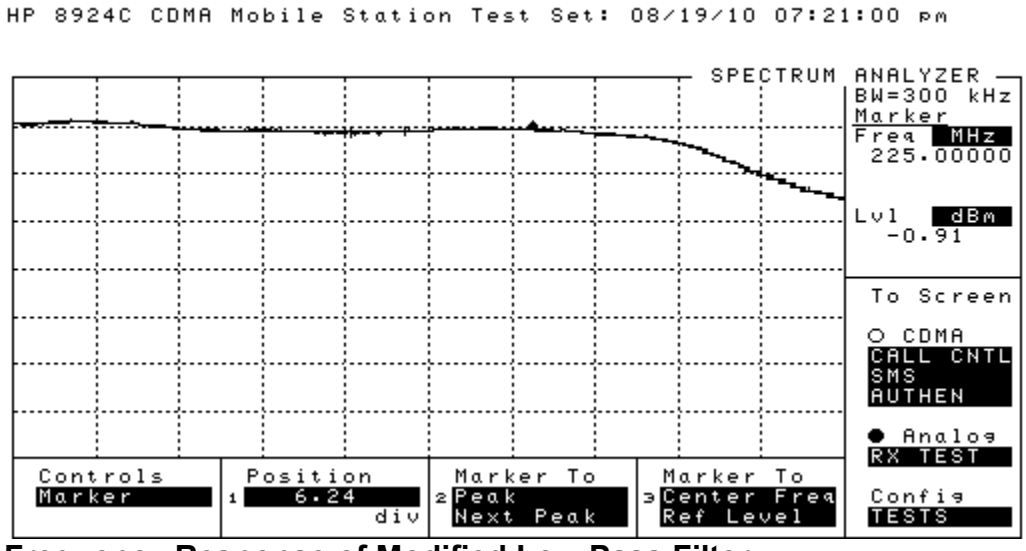
With the RF board out of the radio the Low Pass Filter can be modified easily.

Remove the 18pF capacitor at position C2 and replace with 10pF. Remove the 11pF capacitor at C3 and replace with 4.7pF.

This raises the 3dB corner frequency to approximately 250 MHz. The loss at the 2nd harmonic frequency of 447 MHz was measured to be -56dB



Modified Low Pass Filter Installed on RF Board



Frequency Response of Modified Low Pass Filter

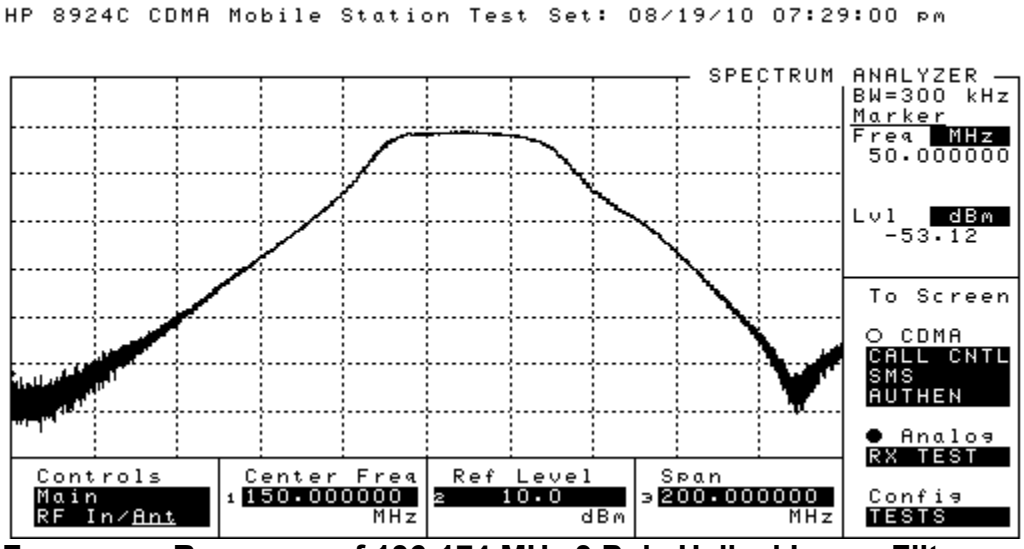
Phase 4: Receiver

Remove RF board from chassis again.

Replace L405 with a 110uH coil, 9 Turns of #22 wire closely spaced on a 1/8” drill bit. The magnet wire is available from Radio Hut in the 315 ft. Magnet Wire Kit #278-1345, It is the spool that is gold in color. Remove the enamel from the ends of the coil and tin it. I like to do both operations at once with a pool of solder on the end of a broad tipped iron. Leave the coil on the drill bit while tinning to act as a heat sink.

Replace L402 with a 44uH coil. 4 ½ turns of #22 closely spaced on a 1/8” drill bit. Follow same procedure as L405.

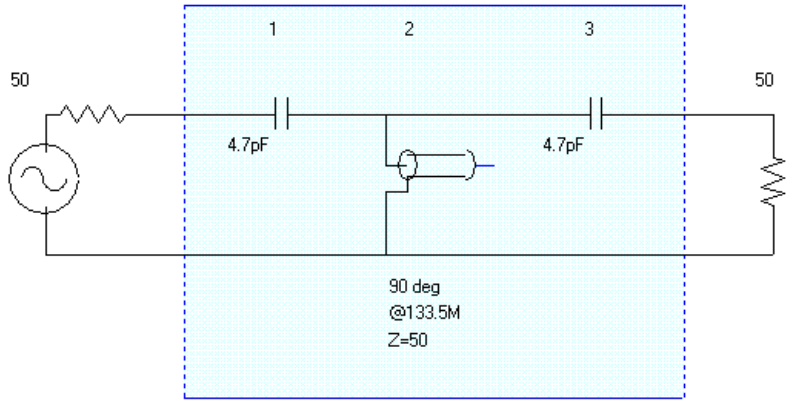
Remove Z401. This is a 3 pole tuned helical filter set to cover 136-174 MHz. The filter was determined to be too small to work on.



Frequency Response of 136-174 MHz 3 Pole Helical Image Filter

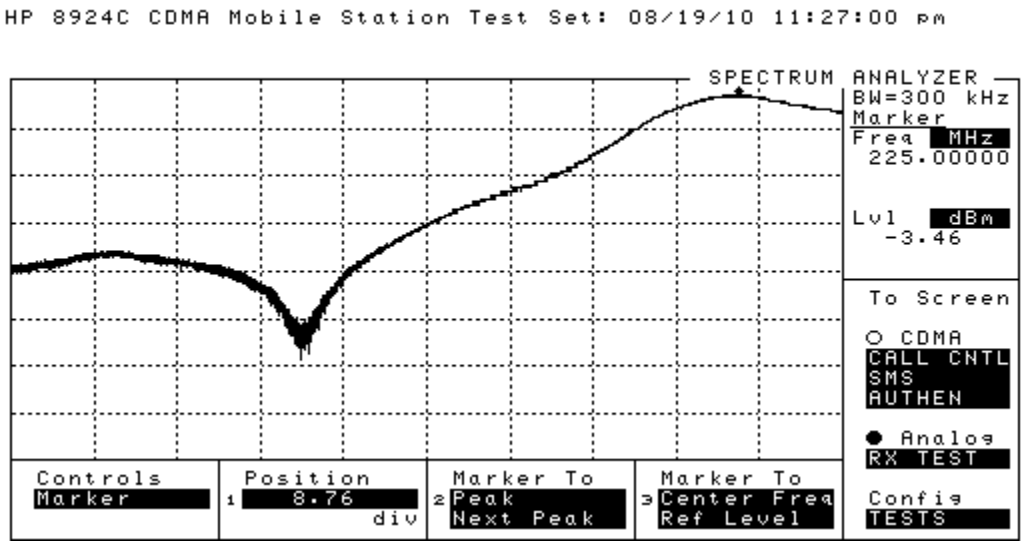
Construct a replacement image rejection filter for with the following components:

2 x 4.7pF capacitors
1 x 90 degree open coax stub cut to 133.5 MHz + 0.5” (15.25” for RG-174u)



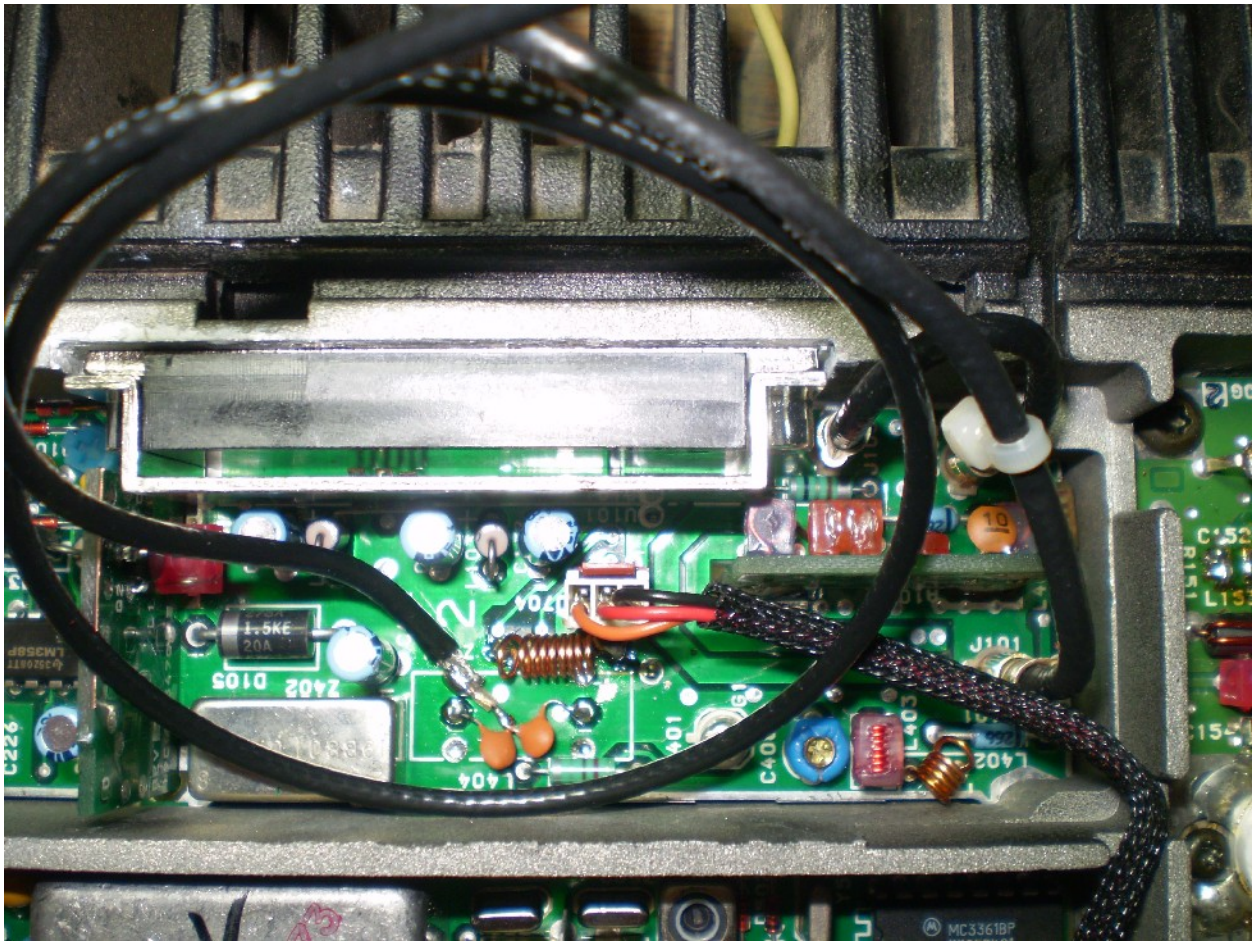
Replacement Image Filter Schematic

Install filter in original position of Z401. Solder the capacitors to the I/O holes of Z401 and solder the outer conductor of the coax stub to ground.



Replacement Image Filter Measured Performance

Reinstall RF board in chassis. Tune receiver. Adjust the spacing of L402, L405 and turn C408. My receiver came to -118dB for 12dB SINAD.



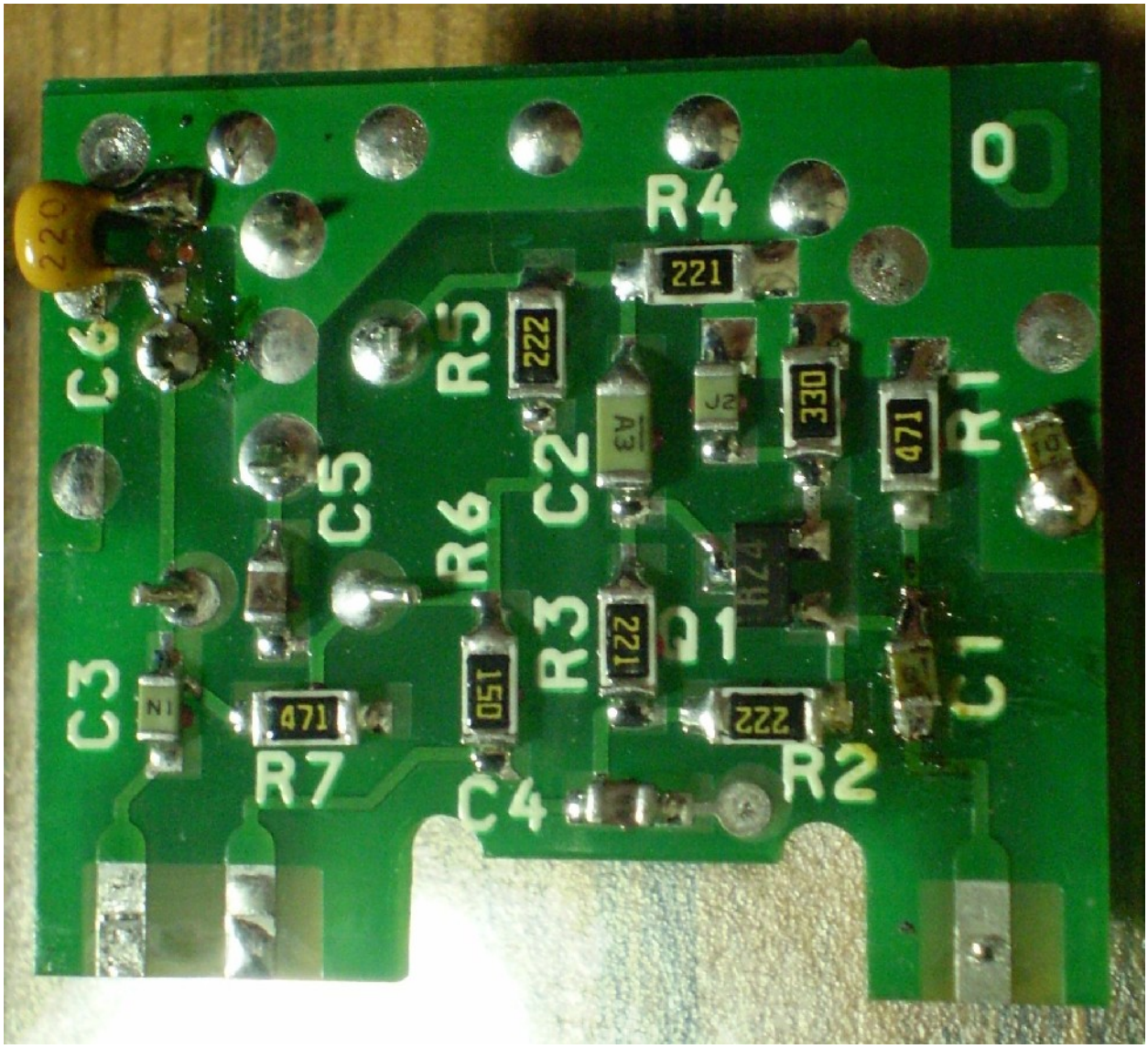
Modified RF board, showing replaced L402, L405 and Replacement Image Filter.

Tune image filter. Set a signal generator for the current receive frequency minus 90 MHz. Trim stub for lowest received signal, increase generator output as necessary. Test radio was able to make 86dB of image rejection.

Phase 5: 200mW VHF TX Exciter

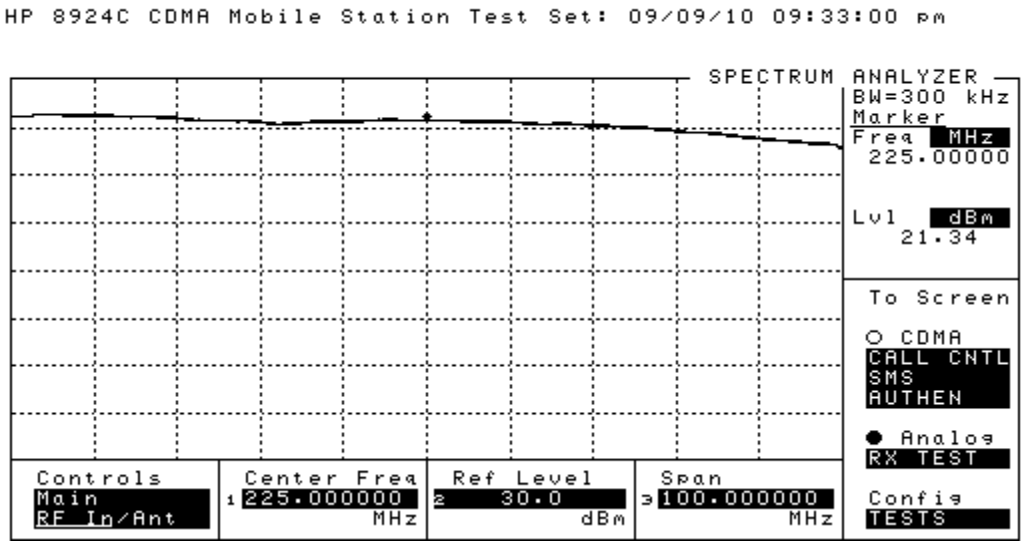
Remove the TX Exciter from the RF board using a wide braid solder wick and suitable iron.

Remove the 39pF capacitor at C6 and replace with 22pF. Replace the capacitor at C1 with the 39pF capacitor removed from C6. This raises the 3dB corner frequency of the exciter to approximately 275 MHz.



Modified TX Exciter Board

Reinstall TX Exciter into RF board. Keep boards at 90 degree angle to each other while soldering.

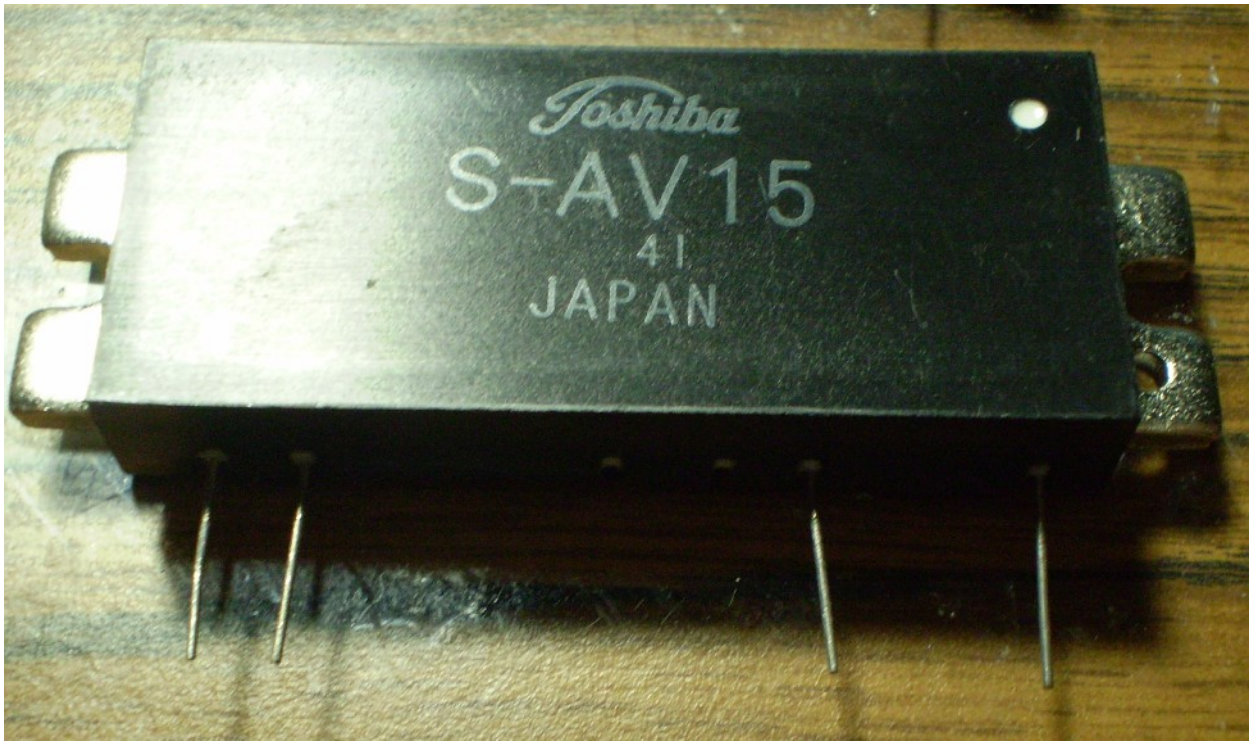


Modified TX Exciter Board Power Output

Phase 6: 10W VHF Power Amplifier Replacement

The following Power Modules are in the H2 style case and are drop in replacements for the M57719 which is currently in the radio.

Module Part Number	Power Input	Power Output
M57774	300mW	30W (Class C)
M68729	300mW	30W (Class C)
SAV15	200mW	30W (Class C)



SAV15 Power Module

While it is pin compatible with the radio, the RA30H2127M requires some additional modifications.

Module Part Number	Power Input	Power Output
RA30H2127M *	50mW	30W (MOSFET)

Pin 2 of the RA30H2127M is Vgate instead of 1st Amplifier Vcc. This pin requires 5 volts to reach full gain of the module. Voltage above 6.5 VDC may cause damage. It is recommended to add a 470 ohm resistor between the base of Q101 and ground, but this has not been tested.

It is also recommended that the metal case of the module be machined flat for optimum contact with the heat sink to enhance the impedance to ground and thermal transfer. It is possible to do this with a belt sander and a fine grit belt such as 220 and higher. Care must be taken not to absorb the metal particles into your skin or breathe them, otherwise metal poisoning may result.

Remove the module currently in the radio and clean the holes with solder wick. Insert the new module into the board but do not solder it until the RF board is inserted back into the radio and the rear case screws are in place. There should be enough excess thermal paste on the heat sink and additional compound should not be necessary.

These modules may provide the user with adequate power and the 45W VHF Power Amplifier stage can be bypassed by placing a coax jumper between J102 and J103 on

the RF board. The test radio was able to produce 25 watts after the low pass filter using the SAV15. If used in conjunction with the 45W PA, power output of the module should not exceed 10W.

Phase 7: 45W VHF Power Amplifier

Remove C151

Replace L151 with wire jumper close to PCB

Replace C152 with 56pF ceramic 1206

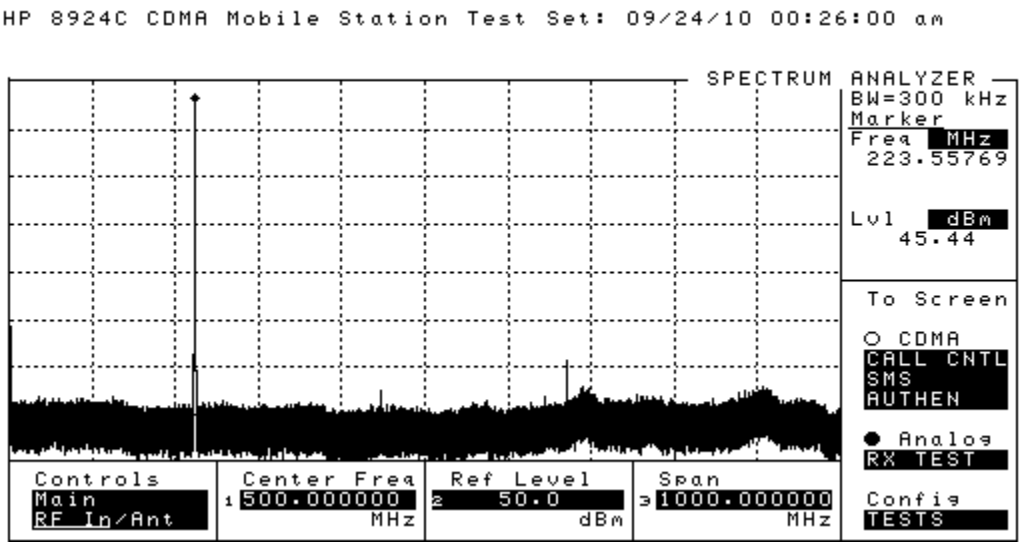
Remove C156 & C157

Install a pair of 43pF ceramic 1206 capacitors or 1 each 39 and 47pF on Q151 Collector and emitter leads

Remove C158, 33pF and install at C157

Remove L156 and modify to 1/2 turn and reinstall

Install 20pF ceramic 1206 at C158



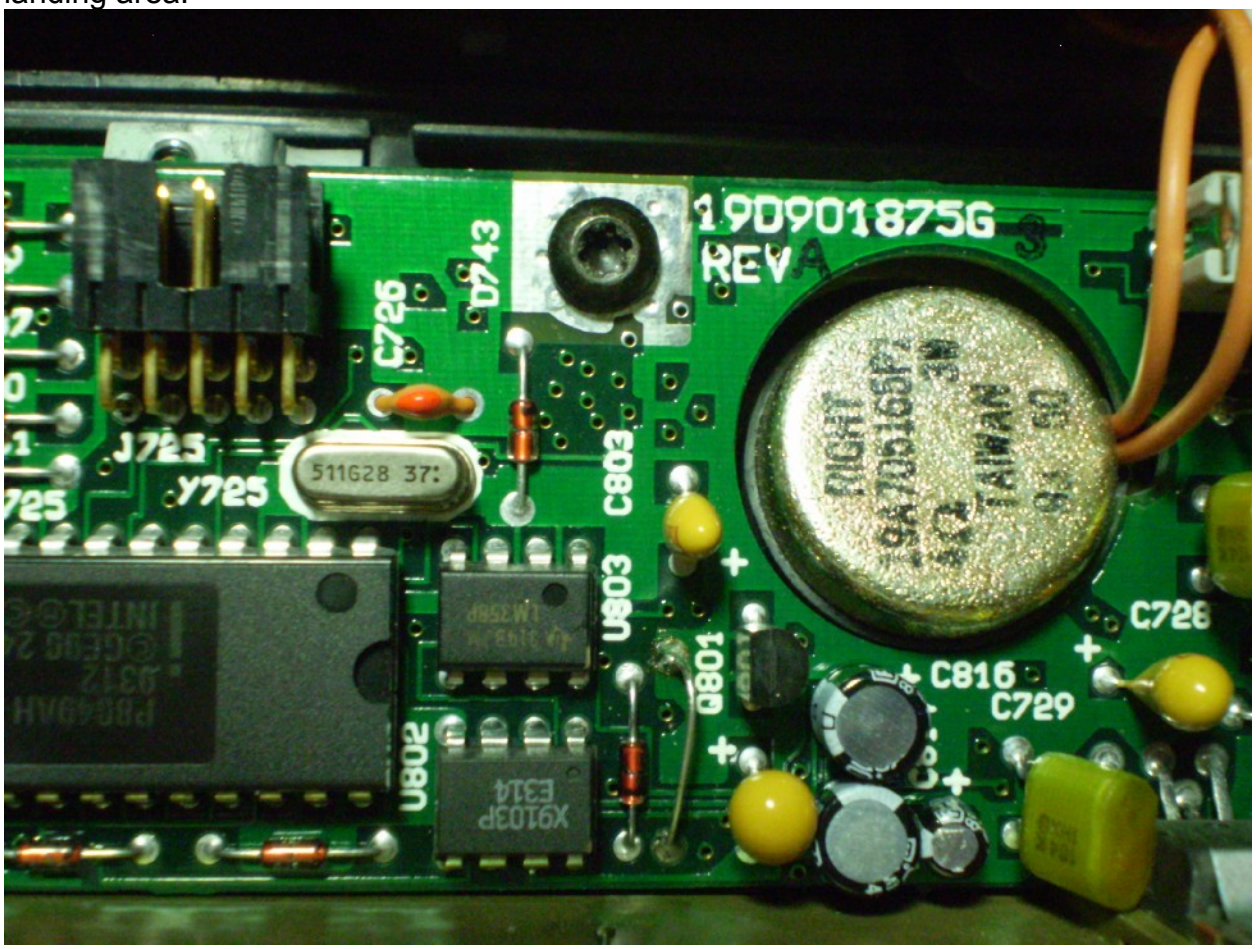
Modified 45W PA Spectral Purity

The test radio was able to produce 45 watts after the low pass filter. 3rd harmonic was approximately -54dBc

Optional Modification: Internal Speaker Audio Level

By design the radio will not silence the speaker audio. This can be annoying if the radio is placed into link service, APRS and other applications where speaker audio is only occasionally needed.

To remedy this, replace R811 on the Front panel board with a 0 ohm resistor or wire lead. If wire lead is used, leave clearance space as there is a via right under the resistor landing area.



Modified Front Cap Assembly

Photographs by: Matt Krick, K3MK

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