FLUX RESEARCH

Technical Service Bulletin:
FXR-16

Modifying GE PCS 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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By: Matt Krick, K3MK
DCFluX@yahoo.com

Radio Model #:

GE PCS - PC1H3A02
PC2H3A02
PC1H3A08
PC2H3A08
PC3H3A16
PC4H3A16

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-38955A PCS Standard / Scan / DTMF Portable Radio Operator's Manual
LBI-39133 PCS Standard / Scan / DTMF 4, 8, 16 Channel Operator's Manual
LBI-38454D PCS Radio Front Assembly - 19D902177G5 (2 Channels), 19D902177G6 (8 Channels)
LBI-38975D PCS Radio Front Assembly - 19D902177G17 Conventional & 19D902177G18 Conventional / DTMF / Scan
LBI-38275F PCS Rear Assemblies 19D902175G1 (136-153 MHz) & 19D902175G2 (150-174 MHz)
LBI-38956A PCS 136-174 MHz Synthesized Portable Radio Maintenance Manual Front Assembly (Front Cap Assembly & Audio Logic Board) LBI-38975, Rear Assembly (RF Board) LBI-38275, Service Section LBI-38623
LBI-38623A PCS Personal Radios Service Section

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. If the radio does not make at least 3 watts of output power, do not proceed with conversion until repairs are made.

Phase 1: Operating Frequency Reprogramming

Hack the original GE PCS Plus v6.0 software to allow out of range programming.

Copy PCSP.EXE to PCSP220.EXE

Using a suitable hex editor such as XVI32, Edit PCSP220.EXE and make the following changes:

Hex Address	Original Data	New Data
&H1F778	16	00
&H1F77C	2E	61

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 now programmed as 133.500 MHz.

For testing program the radio to the following:

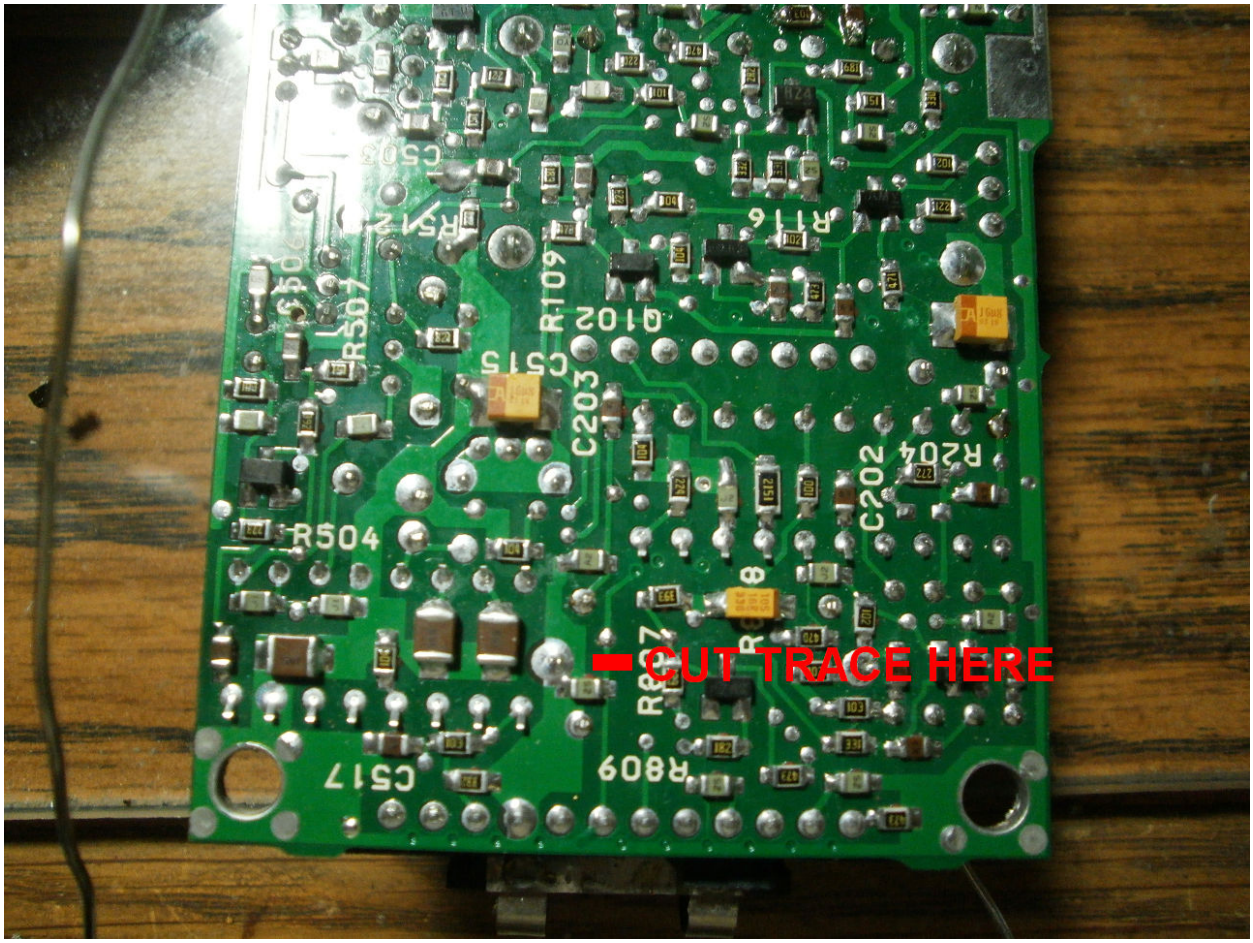
Channel 1 – 223.500 MHz Simplex, 100 Hz PL Encode, High Power
Channel 2 – 223.500 MHz Simplex, 100 Hz PL Encode, Low Power

Phase 2: VCO

Open the radio and remove the Rear assembly. Torx T-10 is used as well as a straight screw driver to pry along the edges.

The BNC connector is removed by first loosening the Alan set screw (0.050) on the rear casing. Desolder the center pin from the strap coming off of the RF board and unscrew the BNC connector from the chassis. A BNC Tee adapter makes a good tool to grip the connector when removing or installing into the chassis.

Cut the trace on the RF board, feeding the /PTT signal to the VCO assembly.



Install a logic inverter consisting of a surface mount NPN transistor with a 10K 1/8 W resistor on the base lead. Solder emitter to ground, base resistor to P801, pin 7 and the collector to the solder pad just after the spot that was cut.

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.

Phase 3: Low Pass Filter

Remove the 33nH inductor at position L107 and replace with 22nH. Wind 3 ½ turns of #22 wire on a 3/32" drill bit.

The magnet wire is available from Radio Hut in the 315 ft. Magnet Wire Kit #278-1345, #22 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.

Phase 4: Receiver

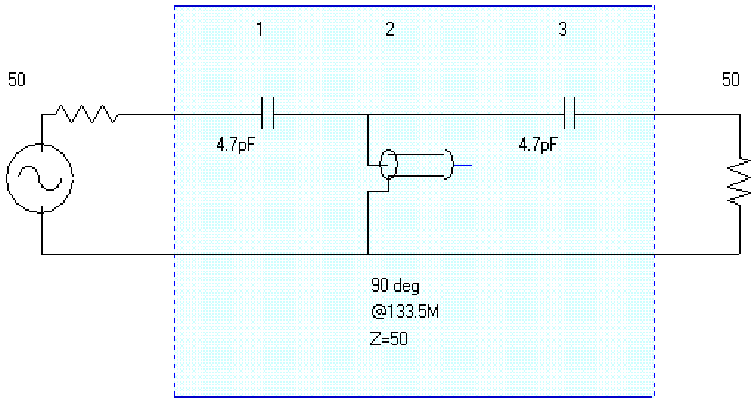
Install 4-40 - 3/8" Brass screws in inductors L401, L402, L403 and L404. On some versions of LBI-38275, L404 is called L454 on the parts placement diagram. Gently insert the screws all the way in to the coil forms.

Remove Z401. This is a tuned hybrid filter set to cover 136-174 MHz. The RF shielding surrounding the filter can be easily removed by peeling the metal away with needle nose pliers and side cutters.

The filter can be bypassed with a single piece of wire bridged across the input and output pads. Leave enough height so that the wire does not come into contact with the ground holes. The image frequency rejection is only 6-8dB with the wire so it is recommended to replace the front end filter.

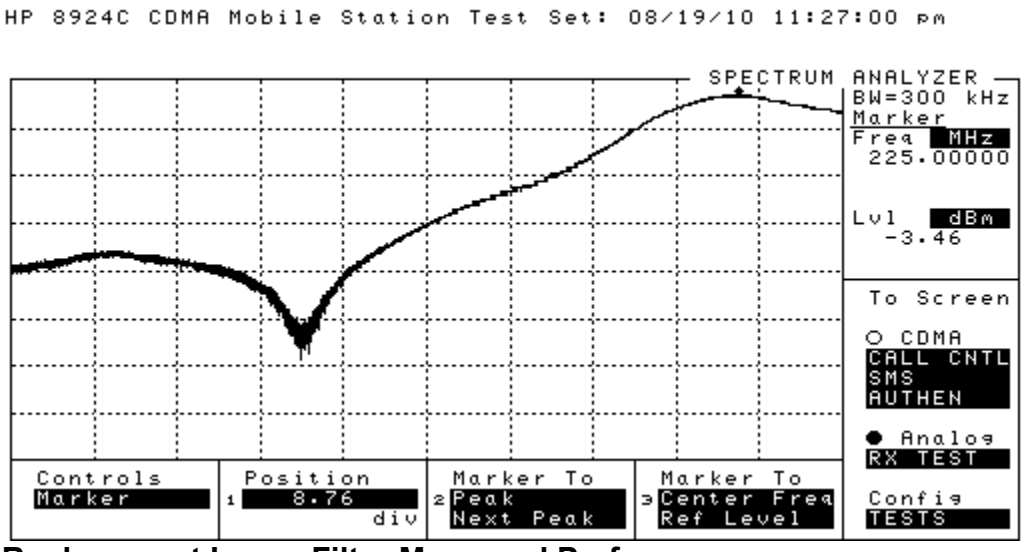
A replacement image rejection filter may be constructed with the following components:

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 the new filter in the 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

Phase 5a: 5W VHF Power Amplifier Replacement

MHW607-4 is specified for operation at 184 - 210 MHz. This would be a drop in replacement for the MHW607-2 that is currently in the radio, however testing was unable to be accomplished due to the availability of the module therefore it is unknown if it is suitable for operation at 220 - 225 MHz.

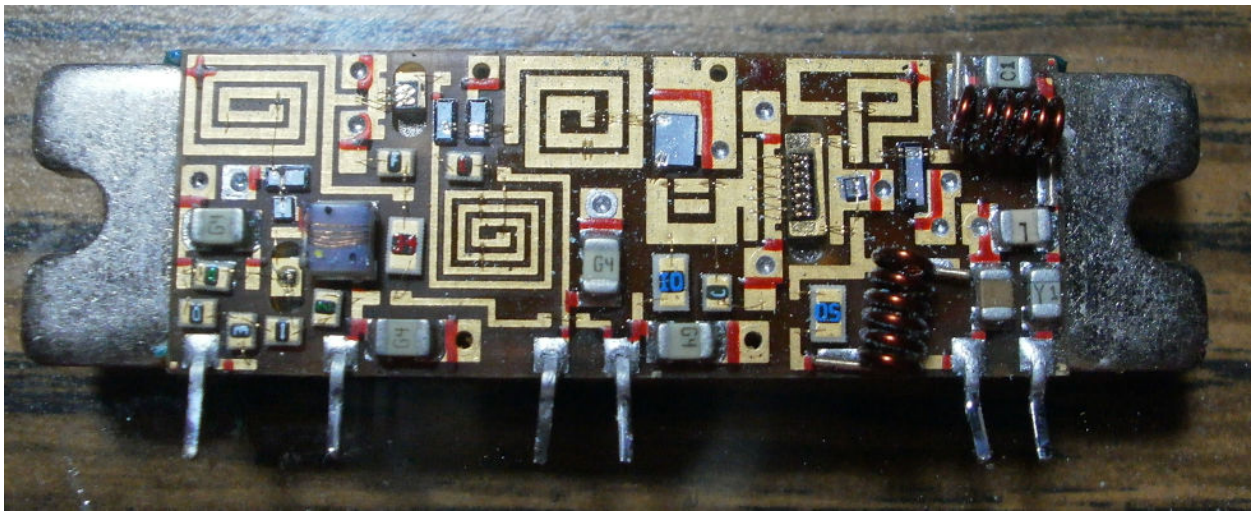
Phase 5b: 5W VHF Power Amplifier Recycling

The MHW607-2 which is currently in the radio can be re-tuned to provide up to 5W in the 220 MHz band.

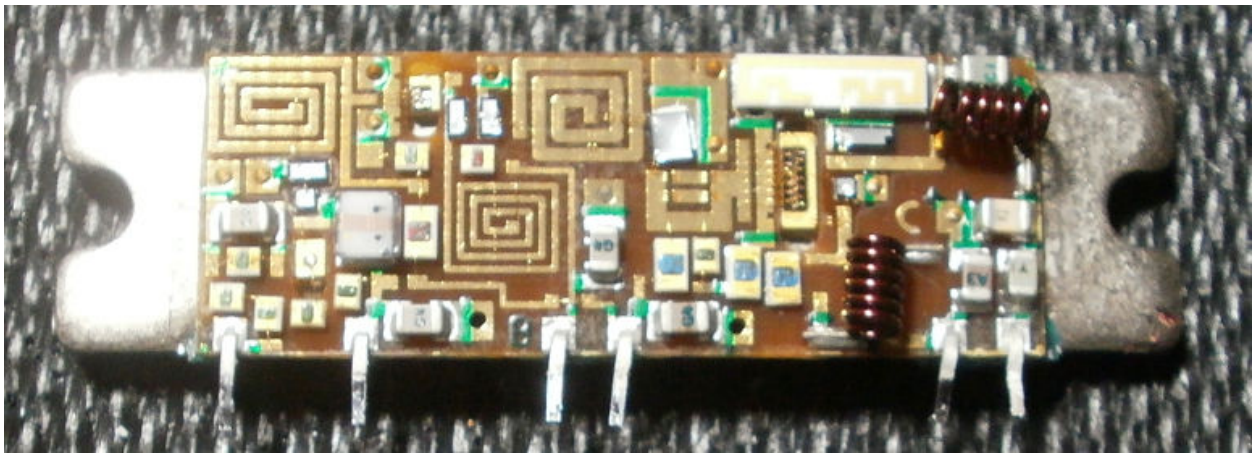
MHW607-2

Start by removing the power amplifier from the RF board and remove the lid. The lid is glued on pretty good and may be damaged during the removal process. Take care not to damage the components under the lid. I separate the front glue by cutting the plastic right above the leads.

There are 2 generations of modules. The late version changed to use a SAW filter after the final transistor.



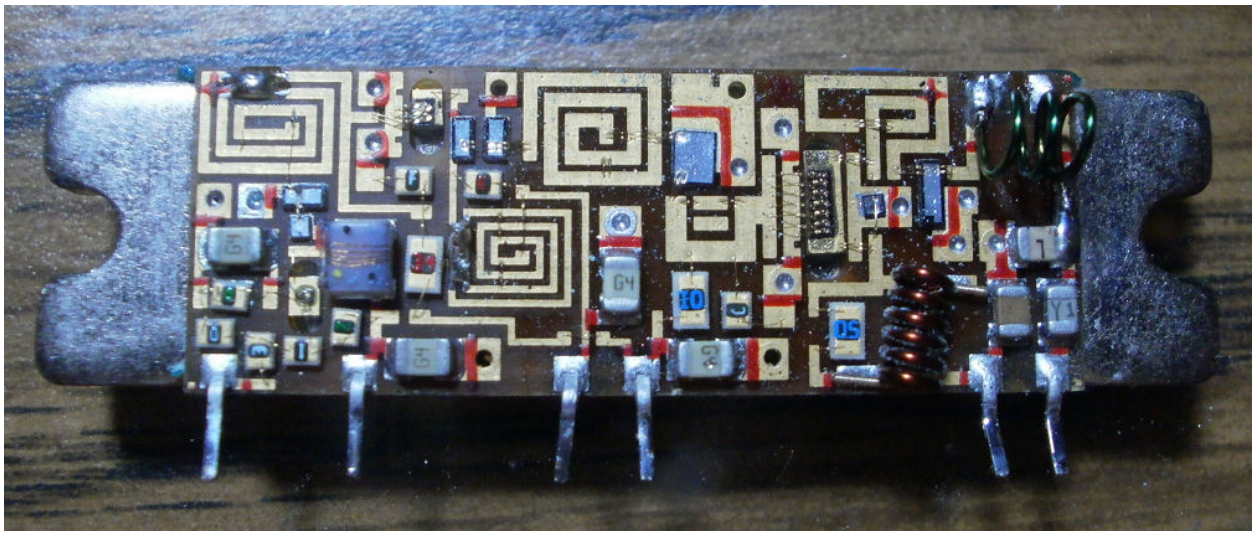
MHW607-2, Date code 9043



MHW607-2, Date code 9251

Some radios were observed to have the SHWJ1039 and the XHW1031, both of which appear to be similar to the late model MHW607-2

Remove the surface mount capacitor and coil in the upper left hand corner of the module. Wind a replacement inductor Using 3 turns of #26 (Green) on a 3/32” drill bit. Install replacement inductor in the position of the original.



Modified MHW607-2, Date code 9043

Cut a hole in the plastic cover to facilitate fine tuning of the inductor that was installed. The cover can also be left off, but take care not to touch the bonding wires on the module while handling.

Reinstall modified module on to the RF board. Reinstall RF board in chassis. Screw in BNC connector and tighten set screw before re-soldering to the RF board.

Modified RF Board

Phase 6: Tuning

Test Cable 19B801406P62 is needed to service this radio while open, connecting the front and rear assemblies together.

A substitute cable was constructed with the connectors salvaged from a dead PCS and some 12 conductor ribbon cable. Standard 0.1” spacing 12 pin male and female SIP headers may also be used.

Opened PCS Radio

Turn R119 fully clockwise. Set radio to a channel programmed for high power.

Adjust spacing of the coil installed at L107 for maximum RF output as seen on a watt meter. Use a fingernail or small screw driver to change the spacing of the windings.

If you recycled the RF power amplifier, Adjust spacing of the coil that was installed on it for maximum RF power seen on a watt meter. Be careful not to short circuit the power module with a metal tool as that usually results in destroying the final amplifier.

Readjust L107 and the PA until no additional improvement is seen. If the radio makes over 5W, adjust R119 to bring power down to that level. Power modules converted were able to make between 2 and 5 watts of output power.

Switch radio to a channel programmed for low power and adjust R11 on the Power Control Board for 2W or the desired output setting.

Adjust R321 until 750 Hz of PL deviation is achieved.

If constructed, Tune the image filter. Set a signal generator for the current receive frequency minus 90 MHz. Trim the stub for lowest received signal, increase generator output as necessary.

Some tweaking of the brass screws can be done to optimize the receiver's sensitivity. Test radios were able to make -117 to -118dBm for 12dB SINAD and squelch threshold was around -120dBm to -122dBm.

R608 sets the receiver's squelch threshold. Refer to LBI-38623A PCS Personal Radios Service Section for the procedure to set this.

Remove test cable and reassemble the radio.