PHILIPS

FM92E

Conversion

To

6 Meters

Part 1

Ver 4.0 - **09 May 2007**

Rod McCosker VK2DOT

Philips FM92E Conversion to 6 Meters Part 1:

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1: Introduction to Project:

This paper is a rough guide for the conversion of a Philips FM92E band transceiver to 6 meters. This project is for the Central Coast Amateur Radio Club's Tuesday Nite Group. The information contained within this document is derived from other Australian 6 meter conversion projects plus our own experimentation. The outcomes of this document, is to enable the easiest method to perform the conversion project. The project will take approximately 12 hours for a component technician or longer for other amateurs. The document should be able to be used by external amateurs to the club who intend to embark on this project.

On the first nite it will be determined if conversion members need a soldering refresher course and, if there are enough numbers to warrant the soldering refresher course, then the Tuesday Nite Group will conduct such a course to enable members to be able to complete this conversion. It is estimated that the Tuesday nite group will take approximately 3 months to complete this project. After each Tuesday nite, this documentation will be updated and uploaded to the VK2AFY web site, so look at the version number above. This should result in the experiences of members being included into this document.

The "Tuesday Nite Group" convenes each Tuesday nite of the month from 7:30pm till 9:00pm. The philosophy and schedule for the group is promulgated on the **vk2afy.dyndns.org** web site under Tuesday Nite Projects & development - **Philosophy**. The meeting Schedule is under the heading – **Meetings**.

The EPROM for the Philips FM92E has been setup for either local or remote heads. The number of channels and the frequency range of the EPROM is 77 channels and from 52.525Mhz to 53.975Mhz. The frequency range has been setup to transmit & receive on the FM allocation within the 6 meter band. There are repeater channels, reverse repeater channels and repeater simplex channels. EPROM's will be supplied to club members who are on the course. At the end of this document is information on programming the EPROM, for external users who intend to program their own EPROM. The software for setting up the firmware is also located on the web site.

This document [**6m_con.doc or 6m_con.pdf**], the 6 meter frequency verses channel list [**6m_fre.rtf**] and the EPROMs [**6m?loc.bin, 6m?rem.bin, 6mtest?l.bin, 6mtest?r.bin** etc] are located on the VK2AFY web site at **http://vk2afy.dyndns.org/6mconv/6mfiles.htm**. Go to the projects section, and click on the **FM92E Conversion to 6 meters**. These files will also be available on the main clubs computer, under the directory "**D:FM92E Conversion to 6 meters**". You will be able to transfer them to your USB memory stick, or print out the documentation on the club's duplex laser printer; You can also burn a CDROM or DVD with the files.

At the end of the 6 meter conversion, Bruce VK2ZAD will be conducting 6 meter antenna building nights. The 6 meter antenna will be a companion for the Philips FM92E we has just converted to 6 meters. He will be supplying a goods required paper – for building the antenna. The building of the antennas will be conducted on the following Tuesday nights, after the conversion is finished.

The FM92E conversion to 6 Meters should start on Tuesday the 6th of March 2007 at the club rooms at 7:30pm till 9:00pm. The club has a number of Philips FM92E's available for conversion. These transceivers will be free to members of the club.

Information for this conversion has been gleaned from and thus acknowledgements to Amateur Radio May 1997, Amateur Radio June 1997, VK2KFJ, VK2TMF, VK2TPH, VK6ZTJ, VK4KTP, VK4KCS, VK2XMD, VK1 Technical Group, VK3GK, VK3BYY, Blue Mountains Amateur Radio Club, SKINNY'S HOME OF RADIO, VK7ZRO plus other Australian amateurs. The information has been collected over 15 years in anticipation to conducting this conversion.

If you need to add extra information or change this document, please send the information to Rod at **vk2dot@iinet.net.au** and we will insert or change your information.

2: PART 1 INDEX:

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PART 3 INDEX:

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3: Initial Check:

- Unfortunately this can not be completed easily with the CCARC FM92E's supplied. So for the Tuesday Nite Group, the Initial Check will be conducted by installing the 6 Meter Test EPROM. All other users of this document should have a EPROM installed in their FM92E transceiver. Thus they should commence the "initial check" as the first thing done. However be careful when checking the transmitter, do test it into a shielded "Dummy Load", for you do not want to interfere with a commercial operator on the transmitter frequency.
- When you remover the covers from transceiver, do not loose or get mixed up with other transceiver top's & bottom's. These covers normally have information on the EPROM's.
- Plug in Test EPROM into FM92E [only for club members]. See chapter 38 "FM92E Test EPROM 68-88 Mhz Channel verses Frequency List:" and chapter 16 "EPROM Change:".

  6mtest1l.bin = Local Head Test EPROM 10.7 MHz IF.
  6mtest2r.bin = Remote Head Test EPROM 21.4 MHz IF.
  6mtest3l.bin = Local Head Test EPROM 10.7 MHz IF.
  6mtest4r.bin = Remote Head Test EPROM 21.4 MHz IF.
- Check under one of the top or bottom covers for the list of frequencies, that was used originally by the transceiver.
- Switch on Transceiver and check that it works ok. [ie lights work & mute works, etc].
- Go to the nearest Mhz of one of the frequencies [68 – 88 Mhz].
- Go to the channel Number for that Mhz on the chapter 38 "FM92E Test EPROM 68-88 Mhz Channel verses Frequency List:" by the up/down buttons.
- With signal generator check that the receiver works.
- With the RF Power Meter check that RF power is being generated into dummy load & power meter.
- Switch off set if working ok.
- Remove EPROM.
- Plug in EPROM **6m1loc.bin**, **6m2rem.bin**, **6m3loc.bin**, **6m4rem.bin**, **6m5.bin**, **6m6.bin**, **6m7loc.bin** **or** **6m8rem.bin** See page 3 on "Files associated with this project". to EPROM socket. EPROM notch points away from hinges of Synthesiser board.
- Replace EPROM tin box over EPROM, 4 screws.
- Screw down the Synthesiser board.
- Replace cover for Synthesiser board side.
- Clean up FM92E transceiver. * This can be done at any time.

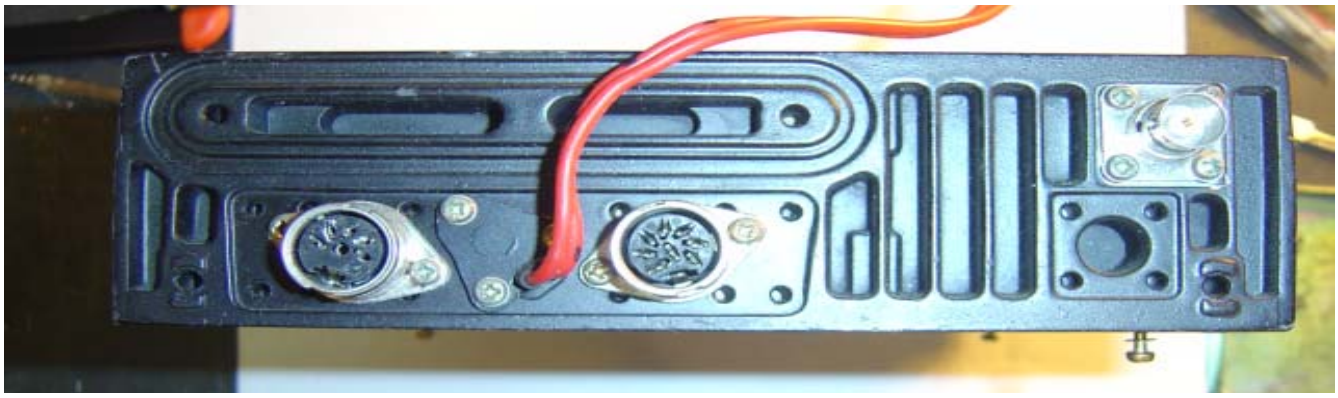
4: Speaker Socket Change:

This change is only conducted if you are converting a Philips FM92E local control head and do not intend to use the rear 5 pin for the speaker socket.
NOTE: The FM900 remote head has a built in speaker, thus this change is not necessary.

5 pin DIN -> Earth - Black Pin # 2
Speaker - Grey Pin # 4
Cradle - Mauve Pin # 1

You only need to change the speaker 5 pin DIN output socket, if you intend to keep all of your speaker leads standard as a 3.5mm socket.

Remove 5pin din socket from rear of chassis.
Replace with flat piece of metal or similar material approximately 20mm by 30mm.
Mark mounting holes from removed 5 pin din socket mounting points.
Mark center from above two marked holes.
Drill 2 holes, the outer two for the two mounting screws.
Drill 1 hole in center to hold 3.5mm socket.
Mount 3.5mm socket.
Black wire to outer shell & **grey** wire to center pin.
Isolate the **move** wire by shrink tubing.

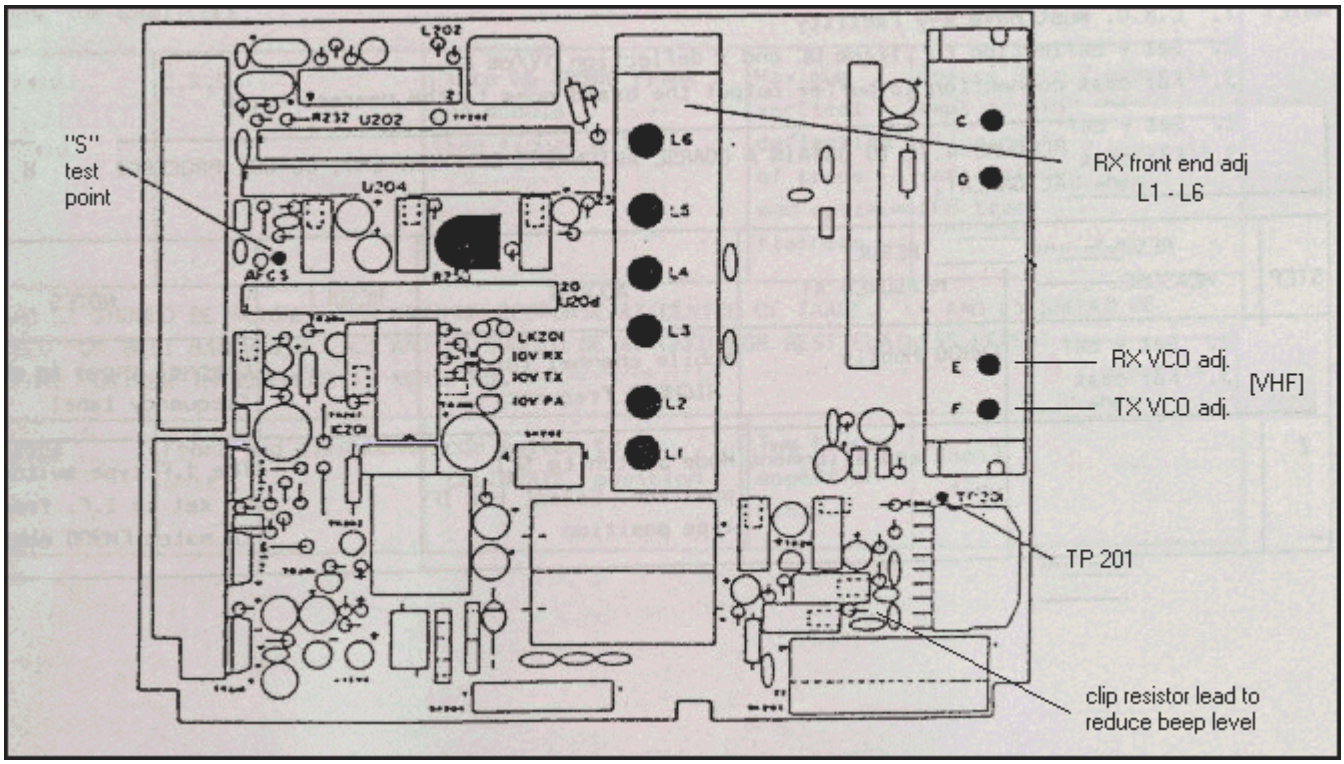


FM92E Rear View.

5: Initial Pull-Apart:

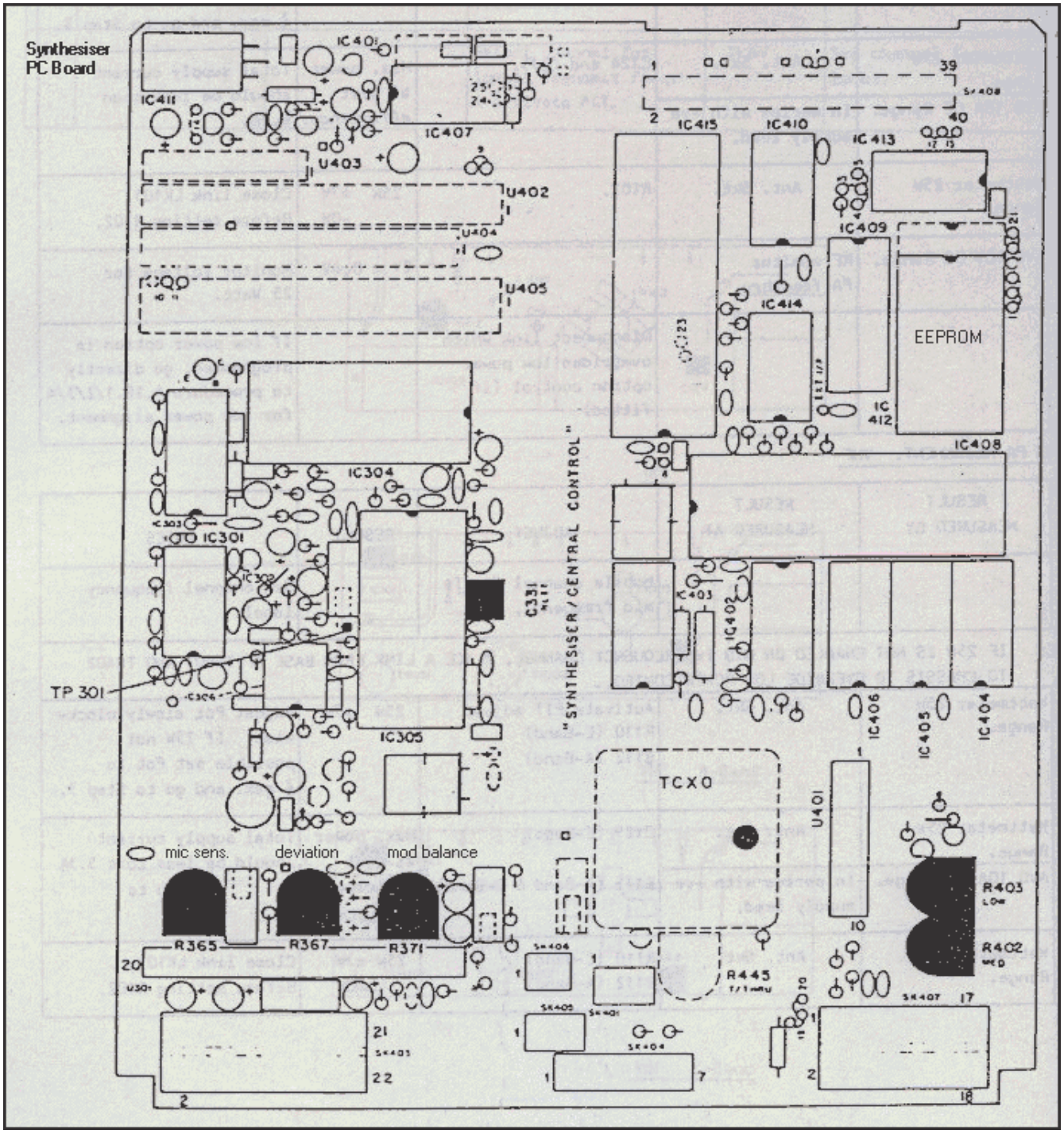
- Remove top & bottom covers from Philips FM92E transceiver.
- Place top & bottom covers into A4 plastic GLAD bag.
- Place all screws into small plastic GLAD bag.

6: Board Layouts:



RF Board:

- All boards are hinged from the front.
- To swing boards upright to allow access to the component side, unscrew the screws on the blank side of the boards, that have an arrow pointing to those screws.
- The screws do not screw all the way out.
- The RF Board has normally 6 screws to undo for the board to swing out.
- The Synthesiser Board has normally 4 screws to undo for the board to swing out.

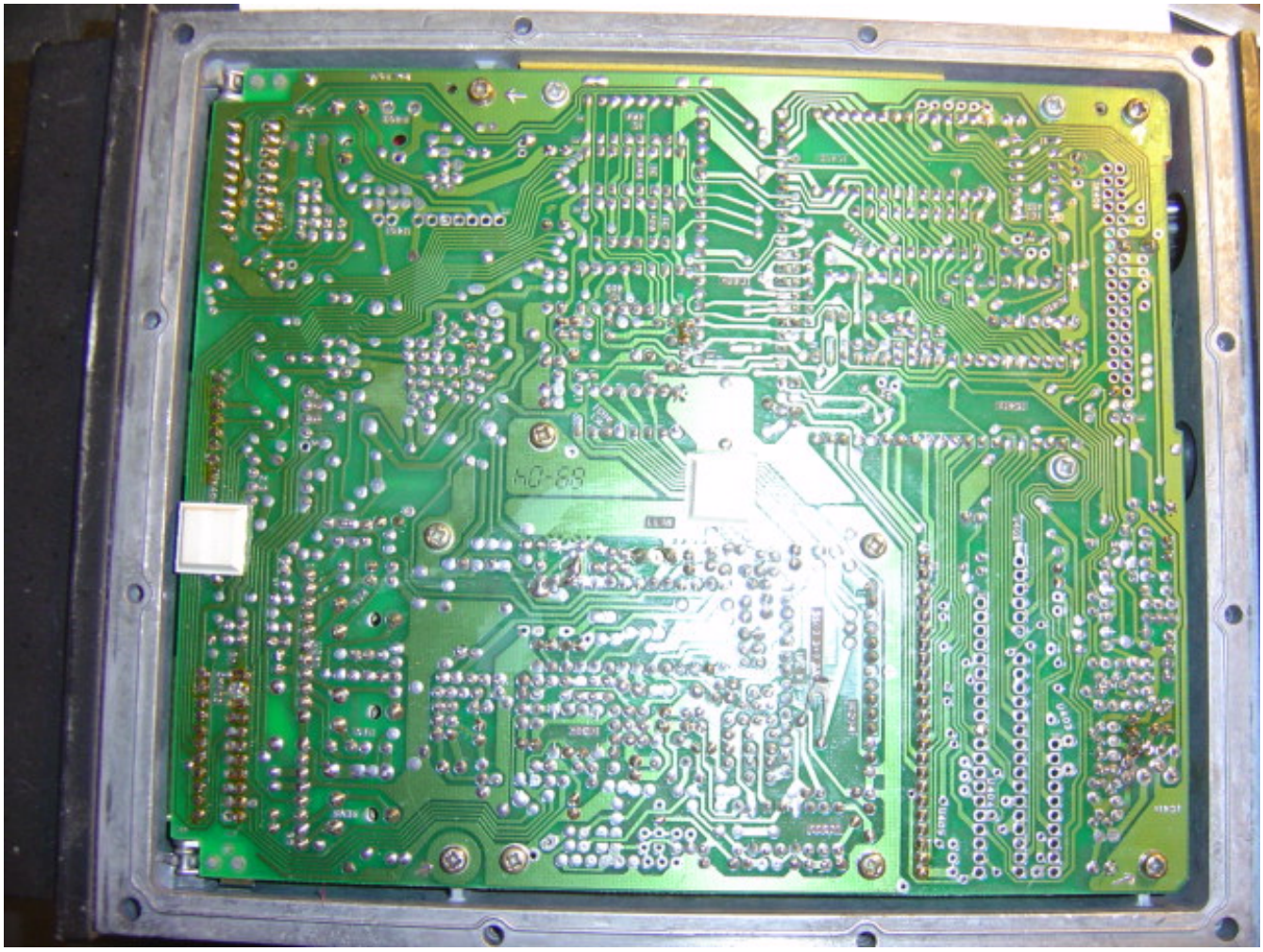


Synthesiser Board:

7: EPROM Change:

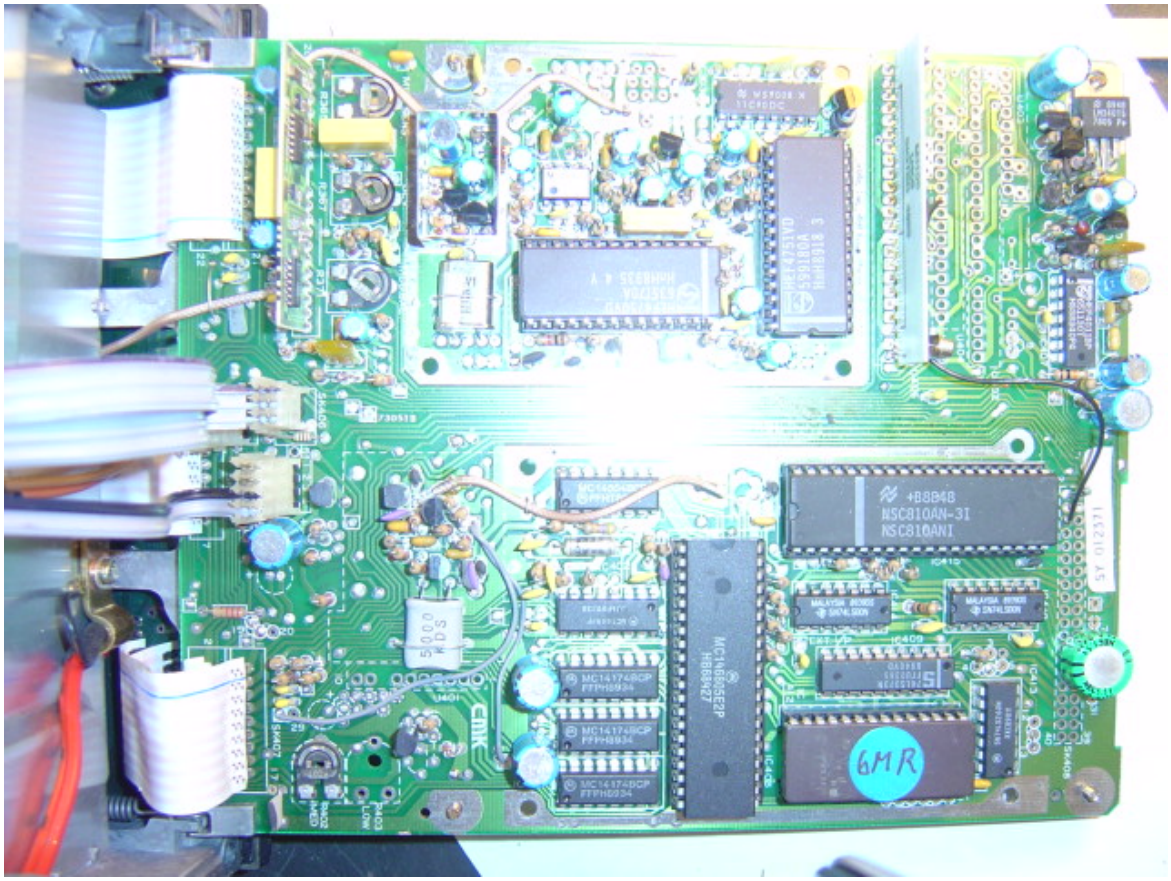
- Remove cover on Synthesiser board side from the FM92E Transceiver, this is the side closest to the two sockets at the rear of the FM92E transceiver. Then mark the cover with your call-sign, then place it & the cover's screws into their GLAD bags & mark your Glad bags with your call sign. Should be a minimum of 5 screws.
- Remove cover from receiver side of FM92E transceiver. This is the side furthest away from the rear two connectors; Side closest to the antenna connection. Unscrew the six screws from the Receiver PCB and swing out.
- Check out and note the IF frequency on the side of the RF/Mixer module. [It is normally hand written.] It should be 10.7 MHz or 21.4 MHz.
- Note if the FM92E transceiver is remotely or locally controlled.
- Note the center frequency or single frequency your transceiver was working on.
- Undo screws, holding the Synthesiser board down. Swing Synthesiser board out.
- Remove can covering the EPROM socket. [4 screws] Place Can & Screws into Glad bag.
- Solder single fuse holder onto positive power lead [red cable from transceiver; **NOT** red lead with black dashes]. Or; remove fuse section on earth lead from transceiver, then connect this section via fuse to the positive section of the red wire from the transceiver. * This can be done before EPROM can removal.
- Solder 12 Volt black cable power cable onto the earth lead from the transceiver [red with black dashes] and red onto end of fuse. * This can be done before EPROM can removal.
- Plug in Test EPROM **6mr912t.bin** [EPROM for Philips FM91E converted to FM92E with remote head] to EPROM socket; For testing the FM92E Transceiver from 68-88 MHz. EPROM notch points away from hinges of Synthesiser board.
- Apply 12 Volts to the FM92E Transceiver. Check that audio emanates from the speaker
- With a Signal Generator check that FM92E receiver mute works under 4 micro Volt on test frequency and note this reading.
- Connect VHF Power Meter and press PTT button so a power out is registered on the Power Meter. Note the power reading.
- Disconnect Power.
- Remove EPROM.
- Plug in EPROM **6mr3.bin** [EPROM for Philips FM91E converted to FM92E with remote head] to EPROM socket. EPROM notch points away from hinges of Synthesiser board.
- Replace EPROM tin box over EPROM, 4 screws.
- Screw down the Synthesiser board.
- Replace cover for Synthesiser board side.
- Go to Section 3, and check out which **6m?t?.bin** file meets the above criteria for testing. eg The FM92E is a **remotely controlled** transceiver with a **21.4 MHz IF**. Then download the test file, to initially check the transceiver. [ie download file **6m?t?.bin**.]
- Download the test file that represents your Philips FM92E on the web site, or on the clubs main PC; [http://vk2afy.dyndns.org/6mconv/6mfiles.htm] for burning the 2764 EPROM for your Philips FM92E.
- Check that your FM92E transceiver works by using the information on **Section 38: FM92E Test EPROM 68-88 MHz**.
- Then again go to Section 3, and check out which **6m??.bin** file meets the above criteria for running on 6 meters. eg The FM92E is a **remotely controlled** transceiver with a **21.4 MHz IF**. Then download the actural file, to run the transceiver on 6 meters. [ie download file **6m??.bin**.]
-
- CCARC members will be given a burnt 6 Meter 2764 EPROM's to be placed into their transceiver for testing and running on 6 meters..

- See below for pictures of Synch board [top & bottom] where to place EPROM.



Synthesiser Board [Bottom View]

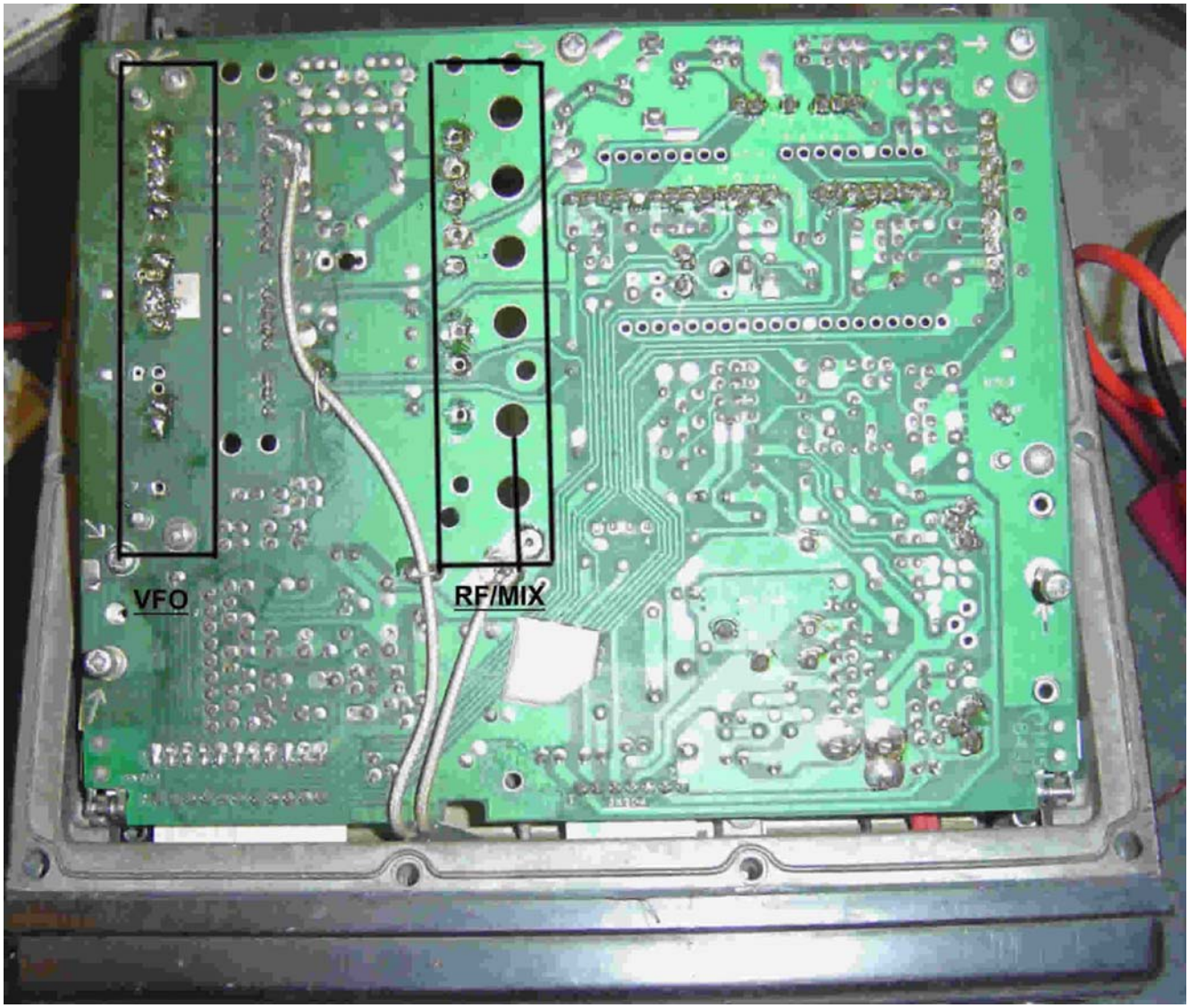
Synthesiser Board [Top View with cans on]



Synthesiser Board [Top View with cans off]

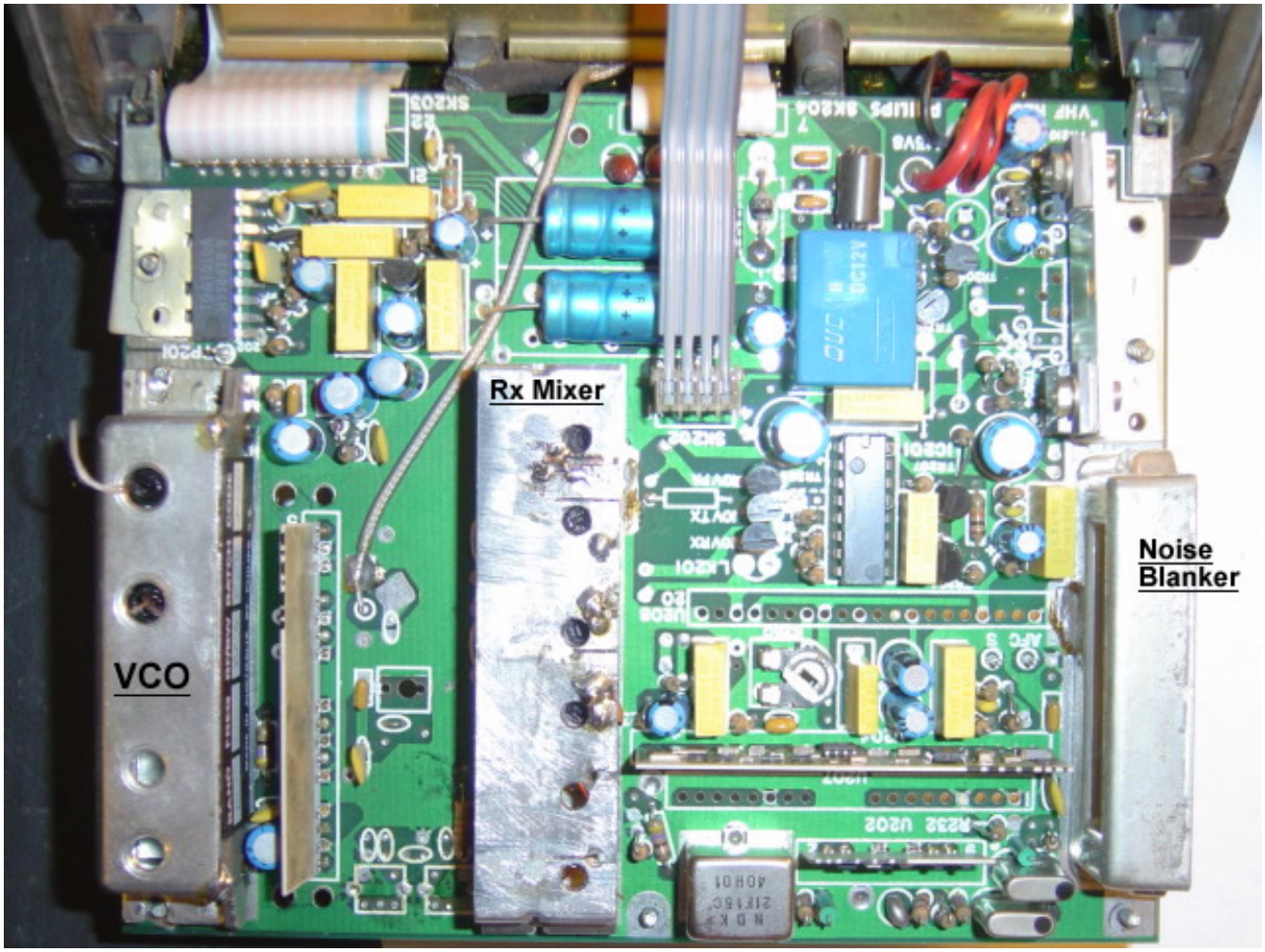
8: VCO Change:

Turn upside down, your FM92E. Remove the base plate. The PCB should be the small one, 12x15cm. Looking down at the board from the front [non-component side], the left hand side back is where the VCO is located on the Receiver board. Note: **VFO** below should be **VCO**.



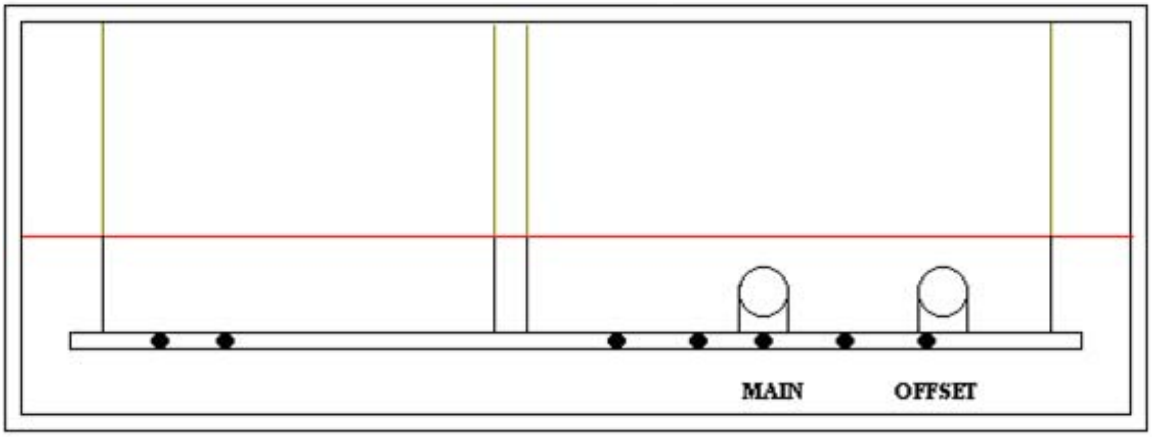
Receiver Board [bottom view]

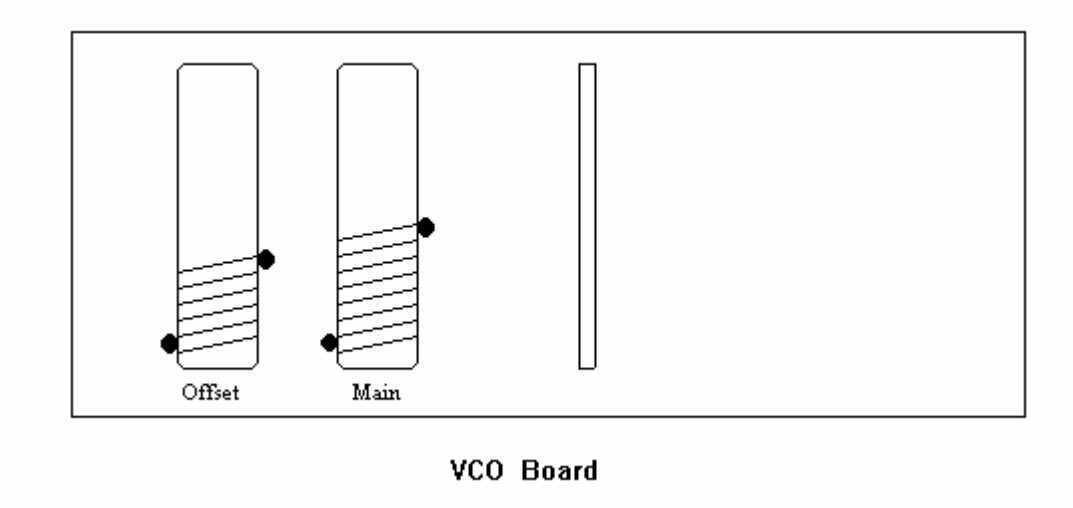
NOTE: You must determine what IF your FM92E is using. This will determine how to wind the VCO Main coil. The IF frequency is normally located on the side panel of the VCO under RF/BW. It will be either 10.7 or 21.4 MHz. In the following examples, the 10.7 MHZ & 21.4 MHz coils are the same.



Receiver Board.

VCO Board





VCO Board

1: Remove the VCO block from the Receiver board by de-soldering the pins and removing the 2 screws. Use a solder sucker or solder wick if you do not have access to a de-soldering station, then ensure that all the solder is removed and the holes in the board are clean (this makes it easy to refit later). The club has a de-soldering station, you will be trained in how to use it during one of the Tuesday night sessions. Be very, very careful of this operation, you can easily break the pins from the module to the "Receiver PCB" – Be **care-full**. You may have to heat the pins up that are holding and gently pry module, this is a three hand job.

   There will be two de-soldering irons at the club rooms, the Rovel De-Soldering station and a Single Shot De-Soldering iron. If you can use the Single Shot De-Soldering iron to remove solder from the non-earth pins and, the Rovel De-Soldering station de-soldering iron for the earth connections of the VCO module. This will enable two users at a time to be de-soldering.

   Firstly, use a wooden **tooth pick** [supplied by the club] to drop VK2ZAD Bruce's **Bug Juice** onto each pin to be de-soldered.

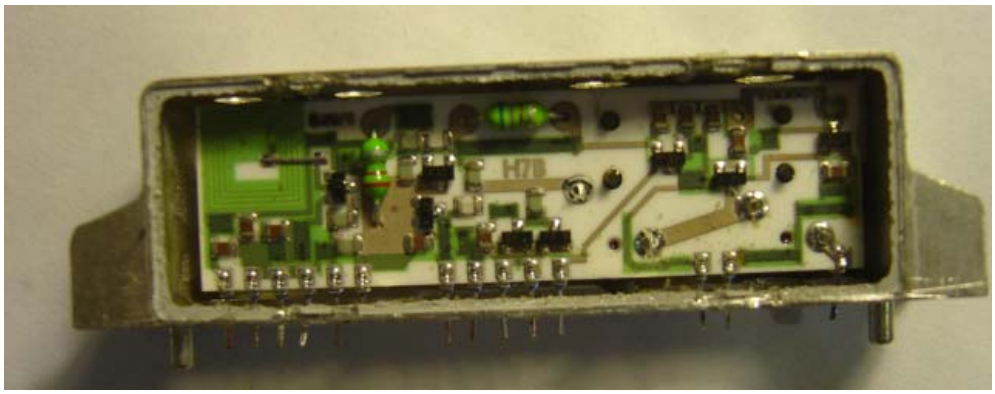
   When you have removed the VCO module, with an old tooth brush, clean the Receiver PCB with methylated spirits. Then, make sure that the VCO ceramic PCB pin holes are clear; if they are not then de-solder them clear. Then re-brush with methylated spirits.

Note the IF frequency [21.4MHz] in the photo above.

2: Once the module is free of the board, put the radio to the side for the time being and concentrate on the VCO. Using a large soldering iron, you need to remove the cover of the VCO. The cover is removed by heating the case along the join and gently prying off the cover whilst ensuring it is not distorted too much, as it needs to be re-sealed later. With the soldering iron on the side of the panel, use a scalpel, small screwdriver, etc, to lift the side panel.

   NOTE: Too much heat and you can unsolder components on the ceramic board, inside of the VCO module.

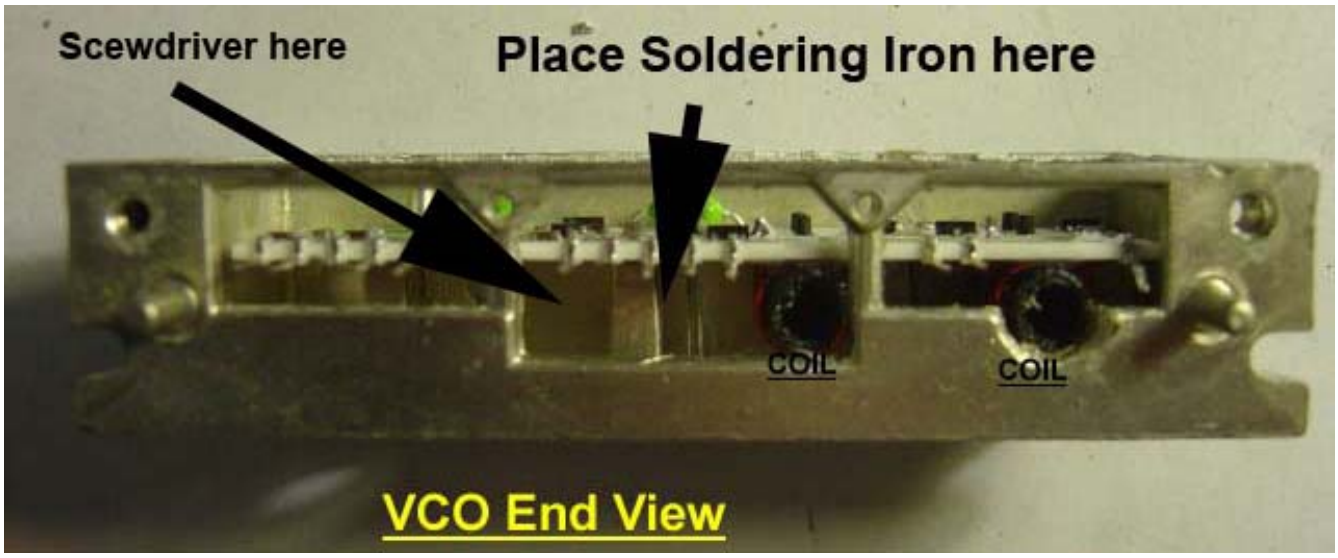
   Or, a better method is to score the solder on four sides of the VFO block with a scalpel; then remove the four sides by prying with the side of the scalpel or a very small screwdriver. As you score the sides, watch your fingers. The scoring causes small slivers of solder to be formed, dispose of these slivers as soon as possible.

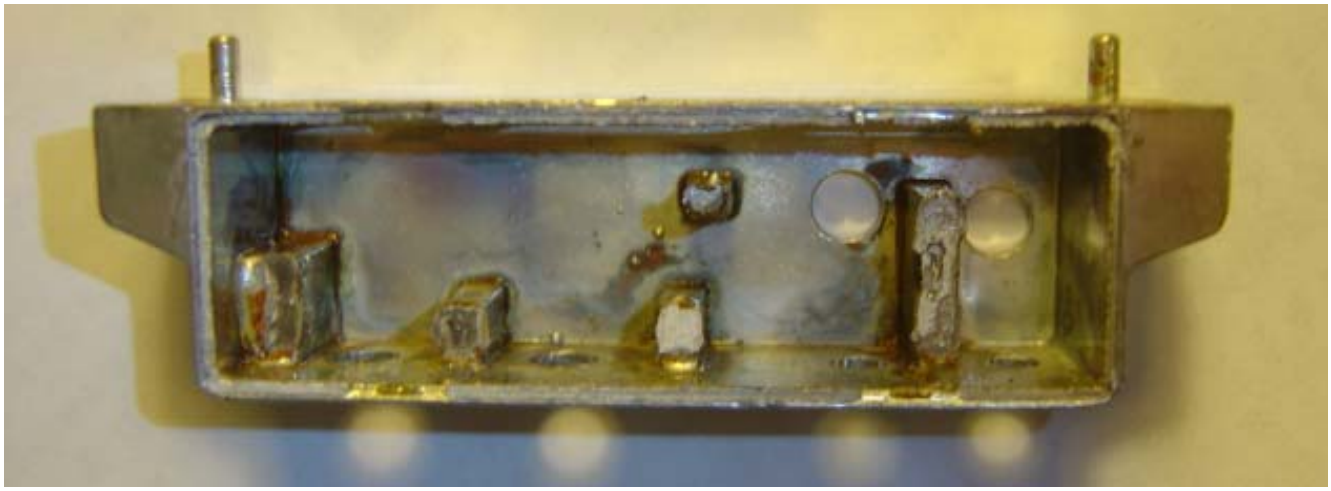


3: Now comes the fun bit, to remove the ceramic board from the VCO module, you need to heat the module case with a soldering iron placed on the side of the center metal post. [see photo below] Where the soldering iron connects to the side of the metal post, which is soldered to the ceramic board, the heat from the soldering iron will travel down the post and the solder will melt, allowing the ceramic board to come free.

You will need to use a pair of pliers or some other device to hold the module whilst this is happening, it will be far too hot to touch! I used a large flat bladed screw driver inserted on the other side of the center post, between the ceramic board and the VCO module case; Then gently twisting the screwdriver as the heat flows into the solder connection between the center post and the ceramic board.

Remember – **gently twist the screwdriver**, you do not want to break the ceramic PCB. You can use the right hand soldering iron of the de-soldering station with success. Too much heat and components on the ceramic board will start to fall off.

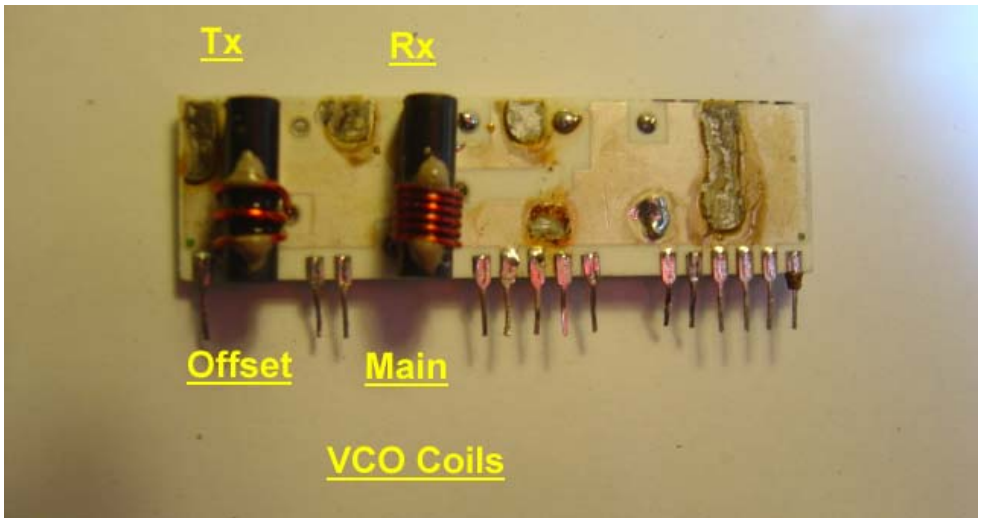




VCO Ceramic PCB Removed above:

4: Once the board is removed from the module, with a smaller soldering iron, de-solder the coils from the board, then with a pair of long nose pliers, gently wobble the coil formers free of the board.

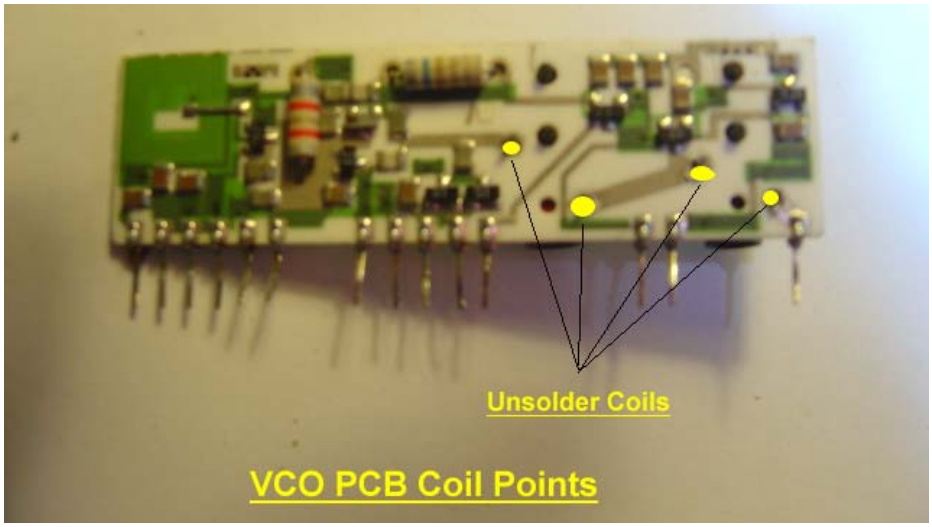
Note: That the coils are normally glued down.



When the 2 formers are free, take the old "main" coil and fit it into the "offset" position, then strip the old Offset coil [remember which way the old offset coil was wound].

If the **IF frequency is 21.4 MHz** then wind a new one of **8 turns** using wire [**150 mm** of enamel coated wire, 0.63mm] [or 146mm of Leon's enamel coated wire, 0.53mm] of the same size (or as near to it as possible); plus wound in the same direction as the old offset coil. This coil needs to be wound tightly and be aligned as per the old one, you may have to distort the ends of the coils to fit them back through the holes. You should remove the enamel coating on the wire and "pre-tin" the wire with solder before fitting, this will ensure a good electrical connection for the coils.

If the **IF frequency is 10.7 MHz** then wind a new one of **8 turns** using wire [**150 mm** of enamel coated wire, 0.63mm] [or 146mm of Leon's enamel coated wire, 0.53mm] of the same size (or as near to it as possible); plus wound in the same direction as the old offset coil. This coil needs to be wound tightly and be aligned as per the old one, you may have to distort the ends of the coils to fit them back through the holes. You should remove the enamel coating on the wire and "pre-tin" the wire with solder before fitting, this will ensure a good electrical connection for the coils.



ie:

- Unsolder the **main** & **offset** coils from the VCO board. Mark each coil as **main** and **offset**.
- When Un-soldering, look at de-soldering points above; do not un-solder **former** mounting points.
- Remember to cut glue off former mounting points. These are on the opposite side to the coil side. You may have to heat up the glue to remove it.
- Be careful of PCB pins, they bend and break easily.
- Refit the old **main** coil into the **offset**'s coil position.
- Strip all wire from the old offset coil. Remember which way the coil was wound.
- Scrape off old glue from former with scalpel and fine file.
- If the **IF frequency is 21.4 MHz** then rewind with **8 turns** of same size of wire [150 mm length, 0.63mm]. [or 146mm of Leon's enamel coated wire, 0.53mm] The same way as the old offset coil.
- If the **IF frequency is 10.7 MHz** then rewind with **8 turns** of same size of wire [150 mm length, 0.63mm]. [or 146mm of Leon's enamel coated wire, 0.53mm] The same way as the old offset coil.
- Refit the old **offset** coil [now 8 turns] into the **main**'s coil position.
- Don't forget to use a hot glue gun or other method of securing the two coil formers to the ceramic board.

Move Main Coil From----------v here
To----------v here

5: As you fit these coils back to the board, we recommend the use of a hot glue gun to both fix the wire to the former, and the former to the board to make sure it can't float about [on the non solder side]. **The next thing to do is to swap the cores between the coils**, and once that is done, it is time to commence fitting it all back together.

At this point in time, check that the VCO PCB pins fit into the "Receiver Board"; if they do not, then **gently** bend them to fit.

You have two options from this point on.

The ***first method*** is the traditional one, where the VCO PCB is replaced into the VCO module, the side of the module is affixed, then the VCO module including the VCO PCB with coils are fitted back to the "Receiver Board". This method is probably the best for mobile operations, however if you intend to use your FM92E converted to 6 meters, then the second method is easier.

The ***second method*** is to cut down the VCO module [without PCB], so the VCO PCB with coils will slip vertically into the VCO module case. This method enables a smooth replacement of the VCO PCB & the VCO module case. This method is the simplest.

Method 1:

6: It's back to the big soldering iron, this time to refit the board back into the module. To do this we recommend that you carefully add some solder to the pads where the module connects to ensure a good joint. Find something raised to rest the board on (a rectangular 9 volt battery is ideal) and place the module over it in the correct place, then apply heat to the module. Again the heat will travel down the posts of the module melting the solder on the board, make sure the board doesn't move at this time, and that the coils align with the holes in the module so you can gain access later for tuning.

Or, glue the PCB with new coils back into the module.

7: When the board has been re-fitted and you are comfortable with the solder joints to the module, refit the cover by sweating the solder around the joints and slowly work your way around the edge. Be careful to overheat the case as the internal board may come loose.

8: Now you need to remount the module back to the board. Carefully fit the pins back through the holes and refit the screws, then solder all the pins making sure that there are no short circuits as a result. When it is all refitted, we can do a quick VCO tune up to make sure what we have done so far is all okay.

ie:

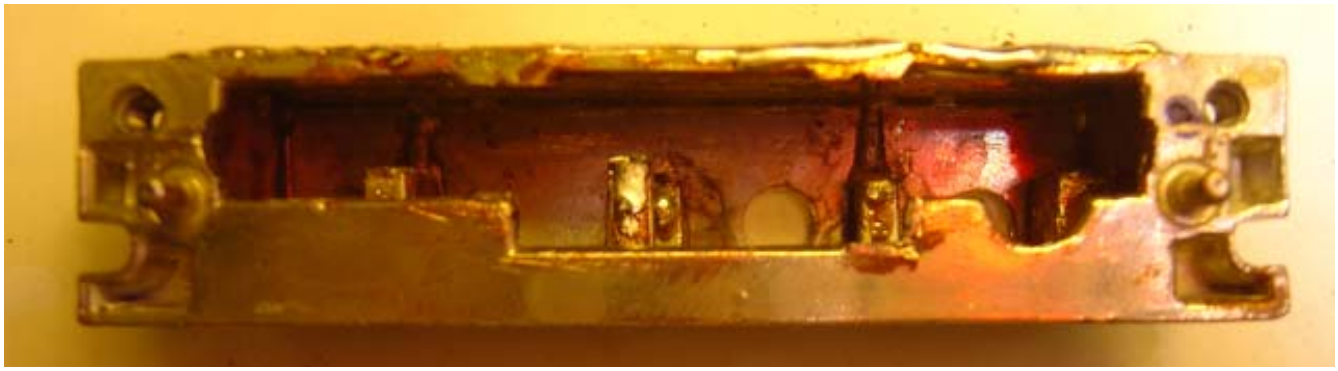
- Replace VCO block back onto main PCB. Screw in 2 screws, then solder pins to board.

NOTE: In the above operation be very careful of the PCB pins, they bend & break very easily.

Method 2:

VCO Module Case Uncut

6: Cut VCO Module Case so the case will fit over the PCB, after the VCO PCB has been soldered into the Main Receiver Board. Use tin snips, files or/and Dremell tool with grinder tip, use a round file to enable coils to be accommodated through case when placing case over PCB. See picture below.

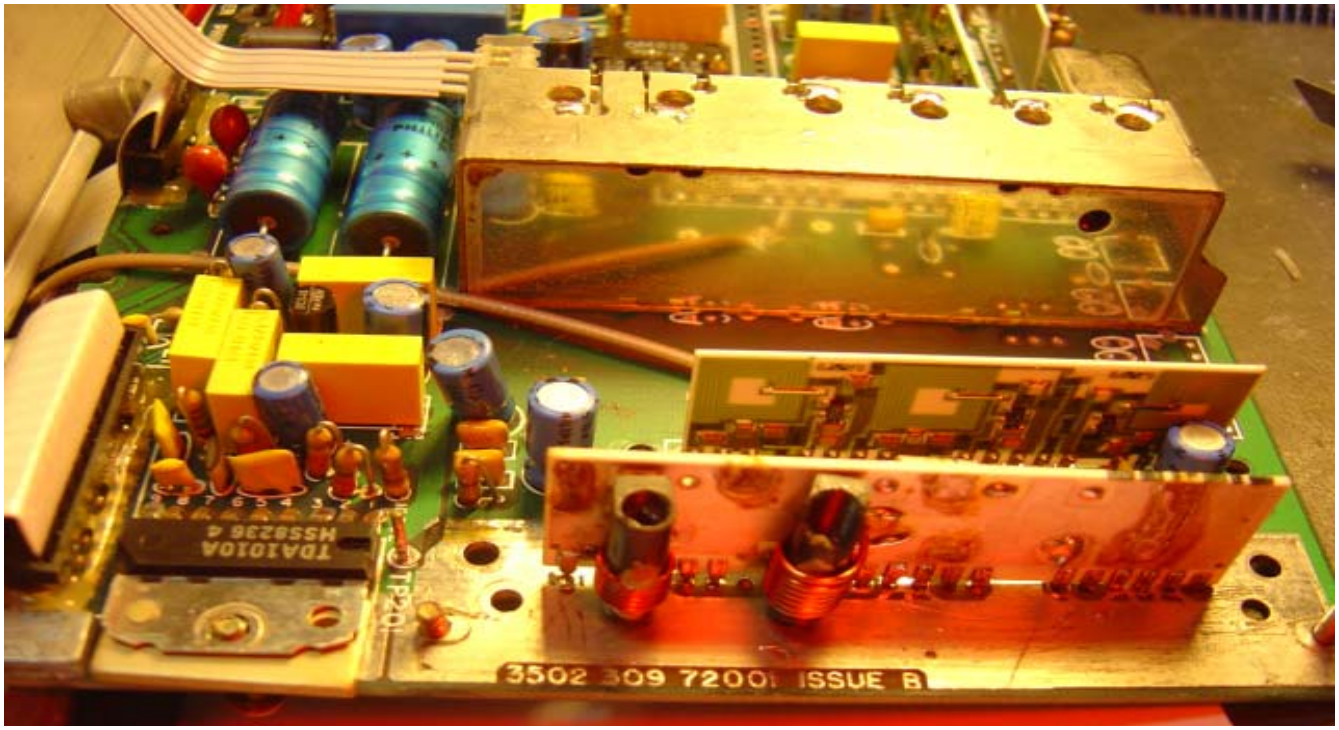


VCO Module Case Modified

7. Clean the receiver board [where the VCO PCB plugs in] with mentholated spirits and a tooth brush. If the holes are not clear, clear with a solder sucker, solder wick, etc.

8: Plug in VCO PCB into the Receiver Board and check that it is upright. Solder the VCO PCB to the board. Check that the soldering is ok. Clean the back of the receiver board with mentholated spirits where you have just soldered.

See picture below.



VCO PCB soldered into Receiver Board

9: Solder side to VCO module can.

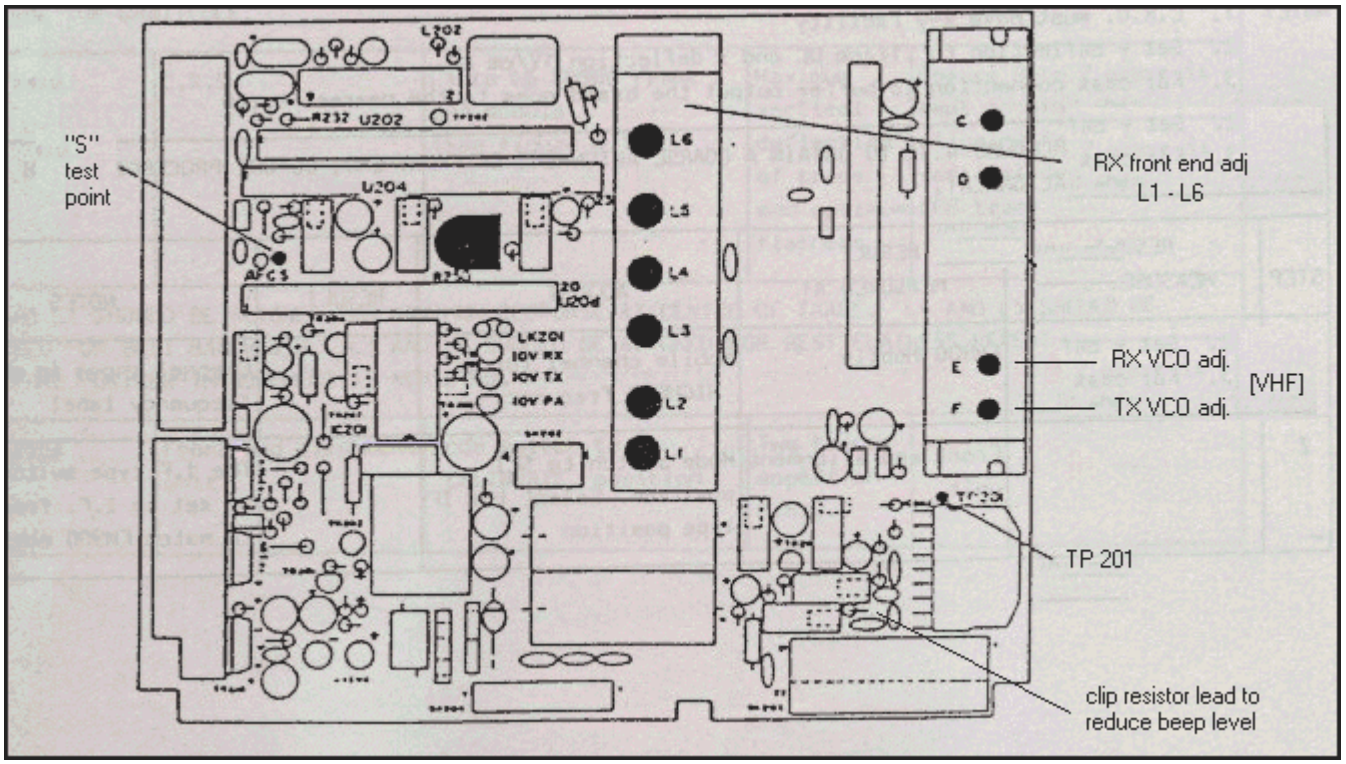
10: You can now check the VCO Tuning [next section] then return back here.

11: Place VCO module over VCO PCB, which has been soldered into receiver board. Do this gently.

12: Screw VCO module to Receiver board with the two screws.

13: The tuning will have changed when you replace the VCO module can. So continue on with “VCO Tune” on next page.

9: VCO Tune:



Rx Board:

Make sure that you have the 6 metre EPROM installed, connect the speaker, microphone, dummy load (through a power meter, however you should not see any TX power yet) and 12 volt DC power, then switch on. Connect a multimeter to the test point below the VCO module, this is TP 201 (positive on pin, negative on case, care should be taken with your test lead, that it does not short to ground on the module case and blow the ceramic PCB). If you have a push-on socket, then that will even be better.

See Section 32 of Part 2, Adjusting Ferrite Slugs. If you do not read this section, you will have to replace your VCO ferrite slugs.

Set the radio to the highest frequency [channel 59], set the multimeter to a 12 volt DC range and with a plastic, or ceramic tuning tool, adjust the core of the **MAIN coil** until you get a reading of around **11.7 Volts** (not above 12V !). When this has been achieved, key the transmitter and adjust the core of the **OFFSET coil** until you get a matching voltage reading. When satisfied that both RX & TX are about the same, select the lowest frequency [channel 1] and check to make sure the VCO test point voltage is above **4 Volts** DC on both RX & TX (we found ours to be around **5.6 - 7 volts**).

NOTE: Be care-full, when you press the microphone button, you can transmit 5 watts.

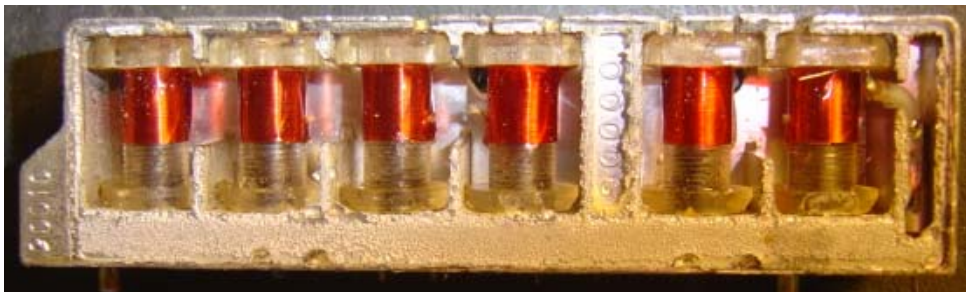
As a final test, with channel 20 setup on the FM92E connect your signal generator to 53.000 MHz. You should hear a signal through the FM92E with approximately 100 mVolt of signal.

NOTE: If the VCO will not tune properly or the transmitter side will not come within voltage range, then check that pin 19 of the VCO module is 0 Volts on receive and 10 Volts on transmit.

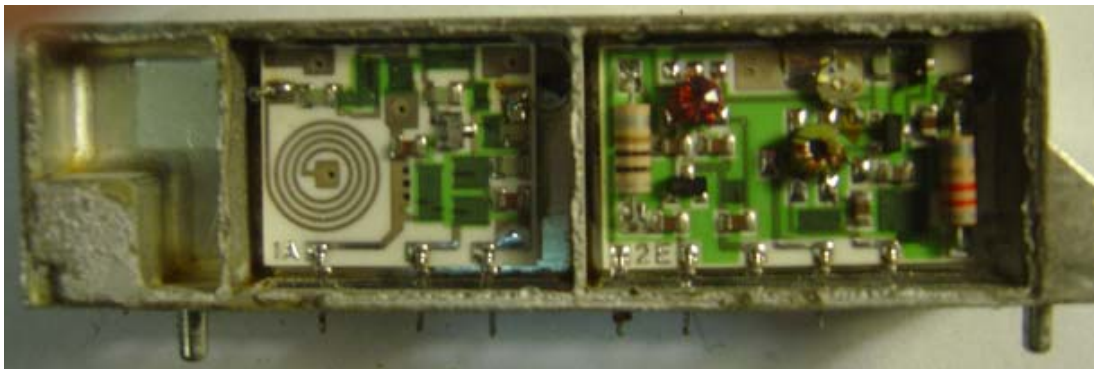
VCO Tune Check References:

Ch #	Rx Freq	Injection Frequency		VCO Voltage		
		21.4MHz	10.7MHz	Rx	Tx	
3	70.000MHz		80.7MHZ	5.3v	4.7V	Not Converted
10	77.000MHz	98.4MHz		9.6V	12.0V	Not Converted
20	53.000MHz	74.4MHz				
20	53.000MHz		63.7MHz			

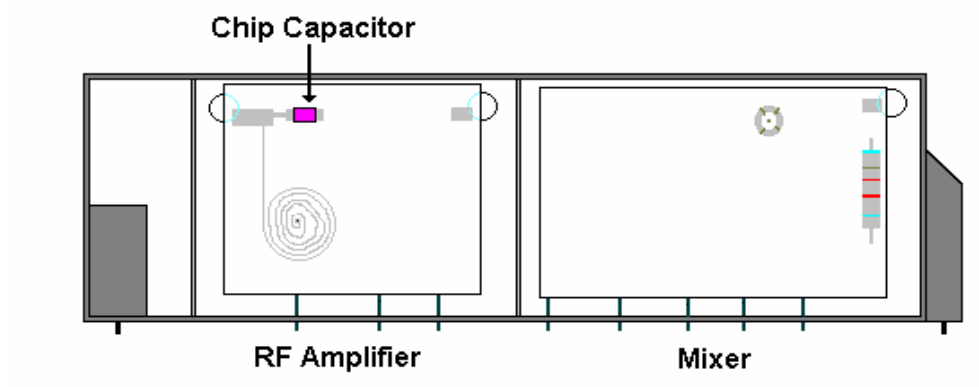
10: Rx RF Amp/Mixer Change:



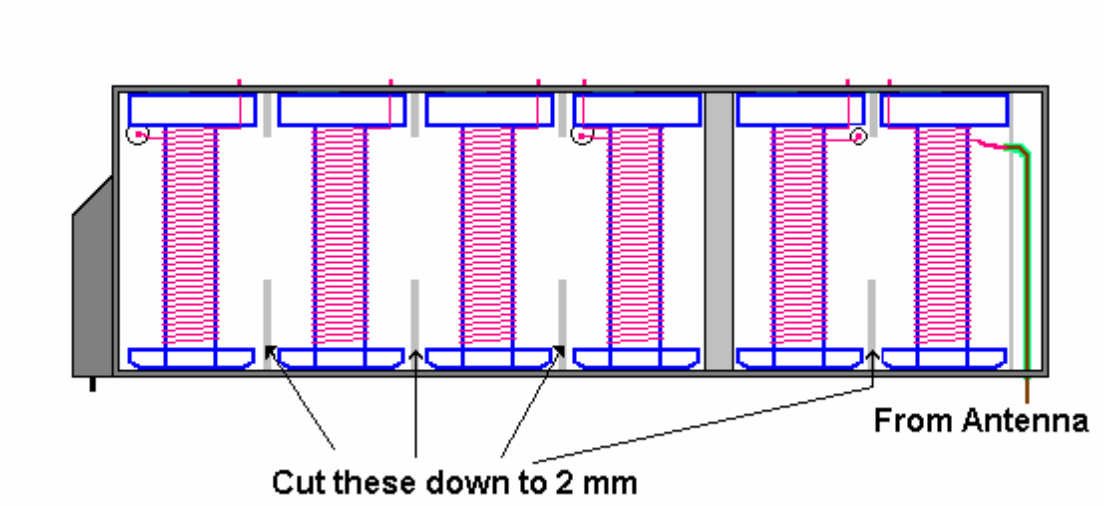
Rx/Mixer Coil Side.



Rx/Mixer PCB Side.



Rx/Mixer PCB Side.



Rx/Mixer Coil Side.

There are two methods available to recoil the “RF amplifier / Mixer”. The first example is recommended by other amateurs and clubs. I have found this method very cumbersome and time consuming, so I will recommend my second method.

Rewinding Coils Method #1:

It is not recommended to wind the coils in this first example, but it may suit some people. All previous examples by other clubs and amateurs have used this method.

Coil # 1:

This is RF antenna input coil.
Move coil slug to center of coil.
Remove by unsoldering antenna input wire and wire going to ground at top of coil former.
Gently remove former from housing.
Pry off bottom 1 cm of wire & remove enamel from that 1cm of wire.
Cut enamelled wire [0.125mm] to 250mm length & remove enamel from that 1cm from one end of wire.
Solder two pieces of wire.
Wind additional 12 turns of wire onto coil former, in same direction as other wire.
When 12 turns completed, hold down wire with glue from hot glue gun.
Cut wire at the 12 turn mark. [just added]
Or; strip all wire & wind on 54.5 turns. Earth bottom of coil. With tap 2.5 turns from earth.

Coil # 2:

This is RF amplifier input coil.
Move coil slug to center of coil.
Remove by unsoldering amplifier input wire [wire on rear PCB near chip capacitor].
Remove wire going to ground at top of coil former.
Gently remove former from housing.
Pry off bottom 1 cm of wire & remove enamel from that 1cm of wire.
Cut enamelled wire [0.125mm] to 250mm length & remove enamel from that 1cm from one end of wire.
Solder two pieces of wire.
Wind additional 12 turns of wire onto coil former, in same direction as other wire.
When 12 turns completed, hold down wire with glue from hot glue gun.
Cut wire at the 12 turn mark. [just added]
Or; strip all wire & wind on 54 turns turns. Earth bottom of coil. With tap 2 turns from earth.

Cut down spacer between coil 1 & 2 to height of approximately 2mm. Then grind down sharp edges.

Coil # 3:

This is RF amplifier output coil.
Move coil slug to center of coil.
Remove by unsoldering amplifier input wire [wire on rear PCB near chip capacitor].
Remove wire going to ground at top of coil former.
Gently remove former from housing.
Pry off bottom 1 cm of wire & remove enamel from that 1cm of wire.
Cut enamelled wire [0.125mm] to 250mm length & remove enamel from that 1cm from one end of wire.
Solder two pieces of wire.
Wind additional 12 turns of wire onto coil former, in same direction as other wire. Total of 54 turns.
When 12 turns completed, hold down wire with glue from hot glue gun.
Cut wire at the 12 turn mark. [just added]
Or; strip all wire & wind on 54 turns. Earth bottom of coil. With tap 2 turns from earth.

Coil # 4:

This is RF amplifier 1st output bandpass coil.
Move coil slug to center of coil.
Remove wire going to ground at top of coil former.
Gently remove former from housing.
Pry off bottom 1 cm of wire & remove enamel from that 1cm of wire.
Cut enamelled wire [0.125mm] to 250mm length & remove enamel from that 1cm from one end of wire.
Solder two pieces of wire.
Wind additional 11 turns of wire onto coil former, in same direction as other wire. Total of 53 turns.
When 11 turns completed, hold down wire with glue from hot glue gun.
Cut wire at the 11 turn mark. [just added]
Or; strip all wire & wind on 53 turns. Earth bottom of coil.

Coil # 5

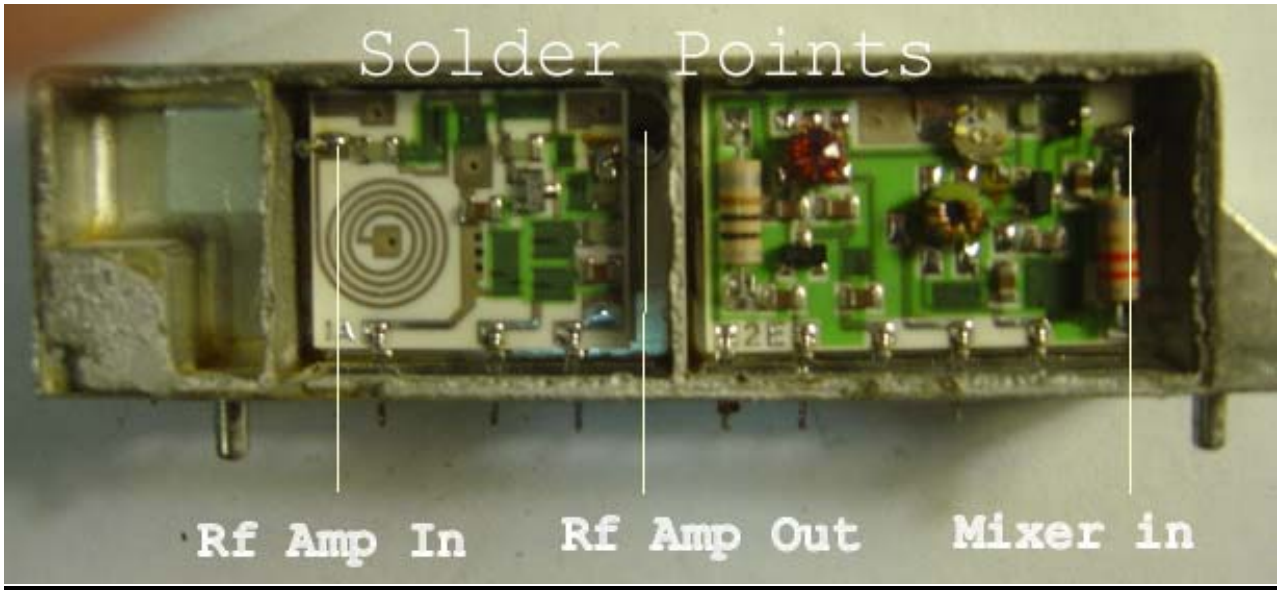
This is RF amplifier output 2nd bandpass coil.
Move coil slug to center of coil.
Remove wire going to ground at top of coil former.
Gently remove former from housing.
Pry off bottom 1 cm of wire & remove enamel from that 1cm of wire.
Cut enamelled wire [0.125mm] to 250mm length & remove enamel from that 1cm from one end of wire.
Solder two pieces of wire.
Wind additional 11 turns of wire onto coil former, in same direction as other wire. Total of 53 turns.
When 11 turns completed, hold down wire with glue from hot glue gun.
Cut wire at the 11 turn mark. [just added]
Or; strip all wire & wind on 53 turns. Earth bottom of coil.

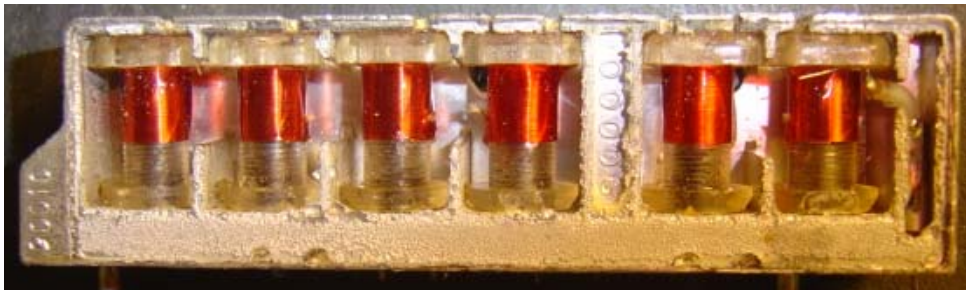
OR;

Rewinding Coils Method #2:

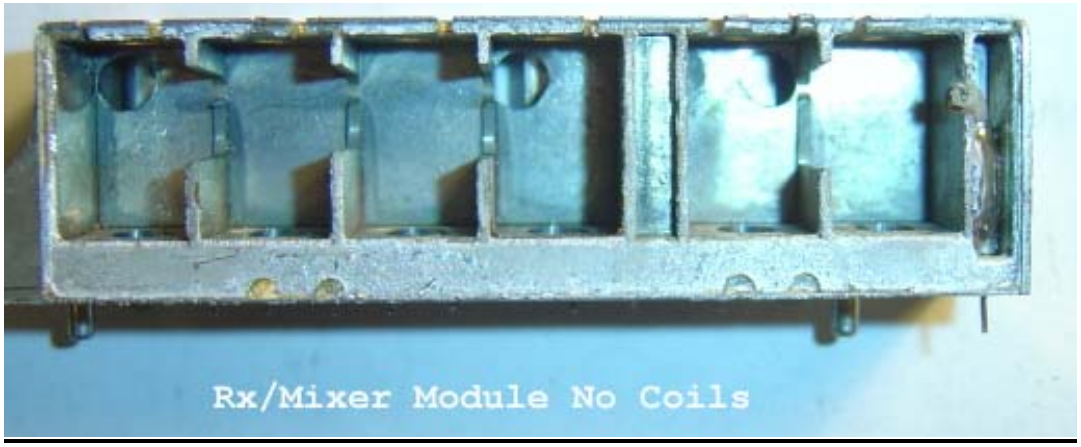
- Rasp off all solder from top of the module with a file. This will break the coils earth wire points, you will not be using the wire for earthing by this method again.

- Unsolder coil wire from RF amplifier input & RF amplifier output, plus mixer input and antenna input.
- Move coil ferrites to middle of coil formers.
- Gently remove all coils from block.
- Strip all wire from all coils and, keep the wire previously stripped.
- Clean coil tops & bottoms, plus clean module coil inserts from old glue.
- File down and clean all earth connections on block.

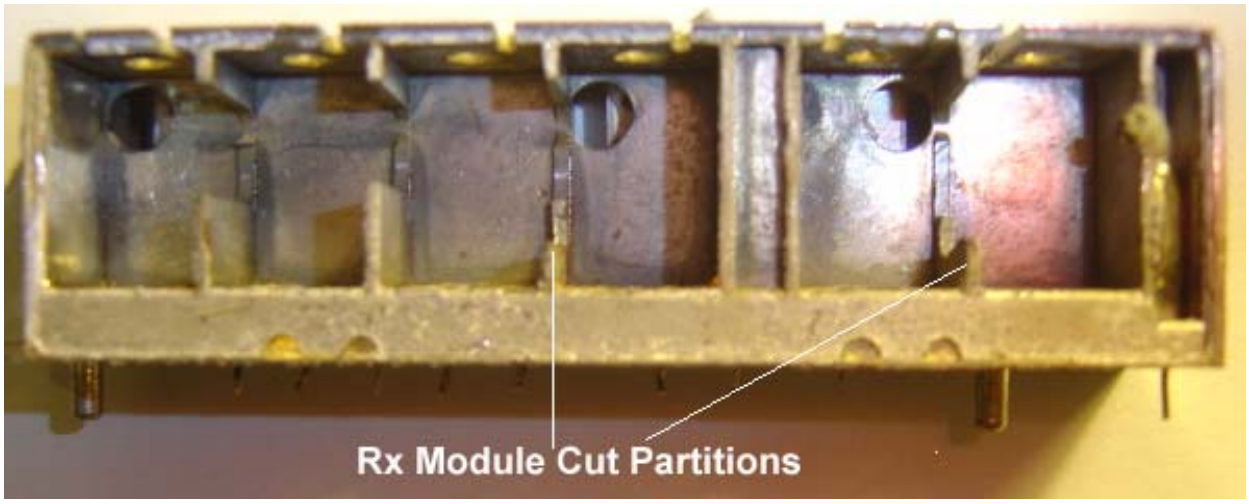




Original Rx Coils



Cut out 50% of the two partitions between coil #1 & coil #2; Plus between coil #3 & coil #4. With a pair of tin snips.

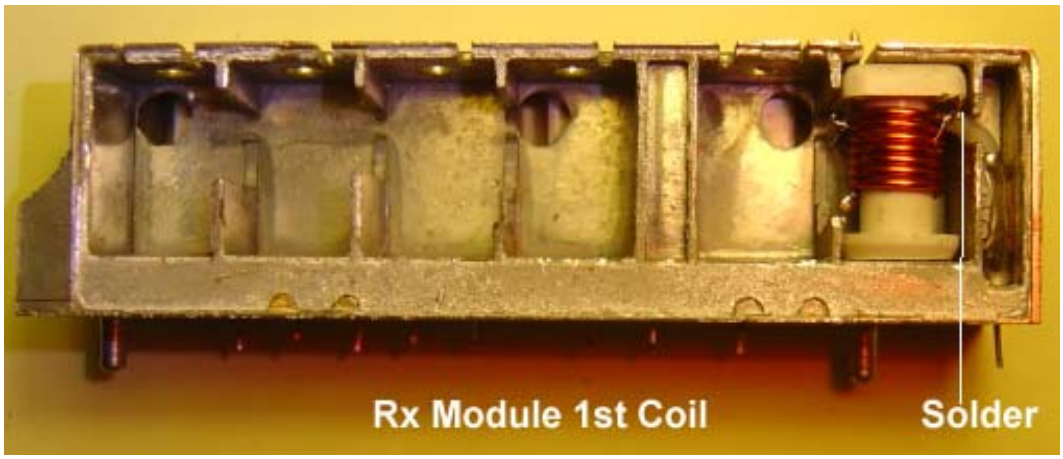


NOTE: All coils have the same fundamental start for winding:-

- Wind all the following coils in the same direction.
- Cut 4 lengths of 160mm of 0.8mm enamel coated wire.
- After cutting wire lengths, clean off all enamel from two ends of wire, one end of 5mm in length cleaned, the other earth end 10mm to be cleaned.
- Solder both ends of 0.8mm wire.
- Bend 8mm of the 0.8mm wire at [10mm tinned end] at right angles.

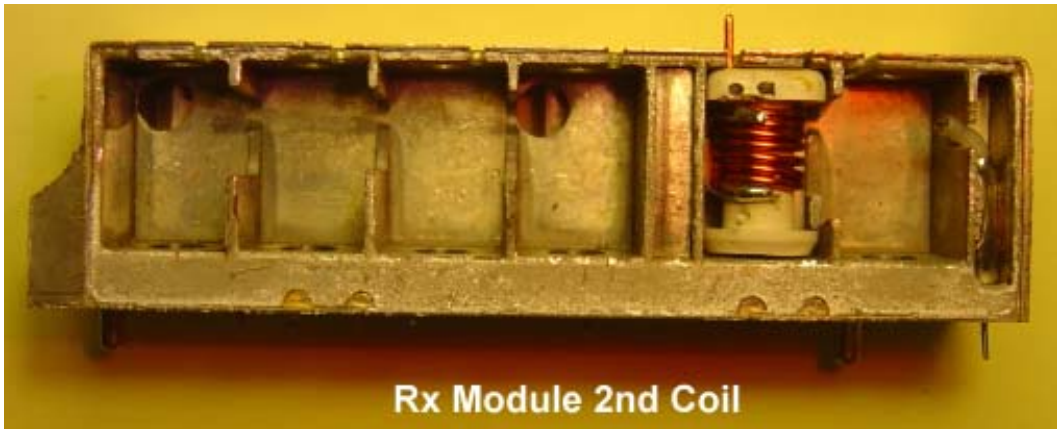
Coil # 1

- Cut a **160mm length** of 0.8mm enamel coated wire.
- Clean off all enamel from two ends of wire, one end of 5mm in length to be cleaned, the other earth end 10mm to be cleaned.
- Solder both ends of 0.8mm wire.
- Bend 8mm of the 0.8mm wire at [10mm tinned end] at right angles.
- Cut **33 mm length** from the original wire; Remove 5mm of enamel from both ends of the original wire; Tin both ends of the original wire; Solder one end of the original wire to the 0.8mm wire at earth end; See picture above labelled “Winding Wire”.
- Push one end of the bent 0.8mm wire through a left hand hole of the square end of the coil former [for earth connection]; Leave a short section [approximately 2-3mm] of the 10mm tinned section on the winding side of the former. Wind tightly, 7 turns of 0.8mm of wire [160mm] onto former.
- With the 33mm of the original wire, which has been soldered to the earth end of the 0.8mm wire; Wind 1.5 turns of from earth connection in same direction as 0.8mm wire; solder other end of the original wire to the antenna input.
- Solder a 33pf capacitor across the 7 turns of 0.8mm wire. Capacitor goes under coil [via left].
- If you are conducting this conversion remote to the club, then check with GDO that the coil resonates at 50.00 Mhz. Adjust the ferrite in the coil to go to that frequency. [look at note below, if this point is applicable]
- Place coil back into coil #1 position in module.
- Solder 0.8mm earth wire to module & solder original wire [33mm] to **antenna connection**. [see solder points on page 28]
- If you are conducting this conversion remote to the club, then check with GDO that the coil resonates at 53.25 Mhz. Adjust the ferrite in the coil to go to that frequency. [look at note below, if this point is applicable]



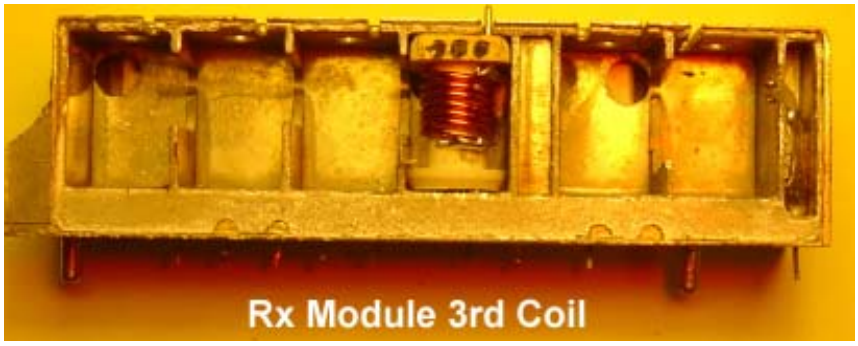
Coil # 2

- Wind coil #2 the same as coil #1, with the exceptions of:-
- The original wire length is **45mm** for coil #2.
- With free end of the original wire, solder to the **amplifier input** on the PCB side of the Rx Module.
- 33 pF Capacitor is placed on left hand side of coil. [alongside of shield]; place capacitor in first, then coil, then solder.
- Place into coil **position #2** of Rx module.
- Solder original wire to **RF amplifier input connection** on rear PCB side of Rx Module. Use a pair of tweezers to help you. [see solder points on page 28]



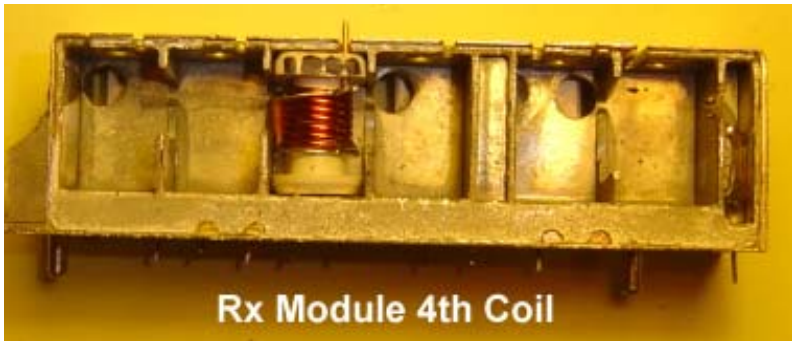
Coil # 3

- Wind coil #3 the same as coil #1, with the exceptions of:-
- The original wire length is **50mm** for coil #3.
- With free end of the original wire, solder to the amplifier output on the PCB side of the Rx Module.
- Push one end of the bent 0.8mm wire through a **right hand hole** of the square end of the coil former [for earth connection]
- 33 pF Capacitor is placed on right hand side of coil. [alongside of shield]
- Place into coil **position #3** of Rx module.
- Solder original wire to **RF amplifier output connection** on rear PCB side of Rx Module. Use a pair of tweezers to help you. [see solder points on page 28]

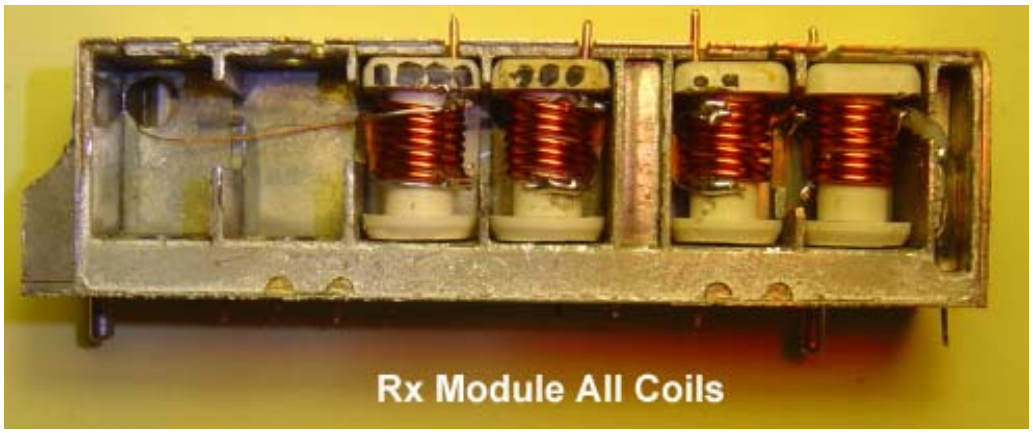


Coil # 4

- Wind coil #4 the same as coil #1, with the exceptions of:-
- The original wire length is **75mm** for coil #4.
- With free end of the original wire, solder to the **mixer input** on the PCB side of the Rx Module..
- Push one end of the bent 0.8mm wire through a **right hand hole** of the square end of the coil former [for earth connection]
- 33 pF Capacitor is placed on left hand side of coil.
- Place into coil **position #4** of Rx module.
- Solder original wire to **RF mixer input connection** on rear PCB side of Rx Module. Use a pair of tweezers to help you. [see solder points on page 28]


Rx Module 4th Coil

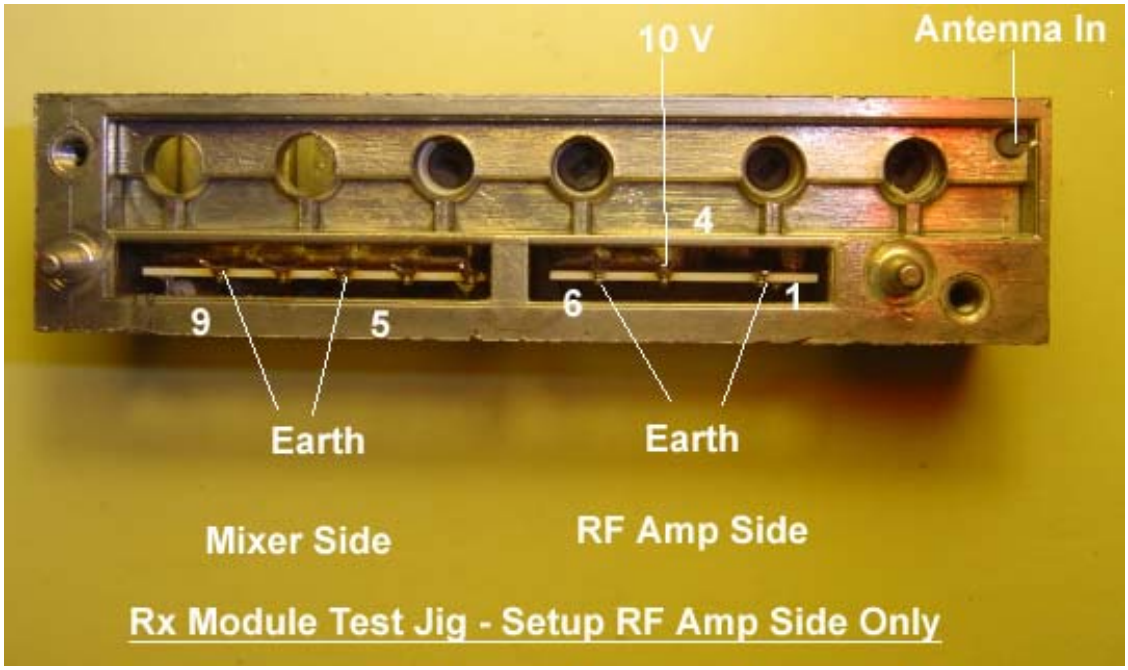
NOTE: A GDO should not be necessary if you are using 0.8mm enamelled coated wire and a NPO 33 pF capacitor. However if you are using different dimensioned wire or a different sized capacitor, then you should check everything with a GDO. Remember, when you place the coil into the Rx Module, the resonant frequency of the coil changes.


Rx Module All Coils

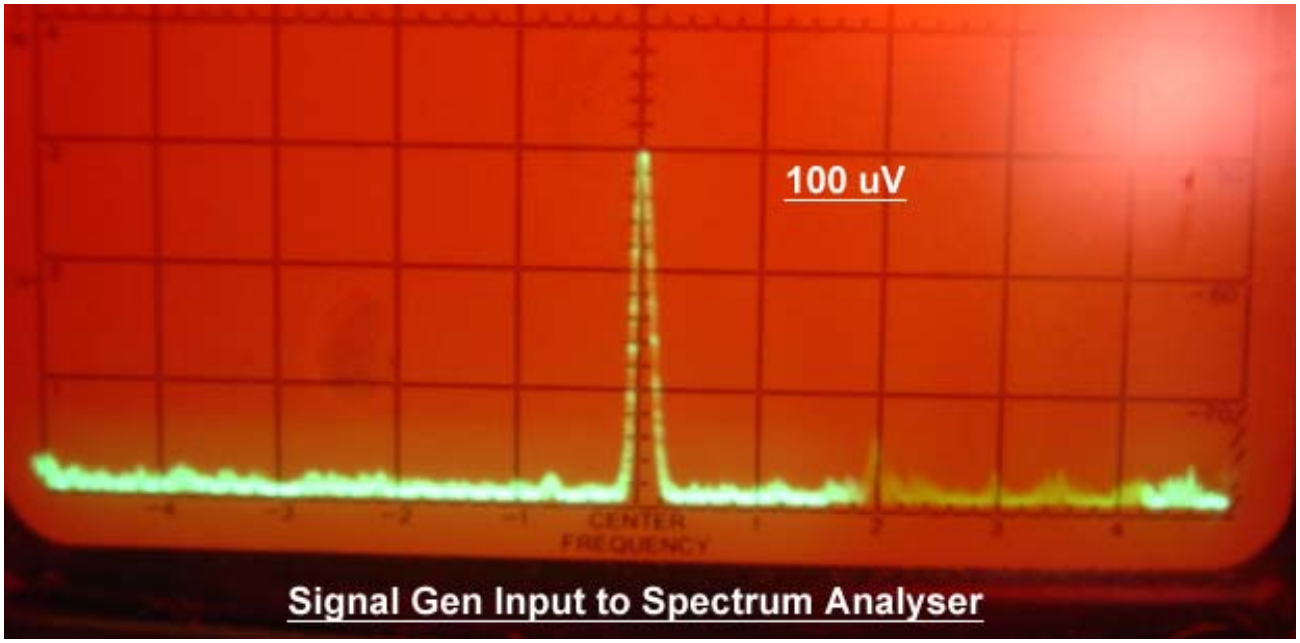
Replacing Module into Board:

- This is the real tricky bit. Check all of your soldering, have you any shorts, is there any shorts to ground.
- Remember, at this point on, when the sides are sealed and you resolder the Rx module back into the Receiver PCB and it does not work, then you will have to de-solder Rx Module and the module sides and recheck your work again.
- At this point, if you are not really sure, then before you even solder the sides on of the Receiver Module, with a signal generator and receiver or spectrum analyser, you can check that the Rx amplifier is amplifying, by setting up a test jig.

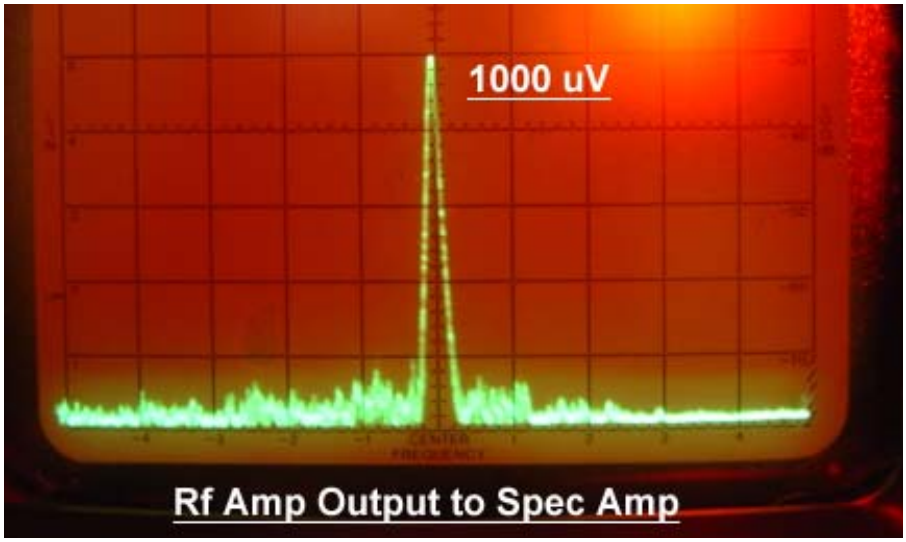
Rx Module Test Jig:



- Earth pins 1 & 6 of RF Amplifier side of RX Module. Be very careful of module pins, they can easily break when soldering wire to them.
- Apply a 10 Volt supply to pin 4 of the RF Amplifier.
- Connect a 53.25 MHz signal generator to a 53.25 MHz receiver or Spectrum Analyser and note the measurement out of the signal generator. [ie setup the signal generator to say Micro Volts.]



- Connect a 53.25 MHz signal generator to the Antenna In pin with the coax earthed to the module.
- Disconnect original wire from Coil 4 to the Mixer Input pin on the Mixer PCB.
- Connect the removed wire to a 53.25 MHz receiver or Spectrum Analyser.
- Check that the RF amplifier is working. See Below:



-

11: Rx RF Amp/Mixer Tune:

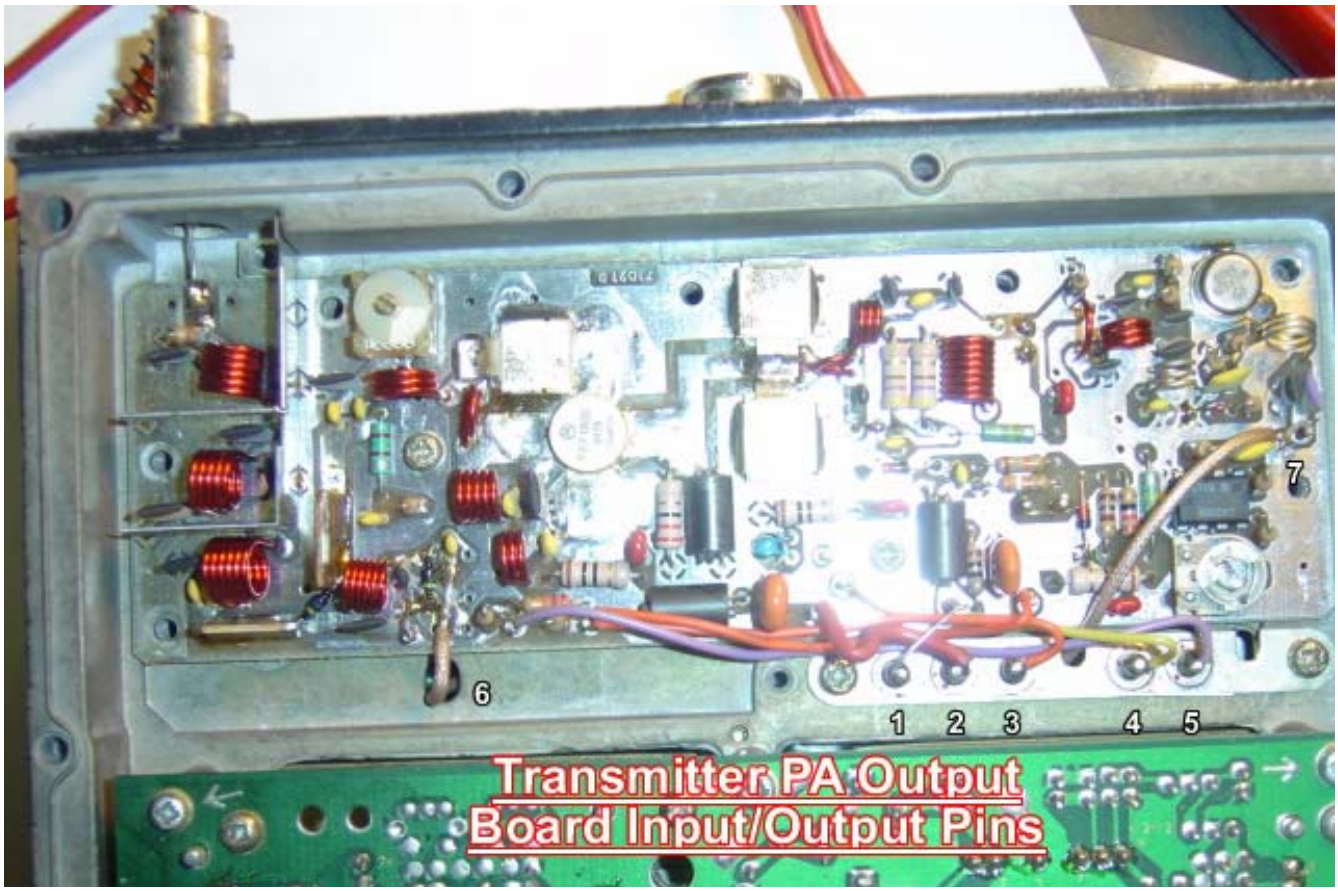
Apply signal at a frequency of 53.250 MHz from you signal generator.

Adjust the RF coil for the best signal to noise ratio. Keep the signal generator at the threshold of noise during the adjustment.

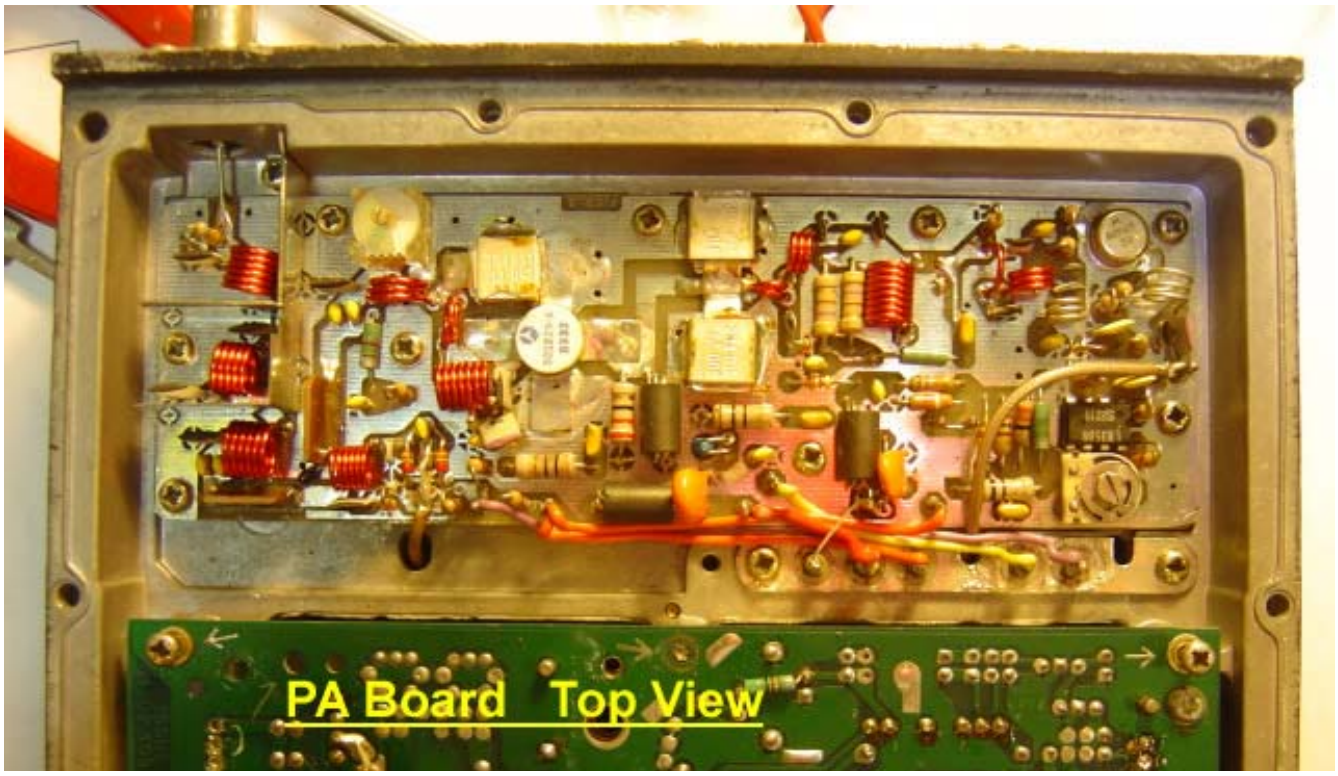
This adjustment should result in the mute lifting for a signal above 0.5 uVolts.

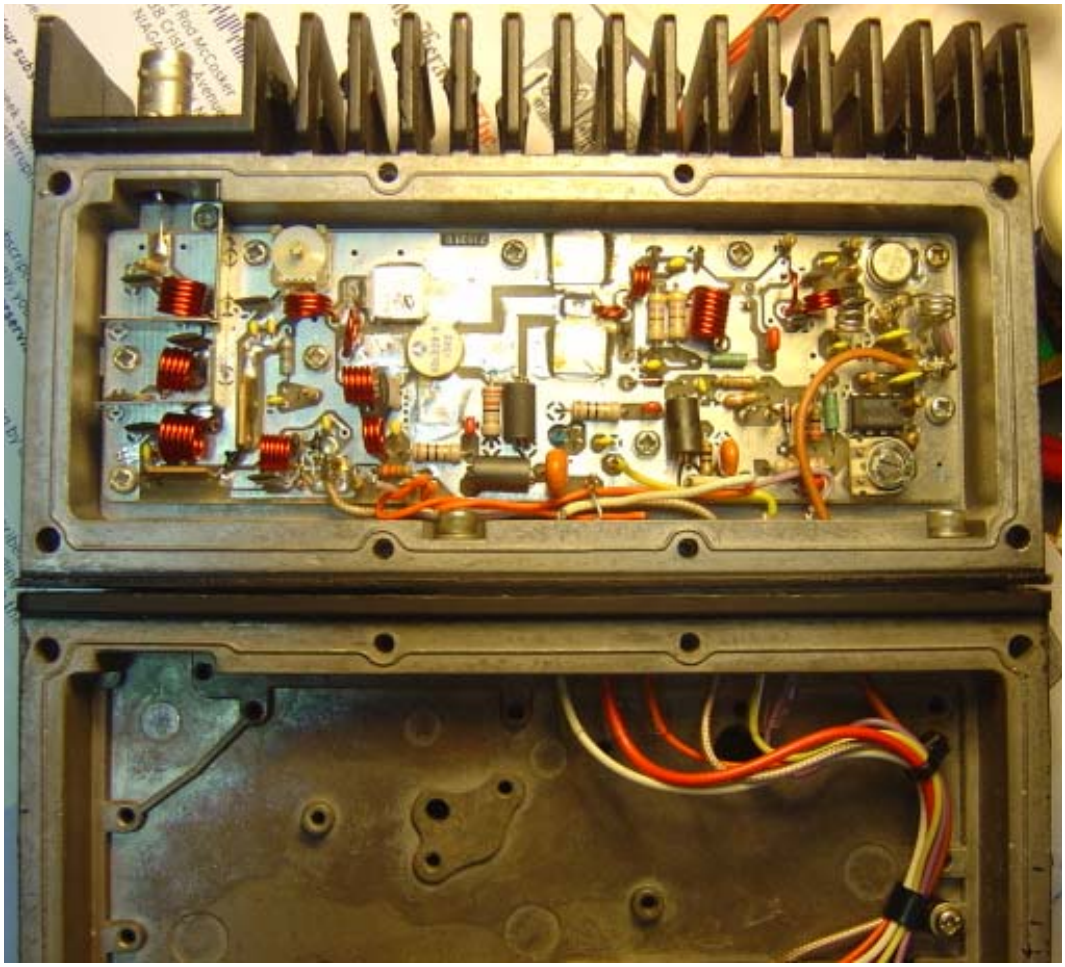
12: PA Changes:

Without any changes to the PA stage you should get between 5 & 7 watts.

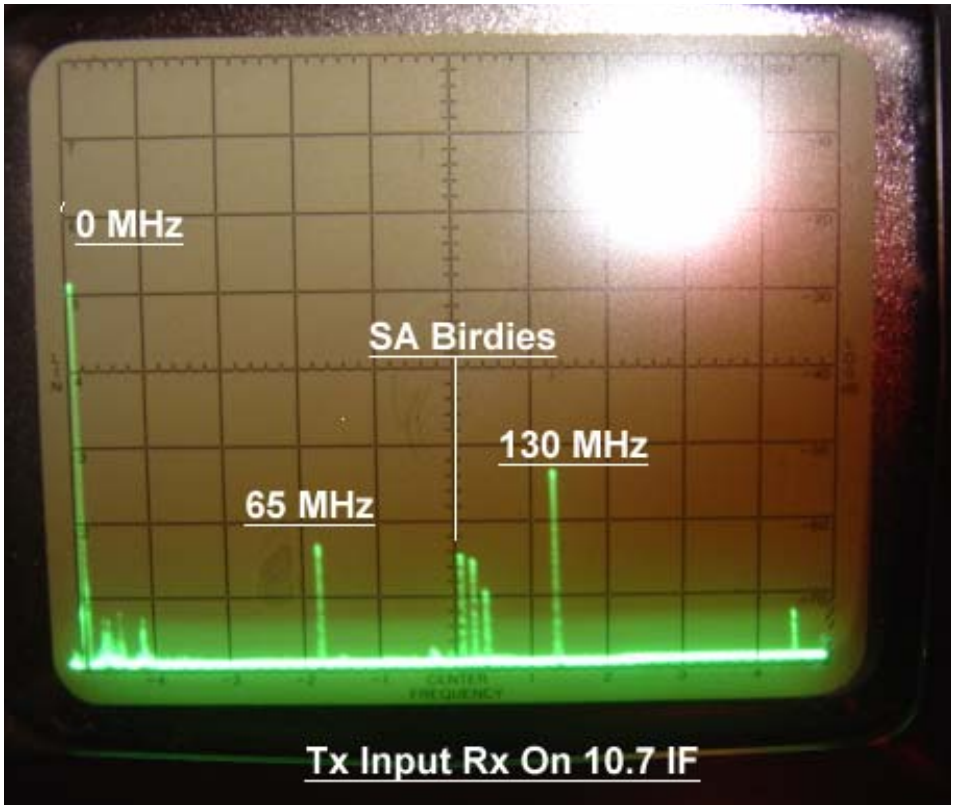


Pin	1 = 12 Volts	Move	
	2 = 13.8 Volts	Yellow	
	3 = 10 Volts Transmitter	Orange	
	4 = 10 Volts PA	Red	
	5 = RF Monitor	Bare Wire	
	6 = Rx to Receiver amplifier input.	Coax	
	7 = Tx PA input from VCO Buffer.	Coax	[25 mW In @ 50 ohms]
	8 = Tx PA output (Top Left Corner)	Bare Wire	[25 W output @ 50 ohms]

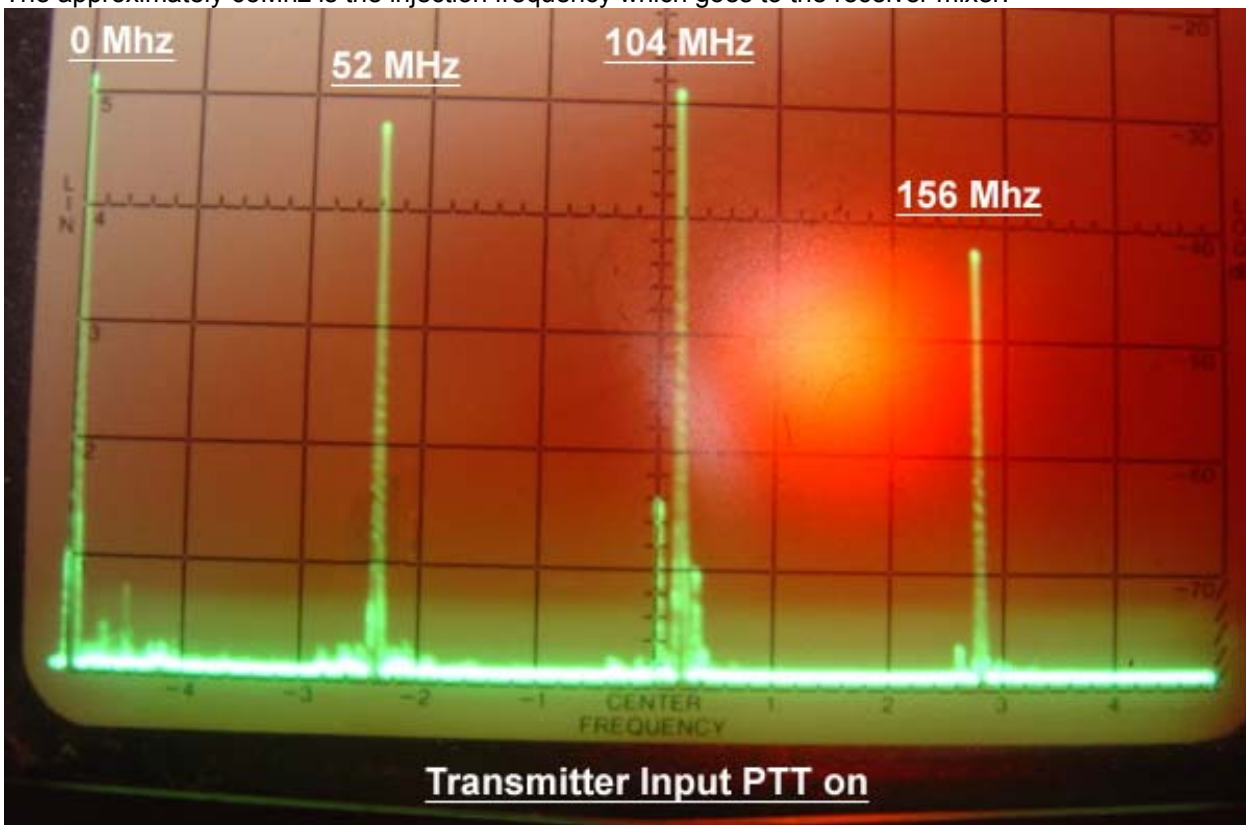




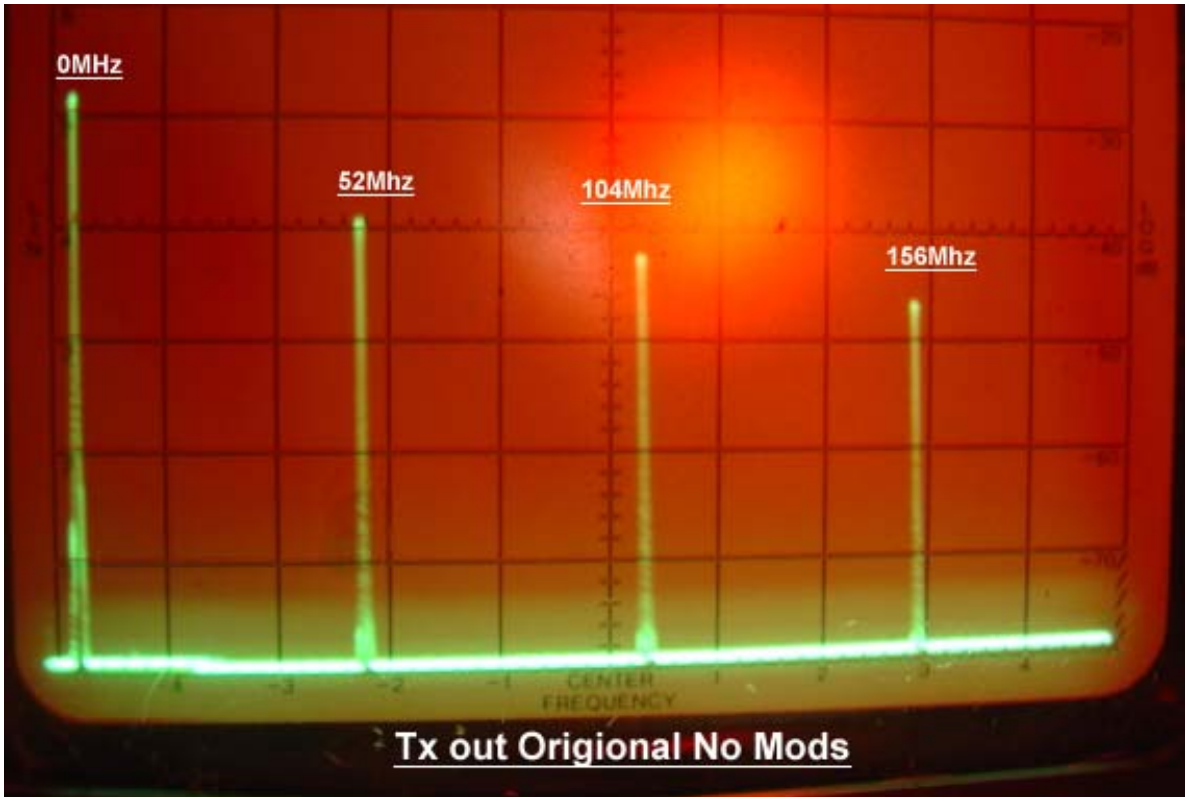
FM91E PA Board above view.

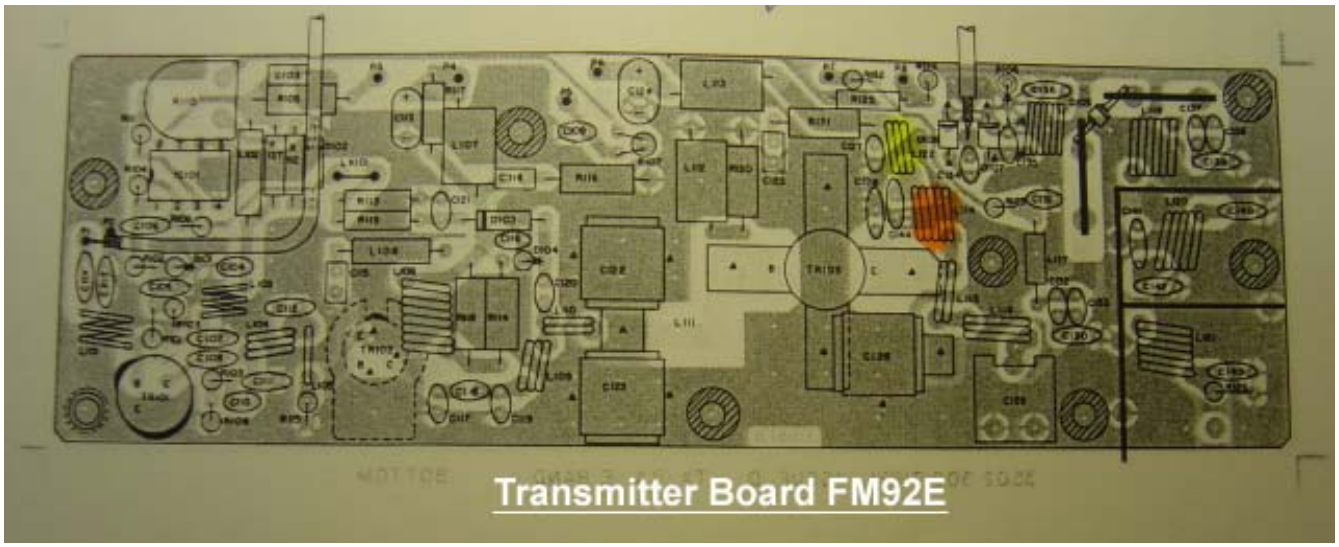


Above is a spectrum analysis of the signal from the FM92E Synthesiser VCO Buffer Output [pin 18] to the transmitter board input via coax with the Transmitter OFF and the Receiver on. The IF in this case is 10.5 MHz. The approximately 65Mhz is the injection frequency which goes to the receiver mixer.



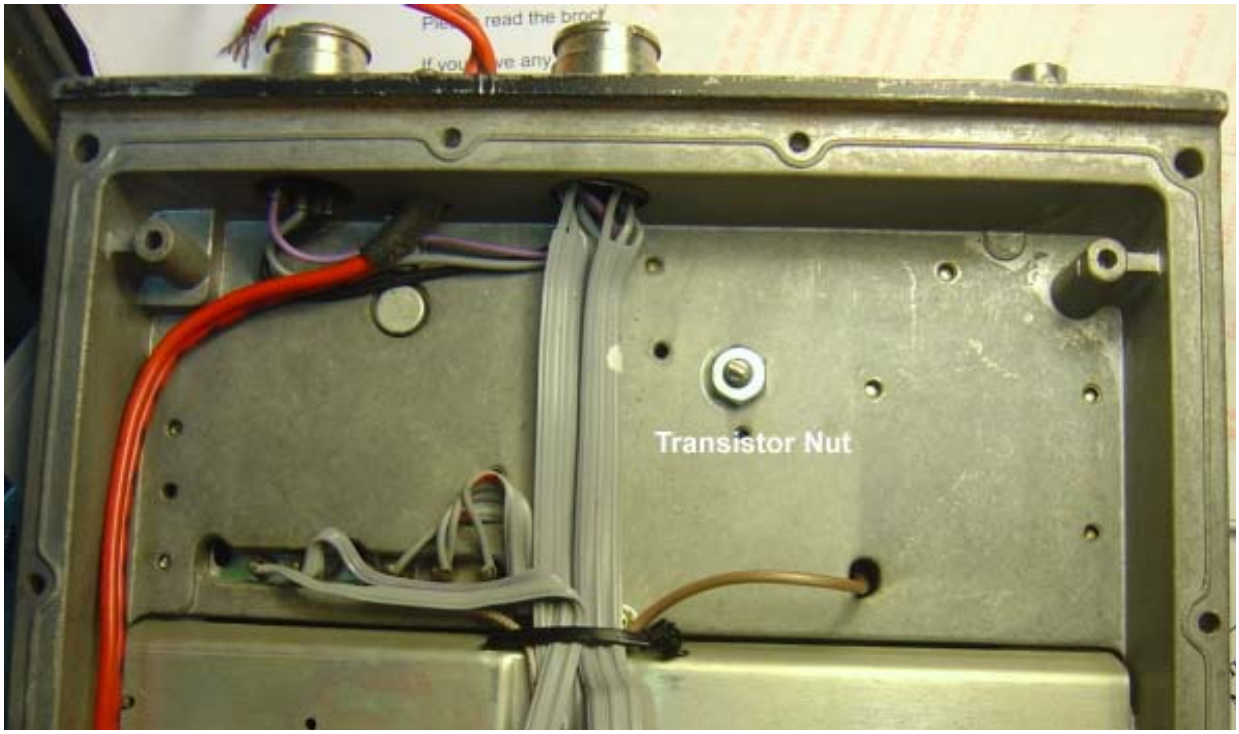
Above is a spectrum analysis of the signal from the FM92E Synthesiser VCO Buffer Output [pin 18] to the transmitter board input via coax, with the Press To Talk key ON, ie the transmitter was keyed. Note the harmonics of the originating approximately 52Mhz frequency.


0MHz
52Mhz
104Mhz
156Mhz
CENTER
FREQUENCY
Tx out Origional No Mods


Transmitter Board FM92E

Release PA Board from Chassis by:

- Remove PA transistor nut from rear of PA Board.

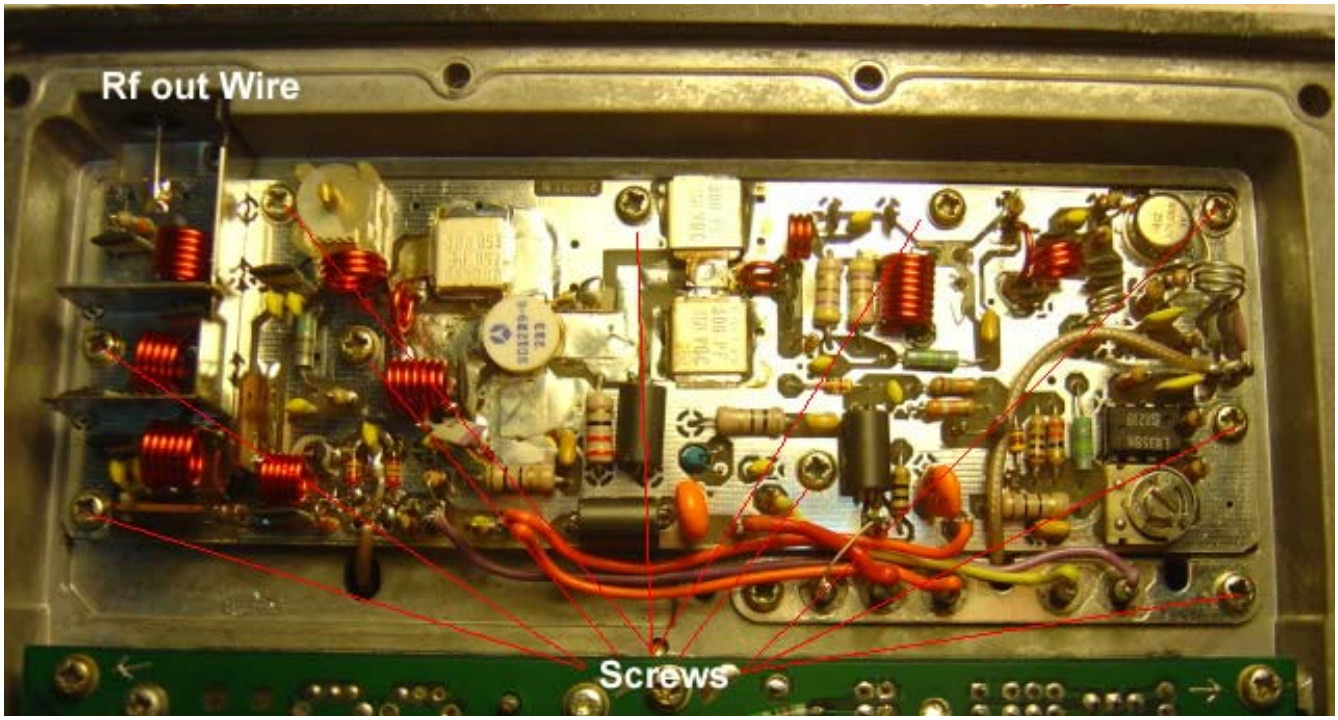


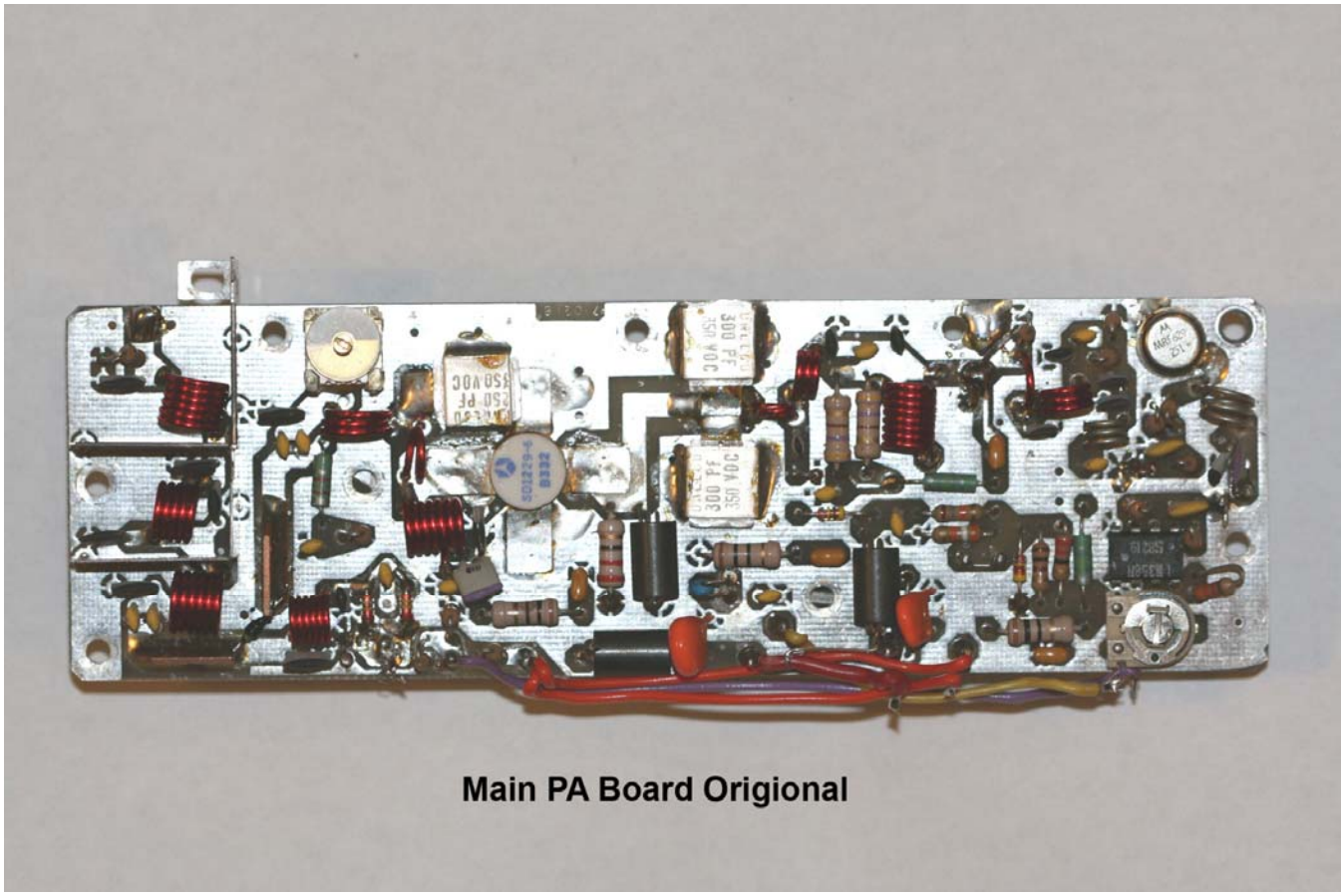
Unsolder RF output wire from PA Board.

Unsolder five of wires from chassis feed through pins.

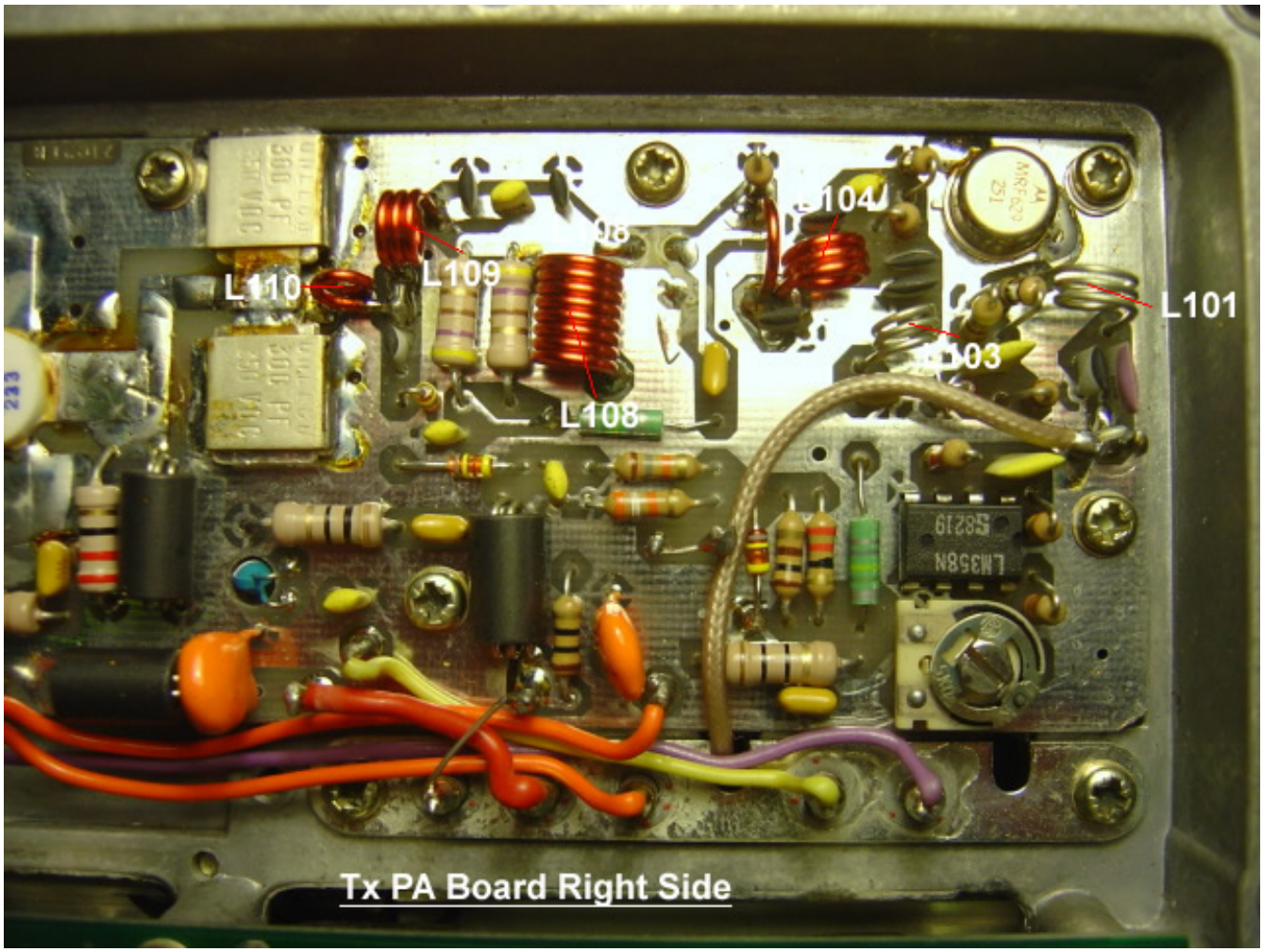
Unsolder two of coax lines going to PA board from PA board.

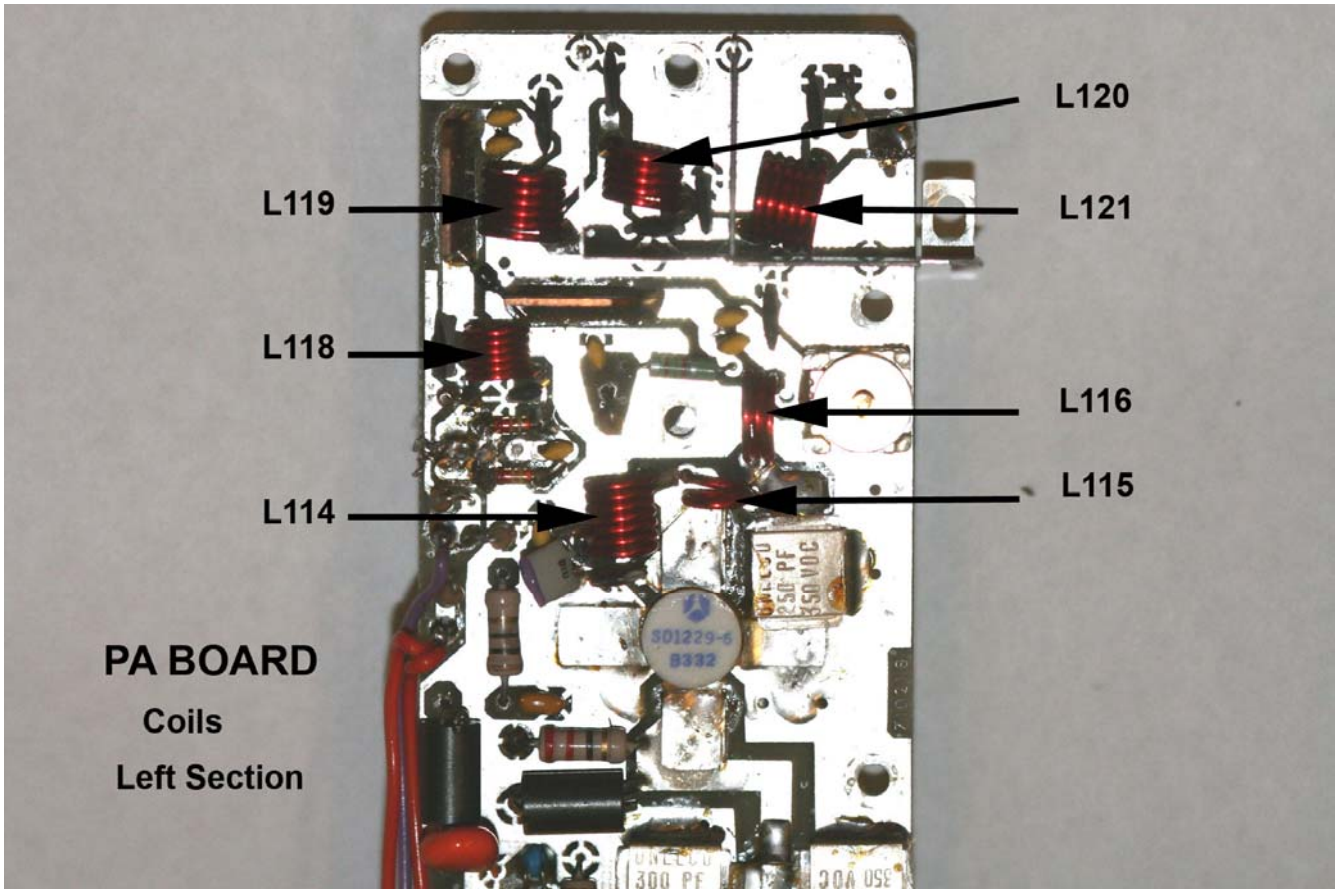
Unscrew screws holding PA board to chassis.

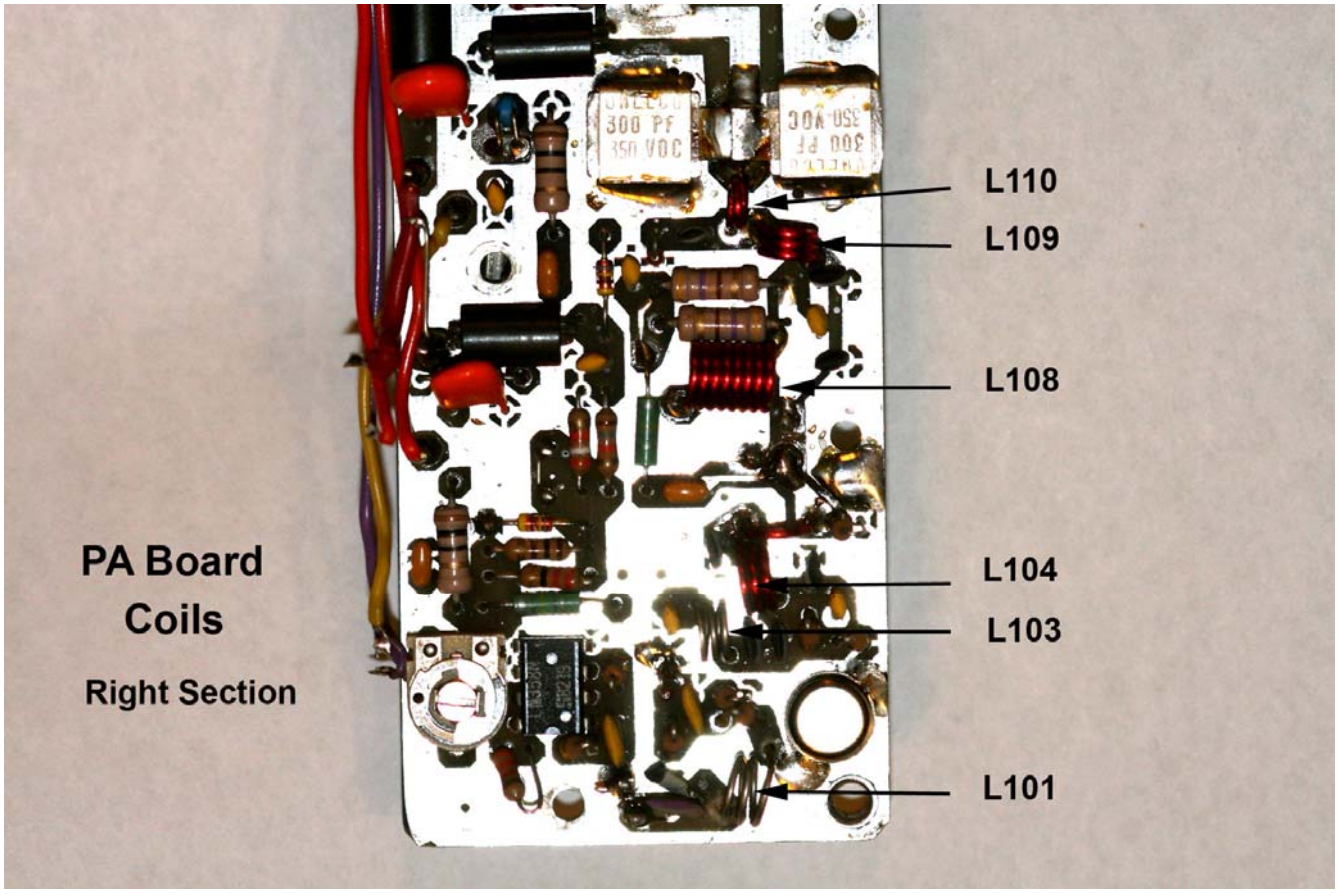


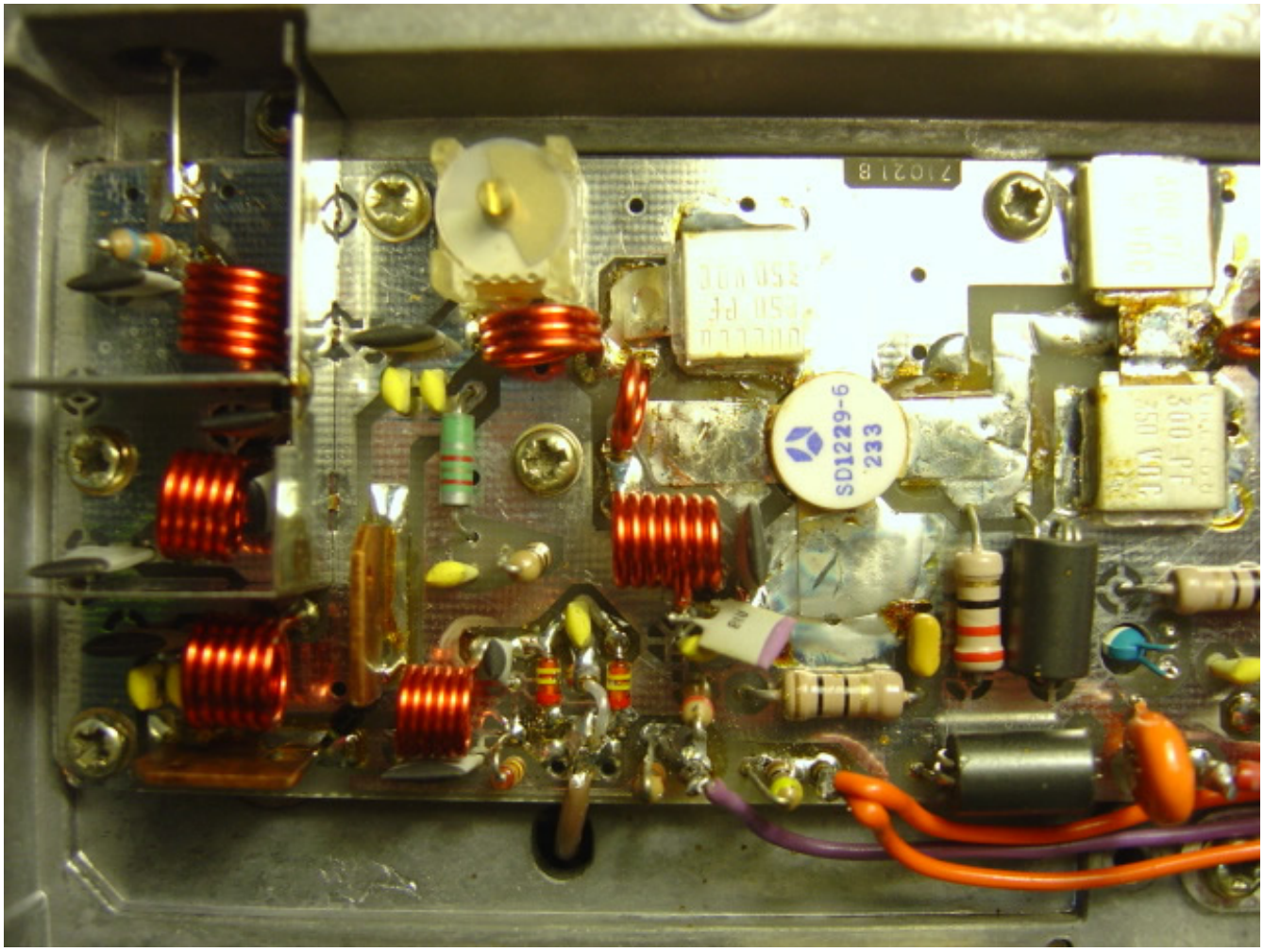


Main PA Board Origional




L120
L119
L121
L118
L116
L115
L114
PA BOARD
Coils
Left Section


L110
L109
L108
L104
L103
L101
PA Board
Coils
Right Section



Coil Upgrade:

Remove by de-soldering and upgrade the following coils to the new turns, with the same diameter on the PA board.

Coil	Original Turns	New Turns	Wire Size	Drill Size for winding coil
L101	2.5	3.5	0.63mm	
L103	2.5	3.5	0.63mm	
L104	2.5	3.5	0.63mm	
L105	0.75	1.0	0.63mm	
L106	No change			
L107	No change			
L108	8.5	10.5	0.80mm	
L109	2.5	3.5	0.80mm	
L110	1.0	1.5	0.80mm	
L111	No change			
L112	No change			
L113	No change			
L114		2.5	0.80mm	
L115	1.0	1.5	0.80mm	
L116	2.5	3.5	0.80mm	
L117	No change			
L118		6.5	0.80mm	
L119	5.5	6.5	0.80mm	
L120	4.5	5.5	0.80mm	
L121	5.5	5.5	0.80mm	
L122		5.0	0.63mm	

Capacitor Upgrade:

The following capacitors have to be purchased. *If original capacitors reused, then the following are necessary.*

		Jacar Part No	Dick Smith Part No
1 of 18 pF	*1 of 18 pF*	RC5315	R2241
3 of 33 pF	*3 of 33 pF*	RC5318	R2247
2 of 47 pF		RC5320	R2251
4 of 56 pF	*4 of 56 pF*	RC5321	R2253
2 of 68 pF		RC5322	R2257
5 of 82 pF	*3 of 82 pF*	RC5323	R2259
1 of 100 pF		RC5324	R2285
3 of 120 pF	*3 of 120 pF*	RC5325	R2287
1 of 220 pF		RC5328	R2293
1 of 270 pF	*1 of 270 pF*	RC5329	R2295

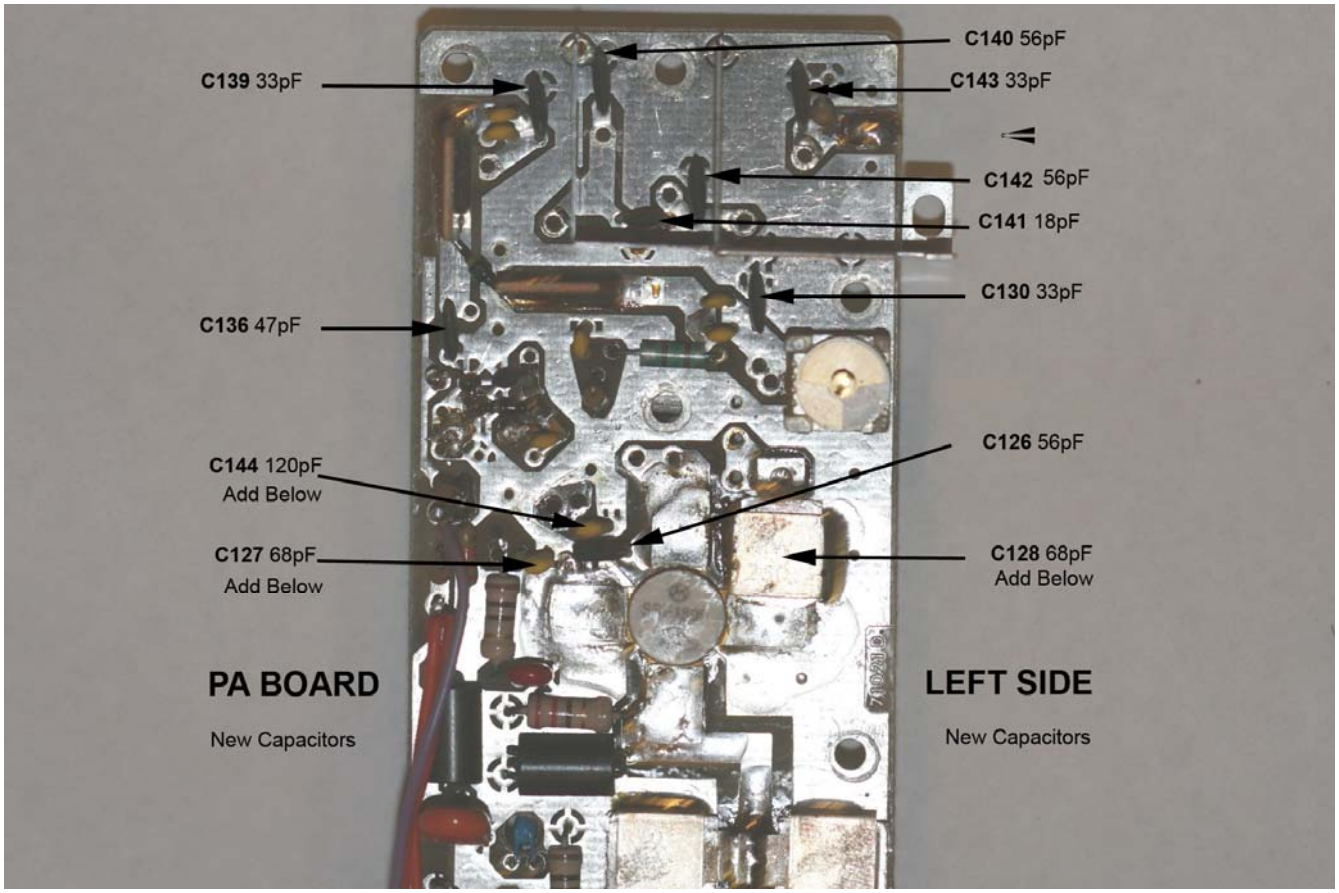
Remove the following capacitors from the PA board, then, replace with capacitors.

Original Capacitor		Replacement
C101	220 pF	270 pF
C102	68 pF	82 pF
C107	100 pF	120 pF
C108	82 pF	100 pF
C111	68 pF	82 pF
C112	82 pF	120 pF
C117	47 pF	56 pF
C118	180 pF	220 pF
C119	68 pF	82 pF
C126	47 pF	56 pF
C130	27 pF	33 pF
C135	39 pF	47 pF
C136	39 pF	47 pF
C139	27 pF	33 pF
C140	47 pF	56 pF
C141	15 pF	18 pF
C142	47 pF	56 pF
C143	27 pF	33 pF

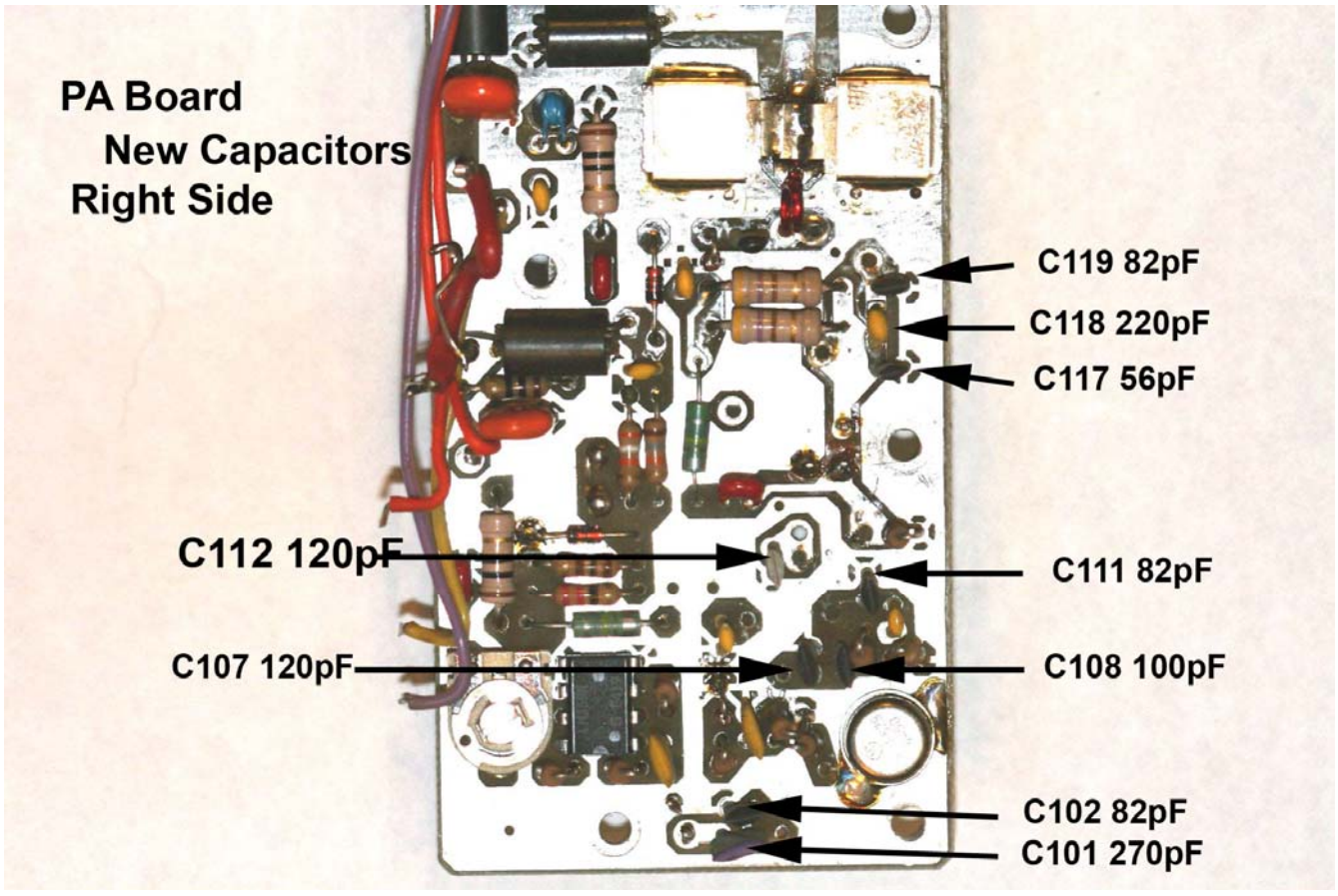
Add the following capacitors across the original capacitors. [ie 2 capacitors in parallel]

Original Capacitor		Add Capacitor	
C122	330 pF	82 pF	
C123	330 pF	82 pF	
C127	270 pF	68 pF	solder beneath board; lay flat.
C128	250 pF	68 pF	
C144	470 pF	120 pF	solder beneath board; lay flat.

REMEMBER: Do not remove capacitors **C128**, **C144** and **C127**; you place the extra capacitors underneath the PA board.



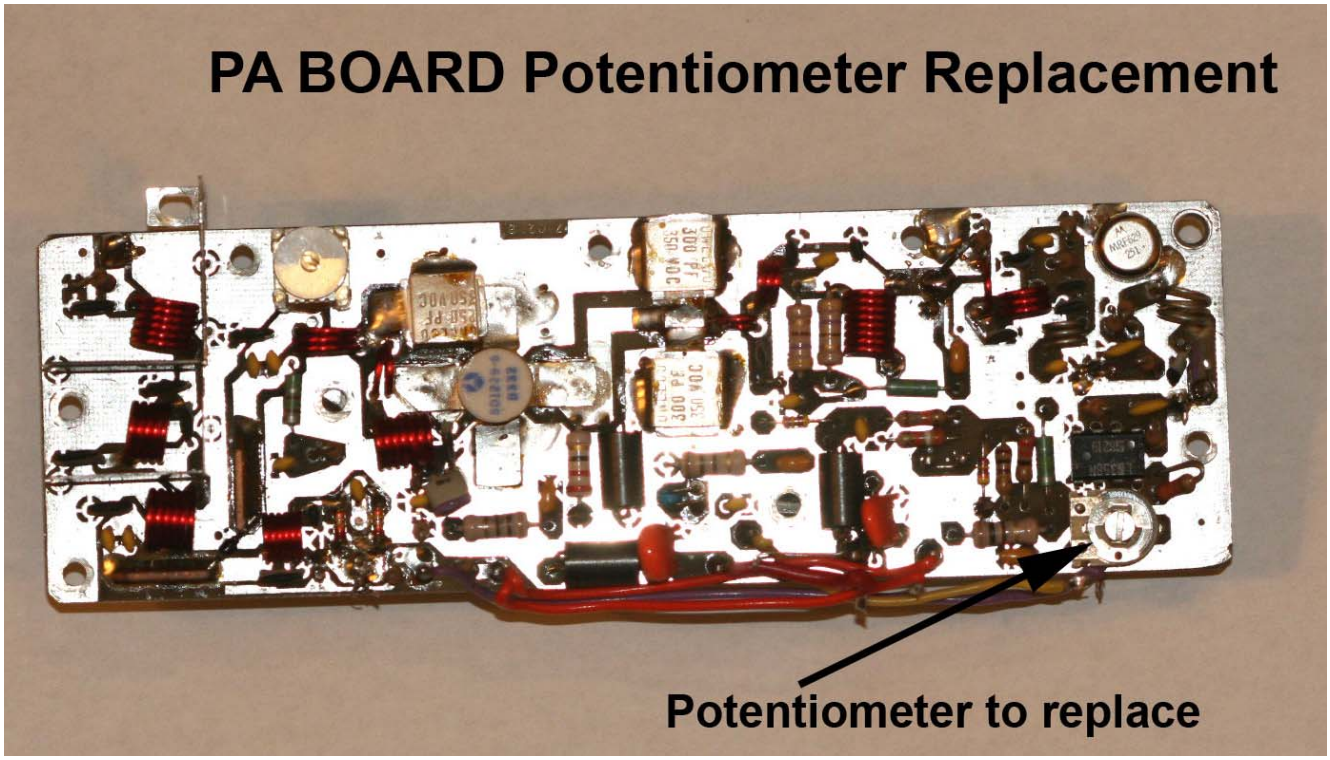
Above is PA Board - left section, at bottom of Screen: **New Capacitors:**



Above is PA Board - right section, at bottom of Screen: **New Capacitors:**

PA Deviation Potentiometer Replacement:

Needed – 1 of 100K ohm potentiometer. Jaycar # - **RT-4366**



Remove the 50K ohm potentiometer and replace with a **100K ohm** potentiometer.

The original FM92E transceiver converted to 6 meters, lacked deviation adjustment and for those who know the circuit, this increases the loop gain of the exciter.

13: PA adjustment:

- Open up the lid on the PA stage (other side of the radio) and adjust R102 (the only pot in the PA) for maximum power.
- Key the radio and adjust C111 and C124 for maximum power. Check the supply current is less than 6.5Amps. What you want is maximum power for least current.
- If you have a deviation meter, connect it and speaking very loudly into the microphone (counting to 10) adjust R367 for a maximum of 5khz.
- If you have a channel programmed as low power, the adjustment is R403