PHILIPS

FM92E

Conversion

To

6 Meters

Part 2

Ver 4.1 - **09 May 2007**

Rod McCosker VK2DOT

Philips FM92E Conversion to 6 Meters Part 2:

Version 4.0 (09 May 2007) Rod McCosker VK2DOT

PART 1 INDEX:

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2: Files Associated with this Project:

6m_con1.doc 6m_con1.pdf = Part 1 Main documentation to convert Philips FM92E to 6 Meters. **Note:** File 6m_con1.doc is approximately 11Mb & file 6m_con1.pdf is approximately 2 Mb

6m_con2.doc 6m_con2.pdf = Part 2 Support documentation to convert Philips FM92E to 6 Meters. **Note:** file 6m_con2.doc is approximately 1.5Mb & file 6m_con2.pdf is approximately 1 Mb

6M_con3.htm = Part 3 Documentation to convert Philips FM92E to 6 Meters. Weekly Procedures

6m_con4.htm = Part 4 Documentation to convert Philips FM92E to 6 Meters. Version Amendments.

6m_fre.rtf = Frequency list of channels of EPROM's below.

Fpp.zip = Software for generating channel verses frequencies for Philips FM92E for 6 Meters.

6m_con.doc = Documentation to convert Philips FM92E to 6 Meters. **Note:** Approximately 13Mb.

6m_con.pdf = Documentation to convert Philips FM92E to 6 Meters. **Note:** Approximately 3.8Mb.

6m_fre.rtf = Frequency list of channels of EPROM's below.

6m_con1.doc = Part 1 Documentation to convert Philips FM92E to 6 Meters. **Note:** Approximately 5Mb.

6m_con2.doc = Part 2 Documentation to convert Philips FM92E to 6 Meters. **Note:** Approximately 5Mb.

6m_con3.doc = Part 3 Documentation to convert Philips FM92E to 6 Meters. **Note:** Approximately 5Mb.

6m_con4.doc = Part 4 Documentation to convert Philips FM92E to 6 Meters. **Note:** Approximately 5Mb.

6m_con1.pdf = Part 1 Documentation to convert Philips FM92E to 6 Meters. **Note:** Approximately 2Mb.

6m_con2.pdf = Part 2 Documentation to convert Philips FM92E to 6 Meters. **Note:** Approximately 2Mb.

6m_con3.pdf = Part 3 Documentation to convert Philips FM92E to 6 Meters. **Note:** Approximately 2Mb.

6m_con4.pdf = Part 4 Documentation to convert Philips FM92E to 6 Meters. **Note:** Approximately 2Mb.

6m_fre.rtf = Frequency list of channels of EPROM's below.

Fpp.zip = Software for generating channel verses frequencies for Philips FM92E for 6 Meters.

EPROM's for 6 Meters transmitter & receiver after modification.

6m1loc.bin = EPROM for Philips FM92E with **Local Head**.
Hardware Code: = **9502** 9221 0000 — 25.0KHz channel, 25W & 10.7 MHz IF.
Software Code = 110400200000000 — Check Sum = **C2FF**

6m2rem.bin = EPROM for Philips FM92E with **Remote Head**.
Hardware Code: = **9502** 9222 0000 — 25.0KHz channel, 25W & 10.7 MHz IF.
Software Code = 110400200000000 — Check Sum = **09FF**

6m3loc.bin = EPROM for Philips FM92E with **Local Head**
Hardware Code: = **9502** 9223 0000 — 25.0 KHz channel, 25W & 21.4 MHz IF.
Software Code = 110400200000000 — Check Sum = **B8FF**

6m4rem.bin = EPROM for Philips FM91E changed to FM92E with **Remote Head**
Hardware Code: = **9502** 9224 0000 — 25.0 KHz channel, 25W & 21.4 MHz IF.
Software Code = 110400200000000 — Check Sum = **FFFF**

6m5loc.bin = EPROM for Philips FM92E with **Local Head**.
Hardware Code: = **9502** 9225 0000 — 12.5 KHz channel, 25W & 10.7 MHz IF.
Software Code = 110400200000000 — Check Sum = **AAFF**

6m6rem.bin = EPROM for Philips FM92E with **Remote Head**.
Hardware Code: = **9502** 9226 0000 — 12.5 KHz channel, 25W & 10.7 MHz IF.
Software Code = 110400200000000 — Check Sum =

6m7loc.bin = EPROM for Philips FM92E with **Local Head**.
Hardware Code: = **9502** 9227 0000 — 12.5 KHz channel, 25W & 21.4 MHz IF.
Software Code = 110400200000000 — Check Sum = **2FFF**

6m8rem.bin = EPROM for Philips FM92E with **Remote Head**.
Hardware Code: = **9502** 9228 0000 — 12.5 KHz channel, 25W & 21.4 MHz IF.
Software Code = 110400200000000 — Check Sum =

EPROMs for testing FM92E 66-88 MHz transmitter & receiver before modification.

6mtest1l.bin = EPROM for Philips FM92E with **Local Head**.
Hardware Code: = **9502** 9221 0000 — 25.0KHz channel, 25W & 10.7 MHz IF.
Software Code = 110400000000000 — Check Sum = **AFFF**

6mtest2r.bin = EPROM for Philips FM92E with **Remote Head**.
Hardware Code: = **9502** 9222 0000 — 25.0KHz channel, 25W & 10.7 MHz IF.
Software Code = 110400000000000 — Check Sum = **F6FF**

6mtest3l.bin = EPROM for Philips FM92E with **Local Head**.
Hardware Code: = **9502** 9223 0000 — 25.0KHz channel, 25W & 21.4 MHz IF.
Software Code = 110400000000000 — Check Sum = **ADFF**

6mtest4r.bin = EPROM for Philips FM91E converted to FM92E with **Remote Head**.
Hardware Code: = **9502** 9224 0000 — 25.0KHz channel, 25W & 21.4 MHz IF.
Software Code = 110400000000000 — Check Sum = **F4FF**

NOTE: You must determine what IF your FM92E is using. This will determine what EPROM to use. 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.

3: FM92E Test EPROM 68-88 Mhz Channel verses Frequency List:

6Mtest1L.bin	= Local Head	Test EPROM	10.7 MHz IF.
6Mtest2R.bin	= Remote Head	Test EPROM	10.7 MHz IF.
6Mtest3L.bin	= Local Head	Test EPROM	21.4 MHz IF.
6Mtest4R.bin	= Remote Head	Test EPROM	10.4 MHz IF.

Channel	Frequency
1	68 Mhz
2	69 Mhz
3	70 Mhz
4	71 Mhz
5	72 Mhz
6	73 Mhz
7	74 Mhz
8	75 Mhz
9	76 Mhz
10	77 Mhz
11	78 Mhz
12	79 Mhz
13	80 Mhz
14	81 Mhz
15	82 Mhz
16	83 Mhz
17	84 Mhz
18	85 Mhz
19	86 Mhz
20	87 Mhz
21	88 Mhz

4: 6 METER FM92E FM FREQUENCIES

Ch	Scan	Rx	Tx					
1	1	52.525Mhz	52.525Mhz	**Voice Main Calling Frequency**				
2		52.550Mhz	52.550Mhz	Voice Simplex for Repeater # 42				
3		52.575Mhz	52.575Mhz	Voice Simplex for Repeater # 43				
4		52.600Mhz	52.600Mhz	Voice Simplex for Repeater # 44				
5		52.625Mhz	52.625Mhz	Voice Simplex for Repeater # 45				
6		52.650Mhz	52.650Mhz	Voice Simplex for Repeater # 46				
7		52.675Mhz	52.675Mhz	Voice Simplex for Repeater # 47				
8		52.700Mhz	52.700Mhz	Voice Simplex for Repeater # 48				
9		52.725Mhz	52.725Mhz	Voice Simplex for Repeater # 49				
10		52.750Mhz	52.750Mhz	Voice Simplex for Repeater # 50				
11		52.775Mhz	52.775Mhz	Voice Simplex for Repeater # 51				
12		52.800Mhz	52.800Mhz	Voice Simplex for Repeater # 52				
13		52.825Mhz	52.825Mhz	Voice Simplex for Repeater # 53				
14		52.850Mhz	52.850Mhz	Voice Simplex for Repeater # 54				
15		52.875Mhz	52.875Mhz	Voice Simplex for Repeater # 55				
16		52.900Mhz	52.900Mhz	Voice Simplex for Repeater # 56				
17		52.925Mhz	52.925Mhz	Voice Simplex for Repeater # 57				
18		52.950Mhz	52.950Mhz	Voice Simplex for Repeater # 58				
19		52.975Mhz	52.975Mhz	Voice Simplex for Repeater # 59				
20		53.000Mhz	53.000Mhz	**Data**				
21		53.025Mhz	53.025Mhz	**Data**				
22		53.050Mhz	53.050Mhz	**Data**				
23		53.075Mhz	53.075Mhz	**Data**				
24		53.100Mhz	53.100Mhz	**Data**				
25		53.125Mhz	53.125Mhz	Voice				
26		53.150Mhz	53.150Mhz	Voice				
27		53.175Mhz	53.175Mhz	Voice				
28		53.200Mhz	53.200Mhz	Voice				
29		53.225Mhz	53.225Mhz	Voice				
30		53.250Mhz	53.250Mhz	Voice				
31		53.275Mhz	53.275Mhz	Voice				
32		53.300Mhz	53.300Mhz	Voice				
33		53.325Mhz	53.325Mhz	Voice				
34		53.350Mhz	53.350Mhz	Voice				
35		53.375Mhz	53.375Mhz	Voice				
36		53.400Mhz	53.400Mhz	Voice				
37		53.425Mhz	53.425Mhz	Voice				
38		53.450Mhz	53.450Mhz	Voice				
39		53.475Mhz	53.475Mhz	Voice				
40		53.500Mhz	53.500Mhz	Voice				
41		53.525Mhz	53.525Mhz	Voice				
42		53.550Mhz	52.550Mhz	Repeater	**NSW**	Albury & Lismore	**Vic**	Melbourne
43	1	53.575Mhz	52.575Mhz	Repeater	**NSW**	Walcha & Snowy	**Vic**	Dandenong
44	1	53.600Mhz	52.600Mhz	Repeater	**NSW**	Narrabri	**Vic**	Gippsland
45	1	53.625Mhz	52.625Mhz	Repeater	**NSW**	Newcastle	**Vic**	Melbourne
46	1	53.650Mhz	52.650Mhz	Repeater	**NSW**	Wollongong		
47	2	53.675Mhz	52.675Mhz	Repeater	**NSW**	Terry Hills Sydney	**Vic**	MelbourneEast & NE Vic
48	1	53.700Mhz	52.700Mhz	Repeater	**NSW**	Goulburn	**Qld**	Sunshine Coast
49	2	53.725Mhz	52.725Mhz	Repeater	**Qld**	KroombitTops/C Qld, Woodridge/BrisbaneSouth		
50	2	53.750Mhz	52.750Mhz	Repeater	**SA**	Summertown/Adelaide		
51	2	53.775Mhz	52.775Mhz	Repeater	**SA**	Crafers/Adelaide	**Qld**	Bundaberg, Atherton Tland
52	1	53.800Mhz	52.800Mhz	Repeater	**WA**	Roleystone/Perth		
53	1	53.825Mhz	52.825Mhz	Repeater	**Tas**	Hobart, Lonah Central N/W Coast		
54	1	53.850Mhz	52.850Mhz	Repeater	**NSW**	Dural/Sydney		
55	1	53.875Mhz	52.875Mhz	Repeater	**NSW**	Lawson/Blue Mts	**Tas**	Mt Barrow/N Tas
56	2	53.900Mhz	52.900Mhz	Repeater	**Vic**	Melbourne		
57	2	53.925Mhz	52.925Mhz	Repeater	**NSW**	ACT & SE NSW	**Qld**	Ipswich
58	2	53.950Mhz	52.950Mhz	Repeater	**Qld**	Brisbane South		
59	2	53.975Mhz	52.975Mhz	Repeater	**Vic**	NE Vic	**Qld**	Mt Gravatt Brisbane

Ch	Scan	Rx	Tx	
60		52.550Mhz	53.550Mhz	Voice Reverse for Repeater # 42
61		52.575Mhz	53.575Mhz	Voice Reverse for Repeater # 43
62		52.600Mhz	53.600Mhz	Voice Reverse for Repeater # 44
63		52.625Mhz	53.625Mhz	Voice Reverse for Repeater # 45
64		52.650Mhz	53.650Mhz	Voice Reverse for Repeater # 46
65		52.675Mhz	53.675Mhz	Voice Reverse for Repeater # 47
66		52.700Mhz	53.700Mhz	Voice Reverse for Repeater # 48
67		52.725Mhz	53.725Mhz	Voice Reverse for Repeater # 49
68		52.750Mhz	53.750Mhz	Voice Reverse for Repeater # 50
69		52.775Mhz	53.775Mhz	Voice Reverse for Repeater # 51
70		52.800Mhz	53.800Mhz	Voice Reverse for Repeater # 52
71		52.825Mhz	53.825Mhz	Voice Reverse for Repeater # 53
72		52.850Mhz	53.850Mhz	Voice Reverse for Repeater # 54
73		52.875Mhz	53.875Mhz	Voice Reverse for Repeater # 55
74		52.900Mhz	53.900Mhz	Voice Reverse for Repeater # 56
75		52.925Mhz	53.925Mhz	Voice Reverse for Repeater # 57
76		52.950Mhz	53.950Mhz	Voice Reverse for Repeater # 58
77		52.975Mhz	53.975Mhz	Voice Reverse for Repeater # 59

5: Basic Specifications:

- Mode - FM only
- Channels - 99, simplex and/or duplex
- Power output - 1 Watt to 25 Watts
- Power supply - 13.8VDC, (-ve) ground
- Power consumption - 6.5A with Transmitter at 25W
- Scanning - 2 groups of 10 channels
- Channel frequencies, simplex/duplex, scan groups and power levels programmable by EEPROM
- Economiser mode for low power consumption
- IF – 20.4 MHz. Earlier versions 10.7 MHz.

6: Philips FM92E Background:

Remote Head for FM92E

This is a general information section on the Philips transceiver model FM-92 before we commence to convert its operation from commercial VHF low band (70-85 MHz) to 6 metres HAM band
There are several versions of the FM-92, for high Band VHF and UHF, this page primarily covers the 99 channel low Band VHF, 25 watt output (E band, 66-88 Mhz model)
The FM-92 is part of the Philips FM-900 series, there are also FM-91 and FM-93 models. It comes in E, A, T, U, W1 & W2 band versions.
This transceiver is EPROM programmable, normally a 2764 (8kbyte) EPROM.

The FM92 is characterised as a mobile base unit, it comes into two variations, a "Local" unit, with front panel fixed to the base unit and the "Remote" unit, which has the front, control panel connected to the main unit by a remote cable with DB-15 connectors at each end approx 25cm L, 20cm W, 6cm D, with a diecast body with heat-sink ribbing and sides and rear panel. Connectors are a 15 pin DB-15 for remote head connection, a BNC antenna socket and 13.8V DC power lead.

The remote Head and Local front panel, includes twin 7 segment displays for channel indication and several buttons for UP/DOWN channel selection, SEND button, AUX button, POWER on/off button, plus Volume and Mute controls, Power, TX & RX indication LEDS.

For those considering using a Phillips FM900 series for amateur radio, and are confused by the band codes used, the Philips FM900 series band plan is as follows:

E Band radios are Lo Band VHF covering 68-88 MHZ: This is the one to convert to 6M
B Band radios are Hi Band VHF covering 132-153 MHZ: These are fine for 2M amateur
A Band radios are Hi Band VHF covering 148-174 MHZ
T Band radios are UHF covering 403-420 Mhz
U Band radios are UHF covering 440-470 Mhz
W1 Band radios are UHF covering 470-500 Mhz: These are the ones for UHF CB use
W2 Band radios are UHF covering 500-520 Mhz

7: A little History:

In the early eighties, Philips Australia started producing a commercial radio for the Australian and international markets. The radios came in various configurations and frequency bands. They where constructed from a one piece die-cast enclosure, with ether a local control face plate or remote control head. The circuitry is contained on 3 main boards (RF, CPU and PA), PCB's are double sided FRG4 fibreglass. All of the components are through hole except the SMT parts mounted on ceramic hybrid SIP's. The whole construction is extremely ruggedised and very solid. The FM900 series came in 3 basic models (FM91, FM92 and FM93). It also came in some special/custom variants and also a waterproof model FM97.

The FM91 is intended as the high end 120 channel model and only came in a remote head version. It has a numeric keypad, function, scan, site, send keys, digital mute and volume, it also has an eight digit seven segment red LED display, most options are programmable from the head.

The FM92 was the standard 40 channel radio (up to 99 CH's), it came in 2 variants, local head and remote head. It has channel up/down, aux and send buttons, analogue mute and volume. The display consists of two seven segment red LED display. The radio can be programmed with almost the same options as the FM91 but it's not changeable from the front panel. The remote head also has a built in speaker. This is the most common FM900 series radio.

The FM93 is the low end 10 channel baby. It has channel up, aux and send buttons, analogue mute and volume. The display is a single seven segment green LED display. It only came in a local head version and differs considerably from the other FM900 series radios, in that it's a servery striped down version, utilising cheaper receiver section and different PLL. It also lacks an A-D chip, therefore it can't facilitate some functions, mainly voting. Sometimes these units actually have FM92 PCB's installed, but they can only display channels 0-9.

The FM97 is basically a waterproof FM92 with an FM91 CPU board. It only came in a remote version, the head was made from a white die-cast jiffy box, it uses Mil-spec bayonet connectors and high quality push button switches with waterproof boots. It has volume up/down, channel up/down, mute, a, b, c function buttons. The display consists of 4, 7 segment red LED displays. According to information from an ex-Philips employee they were designed for police motor bikes!!

The only real deference between the FM91 / FM97 and FM92 is that the FM92 has a standard volume control pot, but the FM91 / FM97 has a 4 bit digital audio attenuator hybrid instead.

All models are based on the Motorola MC146805 CMOS micro controller, and normally have an 8k (2764) EPROM. The EPROM contains the program code and channel data.

All models have provisions for add on modules or "options" as Philips calls them.

```
Selcall                 Type 1
Selcall                 Type 2
CTCSS                   Encode
CTCSS                   Decode
CTCSS                   Encode / Decode
CTCSS                   Encode / Decode and Reverse tone burst
RTB                     ( Reverse tone burst )
Battery Backup          ( CPU current data backup, long duration )
Cap Backup              ( CPU current data backup, short duration )
Extended B/W            for MK2 only
TXCO                    Temperature controlled crystal oscillator Crystal Heater
```

8: Just a few notes, hints, tips and tricks which don't fit anywhere else:

Before swinging back the PC boards, and especially before removing the EPROM, ensure you disconnect the DC supply from the unit. Remember, although the "PWR" switch may be off, there is still DC supplied to the EPROM circuitry and many parts of the boards. On swinging back the boards with DC applied, it is easy to short the 13.8V and 5V supplies. And obviously, removing and replacing EPROMS with power applied, is NOT a good idea!

When reassembling the transceiver unit after disassembly, first spray the panel screws with WD-40, then replace all screws lightly in their respective holes. Then, while maintaining a little pressure on the screw, unscrew slightly until a click is felt, then tighten most of the way. Repeat for all screws, then go around and finally tighten them all. This avoids "second-starting" (cross-threading), which is otherwise easily achieved.

Miscellaneous intermittent problems caused by dry Joints. As mentioned previously, these units have seen service with many commercial operators. Presumably, servicing has been carried out by technicians with various degrees of skill, and possibly in a hurry. As a result of these factors, some of the units have been found to have intermittent problems of all kinds. It has been suggested to me on a number of occasions that all solder joints on each board should be re-soldered!

Be careful with this, however, as some of the pads are very close together, and it is possible to melt the low-temp solder inside the front-end and VCO blocks, causing more problems.

Given the sheer number of joints, and in some cases the extreme proximity of some of these joints (eg, IC connectors) this is not a particularly easy task, but close examination of the circuit boards is certainly warranted.

9: Cleaning up an FM-900 to make it look good:

This assumes, of course, that you don't actually want your new transceiver to have that "lived-in" look. Remember, a clean mind makes you radiate more and be the talking point of your shack.

Since most of these units have seen "active service" in commercial operations including fire brigade tankers and the like, it is unusual to find one which is not absolutely filthy dirty. No problem.

The transceiver unit

- Cover all electrical connectors with tape. Do not remove the top and bottom covers at this time.
- Get a paint brush, maybe 1 or 2cm in width, and brush out the worst of the dust from the grooves and channels.
- It may be necessary to cut the length of the bristles by half, to make a stiffer brush.
- Use a dampened sponge or cloth to finish cleaning as far as possible. Dampen your brush to clean in crevices.
- If the unit is not scratched or badly marked, spray with furniture cleaner (Mr Sheen or similar) and wipe. Another option is Armour-all or similar.
- If the unit is badly marked, obtain a can of auto touch-up spray (Holts or similar) and lightly re-spray the unit. You may like to remove the covers for this, remembering to cover the electrical parts, of course. :)
- If you do remove the covers, place the screws on a cloth and spray them with WD-40 or similar.
- When the unit is dry, remove the tape from the connectors and lightly spray them with WD-40 or similar and wipe off the excess.

The Control (Head) unit

Disassembly

- For this you are going to dismantle the unit.
- fill a sink (with a strainer in the plughole) or any container with warm water and detergent.
- If fitted, remove the mounting bracket from the control unit, and throw the bits in the sink.
- If the microphone connects to the front of the unit (directly under the "PWR" switch), prise it straight off towards you.
- Remove the vol and mute knobs from the front panel. Just pull them straight off. Throw them in the sink.
- Flip the unit over, and undo the four screws from the back corners. Put them on a cloth and spray them with WD-40 or similar.
- Lift off the back cover and throw it in the sink.
- There are two circuit boards in the control unit. They are connected by ribbon cables and need to be removed together, along with the speaker.
- Undo five screws from the upper (back) board, and two screws from the lower (front) board, on either side of the "Ext Spk" switch. (If fitted.)
- Remove the nut holding the "Ext Spk" switch (if fitted) and pull the switch back into the unit. Gently lift the two boards out of the front panel, but only as far as is necessary to reach the screws holding the speaker brackets.
- Remove the screws holding the speaker brackets.
- Remove the circuit boards and the speaker as one unit. On some units, note the position of the hard-wired microphone connector cable.
- From the front circuit board, gently remove the "channel up" and channel down" buttons, as well as the three blue buttons. Just pull them off. Throw the buttons and the front panel in the sink.
- using your cut-down paint brush, scrub all the plastic parts with warm water and detergent, in particular removing all the gunk from the crevices in the front panel, then rinse and dry with a clean cloth.
- It may be necessary to brush the circuit boards with a clean paint brush.

- You may like to spray and wipe the front panel with "Mr Sheen" or similar, or "Armour-all" or similar, or even apply a light coat of clear (matt) varnish (ensure it is safe for plastics!).
- Ensure you now have, nice and clean:
    - two "channel" buttons
    - three blue buttons
    - two knobs
    - the back panel
    - the front panel
    - and all the screws and hardware you started with. :)

Reassembly

- Replace the channel change buttons (arrows pointing out) on the front circuit board switches. They should snap lightly into place.
- Replace the three blue buttons on their switches.
- Ensure the three LEDs are still vertical from the circuit board.
- Re-mount the speaker.
- Replace the circuit boards into the front panel, ensuring that:
    - the three LEDs and five buttons fit properly into their respective holes
    - the white bracket between the circuit boards is correctly positioned (for the mounting screws to locate correctly)
    - the hard-wired microphone cable (if fitted) is correctly positioned.
    - the speaker wires are not caught up
- Replace the screws holding the circuit boards.
- Replace the "Ext Spk" switch (if fitted).
- Replace the knobs (they are different!)
- Replace the rear panel and screws.

Ensure you have no bits left over.

The Microphone

- Undo the four screws at the back.
- Separate the back from the microphone
- blow or brush out any dust
- spray the PTT contacts with WD-40 or similar, wipe off any excess
- Reassemble and wipe with "Mr Sheen" or similar.

Finished!

10: CCARC Equipment Supplied: [at no cost to members]

- Philips FM92E band transceiver
- Remote Control Head or Speaker [for local control head].
- 2764 EPROM [already programmed for 6 meters – 77 FM channels].
- VHF Signal Generator
- RF Power Meter
- De-Soldering station
- Soldering Iron *
- 12 volt meter.
- Tuning stick.
- Grid Dip Oscillator.
- 50ohm RF cables.
- This document plus frequency v channel page.
- 50 watt plus soldering iron with big flat tip.
- Large File [rasp] *
- Methylated Spirits
- Tin Snips *
- Philips Screwdriver *

Note: * = Bring your own if you have one.

11: CCARC Equipment Required: [to be supplied by each member]

- Soldering Iron [if needed]
- Solder wick [if needed]
- Stanley Knife or Scapple or Box Cutter
- Tin snips [if needed]
- Pair of small tweezers
- Engraver with grinder [if needed]
- Hot glue gun [if needed]
- 12 volt meter [if needed]
- Small plastic GLAD bag for holding screws.
- A4 plastic GLAD bag for holding covers.
- Can of WD40.
- Mr Sheen, Armour-all or similar.
- 1cm or 2cm paint brush for cleaning.
- Sponge or cloth for cleaning.
- Masking Tape for cleaning.
- Tooth brush for cleaning.
- Can of black paint [if needed].
- In-Line Fuse holder & 8 or 10 amp fuse.
- 5 pin DIN plug [for speaker] or 3.5mm plug.
- **0.80mm [B&S 20] Enamelled Copper Winding Wire. [Jaycar WW-4020] will cover aprox 10 sets.**
- **0.63mm [B&S 22] Enamelled Copper Winding Wire. [Jaycar WW-4018] will cover aprox 20 sets.**
- 12 Volt 10 Amp Power cable.
- 1 of 100K ohm potentiometer. Jaycar # **RT-4366**

Receiver Capacitors:

- 4 of 33pF ceramic NPO Capacitors [Jaycar RC-5318] for Receiver. Dick Smith Part No R2247

Transmitter Capacitors:

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	R2259
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

NOTE: We will cover the “Equipment Required” at the night of the first lecture, so do not purchase anything before attending this lecture.

12: Faults:

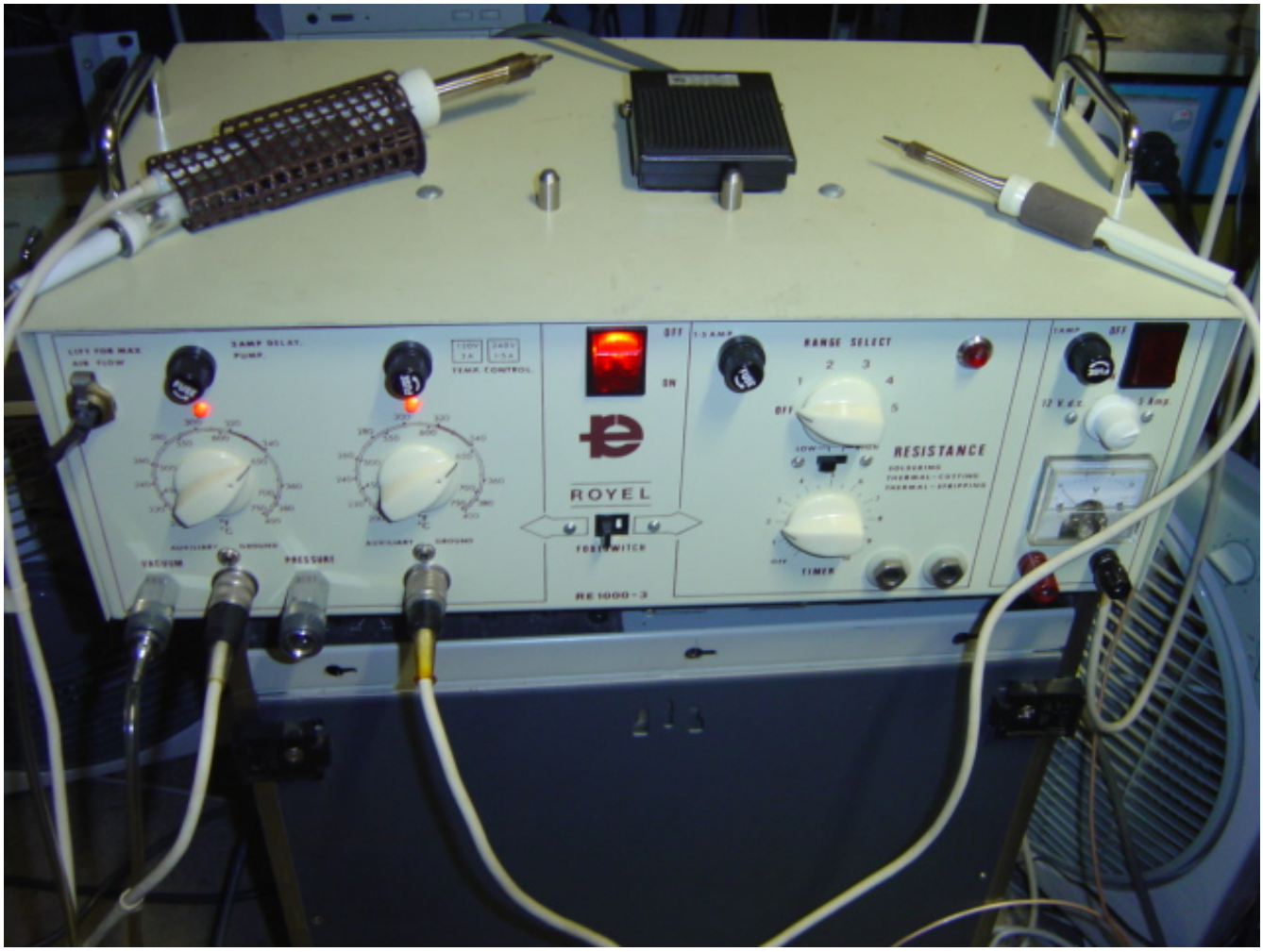
- If all led's are lit when you switch on, then there may be no EPROM in the transceiver.
- If the transceiver switched off after a few seconds of turn on, then it is expected that a new EPROM is needed.
- If the left dot of the 7 segment display is on, this indicates a programming or memory error.
- If the right dot of the 7 segment display is on, this indicates a power out of range problem.

  The red light comes on when the output doesn't reach a set level, either due to antenna mismatch or PA stage failure.
  It also comes on if the PA over-heats, and automatically backs off the output power.
  Setting the output power trimmer pots on the control PCB too low, or the 25W set trimmer in the PA too low will also bring up the red dot.

  I can't remember precisely, but low battery voltage and out of lock VCO may also turn on the red dot???
  In any case, I'd take a close look at the 13.8 volt supply voltage and current, because it could be a cooked power supply (that may explain why the squelch is open....).
  There is also the infamous internal regulator chip problem (a fix is described elsewhere.).

  Otherwise it's most likely that you've cooked an output transistor if the right dot comes on, since these radios are only made to run with a duty cycle of about 5%.

13: Using the Club's De-soldering Station:



Plug in de-soldering tool [Vacuum & power] (left top in above picture) and soldering iron (right top in above picture) into the **Royel de-soldering** Station, then plug into 240V and turn on. Set both to approximately 340 degrees Centigrade. Place vacuum fool control (center top in above picture) on floor and make sure that the foot-switch [on front panel of de-soldering station] is in the left position. Make sure that the de-soldering iron sucks ok when heated up [ie solder is sucked into barrel when foot switch is pressed, (which leaves a hole at the end of the iron tip, barrel)].

The instructions below are based on a right handed person, reverse the instructions if you are left handed. If you have problems using two hands, then get another person to help you with one of their hands.

With left hand pick up soldering iron and place onto the side of the pin to be extracted, then with the right hand feed solder onto the pin [ensure solder flows around pin] then;

Keep the left hand & soldering iron on the side of the pin and, pick up the de-soldering iron with the right hand and place over the pin to be extracted.

With a foot [left or right], press the suction [vacuum] pedal to enable solder to be extracted from around the pin by the de-soldering iron [tool].

Check that the solder has been extracted from around the pin; If not redo the above operation.

Make sure pin is loose and not stuck to the side of the hole. If it is stuck, gently with the de-soldering iron move it to the center of the hole and free.

Do all pins for each module. Then unscrew the two holding screws for each module and gently lever each module off the receiver board. Note: Too much pressure can break a pin or several pins.

"Bugs Juice" The original brew from Bruce VK2ZAD but text modified by Rod VK2DOT.

The following concoction is recommended for users of this document to brew up, this brew will enable your de-soldering to become easier.

Rosin and Methylated Spirits are purchased from your local hardware store.

To brew up this "**Bugs Juice**":

- Crush lumps of rosin and place in a jar or a small tin can with an air tight lid.
- Cover the rosin in the jar or can with methylated spirits.
- Apply the air tight lid and allow to dissolve.
- If the final solution is too thick, then thin with more methylated spirits.
- If the final solution is too thin, then thicken by adding more rosin.
- Apply to the surface to be de-soldered with a small brush, old toothbrush or icy pole stick. We have found that a wooden **tooth pick** has been the most successful method of applying the Bugs Juice to the pin requiring de-soldering.

14: Removal of the annoying BEEP from the FM92E:

One of the first things that will strike you when you operate a Philips FM92E is the annoying beep when you change channels.

Remove the covers so the bottom (solder) side of the Synthesizer board can be seen. This is the board under the plastic sheet.

Position the unit with one side towards you such that the front panel is on the left and the rear panel on the right.

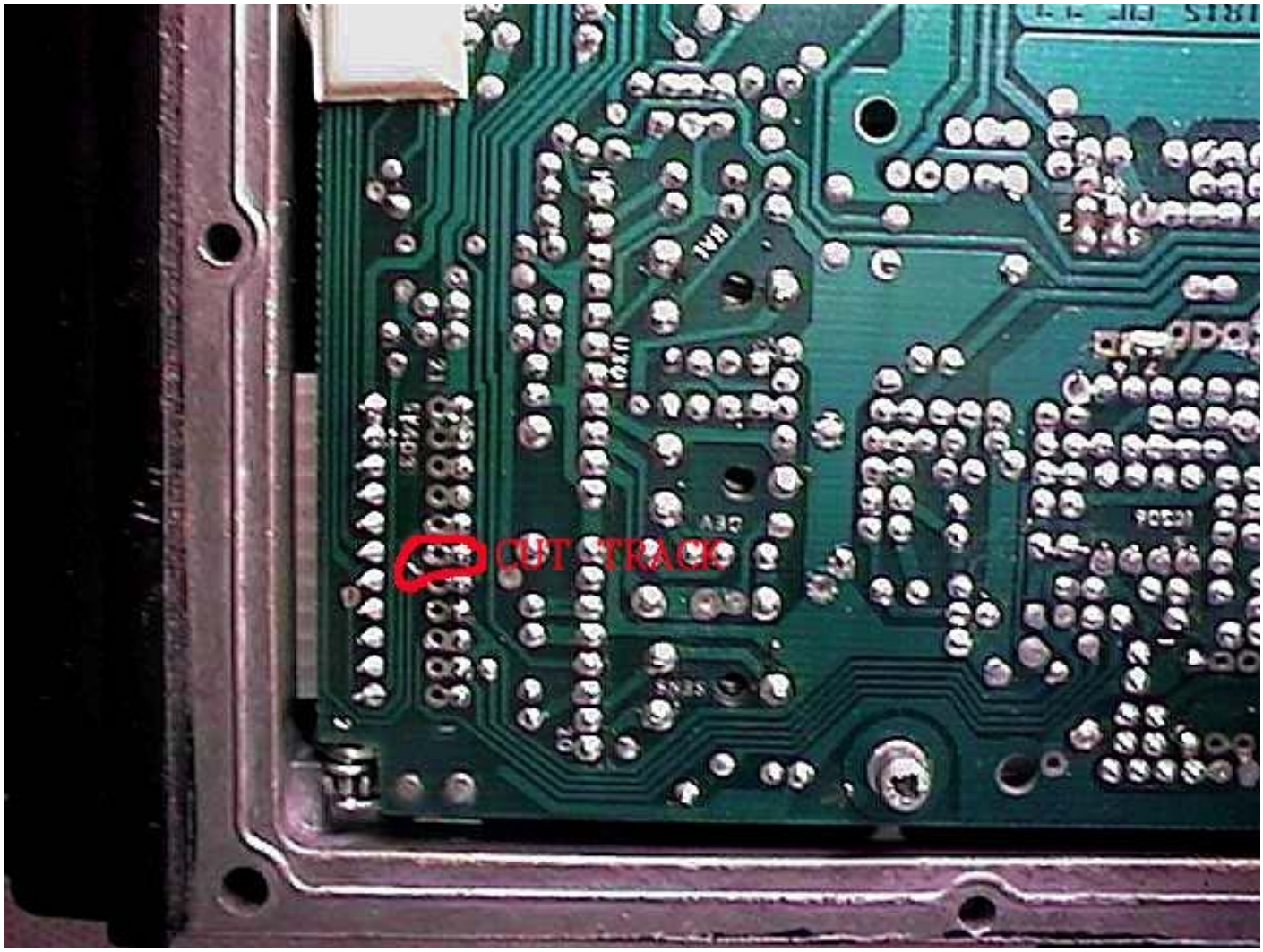
Locate the dual 11 pin solder rows on the left corner nearest yourself, this is labelled SK403.

Looking at the row which is further from the front panel, locate the solder point which is in the middle (6th pin from either end). ie resistor R254.It also can be found on the receiver board, the smaller of the two hinged boards. With the board in a vertical position (the only way to see the components) the resistor is located in the bottom right corner. It is the closest resistor to SK203, a ribbon cable termination device. The resistor is mounted vertically and has a value of 1.5 M ohms. It is also surrounded by capacitors. Second tip about locating this resistor is that it is dead in line with leg number 8 of IC202.

The cut, will not kill the beep completely, but it will certainly make it quieter than it was.

Cut the track joining to this pin with a sharp blade.

No more BEEP!



Synthesiser Board [Bottom View]

15: Disable "scan inhibit" with microphone off-hook:

Precautionary note: We are informed that this mod will disable some functions such as CTCSS, etc.

Normally, the FM92E will not go into "scan" mode unless the microphone is in its cradle. A magnet in the cradle latches a reed switch in the microphone housing, to enable the scan feature.

To enable scanning without hanging up the microphone, locate SK405 at the hinge end of the Synthesiser board, and short pins 1 & 3.

16: Emergency "umbilical cable" replacement:

The multi-pin cable which connects the control unit to the transceiver unit can be replaced by a standard IBM-PC "joystick" extension cable, costing between $10 and $25. Be aware, though, that some cheap computer cables are poorly shielded, and replacement with one of these is likely to result in an audible "whine" resulting from the display switching circuitry pulses getting into the audio. You get what you pay for. If your replacement cable doesn't have metal around the end connectors, it is almost certain to be noisy. I have overheard that cables from DSE are okay.

17: Fixing "tinny" transmit modulation by adjustment:

Some FM-900's sound fine on air, some have a quite "tinny" sound. The simplest way to cure this is by slight adjustment of the "modulation Balance" potentiometer (R371) on the Synthesiser Board. It is the innermost of three potentiometers, and looking from the "track" side of the board, adjust slightly anticlockwise (only a few degrees) to increase both bass response and overall deviation.

Warning!. Do not make large adjustments here, as you could cause over-deviation!

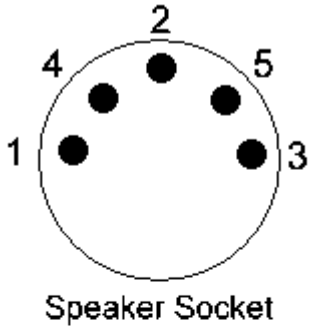
18: Fixing "tinny" transmit modulation by microphone modification:

Some FM-900's sound fine on air, some have a quite "tinny" sound. Another way to fix this is to replace the standard microphone insert with an electret insert, available from various electronics suppliers.

19: Fixing "tinny" transmit modulation by microphone modification:

Simply "flip over" the microphone insert. Truly! This places a "baffle" (the back of the insert) between you and the microphone element, which helps to reduce response peaks.

20: FM92E Rear Connectors:

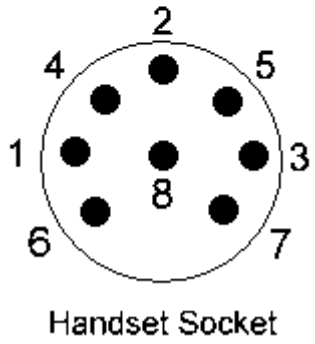


Speaker Socket

Speaker Socket

1 Cradle
2 Ground
3
4 Speaker
5

Pinout are as viewed from rear of plug.



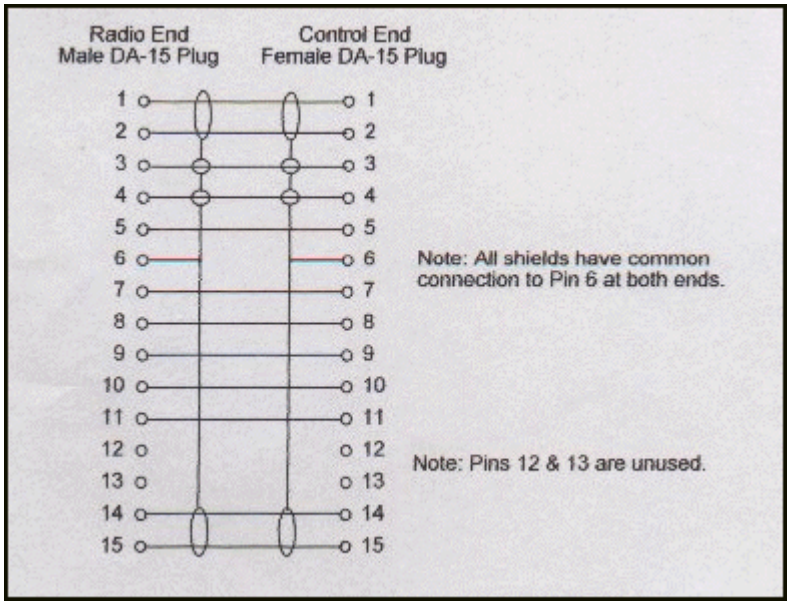
Handset Socket

Handset (Microphone) Socket

1 Cradle
2 Power Ground
3 Mike Ground
4 Speaker
5 Mike Active
6 RX Audio out
7 PTT
8 Not used

Pinout are as viewed from rear of plug.

21: 15 Pin Cable:



22: Philips FM 900 Series Service notes: [compiled by Andy Beales VK4KCS]

Symptom:

Radio keys up when P.T.T. is operated but although the "Tx" light stays on, only a brief moment of power out is observed.

The loudspeaker makes a faint "squeak" whilst this output power is present.

Check:

Using an oscilloscope check to see if Pin 6 of I.C. 201 on the R.F. board shows signs of oscillations while the P.T.T. is operated.

This I.C. takes care of switching the radio from Rx to Tx and some other housekeeping chores.

If oscillations are observed then this is what is causing the problem.

Fix:

1/. Fit a 0.001uF ceramic or polyester capacitor from Transistor Q 203 B to E. This is successful about 80% of the time.

2/. Fit a 0.1uf polyester capacitor from I.C. 201 Pin 6 to Pin 16 (ground). This is almost always successful.

Only one radio I ever encountered needed both these fixes added.

Symptom:

No Transmitter.

Check:

After eliminating all the usual causes for no power out, check that there is switched supply voltage at the Emitter of Q 209 on the R.F. board.

Voltage should be present while P.T.T. is operated.

Fix:

If this transistor is faulty then either leave it in place and short-circuit Collector to Emitter or if a replacement is available then change the device.

General Notes.

Anytime that the lids are off an FM 900 then check the condition of C 432 and C439, 10uF 50v. electrolytics in the Voltage doubler circuit on the Logic board.

This part of the circuit supplies about 17 volts to the P.L.L. circuit, this voltage eventually being used as the Steering voltage to control the frequency of the V.C.O.

All manner of strange symptoms can be observed if this voltage is not stable and fed from a low impedance source.

These capacitors operate at an elevated temperature in the radio and are prone to dry out long before any other components show signs of distress.

I have measured caps removed from a faulty radio as having a capacity as low as 0.5uF.

One of these capacitors is inside the metal shield and one just outside.

Quite often the P.C.B. is is coloured in the vicinity of these capacitors.

V.C.O. and Rx. Front end Modules.

These two modules both suffer a common manufacturing problem in that when the module housing was being plated, they were not cleaned properly of the acid used to initially clean the base metal.

This acid slowly reacts with the plating and over a period of time, Dendrites or very fine metallic whiskers can grow inside the module and eventually short out to the pins on the edge of the ceramic substrate that supports the components or to the components themselves.

These whiskers can be seen with the naked eye if observed under a strong light source.

The usual symptoms of the presence of these whiskers is the Receiver goes deaf, or the V.C.O. becomes intermittent or stops altogether.

A quick fix is described as "Percussive Maintenance", which consists of elevating the radio to a height of 18 inches above a hard surface covered in newspaper or other covering (we don't want to scratch the radio do we ?) and then letting Sir Isaac Newtons' invention do its thing.(drop it !).

This brutal but effective method should only be done to somebody else's radio preferably when the owner is out of sight and hearing range.

The second method is to laboriously, and with a very big soldering iron, remove the offending module from the circuit board, prise the side cover off with a fine bladed screwdriver and then use a small paint brush to thoroughly clean out the inside of the module.

That's the easy part.

Position the side cover back on the module, tack solder it at a number of points around the edge, using a screwdriver to press the cover into place, then flow solder as neatly as possible to reinstate the shielding effect of the cover.

Its impossible to not dramatically heat the module during this process but it doesn't seem to worry it, because the "Circuit Board"' is ceramic.

If you are working on the V.C.O. module check while the cover is off, that the ceramic substrate has not broken free from one or more of the mounting posts inside the module.

This fault is typified by the radio being extremely microphonic on both Rx and Tx.

If this is the case don't try to force the substrate back down, just apply lots of heat to the outside of the module adjacent to the post in question and allow solder to flow into and fill the gap.

Allow the module to cool and then refit to the radio, not forgetting to solder both ends of the V.C.O. module to the P.C.B. ground plane.

Although this procedure seems fairly drastic, the module was faulty anyway and attempting this repair is definitely worthwhile, compared to parting with the hard-earned for a new module, if you can even source one now.

Other problems that can occur include the flexible printed circuits that join the circuit boards at the front of the radio becoming intermittent, especially in early model radios that used paper insulated flexible P.C's.

If they are in a bad way they can be replaced with ordinary ribbon cable, just keep the lengths about the same and maybe apply hot-melt glue to the solder joints after it has been fitted in place, to provide some mechanical support.

The volume and squelch controls have a printed carbon track and due to the cunning design of the adjustable part of the control, the cup that keeps the dust out of the control will wear away the carbon and cause it to go open circuit. GOOD ONE, Mr. P !!

I have had no luck finding an "off the shelf"' replacement that doesn't involve a bit of hacking and gouging to make it fit, but a reasonable job can be done with a "gas axe" and only 2 Kilo's of body filler !!

If water has made its unwanted way into the control head on either the local or remote control versions, the P.C.B. can be removed from the housing, successfully cleaned and repaired.

I use a cut down artists paint brush about 6mm wide to clean around the components with either metholated spirits or preferably one of the low evaporation circuit board cleaners available from Woolietronics or other suppliers.

The plastic housing is best just washed in soapy water and thoroughly dried.

A quick squirt of Mr Sheen restores that "just like a bought one" finish to your pride and joy. Be careful though, not to scratch the red plastic lens that covers the 7 segment displays.

The push-button switches can be carefully prised apart and the contacts cleaned.

It helps to have obtained a rubber pencil" (made by Stadtler for correcting typing errors) from the stationers to achieve this.

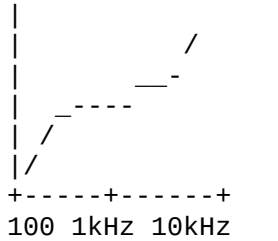
Most solvents/cleaners available will take the carbon film from the moving contact if applied, so use the pencil and then brush the residue out with a small artists brush (the adjective refers to the brush not the artist.)

23: Making my FM92 sound better: (transmit audio) [by Mal VK2TMF]

OK, after some fiddling about I think I now have a nice (well OK at least) sounding FM92.

I modelled the preamp in Electronics Workbench and ran some bode plots with and without the 4.7uF electrolytic capacitor (c3) in the microphone preamp.

With the electrolytic, the preamp boosts treble and cuts base. ASCII art time...

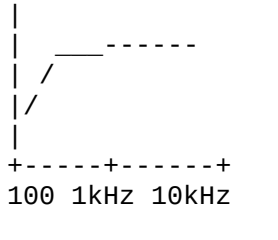



```
at 100Hz, the gain is about 8db
at 1kHz, the gain is about 12db
at 10kHz, the gain is about 21db

the -3db point (9db gain) is at about 110Hz
the +3db point (15db gain) is at about 3.6kHz
```

This explains the 'tinny' sound

Without the electrolytic, you get a reasonably flat response with 12db gain.




```
at 100Hz, the gain is 8.7db
at 1kHz, the gain is 12db
at 10kHz, the gain is 12db
```

the -3db point (9db) is at about 110Hz

So to make an FM92 sound better...

1. Remove the 4.7uF electrolytic capacitor from the microphone preamp.
2. Adjust R365 (microphone sensitivity) on the synthesiser board about 90 degrees, or until it sounds about right anticlockwise with the PCB in place, or clockwise from the component side.

24: Tuning up an FM900:

To tune an FM 900 radio you will need:

- A power meter of some kind (a VSWR meter into a Dummy load will do)
- Insulated tuning tools to suit VCO slugs. Ceramic works best. Available from Dick Smith Electronics at around A$8
- Voltmeter 0-20v Analogue is better.
- Signal Generator.

That's the bare minimum required. If you have access to a FM Deviation meter that will be handy.

Undo the screws holding both lids on noting which side they came from.

Identify the Synth/ Controller PCB . It's the larger of the two PCB's and on the side of the radio opposite the antenna connector. Undo the screws marked with an arrow and hinge the PCB out. Undo the 4 screws holding the shield over the EPROM (its the larger one).

Earth yourself to the radio with one hand or use a anti-static wrist strap. Carefully remove the EPROM. Its the chip with a paper label on it, noting its position. If you don't have a IC tool, carefully lever it up with a screw-diver at each end.

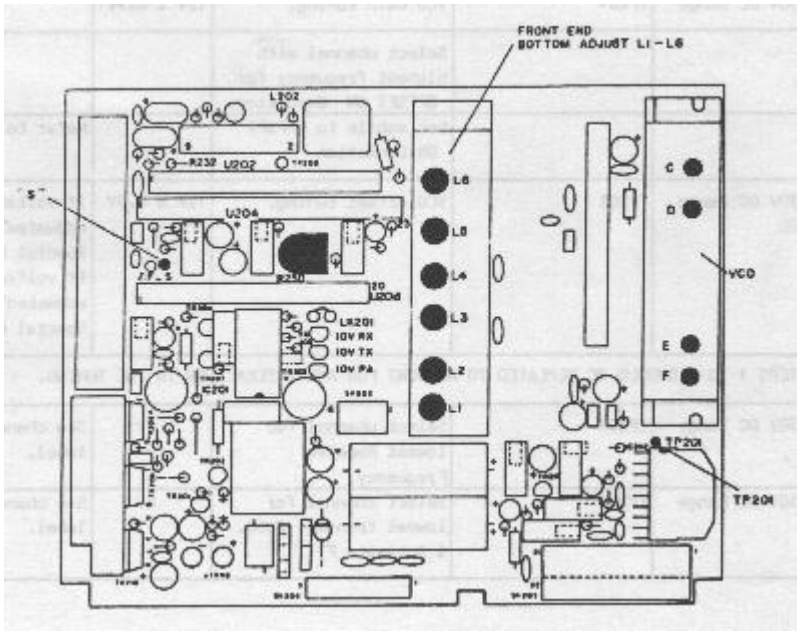
Re-insert the EPROM with your new frequencies

Carefully power up the radio and see if the channel numbers come up on the display. If so good, if not check the EPROM is in correctly and that it is actually a good EPROM. Sometimes they 'give up' while being reprogrammed.

Wind the mute to minimum. If the set is 'ticking' the VCO is out of lock.

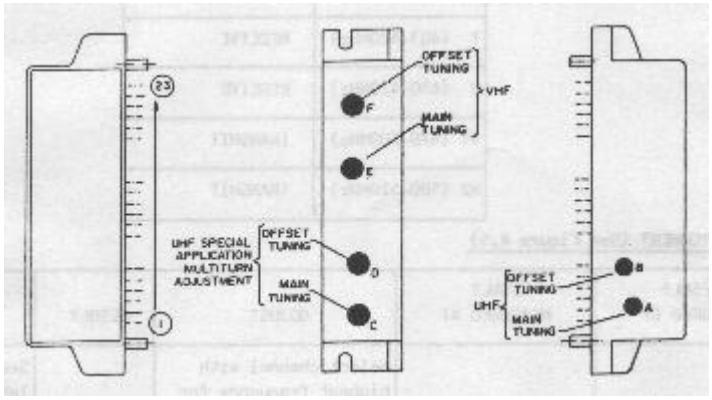
Undo the screws holding the radio board in and hinge it out.

Find test point 201



Connect your volt meter between TP201 and ground.

Identify the VCO slugs.



Carefully- if you force a slug and break it you may as well throw the radio in the bin as changing a VCO is a painful exercise. They do break easily as they are only ferrite cores. Although the UHF ones seem to be more robust than the VHF ones - adjust the VCO for 12v in receive mode and then for 12v in transmit mode. See the following tables for more details. When adjusted the dot in the display should not stay on after the TX is released. If you're lucky it won't come on at all. You may have to turn the set on and off to reset the dot.

FREQUENCY BAND	Mobile mode for **OFFSET OFF** Conditions
E (68- 88MHz)	RECEIVE
A (148-175MHz)	TRANSMIT
T (403-420MHz)	RECEIVE
U (450-470MHz)	RECEIVE
W1 (470-500MHz)	TRANSMIT
W2 (500-520MHz)	TRANSMIT

Note: Switching from OFFSET OFF to OFFSET ON, lowers VCO frequency.

4.6 **VCO ALIGNMENT (See Figure 4.5)**

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Select channel with highest frequency for **OFFSET OFF** Condition		See channel frequency label and above table.
2			Set mobile to **OFFSET OFF** Condition		See offset table.
3	AVO 30V DC Range	TP201	VCO main tuning.	12V ± 0.5V	
4			Select channel with highest frequency for **OFFSET ON** Condition.		
5			Set mobile to **OFFSET ON** Condition		Refer to above table.
6	AVO 30V DC Range	TP201	VCO offset tuning.	12V ± 0.5V	If voltage cannot be adjusted below 13V go to Special Procedure No. 1. If voltage cannot be adjusted above 11V go to Special Procedure No. 2.

To adjust the receiver front end inject a 1 khz tone of 5khz deviation (2.5khz deviation for narrow band sets) at your centre frequency and adjust the tuning slugs starting at L1 (the slug in the centre of the board) through to L6 until the receiver is sensitive enough. *See previous picture for location* .You can use a SINADDER or by ear.

I will assume if you have a SINADDER that you can use it else use the ear method.

EAR METHOD OF TUNING A RADIO

1. Apply enough signal to open the set up (this may be a few volts if the set is really 'deaf')

2. Wind back the level until you can just hear the tone above the hash.

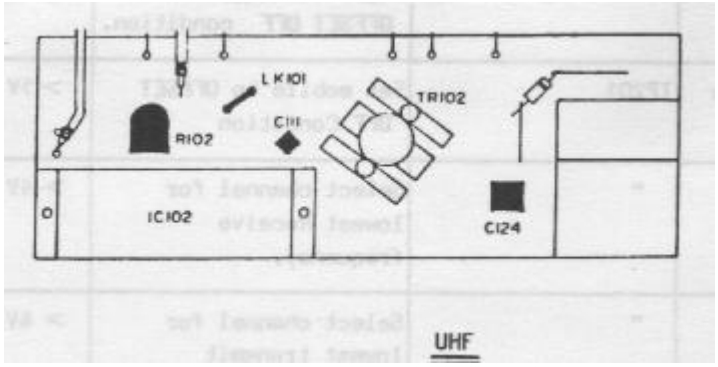
3. Adjust the tuning slugs until the tone is loud and clear.

4. Repeat steps 2 and 3 until the level is less than 1 microvolt.

5. Turn the signal right off, make sure the mute is at minimum (anticlockwise) then slowly wind up the signal until the set opens. If the level to make it open is anything less than .5uV well done. If its less than .3uV go and buy a lottery ticket. If not repeat steps 2 to 5 until it does.

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

25: FM92R Source Listing:

```
1BE8 - Ch 1 frequencies (1st 3 bytes RX - 2nd 3 bytes TX)
1BF0 - Ch 2 frequencies, through to 1EF9 - Ch 99 frequencies.

1F31 - Default Power-up Channel - defaults to Lowest Channel programmed.
1F3E - Ch No (in Hex) of Highest Channel programmed
1F3F - Ch No (in Hex) of Lowest Channel programmed

1F40 - Lists Scan Group 1 Priority Channel.
1F4C - Lists Scan Group 2 Priority Channel.

1F41-1F4A - Scan Group 1 Channels
1F4B - No of Channels in Scan Group 1

1F4D-1F56 - Scan Group 2 Channels
1F57 - No of Channels in Scan Group 2

1F58 (01) and 1F59 (02) are the UP and DOWN buttons on the front panel.

1F64 - Eprom Checksum

1FE2-1FE4 - Date binary file created - stored in DDMMYY format (in decimal).

1FEB-1FEF - Indicates which Master Binary File was used.

eg.      30 30 32 30 3A - (0020:)  FM91   (Hardware Code:9502 97340000)
         30 30 32 38 3A - (0028:)  FM92L  (Hardware Code:9502 92330000)
         30 30 32 39 3A - (0029:)  FM92R  (Hardware Code:9502 92340000)
```

26: FM900 12 Digit Hardware codes:

(A 12-Digit Product Code Is Derived From The Chart Below The First 4 Digits (9502) Denote Australia And Are Fixed. The Remaining 8 Digits of the code detail the type of Equipment And Frequency Band (center 3 Digits- Columns 5,6,7), And Optional HardWare Facilities (last 5 Digits - Columns 8 Thru 12)

1 2 3 4 9 5 0 2	**5** Series	**6** Model	**7** Freq/Band	**8** Local/Remote Spacing	**9** Temp/Range Stability	**10** Signaling Hardware	**11** Selcall System	**12** Option
0					10 ppm Standard	STD (none)	STD No S/Call	STD
1					5ppm Xtal/Heater	CTSS Enc Only	CCIR	Rev/Tone Burst
2		SimPlex	E			CTSS ENC/DEC	ZVIE	
3			B	Local 20/25/30		SelCall Type 1 No CTSS	EEA	
4			A	Remote 20/25/30		CTSS ENC+ SelCall T1	EIA	Ignition Blanker
5			T		2.5ppm TXCO Kit	CTSS ENC/DEC SelCall T1	I/O Exp No S/Call	
6			U			SelCall Type 2 No CTSS	CCIR T2 ENC Only	
7			W1	12.5 Local		CTSS ENC SelCall T2	ZVEI T2 ENC Only	
8			W2	12.5 Remote		CTSS ENC/DEC SelCall T2	EEA T2 Enc Only	
9	Mobile						EIA T2 ENC Only	

27: FM900 Field Personality Programmer (FPP) Guide:

This section has been added for remote users who have an EPROM burner and need to setup their own EPROM for 6 Meters, 2 Meters or 70 CMeters. The information below is applicable to FPP Version 3.0 – the altered version.

Hardware Code made up of eight digits: (ie: ABCDEFGH)

The hardware code for a FM92E with remote head for 6 Meters = **92240000**

A - always **9** for FM900 mobiles

B – **1** = High Simplex (FM91)
2 = Medium Simplex (FM92)
3 = Low Simplex (FM93)
7 = FM92 with FM91 PCBs (FM97)

C - **Band** **2** = E band (66- 88 MHz)
3 = B band (132-153 MHz)
4 = A band (148-174 MHz)
5 = T band (403-440 MHz)
6 = U band (440-470 MHz)
7 = W1 band (470-500 MHz)
8 = W2 band (500-520 MHz)

NOTE: These are the suggested Transmitter limits, however Receiver limits can be programmed up to 30 MHz either side of the specified band edge. No guarantee of PLL lock, however.

D – Radio Type
1 = local control 25.0 KHz Channel Spacing 10.7MHz IF
2 = remote control 25.0 KHz Channel Spacing 10.7MHz IF
3 = local control 25.0 KHz Channel Spacing 21.4MHz IF
4 = remote control 25.0 KHz channel spacing 21.4MHz IF
5 = local control 12.5 KHz Channel Spacing 10.7MHz IF
6 = remote control 12.5 KHz Channel Spacing 10.7MHz IF
7 = local control 12.5 KHz channel spacing 21.4MHz IF
8 = remote control 12.5 KHz channel spacing 21.4MHz IF

E – Mechanical Construction
0 = standard
1 = extended temperature, 5ppm (crystal heater)
2 = waterfroof
3 = extended temperature & waterproof
5 = extended temperature TXCO
7 = extended temperature range, waterproof TXCO

(when using a waterproof radio, a waterproof option in the hardware)

F – Signalling Hardware
0 = none
1 = CTCSS encode only
2 = CTCSS encode/decode
3 = No CTCSS, Selcall type 1(G=>1)
(Selcall type 1 = encode only)
4 = CTCSS encode, Selcode type 1
5 = CTCSS encode/decode, Selcode type 1
6 = No CTCSS, Selcode type 2
(type 2 = encode/decode selcall)
7 = CTCSS encode, Selcode type 2
8 = CTCSS encode/decode, Selcode type 2

Note on Selcall encode & decode: Selcall type 1 can both send selcalls and respond to only one received selcall code and group call if applicable. Selcall type 2 can both send selcalls and respond to and receive multiple and variable selcalls (used for sending status, etc)

G – Selcall Options

0 = none
1 = CCIR selcall
2 = ZVE 1 selcall
3 = EEA selcall
4 = EIA selcall
5 = No selcall with I/O expansion kit
6 = CCIR selcall, encode type 2
7 = ZVE selcall, encode type 2
8 = EEA selcall, encode type 2
9 = EIA selcall, encode type 2

Note that most selcall hybrids can only respond to CCIR selcall tones, the other selcall modes were not well supported.

H – Other Options

0 = standard version
1 = reverse tone burst
2 = dual front end
3 = ignition noise blanker

Software Code made up of 15 Digits:

The software code for a FM92E with remote head for 6 Meters = **110404200000000**

A – Channel Display

0 = intermittent display
1 = continuous display
2 = intermittent + 8 hour timer (auto power off)
3 = continuous display + 8 hour timer

B – Mute

0 = fixed, with defeat
1 = variable with defeat
2 = fixed, no defeat
3 = variable, no defeat

C – Economiser Options

D – Tx Timer

0 = Off
1 = 1 minute
2 = 3 minutes
3 = 5 minutes
4 = 10 minutes

E – Tx Inhibit

0 = Off
1 = Tx inhibit all channels

F – Tx power

0 = 25 watts
1 = 5 watts
2 = 1 watt
3 = Operator selectable
4 = per channel option
6 = 5-25 watts
7 = 1-25 watts adjustable

G – Scanning

0 = none
1 = scan vacant per programmed blocks
2 = scan occupied per programmed blocks
3 = scan occupied, operator selectable, per programmed blocks

H – Voting

0 = No voting
1 = Enabled

I – CTCSS Options **0** = no CTSS
1 = CTSS variable per channel
2 = variable via keyboard
3 = variable per channel, RTB (Reverse Tone Burst)
4 = variable via keyboard, RTB
5 = Community Repeater (CR) per channel
6 = via keyboard and CR
7 = CR per channel and RTB

J – Tone Period **0** = no tone period
1 = 100 ms
1 = 40 ms
1 = 70 ms
1 = 20 ms
1 = 33 ms

K – Simplex Mode **0** = simplex mode (no other option selectable)

LL - Selcall encode (only selectable if selcall is fitted, otherwise program 00)
Selections available: 00-05, 07-09, 11, 12, 15, 16 ,27 ,28, 35 ,36 ,43 ,44 ,51-53

MM - Selcall decode (only selectable if selcall is fitted, otherwise program 00)
Selections available: 00-18 for selcall type 2
00, 31-46, 50, 51 for selcall type 1

Note on Selcall software selection codes: selection of all codes is not available to all radios. See selcall selection chart for the type of radio you have. (not included here due to large size & complexity)

Common error messages:

* Selecting CTCSS tones without the correct hardware being installed at the hardware code and the like will cause error messages. This applies to things like selcall setups etc.
* TX inhibit cannot be selected with Community repeater
* Tone periods 33 & 20 ms are incompatible with type 2 selcall.
* Voting cannot be selected with mute defeat.
* Selcall decode (in software code) must =00 if encode =03 or =07
* Selcall encode 04 & 08 with decode 00 is an invalid combination if type 2 selcall is fitted
* Selcall software code 0400 & 0800 can still be used for special applications (no decode, ident with PTT, and base selcall encode when operating ‘send’ button)
* Community repeater must have CTCSS encode/decode hardware available, and requires CTCSS tone to be entered.
* Voting isn't selectable without NSC810 I/O expander hardware
* Can only have duplicate channel numbers with voting selected on those duplicate channel numbers
* Cannot select economiser and voting on same channel
* Cannot select economiser and selcall on same channel
* Cannot select selcall and scanning on same channel
* Must have more than one channel in a vote group

Programming notes:

NEVER program in XXXXXXX for TX or RX frequency (VCO goes unlocked no matter what)

NEVER program in 000.000 for TX or RX frequency (TX will be *very spurious* no matter what)

IF you want to create a channel as RX only, program in a TX frequency that you are licensed for or a UHF CB channel if in U, W1 or W2 band.

BE VERY CAREFUL when programming in frequencies - there should only be 4 digits after the decimal point and no spaces to pad out the last position, and no leading zeros in the digits before the decimal point in the case of E band VHF.
Incorrect programming will have one of three effects:
radio will not power up (most common)
radio will have unlocked VCO on TX or RX or both (radio inoperable)
radio will cause severe interference due to the transmission of spurii.

3 scan groups available for FM91, FM97
2 scan groups available for FM92, FM93 and all waterproof radios
10 channels per scan group, with one of these only available as a priority channel
Channel number range for FM91, FM97 is 1-120; FM92 is 1-99; FM93 is 1-10
Power selection entry is by the letters H, M, L & S (for high, medium, low and selectable) and must be consistent with the type of radio.

CTCSS Tone selection table

67.0	Q	88.5	A	114.8	D	146.2	P	186.2	3	241.8	*
71.9	R	91.5	W	118.8	M	151.4	H	192.8	4	250.3	#
74.4	S	94.8	J	123.0	E	156.7	X	203.5	5	97.4	=
77.0	T	100.0	B	127.3	N	162.2	Y	210.7	6		
79.7	U	103.5	K	131.8	F	167.9	0	218.1	7		
82.5	I	107.2	C	136.5	0	173.1	1	225.7	8		
85.4	V	110.9	L	141.3	G	179.9	2	233.6	9		

Community repeater: select tone Z

Notes on FPP Version 3.0 (altered)

Normally, FPP will restrict programming of the radio in two ways: first, transmission and reception was fixed within the one band ie. If you had a U band radio 450 to 470 MHz, you could not program in any frequency for outside this band. In this altered version of FPP however, this restriction is lifted. Bear in mind that the VCO has its limits, however. Depending on your setup and tuning, up to 20 MHz reception outside of the band your radio was designed for may be possible. The second restriction was to only allow the selection of low or medium transmit power (1 or 5 Watts) on UHF CB. User selectable power levels was not an option. In this altered version of FPP, this restriction is also lifted, and as a by-product will allow high power selection for UHF CB as well. This altered version of FPP does have its bugs, too. If you try to program in a RX only channel by programming in xxxxxx or 000.0000 as the TX frequency, the radio will either not operate at all, go VCO unlocked on RX or transmit large amounts of spurious signals. BE WARNED!

Help! I get an error message saying the EPROM programmer is not initialised! That is OK. FPP was designed to work with an internal EPROM programming card specific to FPP. What you will need to do is to take the file that FPP saves to disk, and write that file as it is to an EPROM. If you create a personality called, say, “myfreq”, you will find a file called myfreq.bin in the directory x:\fpp\fm900\jobs\myfreq\ Take this file, and copy it to your root directory and then using whatever EPROM burning equipment/software you have, write this file to the EPROM.

Notes for Programming EPROMS using Electronics Australia kit (Dick Smith kit) with Eprom.exe software:

Eprom types suitable for use: 2764 (21-25 V pgm), 2764A (12.5 V pgm) or other 27x64-x EPROMs.

Set device switch on programmer
Set Vcc = 5V
Connect programmer, insert EPROM and turn on.

Select:

Vpp = 12.5V, write pulse 1ms, 1 pulse per byte, final pulse = 0, EPROM multi pulse. If this does not work, then try:

Vpp = 12.5V, write pulse 10ms, 1 pulse per byte, final pulse = 0, standard EPROM single pulse. If this does not work, then try:

Vpp = 12.5V, write pulse 50ms, 1 pulse per byte, final pulse = 0, standard EPROM single pulse. If this does not work, then try:

Vpp = 21V, write pulse 1ms, 20 pulses per byte, final pulse = 0, EPROM multi pulse. If this does not work, then try:

Vpp = 21V, write pulse 50ms, 1 pulse per byte, final pulse = 0, standard EPROM single pulse. If this does not work, then try:

Vpp = 25V, write pulse 50ms, 1 pulse per byte, final pulse = 0, standard EPROM single pulse.

When comparing binary files using DOS command ‘FC’, don’t forget the binary code output from FPP contains the date; two identical personalities may not match using FC due to the different date encoded into the binary file, at locations 1FE2, 1FE3 & 1FE4 from the start of the file, and the checksum, see note below.

Location 1F64 appears to be a data checksum for the whole data stored on the EPROM.

28: Repairing FM92 VCOs by VK7ZRO

Over the last year, I have been involved in servicing about 70 FM92 E band radios. It soon became clear that these radios have a major problem with their VCO's. From my observations, the majority of radios have a VCO problem to some degree, particularly the older radios. Symptoms are varied but generally involve noise, cracking, microphony and in bad cases, the VCO dropping out of lock.

I test the VCO in the following way. Open the case and hinge open the receiver board. Power up the radio and connect a power meter. Monitor the radio on another receiver. Connect a voltmeter to the VCO test point. Press the PTT and note the power reading and the reading on the VCO test point. Gently tap the VCO with the back of your knuckle. With a good VCO there should some microphony but there should not be any cracking or frying noises. Bad VCO's are usually highly microphonic. Watch the meter on the VCO test point. It should remain quite stable, if not you have a faulty VCO. Watch the power meter. If the output drops to zero, the VCO has temporally gone out of lock and is definitely faulty.

After hearing various stories about the repair of the VCO's, I decided to develop my own method. I was in the fortunate position of having a number of radios that I could cannibalise for VCO's should my efforts fail. So far I have repaired about 15 VCO's with a 100% success rate. This includes both 10.7 and 21.4 IF VCO's. I still have a heap more to repair. The repair takes about half an hour including taking the VCO of the board, which is the hardest part. The repair method is quite drastic and is probably not for the faint hearted although it is quite easy to do.

Slide a sharp trimming knife under the label and remove it. Place the label to one side. The cover plate under the label has a number of notches in it. Place the point of the knife in one of the notches and slide the knife along under the cover, breaking the solder joint as you go. The cover plate should come off easily. Make sure the cover is flat and straight and place it to one side. Examine the VCO. Using a small screwdriver VERY gently lever the circuit board upward in the area of the coil on the end of the board. Look very carefully at the soldered joint under this coil. The odds are you will see movement indicating that the soldered joint has broken. Do this very carefully. On all boards that I have diagnosed as needing repair I have found that this joint has broken. I have also found other joints broken but not as often. I have had two cases where the board has been completely loose in the case when I have removed the VCO from the receiver board. I'll leave it to the experts to determine why this joint breaks.

Now for the interesting part. Clamp the VCO in a vice. Clamp it between the ends with the exposed board upwards. Only clamp the VCO lightly as it possible to distort the case. Now heat the VCO using a hot air gun on high. Use an ordinary heat gun, the type used for paint stripping available from most hardware stores. You'll have one for shrinking heat shrink tube anyway. Aim the gun at the VCO at an angle from underneath and at the side away from the pins. This is done to minimise heating of the board. Gently touch the pins with a small screwdriver. When the case is hot enough, you will see the board move as you touch the pins. This takes about 30 seconds to 1 minute. Remove the heat gun. Lift the board out of the case with a pair of long nosed pliers. This is a bit tricky. Be very careful, as it is quite likely that you will have melted the solder on the board and the components will be loose. Don't worry, they seem to survive. Put the board aside to cool. Immediately re-tin the solder pads in the case while the case is still hot. Leave plenty of solder on the pads. When the board has cooled, turn it over and re-tin the board where it solders to the pads in the case. Leave plenty of solder on the board. You could find that some of the silver plating has come off the board. This is why I recommend using plenty of solder. The aim is to get the board soldered to the case in as many places as possible, particularly the pad under the end coil. Put the board back in the case. Position the top edge of the board against the top of the case. Position the board laterally so that the gap between it and the case is the same both ends. This is important, as you won't be able to mount the VCO onto the receiver board unless this alignment is correct. It is critical so make sure its right. Re-heat the case. After about 30 seconds gently push down on the centre of the board clear of any components. When the board is hot enough, the board will sink down onto the pads as you push gently on it. Remove the heat gun. It is important that the board is pushed down otherwise the alignment won't be correct. Be careful not to touch any components as you may have melted the solder on the board. Now place the cover onto the case while the solder is still melted. Hold the cover down onto the case as the solder sets. Wait a couple of minutes and while the case is still warm (not hot) put the label back on. Let it cool. Done properly, the VCO should not look like anything has been done to it.

Put the VCO back onto the receiver board, align the VCO coils and retest as above. I think you will be amazed at the difference.

Have fun. Ron VK7ZRO.

P.S. Since writing the above, I have had one repaired VCO become very microphonic after about 6 months. Running the tests that I outlined above showed that the VCO was OK apart from being very microphonic. It was so microphonic that mechanical feedback from the speaker produced an audio howl. The most sensitive area was around the Rx coil. When I removed the slug an extremely small piece of broken slug fell out. This fixed the problem. There must be a moral here somewhere.

29: 6 Meter Antenna:

30: Philips FM92E Schematic Diagrams:

6M-Rx-L.bmp	FM92E **Receiver** Left Diagram
6M-Rx-R.bmp	FM92E **Receiver** Right Diagram
6M-Tx.bmp	FM92E **Transmitter** Diagram

31: 6 Meter Repeaters:

Output	Input	Call	Service Area	Status	Grid Sq	Date last confirmed	
53.550	52.550	VK2RAY	Albury	unknown	QF33	Jan99	
53.550	52.550	VK2RIC	Lismore-Casino	Op	QG61	Jan 2007	
53.550	52.550	VK2RSJ	Sydney West	scrapped, defunct			
53.550	52.550	VK3RMH	Melbourne N.E.	Operational	QF22	Dec 2006	Wattle Glen (30km NE of Melb)
53.575	52.575	VK2RPW	Grundy Mtn,Walcha	UC	QF59	Feb98	
53.575	52.575	VK2RSM	Tumut, Snowy Mtns	Operational	QF43	Jan 2006	
53.575	52.575	VK3RDD	Melbourne, S.E.	Operational	QF21	Feb 2007	Cockatoo (40km SE Melb)
53.600	52.600	VK2RNW	MtKaputar,Narrabri	Operational	QF40	Jun 2003	
53.600	52.600	VK3RMR	Gippsland	Operational	QF32	Dec 2006	Aberfeldy, nth of Morwell
53.625	52.625	VK2RSN	Newcastle	Operational	QF57	Jan 2006	
53.625	52.625	VK3RHF	Melbourne East	Operational	QF22	Dec 2006	Mt Dandenong/Olinda . 53.625/ 52.625 & 29.640/29.540 & 1273.400/1293.400 linked together, access via 438.750/ 433.750 using 88.5 Hz CTCSS
53.625	52.625	VK4RXD	Sunshine Coast	Operational	QG62	Dec 2006	
53.625	*52.625*	--	*Otago, N.Z.*	*Operational*		*Jan 2007*	*central south island. ZL rptrs are licensed, but dont have callsigns*
53.650	52.650	VK2RMP	Wollongong	Operational	QF55	Feb 2007	50w, split 1/2 wave verticals
53.675	52.675	VK2RMB	Sydney, Nth East	being rebuilt	QF56	Dec 2006	Terrey Hills
53.675	52.675	VK3RAD	Melbourne East	Planned			Mitcham
53.675	52.675	VK3RTN	NE Vic.	Operational	QF22	Oct99	Mt.Gordon, Marysville, 80 km NE Melb. linked to VK3RAG 146.775 and VK3RAD 438.525 VK3RAD/RAG has 123 Hz CTCSS access.
53.700	52.700	VK2RGN	Goulburn	Operational	QF45	Feb 2007	idents every 10 mins, split site.
53.700	52.700	VK4RGY	Sunshine Coast	Operational	QG63	Feb 2007	Maroochydore, 50w
53.725	52.725	VK4RGA	Gladstone	Operational	QG56	Dec 2006	
53.725	52.725	VK4RIK	Cairns	scrapped, defunct			
53.725	52.725	VK4RLB	Brisbane Sth	Operational	QG62	Jan98	Logan. linked to 70cm rptr
53.725	*52.725*	--	*Auckland N.Z.*	*Operational*	*RF73*	*Jan 2007*	*ZL rptrs are licensed, but dont have callsigns*
53.750	52.750	VK5RDX	Adelaide Sth	now moved to VK5RSB			VK5RDX 53.750 and 438.075 are to be linked.
53.750	52.750	VK5RSB	Adelaide Sth	Operational		Dec 2006	Summertown.
53.750	*52.750*	--	*Wellington, NZ*	*off air*	*RE78*	*Jan 2007*	*ZL rptrs are licensed, but dont have callsigns*
53.775	52.775	VK4RAF	Mackay	scrapped, defunct			
53.775	52.775	VK4RBP	Atherton Tablelands	Op	QH22	Dec 2006	Near Butchers Creek, 3,500ft ASL, 60w 1/2wav vertical
53.775	52.775	VK4RRC	Redcliffe, N.Bris.	scrapped, defunct			
53.775	52.775	VK5RAD	Adelaide North	Op 30w	PF95	Jan 2007	
53.800	52.800	VK6RAP	Perth	Op		Nov98	
53.800	*52.800*	--	*Mt.Climie, NZ*	*OFF AIR*		*Jan 2007*	*n.e. of Wellington. ZL rptrs are licensed, but dont have callsigns*
53.825	52.825	VK2RMS	Cooma, SE NSW	cancelled		Jan 2003	
53.825	52.825	VK7RAD	Hobart	Op	QE37	Jan 2007	
53.825	52.825	VK7RNW	Lonah, NW Tas	moved, now VK7RMD			
53.825	52.825	VK7RMD	Mt.Duncan,NW Tas	Op		Dec 2006	

Output	Input	Call	Service Area	Status	Grid Sq	Date last confirmed	
53.850	52.850	VK2RWI	Dural, NW Sydney	Operational	QF56	Feb 2007	
53.850	*52.850*	*--*	*Christchurch, NZ*	*Operational*	*RE66*	*Jan 2007*	*ZL rptrs are licensed, but dont have callsigns*
53.875	52.875	VK2RBM	Lawson, Blue Mtns	Op	QF56	Feb 2007	123Hz access
53.875	52.875	VK7RAA	Mt.Barrow, NE Tas	Op	QE38	Jan 2007	
53.875	52.875	VK7RNT	Tamar Valley	defunct			
53.900	52.900	VK3RMS	Melbourne East	Operational	QF22	Nov99	Mt Dandenong/Olinda (30km East) Receiver site Ferny Creek.
53.925	52.925	VK1RGI	Mt.Ginini	planned	QF44		
53.925	52.925	VK4RBX	The Knobby	unknown			
53.925	52.925	VK8RDX	Darwin	defunct, scappped		Jan 2007	CTCSS 123 Hz
53.950	52.950	VK4RBL	Brisbane sth	?	QG62		Bardon
53.975	52.975	VK3RGM	Mt.Buller NE Vic.	?			VK3RGM 53.975 and VK3RUG 438.175 are linked.
53.975	52.975	VK4RBR	Brisbane	?	QG62		

FM Voice simplex:

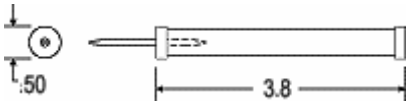
52.525 International	FM voice Call Freq. (everybody hangs out here)
53.500 VK National	FM voice Call Freq. (nobody uses this)

Packet simplex:

53.000 VK2RAG	BBS	Gosford	1200bps
53.000 VK7RPU			1200bps
53.025 VK3RPK			1200bps
53.050 VK2IO	BBS	Sydney	1200bps
53.100 VK2RPH		Sydney Nth	1200bps
53.100 VK3RUG			1200bps
53.100 VK3RMG		Seymour/Yea	1200bps
53.100 VK4BOO-1	BBS	Sunshine Coast	1200 & 2400bps
53.100 VK4RBP		Atherton Tablelands	1200/2400

32: Adjusting Ferrite Slugs:

The drive slots in iron powder and ferrite cores can be broken when tuned with a poor fitting tool. Normal Tuning Tools have a hard ceramic tip and is designed to fit iron powder cores. **Do not use metal screw drivers**, or you will break the ferrite slug.



SHIELDED COIL FORM PERFORMANCE

The quality and characteristics of the magnetic field generated in a variable inductor is determined by the quality and shape of the magnetic core materials, and by the characteristics of the winding.

A cylindrical core in the center of a spring wound wire coil form will create a magnetic field with invisible lines of flux represented by Figure 1. The construction of the Shielded Coil Form traps and channels the lines of flux within a magnetic path way increasing the efficiency and performance of the assembly as represented by Figure 2.

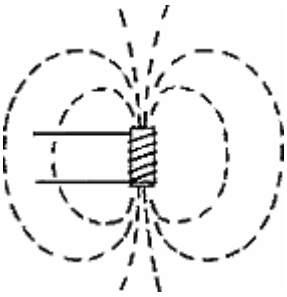


Figure 1

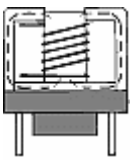


Figure 2

The more complete the magnetic pathway along the magnetic lines of flux, the higher the inductance and the quality (Q) of the assembly. The optimum state for a tuned inductor is to have the desired inductance reached when the tuning core fills the gap in the assembly and closes the magnetic field.

The Inductance of the Assembly: The inductance (L) is listed in ph (micro-henries) for 100 turns on the data sheets for each Shielded Coil Form (SCF) assembly. The number of turns of wire required for a desired inductance can be calculated from the following formula.

The inductance of the assembly is relatively flat with increasing frequency until after the peak of that assembly's Q. Above the peak Q frequency, apparent inductance will climb with frequency until the frequency when self resonance occurs. Inductances are normally measured at frequencies below the Q curve's peak frequency.