

Midland 70-066

Conversion

To

6 Meters

Introduction

Ver 1.8 – 07 Nov 2009

Part 1

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Midland 70-066 low Band Conversion to 6 Meters:

Index:

Part 1:

Acknowledgment:

Modifications:

Parts Needed:

Test Equipment needed.

Information about Midland 70-066

6 Meter Midland 70-066 FM Frequencies – 62 channel EPROM.

EPROM Software:

Part 2:

The Synthesizer Board including EPROM board.

Z-273 EPROM Board:

The Synthesizer Board.

Synthesizer Alignment.

Part 3:

Receiver RF Front end.

The Receiver Board:

Receiver Alignment.

AWA RT85 Receiver Board Top Assembly View

AWA RT85 Receiver Board Bottom Capacitor View:

Part 4:

Transmitter PA Circuit.

The Transmitter PA board.

Transmitter Alignment.

Part 5:

The RT-85 Transceiver – Block Diagram

Receiver Circuit.

Receiver RF Front End Circuit:

Transmitter Circuit.

PA Transmitter Circuit:

Acknowledgment:

This project was started in June 2008 on for amateurs interested in the use of the Midland 70-066 commercial radio transceiver. The conversion of the said transceiver to 6 Meters for amateur radio. Acknowledgement must be given to:- Steve VK2KFJ, Peter VK2ZZA, Roger Baker VK3BKR, Mark Detering VK3TLW, Phil Rice VK3BHR, Mark VK3BYY, Phil VK1PL & Andrew VK4OX for the information gained from their past documentation and generous guidance.

Modifications:

The modifications contained within this document should take the average non technical amateur, the following time's:->

	Modifications	Alignment	
EPROM board	1 hour	Nil	
The Synthesizer board	1 hour	1 hour	
The Receiver board	1 hour	1 hour	
The Transmitter PA board	1 hour	1 hour	
Total:	4 hours	3 hours	Overall 7 hours.

Parts Needed:

IC Socket – Low profile 16 pin.

Capacitors.	Jaycar	
2.2pf - 2 of	RC-5304	Note: All capacitors are 50V Ceramic
5.6pf - 3 of	RC-5309	
8.2pF - 2 of	RC-5311	
22pf - 5 of	RC-5216	
100pf - 1 of	RC-5324	
1000pf - 1 of	RC-5336	

Note: If you acquire your capacitors from “Jaycar Electronics”, then please check the capacitor values in each packet. It has been found the wrong values has been added to packets of capacitors.

For the first few weeks of the conversion - you will need a box or A4 plastic bag to hold your screws and plates of the transceivers. Plus a 16 pin low profile IC socket [if you do not have a Z-273 board burner], 2 of 22pf capacitors, a 5.6pf capacitor, approximately 1 meter of about 0.63mm enamel coated wire & a reel of solder wick. On the first night bring along a Philips screwdriver. Later on, you will need a 5mm drill bit to wind your coils on.

Wire.

Approximately 10cm of 0.5mm (**NOTE:** 0.63mm wire will do the job)
Approximately 1 meter of 0.63mm [22bs] enameled coated wire [Jaycar WW4018].

Markers.

Masking Tape.
Marking Pen. [for putting coil numbers on Masking tape in Tx PA section]

Drill Bit. Size – 5mm

Test Equipment needed:

Hex tuning tool.
Flat blade tuning tool.
Voltmeter.
Signal Generator.
VSWR Meter and/or RF Power meter
Soldering Iron.
De-soldering equipment.
Sharp knife or scalpel.
Philips screwdriver
Wire cutters.
Needle nose pliers – small size.

The Project.

There are five major events to modify your raw low band transceiver.

- **Initially - Test transceiver.** [This has to be done before any other operation.] This operation should take one night for all users to be satisfied that their transceiver **works!!**

If you not happy with your soldering, then become a partner with somebody that is competent with soldering. Remember that if you break or burn something, we cannot replace the transceiver
If you are not sure what you are doing, ask somebody.

- **Z-273 EPROM Modifications.** If you do not have a Z-273 board burner then remove the Z-273 PCB and the associated 2716 EPROM. Then burn the EPROM & return it to the Z-273 PCB via a 2 pin socket; Else program the Z-273 via the Z-273 PCB programmer.
- **Synthesizer Modification.** Remove PCB board, remove coil, make coil, replace board, place capacitors onto underside of board, synthesizer alignment and replace PCB board into transceiver. In this part, you will use test equipment. [Ie Frequency counter & DC meter. Plus tuning tools.]
- **Receiver Modification.** Remove PCB board, solder place capacitors onto underside of board, alignment of Receiver and replace PCB board into transceiver. In this part, you will use test equipment. [Ie Signal Generator & DC meter. Plus tuning tools.]
- **Transmitter PA Modifications.** Remove PCB board, remove coils, make coils, solder capacitors and coils onto underside of board, alignment of Transmitter and replace PCB board into transceiver. In this part, you will use test equipment. [Ie RF Power meter & DC meter. Plus tuning tools.]

The Z-273 EPROM Modifications and Synthesizer Modification must be done first, before alignment can be done. It is advisable that members split into groups, doing an event for each group.

Information about Midland 70-066

Syntech I & 8 Channel

<u>Model</u>	<u>Type</u>	<u>Split</u>	<u>Power</u>	<u>Channels</u>	<u>Comments</u>
70-066	ST1	66-80 mhz	40 watt	80	Dash Mount mid band
70-076	ST1	66-80 mhz	40 watt	80	Trunk Mount mid band

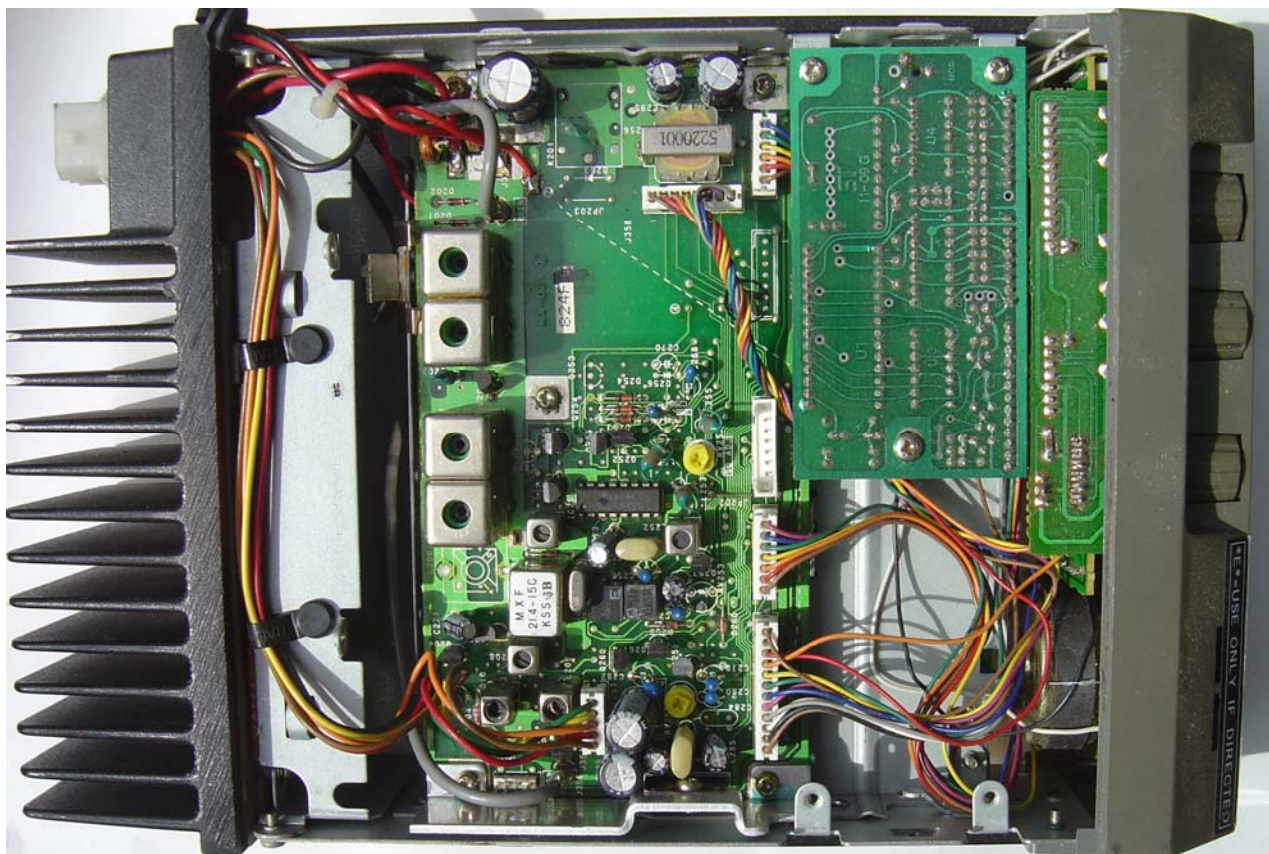
Models = A-66-80 Mhz B-75-88 Mhz



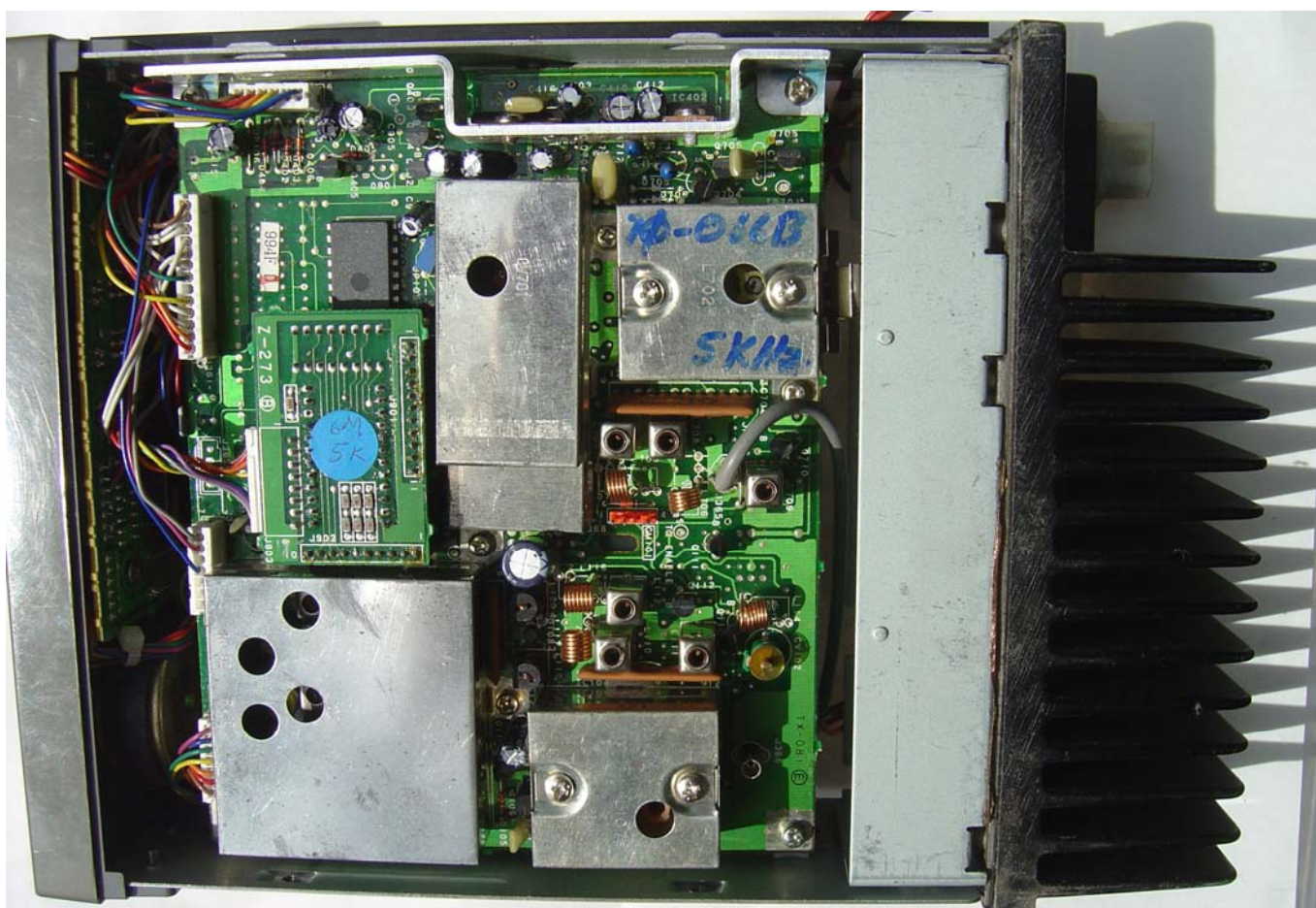
Above –Midland 70-066 Front View,

Above –Midland 70-076 Front View,

Above –Midland 70-076 Case View,



Above – Bottom View



Above – Top View

6 METER Midland 70-066 FM FREQUENCIES – 2716 EPROM:

Ch	Scan	Rx	Tx	CTCSS	Callsign	Service Area
00	1	52.525	52.525		Voice	Main Calling Frequency
01	1	53.550	52.550		Repeater	VK2RAY NSW Albury VK2RIC NSW Lismore-Casino VK3RMH Vic NE Melbourne
02	1	53.575	52.575		Repeater	VK2RSM NSW Walcha & Snowy VK3RDD Vic Dandenong
03	1	53.600	52.600		Repeater	VK2RNW NSW Narrabri VK3RMR Vic Gippsland
04	1	53.625	52.625		Repeater	VK2RSN NSW Newcastle VK3RHF Vic East Melbourne VK4RXD Qld Sunshine Coast NZ Otago
05	1	53.650	52.650		Repeater	VK2RMP NSW Wollongong
06	1	53.675	52.675		Repeater	VK2RMB NSW Terry Hills Sydney VK3RAD Vic Melbourne East & NE Vic
07	1	53.700	52.700		Repeater	VK2RGN NSW Goulburn VK4RSN Qld Sunshine Coast
08	1	53.725	52.725	123	Repeater	VK2RAG NSW Central Coast VK4RGA Qld Gladstone VK4RLB Qld Woodridge/BrisbaneSouth
09	1	53.750	52.750		Repeater	VK5RSB SA Summertown/Adelaide NZ Wellington
10	1	53.775	52.775		Repeater	VK5RAD SA Crafers/Adelaide VK4RRC Qld Redcliffe/N Brisbane VK4RBG Qld Bundaberg VK4RBP Qld Atherton Tableland
11	1	53.800	52.800		Repeater	VK6RAP WA Roleystone/Perth VK4RGO Qld Gold Coast NZ Mt Climie [NE Wellington]
12	1	53.825	52.825		Repeater	VK7RAD Tas Hobart VK7RNW Tas Ulverstone N/W Coast
13	1	53.850	52.850		Repeater	VK2RWI NSW Dural/Sydney NZ Christchurch
14	1	53.875	52.875	123	Repeater	VK2RBM NSW Lawson/Blue Mts VK7RAA Tas Mt Barrow/N Tas
15	1	53.900	52.900		Repeater	VK3RMS Vic East Melbourne
16	1	53.925	52.925		Repeater	VK1RGI ACT Mt Ginini ACT & SE NSW VK4RBX Qld Ipswich
17	1	53.950	52.950		Repeater	VK4RBL Qld Brisbane South
18	1	53.975	52.975		Repeater	VK3RGM Vic Mt Buller NE Vic VK4RBR Qld Mt Gravatt Brisbane
19	0	52.500	52.500		Voice	International calling frequency
20	0	52.525	52.525		Voice	National Calling Frequency
					Repeater	Reverse Channels
21	0	52.550	53.550			Reverse channel # 1
22	0	52.575	53.575			Reverse channel # 2
23	0	52.600	53.600			Reverse channel # 3
24	0	52.625	53.625			Reverse channel # 4
25	0	52.650	53.650			Reverse channel # 5
26	0	52.675	53.675			Reverse channel # 6
27	0	52.700	53.700			Reverse channel # 7
28	0	52.725	53.725			Reverse channel # 8
29	0	52.750	53.750			Reverse channel # 9
30	0	52.775	53.775			Reverse channel #10
31	0	52.800	53.800			Reverse channel #11
32	0	52.825	53.825			Reverse channel #12
33	0	52.850	53.850			Reverse channel #13
34	0	52.875	53.875			Reverse channel #14
35	0	52.900	53.900			Reverse channel #15
36	0	52.925	53.925			Reverse channel #16
37	0	52.950	53.950			Reverse channel #17
38	0	52.975	53.975			Reverse channel #18

Data Channels

39 0 53.000 53.000
40 0 53.025 53.025
41 0 53.050 53.050
42 0 53.075 53.075
43 0 53.100 53.100

Voice Simplex Channels

44 0 53.125 53.125
45 0 53.150 53.150
46 0 53.175 53.175
47 0 53.200 53.200
48 0 53.225 53.225
49 0 53.250 53.250
50 0 53.250 53.275
51 0 53.300 53.300
52 0 53.325 53.325
53 0 53.350 53.350
54 0 53.375 53.375
55 0 53.400 53.400
56 0 53.425 53.425
57 0 53.450 53.450
58 0 53.475 53.475
59 0 53.500 53.500
60 0 53.525 53.525

WICEN

Repeater Simplex

61 0 53.559 53.550

Bugs Juice:

Bug Juice is used in conjunction with your de-soldering gun or iron to enable quick and clean de-soldering of components of the transceiver. The original brew is 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.

Midland Land Mobile Model and Features Table for 70-066 & 70-076:

Syntech I

<u>Model</u>	<u>Type</u>	<u>Split</u>	<u>Power</u>	<u>Channel Count</u>	<u>Comments</u>
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70-066	ST1	66-80 mhz	40 watt	80	Dash Mount mid band
70-076	ST1	66-80 mhz	40 watt	80	Trunk Mount mid band

"A"=66-80mhz, "B"=75-88mhz

EPROM Software:

Firmware.

6meters.fre	Frequency input file for Midland 70-066 62 channel EPROM in text format.
6meters.bin	Binary file for EPROM burning using 62 Channel frequency listing.

Software.

Software Description:

The VK2DOT Midland 6 meter firmware generator Software has the following functions and restrictions:-

- Software will operate under DOS or Windows & from a floppy or hard drive or from a USB stick.
- Software works for AWA RT85 Low Band and Midland 70-066 for 6 Meters.
- The 10Khz and 12.5Khz Frequency step has not been checked.
- The other bands other than 6 Meters has to be checked.

Initial Testing:

Equipment Needed.

Midland 70-066 transceiver [with 66-88Mhz EPROM installed],

Frequency Counter. Reads up to 88Mhz

Power or VSWR/Power Meter to cover 50Mhz to 88Mhz.

12 Volt power supply. 10 Amps capacity.

Signal Generator to cover 50Mhz to 88Mhz.

Testing.

Hopefully, your Midland 70-066 has an installed EPROM. And the EPROM has not been erased, If this is TRUE then;

Connect your transceiver to a 12 Volt power supply and the antenna to power meter and dummy load. Go to channel 1; Press the transmit button to allow the power out to be loosely coupled to a Frequency counter. Measure the Frequency and power out.

Callsign -

Date -

Frequency -

Power Out -

Then - Connect your transceiver to a signal generator and, adjust the signal generator to the above noted frequency; Adjust the mute to just close; then - measure the micro-volts for mute opening, for receiver sensitivity.

Rx Sensitivity –

If all of the above are OK then you may continue with the conversion or repair your transceiver before conversion.

INITIAL TRANSCEIVER REMOVAL of COVERS:

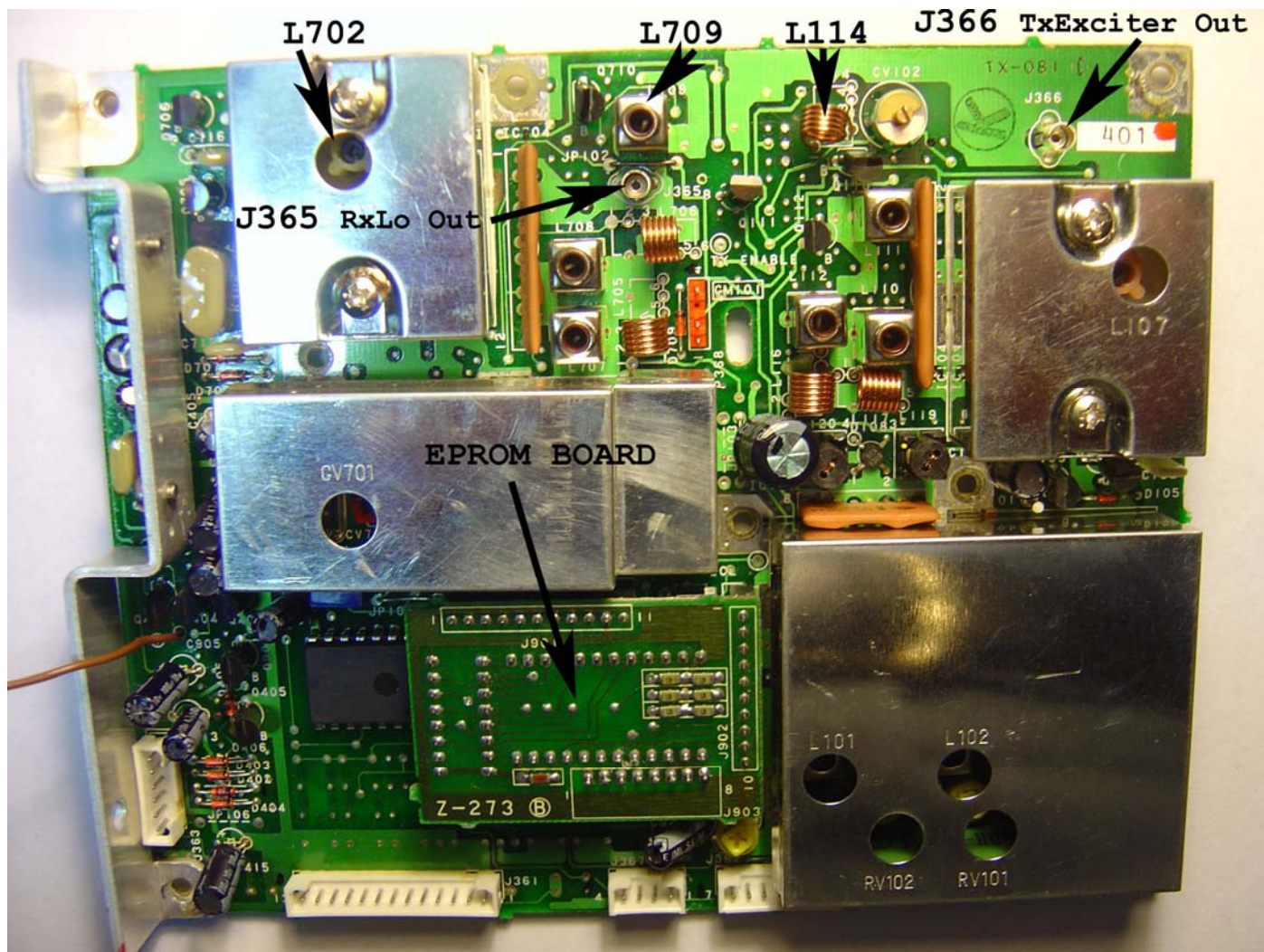
- Remove four screws from each side of the transceiver, then remove the top and bottom covers.
- With a black felt marker pen – Write your callsign on each cover and inside the top and bottom of the transceiver chassis.
- Then – Modify the Z-273 EPROM PCB [part 1], the synthesizer [part 1], the receiver [part 2], and the transmitter PA [part 3].

TEST CABLE's to be BUILT:

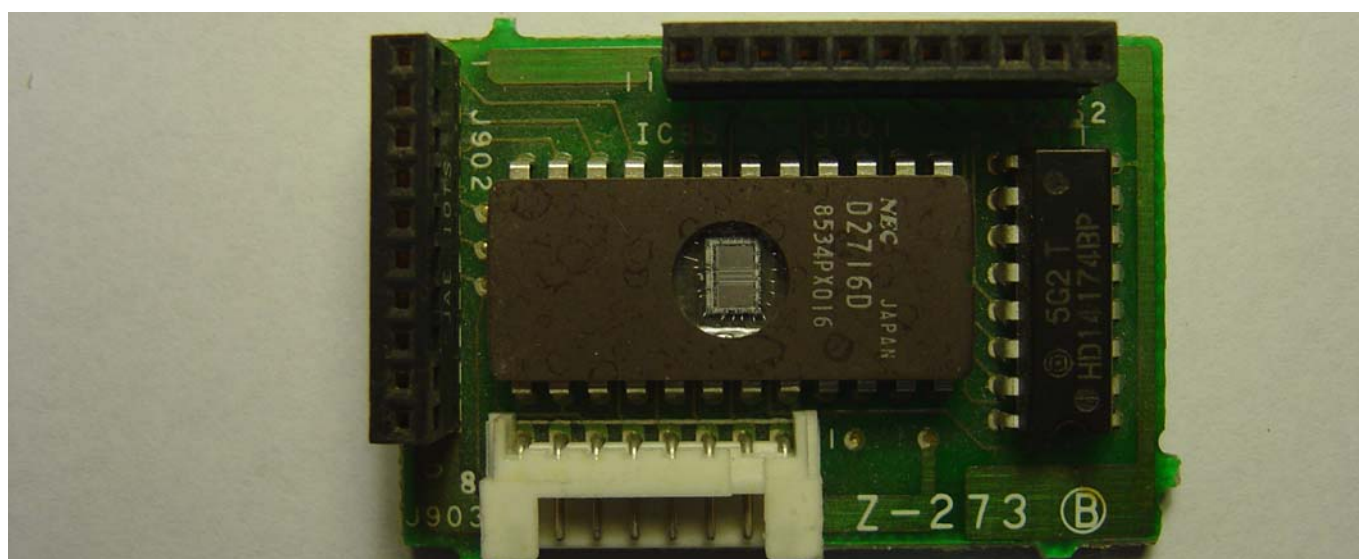
- RF cable Transceiver to Power Meter. RG58 – Type N to UHF connectors.
- RF cable Transceiver to Signal Generator. RG58 – BNC to UHF connectors.
- DC cable for receiver testing. 2 pin connector to 2 of red banana plugs [for DC meter].
- DC cable for synthesizer testing. 1 cable - black banana plug to alligator clip.
1 cable - red banana plug to red clip.
- UV Light assembly for bulk erasing of Z-273's 2716 EPROM's.

The Synthesizer including EPROM Board.

Midland70-066 Sync Board Top View - below:



Remove the EPROM board [above as **Z-273**], reverse view below.



Z-273 EPROM Board:

NOTE: For the CTCSS and receiver to work properly [ie audio out to speaker to work] on the Midland 70-066 transceivers – Make sure the 8 pin plug is plugged into the white 8 pin socket **J903** on the Z-273 EPROM board.

There are three methods of changing the EPROM data for different frequencies,

1. Using a MRP70-1000C (MRP-70) programmer box and software. This method allows you to program the EPROM on the Z-273 board, without de-soldering the EPROM from the Z-273 board. The programmer box can be purchased in Australia for approx \$300 or from the US for approx \$450 US; **or**;
2. Remove the Z-273 board from the Synthesizer Board. Then remove the 2716 EPROM using de-soldering equipment from the EPROM board. Then solder a low profile 24 pin socket to the EPROM board.

Reprogram EPROM with 6 meter firmware, by using the VK2DOT Midland software or any other software.

3. Using the VK2DOT Z-273 adapter [as shown in section 5.]

Remove the Z-273 board from the Synthesizer Board.

Amend the Z-273 board as described in section 5.

Erase the EPROM on the Z-273 Board.

Place the Z-273 board on to the top of the VK2DOT Z-273 adapter;

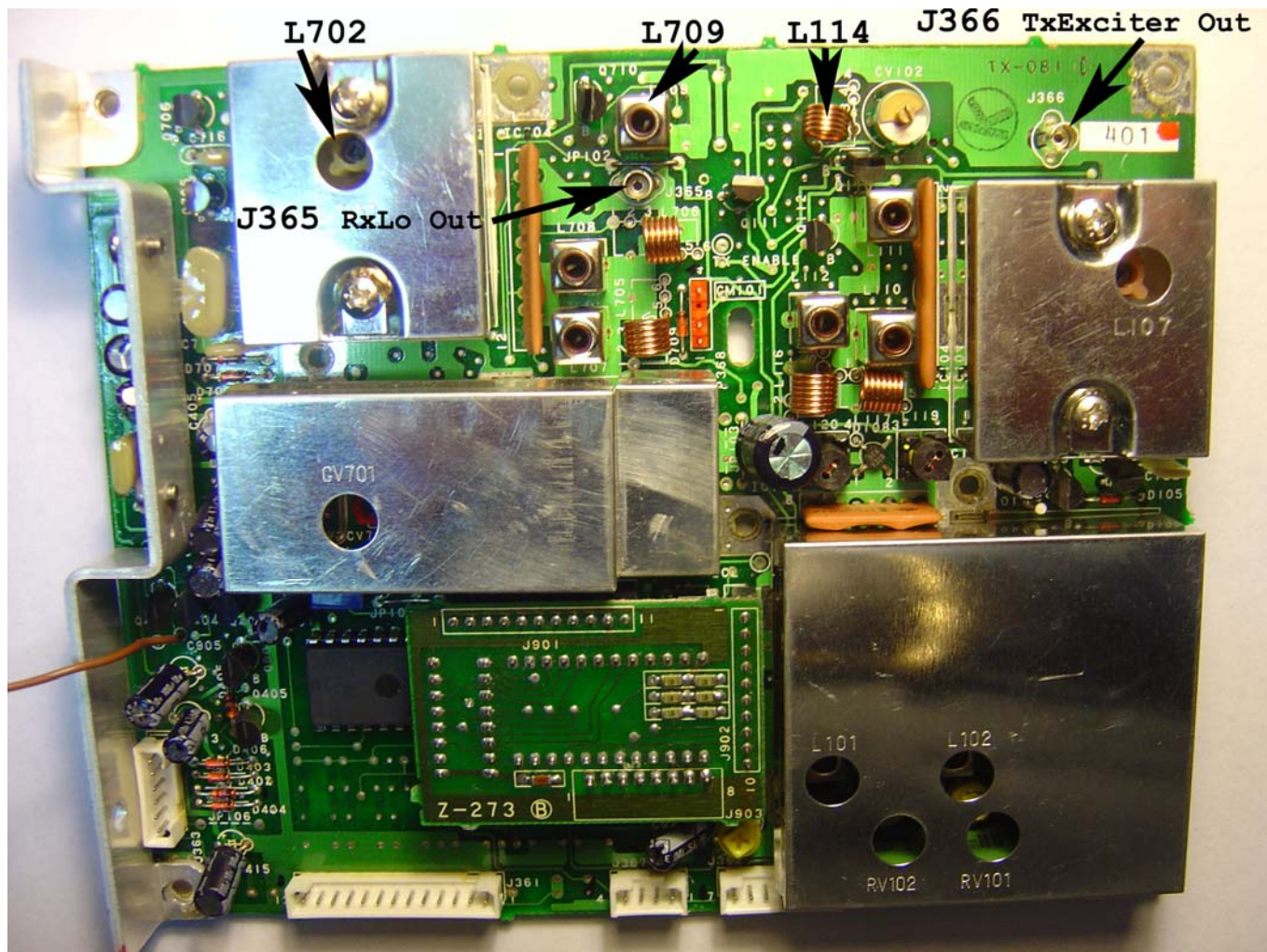
Then insert the adapter into the EPROM zero insertion burning socket.

Burn the EPROM on the Z-273 Board using conventional EPROM burning software, of the file [eg 6meters.bin] containing the new frequencies. Which has been generated by the VK2DOT software.

The Synthesizer Board.

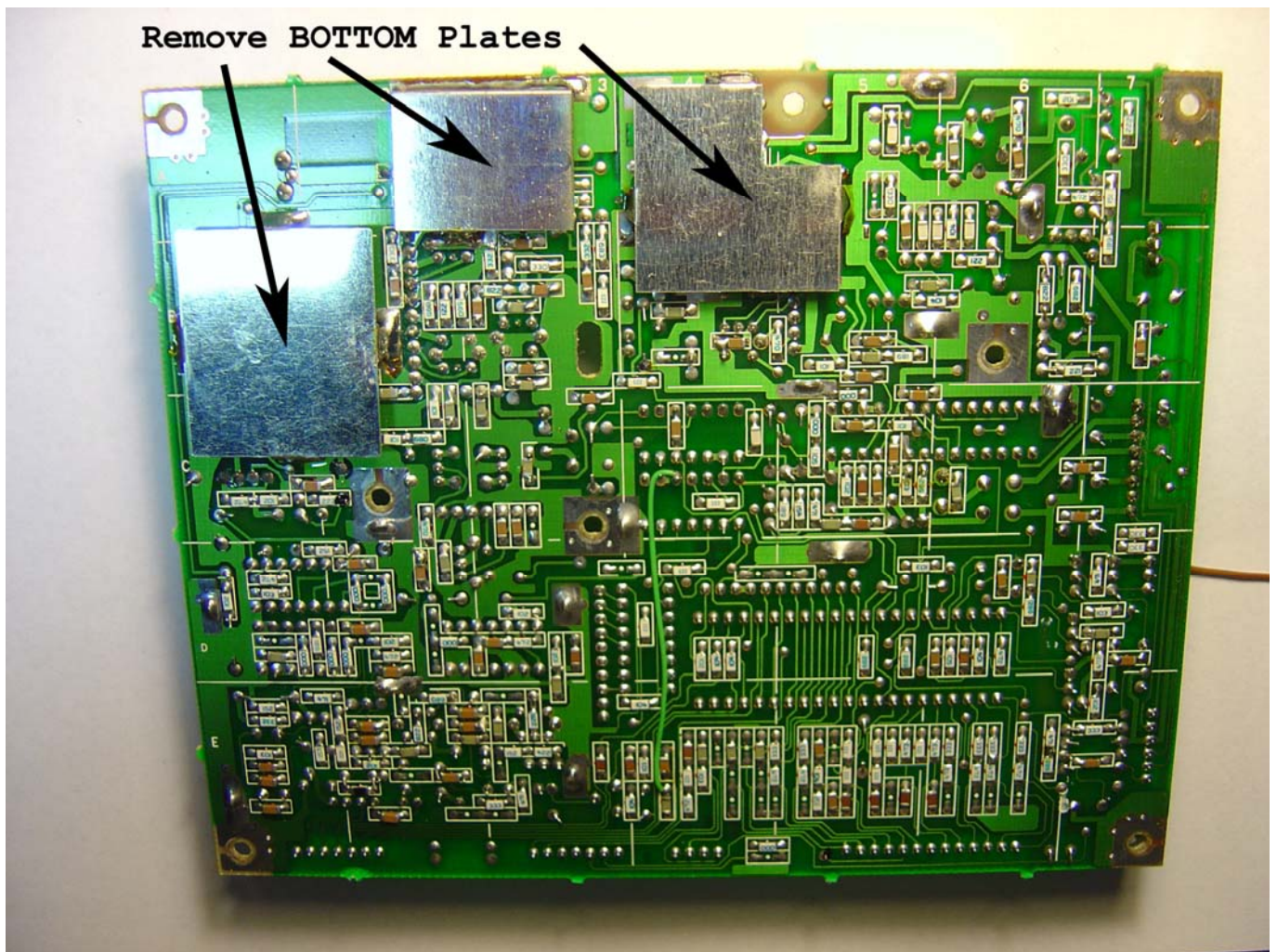
Remove the synthesizer board from the transceiver assembly.

Midland 70-066 Sync Board Top View below:

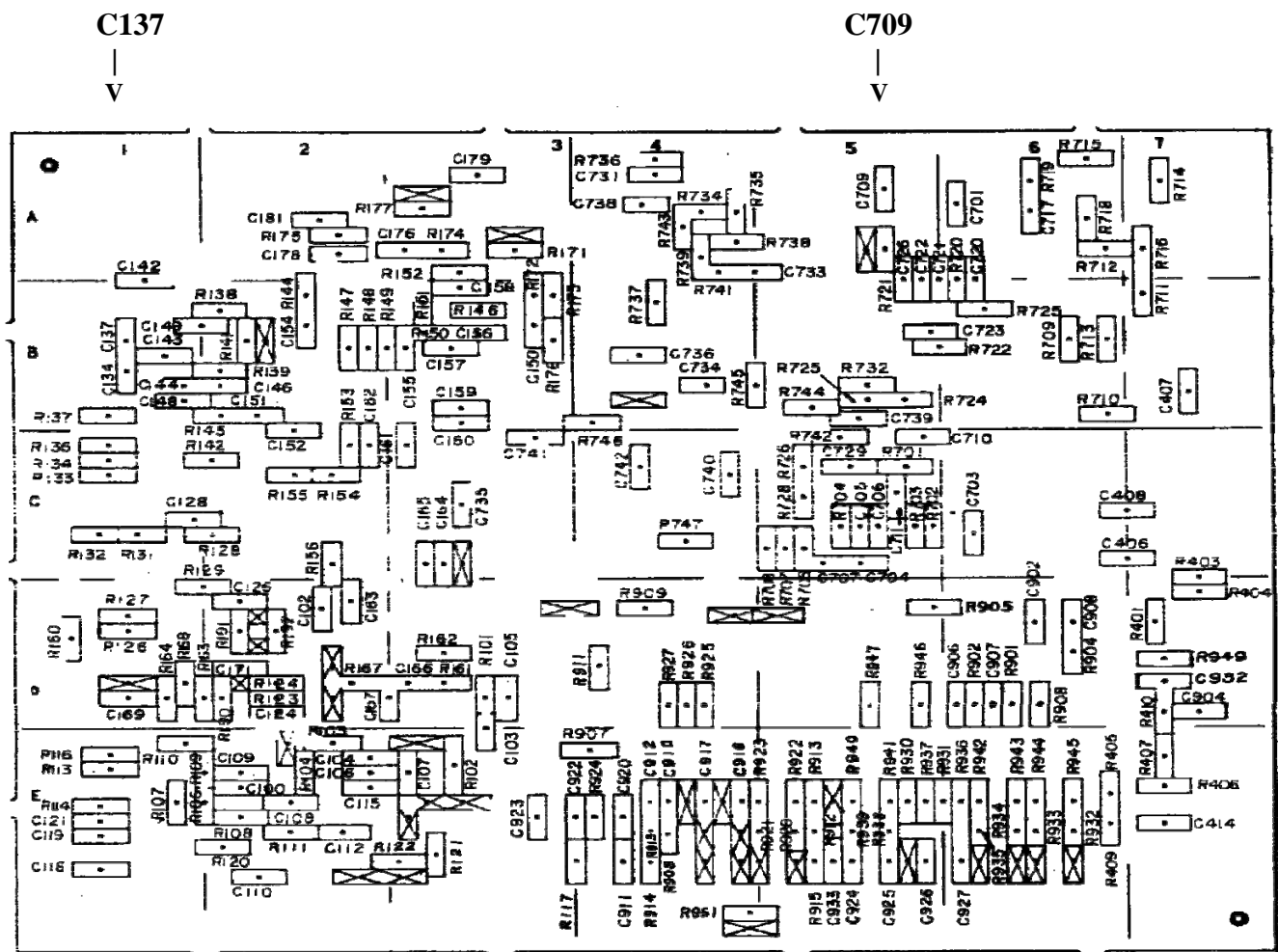


TX buffer, remove L114 and keep for use on the PA board; replace with 7.5 turns of 0.5mm wire, same diameter former.

Midland 70-066 Sync Board Bottom – Unsolder Bottom Plates:



Midland 70-066 Sync Board Bottom View Capacitors - below:

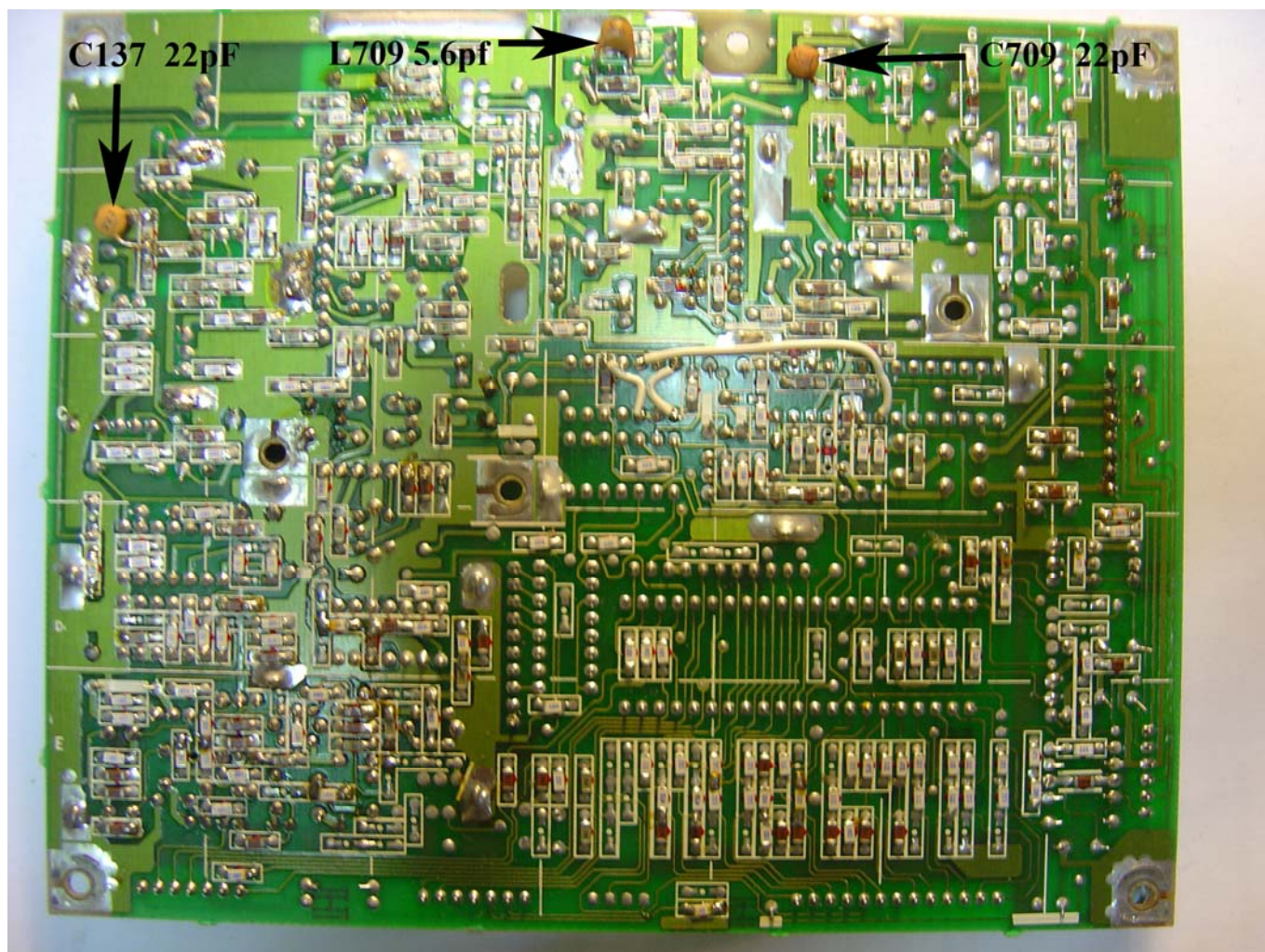


RX (main) VCO, add 22pF to C709.

TX (offset) VCO, add 22pF to C137 [for Midland 70-066],
located under VCO cover on the track side of the board. Some transceivers may
require more.

RX buffer amp, add 5.6pF to primary of L709

Midland 70-066 Sync Board Bottom View New Capacitors - below:



SYNTHESIZER ALIGNMENT

Plug the 6 meters programmed EPROM into the EPROM module Z-273, into the Synthesizer PCB. Disconnect the Transmitter exciter output J366; And the Receiver Local Oscillator output J365. Set the supply to 13.8 V.

- 1: Switch on unit. Adjust the squelch and volume controls so that the loudspeaker is muted

If the Phase Locked Loop (PLL) is unlocked, the channel display will show "95", alert tone will be sounded, and the dc voltage at TP741 will be 6 V or less than 1.7 V.

If the PLL is locked, either the first channel number will be displayed or else the unit will wait blank on channel 00 [for RT85] or 01 [for Midland 70-066A] until either the UP or DOWN button is pressed.

NOTE: If you are using the old RT-80 ten channel head, then above channel numbers displayed are not applicable.

- 2: The main Receiver VCO is set to a frequency which is center of the programmed frequencies, By using the 6meters.bin EPROM – set to **channel 48** [53.225Mhz].

- 3: Use the correct alignment tool on all ferrite cores – the ferrite slugs are easily broken.

Connect DC Voltmeter between ground and TP701. On 10 Volt Range.

Adjust L702 such that the dc voltage at **TP701** is centered on 3.5V for all programmed channels (i.e. some above 3.5V and some below 3.5V). Voltages will swing between 2 Volts and 4 Volts.

- 4: Ensuring that the exciter output is disconnected, operate the PTT button. Check the voltage at TP701 for all channels, and re-adjust L702 for the best balance of voltages around 3.5V for TX and RX channels. Release the PTT button.

- 5: Connect the frequency counter to **J365** and adjust **CV701** for:

$$f = (\text{RX freq} - 21.4\text{MHz}) \pm 244\text{Hz} : \text{for V HF(HB) and UHF}$$

or

$$f = (\text{RX freq} + 21.4\text{MHz}) \pm 244\text{Hz} : \text{for VHF(LB)}$$

$$52.525\text{Mhz} = \text{Tx frequency} \quad \text{then} \quad 73.925\text{Mhz} = \text{Oscillator frequency.}$$

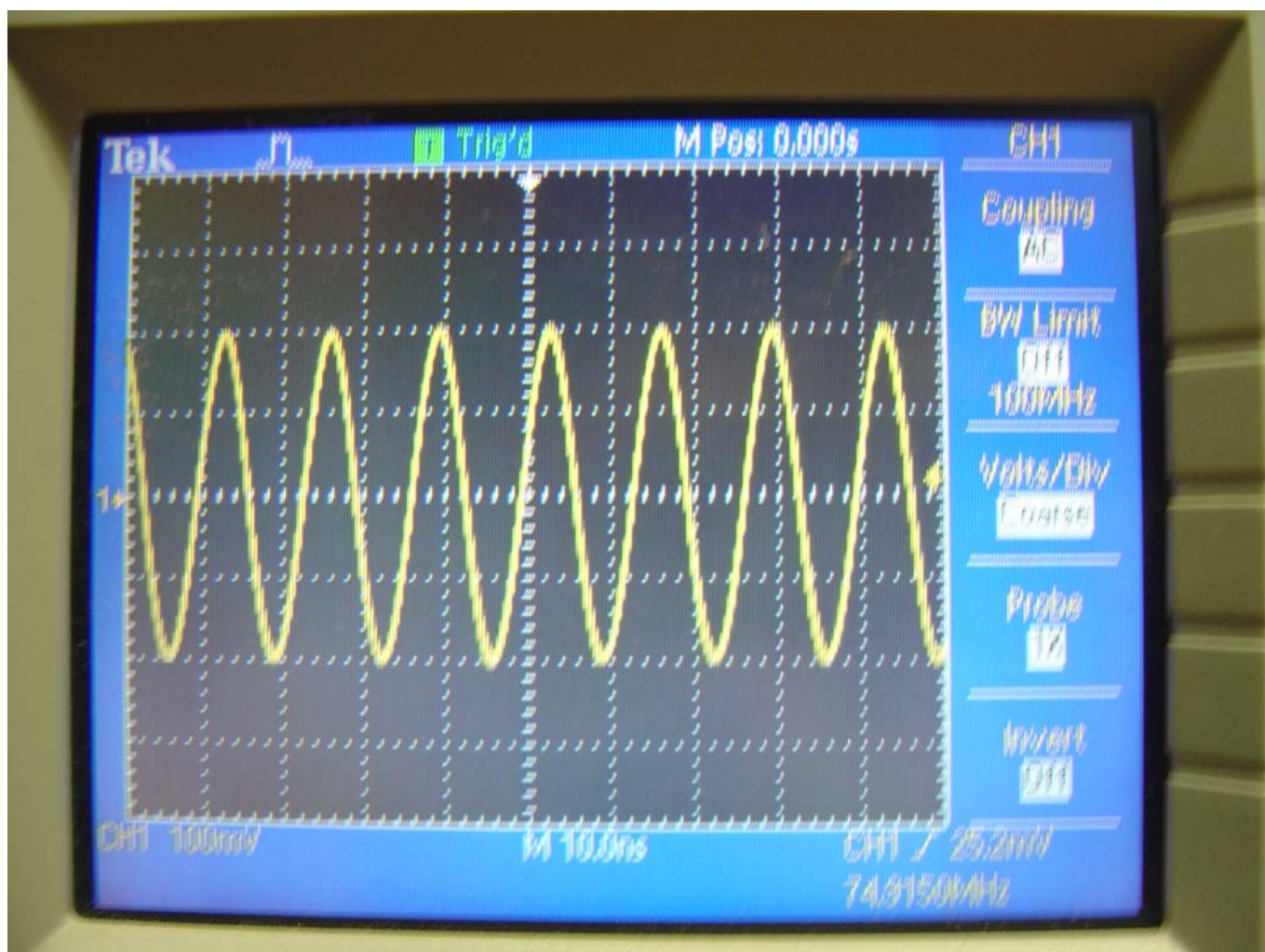
It is only necessary to check one channel, but this measurement may be made for all programmed channels.

Note: For special requirements, high side injection may be employed for VHF(HB) and UHF, and low side injection for VHF(LB); however, a number of components must be changed for this.

5.

The main transmitter VCO should be adjusted on the **highest** programmed frequency.

Select channel



Receiver Local Oscillator output from J365.