Build Instructions for the Indo-ware SSB 6.1 Transceiver (Final Version)

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N.A.Strong

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Transceiver main board Final Version

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My thanks to Ken Mann, Lawrence Galea, Charles Jr Husak and all others who contributed to the production of this document

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1. Intoduction

I make no apologies for any plagiarism or copying that occurs within this document it is designed with the purpose to collate the available information on building the set and any available mods. The Information contained is based on my build and measurements I took and should be used as a guide only I take no responsibility for your own build. The kit is basically the main mother board for building a single conversion superhet 6-band HF SSB shortwave radio transceiver and comes as a kit of parts. The bands covered are: - 3.5MHZ 7MHZ 10MHZ 14MHZ 21MHZ 29MHZ (depending on the VFO settings used) and the modes covered are CW LSB USB. You have to supply the VFO, PA, PA switching and output LPF etc. as extras I do not intend to go into this in depth.

2. Starting the build

There are several things that need to be done first not the least of which is checking the bits are all there against the BOM.

The resistors will have a value code printed on them as will the semis. The capacitors (if you are lucky) will have the values printed on the section of strip, if not they will have to be measured.

I will assume all components and values are known and available.

Some of the extra components required:-

A) Suitable heat sink
B) Control Pots (Depending on VFO Choice)
C) Suitable case, Knobs etc.
D) PSU 12V at a suitable power rating for PA Chosen (Approx. double the PA rating + (20-30W). If using a switched mode supply make sure it is properly filtered both on mains input and 12V output they are notoriously noisy.
E) 10W 4-16 ohm Loudspeaker

I intend building the set in a modular fashion giving voltages and appropriate wave forms etc. as I progress with appropriate photos along the way. With the exception of a couple of Photos all are of my current build.

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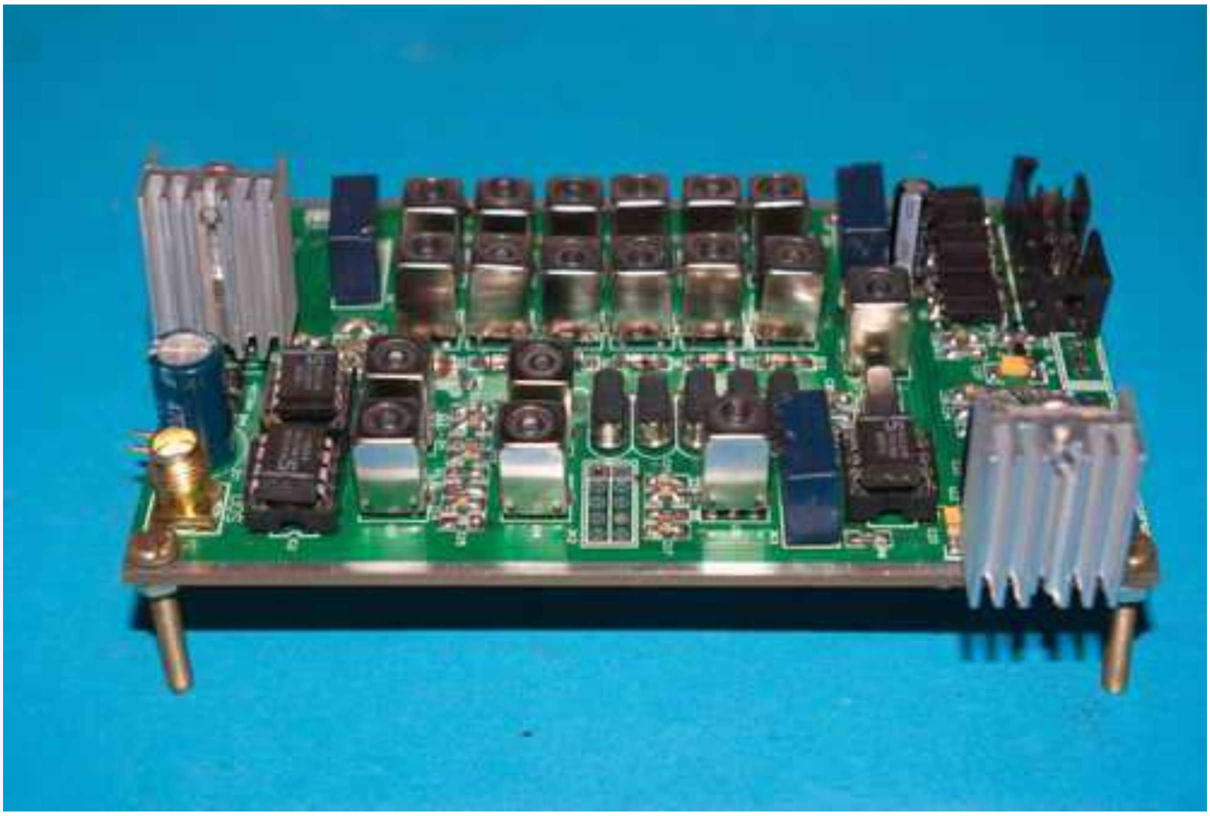
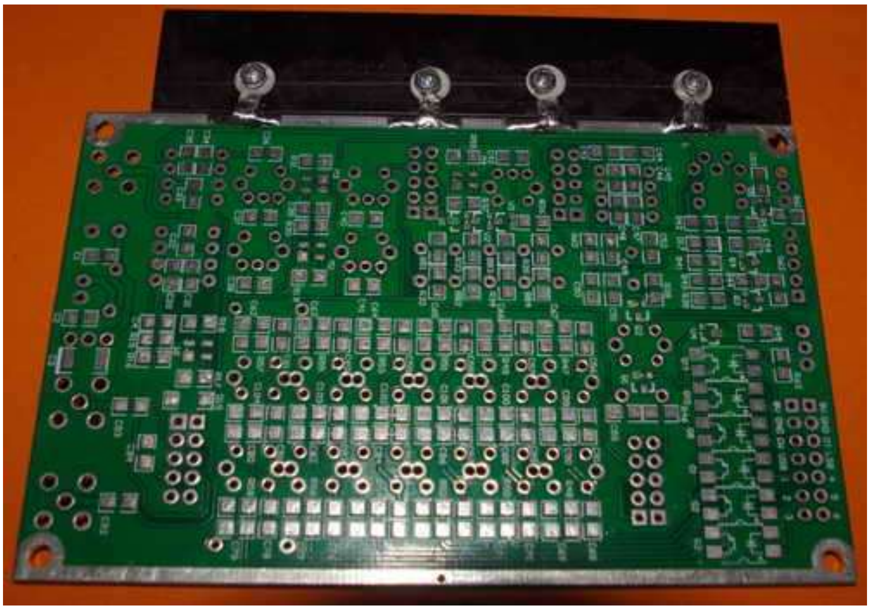


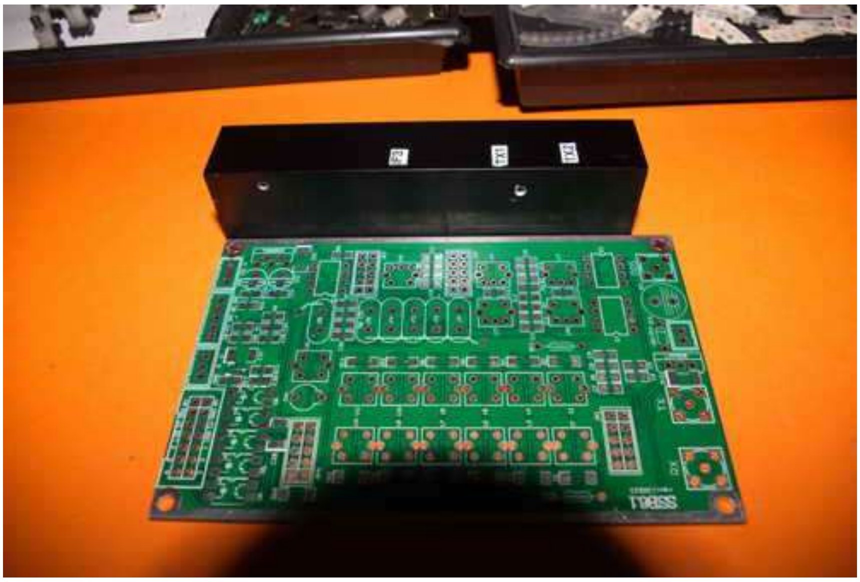
This is an idea to make your boards easier to handle when soldering use nuts and bolts to make temp legs to keep the board level and stable when soldering. This was my first “practice board” I still have to fault find and get this one working. It was also my first attempt at SMT!

Let Battle commence

3. Initial assembly

First fit the optional heat sink to Board if desired, I would recommend using one although it is not supposed to be needed, I used a small LED heatsink about the same size as the PCB and attached it by solder tags to the edge earthing strip, after drilling suitable holes for both mounting and the AF output IC and regulator see pics





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The next step is to clean the board ready for soldering I Just gave it a light rub with an ink rubber to remove any oxides from the tinning. I would recommend using extra rosin based flux for all soldering and preferably a minimum amount of solder to make the joint using a soldering iron with a very small tip.

4. Voltage regulation and PSU

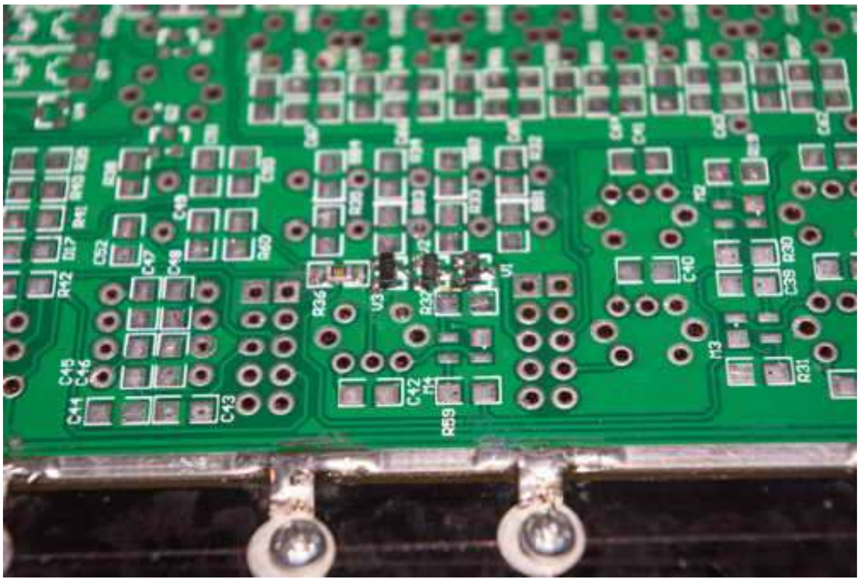
There is nothing difficult here at this stage fit and solder the components in the order listed

Component ID	Type	ID mark		Comments	Fitted	Checked
D14	Axial diode	1N4007		make sure of polarity		
D13	SMT diode	B430	SS34	make sure of polarity		
EC1	Axial Elec	47uF		make sure of polarity lines are negative lead		
C1	SMT Cap	100nF	104			
C2	SMT Cap	100nF	104			
C3	SMT Cap	47uF	476	make sure of polarity		
Power socket				make sure of polarity		
7808	Regulator			Make sure of polarity and Fit into board or on leads depending on preference		
V1	SMT IC	LM431	431			
V2	SMT IC	LM431	431			
V3	SMT IC	LM431	431			
R36	SMT Res	390R	391	labelled R63 on schematic R36 on PCB		

Test voltages

D1	11.66 in	11.00 out
D2	7.95 in	7.65 out
V1 TO GND	2.49 (2.5v)	
V2 TO GND	4.99 (5v)	
V3 TO GND	7.47 (7.5)	

If your voltages agree the PSU section is now built, tested and working ok.



5. Switching Section

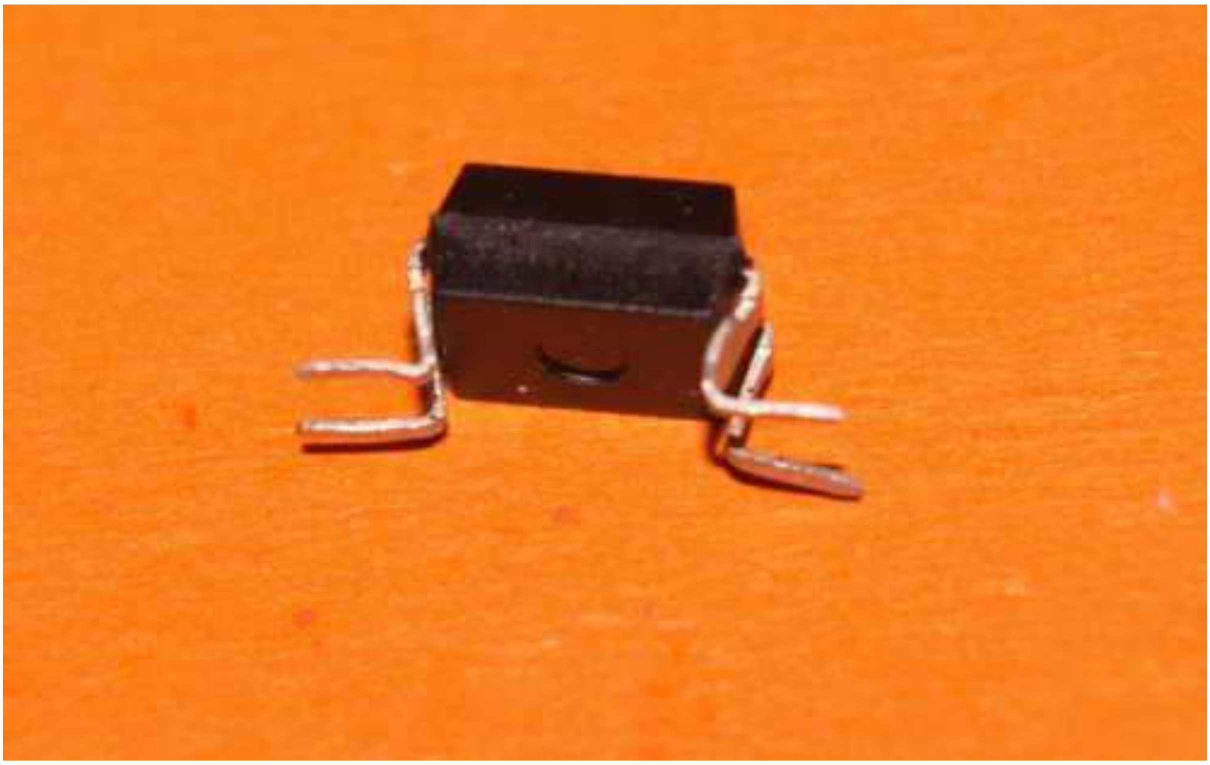
This only includes aspects needed for continuing testing at the moment

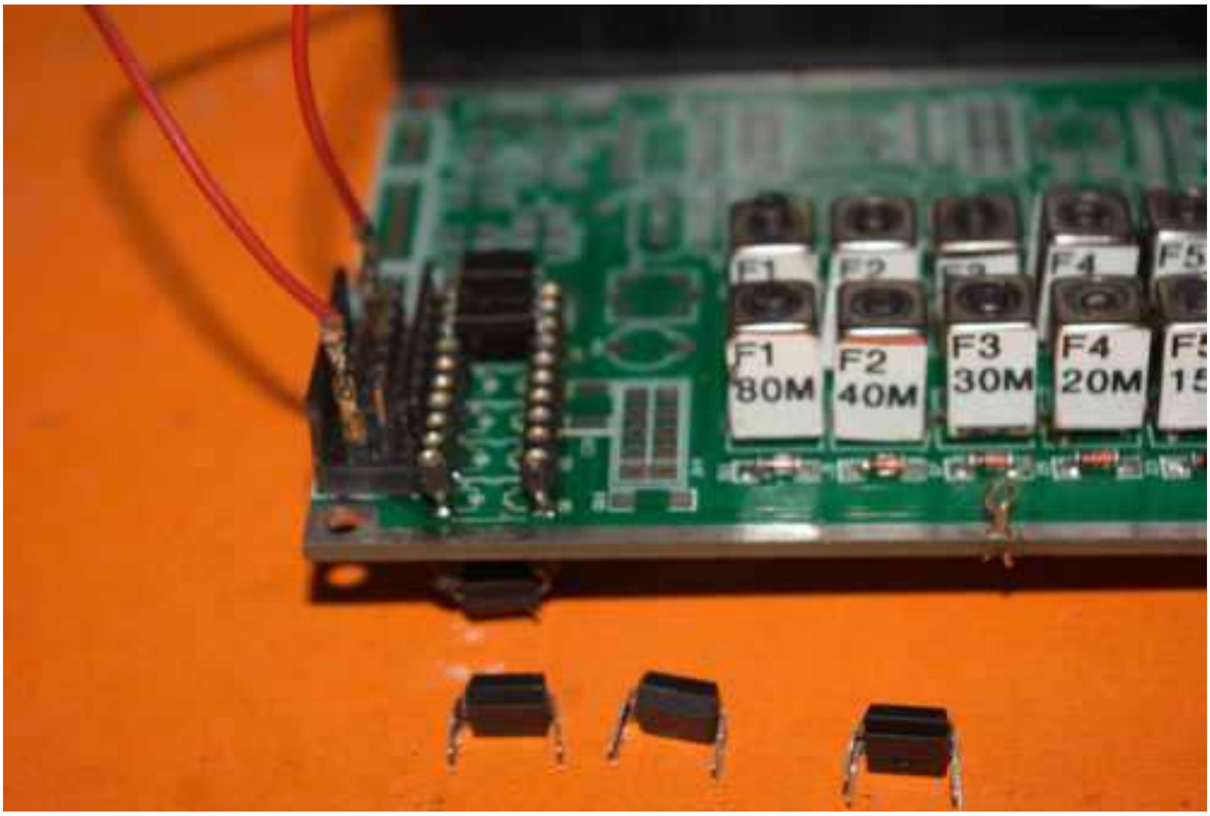
Component ID	Type	ID mark	Fitted	Checked
G1	Optocoupler	PC817		
G2	Optocoupler	PC817		
G3	Optocoupler	PC817		
G4	Optocoupler	PC817		
G5	Optocoupler	PC817		
G6	Optocoupler	PC817		
G7	Optocoupler	PC817		
G8	Optocoupler	PC817		
G9	Optocoupler	PC817		
G10	Optocoupler	PC817		
G11	Optocoupler	PC817		
IDC Socket				

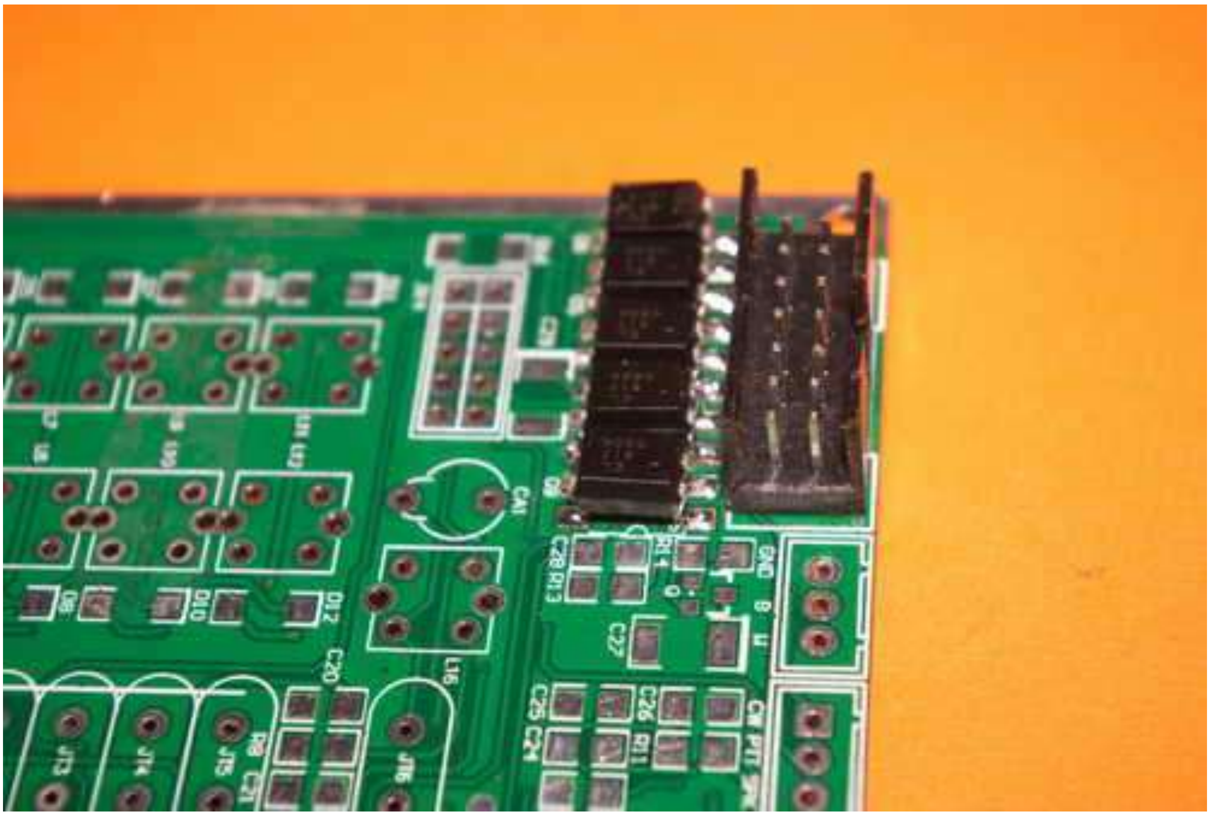
All Opto-couplers make sure of the polarity + bend the legs as per picture trimming if needed for mounting so ONLY the pads are connected to or my preference use strip type ic holders soldered to the board these make it easy to change them if faulty.

IDC socket make sure of the polarity and cut its' ends off before soldering to clear the mounting hole and the adjacent socket

No relays are fitted at this stage




F1
80M
F2
40M
F3
30M
F4
20M

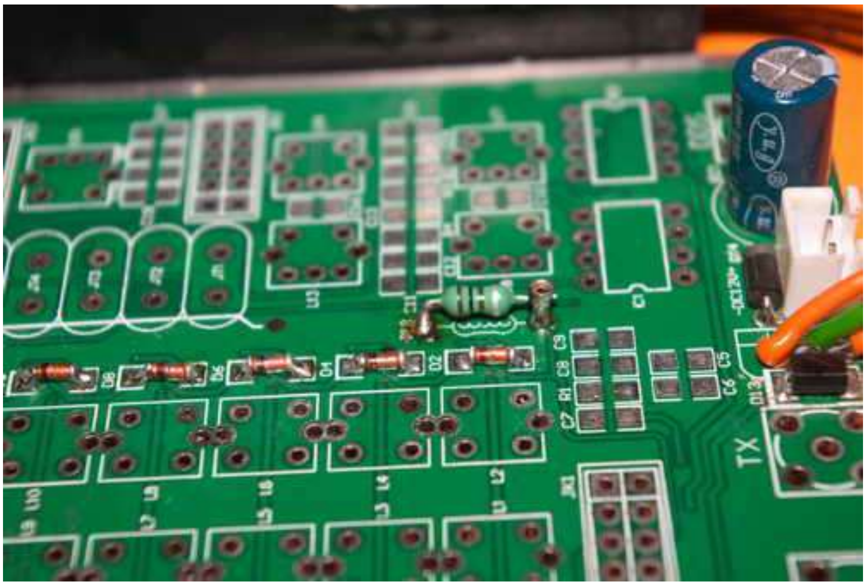


6. Front-end Band Pass Filters

Top PCB components

Component ID	Type	ID mark	Comments	Fitted	Checked
D1	SMT 1N4148	none	make sure of polarity		
D2	SMT 1N4148	none	make sure of polarity		
D3	SMT 1N4148	none	make sure of polarity		
D4	SMT 1N4148	none	make sure of polarity		
D5	SMT 1N4148	none	make sure of polarity		
D6	SMT 1N4148	none	make sure of polarity		
D7	SMT 1N4148	none	make sure of polarity		
D8	SMT 1N4148	none	make sure of polarity		
D9	SMT 1N4148	none	make sure of polarity		
D10	SMT 1N4148	none	make sure of polarity		
D11	SMT 1N4148	none	make sure of polarity		
D12	SMT 1N4148	none	make sure of polarity		
R13	SMT Res 200 Ohm	201			

TP1	TURNED PIN SKT			solder in "live end" of RL1		
TP2	TURNED PIN SKT			solder in "live end" of RL2		
RL1	RF Choke	Coloured bands		solder in to ground and to TP1 side		
RL2	RF Choke	Coloured bands		solder in to ground and to TP2 side		



Bottom PCB components

Component ID	Type	ID mark		Comments	Fitted	Checked
C81	SMT Cap	2pF				
C83	SMT Cap	2pF				
C85	SMT Cap	2pF				
C87	SMT Cap	2pF				
C89	SMT Cap	2pF				
C91	SMT Cap	2pF				
C62	SMT Cap	100nF	104			
C63	SMT Cap	100nF	104			
C64	SMT Cap	100nF	104			
C65	SMT Cap	100nF	104			
C66	SMT Cap	100nF	104			
C67	SMT Cap	100nF	104			
C69	SMT Cap	100nF	104			
C71	SMT Cap	100nF	104			

C73	SMT Cap	100nF	104		
C75	SMT Cap	100nF	104		
C77	SMT Cap	100nF	104		
C79	SMT Cap	100nF	104		
C90	SMT Cap	150Pf			
C99	SMT Cap	150Pf			
C88	SMT Cap	100pF			
C100	SMT Cap	100pF			
C101	SMT Cap	68pF			
C86	SMT Cap	68pF			
C102	SMT Cap	47pF			
C84	SMT Cap	47pF			
C103	SMT Cap	33pF			
C82	SMT Cap	33pF			
C104	SMT Cap	22pF			
C90	SMT Cap	22pF			
C56	SMT Cap	27pF			
C68	SMT Cap	27pF			
C57	SMT Cap	22pF			
C70	SMT Cap	22pF			
C58	SMT Cap	18pF			
C59	SMT Cap	18pF			
C72	SMT Cap	18pF			
C74	SMT Cap	18pF			
C60	SMT Cap	10pF			
C76	SMT Cap	10pF			
C61	SMT Cap	5pF			
C78	SMT Cap	5pF			

Component ID	Type	ID mark	Comments	Fitted	Checked
R47	SMT Res	1k	102		
R48	SMT Res	1k	102		
R49	SMT Res	1k	102		
R50	SMT Res	1k	102		
R51	SMT Res	1k	102		
R52	SMT Res	1k	102		
R53	SMT Res	1k	102		
R54	SMT Res	1k	102		
R55	SMT Res	1k	102		

R56	SMT Res	1k	102		
R57	SMT Res	1k	102		
R58	SMT Res	1k	102		

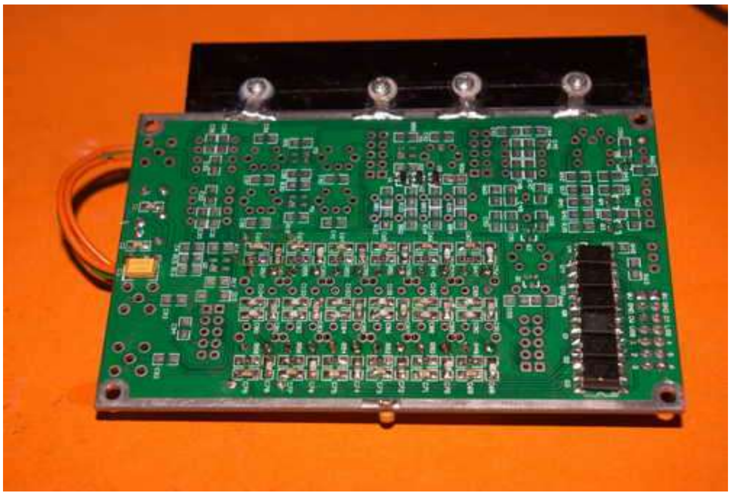
That completes the discreet component part of the assembly now for the coils. These are wound as either two or three adjacent windings in slots 2, 3, 4 on the coil former (See photo) and connected to the two pin side of the former. (I actually used 0.125mm diameter wire rather than the 0.1 supplied gaining slightly on the Q of the Inductors produced). The method of winding start on a pin bring the wire to the second slot from the base and start winding for XXX turns move to next slot for XXX windings move up for final winding or to the end pin. See table below.

Component ID	Type	Total turns	Value	slot 1	slot 2	Slot 3	Fitted	Checked
L1	BPF 28MHz (10m)	10	~1.1uH	5	5	0		
L2	BPF 28MHz (10m)	10	~1.1uH	5	5	0		
L3	BPF 21MHz (15m)	12	~1.3uH	6	6	0		
L4	BPF 21MHz (15m)	12	~1.3uH	6	6	0		
L5	BPF 14MHz (20m)	15	~1.9uH	5	5	5		
L6	BPF 14MHz (20m)	15	~1.9uH	5	5	5		
L7	BPF 10MHz (30m)	19	~2.9uH	7	6	6		
L8	BPF 10MHz (30m)	19	~2.9uH	7	6	6		
L9	BPF 7MHz (40m)	21	~4.1uH	7	7	7		
L10	BPF 7MHz (40m)	21	~4.1uH	7	7	7		
L11	BPF 3.5MHz (80m)	31	~10.7uH	11	10	10		
L12	BPF 3.5MHz (80m)	31	~10.7uH	11	10	10		

Wind and solder the coil ends, cut off any-un used pins. Take care when fitting the ferrite shields on the coils as they are a very tight fit and break easily. Only solder the two winding pins into the board at this stage, the reason for this is quite simple in that it makes it much easier to remove the coil without damage if the number of turns needs to be adjusted.

The front end filter section is now ready to test, do a quick visual check of all soldered joints before continuing.

Firstly plug the power in and switch on there should be no dc voltage on either TP1 or TP2 if there is check the opto-isolators for shorts etc. Select any filter and “switch” it on by connecting the +8V on the IDC connector to any of the 6 band select pins. The voltages on TP1 and TP2 should show ~20mV, if it shows significantly higher check the two chokes for continuity and connection to ground. If there is no voltage check the associated diode, choke opto and resistor. Turn off the power after checking all 6 sections of filtering. This concludes testing the filter switching.




F1 80M
F2 40M
F3 30M
F4 20M
F5 15M
F6 10M

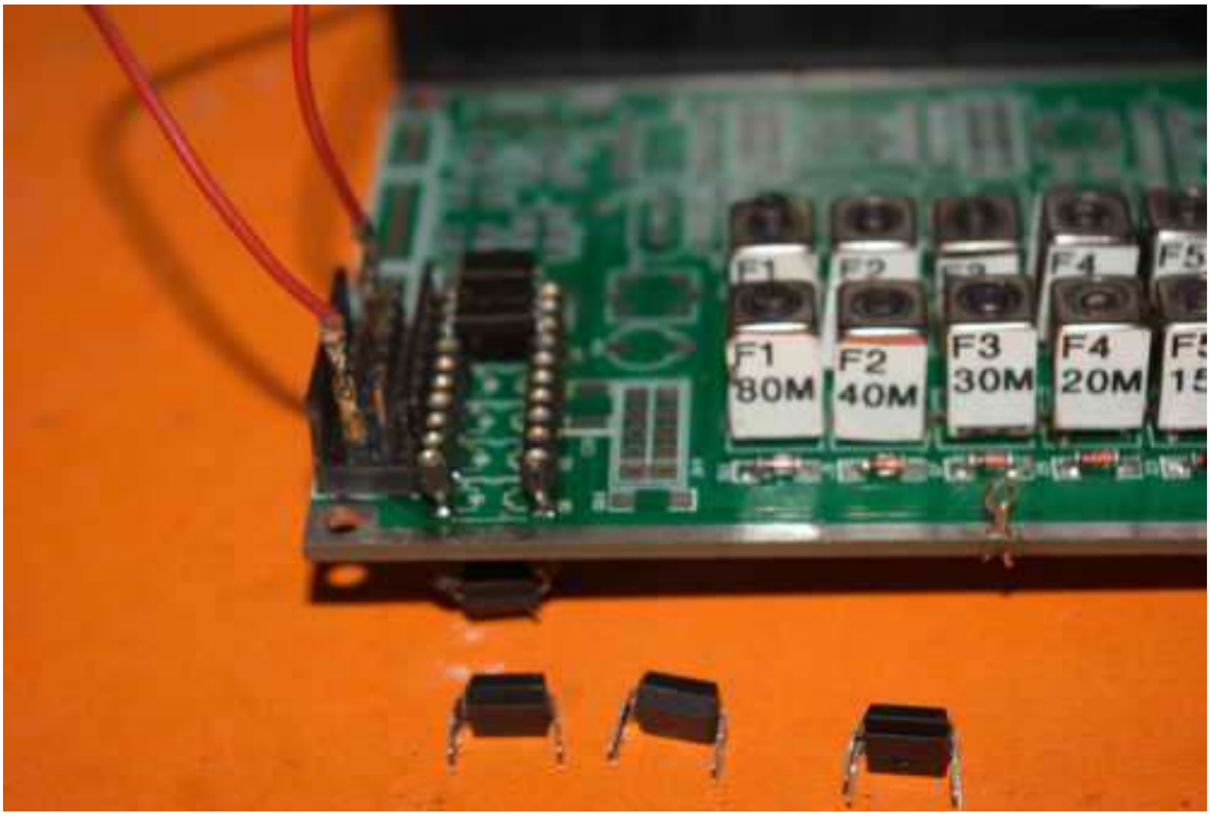
Alignment

To ensure DC isolation of the filter input and output "plug" one end of a 100nF cap into both TP1 and TP2. (One cap for each)

Connect the other end of the cap in TP1 to a low power signal source and by use of a jumper cable connect the plus 8 volts to the filter select pin for the filter to be aligned. (If you wish you could actually use the DDS VFO)

Connect the other end of the capacitor on TP2 to some form of measuring equipment to measure the output voltage so it can be maximised for the middle of the band in question (in order of preference (lowest first) an RF voltage probe, a scope, and if you are lucky a spectrum analyser with sweep gen) mine is obviously set up for the UK.

Band	UK Band MHz	Mid band MHz	Filter number	Aligned	Checked
BPF 3.5MHz (80m)	3.50 to 3.80	3.65	1		
BPF 7MHz (40m)	7.00 to 7.20	7.1	2		
BPF 10MHz (30m)	10.10 to 10.15	10.125	3		
BPF 14MHz (20m)	14.00 to 14.35	14.175	4		
BPF 21MHz (15m)	21.00 to 21.45	21.225	5		
BPF 28MHz (10m)	28.00 to 29.70	28.85	6		



The plots below are my filter characteristics as set up and reasonably aligned their component values do need slight adjustment (particularly the coil coupling capacitors) and possibly slight Q spoiling to increase the band width as some are too tight to cover a whole band without excessive losses. They are however good enough to continue as they are all functioning correctly (Well almost!).

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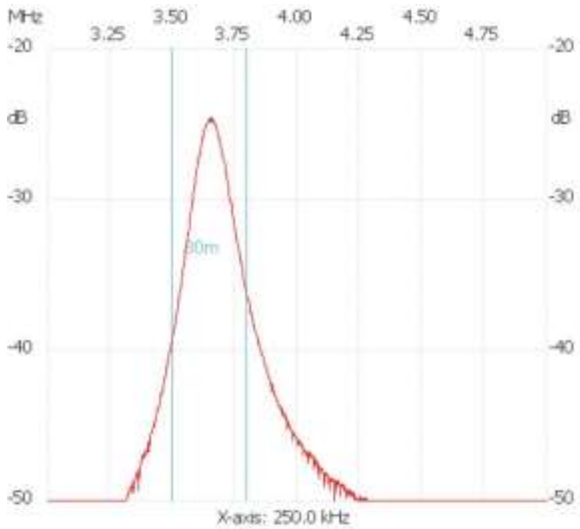
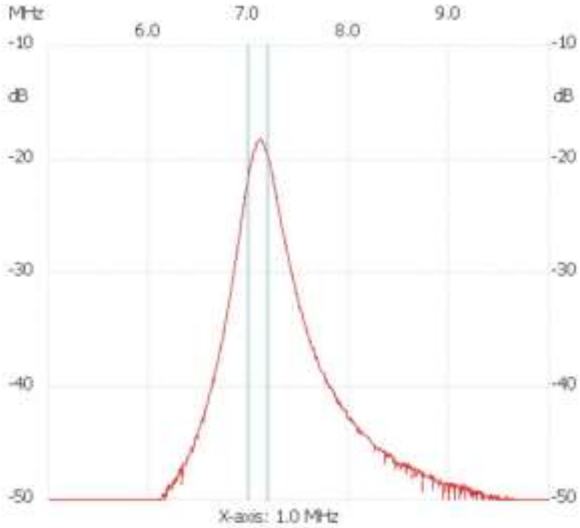
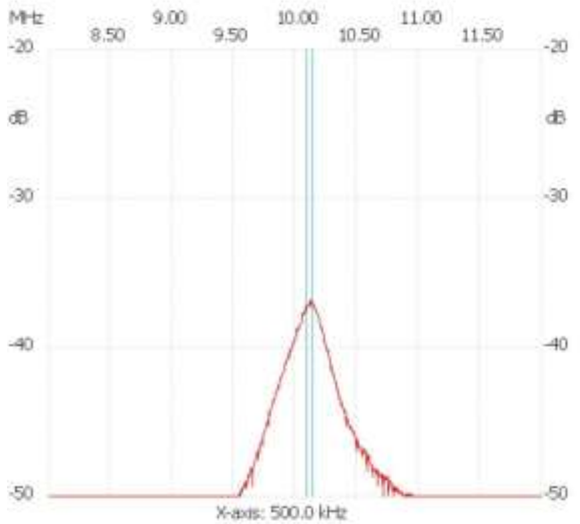
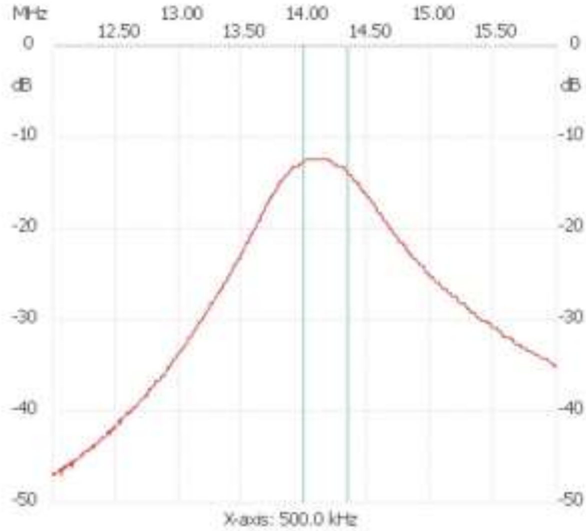
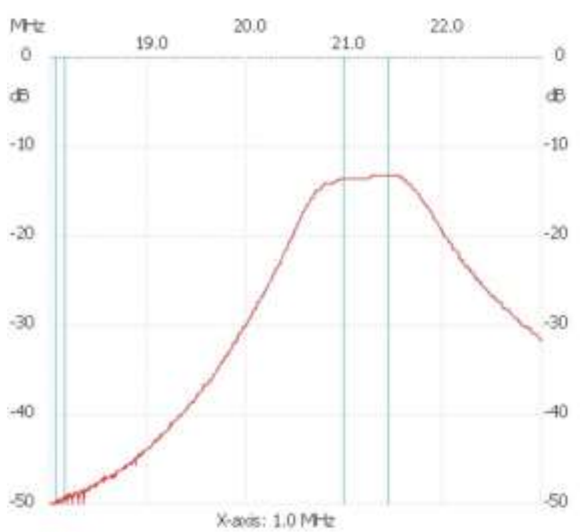
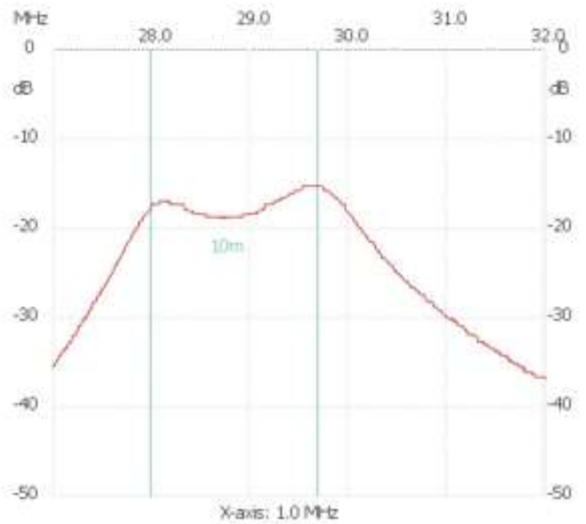












It should be noted here that:

1 A double hump on the filter generally indicates that either the two coils are not tuned to the same frequency or the coil coupling is too large i.e. the 2pF cap needs reducing in value.

2. Too narrow a pass band is caused by the filter having too high a "Q" value this can be cured two ways either offset the tuning of the filter (and increasing insertion loss) and or "Q" spoiling the coils slightly by fitting a high value resistor (Select value on test) across them increasing their bandwidth.

The main reason for not doing this now is so it can be done at the correct input and output impedances.

7. AGC and sundry others

It is now time to fit various other parts to enable work to start on the RF pre-amplifier and other rf parts of the circuit. This includes the AGC system although it will not be used yet it is needed to set the stages concerned at a maximum gain (~7.5 volts with no input and 2.5 with an af signal on D17 giving minimum gain) to enable alignment. Please note R10 is fitted on a jumper to disable the AGC if unplugged (max gain setting)

The AGC operation can be checked easily by injecting an audio signal into diode D17 and monitoring the AGC voltage at TP3 it should vary from ~7.5 volts for no input (max gain) to ~2.5V for a reasonably high level of input signal (minimum gain). If not check D17, Q4 etc.

Component ID	Type	ID mark		Comments	Fitted	Checked
SMA connectors X3						
TP 4, 5, 6	TURNED PIN SKT X3			Fitted on the back of the 3 SMA sockets as test points		
JK1	Relay	TN2-5V				
JK4	Relay	TN2-5V				
C29	Elec Cap	47uF				
C50	SMT Cap	1uF	105			
C54	SMT Cap	1uF	105			
C92	SMT Cap	100nF				
C93	SMT Cap	100nF				
C94	SMT Cap	100nF				
R9	SMT Res	1K	102			
R10	SMT Res	4.7K	472	Fit on two pin jumper to disable AGC when unplugged		
R41	SMT Res	51K	513			
R60	SMT Res	10K	103			
D15	SMT 1N4148	none		make sure of polarity		
D16	SMT 1N4148	none		make sure of polarity		
D17	SMT 1N4148	none		make sure of polarity		
TP3	TURNED PIN SKT			Fit at junction of C50 and R60		
Q4	Semi	491	CMMT491	NPN Trans.		

8. Fluid part

Component ID	Type	ID mark	Comments	Fitted	Checked
TC1	Cup	Various			
CF1	Coffee	To taste	Optional		
TB1	Tea bag	To suit	Optional		
SG1	Sugar	To taste	Optional		
BW	Boiling water		Add quantity as required		
MC	Milk or cream		Choose		

Choose combination of components stir and make a drink while you admire your work to date, you have deserved it

9. IF Filter

The next stage is to build the IF filter and this also includes sorting the crystal to match them, I use a slightly simplified version of sorting as it appears adequate for the purpose although there is some "ripple" in the pass band. The crystals supplied are not the best quality and the purists amongst you may want to buy higher quality professionally matched ones, me I hate to spend money.

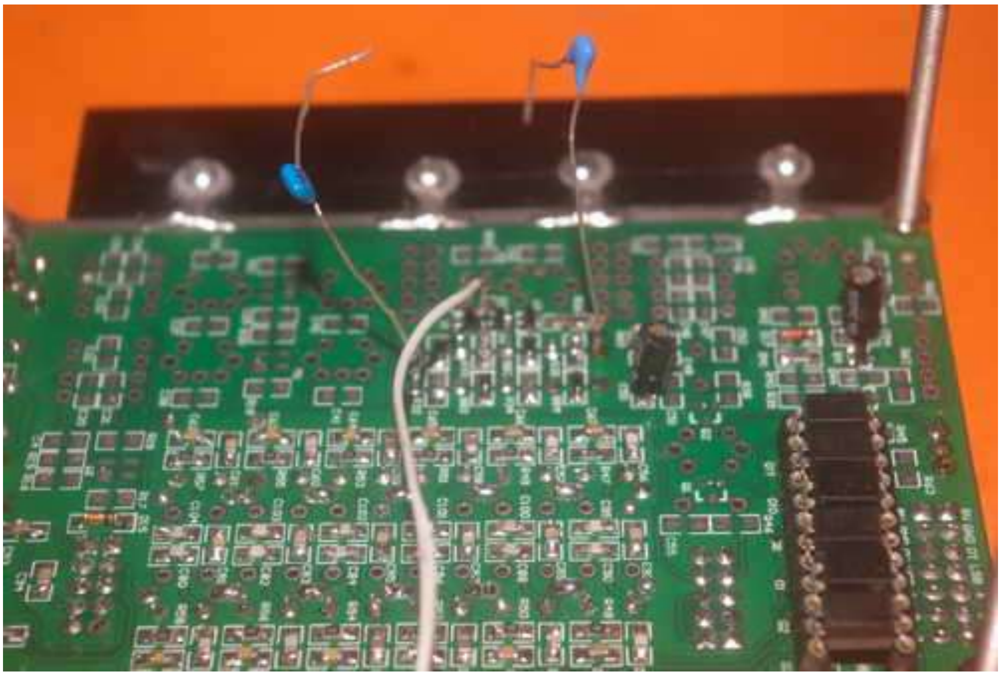
My method is I sort on resonant frequency and capacitance two of the three major parameters to sort on. Care must be taken when soldering the crystals they must be proud of the PCB to make sure that the pins are NOT shorted to the can I placed some small (Approx. 1.5mm ceramic beads on the wires).

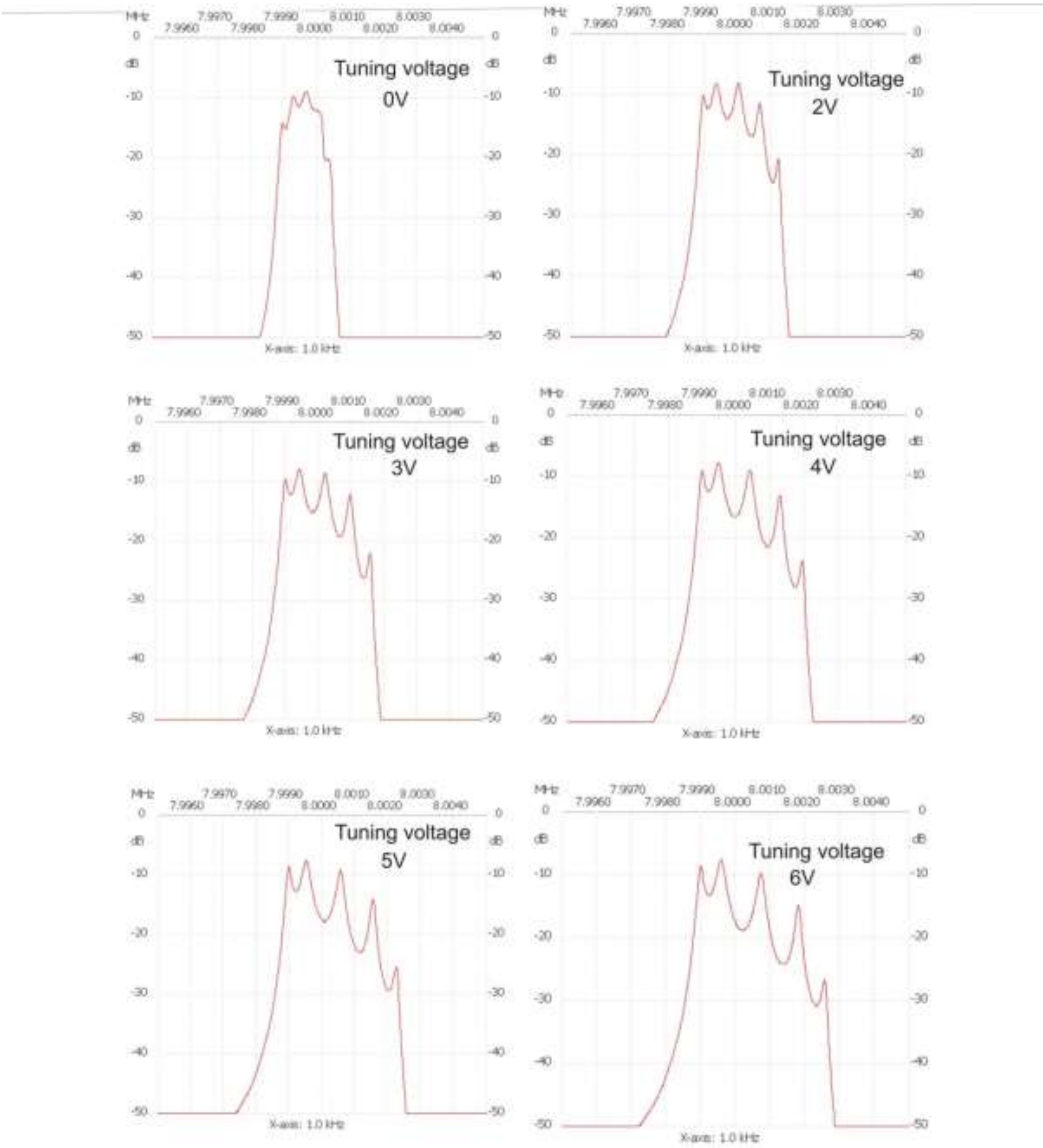
Installation into the filter is easy the outer two (JT1 &JT5) are the best matched pair the next or middle pair (JT2 and JT4) are the next well matched ones the final middle one (JT3) is the best matched of the remaining ones. The frequency is the important parameter.

Please note the filter envelope **will not be symmetrical about 8MHz** but **will be reasonably centred** on it.

Crystal number	Resonant Frequency MHz	Capacitance pF	matched with crystal number	used as crystal JT XX	Fitted	Checked
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						

Component ID	Type	ID mark		Comments	Fitted	Checked
3 pin skt	Connector	CON 3		check polarity and fit in G, BW, W position		
R32	SMT Res	100K	104 (or 1003)			
R34	SMT Res	100K	104 (or 1003)			
R33	SMT Res	100K	104 (or 1003)			
R34	SMT Res	100K	104 (or 1003)			
R35	SMT Res	100K	104 (or 1003)			
TP 7	TURNED PIN SKT	TP11		Solder to BW position on R33		
R8	SMT Res	1K	102			
BB1	Varicap Diode	BB148	P8	SMT		
BB2	Varicap Diode	BB148	P8	SMT		
BB3	Varicap Diode	BB148	P8	SMT		
BB4	Varicap Diode	BB148	P8	SMT		
C20	SMT Cap	1uF	105			
TP 8	TURNED PIN SKT	TP 9		relay side of JT1		
TP 9	TURNED PIN SKT	TP 10		relay side of JT5		
JT1	Crystal	8.000MHz		Space off PCB		
JT2	Crystal	8.000MHz		Space off PCB		
JT3	Crystal	8.000MHz		Space off PCB		
JT4	Crystal	8.000MHz		Space off PCB		
JT5	Crystal	8.000MHz		Space off PCB		





The photograph above shows the board with the filter fitted and the test points connected TP7 is connected to a multi-meter. TP8 is connected to the tracking signal generator of my spectrum analyser and the analyser is connected to TP9 both of them through 100nF dc isolating capacitors

The graphs may seem a bit confusing at first but they show the voltage loss across the bandwidth pot NOT the actual tuning voltage, the tuning voltage applied to the varicaps is approximately 7.5 –the voltage shown, e.g. the tuning voltage applied to the varicaps is 7-0V giving the tightest filtering (i.e. CW)

10. M1 Amplifier and first mixer

Component ID	Type	ID mark		Comments	Fitted	Checked
Holder1	8 pin DIL holder for IC 1					
TP10	TURNED PIN SKT			Amplifier M1 input		
TP11	TURNED PIN SKT			Amplifier M1output		
TP12	TURNED PIN SKT			IC 1 mixer output / IF in		
TP13	TURNED PIN SKT			DDS input to IC 1		
R17	SMT Res	100K		104 (or 1003)		
R18	SMT Res	100K		104 (or 1003)		
R1	SMT Res	200	201			
R15	SMT Res	100	101			
R16	SMT Res	100	101			
C5	SMT Cap	100nF	104			
C6	SMT Cap	100nF	104			
C7	SMT Cap	100nF	104			
C8	SMT Cap	100nF	104			
C9	SMT Cap	100nF	104			
C30	SMT Cap	100nF	101			
C4	SMT Cap	100pF	101			
C32	SMT Cap	100pF	101			
C10	SMT Cap	100pF	101			
C31	SMT Cap	1uF	105			
M1	SMD Mosfet Transistor	BF998R	MOW	Static sensitive device take care		

Fit all components without M1 and IC1 these will be fitted later. Solder test pins to the back of the IC socket.

Plug unit in and do a quick voltage check

TP3 should be whatever the AGC voltage is (around 7V) (G2 pad should be the same)

G1 pad should be 100K ohm to ground

S should be 200 ohm to ground

D should be ~7.5 V

Disconnect supply

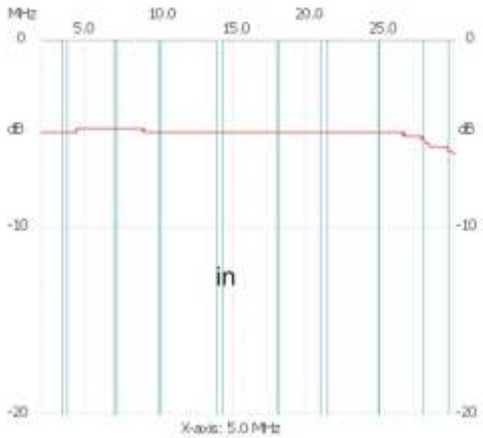
If these voltages are ok solder M1 NOTE this is a static sensitive Device take care. One way that reduces risk I have heard of is get your iron to temperature unplug it and solder the joint after touching something "earthed to discharge yourself".

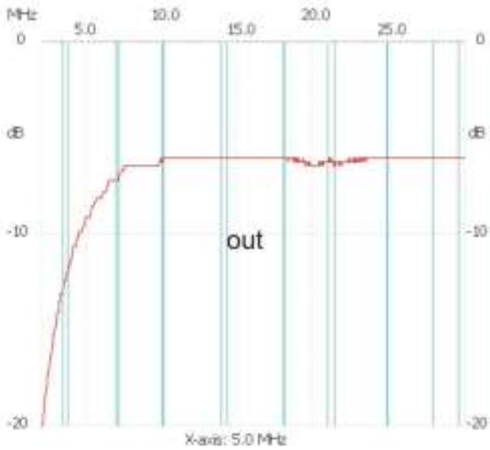
NOTE THE PAD PATTERN IS MISLEADING IF USING THE BF998 (BF998R is ok NO NEED TO REVERSE) YOU NEED TO LIE THE TRANSISTOR ON ITS BACK FOR THE PIN LAYOUT TO BE CORRECT CHECK THE PIN OUTS OF THE DUAL GATE FET SUPPLIED IN YOUR KIT SEE THE PICTURE unfortunately I lifted two pads re-working the transistor ces't la vie !

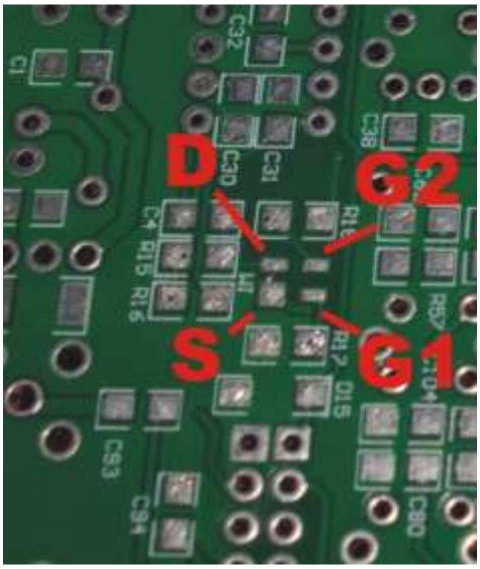
The people who are supplying the kits supplied the BF998 not the BF998R in other words the pin out is reversed ! You have to use it dead bug fashion so check your dual gate fet pin outs before welding. This is in the M1 position I have not got round to the IF's yet but it wouldn't surprise me.

Plug unit in and check amplifier for gain using test points provided. Mine was near enough unity which is what is to be expected from a buffer amplifier.


R17
R16
R15
R18
C4
C31
C30
W1


MHz
5.0
10.0
15.0
20.0
25.0
0
dB
-10
-20
in
X-axis: 5.0 MHz


MHz
5.0
10.0
15.0
20.0
25.0
0
dB
-10
-20
out
X-axis: 5.0 MHz



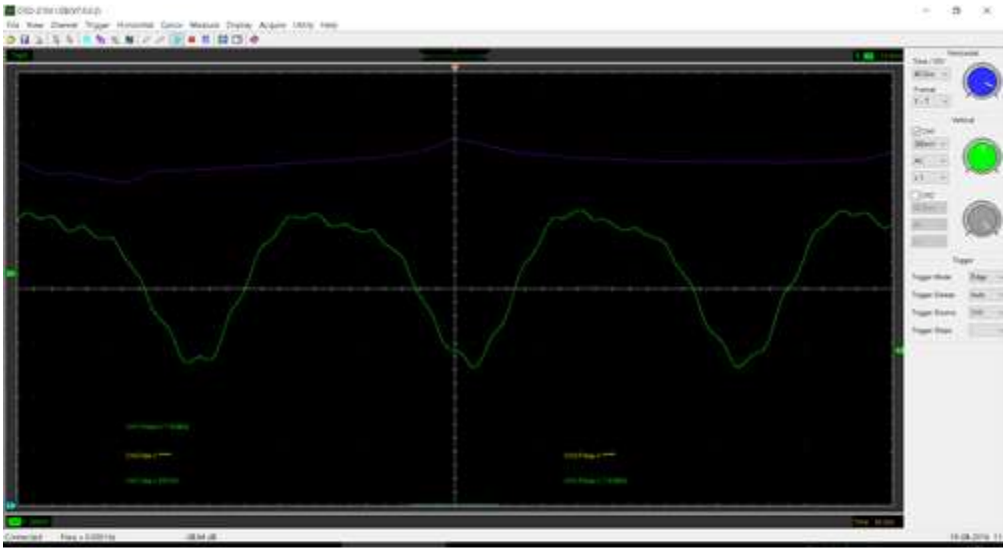
The next step is a difficult one testing the mixer IC1. Just plug it into its socket connect the VFO DDS SMA and the ribbon cable.

Switch on and set the vfo offset to -8MHz (See the VFO instructions) then receive frequency to 0 and Mode to AM you should get the following signals

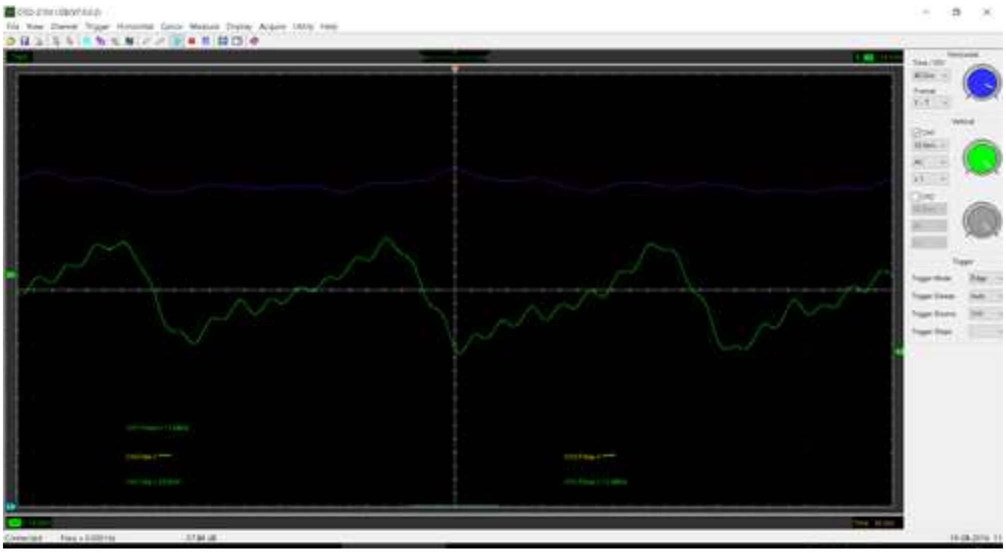
				Checked
TP	11	Amplifier M1output	0MHz	
TP	12	IC 1 mixer output / IF in	8MHz	
TP	13	DDS input to IC 1	8MHz	

If you do all is ok, collect $200 and pass go if not check the circuit components around IC1

DDS input to mixer



IF input from mixer



Don't worry too much about the waveforms at this stage a large amount of the "distortion" is due to the fact that the mixer is not actually mixing two proper signals the output from M1 is going to be from the "airborne" and "PSU" 50Hz mains. The main thing is they are both 8MHz showing the mixer is working.

11. First IF Amplifier

Component ID	Type	ID mark		Comments	Fitted	Checked
C11	SMD Cap	100pF	A2			
C12	SMD Cap	100nF	104			
C13	SMD Cap	100nF	104			
C16	SMD Cap	100nF	104			
C38	SMD Cap	100pF	A2			
C41	SMD Cap	100pF	A2			
R19	SMD Res	100K	104 (1003)			
R30	SMD Res	100K	104 (1003)			
R3.	SMD Res	200	201	marked R4 on pcb R3 on schematic		
TP14	TURNED PIN SKT	IF1 alignment				
TP15	TURNED PIN SKT	IF1 alignment				
M2	SMD Mosfet Transistor	BF998R	MOW	Static sensitive device take care		

Solder all components (Note that R3 on the schematic is marked as R4 on the PCB) with the exception of M2 and the IF transformers

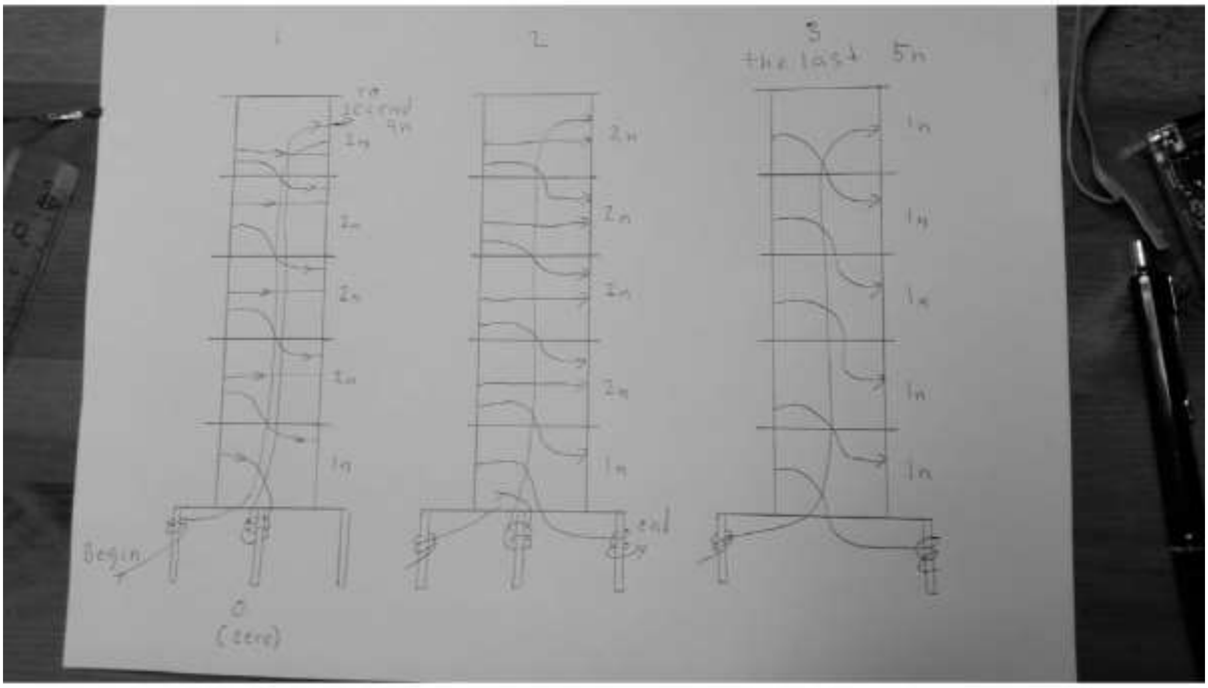
Wind the IF coils as in the diagram below.

Primary is 9 + 9 turns and the secondary is 5 turns.

As before take care when fitting the shield it is a tight fit and they are fragile.

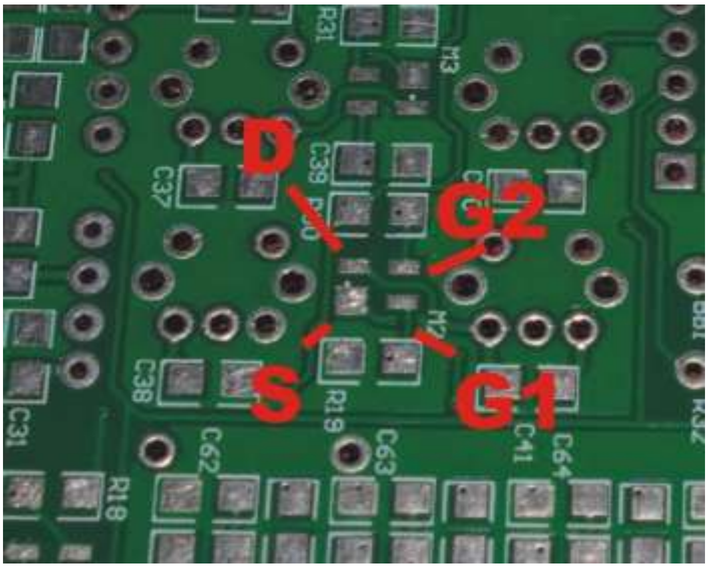
Component ID	Type	Primary turns	Sec turns	Primary inductance uH	Wound and checked	Fitted
L18	IF1 input transformer	9-0-9	5	~3.9uH		
L13	IF1 output transformer	9-0-9	5	~3.9uH		

(Latest version by Hamradioal Copland “How to wind MF trafo”)

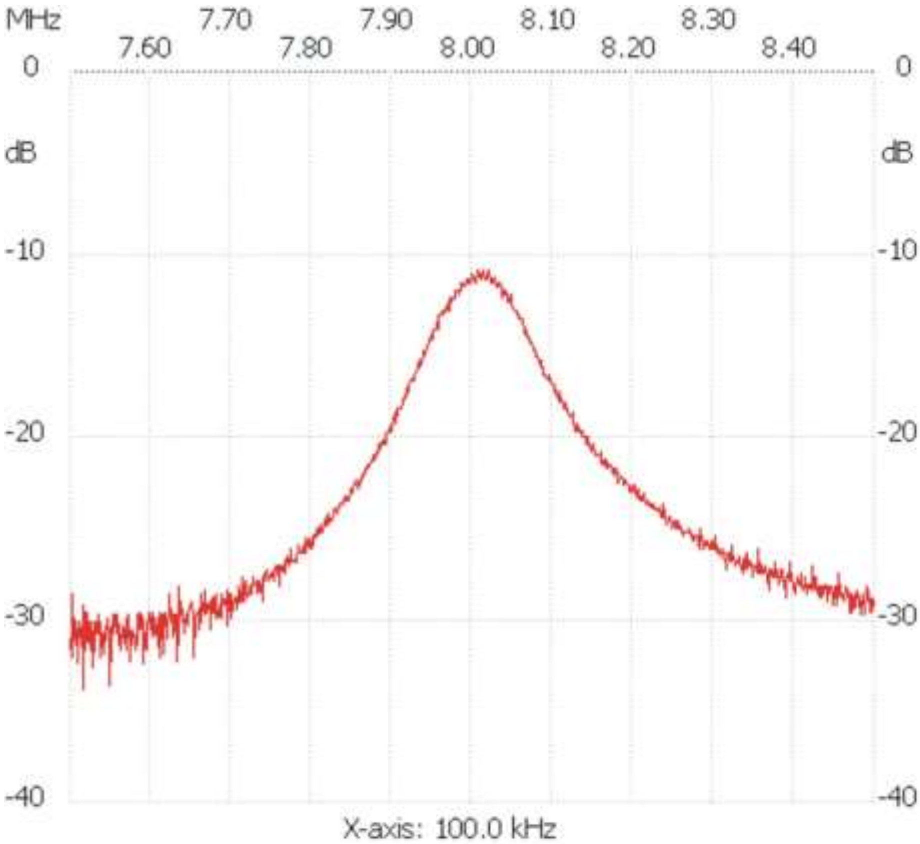


G2 pad should be around 7V, G1 pad should be 100K ohm to ground

S should be 200 ohm to ground, D should be ~7.5 V



Yet another where the FET has to be used dead bug fashion



Remove IC1 (Unplug it)

Inject a low level signal into TP11 and monitor the output on TP15 and tune the transformers for maximum gain at 8MHz.

This is the first If amplifier up and running and giving a gain of around 20 dB (not unreasonable for one stage) at the IF frequency, a little lower than I had hoped but it works and is reasonably tight.

Note I had a 30dB attenuator on my analyser out put the actual trace is ok and the injection level is around -34 dB

Points to note,

Because of where my coils inductance ended up (slightly low ~3.3 uH (compared to ~3.9uH in the BOM) I had to increase the values of C38 and C41 to 150 pF (You will probably be lucky and have spares in your kit, if not solder some of the other spare values you have in pll to C38 and C41) to get the correct resonant frequency of the amplifier.

This is yet another stage where I had to use the FET dead bug fashion.

12. Time for another section 8

Component ID	Type	ID mark	Comments	Fitted	Checked
TC1	Cup	Various			
CF1	Coffee	To taste	Optional		
TB1	Tea bag	To suit	Optional		
SG1	Sugar	To taste	Optional		
BW	Boiling water		Add quantity as required		
MC	Milk or cream		Choose		

Choose combination of components stir and make a drink while you admire your work to date, you have deserved it

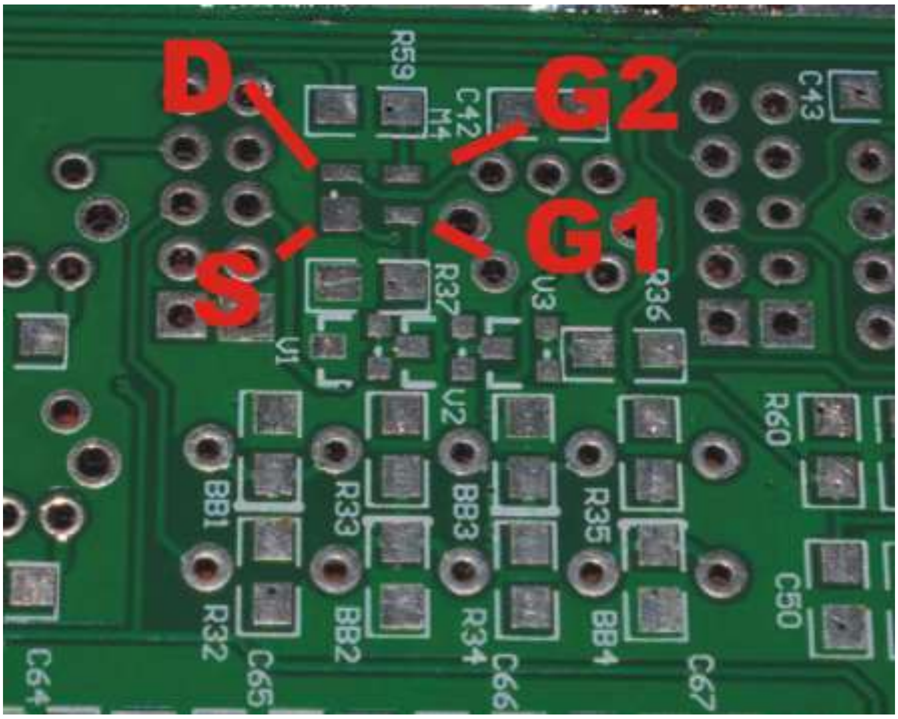
13. Second IF Amplifier

Component ID	Type	ID mark		Comments	Fitted	Checked
C19	SMT CAP	100P				
C17		100nF				
C18		100nF				
C42		100pF				
R59		100k	104			
R37		100k	104			
R5		200	201			
M4	SMD Mosfet Transistor	BF998R	MOW	Static sensitive device take care		
TP16	TURNED PIN SKT			L15 (IF3) input		
TP17	TURNED PIN SKT			L15 (IF3) alignment		

G2 pad should be around 7V, G1 pad should be 100K ohm to ground

S should be 200 ohm to ground, D should be ~7.5 V

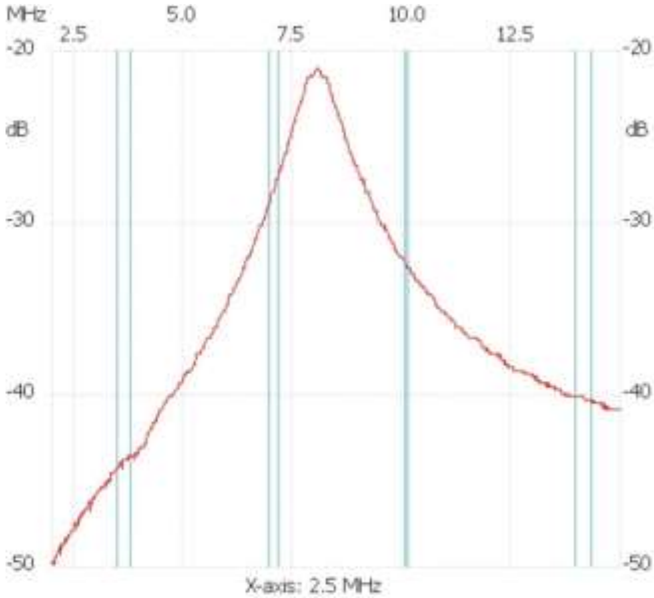
Component ID	Type	Primary turns	Sec turns	Primary inductance uH		Wound and checked	Fitted
L15	IF2 output transformer	9-0-9	5	~3.9uH	Wind as L18		



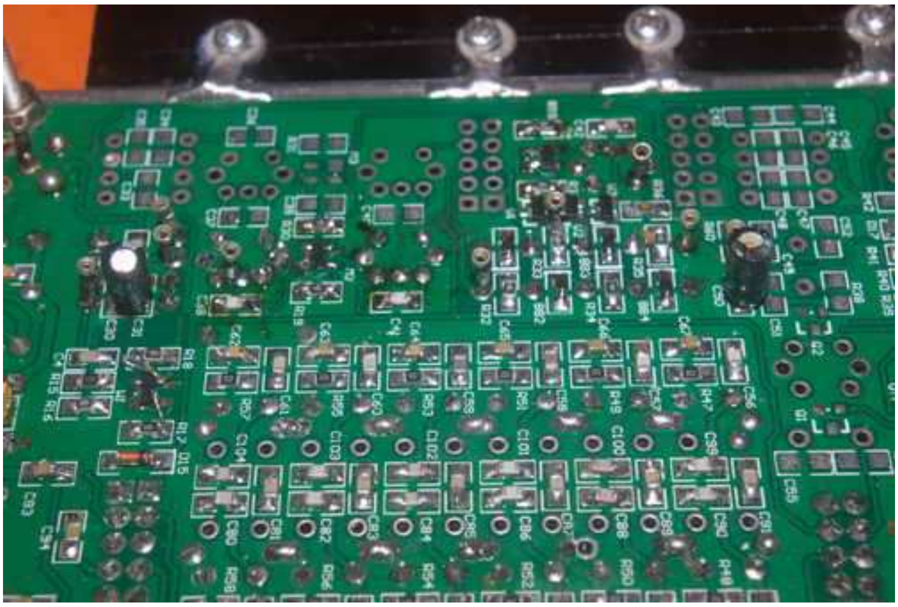
Inject a low level signal into TP16 and monitor the output on TP17 and tune the transformer for maximum gain at 8MHz.

This is the second IF amplifier up and running and giving a gain of around 40 to 50 dB Note I had a 40dB attenuator on my analyser output

This is yet another stage where I had to use the FET dead bug fashion.


MHz
2.5
5.0
7.5
10.0
12.5
-20
dB
-30
-40
-50
X-axis: 2.5 MHz


IF3
IF2
IF1
F1
F2
F3
F4
F5
F6
80M
40M
30M
20M
15M
10M



Another section bites the dust and is working ok

14. BFO

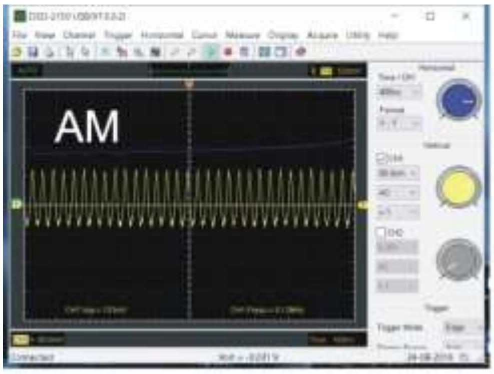
Component ID	Type	ID mark		Comments	Fitted	Checked
C21	SMD Capacitor	1uF	105	Fit first while room		
R6	SMD Resistor	1K	102	Fit first while room		
R7	SMD Resistor	1K	102	Fit first while room		
R38	SMT res	1K	102			
R46	SMT res	1K	102			
C51	SMT cap	10nF				
C55	SMT cap	10nF				
CA1	min trimmer	5-20pF				
JT5	Crystal	8.000MHz		Space off PCB for best performance this should be matched to the filter crystals		
L16	L16 (15 turns)	~1.9uH	BFO 8MHz – LSB (0.125mm wire)	Wind as filters 5+5+5		
C47	SMT cap	1uF				
C48	SMT cap	100nF				
C52	SMT cap	100pF				
C49	SMT cap	100pF				
C45	SMT cap	100nF				
C46	SMT cap	100nF				
R6	SMT res	1K	102	AF LP filter		
C13	SMT cap	10nF	(marked as C43 on PCB)	AF LP filter		
C14	SMT cap	10nF	(marked as C44 on PCB)	AF LP filter		
TP18	TURNED PIN SKT			BFO Oscillator		
TP19	TURNED PIN SKT			BFO output		
TP20	TURNED PIN SKT			BFO Input		
TP21	TURNED			AF to Volume		

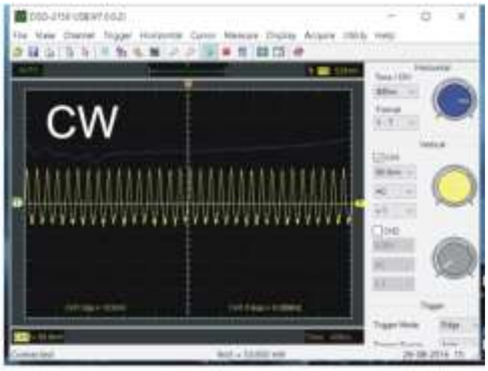
	PIN SKT			pot		
Q1	CMMT491	491	SMD NPN Transistor			
Q2	CMMT491	491	SMD NPN Transistor			
IC3	NE612					
	8 pin DIL	holder	For IC3			
TN2-5V	Relay	JK2				
TN2-5V	Relay	JK3				

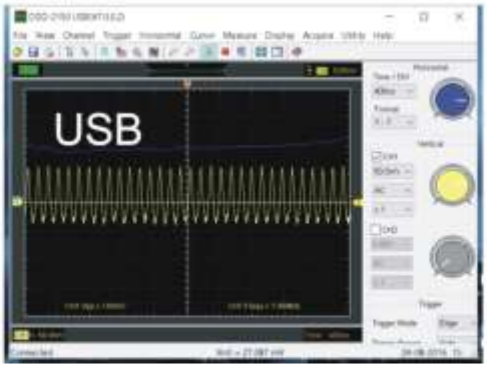
The main components being fitted here are for the BFO and audio LPF from the demod although some “extras” are fitted whilst there is still room to get a soldering iron in.

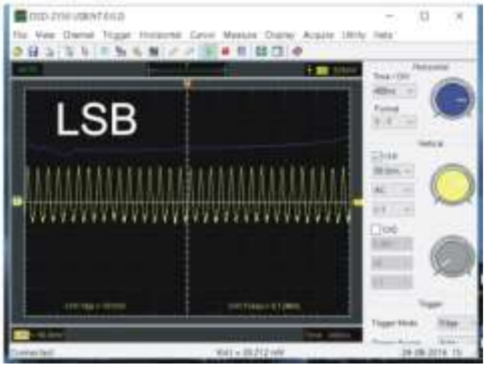
Solder all the components except the semiconductors.
Plug in PSU and check voltages, if ok unplug the psu and solder the semiconductors.

Alignment of this stage is not possible at this stage apart for the obvious i.e. no magic smoke. Its function can be tested however by monitoring TP21 and sinusoidal signals will be present in all modes









I had problems with the oscillator at this point all I can say is it was one of two things either a sub-standard socket or my scope was somehow loading the oscillator part of the circuit (TP18) and I could only get it to ossel on three of the four modes. To solve this I replaced the socket and I also shifted TP18 from pin 6 to pin 7 to minimise loading. Problem solved.

15. AF Amplifier

There are only two areas of the board unpopulated now the corner with the AF amplifier and the area with the remaining TX components. However all the remaining components in the AF corner are fitted as the amplifier requires the use of the two remaining connectors and it is easier to fit them before the connectors are fitted

I should also be noted that C22 is actually 10uF NOT 2.2uF as in some documents

Build Instructions for the Indo-ware SSB 6.1

Transceiver main board Final Version

Component ID	Type	ID mark		Comments	Fitted	Checked
C22	SMD Capacitor	10uF	106			
C23	SMD Capacitor	100nF	104			
C24	SMD Capacitor	1uF	105			
C25	SMD Capacitor	100nF	104			
C26	SMD Capacitor	1uF	105			
C27	SMD Capacitor	10uF	106			
C28	SMD Capacitor	100nF	104			
C53	SMD Capacitor	1uF	105			
EC2	Elect. Capacitor	220uF				
EC3	Elect. Capacitor	220uF				
Q	SMD PNP Transistor	SS8550	1HD			
Q3	SMD NPN Transistor	CMMT491	491			
Q5	SMD NPN Transistor	CMMT491	491			
R11	SMD Resistor	10K	103			
R12	SMD Resistor	1.5R	1R5			
R14	SMD Resistor	10K	103	Incorrectly labelled 51K on schematic		
R36	SMD Resistor	390R	391			
R40	SMD Resistor	100K	104 (1003)			
R42	SMD Resistor	100R	101			
R43	SMD Resistor	1.5R	1R5			
R44	SMD Resistor	4.7K	472			
R45	SMD Resistor	10K	103			
R61	SMD Resistor	10K	103			
R62	SMD Resistor	1K	102			
R63	SMD Resistor	100R	101			
V4	SMD IC	LM431	431			
TDA2003	IC	TDA2003				

The sections that can now be tested are:

a. The AF amplifier touching the wiper pin of the volume control should produce a loud hum from the speaker

b. The ssb ptt should switch the relays
c. The cw ptt should switch the relays with a time delay for returning to receive.
d. The AGC voltage TP3 should be ~7V dropping to ~2.5V or lower when the wiper of the AF amplifier is touched (make sure R10 is plugged in).
e. The microphone audio TP22 in TX mode.

Believe it or not if you have successfully reached this stage you have a working receiver mine heard signals from my sig gen and although I may be kidding myself very weak signals on 40m and 20m. Don't expect miracles at this stage further alignment is needed for it to work fully.

Connect the VFO to the main board VFO in and ribbon cable and/or external pots depending on VFO used. As for the middle "function select connector (5 way) I made up a small interface board to control TX audio out etc. The only problem I had was at the max if filter width it started to ring just reduce the passband using the pot.

As far as connecting the VFO I can only comment on my build using the small one.

I will be going through an alignment setup after the TX side is complete. (Bear in mind it is basically done)

16 Treat time

At this stage you have deserved something stronger than tea or coffee, be my guest I am going to have a single malt whiskey! The good stuff!

17 Transmit components

Component ID	Type	ID mark	Comments	Fitted	Checked
R2	SMD Resistor	200R	201		
R3	SMD Resistor	100K	104 (1003)		
R31	SMD Resistor	100K	104 (1003)		

C14	SMD Capacitor	100nF	104			
C15	SMD Capacitor	100pF	A2			
C33	SMD Capacitor	100pF	A2			
C34	SMD Capacitor	100nF	104			
C35	SMD Capacitor	1uF	105			
C36	SMD Capacitor	100pF	A2			
C37	SMD Capacitor	100pF	A2			
C39	SMD Capacitor	100nF	104			
C40	SMD Capacitor	100pF	A2			
IC2	IC	NE612				
M3	BF998R	MOW	SMD Mosfet Transistor	BF998 may be supplied see write up it is a mirror image pin out you need to use it dead bug for pins to be right confirm what is supplied by testing it		
DIP 8	IC Socket					
TP23	TURNED PIN SKT		M3 gate 2 in			
TP24	TURNED PIN SKT		M3 gate 2 in			
TP25	TURNED PIN SKT		L17 out to IC2			
TP26	TURNED PIN SKT		IC2 TX out to filters			

Component ID	Type	Primary turns	Sec turns	Primary inductance uH	Wound and checked	Fitted
L14	IF transformer	9-0-9	5	~3.9uH		
L17	IF transformer	9-0-9	5	~3.9uH		

As before fit all the components with the exception of the semis

G2 pad voltage should vary depending on the gain setting

G1 pad should be 100K ohm to ground

S should be 200 ohm to ground,

D should be ~7.5 V on TX 0V on RX

Although the spec calls for a 9-0-9 turn primary after winding the previous coils I wound mine as 10-0-10 turns, this gave me he correct inductance values.

If the voltages are correct solder M3 to the board as appropriate, and install IC2

Re-connect the mini DDS and DDS feeds to the board and connect a test instrument (Scope or analyser) to the TX test point (TP5)

Connect the control pots and turn gain to max

Attach a microphone

Plug in and switch on power

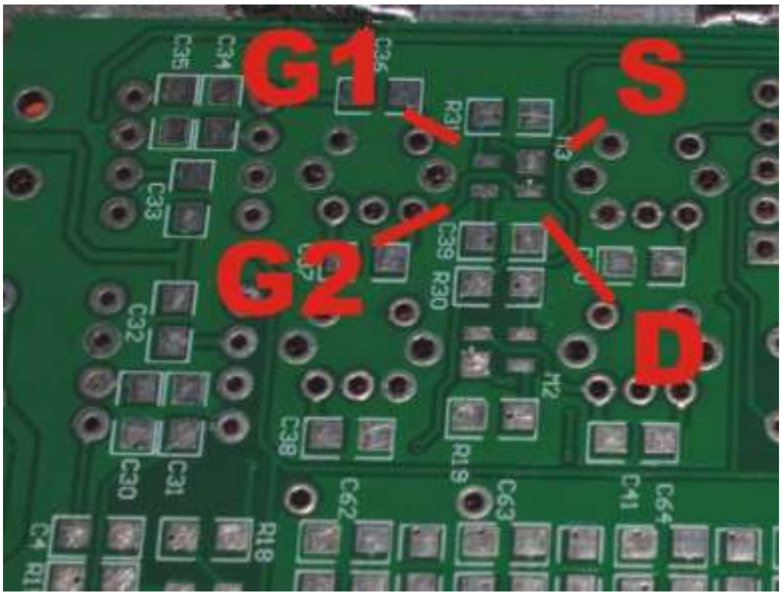
1. change mode to AM press PTT and check for output (NB you need an audio input)
2. change mode to USB press PTT and check for output (NB you need an audio input)
3. change mode to LSB press PTT and check for output (NB you need an audio input)
4. change mode to CW press CW PTT and check for output

For audio input whistle into the mic on TX.

If these work you now have a working RTX board don't worry about slight errors in frequency or lack of sensitivity at this stage these will be sorted in the final alignment section

NB mine tended to oscillate at the widest IF filter setting, don't worry this is in part due to slight misalignments.

This is yet another stage where I had to use the FET dead bug fashion.


G1
S
G2
D

18 Final alignment

This is the home straight and involves the final touches to the alignment and setup of the board. Sections already setup will be left alone where possible and only if needed will be "Tweaked". I intend to follow my previous setup method where I will take a modular approach. **These instructions detail changes I had to make to my set and you will have to adapt them to suit yours**

A18.1 input filters

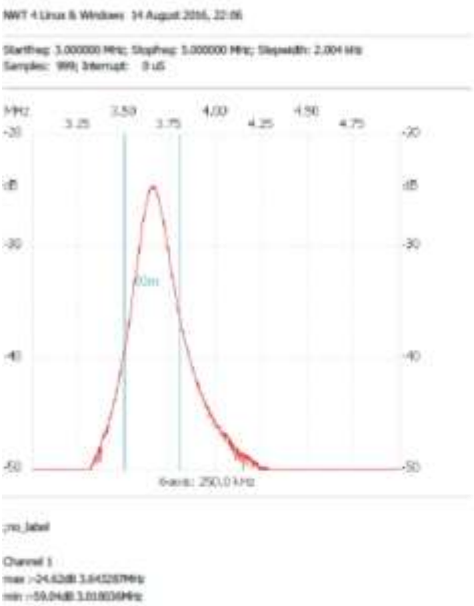
These will require come component value changes and I will show before and after plots to show improvements.

80m Filter as an example

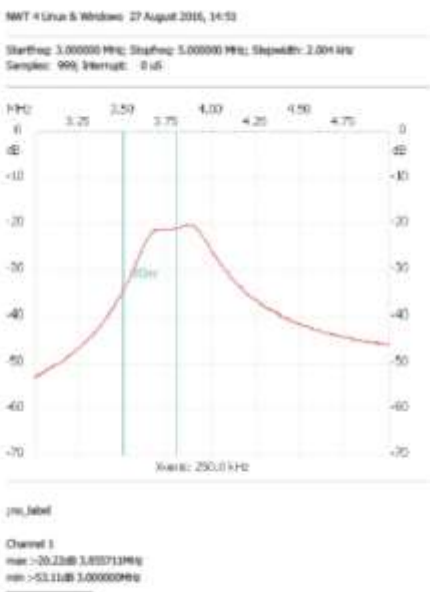
The filter is too tight and is attenuating the signal too much :-

The cure is to slightly increase the coupling this hopefully should cure both.

Set up as the initial alignment of the front end. Solder a small value variable capacitor in parallel to C91 and play with the coil and cap settings to get the best response, when this is obtained remove the variable and replace it with a fixed value cap of the same value (extra C in pll was ~10pF) Retune the filter. Deliberately over coupling the filter decreases its attenuation whilst increasing its bandwidth see below.



Origional



Deliberately over coupled

Optimisation of the filters is realistically your own choice in which ones to do, my only other problem one is the 30m one and at least part of the problem is it has too high a Q value and may need the coils rewinding to better optimise the characteristics in my case by deliberately using a different winding method to obtain a lower coil Q (finer wire and all the windings in one slot. A lot of playing is needed and there is not enough time to do it,

In reality it may be necessary to "re-design" any problem sections and that is beyond the scope of this document. (Use a package like AADE Filter design)

The remaining modifications really need the use of a transceiver covering the same bands as well as other test equipment including connection of some of the extras the DDS a microphone, speaker etc.

A18.2 The power output

Completely attach all the extras mike, DDS etc to the main board

A scope to the TX output test point TP 26

Set up the DDS as per, Appendix 5 Setting up the DDS VFO by Lawrence Galea

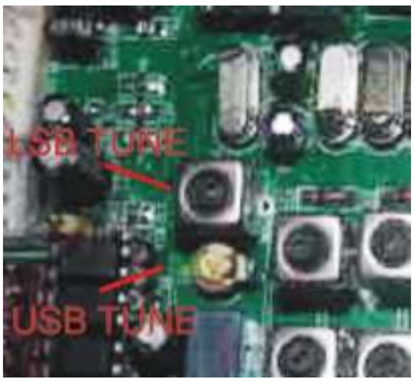
Change the mode to CW on the DDS

Tune L14 an L17 for maximum signal output while pressing the CW PTT

Done

A18.3 Frequency

Bring the set onto the correct frequency (or as near as you can get) using the adjusters shown in the attached picture



Unfortunately the nearest I could get was -1KHz of the indicated frequency on the DDS display and the reason being the DDS was actually 1.5 KHZ low. The only solution I can see at this stage is to remove the “on-board” DDS reference and use a more accurate off board reference oscillator, but that is a job for another day!

This completes the build and I hope you find it helpful in your build, one working project !!!!

73 de Nick G0CWA until the next project

Appendix 1 Test points

TP	1	band pass filter in	
TP	2	band pass filter out	
TP	3	AGC voltage	
TP	4	RX in	
TP	5	TX out	
TP	6	DDS in	
TP	7	IF bandwidth control voltage	
TP	8	IF filter in	
TP	9	IF filter out	
TP	10	Amplifier M1 input	
TP	11	Amplifier M1output	
TP	12	IC 1 mixer output / IF in	*8MHz
TP	13	DDS input to IC 1	
TP	14	L18 (IF1) Alignment	
TP	15	L13 (IF2) alignment	
TP	16	L15 (IF3) input	
TP	17	L15 (IF3) output	
TP	18	BFO Oscillator	
TP	19	BFO output	
TP	20	BFO Input	
TP	21	AF to Volume pot	
TP	22	Microphone output	
TP	23	M3 gate 2 in	
TP	24	M3 gate 2 in	
TP	25	L17 out to IC2	
TP	26	IC2 TX out to filters	

Appendix 2 Other people's input

A2.1 Lawrence Galea

Nick, good idea that you used sockets for the opto couplers in case they need to be changed. What I did was to cut off their pins to the shoulder where they are thicker giving a wider area to solder to the pcb. However your use of sockets is a better idea.
One thing to watch out is the routing of the wires from the dds as the cause hash if you route them together with the others from the variable controls (don't ask how I know).
There are also some birdies from the DDS. The DDS I have is the small one because it was a combined offer.
I had a little spare time today so I checked the Indoware xcver. A little while ago I had built the power supply which is an overkill as far as the stability is concerned and I only intend to use a 20 watt pa with this rig.
My set is working on all bands and although there were no signals that I could receive on 10 although I did receive some weak CW on 15M and CW/SSB on the other bands.
I do have a couple of old signal generators, but what I did to align it was to key my TS520S which is presently connected to the 70MHz xvrter and therefore no PA G2 voltage and aligned the front end filter with the stray signal on the different bands using just enough carrier setting on the TS520S to have an audible signal on the Indoware xcvr.
The I switched the Indoware xcvr to cw and keyed it and peaked the two coils on the TX side for maximum meter deflection on the TS520S meter.
I still have to check and try to better align the carrier frequencies, but it is working, at least on CW. As soon as I find some time I will try it on SSB.
I will write the initial settings that have to be done to the DDS because as you can understand their instructions are in Chinglish.
As soon as I do write them I will send them to you to incorporate them in your write up.

A2.2 Tom Clifton

Avoid the solders with a washable water based flux - too corrosive. Stick with the solders with an activated rosin flux.

A2.3 ME G0CWA

Just a quick thought for anyone building the set why not use the DDS VFO as a signal gen to align the filters and if's etc.

Don't do like I did I misplaced my strip of 1uF caps but fortunately I had some miniature 50V (Standard ones) so I used them), it made a pleasant change to use components you could hold in your hand. I can understand losing the odd one but a whole strip!

A2.4 Charles Jr Husak

I built my SSB6.1 back in February but had some bad oscillations in my audio. I put it in a box and started back on it in July. I found my oscillation problem was coming from my DDS. I discovered you cannot connect the DDS ground to the speaker.

I moved the GRD to a different location and it worked fine.

I also discovered by rewinding the IF Transformers I was able to tune it better. I wound 5 turns on the two bottom slots for the Primary and 18 turns with center tap on the top slots. I was able to tune it very well.

The crystals they sent me did not match very well, I ordered some 8 MHz crystals and found six that match well. If you do not get a good match on the crystals it is almost impossible to suppress the sidebands for USB and LSB.

I have mine working. In the process of adding a PA and Low Pass filters. I had a few problems but was able to solve them. Important things to do are, when winding transformers, wind primary two slots on bottom and the secondary on top, this work the best for me. Also verify you have the closest matching crystals for the filters. When selecting an Amp get one that requires very low input to drive it. If you have any issues just ask me, I experienced several problems but was able to solve them.

A2.5 Peter Johnson components are Smd pakage 0603 Resistors are 5% tolerance (based on the 3 digit codes)

Appendix 3 BOM ref by Hamradioal Copland (additions and corrections by G0CWA)

Value	SMD code	Description	Designator	QTY req'd	No. Supplied	no. extra needed
2pF	H0	SMD Capacitor	C81, C83, C85, C87, C89, C91	6		
5pF	T0	SMD Capacitor	C61, C78	2		
10pF	A1	SMD Capacitor	C60, C76	2		
18pF	G1	SMD Capacitor	C58, C59, C72, C74	4		
22pF	J1	SMD Capacitor	C57, C70, C80, C104	4		
27pF	L1	SMD Capacitor	C56, C68	2		
33pF	N1	SMD Capacitor	C82, C103	2		
47pF	S1	SMD Capacitor	C84, C102	2		
68pF	W1	SMD Capacitor	C86, C101	2		
100pF	A2	SMD Capacitor	C4, C11, C15, C19, C32, C33, C36, C37, C38, C40, C41, C42, C48, C52, C88, C100	16		
150pF	E2	SMD Capacitor	C90, C99	2		
10nF	103	SMD Capacitor	C43, C44, C51, C55	4		
100nF	104	SMD Capacitor	C1, C2, C5, C6, C7, C8, C9, C12, C13, C14, C16, C17, C18, C23, C25, C28, C30, C34, C39, C45, C46, C48, C62, C63, C64, C65, C66, C67, C69, C71, C73, C75, C77, C79, C92, C93, C94	40		
1uF	105	SMD Capacitor	C20, C21, C24, C26, C31, C35, C47, C50, C53, C54	10		
10uF	106	SMD Capacitor	C22, C27	2		
47uF	476	SMD Capacitor	C3, C29	2		
220uF		Elect. Capacitor	EC2, EC3	2		
470uF		Elect. Capacitor	EC1	1		
5-20pF		Trimmer Capacitor	CA1	1		
1.5R	1R5	SMD Resistor	R12, R43	2		
47R	470	SMD Resistor	?R42	1		
100R	101	SMD Resistor	?R42, R63	2		
200R	201	SMD Resistor	R1, R2, R4, R5, R13	5		
390R	391	SMD Resistor	R36	1		
1K	102	SMD Resistor	R6, R7, R8, R9, R38, R39, R46, R47, R48, R49, R50, R51, R52, R53, R54, R55, R56, R57, R58, R62	20		
4.7K	472	SMD Resistor	R10, R44	2		
10K	103	SMD Resistor	R11, R14, R45, R60, R61	5		
51K	513	SMD Resistor	R41	1		
100K	104 (1003)	SMD Resistor	R3, R19, R30, R31, R32, R33, R34, R35, R37, R40, R59	11		
100uH		SMCC Inductor	RL1, RL2	2		

TOKO		Variable Coil	L1, L2, L3, L4, L5, L6, L7, L8, L9, L10, L11, L12, L13, L14, L15, L16, L17, L18	18		
~1.1uH		BPF 28MHz (10m)	L1, L2 (10 turns)	2		
~1.3uH		BPF 21MHz (15m)	L3, L4 (12 turns)	2		
~1.9uH		BPF 14MHz (20m)	L5, L6 (15 turns)	2		
~2.9uH		BPF 10MHz (30m)	L7, L8 (19 turns)	2		
~4.1uH		BPF 7MHz (40m)	L9, L10 (21 turns)	2		
~10.7uH		BPF 3.5MHz (80m)	L11, L12 (31 turns)	2		
~3.9uH		IF 8MHz	L13, L14, L15, L17, L18 (9t+9t:5 turns)	5		
~1.9uH		BFO 8MHz - LSB	L16 (15 turns)	1		
8.000MHz		Crystal	JT1, JT2, JT3, JT4, JT5, JT6	6		
BB148	P8	SMD Varicap Diode	BB1, BB2, BB3, BB4	4		
1N4148	4148	SMD Diode	D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D15, D16, D17	15		
B340	SS34	SMD Diode	D13	1		
1N4007		Diode	D14	1		
CMMT491	491	SMD NPN Transistor	Q1, Q2, Q3, Q4, Q5	5		
SS8550	1HD	SMD PNP Transistor	PNP Q	1		
BF998R	MOW	SMD Mosfet Transistor	BF998 may be supplied see write up it is a mirror image pin out you need to use it dead bug for pins to be right confirm what is supplied by testing them	4		
LM431	431	SMD IC	V1, V2, V3, V4	4		
PC817		Optocoupler	G1, G2, G3, G4, G5, G6, G7, G8, G9, G10, G11	11		
NE612		IC	IC1, IC2, IC3	3		
DIP 8		IC Socket	IC1, IC2, IC3	3		
TDA2003		IC		1		
7808		IC		1		
TN2-5V		Relay	JK1, JK2, JK3, JK4	4		

Appendix 4 Component errors and hints

Please note there may be others these are the ones I am aware of.

PCB Label	Schematic Label	Cpt	Comments
R36	R63	SMT Res	Just confusion there are two R63's on PCB
IDC socket			Cut its' ends off before soldering to clear the mounting hole and the adjacent socket
G1 to G11	PC817	Optocoupler	Not SMT bend legs or use sockets
R10		SMT Res	Fit on two pin jumper to disable AGC (when unplugged) to make setting up easier
JT1 to JT5		8MHz crystal	Need to be well matched for set to work properly ones supplied normally poor quality and need to be spaced off board to prevent shorts between pin and case
M1 to M4	BF998R or MOW	SMD Mosfet Transistor	BF998 (not the correct one BF999R) is supplied (sometimes) these needed to be used dead bug to give correct pin, check fets supplied
R4	R3	SMT Res	Just confusion
C43	C13	SMT Res	Just confusion
C44	C14	SMT Res	Just confusion
C22	C22	SMT cap	Value is 10uF not 2.2 as in some documents
IC HOLDERS			Intermittent contact replace with good quality ones
R14		SMT Res	Labelled 51K on schematic should be 10K

I have included a corrected Schematic in the Zip file

Appendix 5 Setting up the DDS VFO by Lawrence Galea

Setting up the DDS

This writeup is for the small DDS version with 6 push switches on the front panel below the display.

Looking at the display from the front these push switches are numbered from left to right

O O O O O O

S1 S2 S3 S4 S5 S6

PRELIMINARY NOTES

These are initial adjustments and some may change later on as there are some birdies from the DDS.

I have not used a keypad.

You have to make changes within about 5 seconds or the unit will return to the last frequency that the set was used on or to the pre programmed one.

Route all cables from the DDS very carefully as they introduce hash if they are near other unscreened wires.

Preferably screen the DDS from the rest of the transceiver.

S1

Press and keep pressed S1 and switch on the power.

CSN 4.01 appears on the display

After a couple of seconds the display changes to

DDS REF MULT CLK

X1 REFCLK

Release S1.

If your DDS uses the AD9850 chip the display should be set to X1 with the rotary encoder.

If your DDS uses the AD9851 rotate the rotary encoder for the display to read X6

This is because the AD9850 board uses a 125MHz oscillator as the reference clock while the AD9851 uses a 30MHz ocsillator which can be and is multiplied internally by the DDS by 6 to get a 180MHz final DDS reference clock.

This means that the AD9851 should give a higher available frequency than the AD9850

Give a short press to S1 and if the DDS uses the AD9850 the display should read

SYSTEM CLK

125.000000 MHz

If the DDS uses the AD9850 and the multiplier has been set X6 the display will read

SYSTEM CLK

180.000000 MHz

Again give a short press to switch 1 and the display will show

OFFSET FREQ

and a frequency below it. You can set it to the IF + or – the required output frequency. In our case, since the crystal filter is on 8 MHz, this has to be set to – 8.000000MHz. The display will then show

OFFSET FREQ

- 8.000000 MHz

Give a short press to S1 and the display should read

MAX DDS FREQ

and a frequency below it. Using the rotary encoder you can set the maximum frequency that the DDS can generate. Mine goes up to 56.250000MHz. So in my case, if I set it to the maximum frequency, the display will read

MAX DDS FREQ

56.250000 MHz

Again give a short press to S1 and the display will show

MIN RX DDS FREQ

and a frequency below it

Using the rotary encoder you can set the minimum frequency that the DDS can generate.

Set it on a frequency that is higher than the IF which in this transceiver is nominally 8 MHz.

I set mine to 9MHz as an experiment and with frequency offset (RIT) to zero beat the carrier I can receive the local Medium Wave station on 999kHz.

If you set it lower to 8.5MHz you will be able to receive strong medium wave stations from 500 kHz up as they use high power and can still get through the 3.5MHz bandpass filter.

However, do not set it very near 8MHz as this will cause interference by leakage into the IF which is at 8MHz. I also tried setting it to 8.1MHz and if there are strong local stations you may be able to hear them as I have heard local aircraft NDB's.

Soif the minimum DDS frequency is set to 9 MHz, the display reads

MIN RX DDS FREQ

9.000000 MHz

Again give a short press to S1 and the display will show

SSB OFFSET

0.000000 MHz

Using the rotary encoder you can change the offset to correct for the filter slope where you had adjusted the carrier. If you cannot measure the carrier frequency you can adjust the offset to + or - 1.4 kHz (0.001400). You can adjust this later on. If you set it to + 1.4 kHz the display will then read

SSB OFFSET

0.001400 MHz

Again give a short press to S1 and the display will show

CW OFFSET.

0.000000

Adjust it to your preferred tone, say 700Hz or whatever you prefer. You can set it to either + or - If you set it to say + 700 Hz, the display will read

CW OFFSET

0.000700 MHz

Again give a short press to switch 1 and the display will show SAVING and your settings will be saved.

You can always adjust everything later on.

S2

Push S2 and hold it down. You will see a bar under one of the digits on the display. You can change the bar to put it under any of the digits by the rotary encoder and then release S2. If you put it under the first digit on the left hand side, turning the rotary encoder will change the display and the DDS frequency by tens of MHz for every click of the encoder, if you put it under the second digit you will change the display and DDS frequency by 1MHz for every click of the encoder, if under the next digit by 100kHz, etc. This provides you with a quick band change. For example, if you are on 3.5MHz and want to go on 28MHz, shift the second digit to 8, press and hold S2 to shift the bar under the first digit and switch it to 2 and you will be on 28MHz. This applies to all settings using the rotary encoder.

S3

Short presses on S3 cycles the set from AM to CW to LSB to USB. A long press will lock the encoder and the display will show LOCKED and the frequency you were tuned to will remain under it, but when you release S3 you will not be able to change it with the rotary encoder. However, you can still change the mode by short pressing S3. Another long press will show UNLOCKED on the display and you can again change the frequency by the rotary encoder. You can listen to AM stations by tuning the station to zero beat. Not hifi but good enough as both the DDS and broadcasting stations have very good stability.

S4

S4 s a fine tune button which allows you to tune in a station which is not exactly on your frequency without changing your main frequency. A short press activates this feature and allows you to set the required offset either + or – from your main frequency. This is also known as RIT or Receiver Incremental Tuning.

S5

Short presses of S5 changes from VFO A to VFO B and back again.

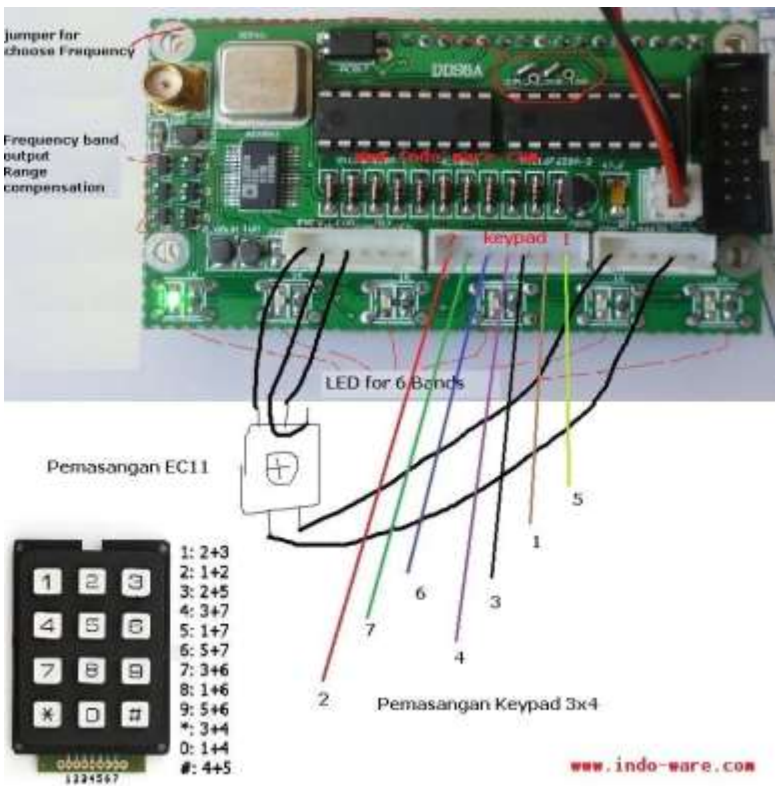
S6

S6 switches from VFOs to Memory. There are 19 memory Channels. All settings are saved in the memory, that is, frequency, mode etc, but I haven't yet had time to see how to enter a frequency in a memory.

I hope that at least this helps you to initially adjust the DDS settings to get your set going.

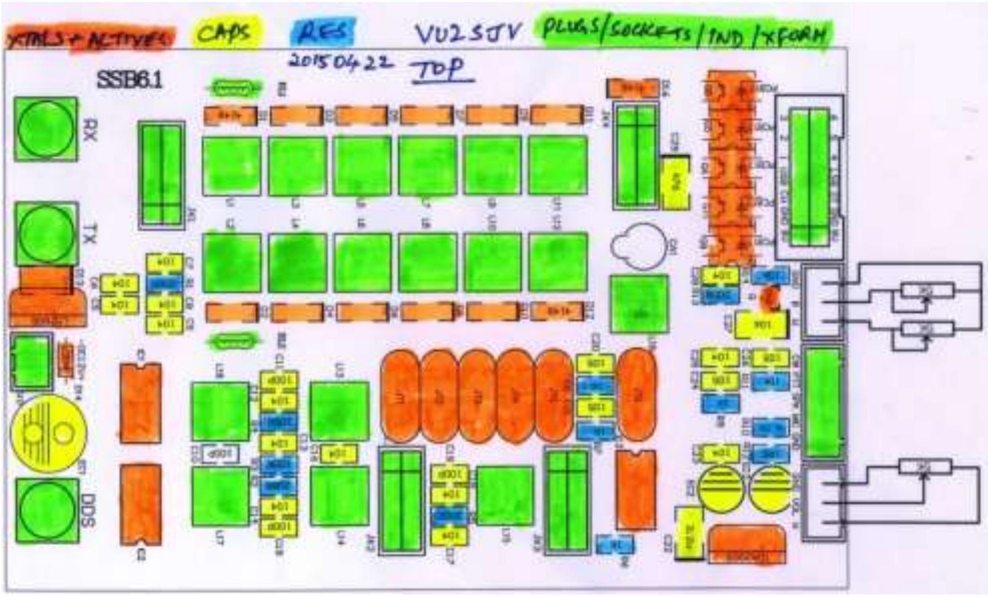
Lawrence 9H1AV

This fits in nicely with Lawrences instructions so I have included it here Nick

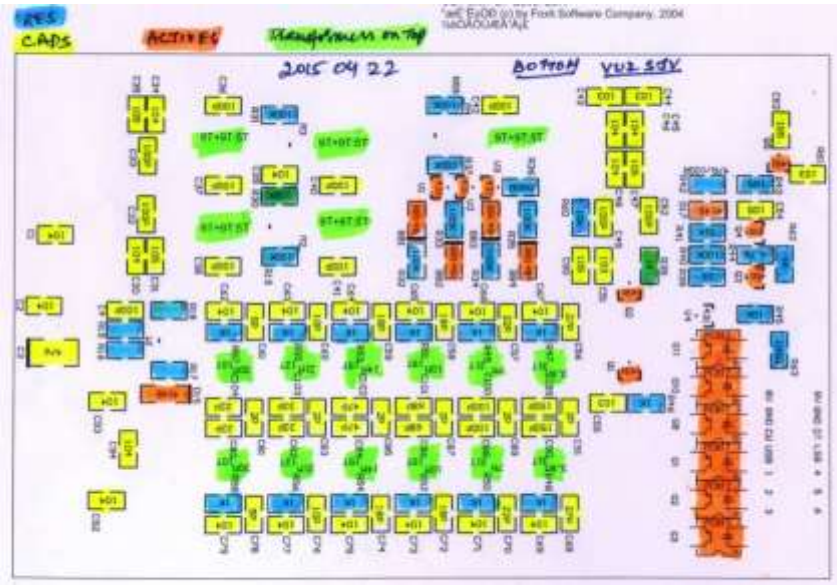


Appendix 6 Component overlays

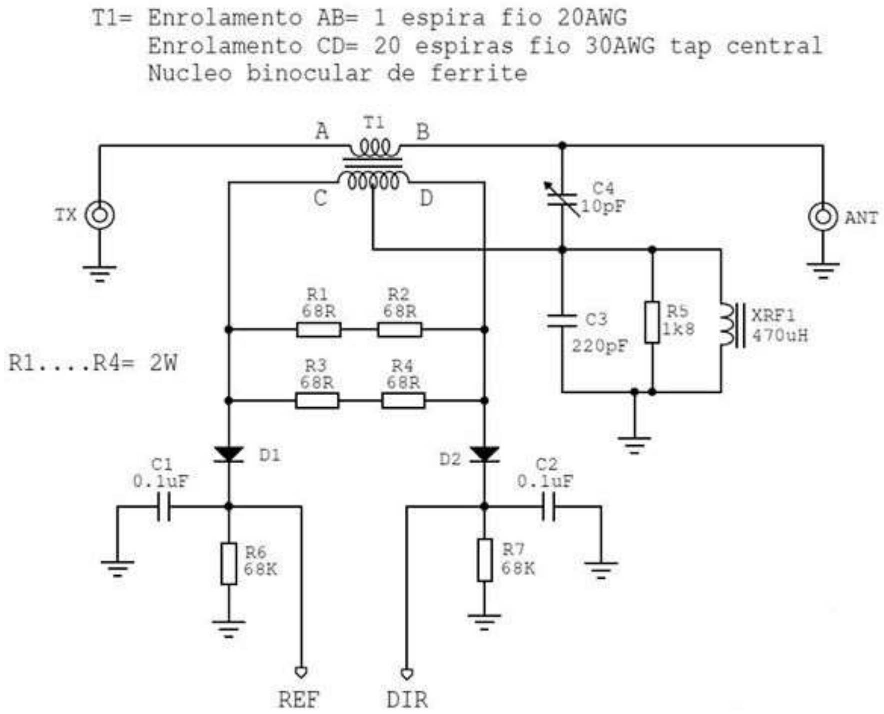
Top

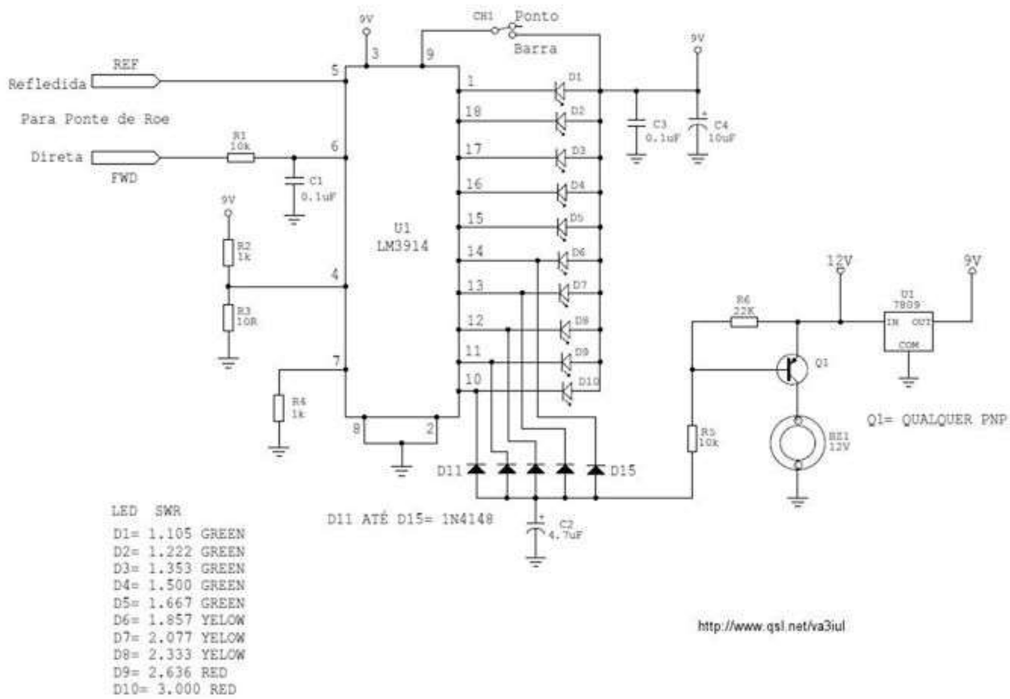


Bottom



Appendix 7: LED SWR meter





Appendix 8 Additional information

None as of 26/8/16

Appendix 9 Errata

None as of 26/8/16

My build notes Name	**Call sign**	**Date .**