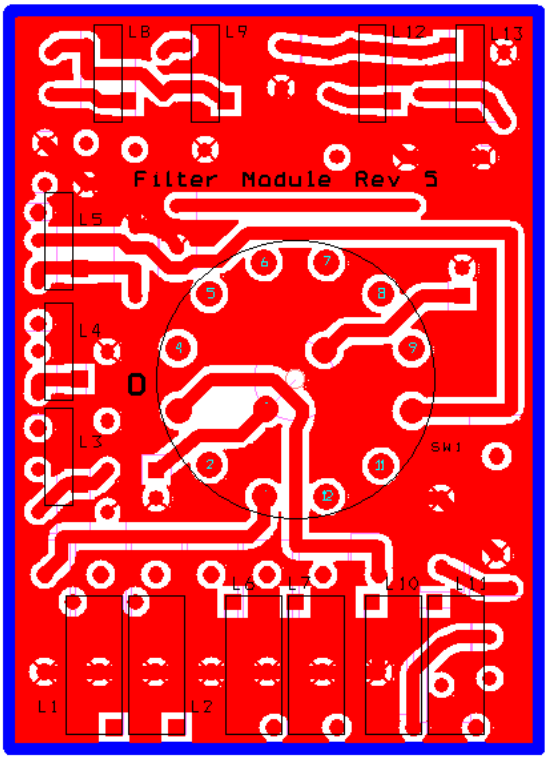
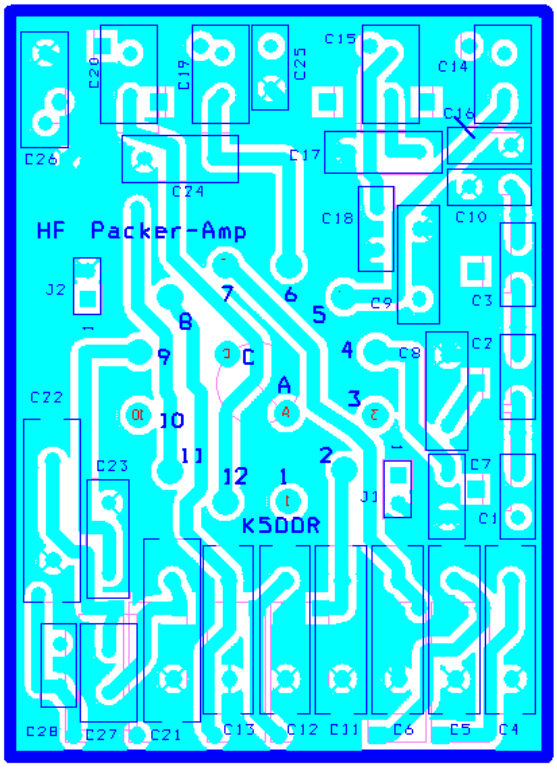
HF PROJECTS
Low Pass Filter Module Construction Manual

FILTER MODULE REV 5





REF	TYPE	Inductance	TURNS	INCHES
L1,L2	T50-1 Blue	5.08uH	22	17
L6,L7	T50-2 Red	2.51uH	21	17
L10	T50-2 Red	1.37uH	15	13
L11	T50-2 Red	1.17uH	13	12
L3	T37-6 Yel	580nH	12	9
L4	T37-6 Yel	470nH	11	8
L5	T37-6 Yel	430nH	10	8
L8	T37-6 Yel	470nH	11	8
L9	T37-6 Yel	430nH[1]	8	8
L12	T37-6 Yel	360nH	10	8
L13	T37-6 Yel	280nH	8	7

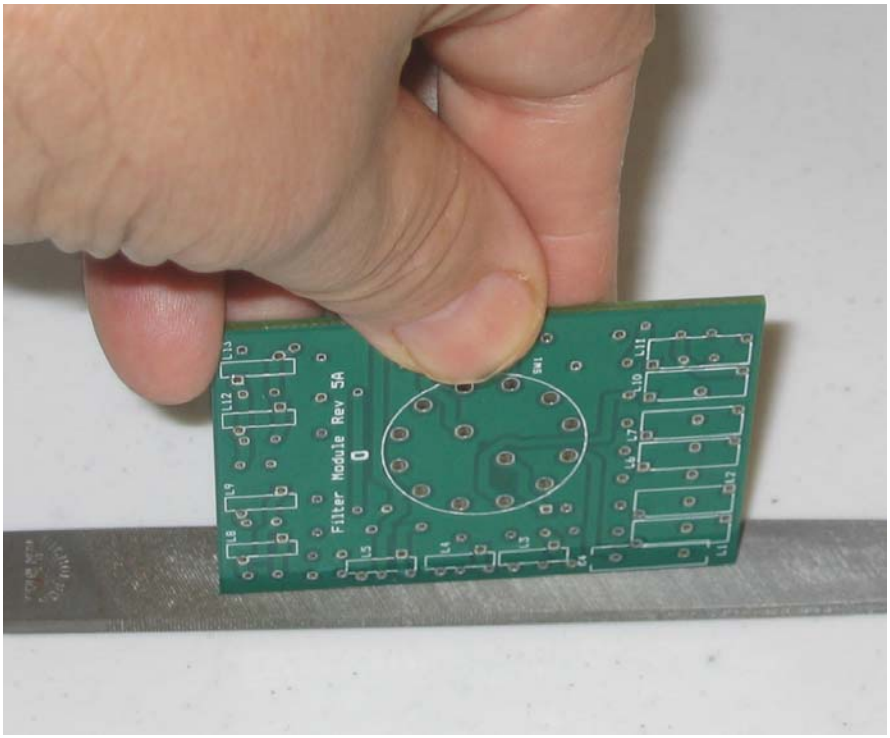
Inductor Table 1

[1] L9 circuit board value needs to be about 300nH to compensate for board inductance.

Circuit Board Preparation

1. This fabrication of circuit boards exhibits a tiny amount of residue that can resist soldering. I recommend cleaning the board with ISOPROPYL ALCOHOL before assembly.

2. The circuit board measures 1.9 x 2.6 inch. The 1.9 inch width is a tight fit in the case. I recommend filing the edge shown in the picture below to reduce the width about 0.01 inches.



The proper edge to file is the edge with the L3, L4 and L5 outlines as shown in the picture above. A firm even pressure while moving the board along the length of the file will quickly remove excess fiberglass. Inspect the filed edge. Stop when the copper planes (top and bottom) just begin to show. A wire brush will clean the file.

Inductor Fabrication

All inductors are wound in the same direction as shown in the picture.

1. Cut the #24 wire to length in inductor table
2. Each pass of the wire through the core counts as 1 turn
3. Place the core in the center of the wire length.
4. Wind one half with one end and the other half with the other end of the wire.
5. Use a hobby knife, small file, dremel tool, etc to remove the insulation from the wire at the base of the core as shown.
6. Tin the lead with solder
7. Adjust the windings to evenly distribute the windings on the core.
8. Measure the inductance and adjust the winding to match the target inductance.
9. Preform the leads by inserting in the circuit board and pulling the leads tight.
10. Organize and identify each core on a sheet of paper. Hold in place with scotch tape. Set aside for later assembly.

Capacitor Assembly

1. Organize the capacitors on the table from left to right by increasing value.
2. Insert the capacitors by row. Pull snug and bend the leads slightly to hold in place.

REF	PF	REF	PF	REF	PF
C26	68	C20	39	C19	12
C25	150	C15	39	C14	12
C24	82	C17	220	C16	150
C10	47	C18	100	C9	220
C3	100	C8	220	C2	150
C7	100	C1	27	C22	680
C23	330	C28	110	C27	39
C21	390	C13	1200	C12	1800
C11	1200	C6	1500	C5	2700
C4	1500				

Capacitor Table

Note: C4 mounted on inductor side after inductors installed.

3. Solder the wires from the outside periphery inward.
4. Trim soldered leads flush to expose more leads to solder.
5. Reflow all solder connections.

Inductor Assembly

Insert each inductor in the order given. Pull the leads tight and solder.

REF	REF	REF	REF	REF	REF
L8	L9	L12	L13	L5	L4
L3	L11	L10	L7	L6	L2
L1					

Inductor Table 2

Note: L1,2,7,6,10,11 require to be soldered from the inductor side. Prepare the inner lead short (1/8th inch). Preform the leads before installation.

Switch Assembly

Insert the switch at the position indicated. The position of the alignment tab must align with the silkscreened “O”on the circuit board.

To obtain maximum spacing from the case to the circuit board, insert the switch with just the tips of the pins protruding through the circuit board.

1. Lay switch and circuit board on the bench. Adjust until just a tip is protruding
2. Tack one pin with solder at the proper distance.
3. Flip the circuit board over and adjust angle so that a tip from the other side is just protruding. Solder
4. Reheat soldered pins as necessary so that the switch pins are evenly protruding through the circuit board.
5. Solder all pins.

Cleaning and Inspection

1. Use a cleaning solvent such as Blue Shower (TECHSPRAY) to wash away the solder flux. Use in a ventilated area.
2. Inspect your work under a magnifier lamp to detect solder joint problems.

Ohmmeter Test (Continuity and Short Tests)

1. Measure from pin 1 to pin 1 on J1 and J2
2. Rotate the switch through all 6 positions. Continuity should be in all positions.
3. Measure from pin 1 to 2 of J1 or J2.
4. Rotate the switch through all 6 positions. No continuity should be measured.

Electrical Test

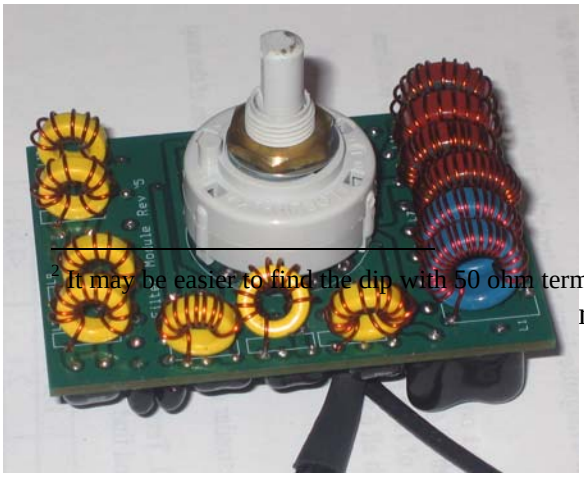
1. If you have a MFJ259 or similar device, you can measure the bottom of the stop band for each filter.
2. Connect the MFJ259 to J1. Terminate J2 with 50 ohms
3. Select the each position and find the dip frequency.[2]

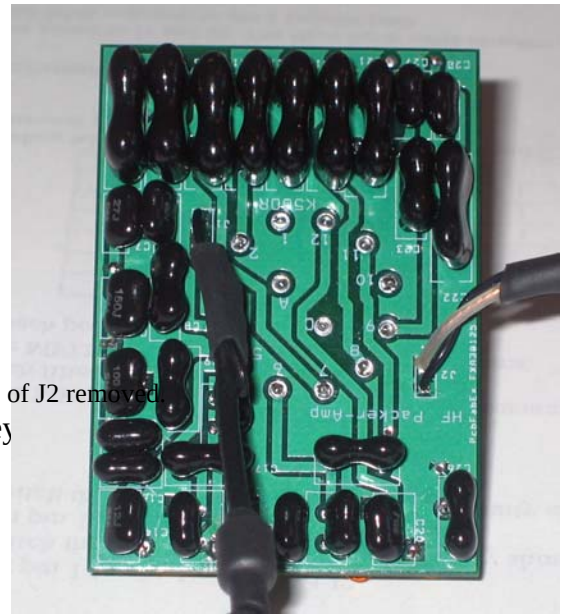
BAND	DIP MHz	SWR
160	2.4	<1.5:1
80	4.0	<2:1
60/40	8.4	<1.5:1
30/20	16.3	<1.2:1
17/15	26.5	<1.5:1
12/10	33.2	<2:1

4. Your reading will not be exact due to tolerance of L and C
5. If you discover a gross error, look for problems.

Cable Attachment

The coax cables attach to J1 and J2. The short input cable attaches to J1. The center conductor of the cable connects to pin 1 (square pad).





[2] It may be easier to find the dip with 50 ohm termination of J2 removed.

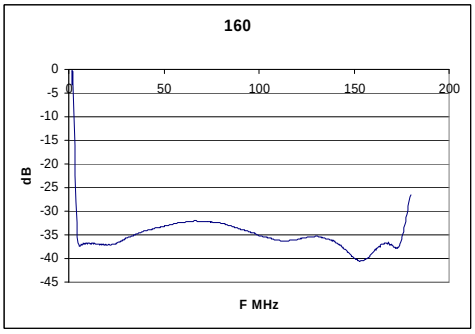
Views of Filter Module. For full size, high resolution images, visit the Yahoo HF Projects Group.

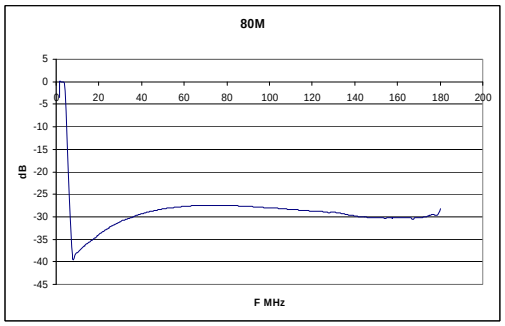
Note: C4 moved to inductor side.

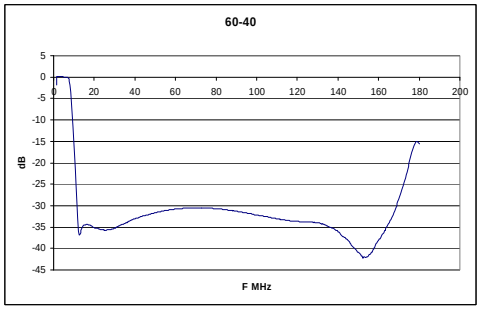
Low Pass Filter Rev 5 Response

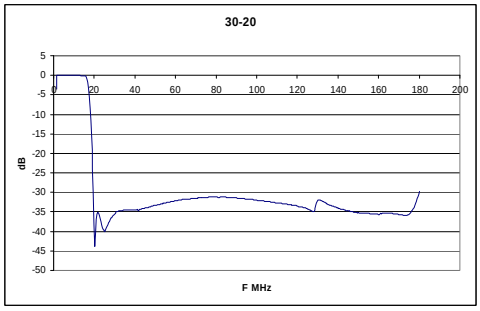
The miniVNA (vector network analyzer) from mRS was used to capture the response of the HF PROJECTS LOW PASS FILTER MODULE Rev 5 from 1 to 180 MHz. The data captured to an Excel spreadsheet was formatted for the plots shown.

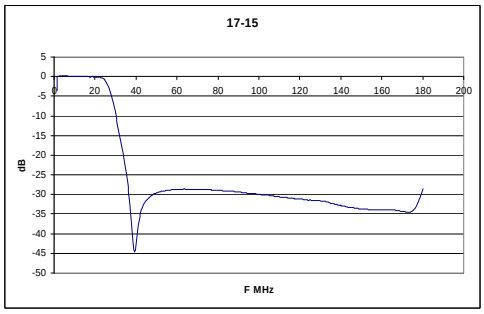
These transfer functions coupled with Push-Pull Amplifier inherent rejection of 2nd harmonic and the limited frequency response of the IRF510 MOSFET achieves the stated -40dB attenuation.

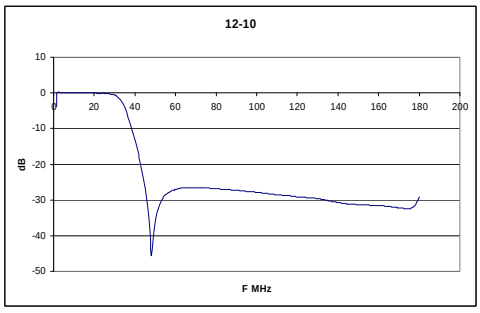












Bill of Materials

ITEM	DESCRIPTION	QTY	CHK
1	10-5982-10-500V12 Cap, 12 pF 5982-10-500V12	2	

2	10-5982-10-500V27 Cap, 27 pF 5982-10-500V27	1	
3	10-5982-10-500V39 Cap, 39 pF 5982-10-500V39	3	
4	10-5982-10-500V47 Cap, 47 pF 5982-10-500V47	1	
5	10-5982-10-500V110 Cap, 110 pF 5982-10-500V110	1	
6	10-5982-15-500V68 Cap, 68 pF 5982-15-500V68	1	
7	10-5982-15-500V82 Cap, 82 pF 5982-15-500V82	1	
8	10-5982-10-500V100 Cap, 100pF 5982-10-500V100	3	
9	10-5982-10-500V150 Cap, 150 pF 5982-10-500V150	3	
10	10-5982-15-500v220 Cap, 220 Pf 5982-15-500v220	3	
11	10-5982-15-500V330 Cap, 330 pF 5982-15-500V330	1	
12	10-5982-15-500V390 Cap, 390 pF 5982-15-500V390	1	
13	10-5982-19-500V680 Cap, 680 pF 5982-19-500V680	1	
14	10-5982-19-500V1200 Cap, 1200 pF 5982-19-500V1200	2	
15	10-5982-19-500V1500 Cap, 1500 pF 5982-19-500V1500	2	
16	10-5982-19-500V1800 Cap, 1800 pF 5982-19-500V1800	1	
17	10-5982-19-500V2700 Cap, 2700 pF 5982-19-500V2700	1	
18	15-FilterModuleRev5 Circuit Board REV 5	1	
19	45-T50-1 Toroid T50-1 (BLUE)	2	
20	45-T50-2 Toroid T50-2 (RED)	4	
21	45-T50-10 Toroid T37-6 (YELLOW)	7	
22	85-10WA175 Switch, Rotary, 10WA175	1	
23	95-566-8052 Wire, #24 AWG magnet wire, Poly-Thermaleze 1 ft	14'	

FILTER MODULE BILL OF MATERIALS REV 5

8/27/2009

ITEM	DESCRIPTION	QTY	CHK
1	10-5982-10-500V12 Cap, 12 pF 5982-10-500V12	2	
2	10-5982-10-500V27 Cap, 27 pF 5982-10-500V27	1	
3	10-5982-10-500V39 Cap, 39 pF 5982-10-500V39	3	
4	10-5982-10-500V47 Cap, 47 pF 5982-10-500V47	1	
5	10-5982-10-500V110 Cap, 110 pF 5982-10-500V110	1	
6	10-5982-15-500V68 Cap, 68 pF 5982-15-500V68	1	
7	10-5982-15-500V82 Cap, 82 pF 5982-15-500V82	1	
8	10-5982-10-500V100 Cap, 100pF 5982-10-500V100	3	
9	10-5982-10-500V150 Cap, 150 pF 5982-10-500V150	3	
10	10-5982-15-500v220 Cap, 220 Pf 5982-15-500v220	3	
11	10-5982-15-500V330 Cap, 330 pF 5982-15-500V330	1	
12	10-5982-15-500V390 Cap, 390 pF 5982-15-500V390	1	
13	10-5982-19-500V680 Cap, 680 pF 5982-19-500V680	1	
14	10-5982-19-500V1200 Cap, 1200 pF 5982-19-500V1200	2	
15	10-5982-19-500V1500 Cap, 1500 pF 5982-19-500V1500	2	
16	10-5982-19-500V1800 Cap, 1800 pF 5982-19-500V1800	1	
17	10-5982-19-500V2700 Cap, 2700 pF 5982-19-500V2700	1	
18	15-FilterModuleRev5 Circuit Board REV 5	1	
19	45-T50-1 Toroid T50-1 (BLUE)	2	
20	45-T50-2 Toroid T50-2 (RED)	4	
21	45-T50-10 Toroid T37-6 (YELLOW)	7	
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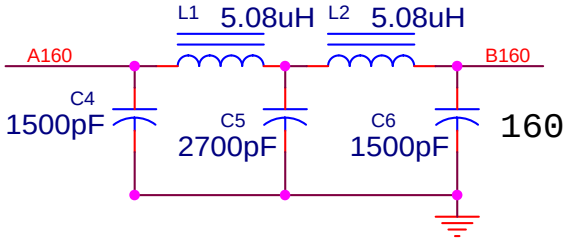
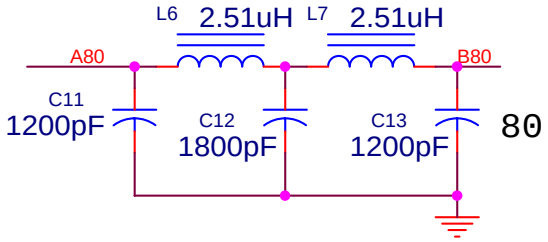
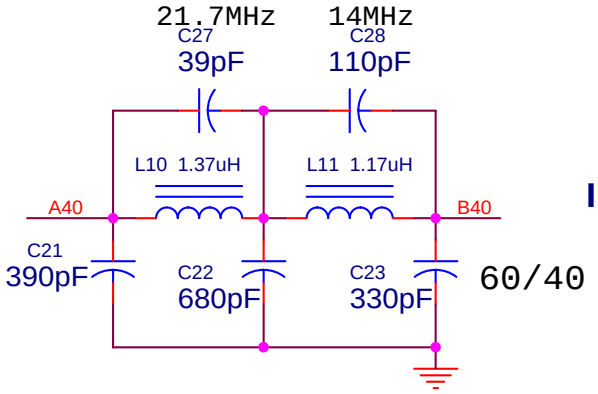
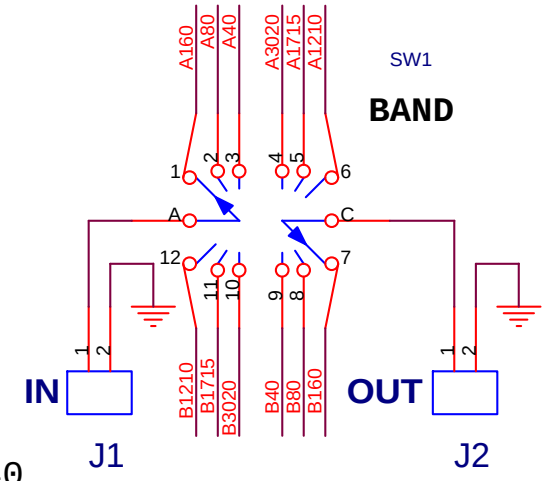


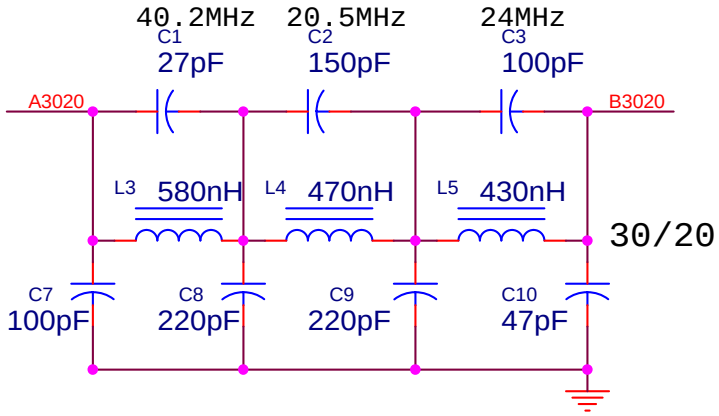


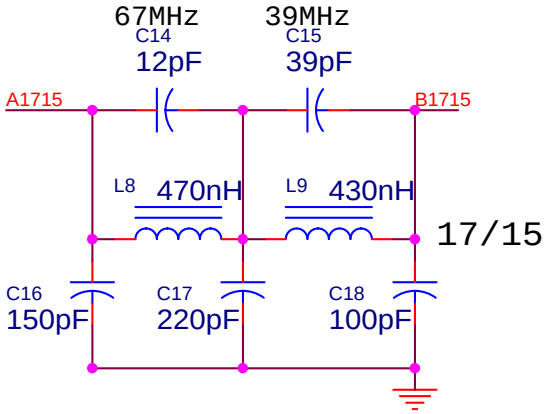


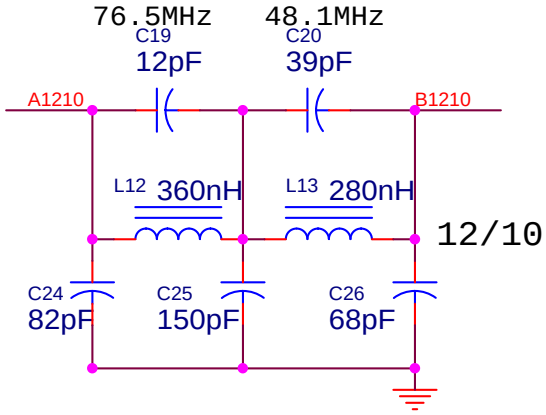
L1,L2	T50-1	22T	17 In.
L6,L7	T50-2	21T	17
L10	T50-2	15T	13
L11	T50-2	13T	12
L3	T37-6	12T	9
L4	T37-6	11T	8
L5	T37-6	10T	8
L8	T37-6	11T	8
L9	T37-6	8T	8
L12	T37-6	10T	8
L13	T37-6	8T	7



L9 schematic inductance includes board inductive contribution so the actual L9 inductance is closer to 300 nH to achieve the desired frequency response.







Filter Module Rev 5
HF Projects by K5OOR 2009