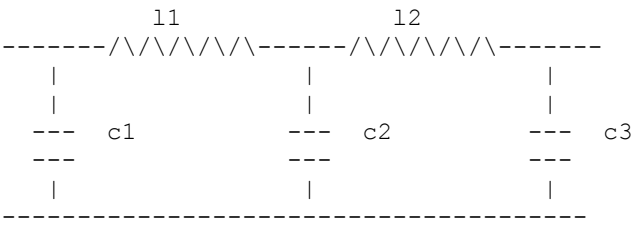
Lowpass filter for 5MHz

From: G8MNY@GB7CIP.#32.GBR.EU
To : TECH@WW

From Brian g3yrh @ GB7BMX Updated Aug 04

The following lowpass filter was built using the tables in the ARRL manual, it is a 5 section one and seems to work ok, no definitive measurements were taken other than measuring power at 5MHz and 7MHz, seems to cut off at 6MHz.



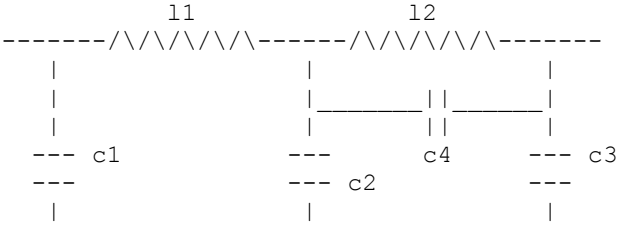
c1 = 330pf 1% silver mica
c2 = 500pf + 250pf silver mica
c3 = 330pf 1% silver mica
l1 = 17t 22swg on t50-2 toroid
l2 = 17t 22swg on t50-2 toroid

G8MNY comment...

Doing some analysis on a 50Û source & load, the Ls needs to be about 2uH. Excluding losses the response is...

MHz	Loss dB
5	0.1
7.4	3
10	16
15	34

If there is a lot of 2nd harmonic to remove from the Tx (e.g. not a push pull PA)
a "M" derived filter should be considered. This is where a capacitor across one of the coils is used to resonate it near 10MHz to improve the rejection.



c1 = 330pf 1% silver mica
c2 = 500pf + 250pf silver mica
c3 = 330pf 1% silver mica
c4 = 170pf
l1 = 17t 22swg on t50-2 toroid
l2 = 15t 22swg on t50-2 toroid

With L2 = 1.5uH & tuned with a 170pF to 10MHz then response...

MHz	Loss dB
5	0.1
6.6	3
10	>50
15	35

Comments from Tony G3NXC@GB7SOL.#29.GBR.EU

The frequency response figures that you quote based on a 2uH inductor value are in agreement with my own calculations. Unfortunately, though, 17t on a T50-2 toroid does not yield 2uH! The AL figure for this core, taken from the Micrometals web site & other places, is 4.9nH/N**2 and this results in an inductance value of 1.42uH for 17t.

Using 1.42uH as the inductor value actually results in a lower input VSWR at 5MHz than 2uH - 1.05:1 compared with 1.1565:1. The cut off frequency, as you would expect, is higher with the -3dB point being at 8.13MHz; the attenuation being 12.1dB at 10Mhz & 29.5dB at 15MHz.

If it is felt necessary for the inductance to be increased to 2uH then the number of turns should be increased to 20. Another solution would be to leave the inductors as they are and increase the capacitor values with C1 and C3 becoming 360p and C2 becoming 820p. This would result in the input VSWR being 1.12, the 3dB point being at 7.85 MHz and the 10MHz and 15MHz attenuation figures becoming 13.8dB & 31.1dB.

I'm not convinced about the need for a notch in the response characteristic at 10MHz. The attenuation characteristics calculated for the basic filter rely on the load remaining at 50 Ohms independent of frequency. This is not, of course, the usual situation in practice. Assuming that the load is a dipole, the feed impedance will be around 50 Ohms at resonance: at the second harmonic, though, the feed impedance will rise to around 5000 Ohms. This load will transformed by the feeder but whatever value appears as the filter load, the result will be that would be difficult to transfer any power to the aerial through the filter.

Apart from anything else, the 100:1 VSWR would cause the feeder losses to rise significantly. So even if some second harmonic were to 'escape' the filter, very little would actually reach the aerial - assuming 100ft of UR67, the attenuation of the second harmonic resulting from feeder loss alone would be around 9dB.

All of the above apart, the physical size of the inductors means that the filter is only really suitable for moderate power applications!

73 de Tony, G3NXC@GB7SOL

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