Inter-Station Interference Filters for Field Day

We selected a 3-section filter design detailed in this ARRL QST article:

https://www.arrl.org/files/file/Technology/tis/info/pdf/8809017.pdf

to build for mitigation of inter-station interference for Field Day. We Built 15 filters to support 5 CW bands; 5 digital bands; and 5 phone bands (80/40/20/15/10 meters). These filters will support 100 watts TX power (with about 50% duty cycle) and are designed for 50 ohms input/output impedance. The operating SWR should be kept below 3:1 and below 2:1 is desirable. These filters have in-band losses of 0.5 to 0.7 dB when properly tuned (fine tuning is achieved by squeezing turns on the toroids). Course tuning was done on the first filter built for each band by adjusting the number of turns on each toroid. About 30 dB of rejection of adjacent bands is achieved between 80, 40 and 20 meters, and about 15 dB of rejection is obtained with the adjacent bands between 20, 15 and 10 meters, but much more rejection for 15 meters to 40 meters, for example. The use of such filters will mitigate RX front-end overload between bands and also mitigate harmonics, spurious signals and broadband noise from TX operation between bands.

Far Circuits provided small simple PCB's for each filter. The cost of 20 PCB's was $79. Kits and Parts provided 50 T-80-6 toroid cores for $44. Just Radios provided the silver mica caps for about $75. We used 1000 volt caps for the series resonant LC filter section in each filter, and 500 volt caps for the two parallel input and output LC filter sections (the series LC filter section sees voltages significantly higher than the input/output voltages at 50 ohms). Max-Gain Systems provided 32 UHF female bulkhead connectors for about $70. Circuit Specialists provided the 15 Hammond aluminum enclosures (4.75" x 2.61" x 1.42") for about $108. The wire for the toroids was #20 enameled bought on Ebay for about $12 for 160 feet. We also bought 200 M3 stainless steel bolts, lock washers and self-locking nuts, and 100 solder tabs.

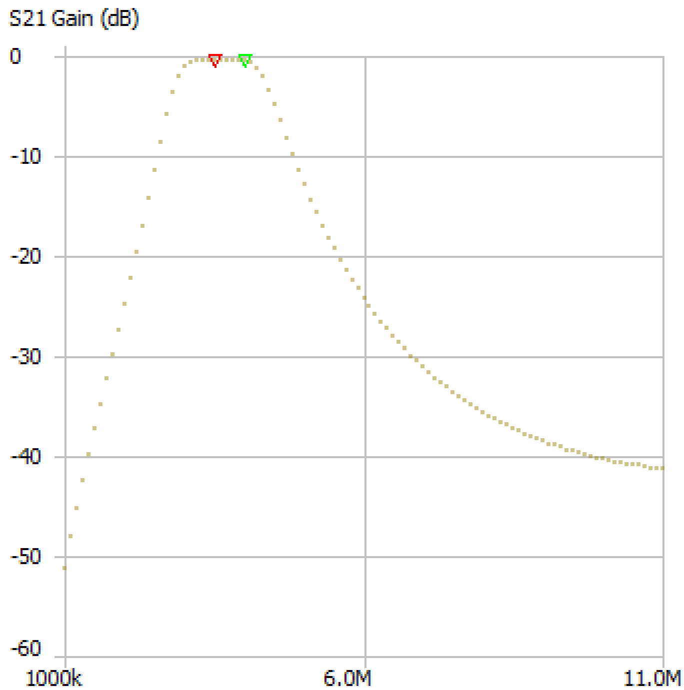
The capacitors and inductors used in these filters are as follows (these vary a bit from the design article);

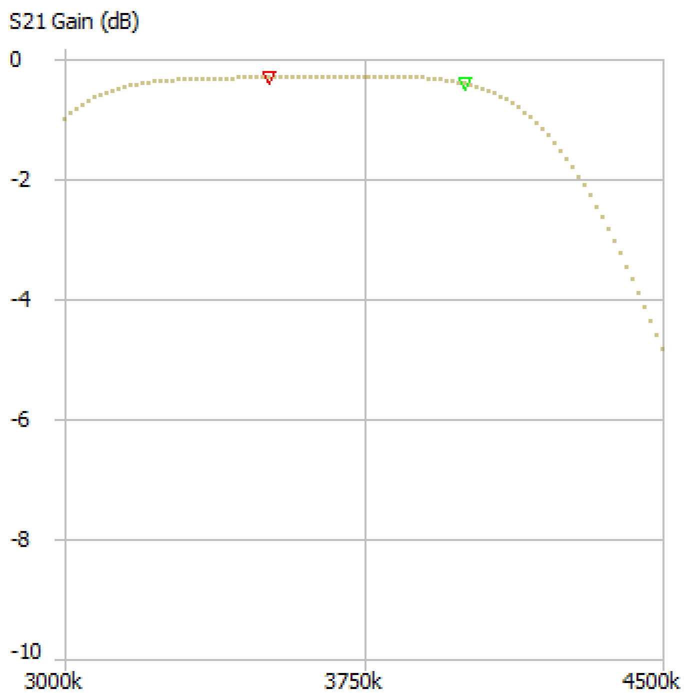
Band	C1/C3 (pF)	C2 (pF)	L1/L3 (turns)	L2 (turns)
3.5 MHz	2000	200	13	43
7.0 MHz	1000	100	10	31
14.0 MHz	500	50	7	23
21.0 MHz	330	33	4.5	17
28.0 MHz	200	25	3.5	12

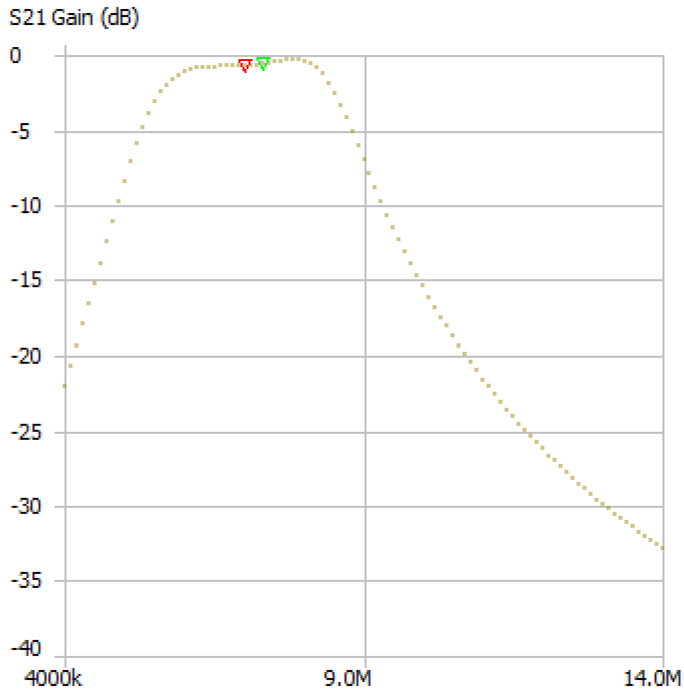
The first steps were to drill holes in the aluminum enclosure to mount the UHF female RF connectors on each end of the enclosure, and also drill 2 holes to secure the PCB. Then for each band, a first filter was constructed and tested. Then the toroids were tuned by adding/removing turns. Then all the filters for that band were built. Fine tuning of the filters was down using a NanoVNA and by squeezing/spreading turns on the series resonant toroid.

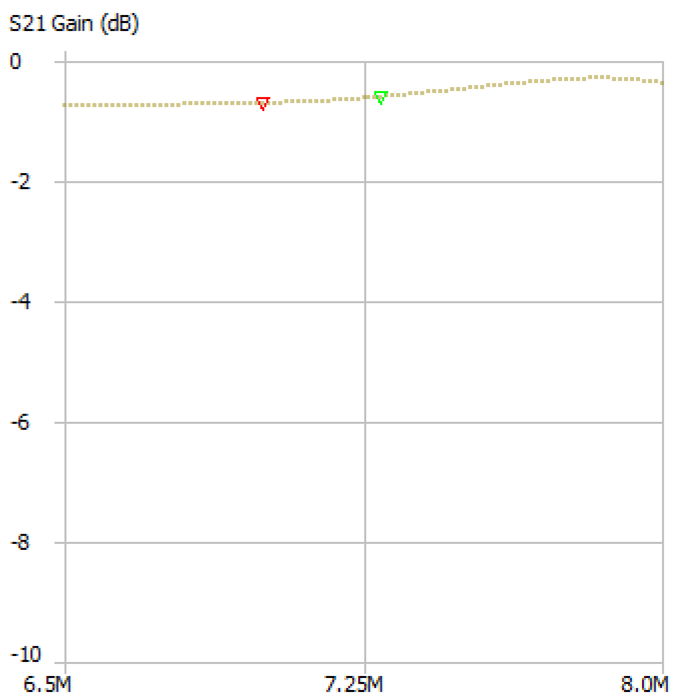
I found that the NanoVNA was very helpful to tune the toroids to achieve close to 0.5 dB of loss inband. Also, the 10 meters filters were shifted up in frequency 3 to 4 MHz to provide better attenuation of 15 meters of about 16 dB. The original tuning only provided about 6 dB attenuation of 15 meters. Also the 15 meters filters were shifted up about 1 MHz to provide better attenuation of 20 meters. The inband losses remained near 0.5 dB with these changes.

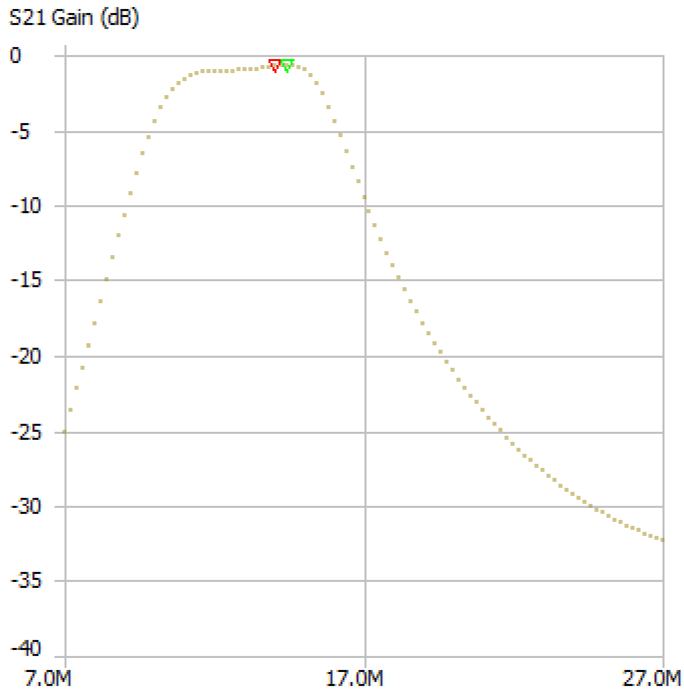
80/40/20/15/10 meters bandpass filters measured responses using a NanoVNA



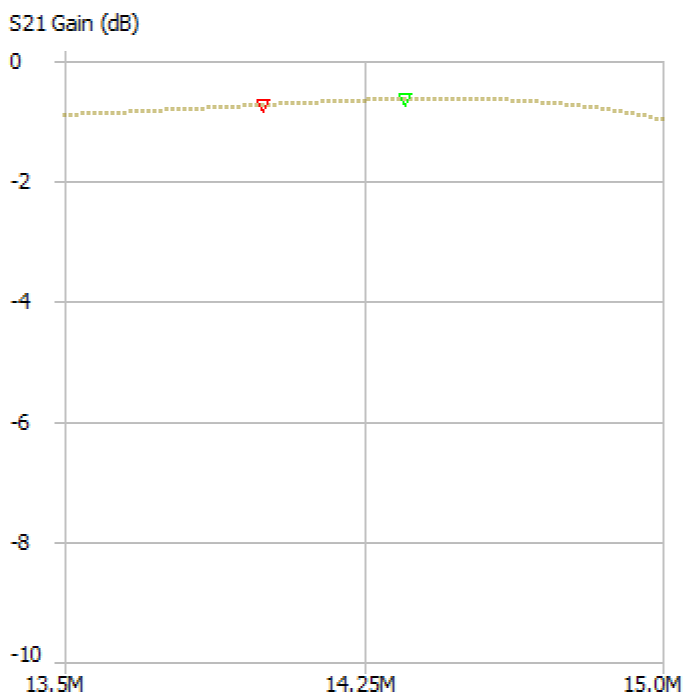



S21 Gain (dB)
0
-5
-10
-15
-20
-25
-30
-35
-40
4000k
9.0M
14.0M

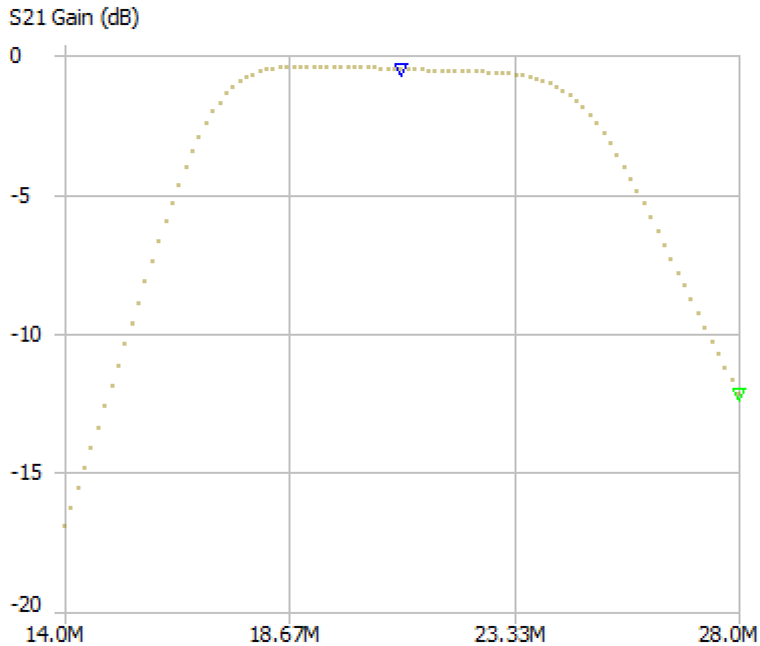

S21 Gain (dB)
0
-2
-4
-6
-8
-10
6.5M
7.25M
8.0M

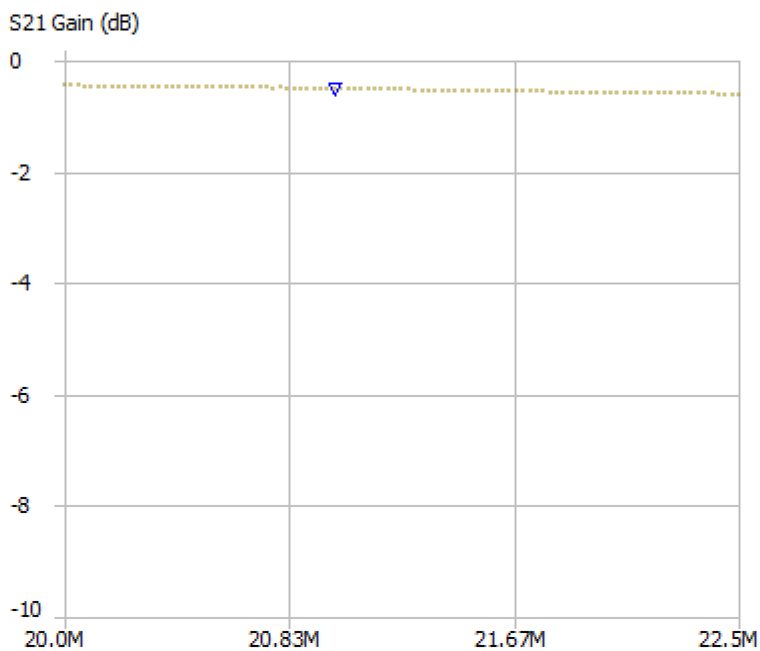


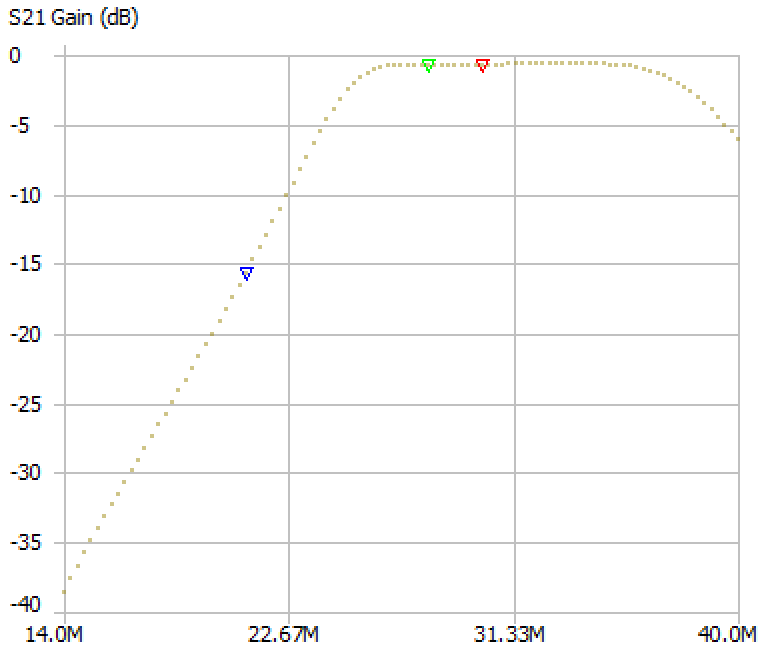
S21 Gain (dB)
0
-5
-10
-15
-20
-25
-30
-35
-40
7.0M
17.0M
27.0M

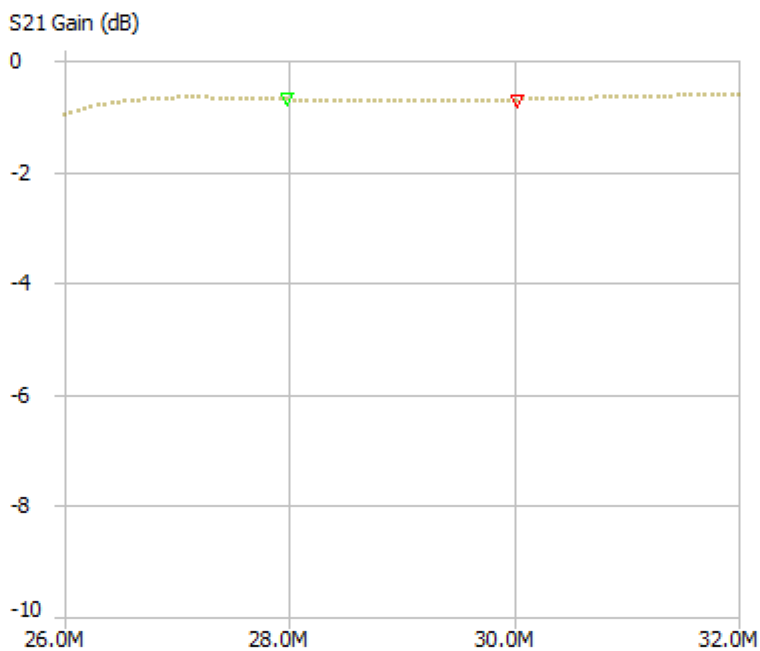


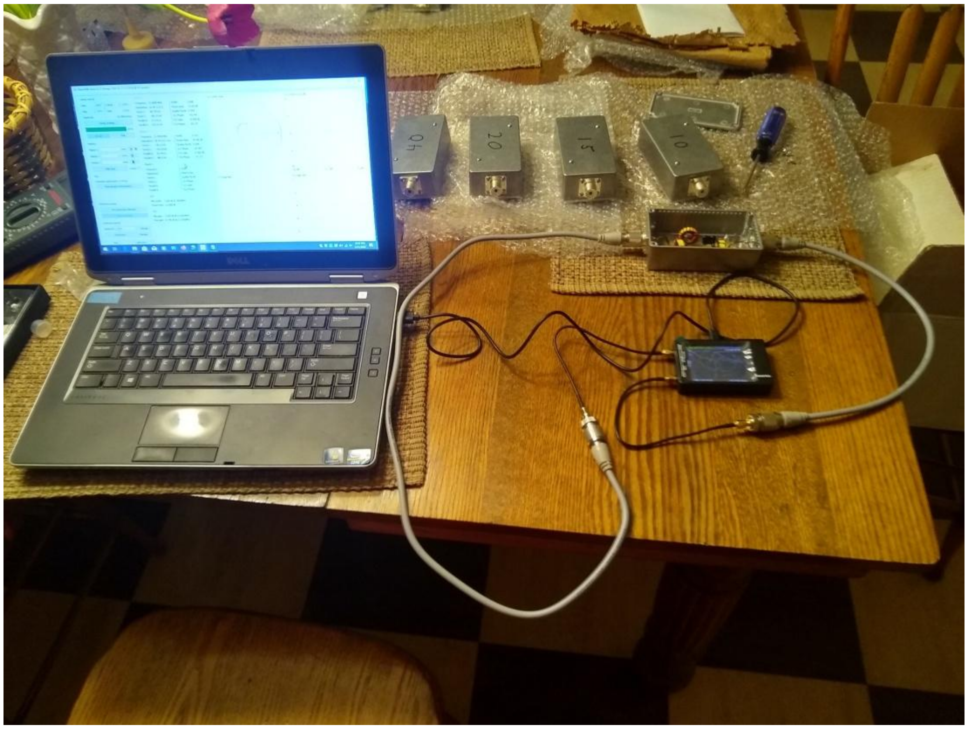
S21 Gain (dB)
0
-2
-4
-6
-8
-10
13.5M
14.25M
15.0M


S21 Gain (dB)
0
-5
-10
-15
-20
14.0M
18.67M
23.33M
28.0M


S21 Gain (dB)
0
-2
-4
-6
-8
-10
20.0M
20.83M
21.67M
22.5M


S21 Gain (dB)
0
-5
-10
-15
-20
-25
-30
-35
-40
14.0M
22.67M
31.33M
40.0M


S21 Gain (dB)
0
-2
-4
-6
-8
-10
26.0M
28.0M
30.0M
32.0M



Filter measurements with a NanoVNA, and an opened filter