Bandpass Filters – Preventing HF Transceiver Interference

By Barry Basile KG5IRR
For the Oak Forest Amateur Radio Club
Presented 11/20/21

Background

- When two or more transceivers are operated nearby, even on different bands, the front end of one station's receiver can be over driven by the other transmitter and normal reception is not possible
- Bandpass filters between the transceiver and antenna will mitigate the problem
- The bandpass filter is tuned to the operating frequency band of each station

Ralph's Kits

- In the past, Ralph (KE5HDF) has helped us build bandpass filter kits for various bands
- His kits are based on the "Ugly filter" project developed by the Nashoba Valley Amateur Radio Club (NVARC)
- For the details, see: https://n1nc.org/Filters/

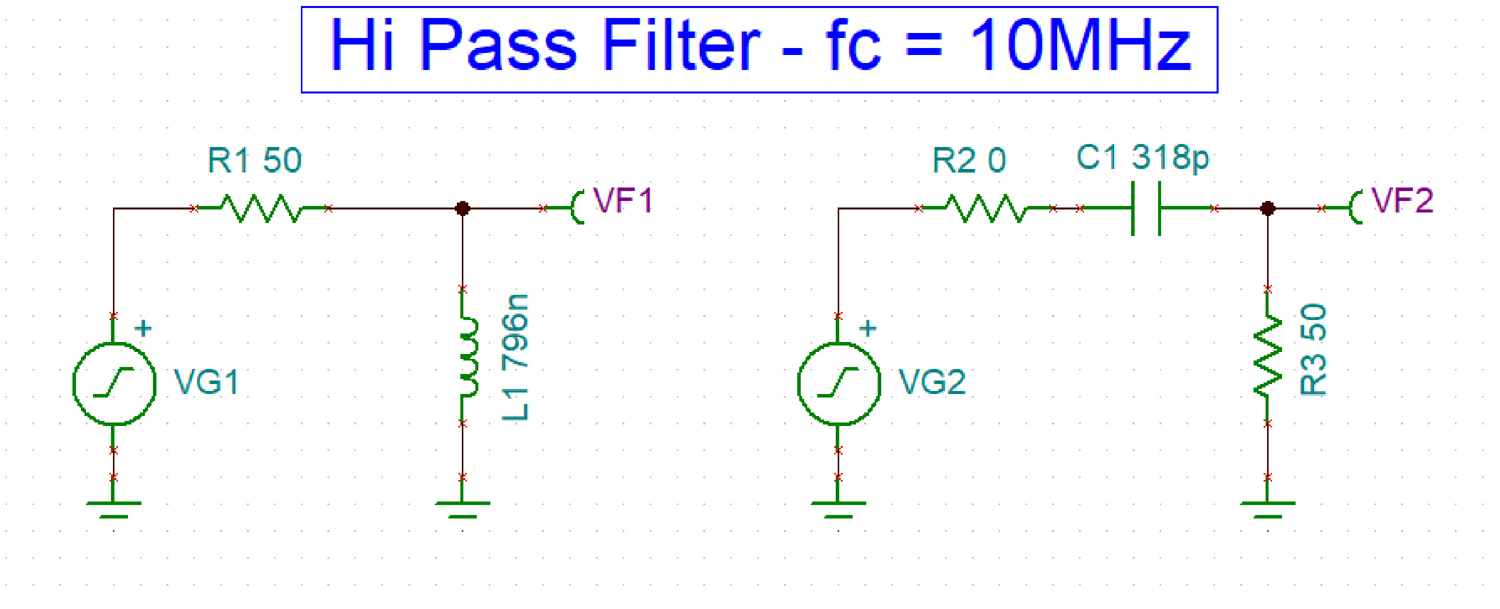
Implementation

- The circuits consist of cascaded parallel and series LC elements that have slightly different resonant frequencies
- By cascading these "tanks", a narrow band filter skirt can be created the that:
  - Has very sharp roll-off at the band edges and
  - Very little ripple in the passband

Useful Formulas

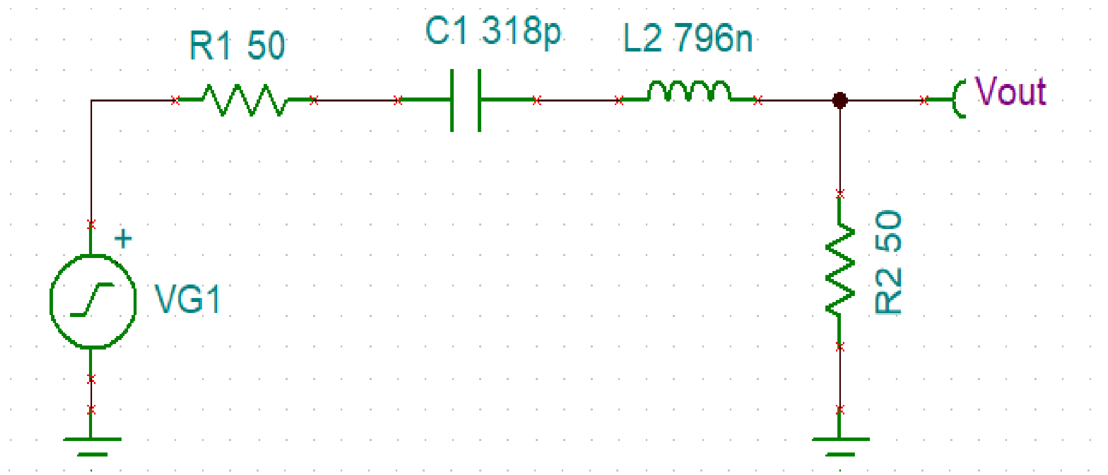
- Hi/Low Pass Cutoff frequency
  - $Fc = 1/(2\pi RC)$
  - $Fc = 2\pi RL$
- Resonant frequency
  - $Fr = 1/\ (2\pi \sqrt{LC})$
  - $BW = Fr\ /\ Q$
  - $Q_p = R/(2\pi\ Fr\ L) = 2\pi\ Fr\ RC$
  - $Q_s = (2\pi\ Fr\ L)/R = 1/(2\pi\ Fr\ RC)$
- Power
  - $P = IV$
  - $½\ P = IV/2 = I/\sqrt{2} * V/\sqrt{2}$
  - $V\ db = 20 \log (Vout/Vin)$
  - Note: at −3 db, Vout/Vin = 70.7%

High Pass Filters

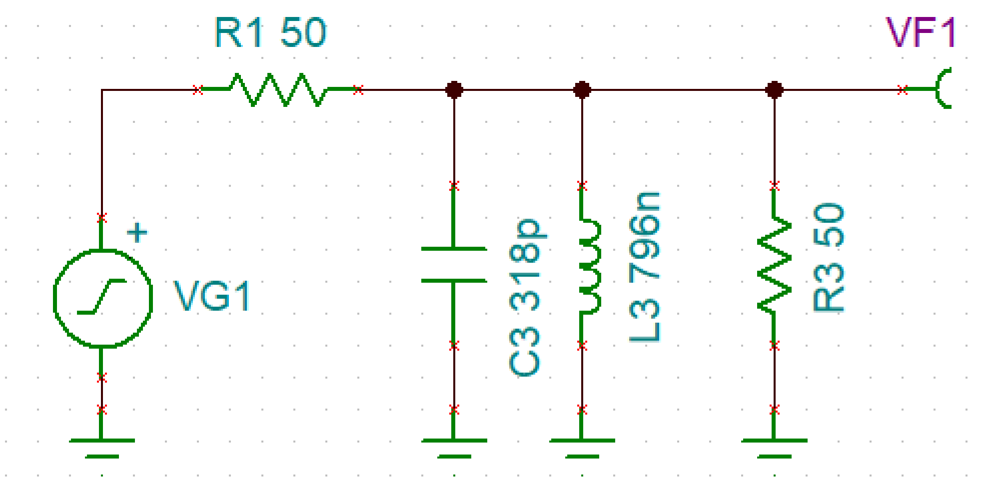


Simple Single Stage BPFs

- Series BPF:

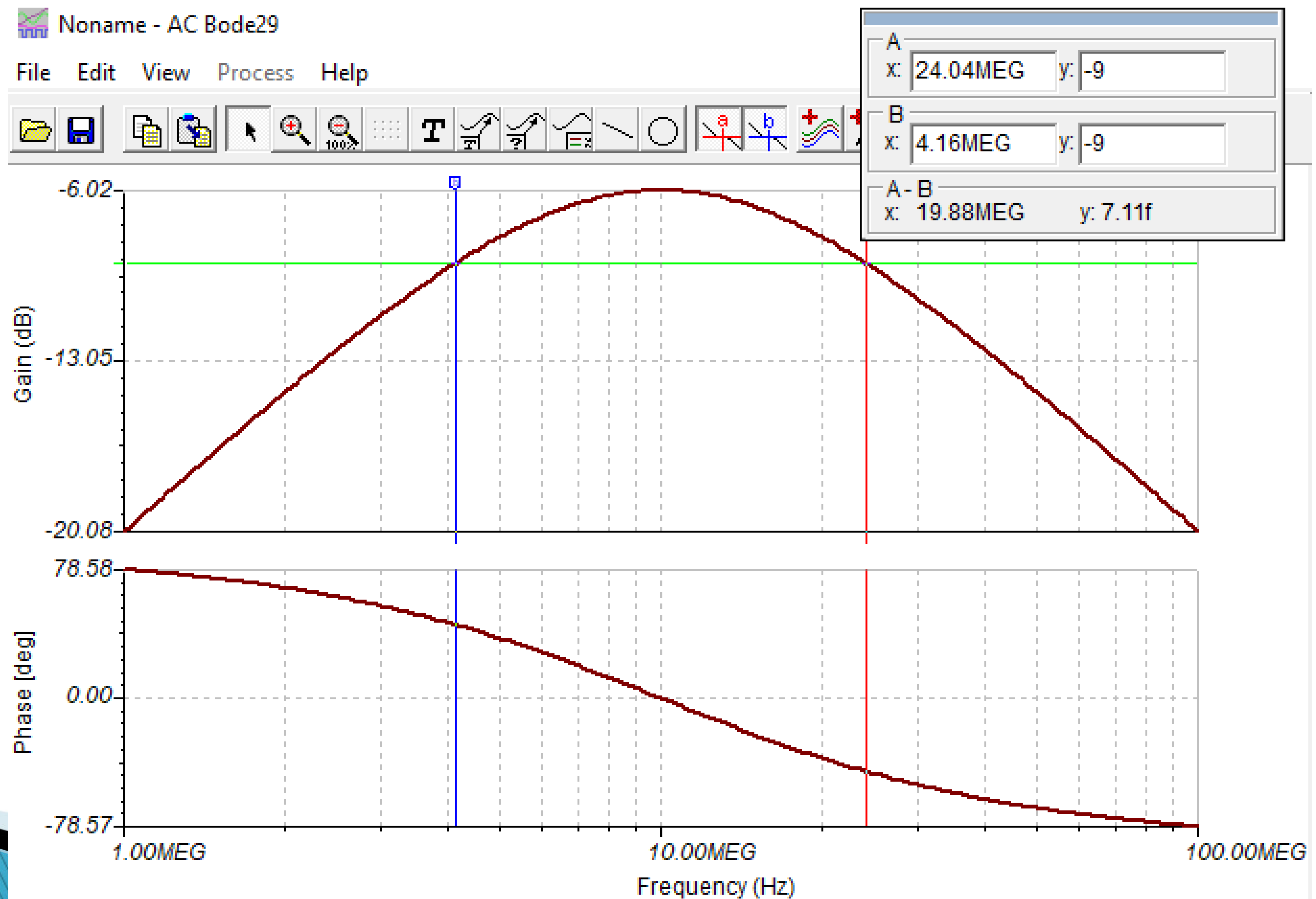


- Parallel BPF:

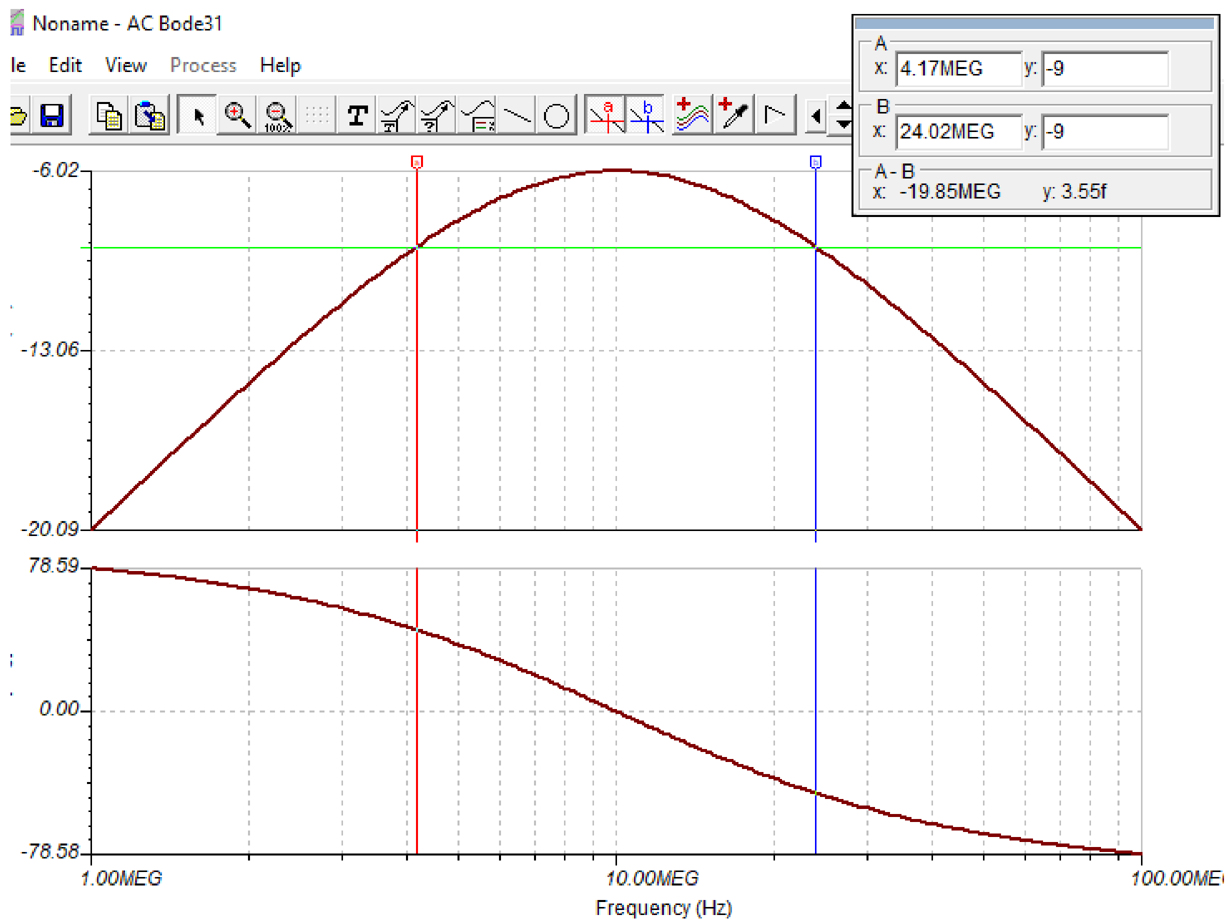


Parallel BPF Simulation

- We'll use a simulator to show the behavior using AC circuit analysis that creates a Bode plot
- Parallel:



Series BPF Simulation

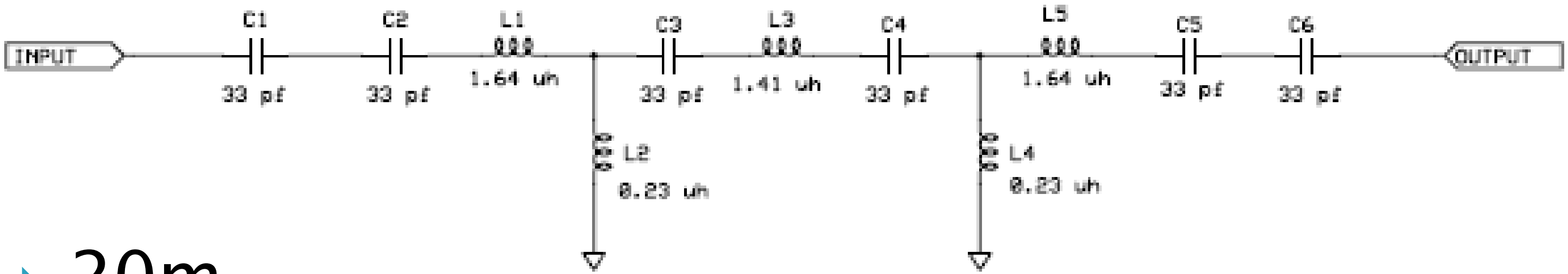


Some Discussion…

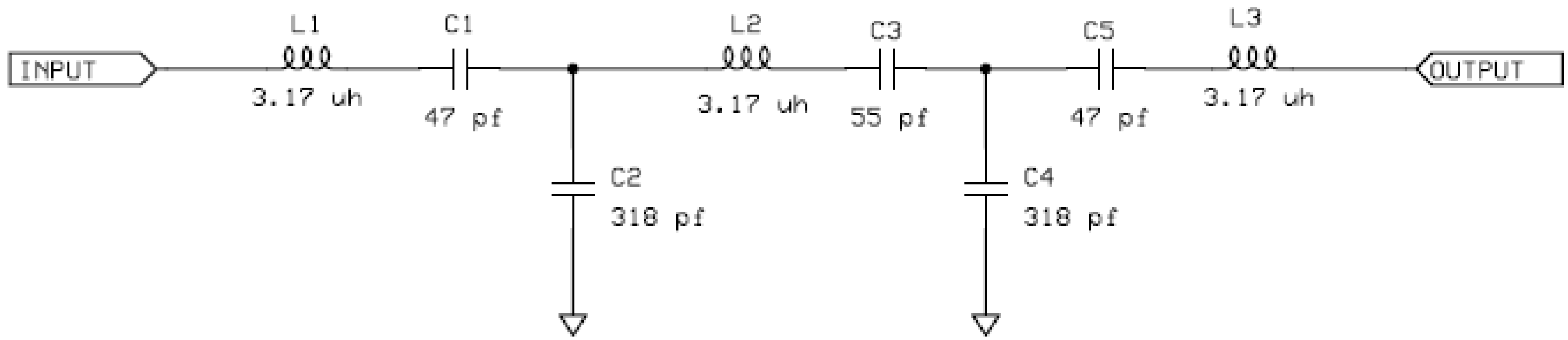
- Why is the peak amplitude of the filter at –6db ?
- Why are the cursors at the –9db points?
- What is the half power bandwidth?
- Why is the phase > 0 at low frequencies?

NVARC Circuits 10/20

- 10m

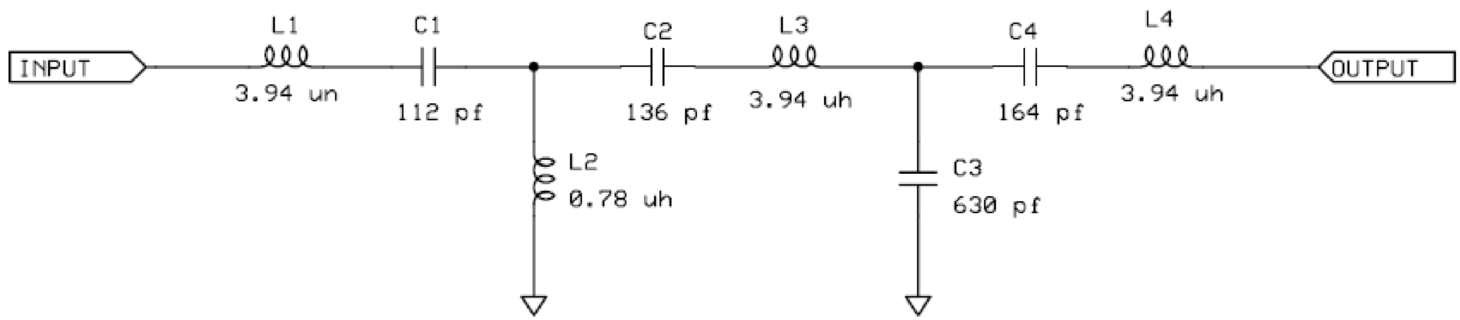


- 20m

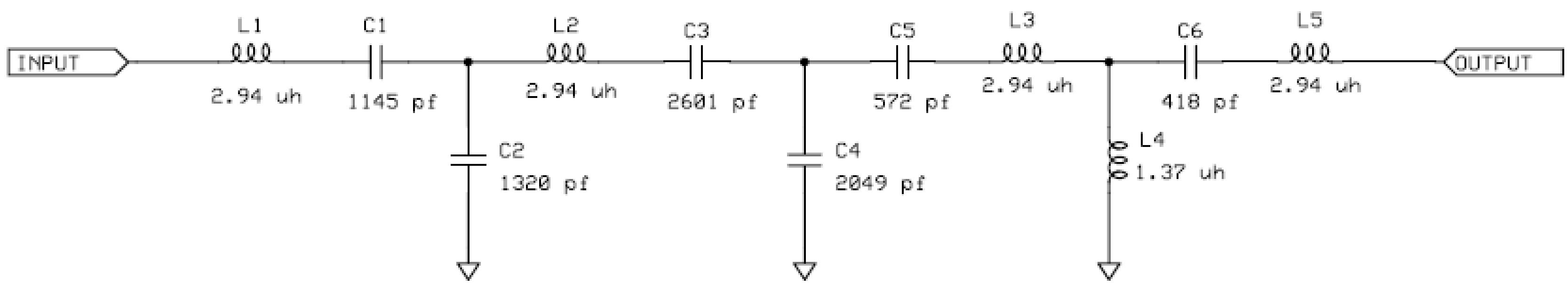


NVARC Circuits 40/80

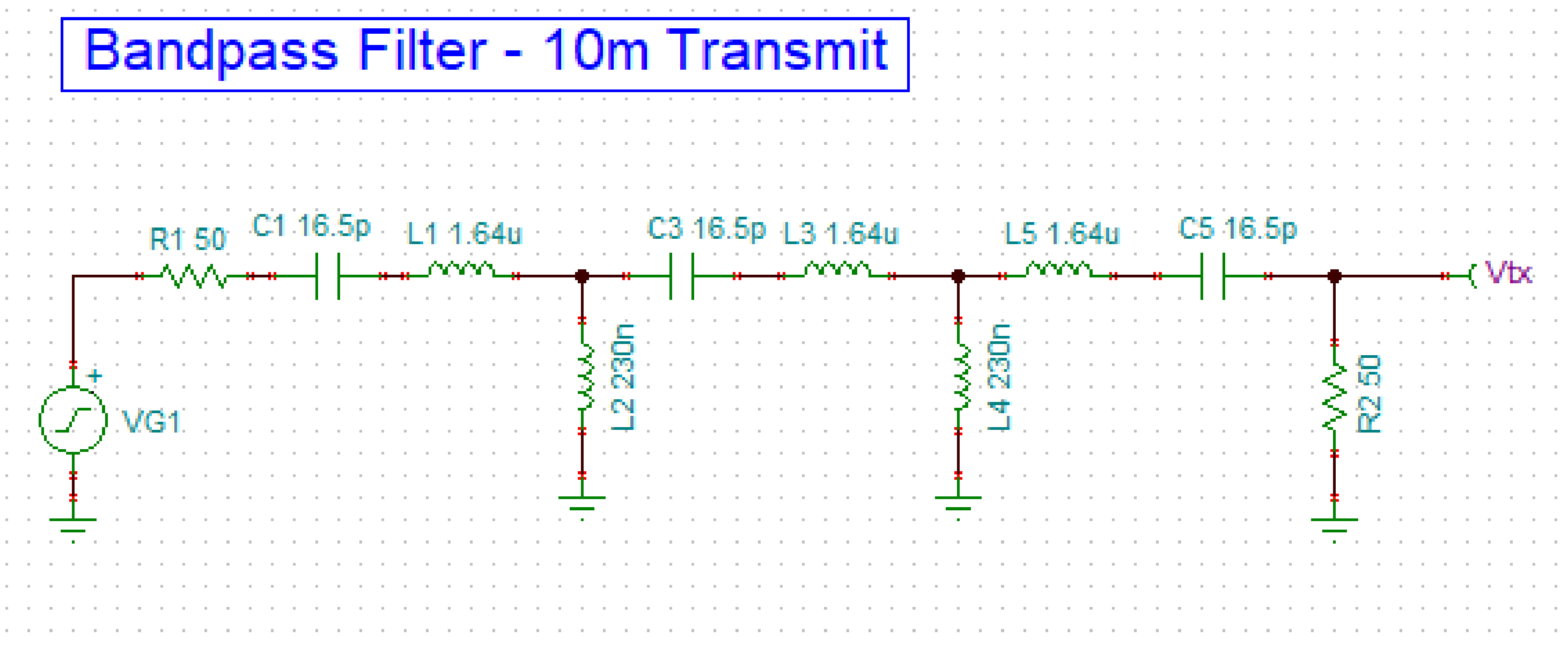
- 40m



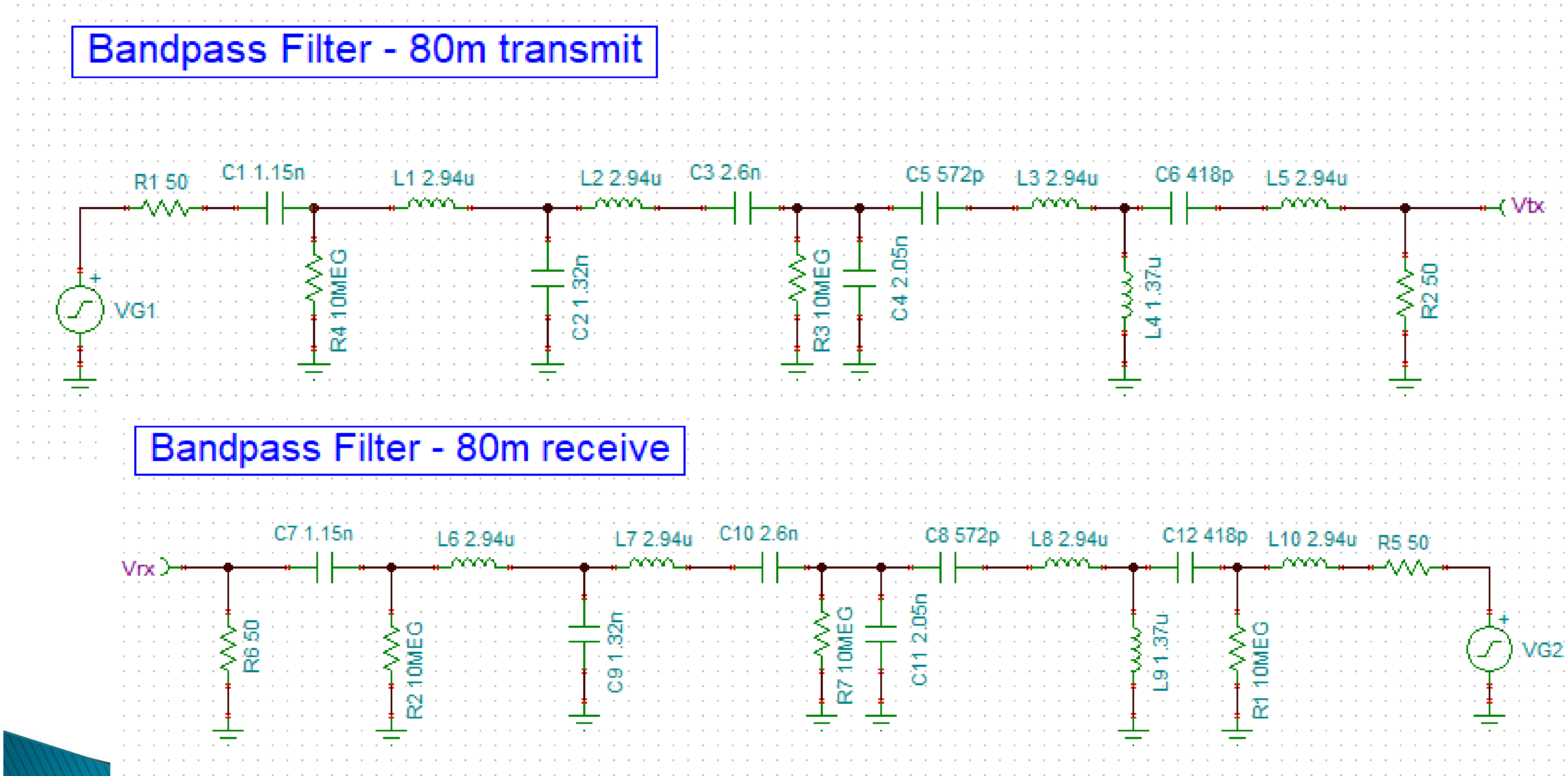
- 80m



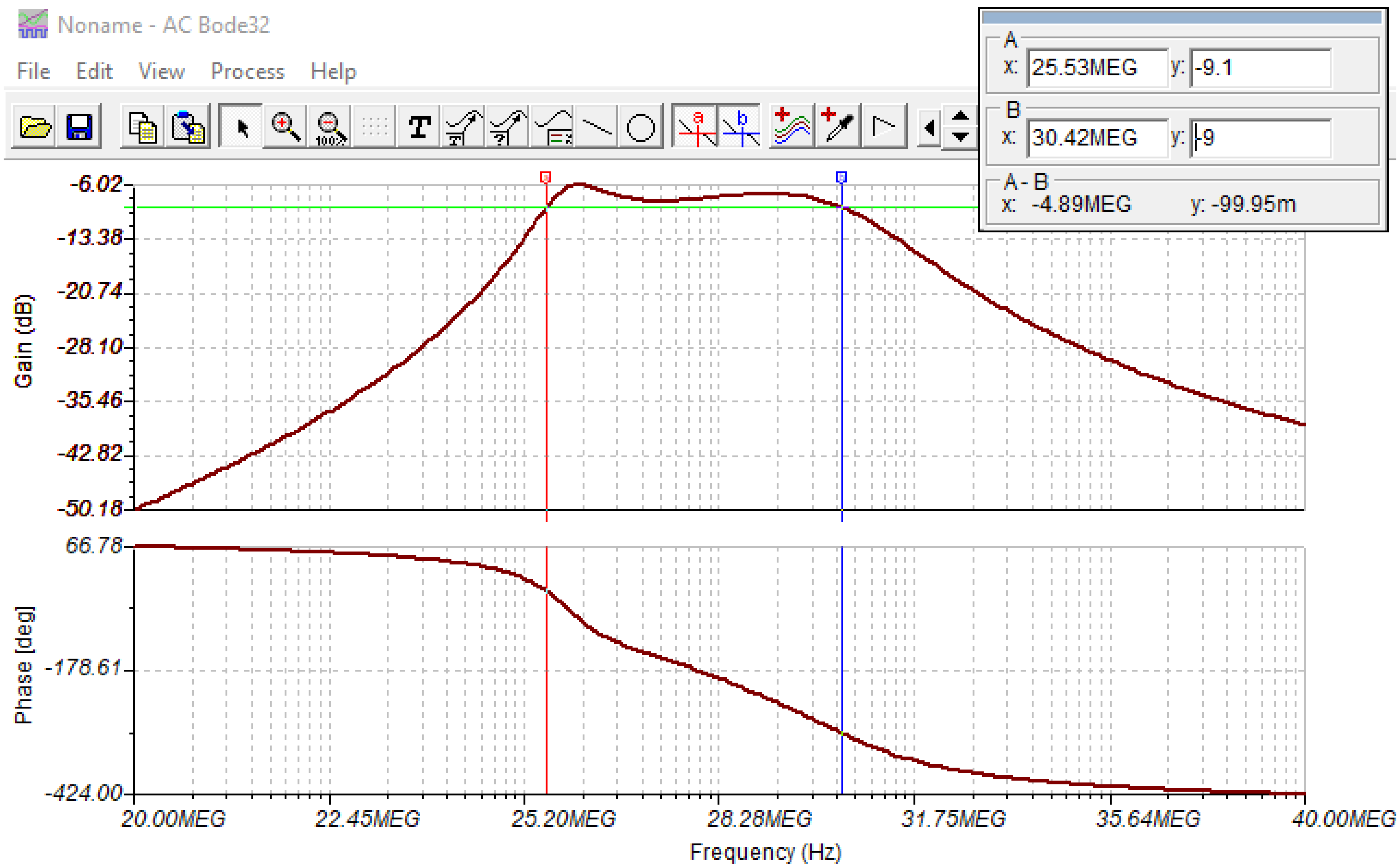
10m Transmit



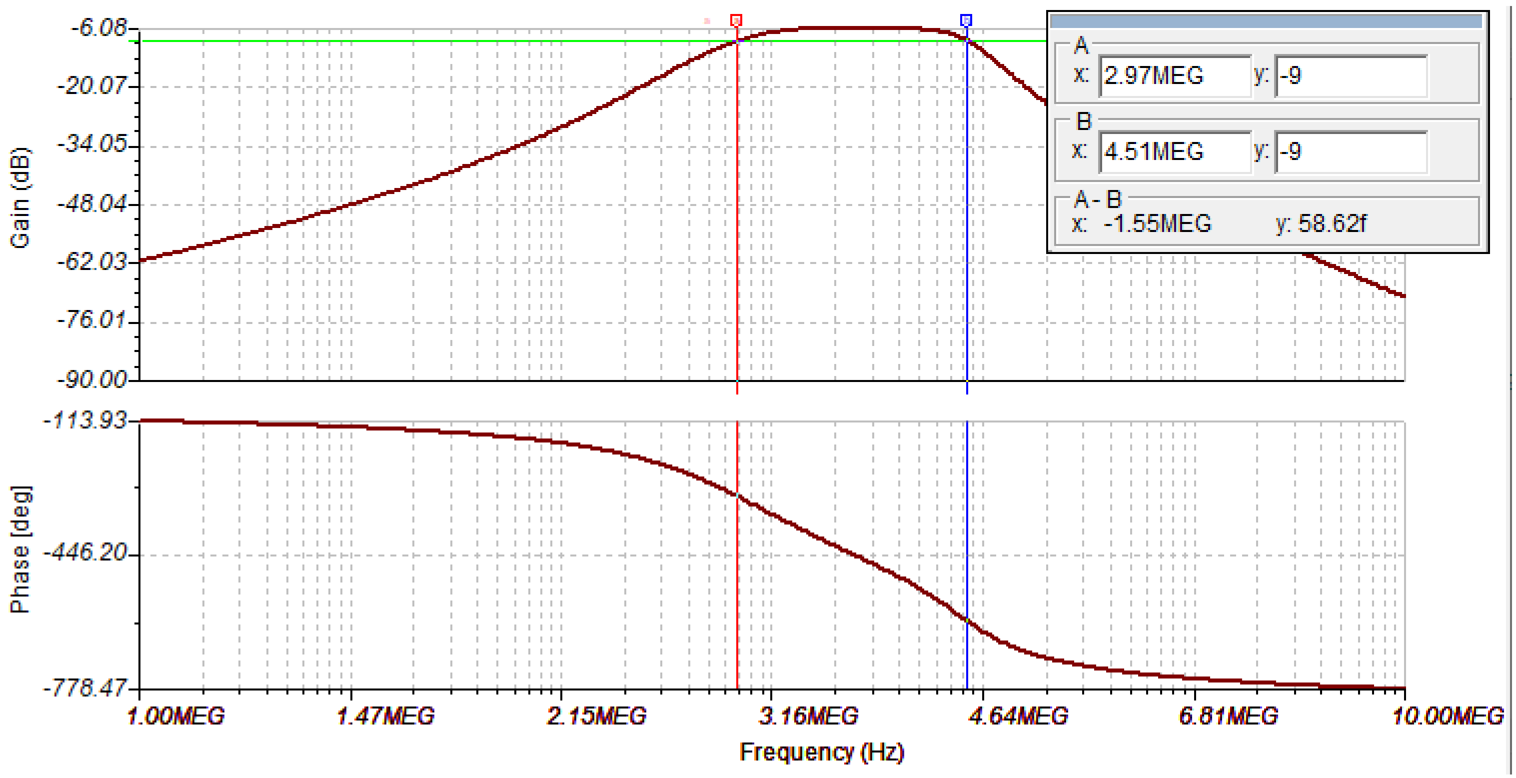
80m Transmit/Receive



10m Simulation



80m Receive



-6.08
-20.07
-34.05
-48.04
-62.03
-76.01
-90.00
Gain (dB)
-113.93
-446.20
-778.47
Phase [deg]
1.00MEG
1.47MEG
2.15MEG
3.16MEG
4.64MEG
6.81MEG
10.00MEG
Frequency (Hz)
A
x: 2.97MEG y: -9
B
x: 4.51MEG y: -9
A - B
x: -1.55MEG y: 58.62f

Additional Comments

- The NVARC project page emphasizes that the filters should be installed between the transceiver and the antenna; If the rig has an internal tuner, it should be disabled. When required, the tuner should be located between the bandpass filter and the antenna.
- There was some speculation as to whether BPFs are more effective on the receiver side or the transmitter side. The club plans to experiment different bands, each with a bandpass filter can report S units when the other rig “keys up” with and without bypassing the filters.

Additional Information

Tina Simulator (free!):

https://www.ti.com/tool/TINA-TI

Resonance:

https://www.electronics-tutorials.ws/accircuits/parallel-resonance.html

https://www.electronics-tutorials.ws/accircuits/series-resonance.html

Max Power Transfer:

https://ultimateelectronicsbook.com/maximum-power-transfer-and-impedance-matching/