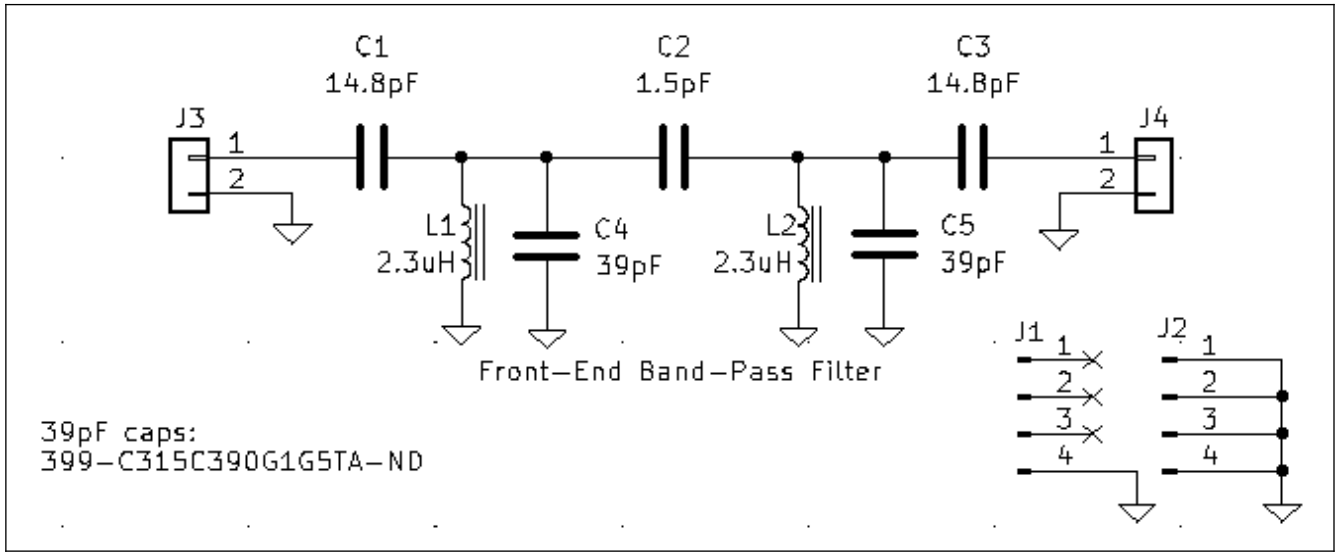
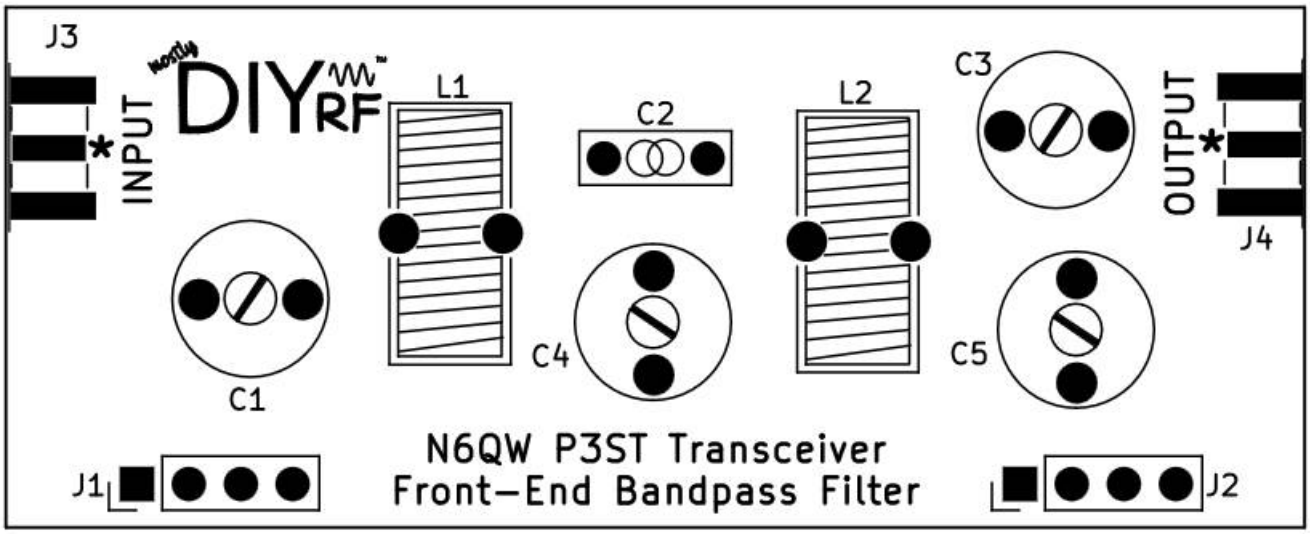
Mostly DIY RF / P3ST Transceiver
Front-End Bandpass Filter

Assembly and Test Instructions

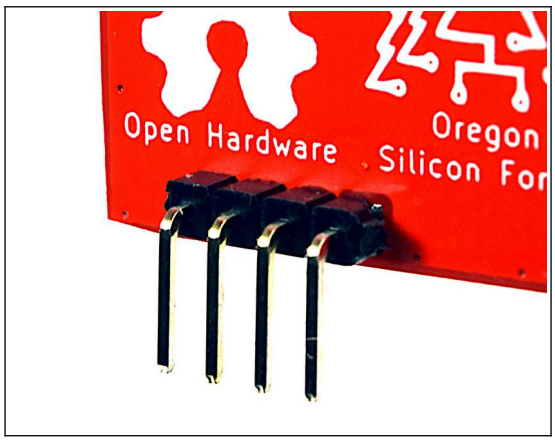
Inasmuch as one wants a transceiver to transmit and receive only on desired frequencies, it makes sense to eliminate (or significantly attenuate) out-of-band signals at the earliest opportunity. For the receiver side of the P3ST transceiver, that is the role of the band-pass filter (BPF). Ideally, a sharp-cutting filter would pass only the desired signals, but for analog filters that would also mean excessive "insertion loss," the attenuation of some of the signals you want. Thus a band-pass or low-pass filter is a compromise (as is pretty-much everything in all types of engineering). It is a nodal capacitor-coupled (non-Cauer) BPF design.



Assembly



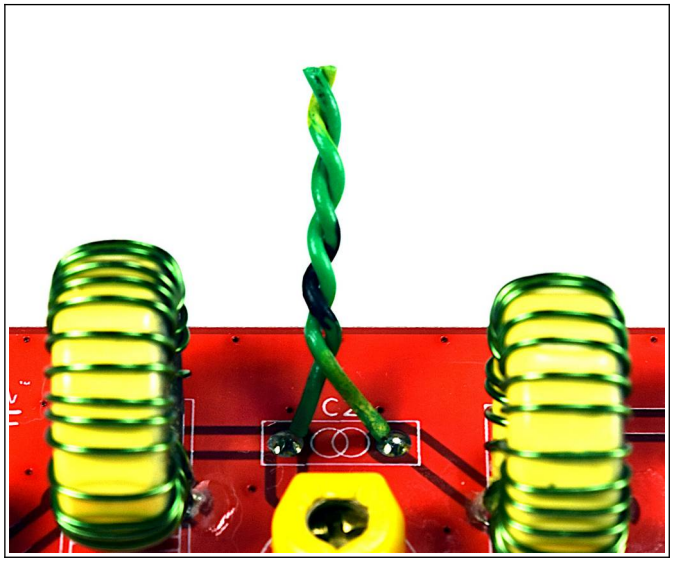
1. As with the 4-pin headers on all the modules, install them with the right-angle pins extending out the back side of the PCB. Also as with all the modules, the input and output pads may be used either to attach board-edge-style SMA connectors or, with the help of the thru-holes in the middle of the pads, directly-soldered connections may be made.



Four-pin right-angle header orientation

2. Install trimmer capacitors with their flat side facing right (red C1 & C3) or facing up (yellow C4 & C5). If you have the means to measure small capacitances, preset each trimmer near the values called out in the schematic before installing them.

3. C2 is a "gimmick' capacitor. It is formed of insulated solid-strand wire (22AWG) twisted tightly (6 to 8 twists per inch). Strip about a 1/4 inch of insulation off one end of the wires. Leave the other ends insulated, and make sure they are not shorted together. Again, if you can measure small capacitances, trim the resulting "capacitor" to approximately 2pF. At that point it will be well under two inches in length. You will later trim it down to about 1.5pF.



4. Using the T50-6 toroid cores, wind L1 and L2 using the 26AWG enameled wire provided. Each will required 24 turns (about 18" of wire). Remember that a turn is counted as every time

the wire passes through the toroid. If this is your first time winding toriods, see W2AEW's video: **https://bit.ly/w2aew-toroids** and N2CQR's **https://bit.ly/n2cqr-toroids**.

Do not apply coil dope or any other coating to the windings at this time. This will allow you to adjust the windings by moving them closer together (increasing inductance) or further apart (decreasing inductance). The magnet wire included has a "solderable" enamel coating. Theoretically, you can solder right through it. Do not trust this claim. Instead, you should tin the leads on the wound toroids by running a soldering iron charged with solder along the leads, perhaps back and forth several times. Once tinned, the leads can be reliably soldered to the PCB. If you wish, you can apply a small drop of multi-purpose glue where the wound toroid touches the PCB to stabilize it. Avoid getting the glue on more than a few turns.

Static Test Procedure

1. Using magnification, visually inspect both sides of the PCB to look for solder bridging or other conductive debris. It's usually best to clean off flux residue first. Because the power, input, and output pins are closely-spaced, do not use alligator (a.k.a. crocodile) clips for temporary connections. Dupont-style jumper leads, however, are very convenient for this purpose.

2. As you can see from the schematic, there should be ***no*** DC continuity between the input and output pads on the PCB. Also clear is that there ***should be*** DC continuity between the top of each shunt inductor and GND.

3. Ensure that pins 1-3 on J1 are isolated from GND (they should have no connection at all), and that pin 4 of J1 and all the pins of J2 have good continuity to GND.

Dynamic Test Procedure

The surest way of dynamically testing a filter is to examine it with a vector network analyzer. If you have one (including a nanoVNA), look at this BPF to have a passband (3dB down) from just under 14MHz to somewhere over 15MHz. It will be instructive to adjust the trimmer capacitors while observing the passband. Adjust for the center of the passband to lie over the SSB portions of the 20 meter band. If you find that the passband has two peaks, this means there is too much coupling between the two halves of the filter. This coupling is accomplished through the "gimmick" capacitor. To reduce the coupling, trim the capacitor (in maybe 0.10" increments) until the two peaks merge into a single peak.

To see this sort of dynamic testing being done, watch the videos by M0NTV at **https://bit.ly/m0ntv-bpf** (on a similar BPF) and by ZL2CTM at **https://bit.ly/zl2ctm-bpf**. For examples of how to do this with a signal generator and oscilloscope, see videos by N2CQR at **https://bit.ly/n2cqr-bpf** and by VE6WV at **https://bit.ly/ve6wz-bpf**.

General Tips and Tricks

■ Save yourself some troubleshooting grief later on: test every part before you install it. Though MDRF uses components only from reputable sources, even those have finite failure rates. Testing is easier than it sounds, and it's quick since you only need to test for part failure.

- **■ Test resistors for continuity and approximate value (±5%)**
- **■ Test capacitors for *no* continuity. DC resistance should be infinite or ultra high after they charge up during testing. Note: this may take several seconds since the current an ohmmeter injects is very low.**
- **■ Test diodes to ensure no reverse continuity.**
- **■ Test transistors for high or infinite collector/drain and emitter/source DC resistance. Use diode test function to test base-emitter junction (base as anode).**

■ Double-check component markings and color codes. Pin up a reminder chart nearby. Whether you need it or not, look it over before an assembly session.

■ It's usually easiest to begin stuffing parts in the center of a PCB and work your way out.

■ Insert component leads and bend them about 45 degrees to keep the parts from falling out when you flip the board over to solder on the backside.

■ The PCB holes are "through-plated" (copper plated and solder coated on the insides of the holes) for maximum connectivity and mechanical strength, but this makes rework (removing a part and installing a new one) a little more difficult than with other circuit-board methods. So before soldering, double check the component value and orientation.

■ A good habit is to install components such that they are "right-reading" relative to circuit-board nomenclature. For a resistor, this would mean the color code would read from left to right when the silk-screened legend does. For parts oriented vertically, they should read from top to bottom. For other non-polarized parts (such as ceramic capacitors) it's useful to install so their values can be read at a later time (and not, for instance, obscured by another part).

■ Because the power, input, and output pins are closely-spaced, do not use alligator (a.k.a. crocodile) clips for temporary connections. Dupont-style jumper leads, however, are very convenient for this purpose.