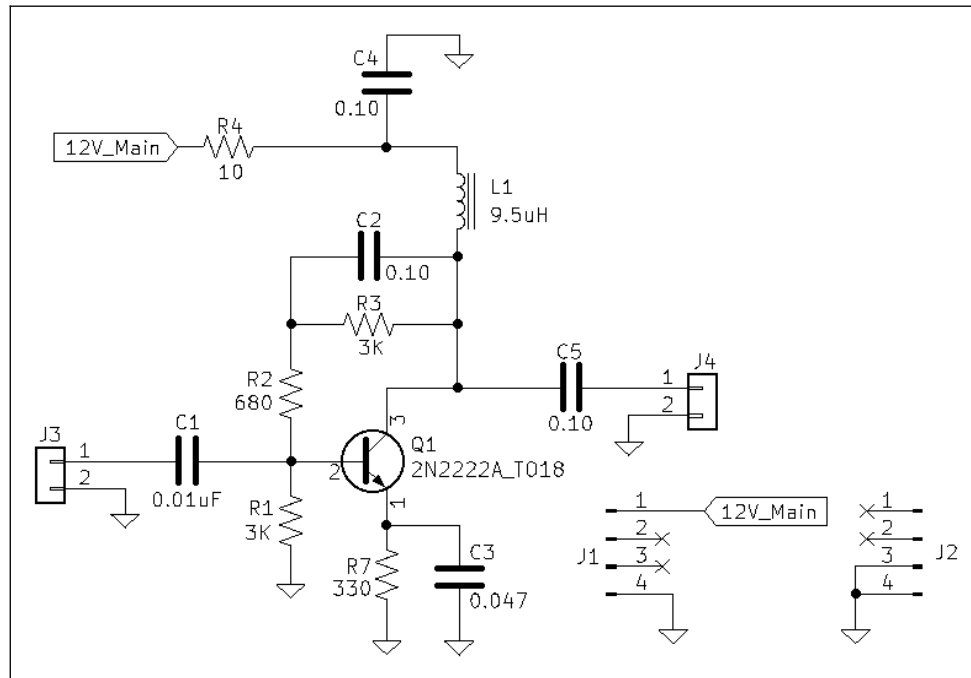


# Mostly DIY RF / P3ST Transceiver Kit

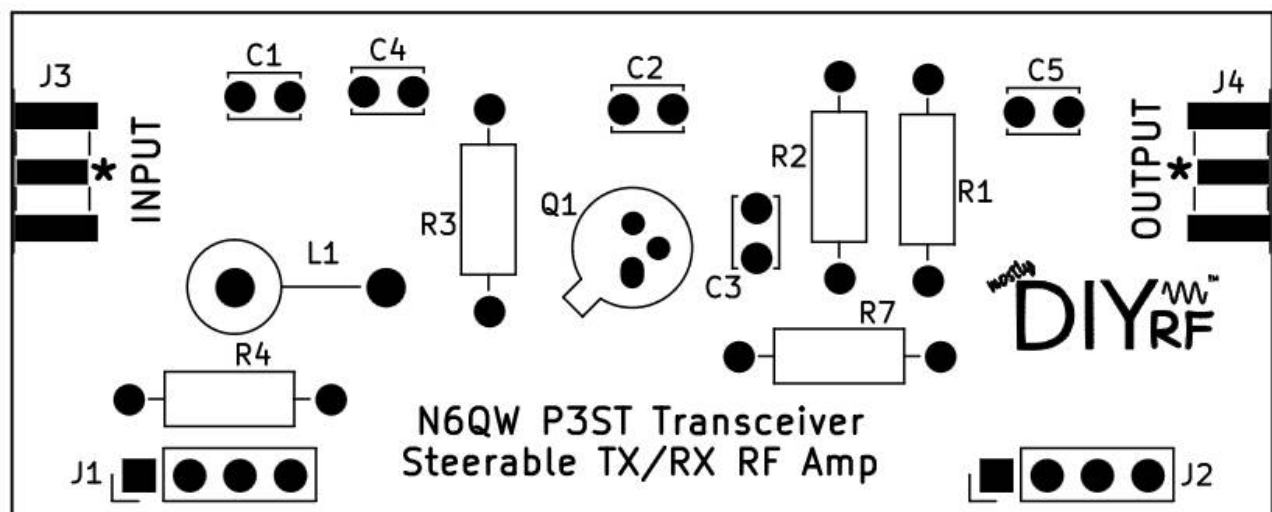
## Steerable RF Amplifier

### Assembly and Test Instructions

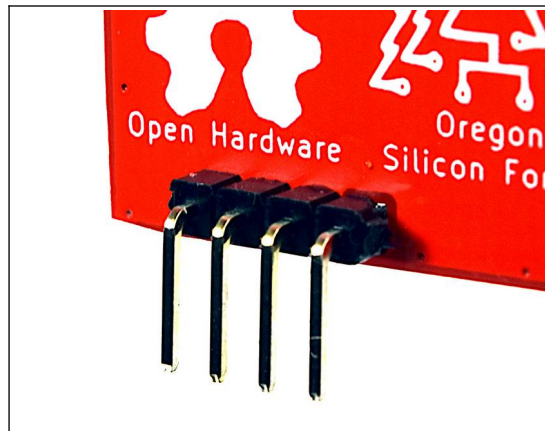
The P3ST's "steerable" mic amp features a single NPN transistor in common-emitter configuration. It has AC-coupled input and output. Like all the P3ST modules, its power and ground connections are made through its 4-pin mounting connectors. Because it is used for both transmit and receive, the module is powered by the always-on 12V line.



### Assembly



1. As suggested by **General Tips and Tricks** (see last page), begin installing components (two or three at a time) near the center of the PCB, bending their leads slightly on the underside of the board to hold them until they're soldered. Prior to soldering, though, double-check their values and orientation.
2. 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

3. When installing the metal-can **2N2222A** transistor, place it so its bottom touches the surface of the PCB. This will allow the top ground-plane of the circuit board to act as a heat sink.

## Static (Pre-Power-Up) 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. Connect an ohmmeter to the **+12V input** pin and one to a **GND** pin. The measurement should settle somewhere around **6.6K $\Omega$** . Anything significantly lower than that means trouble. Aside from solder bridges, the two possible culprits could be a leaky or shorted **C2** or **C4**, or a bad (shorted-out) **Q1**.
3. You must not attempt to power-up the amplifier until you find and correct any problem(s) you found in steps #1 and #2.

## Dynamic (Powered-Up) Test Procedure

1. Use a clean and stable power supply (+12V) for all tests. Because there is no reverse-polarity protection at the module level, take extra care when applying power for testing. All of the following tests are with the module powered-up.
2. Read voltage at top of R1 (the junction with R2 and the base of Q1). It should be near 5.1V.
3. Read voltage at top of R7. It should be about 0.6V below the reading at the top of R1 (about 4.5V).
4. Ensure there is no DC voltage on the amplifier input or output.
5. There are a number of ways to test the signal performance of the amp using a nanoVNA, a TinySA, or a signal generator and oscilloscope. Some care should be taken that whatever method(s) you use that you do not over-drive the input. It's unlikely you'll damage the amplifier by doing so, but your tests will not show meaningful results. It's also important you do not exceed the input limits of the instrument you're using for the testing. Limit the amplifier input to around 15mV peak-to-peak ( $\approx 5\text{mV}_{\text{rms}}$  or  $\approx -32\text{dBm}$ ) and you won't be overdriving it or risk overdriving the test instrument.
6. For more on dynamic testing of small-signal amplifiers, see the videos by W2AEW (<https://bit.ly/w2aew-amptest>), by M0NTV (<https://bit.ly/m0ntv-amptest>), by IASMI Guy (<https://bit.ly/iasmi-amptest1> and <https://bit.ly/iasmi-amptest2>) and by Erik Kaashoek, designer of the nanoVNA and TinySA (<https://bit.ly/erik-amptest>).

## 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 ( $\pm 5\%$ )
- 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.