Connecting the FCC-2 to the Hendricks DC Kits

Bob Okas, W3CD

This is an application note that describes how you can connect the NorCal FCC-1/2 combination to the DC kits. It involves a few extra components and simple, easily reversible modifications. The FCC-2 low impedance output is used to drive the DC kit to provide VFO operation. A simple matching network is used to adapt the FCC-2 output to the DC kit crystal oscillator stage. The DC keyer chip controls the FCC-2 output frequency, so advanced features such as dual VFOs and split operation are available.

To implement the modification, you will need the following items:

1. T37-6 toroid
2. 30” of 30 AWG enamel wire
3. 22 pF NPO capacitor (DC-40A kit only)
4. Solid hookup wire
5. 12” of 24-30 AWG stranded hookup wire
6. 6” of RG-174 coax or similar
7. 1/8” mono phone jack
8. RCA jack (recommended) or BNC connector
9. An oscilloscope (preferred) or RF probe.
10. 5 Watt dummy load and optional power meter

1. Preparation

- ❑ If you haven’t yet assembled your kit, follow the kit instructions for Groups 1 &2. If you’re modifying a completed kit, remove the following components:

  - o C31
  - o C33
  - o C41
  - o Q4
  - o R16
  - o X1

  You can clip out C31, C33 and R16, but the rest must be unsoldered and the plated holes cleared.

- ❑ For a new kit, install the components listed in Group 3 of the instructions, but don’t install C31, C33, C41, Q4, R16 or X1. Figure 1 shows how the board should appear after you complete this step.

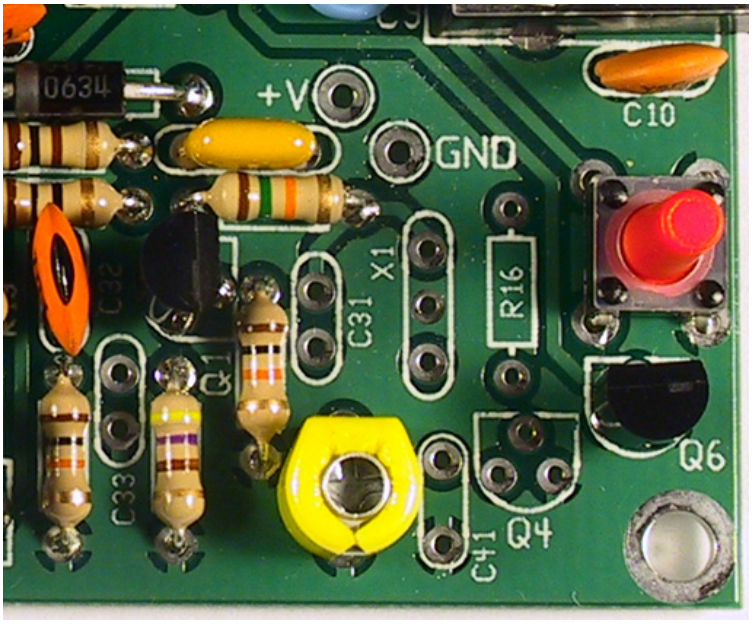

Figure 1. DC Rev A Kit Ready for Modification

2. Board Modification

- ❑ Refer to Figure 2. On the solder side of the board, cut the trace from C34 to C41.

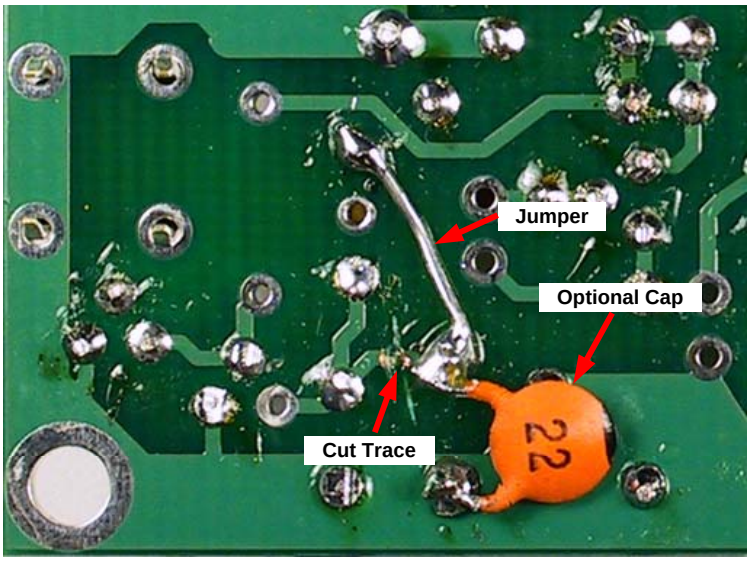

Figure 2. DC Kit Rev A Solder Side Modifications

- ❑ Refer to Table 1 for toroid winding data. Wind the appropriate number of turns for your particular kit. Strip the enamel coating and tin the wire close to the core.

Band	Turns
40m	50
30m, 20m	33

Table 1 Toroid Winding Data

- ❑ Install the toroid into the outer plated holes of X1, as shown in Figure 3.
- ❑ Install a jumper wire between the top pad of C34 and the top pad of X1. If you are modifying a 40m kit, you will need to install a capacitor across C34, as shown in Figure 2.
- ❑ Use two 6” lengths of stranded hookup wire to bring out the keying signal for the FCC-1. Attach the “hot” lead to the center pad of Q4. Attach the ground return lead to the right pad of Q4. Connect the keying signal to the 1/8” jack. The ring is ground and the tip is the hot lead.
- ❑ Strip one end of the coax and tin the center conductor. Clip off several strands of the shield so that it will fit into the bottom hole of C41.
- ❑ Install the coax jumper at C41. The center conductor goes into the top hole while the shield is soldered to the bottom hole.
- ❑ Strip and tin the other end of the coax and attach the RCA or BNC connector. This is your VFO input jack. That’s it for the mods.

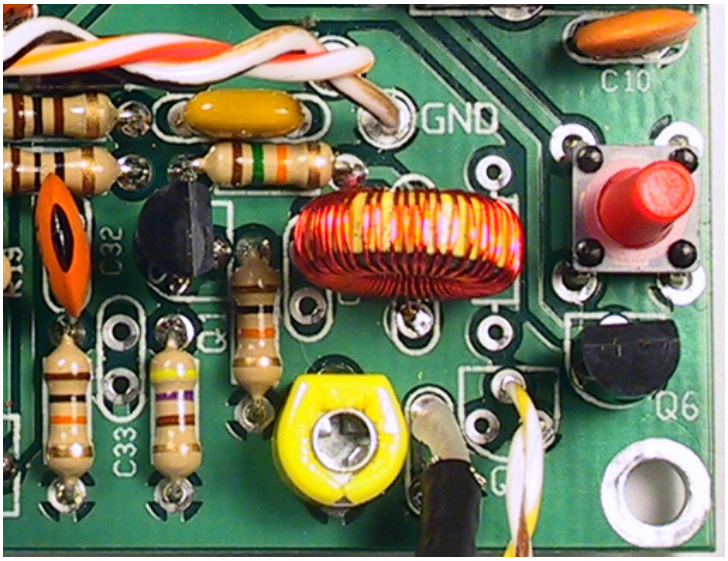

Figure 3 DC Kit Rev A Component Side Modifications

3. Smoke Test

Before we check out the full DC kit, we need to set up the FCC-2 and verify the modifications.

- ❑ Set the FCC-2 GAIN pot fully clockwise.

- ❑ Apply power to the FCC-1/2 and set the FCC-2 programming values as follows:

    - TX IF Offset: 0 KHz
    - RX IF Offset: 0.600 KHz
    - TX Calc: Direct
    - RX Calc: VFO + IF

- ❑ Dial in the frequency appropriate for your particular DC kit. For the DC-20A, use 14.060 MHz. Use 10.106 MHz for the DC-30A and 7.040 MHz for the DC-40A. Wait at least 30 seconds to allow the value to be recorded as the last used frequency in the FCC-2 firmware, then remove power.

- ❑ Connect the FCC-2 LO-Z output, J2, to the coax attached to C41.

- ❑ Connect the DC keyer signal to the Key Input connector, JP2 on the FCC-1 board. Make sure the DC keyer “hot” lead is connected to JP2 pin 2.

- ❑ Apply power to both the DC kit and FCC-1/2.

- ❑ If you have a scope available, connect the probe between the top pad of the DC kit C33 and ground. Observe the waveform and adjust C34 until you see at least 10Vpp output. The waveform should be rectangular in shape with a duty cycle less than 50%. If you’re using an RF probe, adjust C34 for maximum output.

Now we’re ready to perform the Group 3 smoke test. Use the following steps instead of those provided with the kit.

- ❑ Connect a paddle and headphones. If you’re modifying a previously built kit, connect a dummy load as well. Make sure the FCC-2 is still connected.

- ❑ Apply power to the DC kit and the FCC-1/2.

- ❑ Click and hold closed the switch until you hear the letter “T” in the headphones. The keyer is now in Tune mode. Tapping the DASH paddle will put the rig into Transmit mode. It will remain so until you tap the DOT paddle. You can continue to toggle back and forth between transmit and receive using the DOT and DASH paddles. To exit tune mode, click the switch again.

- ❑ Set your “big rig” receiver USB mode and dial in a frequency 1000 Hz higher than the FCC-2 setting. Connect a test lead to your big rig and drape it near the DC board. You should hear the FCC-2 signal.

- ❑ Now enter the DC tune mode and key the transmitter. The tone in your receiver should drop to 400 Hz, indicating that the FCC-2 is in transmit mode. If not, correct the keying input to FCC-1 JP2.

- ❑ This completes the Group 3 smoke test. If you’re building a new kit, complete Group 4 assembly.

After Group 4 has been assembled, you can perform the final tests in the DC manual. Since the kit has been modified for VFO operation, one final adjustment will be necessary.

- ❑ Connect a dummy load to the RF kit output. Monitor the RF output voltage with a scope or RF probe.

- ❑ Fine tune C34 for maximum output power. With a 13.8V supply, you should see over 1 Watt.

5. Operating Tips

With the FCC-2 hooked up to your DC kit, you have the freedom to move about the band. Plus, a lot of operating conveniences await you.

You can use the dual FCC-2 VFO feature to dodge QRM while still maintaining your transmit frequency. Simply copy the current VFO 1 setting to VFO 2 and enable Split operation. Use VFO 1 to tune around the receive signal to put the interference outside the receiver’s audio bandpass filter. As programmed, the FCC-2 receive frequency was set 600 Hz higher than transmit, just like the stock kit. You can change this offset to suit your preference, but remember that the keyer sidetone will remain at 600 Hz.

RTTY operation isn’t recommended with the stock kit because Q2 can get quite hot during extended key-down periods. Adding a heatsink will help, but this hasn’t been tried. It’s a good area for experimentation, but keep in mind that Q2 may become inoperable.

There is one important thing to keep in mind: The matching network that was added to your DC kit is a resonant circuit. Without the FCC-2 connected, Q1 will oscillate at a frequency which is likely outside of a ham band. Don’t transmit without the FCC-2 connected and operating.

6. Theory of Operation

The DC kit requires at least 13Vpp at the base of Q1 for full output power from the transmit stages. In the stock kit, this is provided by X1. The FCC-2 output is designed for 2Vpp output into a 50 Ohm load, so impedance matching is required. The added L network transforms the low output impedance of the FCC-2 to a higher impedance suitable for driving Q1, subsequently providing the required drive voltage.

The keyer chip Mute signal is used to control the keying of the FCC-2. When the DC kit is in receive mode, Q6 is nonconducting and the internal pullup resistor in the FCC-1 pulls the keyline to +5V. When you start sending, the Mute signal switches to +5V and turns on Q6. The key input to the FCC-1 goes to 0V and the VFO switches to the transmit frequency. It takes about 1ms for the FCC-2 to change its output frequency. The DC Mute stays low during active keying, so the FCC-2 produces the transmit frequency as long as you're operating your key. After you stop sending, the keyer chip drops the Mute signal to 0V and the FCC-2 changes its output to the receive frequency. Again, this takes about 1ms.

7. Conclusion

Adding VFO control greatly magnifies the fun one can experience with a minimalist rig. You can operate anywhere in the band and adjust the receive frequency to eliminate QRM and get the tone that's pleasant to your ears. Working split is straightforward for Foxhunts or chasing rare DX. Many pleasant operating hours await!

73,
Bob – W3CD