
Drake R-4 and T-4 Series Internal Frequency Display and VFO Supply Regulation

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Introduction

I've been collecting and using Drake equipment for about 40 years. Recently I became curious if an internal frequency display could be mounted inside of my R-4C and T-4XC. I came across a mini 1-50 MHz frequency counter on eBay, and ordered a couple of them to experiment with. I was immediately impressed, and I started the task of testing it on both the R-4C, and T-4XC. The test proved that the counter was compatible with both R-4 series receivers, and T-4 series transmitters. I assumed it would be difficult to figure out the mounting, however, it turned out to be

pretty simple.

There is one thing that is worth nothing before we start the upgrade process:

I installed the counter in 2 different R-4Cs, with similar drift characteristics. Both drifted close to 1 kHz over about a 3 hour period. Different results were obtained in both, as far as frequency stability. Both receivers also received better PTO voltage supply regulation; per the procedure at the end of this article.

My first installation was a 16K serial number model. It had plastic gears. The second R-4C was a 29K serial number, and it had metal gears. I chose to remove the plastic gears on the 16K receiver; making it have almost zero drag characteristics. I kept the metal gears in



Figure 1: This classic Drake R-4C receiver has been upgraded with a modern digital display.

place on the second, but I removed one of two idler gears that keep the gears under pressure. Both upgrades were electrically identical.

The end result showed drastic improvement in drift in the 16K version to only -100 Hz in the first 15 minutes, then it stopped and the drift changed direction. The drift noted over the next 6 hours was about +200 Hz, but in the opposite direction of the initial 15 minute drift.

The second receiver showed about half the improvement of the first. Does that confirm the drift Drake users have attributed to heat effecting the PTO electronics was actually been from heat effecting gear train mechanics to one degree or another? More testing is



Figure 2: Here is the counter outside the R-4C receiver. To purchase one, search for the eBay seller i.d. "Elecbuy" using the "advanced" search feature.

required.

Adding an Internal Digital Frequency Counter

These counters (figure 2) are distributed by an eBay seller "elecbuy," There are several important things to note:

- The counters are affordable; running between \$10-12 from

the above seller.

- These counters are easy to install in about 2 hours.

- I've installed this in my T-4XC and R-4C with the same results. This upgrade will also work in the older lines of the T4 and R-4 series.

- Required power is 8-15 volt DC.
- The small size, (3.5 x 1 x .75 inch) makes it easy to install internally or externally.

- It has a provision for one positive or negative IF offset, in this case 5645 kc.

- It has the capability to read down to 100 or 10 Hz resolution.

- Intensity can be adjusted in 1-8 steps.

Installation Steps

1. Measure the DC voltage at the C-166 electrolytic, see figure 3. If it's less than 15 volts, the power for the counter can be received directly from this location. I've measured this in three R-4Cs, and they have all been the same.

2. Remove the front panel, and the VFO, to gain access to the dial plates. Removal of the dial plates is required to make room for mounting the counter. As an option, the gears can also be removed if you prefer a freely moving dial with no backlash. I personally prefer the later.

3. Cut the #47 bulb wires and remove from the holder unit. Heat shrink the exposed ends of the wire, and tie them



Figure 3: Location of C-166

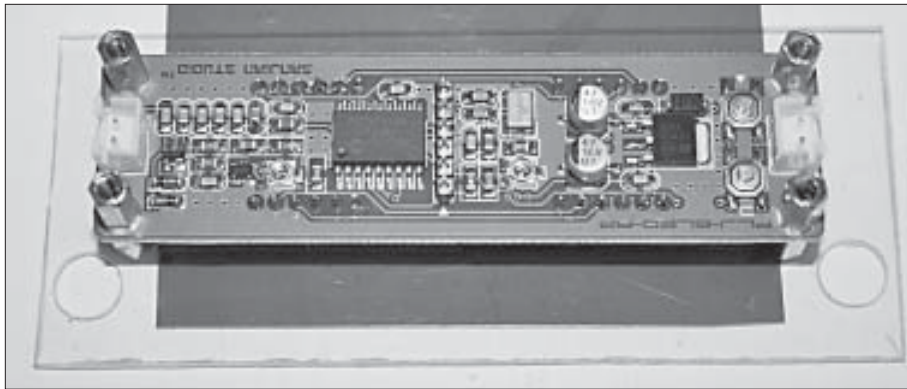


Figure 4: The frequency counter has been mounted to Plexiglas.

out of the way: it will no longer be needed.

4. Before mounting the unit, hook the counter to a 9 volt battery, and experiment with the two programming buttons to better understand their use. To set in the IF offset, you need to cycle the first digit to the left through its range from 0-9, then back to zero. This is done with the lower button. Press the lower button, and the first digit front the left will start blinking. Pressing the top button will let you increment that digit. Once it's back to zero, press the top button and that will increment to the next digit. Each press of this button gets you to the next digit. Pressing the bottom button enables you to enter your offset digits. You can view a YouTube video to walk you through the process at: https://www.youtube.com/watch?v=1_neC5Z_wEg

5. Once the 0.5645.00 offset is entered, set the IF to a "U" (upper).

6. The last settable option is the display brightness; entered from 1-8, with 8 being the brightest.

7. Make note that the counter input positive and negative is reversed from the standard coloring used on the the

connectors input. The counter input is the black wire and the ground is the red. It's correctly labeled on the board. The counter's DC input color code is correct with red being positive; and black being negative.

8. I used a piece of 4 x 2 x 1/16 inch Plexiglas (**figure 4**) to attach the counter. I suppose that the old, original clear window could also be used if you prefer not to cut Plexiglas. Two mounting holes need to be drilled in the same position as the original blue filter holes that you can use as a template. These will be used for mounting the completed unit to the rear of the front panel, as indicated in this picture.

9. Place the unit inside against the rear side (see **figure 5**) of the window, and position it so the display is centered in the window. Mark the location with a felt tip pen on the Plexiglas where the unit needs to be glued.

10. I used E-6000 adhesive to mount the counter to the Plexiglas, although any Silicon based product will work. Put a small amount on each of the standoffs located at each corner, in addition to the corners of the blue filter material, to hold it in place. Using adhesive has

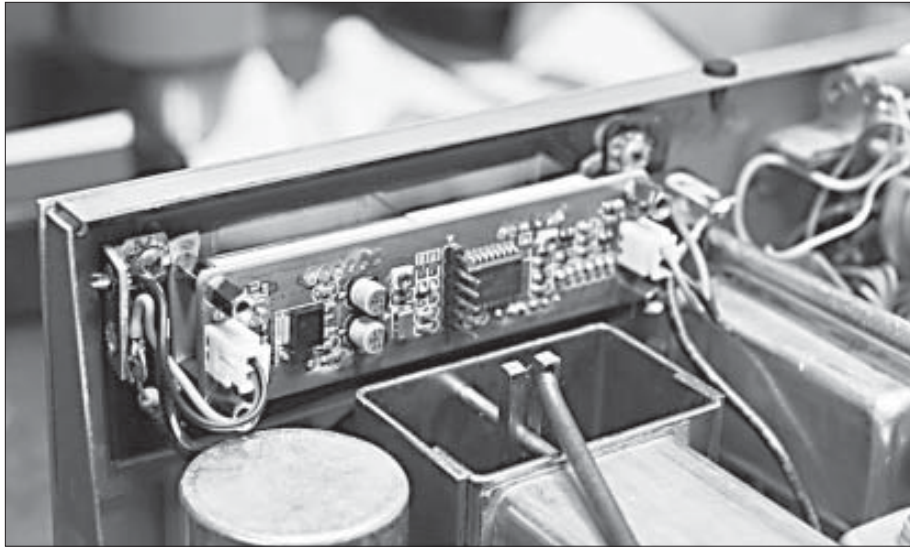


Figure 5: The counter has been temporarily mounted for marking on the Plexiglas.

proven to be a good method for mounting.

11. Once the adhesive has dried, (approximately 24 hours), the unit can be added. Mount it to the panel where the original frame was located that originally held the blue and white filters and a #47 bulb.

12. I used 2-post terminal strips, shown in **figure 6**, on each mounting screw as a convenient termination point to solder

the power and counter input wires.

13. Route the power wires to your power source: in my case C-166.

14. Use RG-174, or other shielded cable, to route the counter input to the injection jack on the rear inside of the unit through a 27 to 100 pF coupling cap. I've used 27 pF with no ill effects. You can determine the optimum value using an O-Scope to watch the Injection signal for indications of loading. The

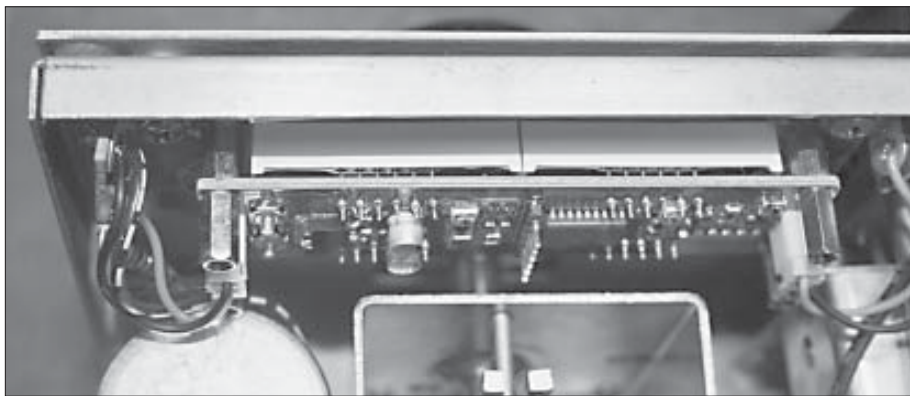


Figure 6: Terminal strips are used as a wiring termination point.

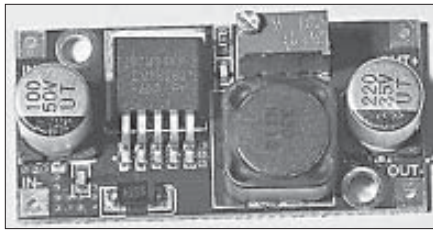


Figure 7: The power supply step down module can be purchased from eBay by searching for the seller “ashleytrade84 “ or possibly direct from the Chinese manufacturer, “comelili.” For an eBay item search, use the title “DC-DC 3A Buck Converter Adjustable Step-Down Power Supply Module LM2596S.”

coupling cap limits counter loading on the injection line.

15. Before installing the front panel, power up your unit and check to make

sure it’s all working correctly.

16. Before closing things up, tune into a station on a known frequency. You might need to tweak the offset a few cycles one way or another to match the counter to your listening preference.

17. Reinstall the VFO, front panel and knobs, and enjoy your new radio.

Adding Additional PTO Voltage Regulation to Increase Stability

In checking the voltage supplied to two of my R-4Cs, I found it was not uncommon to see the voltage swing $\pm 1/4$ volt over a 15 minute period at the PTO Zener diode. The Zener is mounted inside of the PTO and regulates the 11 volts being supplied down to 10 volts. On the surface that did not seem like a lot, but I wanted to see if stability could be increased through greater voltage

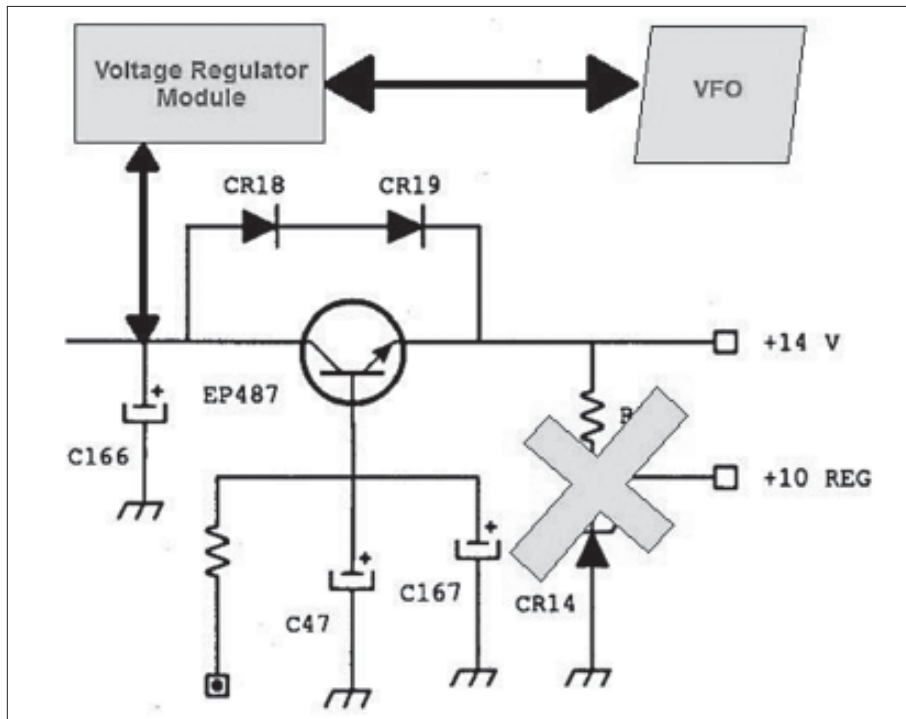


Figure 8: Wiring Diagram for Powering the Module

regulation.

Since the purpose of the PTO Zener diode is to try and regulate that voltage, I was doubtful any notable improvements could be obtained, but I thought it was worth a try. With today's technology, a higher voltage regulation is standard and expected. With the part shown in **figure 7**, I've only seen voltage swings at the Zener of maybe .001 volt instead of the noted .25 volts. This has reduced drift.

I installed one of the following step-down power-supply modules in 2 different R-4Cs, and in both cases, better stability was obtained. You can also use it to provide power to the above frequency counter. I've also used it to power the heterodyne oscillator board, but with little improvement noted.

Installation Steps

1. The VFO needs 11 volts supplied through the audio board.
2. I used double sided tape, and mounted the module to the inside front cabinet wall.

3. Run a wire from the power (+) on the new module to C-166 in **figure 2**. This will be used to power the module.

4. Run input wire from the (-) wire to a convenient ground point. I used one of the tabs on C-166.

5. Before hooking the VFO or frequency counter to the module, power up the R-4C and adjust the module output for 11 volts. This can also be done prior to installation using an external supply.

6. Locate the VFO + power wire (**figure 8**), located on the audio board, and rewire it to the new module (**figure 8**).

7. Locate the Frequency Counter positive power (Red) wire, and hook it up to the Output of the module.

8. Locate the frequency counter negative (Black) wire and hook it up to the output of the module.

9. You should now have 11 volts routed to the VFO, and/or, frequency counter.

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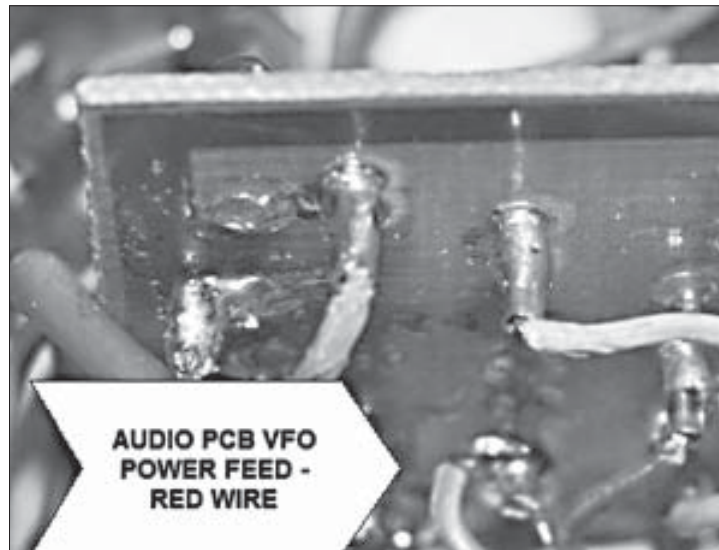


Figure 9: Location of the power feed from C-166