The N4YG DDS VFO and the Drake TR7

Overview

This document describes the installation of a N4YG DDS VFO into my Drake TR7 transceiver. The VFO is a terrific improvement over the original PTO and adds function not present in the original TR-7. Many thanks to AD3G for his guidance and ideas from what may have been the first such installation.

If you are uncomfortable making a serious modification to your TR-7, you should consider building the VFO in an old RV7 external VFO or one of your own design. That would eliminate any modifications to the TR-7 and the new DDS VFO would just plug into the existing RV7 connector on the rear of the TR7.

The documentation provided with the VFO is excellent, and gives you just about everything you need to install the VFO in the TR7. You'll have to find the TR7 connection points for a couple of the interface connections in the TR7 and I've included photos here to show the connection points I used.

While the VFO includes an LCD readout capability, that isn't used when installing the VFO in the TR7. The original digital board and readout are used to display both VFO-A and VFO-B. If building the VFO into an external cabinet, the LCD readout would be an easy and desirable addition.

Mechanical issues

The N4YG DDS VFO (hereafter referred to as the VFO) consists of a single circuit board that comes pre-wired and tested. A complete set of connectors and leads is included to allow for the necessary connections to the TR7. As was pointed out by AD3G, the card will fit in only one place (behind the TR7 dial) and position and can be mounted to the front panel using two of the PTO mounting points. The encoder provided with the VFO is not a good match for the TR7 front panel as the shaft is very short. To mount the encoder, a thin piece of sheet metal must be fabricated to fit between the escutcheon and TR7 panel to hold it.

Proper operation of the VFO demands that you either use existing TR7 pushbuttons or add new ones. Not wishing to alter the existing panel or add a subpanel below the TR7 panel, I chose to use the FIXED XMIT and RCV buttons . Those are used only for selecting crystal control with an AUX card and that was something I decided I no longer needed. The FIXED pushbuttons are latching type switches, but are easily modified to be momentary contact for this application.

I think the best way to work on the TR7 front panel is to remove the top two screws that secure the front panel to the side panels on each side and loosen the bottom screw. You can then hinge the front panel downward enough to get everything done. My VFO board was mounted a bit closer to the front panel than AD3G specified (he used 1" standoffs). Even so, I found that the J3 connector came into contact with the chassis when moving the front panel back into position. I remedied that by clipping off the corner of the connector with a wire cutter and that was possible because the last two connector positions do not have wires attached.

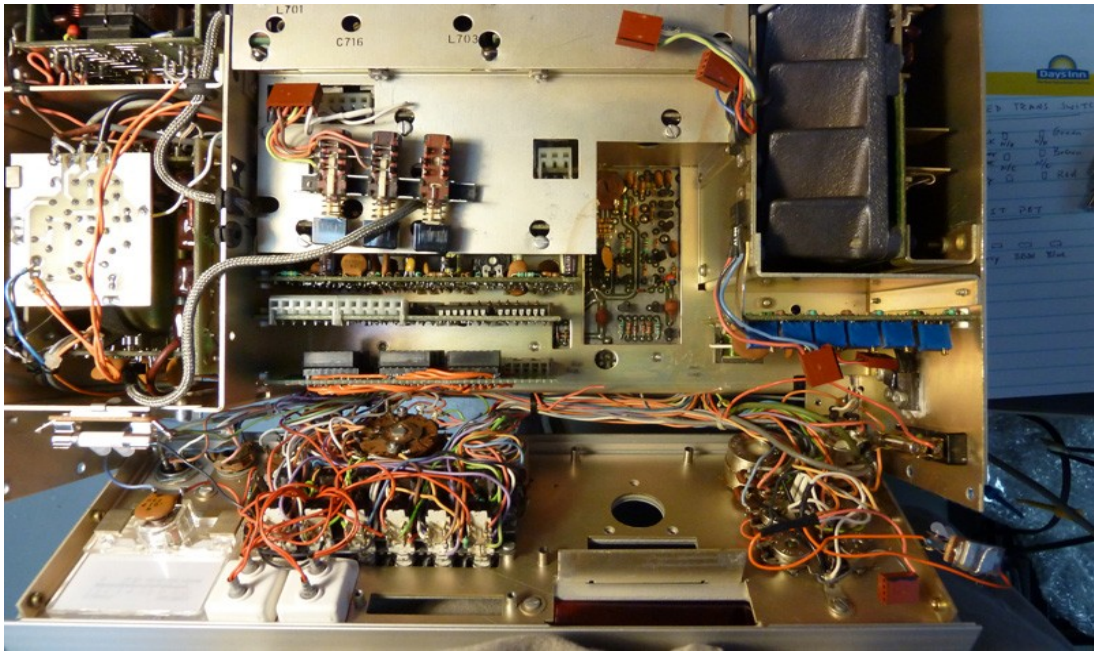

Figure 1: TR7 with the PTO removed and front panel hinged down ready to begin

The wiring of the pushbutton switches in the TR7 is best described as a barrel of snakes. So, if you will be using the FIXED buttons as I did, be prepared for some intricate work.

All of this work requires the removal of the digital board in the TR7 and you'll end up installing/removing it multiple times during installation and testing.

Switch Details

The FIXED switches are easily converted from latching to momentary operation and can even be

restored later if you choose. The following photo shows the small metal wire piece that can be pulled out easily with needle nosed pliers after pulling the spring back slightly. Once that wire is removed, the buttons will no longer latch. If you use the FIXED switches, you'll need to remove all the currently connected wires and make sure to tie together those that would normally be connected via the normally closed switches.

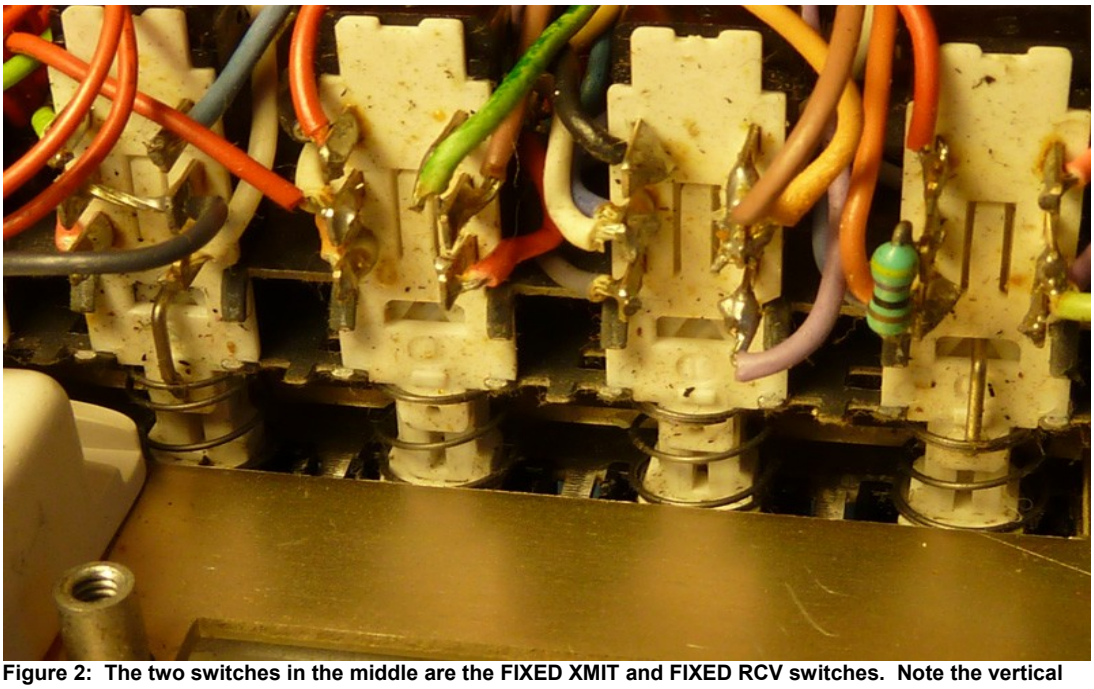

Figure 2: The two switches in the middle are the FIXED XMIT and FIXED RCV switches. Note the vertical wire in the lower center of the two end switches. The wire was removed from the two switches in the middle by pulling back the spring and lifting the wire out with pliers. That converts them from latching to momentary switches.

The STORE switch is also a good candidate for use here, but I had previously used that switch to turn on/off the DF4DW preamp I have installed.

Most of the pushbutton switches on the TR7 have the contacts/terminals mounted in a thin plastic. Those are easily identified as they're white as shown above. When unsoldering/soldering those terminals, you must use some sort of heat sink to prevent melting the plastic. If you do accidentally pull out one of the terminals, it can be reinserted and pushed into place. A dab of epoxy will hold it in place after soldering is complete.

Dial Details

The TR7 dial is replaced by the LED panel described below and the tuning knob drives the new encoder directly. The encoder mounts in a standard 3/8” hole and so you have to somehow reduce the available opening and AD3G came up with the perfect solution for that. Copying his approach, I used a piece of copper sheet (about .020 inches thick) from a roll of copper tape meant for grounding. As you can see in the photo, you drill a hole in the copper for mounting the encoder, along with three addition

1/8” holes that line up with the existing holes in the panel. This piece of copper is then sandwiched between the escutcheon and panel. The slight gap that results between the panel and escutcheon is hardly noticeable.

Figure 3: The encoder mounted to the front panel using the thin piece of copper sheet. Note the terminal strip mounted with the left corner screw - the escutcheon LED leads are attached there. The screws are removed and inserted through the escutcheon when the escutcheon is mounted.

Figure 4: Escutcheon mounted to panel with copper encoder mounting sheet sandwiched between escutcheon and panel.

LED Details

I chose to use all five supported LEDs and those are:

1. RIT active
2. Lock active
3. VFO-A active
4. VFO-B active
5. Split active

Since I used the FIXED switches, I decided the current FIXED lamp was no longer needed, so I used that position for the LOCK LED. For RIT, I replaced the current RIT lamp with an LED. For those two LEDs, I used an LED with a diameter of about xxx", which was close to the diameter of the original lamp. I wrapped a couple of turns of Magic Mending tape around the LED body and that made for a press fit into the old lamp housing. Note that there's no switch for turning on the RIT in the new VFO. When the RIT pot is centered, the RIT LED will be out, but turning the RIT pot either direction will cause the RIT LED to light. For these two LEDs, I used very bright LEDs that duplicate the brilliance of the original lamps.

I mounted the other three LEDs in the old analogue dial window in the escutcheon, above the tuning knob. The original blue plastic filter was removed and replaced with a piece of blank circuit board that was trimmed to fit. The piece was then painted a semi-flat black to make it blend with the escutcheon. Here I used miniature LEDs, which I epoxied into 1/16 inch holes drilled through the circuit board piece. That assembly was then epoxied to the escutcheon.

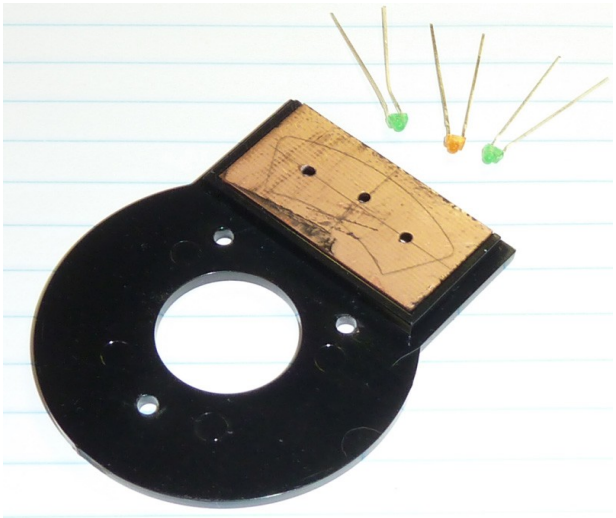

Figure 5: Rear of escutcheon showing the LED mounting plate in place.

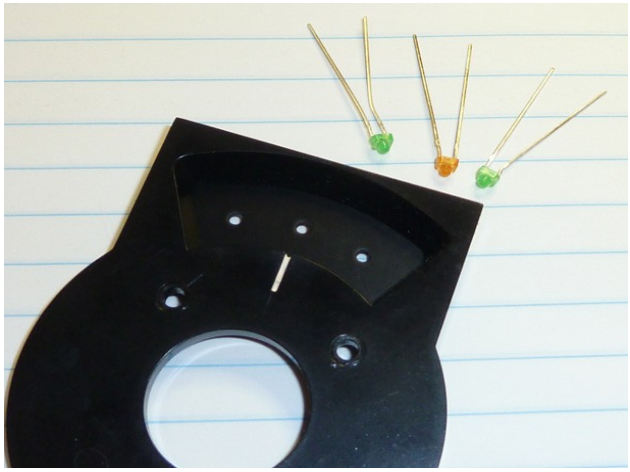

Figure 6: Front of the escutcheon – plate painted satin black.

Figure 7: Finished escutcheon. The center LED is the SPLIT indicator and is yellow. The other two LEDs are for VFO-A and B and are green.

RIT Details

I used the existing RIT pot on the TR7 after removing the existing wires from the terminals (clip the bare ends and use a piece of heat shrink to seal the ends). You no longer need to use the RIT button since the new VFO RIT activates when you turn the RIT pot off of center position.

Interfacing with the TR7

Other than the switches and LEDs, there are a few other connections you'll have to make in the TR7. These are identified in the VFO instructions in general terms, leaving you to fill in the details. In the following, you'll see photos of where I made the connections in the TR7.

The connections you'll need include:

1. DC power supply (Pin 1 of VFO J6 connector)
2. VFO output to TR7
3. Tx/Rx line (Pin 3 of VFO J1 connector)

Since the original TR7 dial lamp was no longer needed, I used the + lead from that lamp as the source of DC power for the VFO. That provides approximately 13.6 VDC.

Unlike the original PTO, the VFO uses a coaxial lead to deliver RF to the TR7 motherboard. Luckily, the motherboard already has an unused hole in the board ground plane right next to the RF input hole and I used that for the coax braid.

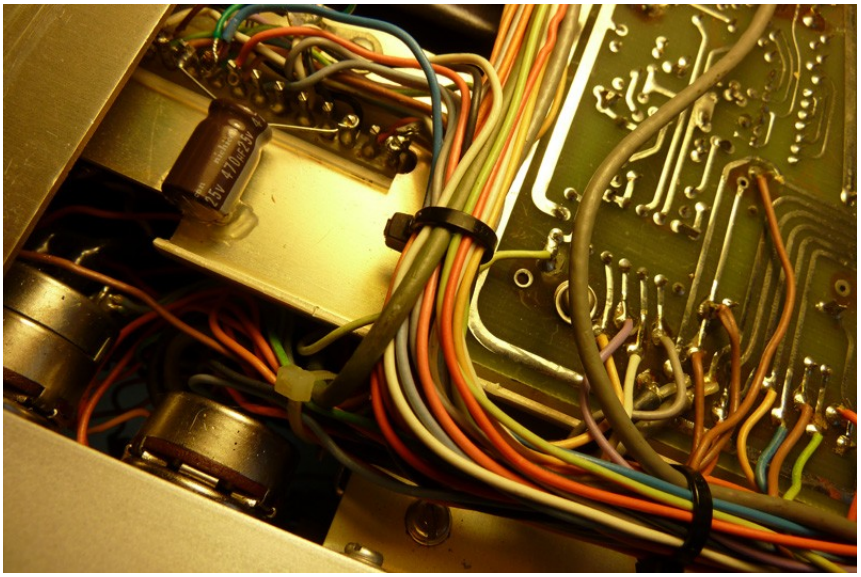

Photo 8: The original RF connection from the PTO to the motherboard is the light green wire just above the screw head.

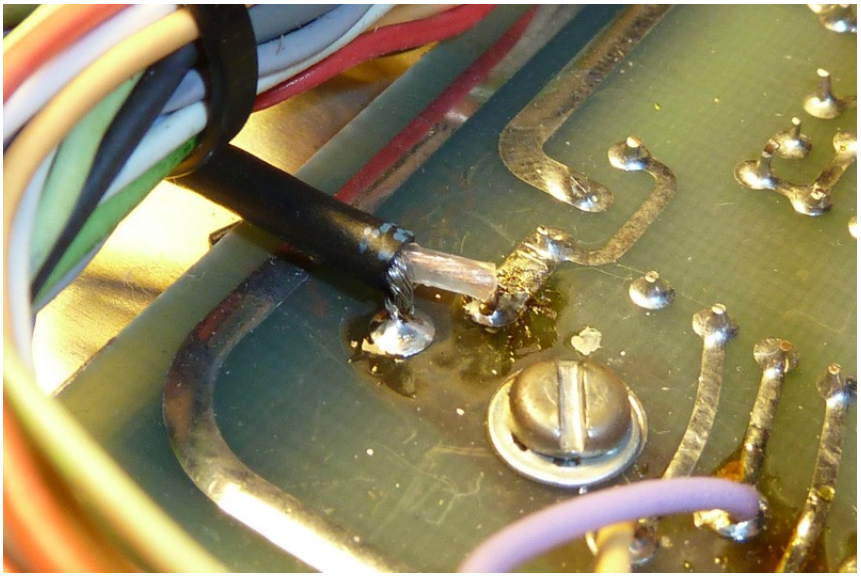

Photo 9: The coax from the VFO - the shield is soldered to the empty hole seen in the above photo.

Regarding the Tx/Rx line: In the TR7, there's a line referred to as +10T which is at 0 volts in receive mode and +10 volts in transmit mode. The +10T line is clearly identified on the motherboard with +10T near the trace and you can solder your connection anywhere on that land. Warning: This line is driven from the transmit exciter board in the TR7 and is not current limited. So, as the TR7 Service Manual warns, if you accidentally ground this line you'll destroy the transistor that drives it.

VFO output level adjustment

The only adjustment required after installing the VFO is to set the RF output level. Unfortunately, the adjustment pot on the VFO as provided will be inaccessible to you after everything is put back together. I replaced that pot with another that could be accessed with a screwdriver in the space between the front panel and the chassis. The VFO instructions advise you to set the level to the minimum that gives stable full performance. I set the output to 1 volt (peak-to-peak) because the Translater schematic in the TR7 Service Manual shows 1 volt peak-to-peak as input from the PTO. The smart thing would be to measure your PTO output level before disconnecting it from the motherboard and removing it.

If you have a spectrum analyzer available, or an SDR such as the SDR-IQ with SpectraVue software, it would be a good idea to set the VFO level while watching a 150 Khz wide band around the carrier. Adjust the VFO output level while watching the strongest spurious responses and set the level to a spot where they are minimized. Using this approach, I found that the original adjustment resulted in spurs that were only 38 dB down from the carrier. Adjusting the output while watching the display allowed me to reduce the strongest spur to -45 dB. The spurs were most prominent on 40 and 20 meters, with 40 being the worst. Note that current FCC regulations require spurs to be down at least 40 dB from the carrier for rigs of this vintage.

The encoder

The encoder included with the VFO really is not a good fit for the TR7. I used a Honeywell 601-VCS encoder from DigiKey and that one has a shaft long enough to use the Tentec tuning knob, but not long enough to accommodate the original Drake tuning knob and skirt. Other encoders with longer shafts are available. The Honeywell goes for $28-40. There are four terminals on the encoder and you'd expect the layout to be standardized, but it's not. The connections are for +V, Chan A, Chan B, and Ground. The VFO connector assumes them to be in that order, but the Honeywell encoder is in this order: +V, Chan A, Ground, Chan B. There is no datasheet available for the Honeywell, so if you use that encoder make sure you reverse the leads in the connector to match the encoder.

Other Photos

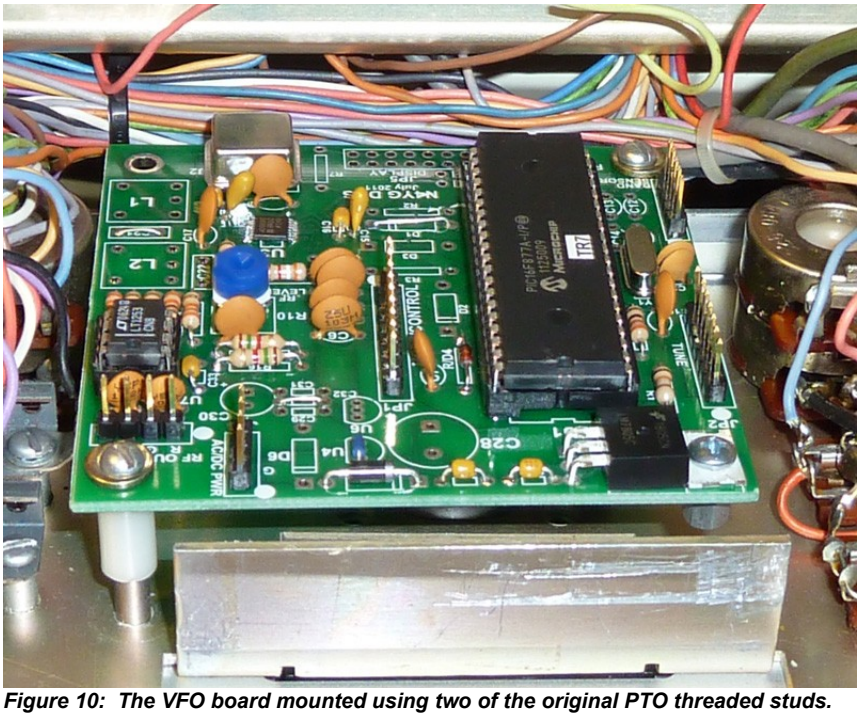

Figure 10: The VFO board mounted using two of the original PTO threaded studs. The board holes are about 1/8" further apart than the studs, but the long spacers and screws can be moved just enough to make things fit.

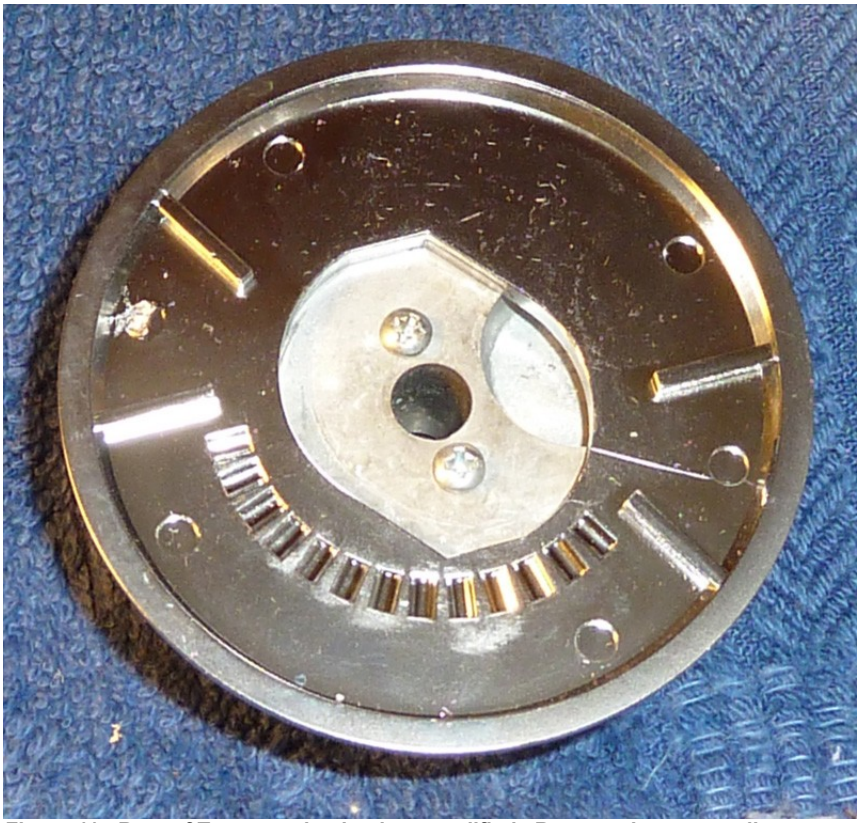

Figure 11: Rear of Tentec tuning knob as modified. Remove the two small screws and take off the friction fingers. Then glue the skirt to the knob body.

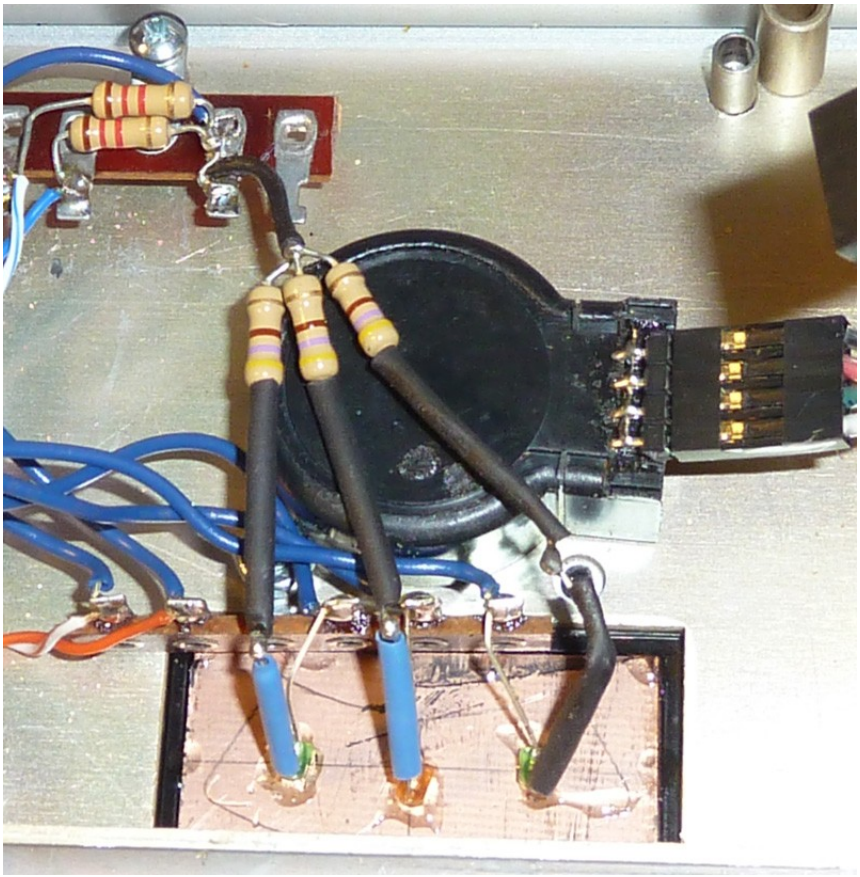

Figure 12: This shows the rear of the escutcheon plate with the LEDs mounted. The blue wires are from the connector on the VFO board. The VFO board fits over all this with room to spare.

Figure 13: I used nylon spacers sitting on top of the old PTO studs for mounting the board. The studs accept 4-40 screws and these are about an inch long.

In conclusion

The N4YG VFO is a reasonably priced approach to solving the PTO problems of the TR7, including stability and tuning rate. The installation is non-trivial and it would be easy to get into trouble while making the modification if you don't have the required skills and experience. These problems can be completely avoided by installing the VFO in an external cabinet (re-use an old RV7). If you don't already have an external enclosure, Tentec makes an excellent line of cabinets that would serve well. One thing you lose with the TR7 internal installation is the ability to read out the frequency to the tens of kiloHertz. If you happen to have a TR7 without the digital board installed, it appears that you could mount the VFO LCD display in the location intended for the TR7 digital readout.

The variable rate tuning takes some getting used to, but that's the best answer to the requirements of a slow tuning rate along with rapid tuning to another part of the band. The DDS VFO solution based on the IQPro is a bit better in this respect as it offers a FAST button that applies additional acceleration to the tuning for large frequency changes, while retaining the slower fixed rate tuning. But, the IQPro solution will cost you at least $100 more. At the time this was written (February 27, 2012) the VFO cost for the TR7 was $139.95 and that included the wired and tested board, encoder, all connectors and wires.

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