Drake TR-7 improvements

By Marinos, sv9dru

The TR-7 remains one of the top choices of a radio which offers extremely clean Rx performance, robust construction and no infestation by the all too usual nowadays DSP sound “enhancement” gimmicks which manufacturers are using to lure customers into buying new rigs.

This excellent rig can be further improved in a couple of areas, with a few straight forward interventions that will bring it to the level of functionality that we have come to expect of the modern radios. This topic has been covered a few times in the past, and I would like to share my experience in two areas:

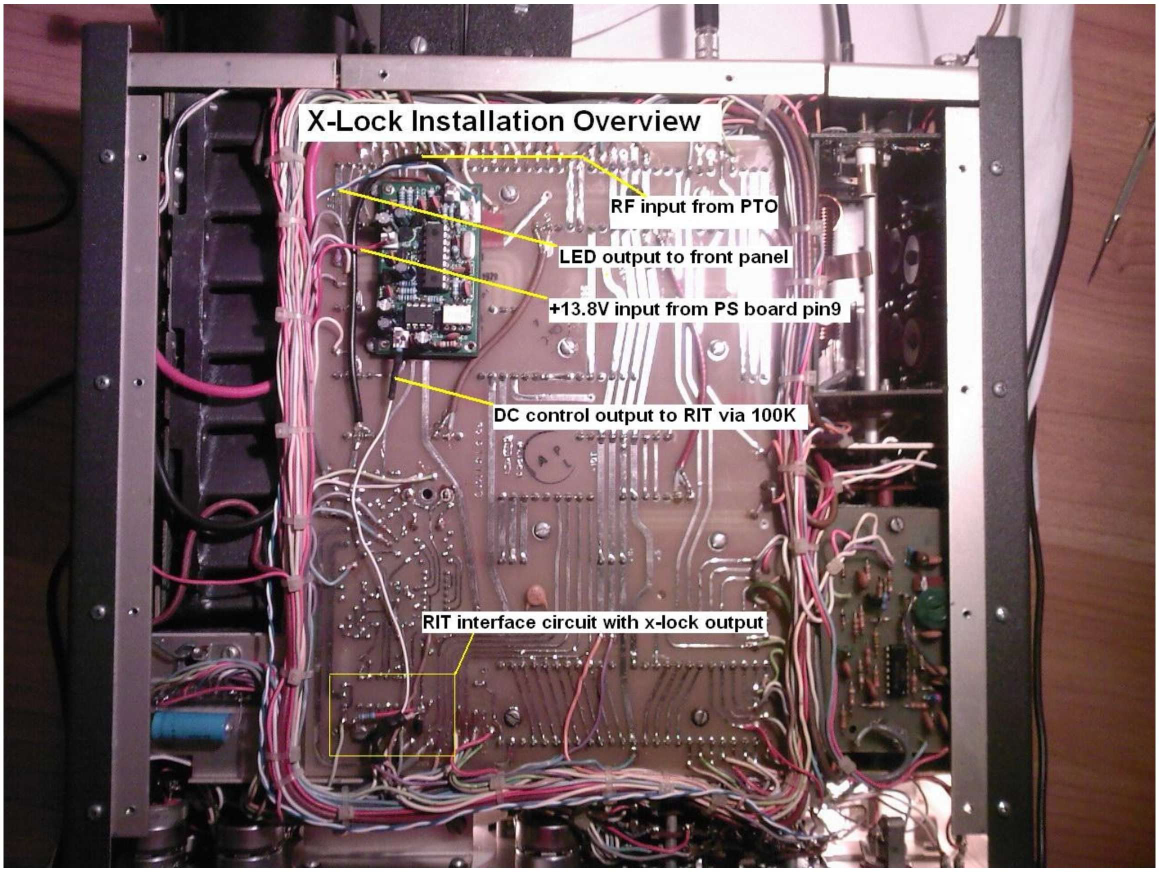
1) Installing the Cumbria Designs x-lock stabilizer in the TR-7

2) Improving the SSB TRx audio quality

Installing the Cumbria Designs frequency stabilizer, a new twist to an old project.

Having an analog PTO gives the TR-7 a low phase noise frequency generating ability, but also its inherent, temperature depended frequency drift. This seems to stabilize quite a bit after 1 hour of operation and can be reduced by installing the optional fan, but cannot be totally eliminated.

The Cumbria Designs X-lock stabilizer kit http://www.cumbriadesigns.co.uk/x-lock.htm is offered at a very reasonable price and has several refinements over the original Huff-Puff stabilizer as well as other similar circuits that can be found on the internet. Following a few simple steps, it can be integrated in the TR-7 and provide rock solid frequency stability from a cold start!!



Installation Overview: A picture is worth 1000 words !

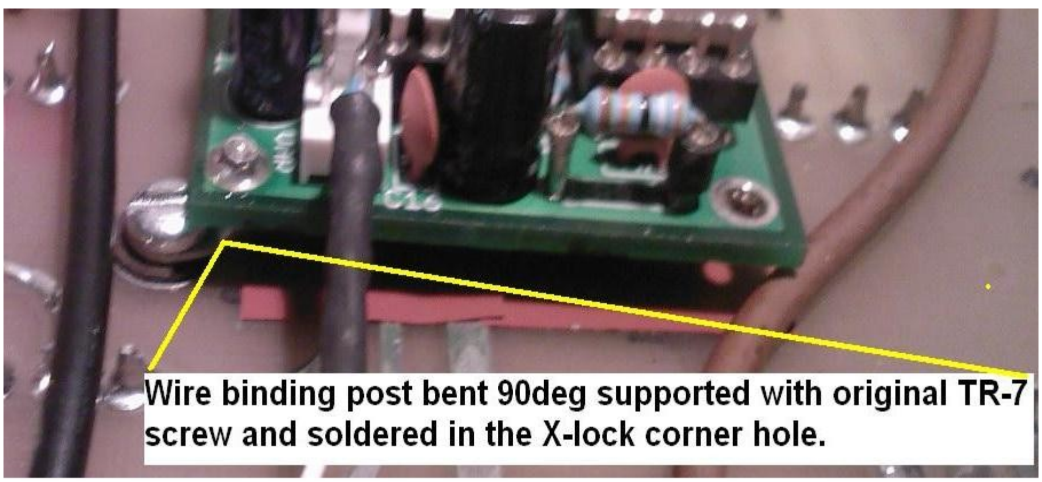
First step: Where and how to install the X-lock in the TR-7.

As luck would have it, 2 of the 4 corner holes in the kit's PCB align perfectly with 2 of the supporting screws in the back left corner of the TR-7's underside.

While someone could potentially try to locate longer screws and pass them through the mounting holes of the X-lock, through short spacers and into their original positions, I choose to do it a simpler way:

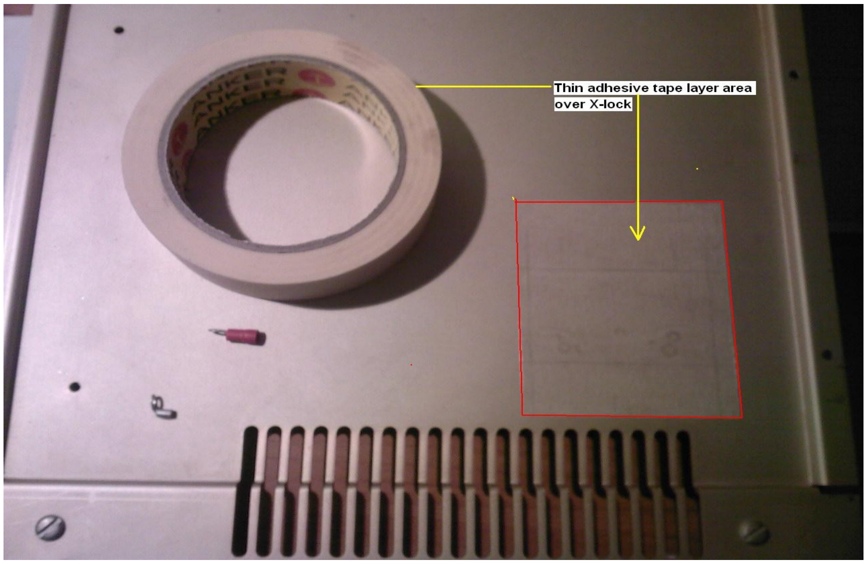
Electrical wire small binding posts were obtained from a local electronics store. After removing their plastic insulation, I bent them 90 Deg (Photo 2) and adjusted their cylinder diameter (using a flat fine file to remove some of their metal on top, followed by bending them into a smaller size cylinder) in order to make them fit into the PCB mounting holes.

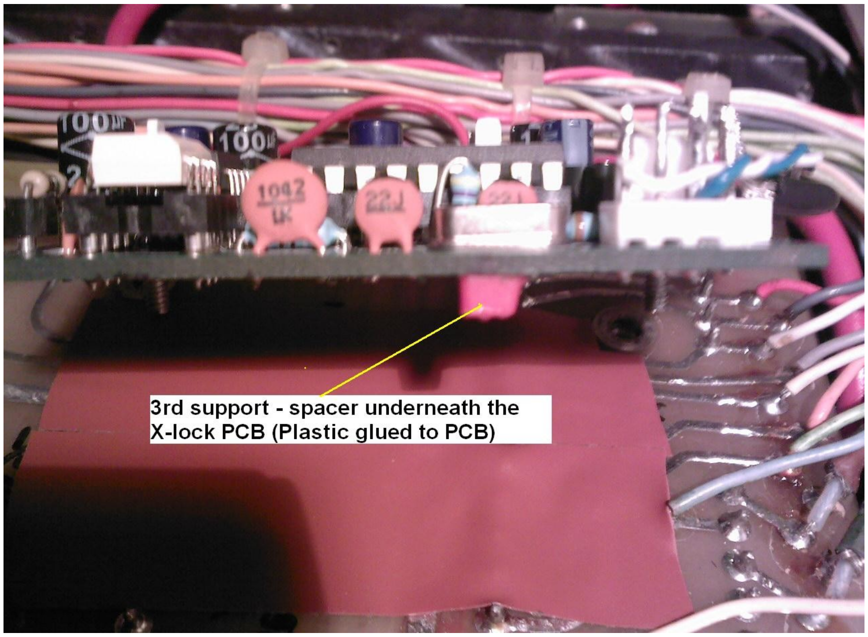
After installing them on the Tr-7 using the original hardware, I fitted the X-lock through them, using a temporary spacer to keep a safe distance between the under-surface of the motherboard and that of the stabilizer, and soldered them. The X-lock mounting holes are grounded and through plated which makes for a very secure and mechanically stable connection.

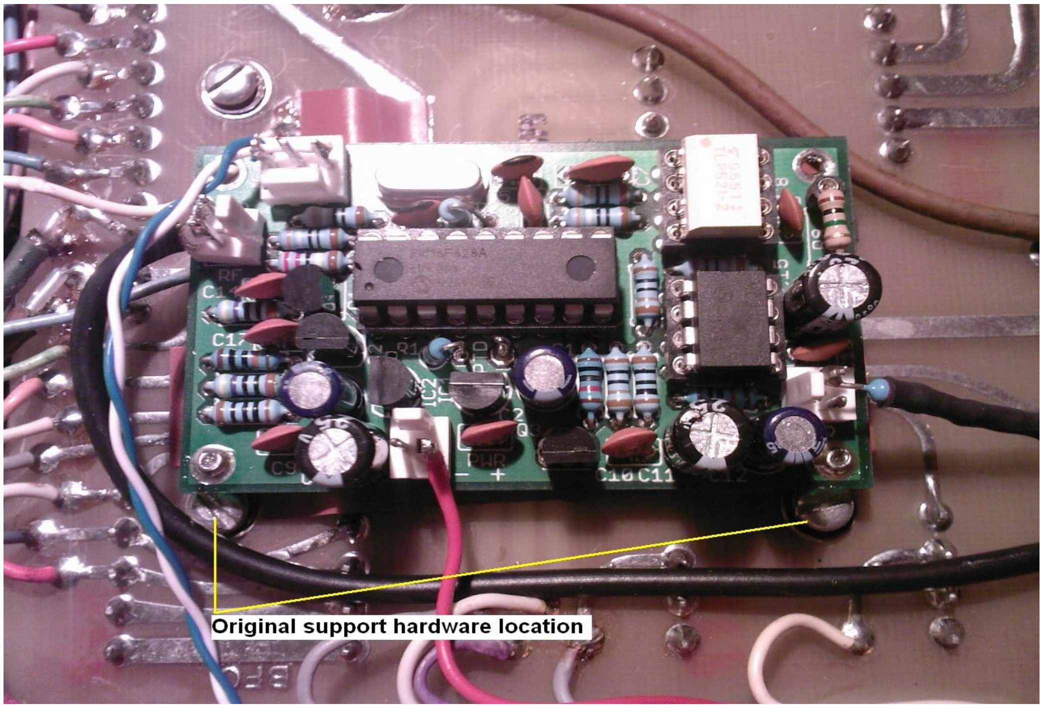


The stabilizer PCB is rather small size and supporting it by its 2 side holes gives adequate stability. A 3rd support structure at the opposite end was placed under the X-lock PCB as shown in the next picture, mainly to keep a safe distance from the TR-7 motherboard. Since the distance between the pins of the motherboard under the X-lock is rather marginal, I cut the tips of these pins flush to their solder joints and placed a layer of electrical tape over them.

Next, one must pay attention at the clearance of the higher points at the component side of the X-lock from the metal cover of the TR-7. These are the tops of the 100μF and 10μF caps, and even though they should not have any significant voltage difference with ground, I placed one layer of thin adhesive tape on the area of the bottom cover over the stabilizer.





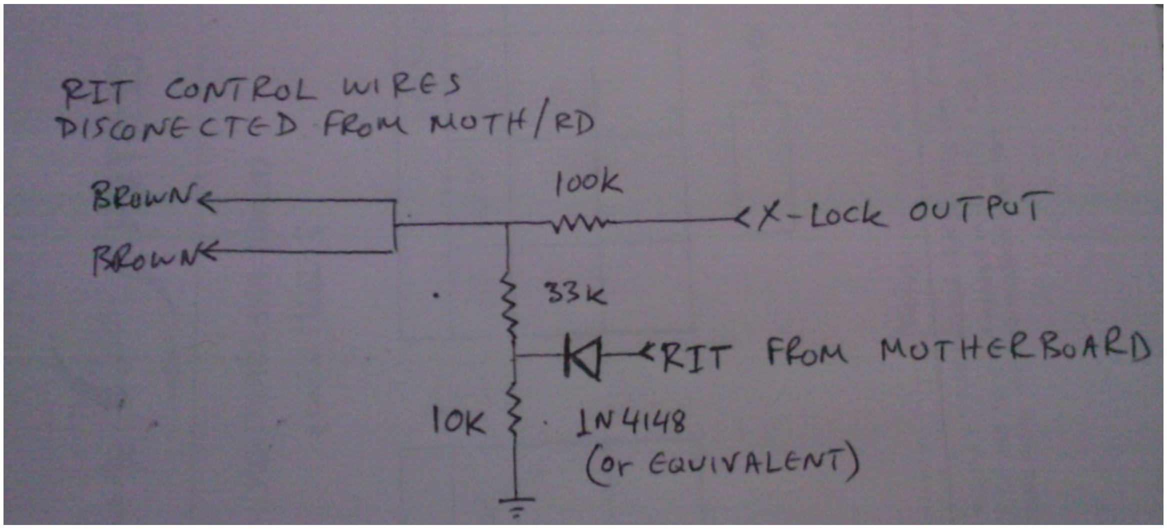


Step# 2: How to interface the X-lock to the TR-7 circuit.

Since this stabilizer includes its own reference crystal, the only connections needed to the TR-7 are the PTO sampling frequency (RF input), the power supply (13,8V) and the correcting voltage to the already existent RIT circuit built in the TR-7 (X-lock DC output). This makes for an easy and straight forward step #2.

The PTO connection is via a small caliber 50 Ohm coaxial cable RG-174 from the posts with the **PTO sign** of the motherboard to the **RF in** of the X-lock. The **+13,8V** power supply comes from **pin# 9** (counting from the right when the unit is upside down) of the PS board assembly of the TR-7.

As for the DC control voltage connections, I followed the instructions from the original article at http://downloads.hanssummers.com/stbham.pdf You essentially need to unsolder the 2 RIT cables (brown wires) from the motherboard and connect them to the X-lock DC output voltage via a simple resistor and diode circuit as seen in the following schematic.



In my case there was not even a need to re-center the RIT after integrating the X-lock to the TR-7, but this can easily be accomplished by following the instructions in the above article or the service manual, should you need to do it.

The last and most enjoyable step is the installation of the stabilizer status indicator LED, which fits perfectly in the place of the “FIXED” bulb indicator. The 2 LED control wires need to be connected directly to the X-lock and the ground LED wire can be connected to the ground connection of one of the nearby switches (UP DOWN FIXED). Here I made a slight modification to allow the “FIXED” light to shine in its original RED color through its red filter by reversing the red-green LED connections.

Normally the X-lock LED will shine red when the device is unlocked during fast turning the PTO, and returns to green when the stabilizer has locked the PTO. The problem is that green light will not get through the already existent red filter of the original TR-7 FIXED light assembly and thus one can only see the LED in its “unlocked” red state. By reversing its connections though, it will shine red, and be visible as “FIXED” when the stabilizer has locked the PTO frequency, which I think is more appropriate. It was very nice indeed for Drake to include the “FIXED” illuminated indication 30 years ago !!!!

Finally, while the default delay time for the X-lock to “grab” and stabilize the PTO once any movement of the tuning knob has stopped is 2 seconds, I found it more convenient to increase it to 10 seconds (using the process described in its manual) for my tuning habits. I like to try and bring the incoming station as close to its correct frequency as possible by small precise fine tuning movements of the PTO knob, which most of the time take longer than 2 seconds.

This may result in me fighting with the X-lock while trying to fine tune. After expiration of its 2 second tolerance it will detect my fine tuning as slow drift and tries to correct it!! Thus both me and the machine are getting aggravated… Everything can go back to normal though, if you increase the stabilizer's off time, say to 10 – 15 seconds which would give it “a brake” while you are trying to fine tune your new extra stable PTO….

Improving the TR-7 SSB audio quality

The stock SSB filter in the 2nd IF is 2,3Khz wide. While this will give good communication quality audio, it leaves something to be desired, especially if you listen to it side by side with a rig using a 2,7Khz filter like a TS-830S / 930S / 940S, an Atlas 210X etc.

I am not referring to the “ESSB” sound that some fellow operators like to use, but rather to a “dryer quality” sound of the 2,3Khz audio which, without providing an appreciable improvement of selectivity compared to the 2,7Khz one, removes some high frequency spectrum form the audio which makes listening less rewarding and to some extent may even reduce the intelligibility of voice especially when listening to lower signal strength, close to the noise floor of the band.

While searching for an alternative filter, I came across an offering from Sherwood Engineering at a width of 2,85Khz. This is a little wider than the above mentioned 2,7Khz “optimum, but it does seem to have excellent shape factor, which allows for richer sound reproduction without becoming a “barn door” filter allowing excessive interference or “hiss” to spoil its performance. Practically, for 90% of SSB work I have found even the 1,8Khz filter to offer little additional selectivity or QRM suppression, with the exception of crowded band conditions.

Substituting the 2,3Khz original filter in the first position of the filter board of the TR-7 is straight forward, with caution when de-soldering the original in that you have to use a 40W soldering iron. Also I ended up prying it out gradually using a very small flat (jeweler's) screwdriver close to each of its connections while heating its connecting posts. It is rather hard to try removing all the solder from each connection since even the smallest amount of residual solder is enough to prevent any movement of the filter from its tight connection posts through the double sided PCB.

This is the first and most important step in improving both the Rx and Tx audio bandwidth. I did undertake one more step, which allowed slight further improvement of the Rx audio with little additional work or risk.

Following the suggestions seen in the **PA0CMU** site http://members.ziggo.nl/cmulder/drake.htm#bookmark6 I experimented with changing a few capacitors and 2 transistors in the 2nd IF board, at the final audio amplifier circuit, in order to improve its frequency response as described in the article.

After trying the proposed changes, I ended up implementing the following:

Changed **Q1111** and **Q1113** from the general purpose **2N3904** to the low noise **BC549C** model. (**Warning observe the different pinout** !). And Changed **C1116, C1164 and C1167** caps from **0.01μF** to **4,7nF**. This increased the high end Rx audio response and made a significant improvement in the intelligibility of marginal SSB signals, at least to my ears.

I did not change the other caps (actually reinstalled the originals after trying the proposed changes) for 2 reasons: a) Increasing the values of C1150 and C1152 gave the audio rather too much lows, which resulted in listening fatigue (again for my taste). b) Changing the C1173 to 220pF from the original 330pF, resulted in a constant low level audio "whine" mostly noticeable when listening at low audio gain or with the antenna disconnected.

The final result after the above changes, gave my TR-7 a smooth a pleasant audio which rivals that of my Kenwood and JRC radios, while maintaining the legendary Drake clean "tube like" audio quality. All of them are easily reversible if one wants to go back to the original configuration, and with the exception of the new crystal filter, will cost less than $3 in parts. Admittedly, I did perform the changes in the audio amplifier circuit after having substituted the filter with the 2,85Khz one, so can not comment on their isolated effect, but of course these 2 steps are independent from each other.

Hope you enjoy keeping an excellent classic as a TR-7 working and improving it as much as I do.

73,

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