

R-390A 2nd Crystal Oscillator Repair
11-18-2021, Larry Haney

I decided to write this document because over the years I've seen a lot of discussion about this subject and I did not find a comprehensive document covering it. Even after going through the Pearls, I did not see a clear explanation of how to determine if the 2nd Crystal Oscillator was a problem or not and if it is, a procedure on how to find the bad part.

I think I covered the question of 'is the 2nd Crystal Oscillator a problem or not' in my document titled 'R-390A Oscillator output level effects' on the R-390A website 'tutorials' section. The conclusion I came to is the average output for the 2nd crystal oscillator at test point E210 in stand by is -7.5 volts DC, and a reasonable minimum is -4.5 volts DC. What I meant by that is if the output is much below -7.5 volts DC, it's performance is below normal and you might consider fixing it. But, you may see satisfactory operation as long as the output is above -4.5 VDC. Remember, you should make these measurements with a meter that has 10 megohms/volt sensitivity or better. Satisfactory operation in my mind is if the sensitivity and s/n are good, not just ok.

The 2nd Crystal Oscillator that I just finished has the output for most of the bands between -7 and -9 VDC with 5 bands above that range (a high of -12.6 VDC) and 9 below it (with 3 of them below -6 VDC, but still above the minimum). I do want to comment on the output of the 7 MH band crystal because this frequency seems to be of interest as it's running on the 3rd overtone - it's -7.2 vdc. That is very close to the output of bands 0 through 3, which are 2nd overtone frequencies of crystals (as most are in the R-390A). So, although the crystal activity is usually a little lower on the 3rd overtone, it still can provide a good level of oscillator output.

So now we get to the point where we need to decide if an output of one band that is between the minimum and the average needs to be fixed. If just one or two bands are low, then where do we start? My feeling is that you always start at the same place: the tube and its contacts, the crystal and its contacts, correct alignment of the band select switch in the oscillator deck, the RF coax connector and its contacts, or the trimmer adjustment for that band, or finally, T 401 adjustment. Why, because they can be the problem and are easy to check. Substitution is the only valid test for the tube and crystal. Most of the problems are going to be resolved by either the tube, trimmer adjustment, bad contact or crystal. About crystal substitution, it would certainly be nice if you had the correct value to try, but it's not necessary. You can use one that is .5 MH above or below, just to see how the output changes. The rx will not work on that band, but if the output goes up after you adjust the trimmer, then that's a big clue. The adjustment of T 401 is only to be done if a trimmer is at the end of adjustment. The adjustment of it should not be done arbitrarily. When it is changed, all trimmers must be readjusted and hopefully, the adjustment did not prevent the trimmers from still being within range (not at the end of adjustment). Adjustment of T401 should be made in small increments so as to prevent other trimmers from becoming out of range. If all trimmers can not be adjusted within range, then a trimmer or parallel SM cap is bad and needs to be fixed.

Now, if the above don't cut it (fix it), then you need to decide if pursuing it farther is warranted, as the next items are more difficult. There are four more things that could be the problem and you need to remove the 2nd Crystal Oscillator deck to get at them: the band switch, the oscillator components, the trimmer caps, and the fixed SM caps across the trimmers.

See the tech refs for directions on removing the oscillator deck. In order to successfully work on it outside of the rx, you will need a power jumper cord. I would not bother with getting a coax to connect it's output to the rx, as its capacitance will detune the output. You will need about a 1.5 foot long coax on the output to correct the capacitance (so you will not need to tune all the trimmers and/or T401) and also connect the output to a scope. You should only need to adjust T401 very slightly for a peak and then put it back when reinstalling it.

If all of the bands outputs are low, then the problem is probably something in common – input or output band switch contaminated or damaged, a component in the oscillator circuit, including a shorted winding in T 401 (low probability). If one or two bands output is good (greater than -8 vdc), then T 401 is probably

ok.

In this case closely check both switches and likely components in the osc circuit. The input and output switches must not be contaminated. Sometimes cleaning the contacts with a harmful cleaner will soak into the switch insulator disc and reduce its Q. This can happen easily when sprays are used for contact cleaning. The contaminated area(s) can be very small or quite large. If it does not look new and clean, you can try to clean it with alcohol or some other good cleaner that does not leave a residue. Make sure it is totally dry before applying power to it.

If the switch discs are ok, then move on to the bypass caps and voltages. C409 must be large enough to provide sufficient bypass to the cathode so the plate gets enough output and small enough to provide feedback to the control grid.

The other two items are the trimmer caps and the SM caps in parallel with them. The trimmers can easily get dirty and just need to be cleaned with alcohol. What usually happens to them is contamination reduces their Q. Leakage in the SM caps does the same thing. The SM caps can also change value causing the trimmer to not tune correctly. If the output frequency is not stable on some bands, these two caps are probably the problem.

The following picture shows that the trimmers are mounted in the chassis facing up so that dirt and contaminants can easily settle on and around them. Then, when the top of the oscillator deck is cleaned around the trimmers, the dirt and contaminants can easily work their way into the trimmers. If the trimmers adjust easily and smoothly, they may not be the problem. There's only one way to tell – open it up.



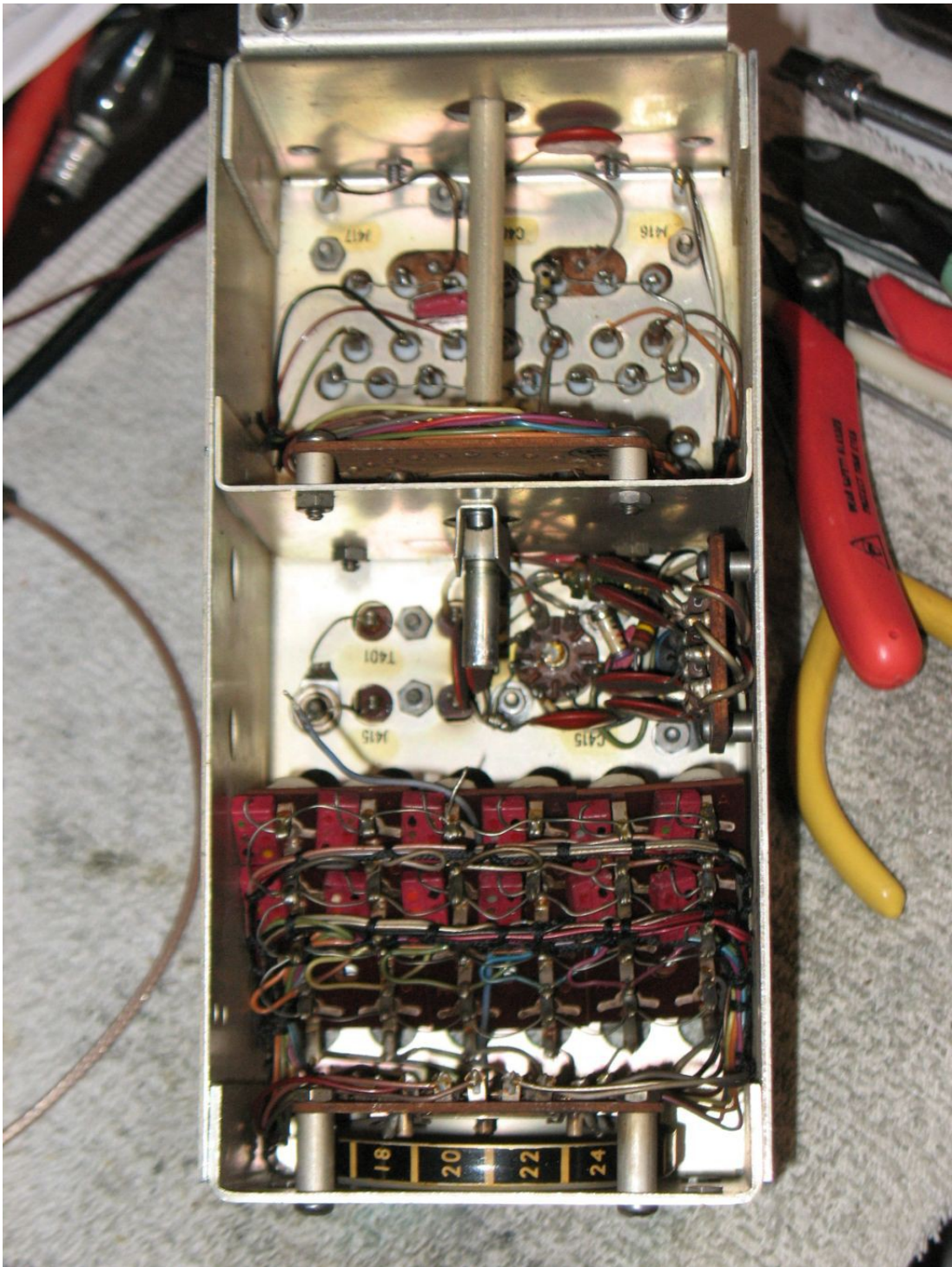
After the 2nd Crystal Oscillator deck is removed and turned upside down, you can see that all the trimmers are mounted on three phenolic boards. They are pretty much wired together, so to get access to the trimmers, the 3 boards must be raised up together.

This picture shows the C clip holding the band switch shaft in place. **Carefully** remove it, as it will easily fly across the room. It needs to be removed so the switch shaft can be pulled back to allow the 3 phenolic boards to be raised up on one end.

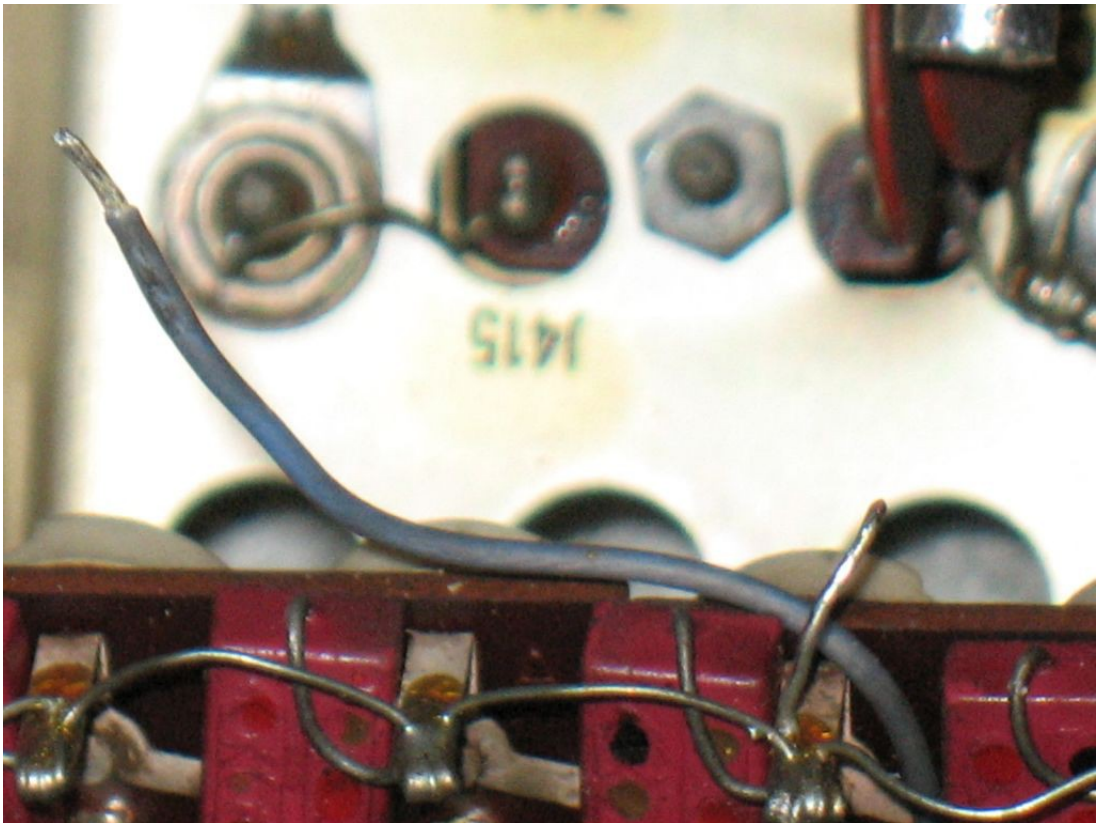


Once the C clip is removed, the shaft can be pulled back.

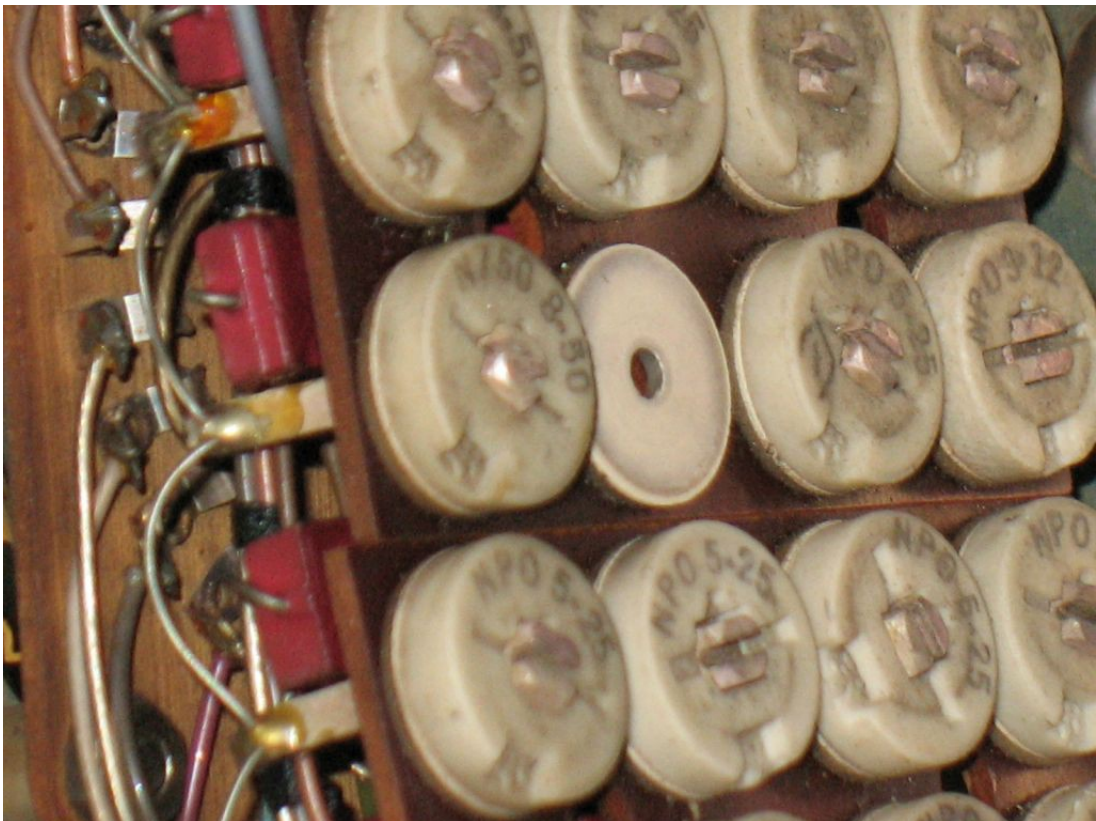
The following picture shows the bottom side of the deck. The band switch shaft has been pulled back out of the way of the trimmer mounting boards and one end of the board raised up a little.



The 3 boards are easy to raise up on one end, once the 2 wires are disconnected as shown in the next picture.



The short uninsulated wire is common and is connected to ground. The gray insulated wire is connected to the plate circuit for tuning. Once these two wires are disconnected, the 3 boards can be raised up on this end (where the 2 wires were disconnected) to expose the other side of the trimmers for cleaning.



Even if your trimmers are not frozen, you should see: 'Repairing Frozen Ceramic Trimmers In Collins S-Line / KWM-2' by Glen E. Zook, here: [Repairing-Frozen-Trimmers-Zook-Copywrite.pdf \(collinsradio.org\)](#) . The first page is not applicable to the R-390s. Thank you Tom Hoyer for this reference. **Important** – the thin ceramic disc on the board is very **fragile!**

The top of the trimmer comes off fairly easily, as shown above. You can use a screwdriver to carefully push the retaining clip away from the mounting stud on the other side, to release the top half that is the adjustable half. It may fall right out, so be careful not to drop it. Once it's out, you can clean both sides and dry them well (very important) before putting it back together. If cleaning the trimmer did not increase the output enough, then the problem is more than likely the SM cap in parallel with it.

If the bottom half of the trimmer needs attention, as mentioned before, be very careful with it – it's very fragile.

To put the 2nd crystal oscillator deck back together, just follow the procedure backwards. When reinstalling the band switch shaft, be sure the band indicator wheel is lined up correctly. Remember, that pesky C clip can fly away easily (when reinstalling it, too).