Brush Off Your

Troubleshooting skills

And take on a Repair Project!

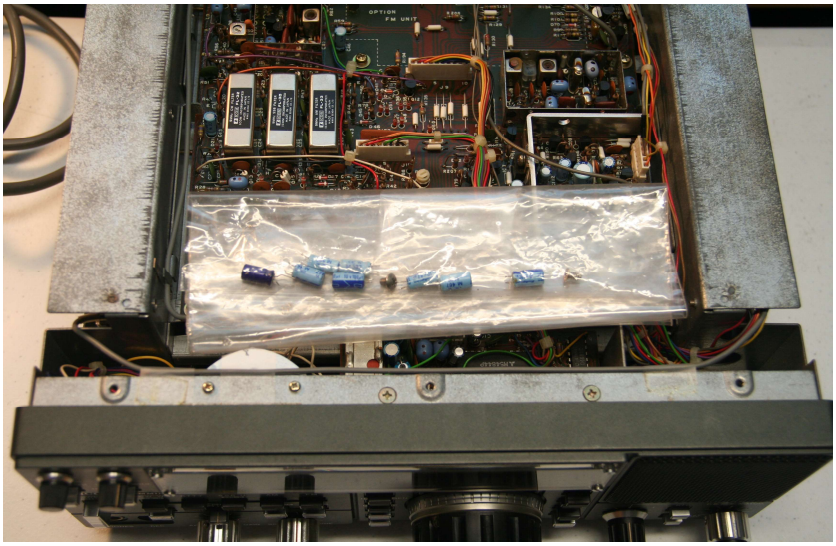
-Or-

Repairing the Icom IC-R70 Receiver

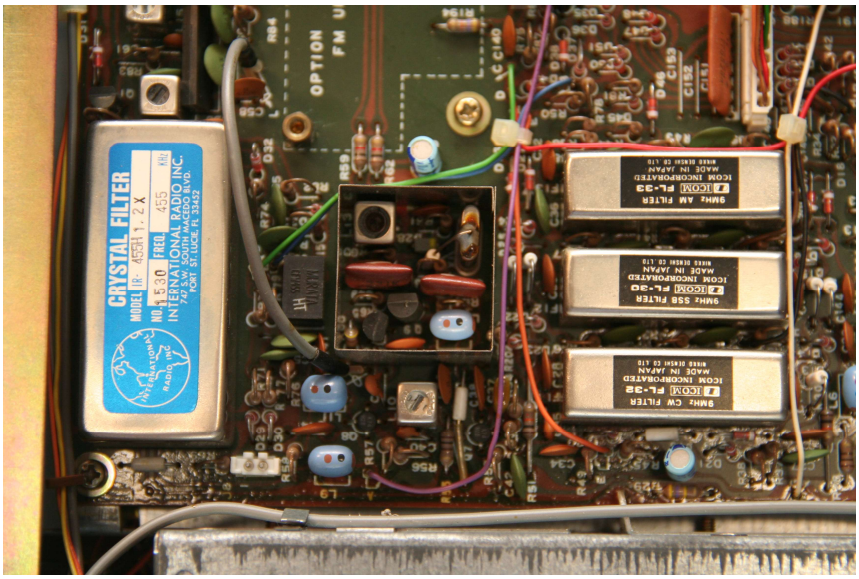
A recent visit to a local “tailgate meet” resulted in my acquiring an Icom IC-R70 Communications Receiver (Circa 1982). The price was right (Free) so I was not going to be surprised if there were some issues. The R70 was in the original box and included the original owner’s manual and the Icom Service Manual (SM) with X-ray circuit board views and a full fold out schematic. The owner indicated he had attempted replacing several capacitors in an effort to restore operation but this did not result in a functional unit.

Onto the bench---General appearance of the 30+ year old receiver was very good with only minor wear to the covers. The face of the receiver was very nice with no missing knobs, switches or buttons. The initial power up was not met with any unusual

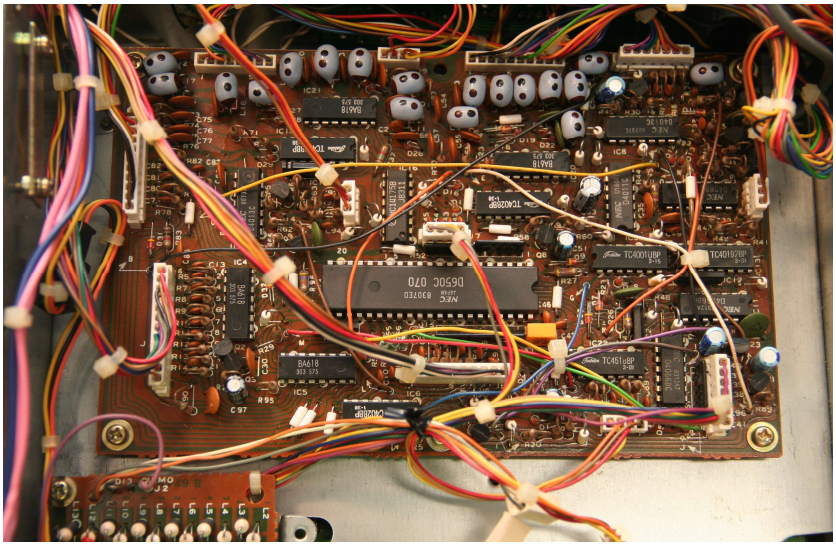
smells or “magic” smoke leaking out! There was audio hiss which varied with the volume control and changed pitch with the tone control (Audio section functioning). Rotation of the RF gain pot muted the receiver and swung the S-Meter to the far right -- all good signs. However, the display only indicated 2 decimal points and none of the front panel buttons activated any features or modes! So it’s time to pop the covers. After removing the top cover I find a small zip lock bag with several electrolytic caps and a few screws. Not exactly what I wanted to find but seems to confirm the info from the original owner.



With covers removed, I take a quick look for burnt components, missing parts, disconnected leads, bulging electrolytic capacitors etc. Finding none, I suspect there is a glimmer of hope this Receiver is repairable. I also note this Receiver has an optional InRad SSB XTAL filter in 455 KHz IF section!



Let's start with some basics. Having already performed a quick visual for obvious issues, the next place I like to look is power supply voltages. Reviewing the schematic I find all main supply voltages are present and reasonably close to spec. Taking a look at the block diagram and thinking about the symptoms, it seems to me there must be a logic board problem. So I next start looking in the vicinity of the main logic chip for presence of VCC, clock signals, I/O activity etc. The main logic chip (a 42 pin DIP) has VCC present and utilizing my scope to probe the appropriate pins, I determine the clock is running. However, probing various I/O lines with my scope indicates no activity. This could signal a quick end to this project if the Custom logic chip is dead and is composed of the dreaded element in the Periodic Chart known as "unobtainium".



Reviewing the circuit diagram for the logic board, I notice several power supply voltages are utilized outside of the basic supply voltages checked earlier. By probing nodes with my DVM, I quickly determine that a 6.2 VDC supply is not present. The problem is traced to a TO-92 pkg. 3 terminal regulator that is defective. I don't have a 6.2 volt version but I do have a 5 volt LM78L05 replacement. I install the LM78L05 after removing the logic board. Power is applied after having reinstalled and reconnected the board. I now have a functional display and the front panel buttons are active! I power down and remove the logic board again and add 2 silicon diode drops in the ground lead of the 5 volt regulator to shift the regulated output slightly north of 6.0 volts. When I power back up, I now have a stable 6.18 VDC supply voltage. (Final repairs include replacing with the proper LM78L62 regulator) The next order of business is to see if I can tune in any signal and begin verification of the various functions of the receiver.

With an antenna connected, rotation of the main VFO knob results in the proper frequency display change but the audio coming from the speaker does not seem to be tracking as the readout moves. I shift to the AM broadcast band to try tuning a "target rich" band and I find that the receiver is not functioning correctly as it is tuned. There are positions within the band where a station can be heard but several turns of the VFO knob does not move the actual tuned frequency when the 10 Hz step size is selected. Large excursions of the VFO knob will result in an eventual abrupt frequency change but no fine tuning is available. So my suspicion is PLL issues or Logic board problems feeding the VCO in the 2nd loop. (The block diagram indicates the 2nd loop is where the 10Hz steps are generated.) So now it is off to the alignment section of the Service Manual to test the health of the PLL circuits. Note: PLL circuits can be tricky to troubleshoot…..they either work like they are designed to or they are generally dead, hence the difficulty in troubleshooting. By the way, this is where a service manual with circuit descriptions is invaluable!

This receiver has three Phase Lock loops and utilizes a quadruple conversion Superhet design. Checks and adjustments progress through the first couple of sections of the PLL alignment. The 61.44 MHz Ref. frequency is present, stable and can be adjusted to spec. The first loop frequency is functional on the band selected and producing the 1st local oscillator signal. Alignment of the 2nd loop section indicates a possible problem as the phase lock DC voltage is higher than spec. and will not adjust or change as the VFO dial is rotated. The 2nd loop Xtal frequency is shifted via Varactor diode tuning from a D/A (digital to analog) output from the logic board. It is used to produce the 10 Hz tuning steps and or the RIT control. The third loop seems to be functional.

The next section of the SM checks the various VCOs used to cover the band segments of the 1st loop local oscillator output. Two of the four VCO sections will not adjust and produce no indication of the phase lock DC voltage. I pop the cover to the VCO section and take a look. I notice right away that the electrolytic caps under this cover do not look like the rest of the caps on the board. Recall all of those electrolytic caps I found in the zip lock bag! I decide I better take a closer look at this board. So the PLL board is removed along with shield covers from the bottom side of the board. I notice this board has excessive flux residue and questionable solder joints. Wisdom is telling me it is time for a complete magnified inspection of the solder side of this board. I scrub the solder side with Alcohol so I can inspect the joints. In the VCO section I find 3 solder shorts between pins close to the caps that were changed. I find another solder short under the 2nd loop can shield. I rework all of these and continue to clean and inspect the solder side. When I am confident there are no more issues, I re-solder the shields in their original locations and reinstall the board. When power is reapplied, I find the tuning is still malfunctioning and the 2nd loop Phase lock voltage is still out of range

and will not adjust. The 2 dead VCO circuits are now functioning and I have all band segments operational in a semi-functional state! Progress.

Getting back to the 2nd loop issue, I consult the circuit description section of the SM and after review I am convinced the IC that functions as an oscillator, mixer and amplifier (IC8) is the problem. This is also the chip where I found a short between 2 adjacent pins. I suspect it is now defective as the A/D output from the logic board is providing a stepped DC voltage to the Varactor diode in this circuit when the tuning dial is rotated in the 10 Hz / step mode. Additionally, when the RIT function is selected the Varactor DC voltage swings smoothly positive and negative. Off to the Internet to see how difficult it is going to be to find a TA7310P chip. I find a couple close to me via an auction site and submit a best offer. While I wait for a reply to the offer I decide to do a web search on this chip for a data sheet. The first hit I get on this part is a CB repair site that indicates this chip is used on many CB radios. Hummmmmm, I have a few old Junker CB radios in the shop. I pop the cover on one and low and behold this chip is indeed present. So I heat up the de-soldering station and in about 10 minutes I have this chip removed.

I pull the PLL board back out, remove the can shield cover and solder side shield to expose the chip. The chip is removed; replaced; solder inspected; shield covers soldered back in place and the board reinstalled. This time at power up the received audio now tracks with the VFO in the 10 Hz per step mode! A quick check of the Phase lock voltage in loop 2 shows that it is no longer stuck high. I make the required test equipment connections and adjustments and have it set to specification in short order. A quick check of the various bands and functions indicates we now have a functional receiver again.

Checking all of the modes and functions, I notice a significant pitch change when shifting from LSB to USB so there are likely more alignment issues, possibly with the BFO or the pass band tuning circuits, which need to be dealt with. I'll get to those when I have another day with no other pressing projects.

So it's been a few days now since the main repairs were completed. I have also completed all of the SM alignment steps with no further issues. In the SM there is no mention of BFO adjustments but I did find the adjustment locations pointed out on the main board diagram. USB BFO is adjusted with a trimmer cap and the LSB BFO is adjusted via a tuned inductor. I suspect the USB pitch issue will be corrected by shifting the USB BFO signal so as to place the Upper sideband signal back into the center of the sideband filter pass band. Tweaking this Cap instantly reveals the problem - barely touching the trimmer cap results in an instant and huge pitch shift in the USB signals. The cap has become intermittent. I give the cap a shot of cleaner that evaporates and leaves no residue. I rotated the cap back and forth many times to break down the oxidation. After allowing time for cleaner evaporation, I installed the top cover, allowed the rig temperature to stabilize and make final adjustments utilizing WWV on 10MHz and adjust both SSB BFO's to achieve (by ear) matching pitch with the AM WWV signal tones. Repairs and alignment complete! I plan to replace those pesky trimmer caps in the VCO and BFO section at a later date. Sidebar – the next day one of the band VCOs had stopped functioning. Care to guess what the issue was? Yes, one of those trimmer caps. I happen to have 2-15 and 3-25 pF mini ceramic trimmers, so I pull boards and replace all trimmers and realign one final time. (Additional sidebar – these trimmer caps, I believe, are the main culprit contributing to intermittent alignment issues and I think this is what the original owner was going after but went astray and started changing electrolytic caps.) I also find, via an internet search, the BFO frequencies from the R-71 receiver which happens to use the same IF and Xtal filters as the R-70. This time I am able to adjust the BFO's for USB,LSB and CW to within 5 Hz of the specified frequencies.

Utilizing your troubleshooting skills can result in a positive outcome and tremendous satisfaction when you follow some basic processes (in the correct order), think about the symptoms (and the circuits responsible for them), use the information the owner/seller has provided, utilize your resources (DVM, Scope, Service manual, circuit descriptions, schematics, the internet, donor rigs, etc.), take your time and don't give up!

73 for now,

Rodger

N4NRW