At the Repair Bench – Icom IC-3210 – July 2023

This month's repair tale involves an Icom IC-3210 dual-band mobile radio (Figure 1), which came in for two separate problems. First of all, the front panel backlighting was inoperative, making it almost impossible to read the display without the use of a flashlight. The second problem was that the radio would not lock in properly on the UHF band most of the time, though occasionally it would work normally. That problem is one of a type that is normally quite difficult to locate – an intermittent problem.

Figure 1 - IC-3210

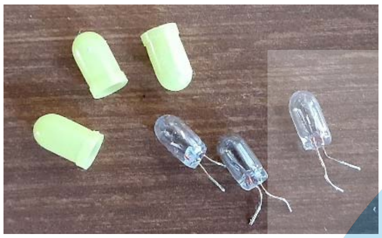

Figure 2 - Original lamps with boots

The backlight problem was one that was to be expected with a radio of the age of this particular unit. The front panel on this model is backlit by a set of three T-1 12VDC incandescent lamps that are soldered in place on the front panel printed circuit board (PCB), called the *logic board* by Icom. Each of these lamps is covered with a yellow plastic boot (Figure 2) that provides the desired color to the illumination provided. The lamps sit down into holes in the PCB (Figure 3 & Figure 4) and have their wire leads soldered to pads on the PCB. The PCB holes index with recesses in the front panel carrier housing, directing the provided light into the rear area of the panel. All three of the lamps were burned out.

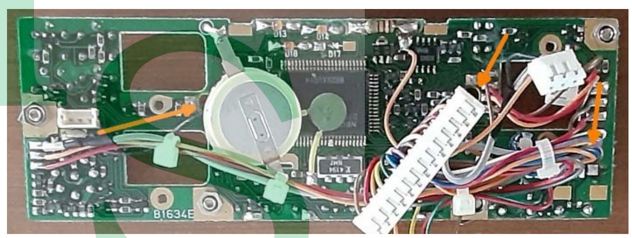

Figure 4 - Logic PCB with lamp holes indicated

While replacements for the original lamps are readily available from standard component sources. I decided to replace them with LED's instead, so as to preclude the probability of a repeat failure of the backlight system. In order to access the PCB and remove the failed lamps, the front panel subassembly must first be removed from the radio chassis, and then further disassembled. This involves removal of the steel frame and the plastic front cover, followed by removal of the three rotary controls. Finally, the LCD panel and its insulator can be removed by twisting the locking tabs to align them with the slots in the PCB. Once the tabs are aligned with the slots, the LCD panel can be pulled straight out from the PCB. After the LCD panel is removed, the plastic front panel carrier housing can be removed from the PCB by removing the small screws that secure the PCB to the carrier. Finally, some of the wiring harnesses can be gotten out of the way by unplugging them. As always, this is the time for some photos of the harness connections to be taken, against the future reconnection of these plugs to the main PCB.

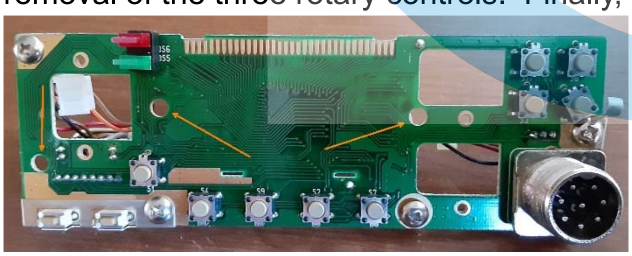

Figure 3 - Logic PCB foil side with lamp holes indicated

Once the PCB is stripped down as far as is possible, removal of the lamps was a simple matter of heating their soldered lead connections and lifting the lamps out of their holes. I then cleaned the excess solder off the pads using a soldering iron and some flux-impregnated braided solder wick.

As mentioned above, I had decided to use LED's instead of the OEM incandescent type of lamps for the replacements. I chose cool white LED's in the 3mm (T-1) size, and I paired each LED with a 1kΩ resistor for current-limiting purposes. I removed the yellow plastic boots from the original lamps and installed them onto the LED's. I then placed the LED's in the lamp holes of the PCB, soldering the cathode leads to the appropriate pads. Next, I added a resistor to each of the LED anode leads, and then soldered the opposite end of the resistors to the appropriate PCB pads. Application of 12VDC from a power supply to the PCB showed that all three LED's worked perfectly. It was time to move on to the other problem that the radio's owner had reported.

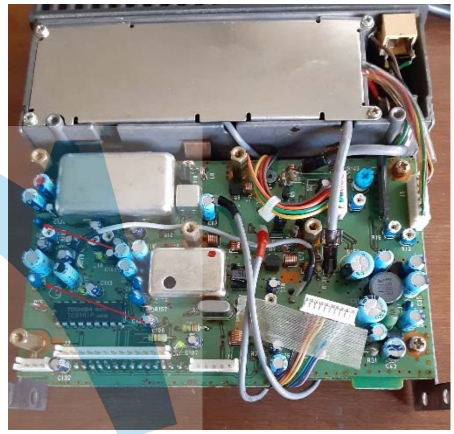

Figure 6 - Locations of failed capacitors

I chose to tackle this problem while the front panel was still disassembled due to the fact that the most likely problem was the switch that is used to switch between bands. That switch is a 6mm x 6mm normally-open (NO) tactile pushbutton switch. When tested, the switch would make only when pressed *very* firmly. A normal pressing action on the switch would have no effect on the band selection. This one turned out to be a simple replacement of the switch. I desoldered the original switch, and installed the replacement, which I had on hand as it is a standard switch. Easy peasy, right? Not so much as you might think. It turned out that there was also a known problem with this radio model in that two capacitors on the main PCB are known to fail together with this switch. What happens is that two tantalum capacitors, C87 (0.22µF/35V) and C97 (4.7µF/35V) (Figure 5) have a tendency to fail with high leakage, causing the UHF phase-locked loop circuit to lose phase lock. The user causes the switch damage by repeatedly working the switch, often aggressively, in an attempt to get the radio to lock onto the UHF band. This action causes the switch to become fatigued internally, leading to the switch failure found on this unit. As a result, the switch merited replacement, as did the two tantalum capacitors. On testing of the removed capacitors, they both had extremely high DC leakage values, and had ESR readings of 14.6Ω for C97 and 9.3Ω for C87.

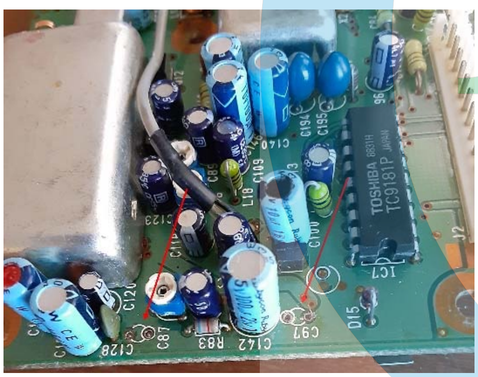

Figure 5 - Tantalum capacitors removed

I next checked the memory keep-alive battery, a BR-2032 coin cell. Yes, that is correct and *not* a typographical error. It turns out that the BR-series of coin cells are designed for low current drain over an extended period of time. Whereas I had CR-2032 cells in stock with the right welded tabs, I did not want to change the life expectancy of the coin cell in the radio by installing a CR-2032 cell.

The radio dates back to the late 1980's – its production was discontinued in 1990. The cell in place in the radio had the Icom part number on it, so it was either an original part or a replacement installed by an authorized service center (or someone who bought the cell from Icom). While it is *possible* that this was the factory cell, it is equally unlikely that it was still original after all of these intervening years. I disconnected it from the circuit for testing, and found that the open-circuit voltage was reading right about 3 volts (3.04V to be exact), which is the nominal voltage of the cell. However, when tested under load, the voltage dropped down to just over 1 volt (1.156V to be exact). Load testing of these cells is best done by installing a 100Ω resistor between the voltmeter leads when measuring the cell voltage. The resistor provides the requisite load, which really tells the story.

I keep a couple of resistors of different values, soldered between small alligator clips, on hand for just this purpose. To use them, I simply select the one with the load value that I want to use, and connect the alligator clips to the voltmeter probes. Then, whenever I measure a battery or cell with the voltmeter with the resistor clipped in place, it is automatically providing a load test for the battery or cell. You can develop a list of desired resistor values for this task by perusing the various battery or cell datasheets. The datasheet will usually provide testing information which includes the load placed on the DUT during testing.

Anyway, I ordered in the correct BR-2032 with the necessary welded tabs for this application, and when it came in, I installed it. However, I *did* do a load test on the new cell before installation. This one started out at 3.49V open circuit, and only dropped to 3.15V under the 100Ω load test.

After the installation of the coin cell, it was time to re-assemble the radio. Re-assembly went without a hitch, with the only point of note being that the contact fingers along the edge of the PCB where the rubberized contact pad for the LCD panel mates with the PCB need to be clean. I scrubbed them with a pencil eraser, and then removed any skin oil using 99% isopropyl alcohol (IPA) on a cotton swab. This provides for trouble-free connection to the LCD panel after handling the PCB as much as I had done. If you had inadvertently touched the business edge of the rubberized contact pad, that too should be cleaned of skin oil with some 99% IPA on a cotton swab.

Assembly is otherwise the reverse of the disassembly operation. Take care to properly tighten the control nuts on the three rotary controls, and to tighten the PCB to plastic carrier screws without overtightening and stripping them.

A quick word about screwdrivers, which maybe should have been mentioned earlier. This radio was manufactured in Japan and therefore uses JIS screws throughout. As a result, JIS screwdrivers are needed to loosen any tight screws without stripping the drive recess in the screw head. Standard Phillips screwdrivers or any variation thereof will certainly cause damage to the screw heads. During disassembly, I found that one of the screws that secured the shield plate and the front panel metal frame to the radio chassis had been stripped in that manner, telling me that someone had been into this radio before and most likely had not realized at first that the screws were JIS screws. I used a specialized extractor to remove the screw, and I replaced that screw upon reassembly with a new JIS 3mm-0.5mm x 6mm flat head machine screw from my inventory.

Remember that in screw dimensioning, the first part (before the hyphen) is the nominal thread diameter, while the second part (after the hyphen) is the thread pitch reference (more about that later). The number after the “x” is the fastener length. Metric fasteners and Imperial fasteners utilize different thread pitch designation methods. With a metric threaded fastener, the pitch information is reported as the distance from the peak of one thread to the peak of the adjacent thread. Thus, a machine screw with a pitch designation of 0.5mm will have a measured distance of one-half of a millimeter from one thread peak to the next. Imperial fasteners use a system that reports the number of thread peaks in an inch of fastener length. Thus, a machine screw with a pitch designation of 32 will have 32 thread peaks in an inch of screw length. Keep in mind also that while most headed fasteners are length-measured from the underside of the head, flat-head fasteners are length-measured for overall length, including the head length.

Reconnecting of the various wire harness plugs to the main PCB is pretty much a straight-forward matter of matching the plug size to the socket size. The is only one possible mix-up, and that is with the squelch control harness plug and the speaker harness plug. This can be resolved easily if the photos recommended earlier were taken. If not, refer to the schematic diagram found in the IC-3210 service manual to determine that the squelch control harness plug goes to connector J6 on the main PCB, while the speaker harness plug goes to connector J9.

Once the reassembly is complete, it is time for a functional test of the repairs. As luck would have it, another problem became evident quite quickly. It turned out that the rotary control used as the main up/down control signal source was inoperative. As a result, frequency could not be adjusted within each band, although the radio was otherwise fully functional on each of its two bands. In a similar manner, *none* of the radio's optional settings that require an up/down selection normally made via that control were operational. Thus, the tuning step intervals, the CTCSS tones, and several other functions could not be changed. The problem gets worse… it turns out that the microphone Up/Down controls were also inoperable. This would seem to point to some circuit or component that is common to both control methods. In this case, I worked through the block diagram, the unit schematic, and the X-Ray views of the printed circuit boards in an effort to try to isolate the cause of this problem. Unfortunately, all of this testing and probing led to the inescapable conclusion that the problem lies within the logic board CPU integrated circuit, a µPD75308GF-101-3B9 device that is no longer available. So… while the relatively minor faults for which the radio came in were all corrected, the radio is nonetheless still inoperable, as the VFO frequencies cannot be changed. When powered on, the radio comes up on the designated calling frequencies of 146.520MHz for VHF and 446.000MHz for UHF.

Continued testing showed that one of the four output strobe lines from the CPU to the control matrices was extremely low in voltage as compared to the other three strobe lines, though its signal waveform was of the correct shape – just lower in amplitude than it should have been. I also noted that when exercising any of the switches on that particular strobe line, there was no response in the CPU, as those lines were not brought to a deep low with the switch activation – they were *already* low, so the CPU did not see the switch activations as changes of state on those lines. Unfortunately, no ready repair was available for this problem, as the CPU integrated circuit is obsolete and is therefore currently unavailable.

Sometimes, due to the so-called "planned obsolescence" so prevalent in the output of many of today's manufacturing plants, an otherwise great little dual-band radio is relegated to the junk pile. I will keep my eyes and ears open on the lookout for another IC-3210 that I can pick up for parts, but I imagine that to be a rather futile effort. There are surprisingly few hits on Google when searching for that model number. I cannot in good conscience charge this radio owner a penny for my time spent and for the repairs that were made, as the end result was not a working radio.

See you next month!