At the Repair Bench – Icom IC-7300 – February 2026

Figure 1 - Icom IC-7300 transceiver

I recently had a fellow GCARC Club member call me and ask for some help with his failed radio – the popular Icom IC-7300 – that had suddenly lost all output power. Now… sudden loss of output power is not really uncommon, but it is not at all a common occurrence with this particular radio. The IC-7300 (Figure 1) is a fairly robust unit, and its protection circuits are quite capable of doing power roll-back when a serious antenna mismatch is detected. Because of the circumstances, I decided that I would go to his place and pick up the radio, and would do some other investigation while I was there.

I brought my RigExpert AA-650 ZOOM and my CCT-01 coaxial cable tester with me. Upon arrival, I first checked the radio and verified the reported output condition as shown by the radio itself. I next tested the short coaxial cable that was in use between the radio and its attached MFJ-993B IntelliTuner automatic antenna tuner. That cable checked out just fine, as did a second cable that the owner had sitting there for backup use. I then checked the condition of the antenna system beyond the tuner, using the RigExpert. The antenna system left a lot to be desired in terms of acceptable matches across the various bands on which he operates, but the condition was not bad enough in my opinion to account for the lack of output power by itself, or any potential radio failure. I decided to take both the radio *and* the IntelliTuner back to the shop with me for further investigation. The customer also requested that I replace the real-time-clock (RTC) battery while I had the radio in the shop. He did not say why he wanted this done, so I sort of figured that it was a preventative measure based on the age of the radio.

At the shop, I began by connecting a directional wattmeter to the radio and again verified that there was no measurable output. I opened up the radio and starting by measuring the output from the RF board into the power amplifier (PA) board, and found a healthy output signal going into the PA. Next, I started making measurements and various tests on the PA board itself. What I found was quite surprising, in that the unit had suffered a complete failure of the PA chain, taking out a total of five transistors on that board.

The power amplifier chain consists of a 2SK2854 N-channel MOSFET used at the PA input as an RF amplifier, which then feeds into the pre-drive amplifier transistor, an RD01MUS2 N-Channel power MOSFET. The output of the pre-drive amplifier is then directed to and through the drive amplifier transistor, an RD15HVF1 N-channel power MOSFET. Finally, the drive amplifier output is directed to the power amplifier, which is made up of two RD70HVF1C N-channel power MOSFETS in a push-pull configuration. *All five of these transistors had failed!*

As most of my long-time readers are well aware, I am never content with simply repairing a faulty device. I also have this compelling need to know how or why the failure occurred. Part of this is ego. I simply do not want a unit that I have repaired to fail immediately, or shortly after, being placed back in service. But… another part of it is a sense of responsibility to the customer. To my way of thinking, a customer who has paid a repair invoice deserves the most complete service that the technician – namely yours truly – can provide. This includes investigating the cause of the failure so as to prevent repeat failures whenever possible.

I have written another article in this series that describes the cause of the failures in this radio, but I will (spoiler alert) tell you that the failure was caused by a failure of the MFJ-993B IntelliTuner automatic antenna tuner that was in use with this radio. I will not go into the specifics of that failure here. You will need to wait until you read that article (if you haven't already done so) to read about the particulars of the MFJ-993B failures. Suffice it to say that it was a good move on my part in bringing both the radio and the tuner to the shop.

Going back to the IC-7300… I left off by stating that all five transistors in the PA chain had failed. This is a rather unusual occurrence. I rarely see such complete destruction in a power amplifier failure. However, as will be seen in the MFJ-993B article, the radio was in essence operating with a wide-open antenna channel. There was no antenna load whatsoever connected to the radio at the time that the failure occurred. In addition to that, the antenna was in poor condition as regards tuning, so that when there *had* been a signal path, it was in terrible condition.

The customer normally operates primarily on 40 meters, almost exclusively in FT8 mode, specifically at about 7.074 MHz. His antenna was a wire dipole fed via a length of 450Ω window line. The antenna, which had been installed many years ago, had dipole leg lengths of approximately 47 feet each, for a total dipole length of about 94 feet. Calculated using the normal equations, as shown below, the dipole leg length should have been much shorter:

$$\frac{984}{7.074} = 139.101$$

$$139 \times 0.5 = 69.5$$

$$69.5 \times 0.5 = 34.75$$

$$34.75 \times 0.95 = 33.0125$$

Let's work this through. The first line shows the calculation for the free-space length in feet of a full wavelength (λ) antenna at the specific frequency of 7.074 MHz. The second line shows the reduction to a half-wavelength ($\lambda/2$) antenna at that same frequency. On the third line, we calculate the free-space length of each segment of that $\lambda/2$ antenna. Finally, on the fourth line, we derate that length by 5% to account for the fact that the signal is being transmitted in a wire instead of being transmitted in free space. Thus, each segment of the dipole should have been at about 33 feet instead of the nearly 47 feet that they were in actuality.

So… what effect did this overlength antenna have? Simply put, it made the antenna tuner work harder to match the antenna to the radio, and in all likelihood, the tuner could not do so, causing the radio to roll back its output power almost all of the time that the radio was operated in TX mode. This in turn taxed the power amplifier chain, generating excessive heat and putting undue stress on all of the PA chain components. It therefore did not take much of a push to send the whole chain over the edge and into failure. The problems in the MFJ-993B provided just that little shove.

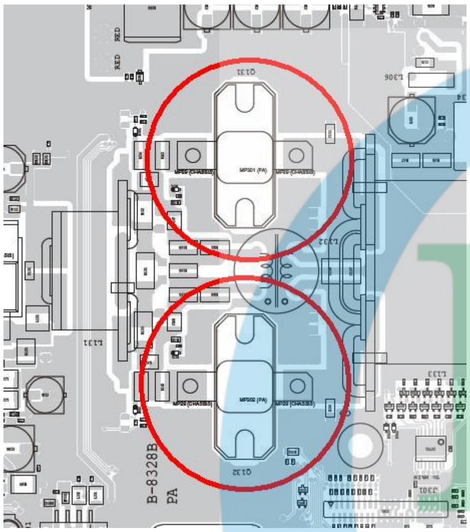

Figure 2 - PA board layout excerpt

Repair of the radio consisted of replacing the five transistors. Most of these transistors are surface mount devices (SMD's), and all of them, as already mentioned, are MOSFET's, mostly power types. The 2SK2854 transistor Q101 and the RD01MUS2 transistor Q111 can be replaced using standard SMD procedures. The driver and power amplifiers are a bit different. These three transistors are all secured to the chassis via machine screws that go through the transistors and into threaded holes in the chassis. The two power amplifier transistors each have a sheet metal shield installed over the body of the device, each being retained in place by the two machine screws that retain the transistor to the chassis. The amplifier driver transistor uses a single machine screw through the tab of the transistor.

The repair process is as follows. Begin by removing the PA PCB from the chassis, which starts with taking a photograph of the installed and connected PA board, clearly showing all of the various connectors that attach to the board. Next, disconnect the various connectors. These include three coaxial cables (J101, J801, and J961), one Molex connector (J331), and one ribbon cable (J301). The incoming DC power connector must be unclipped from the rear chassis panel. Then remove the eight machine screws that secure the PA board to the chassis, followed by the four machine screws and sheet metal shields from the power amplifier transistors, and the single machine screw and bushing that secures Q121 to the chassis. Lift the PCB out of the chassis, and carefully wipe off all of the old thermal compound from the chassis bosses where it was applied.

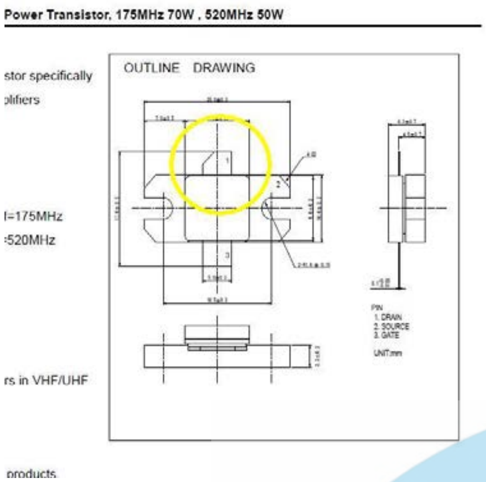

Figure 3 – RD70HVF1C datasheet excerpt

Once the PA PCB is out of the chassis, basic SMD removal techniques can be employed for Q101, Q111, and the two power amplifiers Q131 and Q132. Solder wick or a vacuum solder removal device should be used to de-solder Q121 from the PCB. The printed circuit board (PCB) must be cleaned thoroughly of excess solder and any flux residue, as well as of any thermal compound on its lower surface.

Install the 2SK2854 Q101 and the RD01MUS2 Q111 transistors to the PCB in the usual manner for surface-mount devices, being sure not to form any solder bridges between traces and/or pads.

Set the PA board back in place and start all of the PCB retaining screws into their respective holes in the chassis. Do not tighten the screws at this point, as the PCB will be removed again before the job is done. Next, place the two power amplifier transistors into place in their holes in the PCB. *Pay careful attention to the proper orientation of these transistors, as follows.*

The RD70HVF1C N-channel power MOSFET's used as the power amplifier transistors, commonly called the *"finals",* have a unique shape as shown in Figure 2. The Figure 2 illustration is an excerpt from the IC-7300 service manual's PA PCB component layout diagram. Refer also to the datasheet excerpt in Figure 3. Note that each of these two transistors has two slotted mounting tabs through which the retaining screws pass, and then there are two foil leads that are surface-soldered to the PCB. Comparing the component outlines from Figure 1 to the datasheet excerpt in Figure 3, we can see that the *drain* lead, marked as terminal #1 in the Figure 3 drawing, has a clipped corner on the foil lead, while terminal 3, the *gate*, has no clipped corners. A careful look at the PCB will reveal that the pad for the *drain* terminal also has a clipped corner, which will align with the clipped corner on the transistor lead. Installing these transistors in an incorrect orientation will cause immediate failure of the new transistors.

To install these transistors, first identify the correct orientation as explained above. Next, with the PCB in place in the chassis and the PCB retaining screws started into their holes, drop the power amplifier transistors into their holes in the PCB and start their retaining screws into their holes, but once again, do not tighten them, and do not put the shields in place yet. Tack-solder the transistors to the PCB at both the *gate* and the *drain* terminals.

Next, drop the RD15HVF1 Q121 transistor into place and start the machine screw, with its bushing in place on the screw, into the hole and run this screw down until the bushing centers in the hole, but do not fully tighten the screw. Doing so will make soldering the transistor more difficult because of the heat-sinking property of the chassis when the screw is tight. Now, solder this transistor into place on its traces. Then, remove all of the screws and lift the PA PCB back out of the chassis.

With the PCB on the bench once again, finish soldering the two power amplifier transistors Q131 and Q132 to the PCB, being sure to adequately solder each of the foil leads to the PCB pads. The PCB is now ready for reinstallation.

Apply a light coating of thermal compound to the bosses where the driver transistor Q121 and the two power amplifier transistors Q131 and Q132 will mate with the chassis. Set the PCB down into the chassis and start all of the eight PCB retaining screws into their holes once again, but do not tighten them yet. Next, insert the machine screw and bushing into the tab of the driver transistor Q121, but once again, do not tighten it yet. Now set the two sheet metal shields into place over the power amplifier transistors Q131 and Q132, and insert their machine screws through the shields and into the chassis. Tighten these screws securely.

Tighten the machine screw in the driver transistor Q121, making sure that the bushing centers properly in the transistor tab. Then, following the numerical sequence marked on the PCB adjacent to each of its securement holes, tighten the PCB retaining screws in two stages. Re-connect all of the board connecting cables and install the DC power connector into the chassis rear panel.

I usually do not do a deep-dive into specific procedures in these monthly articles. Due to the ease with which damage can be done to this radio during transistor replacement, I felt that an explanation of the process might be well-advised in this case.

Simply replacing the transistors does not complete the repair in this radio. There are adjustments that are required to be done following such replacements. The IC-7300 service manual provides the procedure quite clearly, and that is what I used as a reference when making these adjustments.

The first step in the adjustment process is to ascertain that the radio has the most recent firmware release installed, and to upgrade the firmware to that level if it is not already there. In accordance with the IC-7300 service manual, alignment adjustments are generally made via software. However, there are some hardware items required in order to accomplish the task. One of these hardware items is a shunt plug, which is easily fabricated using a 1/8” mono TRS phone plug.

It is very important that the device firmware is fully updated. The current firmware as this is written, version 1.42, is available at the Icom website, and is located on the IC-7300 downloads page. Prior to installing the firmware update, it is strongly advised that the radio’s settings be backed up to a Micro-SD card inserted into the card slot on the front face of the radio. Then, after the firmware update, the settings can be restored directly from the Micro-SD card.

The IC-7300 service manual, which is readily available online, provides the step-by-step alignment instructions together with the target values for each adjustment to be made.

For that reason, I will not go into describing the procedure in any more detail than has already been shown. What I *will* say is that if any given step of the alignment process does not result in the expected outcome, go back over the process starting with the last step that *did* provide the expected results. This alignment is really *very* hard to mess up, so long as the instructions are followed exactly as written.

Once the alignment is completed, I usually perform a final test of the transmitter output in all modes and on all bands, recording the results of these tests in my repair records for the unit. This allows me to have something definitive to which I can refer if a problem should arise later on, instead of having to rely on my memory. This is a step that I take due to the large volume of repair work that I do; it may not be necessary for the ham working on his/her own equipment.

Iin this case, the unit exhibited a maximum power output of 102 watts on the FM mode, 100 watts on RTTY and also on CW operations, and 99.5 watts on single sideband modes. Modulation was clear and crisp, and the audio throughput was close to perfect. The two-tone linearity test showed near perfect linearity. Receiver sensitivity and selectivity were both about as best as can be expected from this particular model.

One anomaly that was noted and subsequently corrected was the extremely short transmit delay period. The transmit delay function is important when using many types of connected accessories, but especially so when an RF amplifier is connected downstream of the transmitter. It is important that the amplifier is fully switched and ready for an incoming signal before the transmitter actually sends that output to the amplifier.

The IC-7300 provides an adjustable transmit delay period that ranges from a minimum nominal delay of ten milliseconds up to thirty milliseconds, in five millisecond increments. What I noted was that the transmit was virtually instantaneous, with no apparent delay at all. Now… with the type of operation that the owner of this radio was customarily employing, this was really no big deal, though it was not correct. According to published information, the nominal ten-millisecond delay setting will normally result in a measured delay of about seven milliseconds. In this case, the measured delay was only 2.6 milliseconds. This was a change that occurred on installation of the v1.42 firmware; the radio had previously been running on firmware version 1.40 and had a measured transmit delay of 9.4 milliseconds.

As was already mentioned, this short delay could be very problematic if an RF amplifier is installed after the transmitter, as it would potentially permit *"hot switching"* of the amplifier, where the amplifier is attempting to shift into its transmit mode with an incoming RF signal already present. This can and usually will cause damage to the amplifier, and especially so when the amplifier is a tube-type appliance.

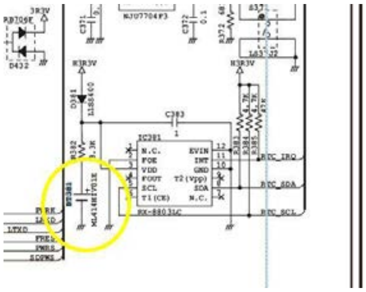

Figure 4 - RTC battery circuit

My first step in trying to remedy this situation was to set the TX DELAY value to its maximum value, a nominal 30 milliseconds. This had an immediate effect, with the measured delay now being 31.4 milliseconds. I then set the TX DELAY value to its default setting of *"OFF"*. This is supposed to produce the minimum ten-millisecond delay period. In this case, it produced a measured 8.3 millisecond delay. I was happy with that, so I left it there. I did, however, follow the same steps with the 50M TX DELAY setting, which sets the delay value for the 6-meter band.

It is noteworthy that this value was not as expected following a firmware update, and it is rather unlikely that many hams doing their own firmware update would have noticed the lack of a delay. Quite frankly, I am sort of surprised that I noticed it, but I did. Fortunately, it was a very simple fix… but it is something for which I will watch out in the future.

I was not finished with the radio yet. The customer had asked for a replacement of the RTC battery, remember? This battery is a tiny ML414HIV01E coin cell that has welded solder tabs installed to the cell. When I say tiny, I really mean just that. The battery number gives us its dimensional sizes – 4 mm diameter by 1.4 mm thick. For comparison purposes, consider that 4 mm is equal to about 5/32". It is a 3.0V cell that is charged by the H3R3V supply line on the *MAIN* board of the radio. The battery feeds the RTC chip IC381, an RX-8803LC integrated circuit (IC) through a 3.3kΩ current-limiting resistor R382 (Figure 4). The charging current is delivered through an L1SS400 diode D381, whose job is to isolate the coin cell, allowing it to permit the flow of current to the RTC chip but *not* to the remainder of the radio's circuits, while also permitting the flow of charging current into the coin cell. Enough about the circuit. Let's talk about replacing the coin cell.

This cell is most easily replaced by first removing the MAIN board from the radio chassis. There is a series of ribbon cables to be disconnected, as well as one coaxial cable and three Molex connectors. As always, a photo is worth taking so as to help you with the reassembly. The MAIN PCB is located under the lower cover of the radio, but both the upper and lower covers must be removed, as the front panel retaining screws, one at each corner of the front panel, must also be removed so that the front panel can be swung off to one side. This permits the range of movement necessary to be able to get the MAIN board out of the chassis. There are seven retaining screws for the PCB. The board itself sits on a series of pins on the chassis, and is supported underneath by a bracket that attaches to the MAIN board via some adhesive foam. A bit of maneuvering is required to get the board out, but it is easily done, and the board is on the bench before you know it.

As I usually do, I used my hot tweezers to remove the original cell. I do not mind doing this, because the cell is being removed for replacement, so I don't really care if I make a direct short circuit across the cell as I desolder it. The cell is, in most cases, depleted or nearly so anyway. The important point is that the new cell cannot be installed using the hot tweezers, as that would deplete the cell almost immediately via the short circuit created by the tweezers. Instead, a fine-tipped soldering iron and some fine rosin-core solder is used to solder the new cell into place, just like any other SMT device. I installed the new coin cell and then reassembled the radio. Installation of the MAIN PCB is simply a reversal of the removal process. The tightening sequence for the seven retaining screws for the board is identified on the board, by a numeral printed adjacent to each screw location. Tighten the screws in two steps, following the sequence given.

I delivered the radio back to the customer, where I also helped him to adjust his dipole length and to install a coaxial feedline and balun in place of the window line. His window line ran just a few inches from an aluminum downspout at the corner of his house, and its extra length was sort of doubled back on itself. These are not ideal conditions for any OWL installation. Changing his setup over to a coaxial feedline really cleaned things up for him. The radio – and the repaired tuner (more about that in its own article) – worked flawlessly, we thought. However, as it turned out, there was a small problem that cropped up later. I will address that in another article, as it is a topic that deserves its own story.

That just about wraps this one up. See you next month!