At the Repair Bench – Yaesu FTM-400 – May 2024

Sometimes, a repair does not only involve schematics, components, and solder. That was the case recently when a Yaesu FTM-400XDR (Figure 1) came in for repair. The FTM-400XDR is a dual-band 2m/70cm mobile radio with digital, data, APRS, and Bluetooth capability in addition to the usual analog modes.

Figure 1 - Yaesu FTM-400

The radio's owner brought it to me, saying that it would not allow him to reach the club's repeater at 147.180MHz. He and I, several weeks prior, had spent some time noodling around with the radio for the same complaint, and I found then that it worked quite well in simplex mode, and that when I entered the correct CTCSS frequency and set the radio for automatic repeater offset operation and proper squelch mode, it worked well on the repeater as well. I told him to go through the programming of the radio and at that point I believed that the problem was resolved.

Fast-forward a few weeks, and the radio is back, this time having been replaced by an FTM-500 series unit out of frustration (and probably a little bit of desire). The more features any given radio offers, the more complex the operation and therefore the setup or programming of that radio will be. This is what turned out to be at the root of this failure, but I am getting ahead of myself.

Having the previous history in mind, the first thing that I looked at was the programming of the memories in the radio. What I found surprised me. There were no stations programmed other than the club's 2-meter repeater, and that one had an incorrect CTCSS frequency entered. The tone was set to 100.0Hz rather than to the correct 131.8Hz. Further, I found that the *Squelch Mode* setting was set to *Noise* rather than to either *Tone* or *Tone Squelch.* This meant that that the radio was generating a 100Hz subaudible noise signal instead of the clear 131.8Hz subaudible sine wave tone required to allow access to the repeater.

Funny thing… I remembered additional memory channels having been populated when I looked at the radio previously. I couldn't see the owner deleting all of the other channels, including the *"Home"* channels, so I began to wonder about the memory of the radio. I programmed in three each VHF and UHF repeaters manually, and then I set the radio aside for a few days. When I came back to the radio, the memory slots were not empty, but neither were the stored values the same as I had entered. For example, the text strings assigned to the memory slots had been corrupted, and the CTCSS tone frequencies had changed. In addition, the *Squelch Mode* settings for each of the memory slots had also reverted to *Noise*. At that point, I believed that I had narrowed the problem down to a failed memory battery in the radio. This is reinforced by the fact that the date and time stored in the radio, which I had reset, were also incorrect.

Investigation of the radio service manual showed that the radio actually uses two batteries, which are actually coin cells – one each in the Front Panel module (Figure 2) and the Main module (Figure 3). In both locations, the cell is an industry standard ML614R-TT31 cell carrying a Yaesu replacement part number of Q9000895. This is a lithium-ion secondary cell with a 3.0V 2.5mAh

Figure 2 - Front panel coin cell location

rating and an anticipated life of five years, and is designed for a discharge rate of 0.005mA. The specifications for these cells are shown in Figure 4. The specification list for the M614R-TT31 shows that it was designed for only a 10% discharge depth, with a charge/discharge cycle count of around 300 cycles.

According to the serial number of the radio at hand, it was produced in September of 2020. Making the coin cells almost three years of age in use, but there is no real way of knowing how much of their shelf lives had expired at the time of installation. It is not unreasonable to find these cells to be failing at three years of radio life. Upon opening the radio's Main module and measuring the mainboard cell, I found it to be at 2.58V. Next, I opened up the Front Panel module and measured that cell. The Front Panel module cell measured out at a very low 0.612V. It was obvious at this point that replacement of both of the cells was necessary, so I ordered them in. As it turned out, even though the FTM-400 uses two of these cells, Yaesu's USA service center *Standard Horizon* stocks only one of these cells. They get $1.49 for each cell and about $11.00 for the shipping, and said that the second cell would have to come from Asia and would entail additional shipping charges. Instead, I ordered a set of ten cells from an Asian supplier at a reasonable cost and with less than a two-dollar shipping fee. The only rub is that the cells, ordered in the middle of May, are not projected to arrive until almost the end of July, about the same lead time that Yaesu had offered.

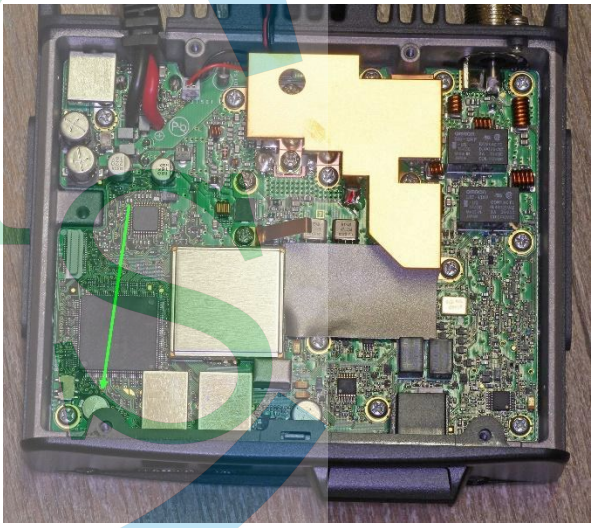


Figure 3 - Main module coin cell location

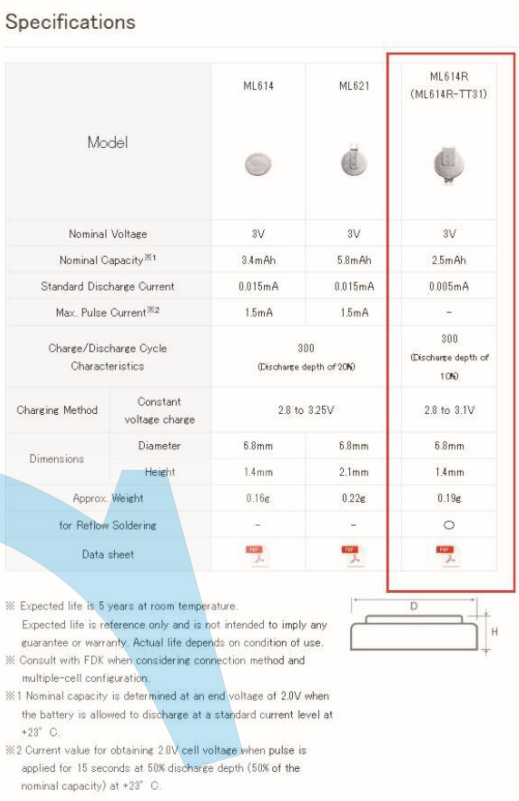
You would think that a consumable item with a finite life cycle such as these lithium-ion cells, which also have a relatively low expected charge/discharge cycle count before failure, would be more readily available here, where so many of these radios have been sold. The Yaesu parts counterman said that he only gets orders for these cells one at a time. That may well be, as other models use the same cell but in a single cell scheme. The FTM-400, however, uses two of these cells, and the manufacturer should be ready to support the radios as these cells fail. The failure of these cells is inevitable and should therefore be anticipated, with an accompanying adjustment in stocking levels. This looks like poor planning, if you ask me.

OK – the batteries – or cells, to be more accurate – have arrived and have been installed. Now the voltages measured are as follows: 2.98V on the mainboard, and 3.02V on the front panel board. Hopefully, this repair will keep the memories in this radio operational for several years. These cells are lithium-ion secondary cells, which are rechargeable, and they do receive a charging current during radio operation. However, there is a finite limit to the number of discharge/charge cycles which the battery can experience before it will fail to accept additional

charging. It is safe to assume that between the relatively short “shelf” life and the limited “cycle” life of these cells, they have simply met their limits and needed replacement.

Replacement of the cells was straight-forward. I used my SMT soldering tweezer to heat both tabs of each original cell at the same time, simply lifting the cell clear once the solder flowed. The soldering tweezer was *not* used to install the new cell, as I did not want to place a short across a new cell. I simply placed each cell into its proper position onto the pre-tinned pads on its respective board, and then soldered it in place with my pencil iron. To simplify the installation, I pre-tinned the solder tabs and the PCB pads before placing the cells on their boards. Having done that, the final step was a simple reflow of the tinning solder.

Following the installation of the cells, it was time for the radio to be programmed and tested. I used the RT software and cable provided by the radio owner for the programming steps. Once that was completed, I took the radio to an antenna, feeding the output through my trusty Bird 43 directional wattmeter with an appropriate element in place.


Specifications

Model		ML614	ML621	ML614R (ML614R-TT31)
Nominal Voltage		3V	3V	3V
Nominal Capacity※1		3.4mAh	5.8mAh	2.5mAh
Standard Discharge Current		0.015mA	0.015mA	0.005mA
Max. Pulse Current※2		1.5mA	1.5mA	-
Charge/Discharge Cycle Characteristics		300 (Discharge depth of 20%)		300 (Discharge depth of 10%)
Charging Method	Constant voltage charge	2.8 to 3.25V		2.8 to 3.1V
Dimensions	Diameter	6.8mm	6.8mm	6.8mm
	Height	1.4mm	2.1mm	1.4mm
Approx. Weight		0.16g	0.22g	0.19g
for Reflow Soldering		-	-	○
Data sheet				

※ Expected life is 5 years at room temperature.
Expected life is reference only and is not intended to imply any guarantee or warranty. Actual life depends on condition of use.
※ Consult with FDK when considering connection method and multiple-cell configuration.
※1 Nominal capacity is determined at an end voltage of 2.0V when the battery is allowed to discharge at a standard current level at +23° C.
※2 Current value for obtaining 2.0V cell voltage when pulse is applied for 15 seconds at 50% discharge depth (50% of the nominal capacity) at +23° C.

Figure 4 - Coin cell specifications (ML614R-TT31 boxed in red)

All operational testing of the radio went as expected. The output power level on the 2-meter band measured a nice 49.2 watts on the *High Power* setting, 19 watts on the *Medium Power* setting, and 4.75 watts on the *Low Power* setting. The 70-centimeter band did not fare quite as well, measuring 46.5 watts on the *High Power* setting, 18.25 watts on the *Medium Power* setting, and 4.5 watts on the *Low Power* setting. While all of these power levels are somewhat lower than the advertised maximums for this radio, they are none the less within reasonable limits for each of the individual power level settings, and were therefore accepted as being “normal”. It must be noted that Yaesu does not publish an output power range for each band in their service manual for this radio, choosing instead to publish only the maximum power levels expected. The technician must then make a decision as to whether or not a given measured output is acceptable. I considered 10% to be a reasonable lower limit for the various power levels, therefore giving us lower limits of 45 watts, 18 watts, and 4.5 watts respectively for the three power levels offered in this model – high, medium, and low. All of the power measurements were either above or right at these lower-level limits, and were therefore accepted as being within “normal” operating power ranges.

All that was left now was to reassemble the radio, do a final after-reassembly test, back up the programming to the onboard micro-SD card, and get the radio back to its owner. As a convenience to the owner, I printed off a copy of the service manual, so that he would have one for any future needs.

In summary, it can safely be said that this family of radios is coming of age to the point where they will begin requiring lithium-ion cell replacements, as these cells are about at the anticipated extent of their life spans. This means that more of these radios will be coming in for coin cell swaps, and the repair shops should be prepared to service these units. I have now got sufficient inventory on these cells and I am therefore quite prepared. I hope that other repair facilities follow suit and get themselves ready for the rush, as quite a lot of these radios have been sold.

See you next month!