At the Repair Bench – MFJ-259B – January 2024

I just (at the time of writing this, in early August of 2023) completed the repair of an MFJ-259B SWR Analyzer. The item belongs to one of the GCARC club members, but had been donated for long-term use to the GCARC Clubhouse. I came across the unit when it was discovered that it would sometimes operate from an AC power adapter, but would not operate at all from its internal battery. What specifically would happen is that the meters came alive, but the LCD panel did not.

The AC power supply for this unit is a 12VDC 1000mA wall-wart type supply. The internal battery is a bank of ten 1.5VDC “AA” cells. The unit is designed to use either regular disposable alkaline cells, or it can use rechargeable Ni-Cad cells. If the Ni-Cad cells are used, a jumper on the MJ-259B main circuit board must be moved to the *“CHARGER ON”* position; otherwise, the jumper should remain in the *“CHARGER OFF”* position. Of course, this is necessary so that the integrated battery charger can recharge the Ni-Cad cells when AC power is provided.

What I found when I opened up the case was a mess. The alkaline cells that had been installed were obviously flat, and had leaked considerably inside the unit. I spent about an hour cleaning the corrosion out of the battery box and the surrounding area. I then replaced the “AA” cells with fresh alkaline cells and tried the unit, to no avail. It would not operate from the battery. Interestingly enough, it also would no longer operate from the external power supply. The same behavior – active meters but dead LCD panel – was exhibited.

This unit was made to the RoHS Directive standard, using lead-free solder throughout. This was evident by the appearance of the solder joints, with their characteristic flat grey appearance so indicative of lead-free solder use. Lead-free solder joints are prone to early failure due to stresses placed on the board and joints, and I also noted several cold joints in various spots on the main board. I went over the board carefully, re-flowing every joint and removing the solder from any that were suspect in appearance. I re-soldered those joints, and again tested the unit. No luck – it was still inoperative in the same manner as before.

This unit has two five-volt DC supplies internally, one of which is used for the oscillator circuit, and the other of which is used for the logic and display circuits. I was getting intermittent five-volt power to the microprocessor and the LCD panel. One of the areas that had cold joints was the power switch on the main board, which is a DPDT latching push-button switch. The two separate sides of this switch provide current to each of the two five-volt supplies. I wanted to validate the power switch, so I removed the switch and tested it out of circuit, where it tested fine. However, after re-installing the switch, the five-volt supply to the microprocessor and the LCD panel came alive. Progress, but not enough. The LCD panel was still dead.

I next took a look at the ground side of the LCD panel. Pin #1 of the LCD harness is the ground wire, while Pin #2 is the +5VDC lead. When I measure the voltage between these two points, I got no voltage reading at all. When I measured Pin #2 to chassis ground, the +5VDC was present. I next placed a temporary jumper wire from Pin #1 of the LCD panel to chassis ground, and the panel came alive and worked normally.

OK – was there an open in the harness to the LCD panel? Or was the problem elsewhere? I moved the jumper wire from the LCD panel to the Pin #1 wire connect point on the main board, and the panel remained operational. This told me that the wire harness was OK, but that the connection point on the main board had lost its ground connection somehow. I re-flowed that joint again, but that still did not solve the problem.

Ultimately, I resolved the issue by soldering in a jumper wire from the Pin #1 connection on the main board to another chassis ground point on the main board. Problem solved.

The mystery still remains as to how and why that particular pad on the PCB lost its connection to the ground plane, but it was not worth digging any further. The intent was to make the unit operational, which I did. The stresses that contribute to the early failure of lead-free solder joints can be thermal stresses, electrical stresses, or physical stresses. It is for this reason that lead-free solder use is prohibited in mission-critical applications like aerospace, military, or medical applications.

What is interesting about this unit, and something that I believe led to the failure of the PCB connection, is the fact that the battery holder for this unit is mounted directly to the PCB, at two points that span the area of the LCD panel connection to the main board. It is likely that the stresses imposed by removing and re-securing the battery compartment caused some flexing of the printed circuit board, resulting in the failure.

Whereas I am not a big proponent of willy-nilly soldering in jumper wires, in this case it was the best solution to the problem at hand. I do not recommend this approach for every open-circuit problem, as there may be another underlying problem that could worsen if not tracked down. In this case, though, I am fairly confident that the problem is related to the lead-free stress failures, possibly internal in the circuit board. So, in this case I used the jumper wire solution to the problem.

See you next month!