At the Repair Bench – MFJ-704 Low-Pass Filter – March 2026

Figure 1 - MFJ-704 Low-Pass Filter

One of my fairly regular customers brought a rather unique piece of kit to me for evaluation and repair. This was the strangely-built *MFJ-704 Low-Pass Filter* unit. I say *"strangely-built"* because of the manner in which the internals of this device were fabricated. That will be explained in detail later. For now, let's talk about the basic specifications of this piece of equipment.

According to the MFJ-704's front panel markings, it is usable for the frequency range of 0 to 30 MHz. It can handle power levels up to 1.5 kilowatts continuous wave input, and it has a stated through impedance of 52 ohms. The unit came to me for repair with the described fault being that the customer experienced high SWR when the filter unit was installed in the signal path.

Because of the design of this device, there is actually very little that can go wrong with it. I guess that this is as good a time as any to talk about that *"strangely-built"* property of the MFJ-704 that I mentioned earlier.

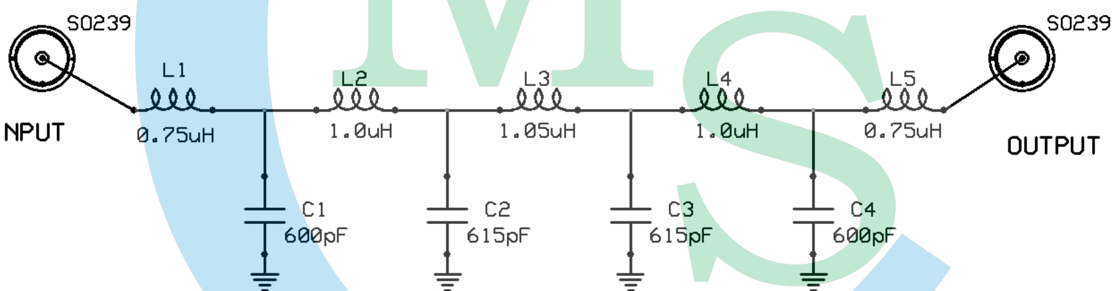

Figure 2 - MFJ-704 schematic diagram

The filter has a standard-enough schematic diagram once you trace it and draw it out on paper or in software, as I did. Figure 2 gives us a look at the circuit design for this unit. It looks pretty simple, but it is amazing how the unit was constructed. While the coils are actual discrete coils of wire, the capacitors are not. The manufacturer started with a sheet of rigid but flexible non-conductive material, possibly fiberglass or even phenolic, which seems most likely. On one surface of this panel, a copper ground-plane pour was placed that covered almost all of the surface on that side of the panel. A small semi-circular area was left un-plated at the center of each end of the panel, which itself measures about two-and-a-quarter inches by seven inches, and is a mere ten-thousandths of an inch thick.

These semi-circles have their own small copper pours that are isolated from the ground-plane pour. Each of these small pours is soldered to the center pin of the SO-239 connector at that end of the unit, with the SO-239 flanges being tied to the ground-plane pour. Each of the small pours also has one end of a coil soldered to it, which would be

L1 and L5 in the schematic diagram at Figure 2. The ground-plane pour has eight small circles that are un-plated, but are drilled to accept the leads of the coils that are installed to the opposite (component) side of the panel.

COIL DATA			
ID	CONFIG	LENGTH	DIAMETER
L1	14AWG 7T	0.695"	0.500"
L2	14AWG 13T	1.250"	0.500"
L3	14AWG 14T	1.355"	0.500"
L4	14AWG 13T	1.250"	0.500"
L5	14AWG 7T	0.695"	0.500"

Figure 3 - Coil data table

The component side of the panel has four rectangular copper pours of approximately equal size, arranged in a row along the length of the panel, spaced about 5/16" apart. The center two pours are slightly larger in area than are the two end pours. Each of these pours, when taken together with the insulating panel and the ground-plane pour on the opposite surface of the panel, form a set of four capacitors. The difference in the areas of the four isolated pours is reflected in the measured capacitance offered by each of these capacitors, as shown in the Figure 2 schematic diagram.

The coils are not all the same, either. The table in Figure 3 shows the pertinent data for the five coils used in the MFJ-704. Note that the coils are paired working inward from the ends, with two identical coils at the outermost positions, and then two coils that are identical to each other but different from the end coils occupy the intermediate positions, and finally a third coil type is used as the center inductor in the filter. These pairings are also evident in the inductance values as measured for each of the coils.

The repair of this unit was extremely simple and immediately visible when I opened up the enclosure. The solder joint at the input end, at the SO-239 center pin, was broken. It is most likely that this break was a result of the use of lead-free solder in the construction and assembly of the filter unit. Over time, lead-free solder joints ***will*** fail due to shrinkage of the alloy. On a PCB, this can cause open circuits between component leads and their associated PCB pads, and it can also cause lifting of the copper traces from the PCB substrate. In this case, it simply caused a breakage in the connection of the filter board to the SO-239 center conductor.

Repair of this unit involved not only re-soldering the failed joint, but also in removing (as much as possible) the lead-free solder from the remaining solder joints in the device, and then re-soldering everything with a eutectic alloy of tin and lead in the form of a 63/37 lead/tin rosin-core solder.

Post-repair testing showed the through DC resistance to be about 0.4 ohms, while the through signal impedance came in at about 51.6 ohms. Placing the repaired filter inline with a known good antenna system had a negligible effect on the standing wave ratio of that antenna system.

In a device such as this one, the DC resistance through the unit will be only the DC path through the coils, which will have a *very* low resistance, too low in fact to be accurately measured with a standard ohmmeter. Instead, the DC resistance in a device like this must be measured using an instrument similar to my Ascel Æ20218 milli-ohmmeter, which due to its Kelvin four-wire measurement system, is capable of measuring resistances down to the 0.0001Ω level, or one-tenth of a thousandth of an ohm.

There may be some readers who are interested in the process for measuring the signal impedance as opposed to simply measuring the DC resistance through a device, which is a much more useful gauge of the integrity of a device such as this MFJ-704 low-pass filter. The process is actually quite simple, and is exactly the same as the feedline or cable impedance measurement method, using a NanoVNA, that I described a while back in a *CrossTalk "From the Help Desk"* article. If memory serves, this was published in the November 2025 issue of *CrossTalk*. In the case of measuring the impedance of the filter, that device is simply substituted for the cable in the measurement process. However, a suitable *STOP* frequency must be determined.

A good rule of thumb for determining the *STOP* frequency is to begin by adding up the wire lengths of the various coils in the circuit. We do this by applying the equation for circumference… $C = \pi \times d$, where C is the circumference of the coil, and d is the coil diameter. We do not need a level of accuracy that would involve inside versus outside diameter or taking into consideration the wire diameter. Rough numbers are all we really need for this purpose. Using the data from Table 1 above, each of these coils has a diameter of 0.500", so the equation becomes $C = 3.1416 \times 0.500$, or $C = 1.5708"$. We then multiply that value by the number of turns in the coil under consideration, and add a half inch at each end of the coil for the coil connecting lead through the board. Finally, we add a half inch at each end of the unit for the SO-239 connections. This gives us the following:

- Inductor L1 – *7 turns x 1.5708" = 10.9956" + 1.000" = 11.9956"*
- Inductor L2 – *13 turns x 1.5708" = 20.4204" + 1.000" = 21.4204"*
- Inductor L3 – *14 turns x 1.5708" = 21.9912" + 1.000" = 22.9912"*
- Inductor L4 – *13 turns x 1.5708" = 20.4204" + 1.000" = 21.4204"*
- Inductor L5 – *7 turns x 1.5708" = 10.9956" + 1.000" = 11.9956"*
- Connector ends – *2 x 0.500" = 1.000"*
- Total circuit length – *90.8232" or 7.5686 feet.*

If we are looking for a *STOP* frequency that would be appropriate, we would then divide the $\lambda/4$ medium-adjusted light-speed value of 246 feet by a value that is slightly higher than our measured or estimated circuit length. In this case, I would then divide 246 by 9 to get a *STOP* frequency of 27.3333 MHz. We can round that to 27 MHz and it will work fine in the impedance measurement. Of course, we start with a *STIMULUS > START* frequency of 50 kHz. Just follow the rest of the procedure as explained in the *CrossTalk* article.

Because of the extremely low DC resistance, there is really no way other than an impedance measurement to know that the filter is healthy. Naturally, with a design as straightforward and simple as this one is, much can be determined simply by a thorough visual inspection. However, because not all circuits are as simple as this one is, it is a good thing to know how to make the impedance measurement effectively.

I made a final inspection to ensure that nothing was overlooked, and then I re-assembled the filter unit, prepared the invoice, and sent everything off to the customer.

To close things out, sometimes a failure is just this simple. However, to just resolder that joint without going any further would be a serious disservice to the equipment owner. This is because the condition that caused the initial failure was still present in the remainder of the unit. It might have been a different story if I had found the SO-239 connector loose in its mounting to the filter enclosure. A loose connector mount could have resulted in a twisting of the connector that could have broken the solder joint. That *was not* the case here. The connectors were both properly secured in their holes in the enclosure, so twisting was *not* the cause of the failure. That leaves only the lead-free solder as the possible cause, and so that needed to be addressed properly. The repair so made should now leave the MFJ-704 low-pass filter in good condition for many years to come.