Acoustat Magne-Kinetic Interface MK-121-2 – A Successful Restoration

History

- These Acoustat Model 2 Slimline Series electrostatic loudspeakers with Magne-Kinetic Interface MK-121-2, serial numbers 104333 and 104336 I purchased new in 1980 from Straight Gain Electronics, Toronto ON.

Figure 1. Acoustat Model 2 home setup – *photo taken October 2023 after restoration.*

- I was extremely pleased with the sound quality of these electrostatic loudspeakers throughout 20 years of worldwide assignments in Canada, Japan, UAE and UK, beautiful sound no matter where they were setup. Sadly, I had to put all my audio equipment into storage in 2001 due to shortage of living space.
- Early 2022 brought my Acoustat Model 2s out of storage and powered them up for the first time in 20 years, and although the speakers were still working and usable, they needed considerable work.
- My goal was to fully restore these speakers to their original (or better) condition, while keeping their external appearance original.
- Having no experience in repairing an electrostatic speaker, I proceeded cautiously with this restoration over 1 ½ years.
- One advantage of a long-term restoration project like this, it allowed me to evaluate step-by-step the individual improvement in sound quality and reliability that each upgraded or replaced component contributed.

Initial Symptoms

a) When powered up, annoying hum noise coming from both interfaces.
b) "Snare drum" sound whenever speakers are moved.
c) When powered up, persistent clicking noises from the speaker front faces.

- Issue a) is documented in this report, while issues b) and c) are independent of the interface restoration discussed here and will be addressed in future postings "Acoustat Stator Wire Repair: Hints and Lessons Learned", and "Acoustat Diaphragm Heat Shrinking: Hints and Lessons Leaned" – *under preparation.*

Observations before Restoration

- Removing the interface top cover plates revealed some problems inside.
- Oil had leaked out from the high-voltage audio capacitors, leaving a sticky goo on the inner surface of the chassis (Fig. 2).

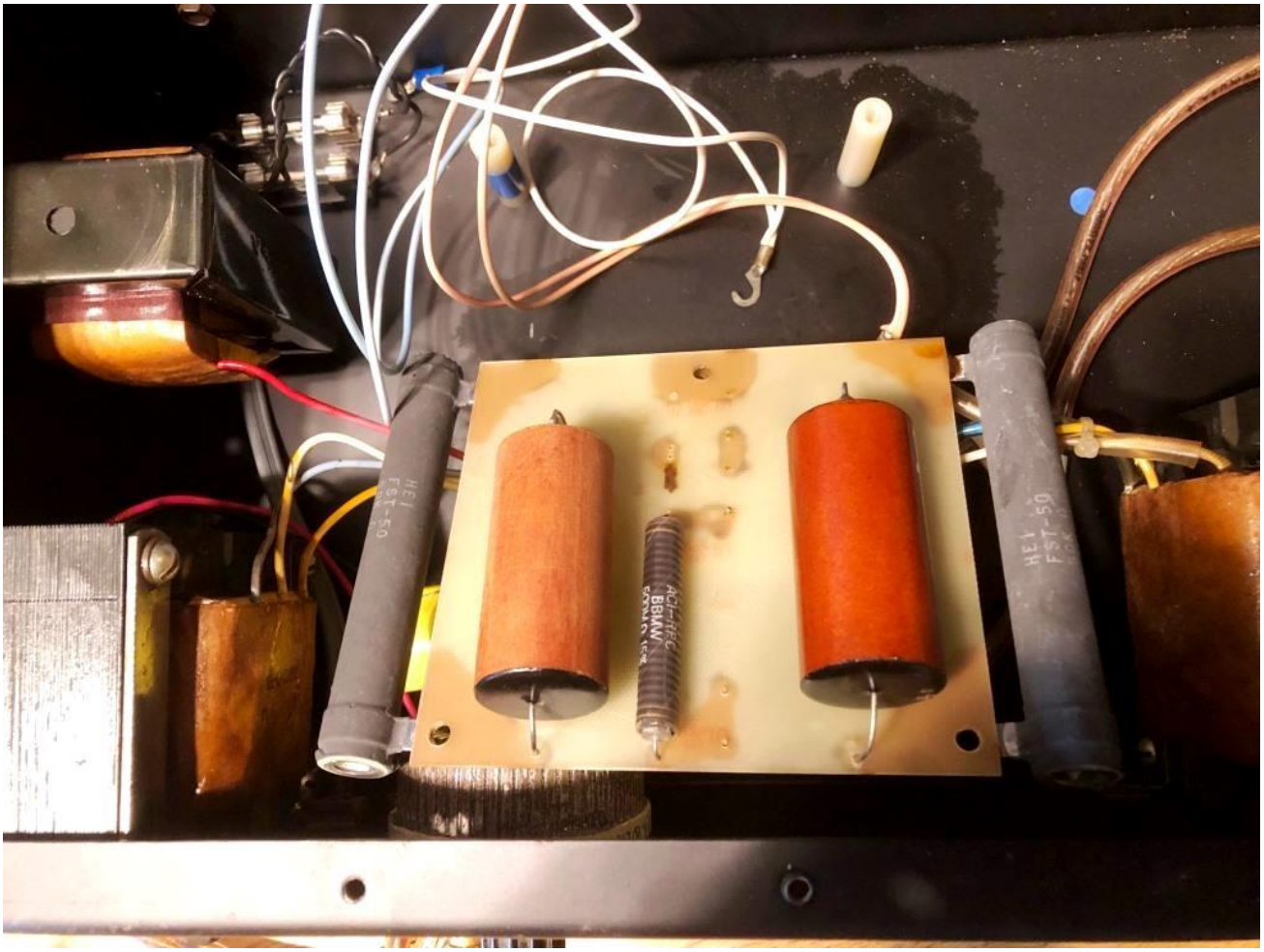


Figure 2. Interface 104333, oil leakage from discoloured right-side capacitor – *board displayed upside down to show capacitors.*

- Discolouration, corrosion in the low-frequency internal wiring (Fig. 3).

Figure 3. Discolouration in low-frequency wiring conductors – *sheath pulled back for clarity.*

Restoration of High-Voltage Board

- With oil leakage from the high-voltage audio capacitors, priority was to rebuild the high-voltage board. No work had been done to the high-voltage board since these speakers were purchased new in 1980.
- To better understand the component circuitry and layout, circuit diagrams were created for the original 1980 configurations, high-voltage section (Fig. 4) and audio section (Fig. 11).

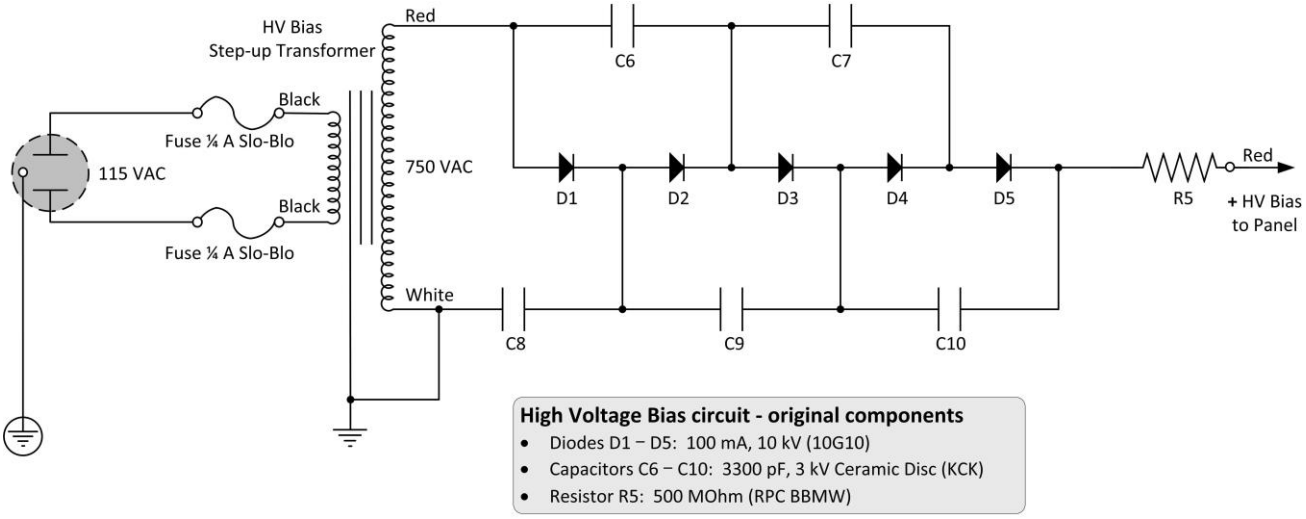


Figure 4. High-voltage circuit, original as purchased new - 1980.

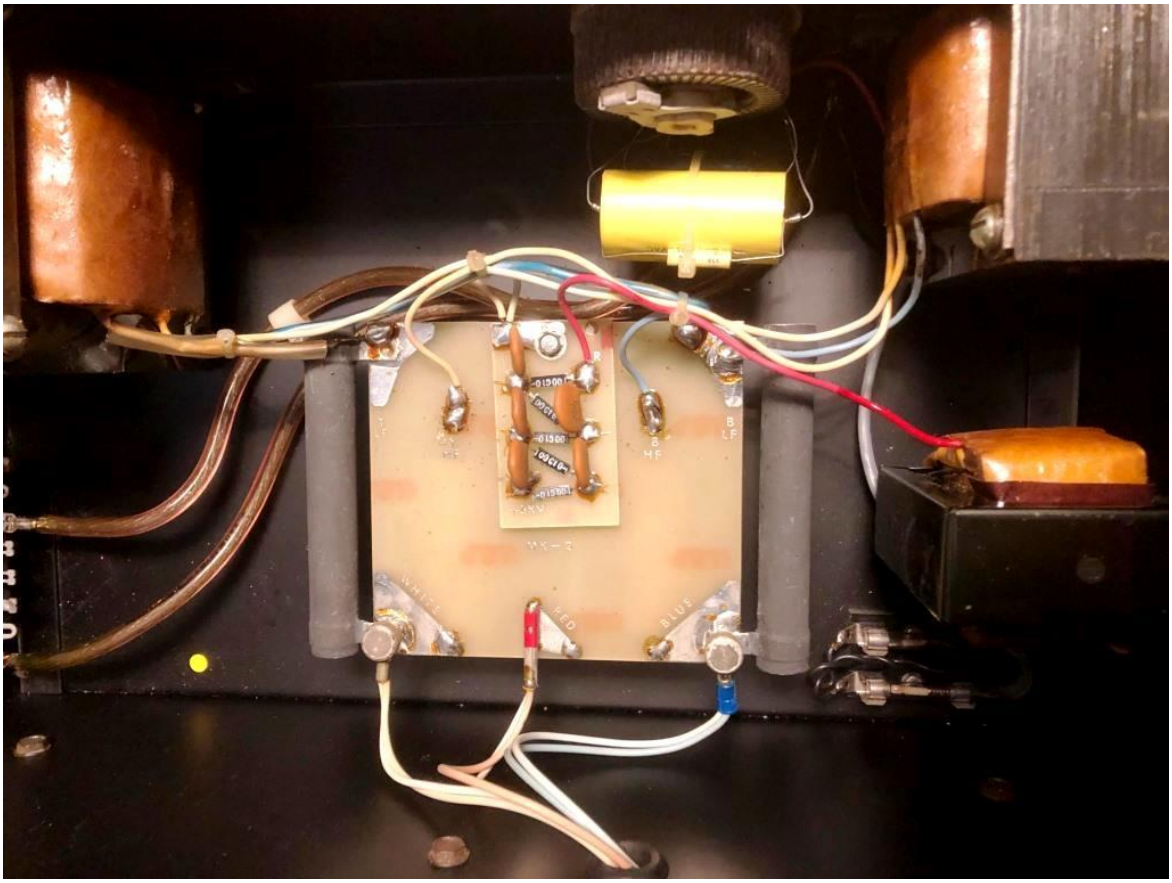


Figure 5. Interface 104336, original high-voltage board before rebuilding.

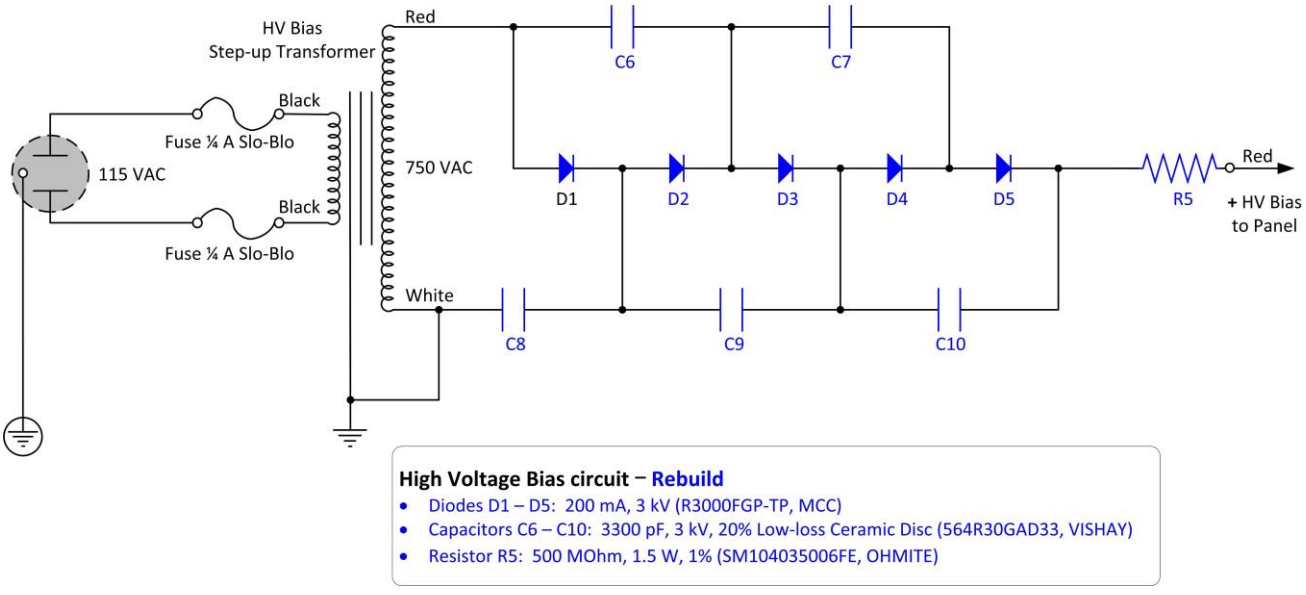


Figure 6. Step 1, high-voltage ladder components replaced during rebuild *(replaced components coloured in blue).*

- Original diodes D1 - D5 and capacitors C6 – C10 on both boards were tested out of circuit and although nothing untoward was found using a low-voltage DVM, these parts were replaced with equivalent or better rated components (Fig. 6).
- On one of the boards, resistor R5 would go intermittent open circuit when lightly pushed. While this did not appear to affect operation, resistors R5 on both boards were replaced with modern components.

- Already just by rebuilding the high-voltage boards with new components the sound quality became clearer.
- Next step was to try and improve the high-voltage bias circuit's storage capacity by adding a 0.01 uF, 6 kV WIMA polypropylene capacitor at the output of the capacitor-diode ladder (Fig. 7).

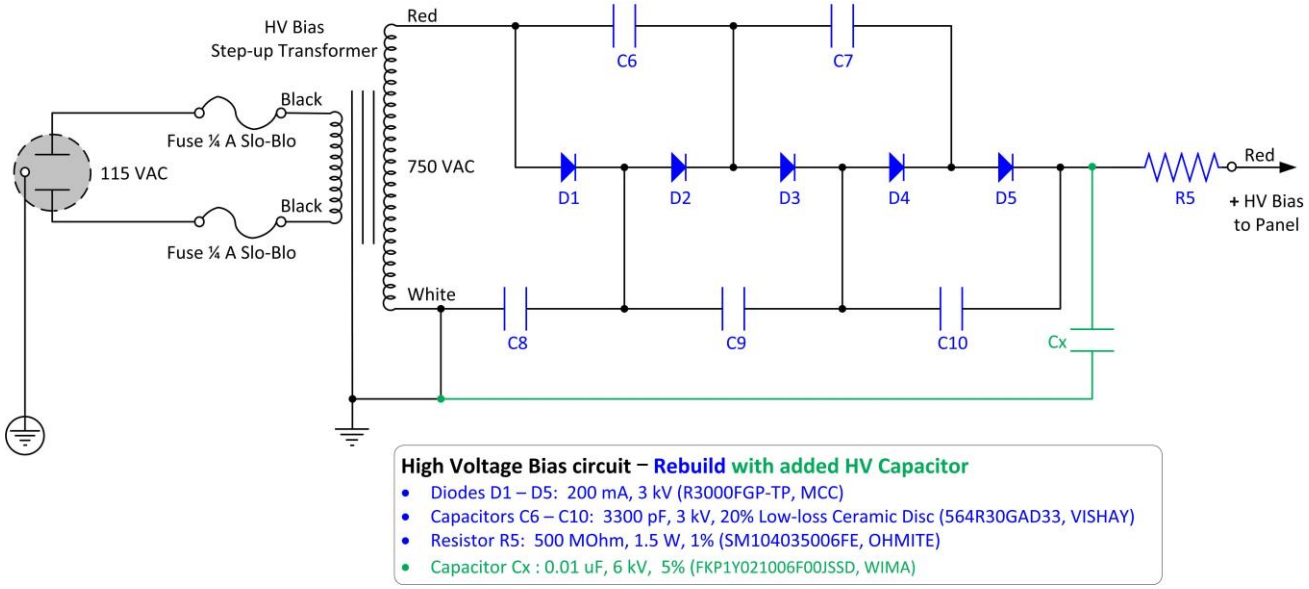


Figure 7. Step-2, high-voltage polypropylene capacitor added to high-voltage ladder *(new component coloured in green).*

- Adding this one polypropylene capacitor to the high-voltage ladder produced a noticeable improvement in sound quality, less graininess but more remarkable was a substantial improvement in the bass frequencies delivering more "punch". It really surprised me.
- Based on the sonic improvement from the addition of this capacitor, I decided to add a second 0.01 uF, 6 kV WIMA polypropylene capacitor to the output of the capacitor-diode ladder (Fig. 8).

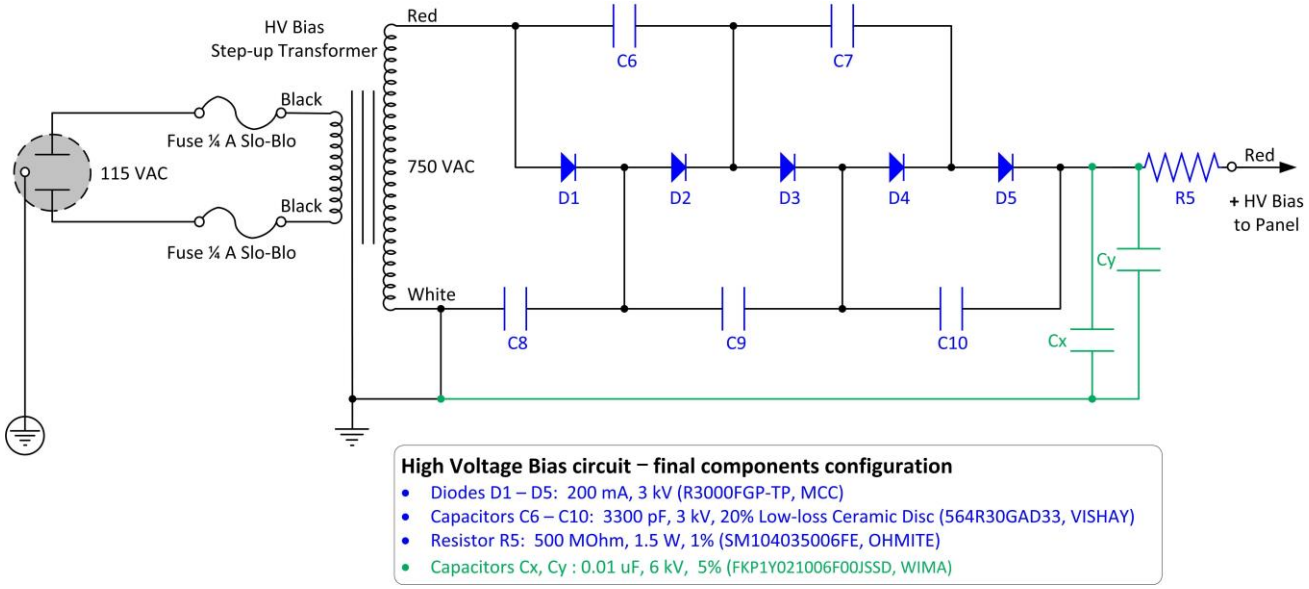


Figure 8. Step-3, high-voltage polypropylene capacitors added to high-voltage ladder *(new components coloured in green).*

- Adding this second polypropylene capacitor to the high-voltage ladder resulted in only an incremental improvement to the sound quality, suggesting that the first capacitor on its own made the biggest

impact and was probably sufficient. Nevertheless, I left the circuit as is with both WIMA polypropylene capacitors connected (Fig. 9).

- Safety! As others have kindly commented, these added capacitors hold their high-voltage charge for considerable time after power has been disconnected. Recommend waiting 24 hours after powering off before attempting work on the interface.

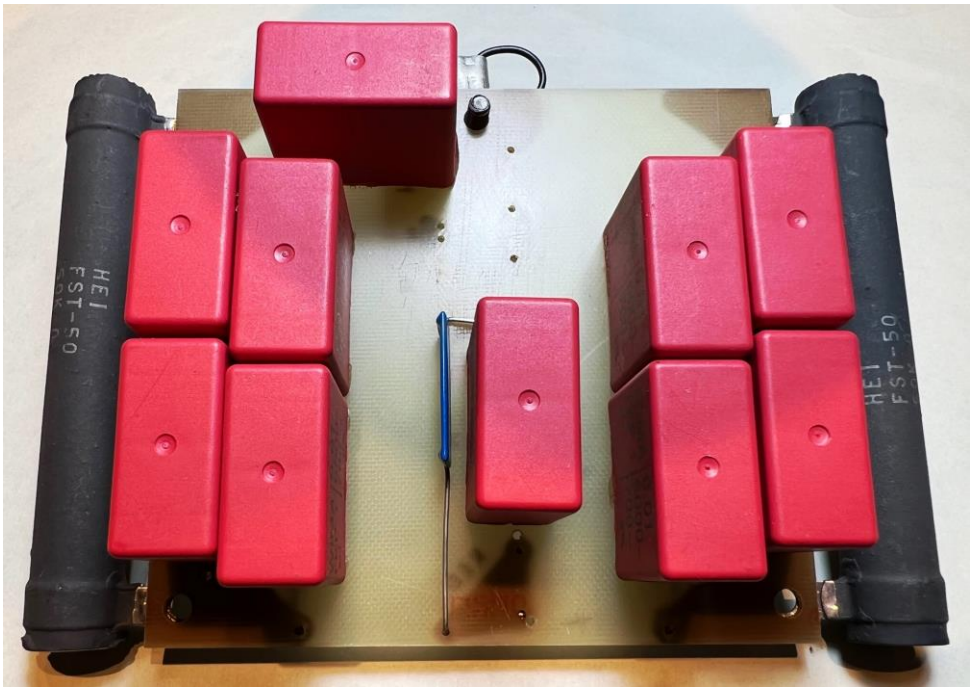


Figure 9. Bottom side of rebuilt high-voltage board *(added 1st capacitor in centre, added 2nd capacitor at top-left).*

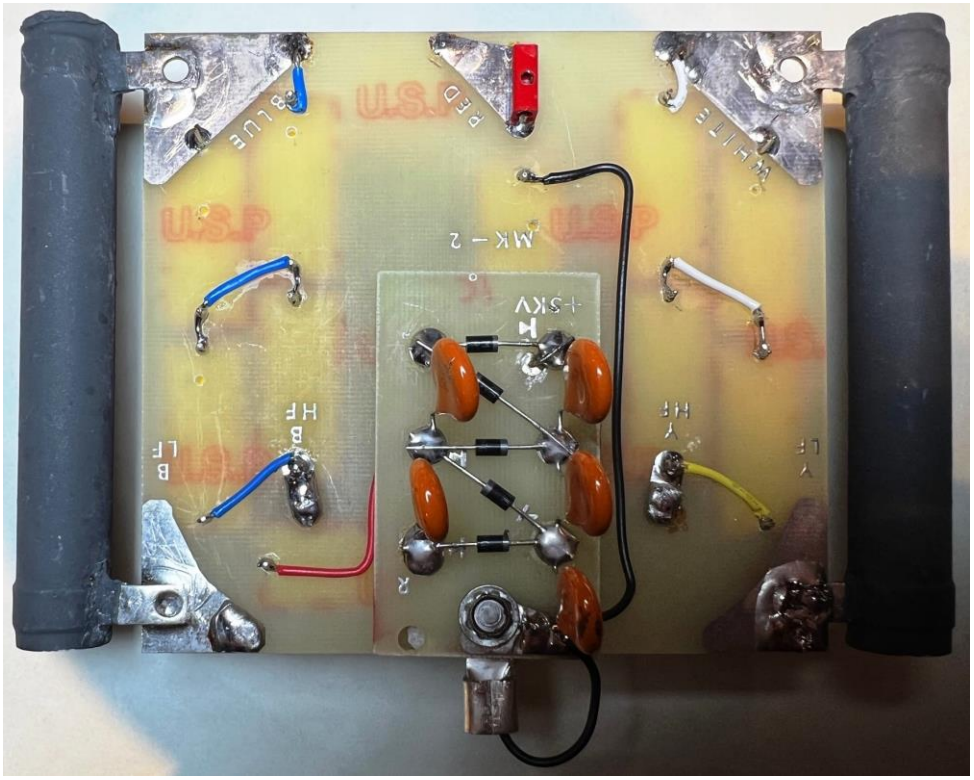


Figure 10. Top side of rebuilt high-voltage board, showing 1st capacitor ground wire *(Black),* **2nd capacitor positive wire** *(Red).*

Restoration of Audio Circuit

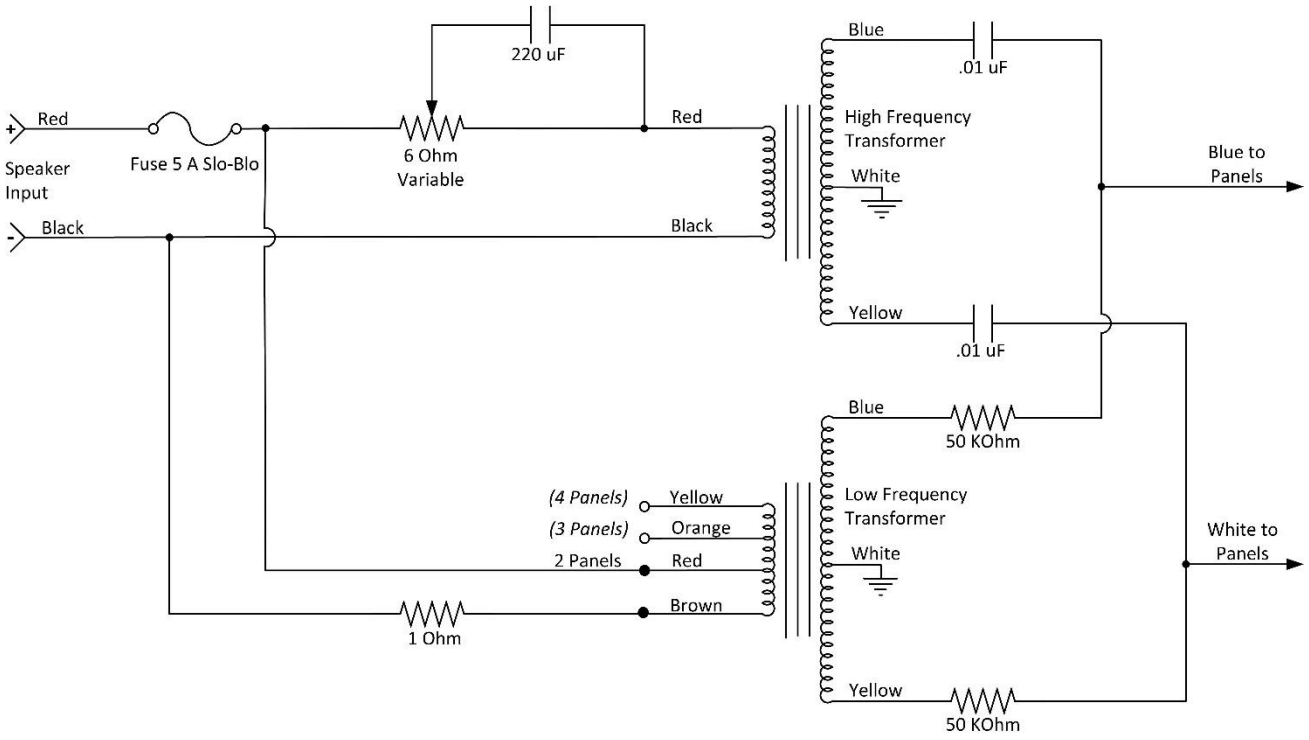


Figure 11. Audio circuit, original as purchased new - 1980.

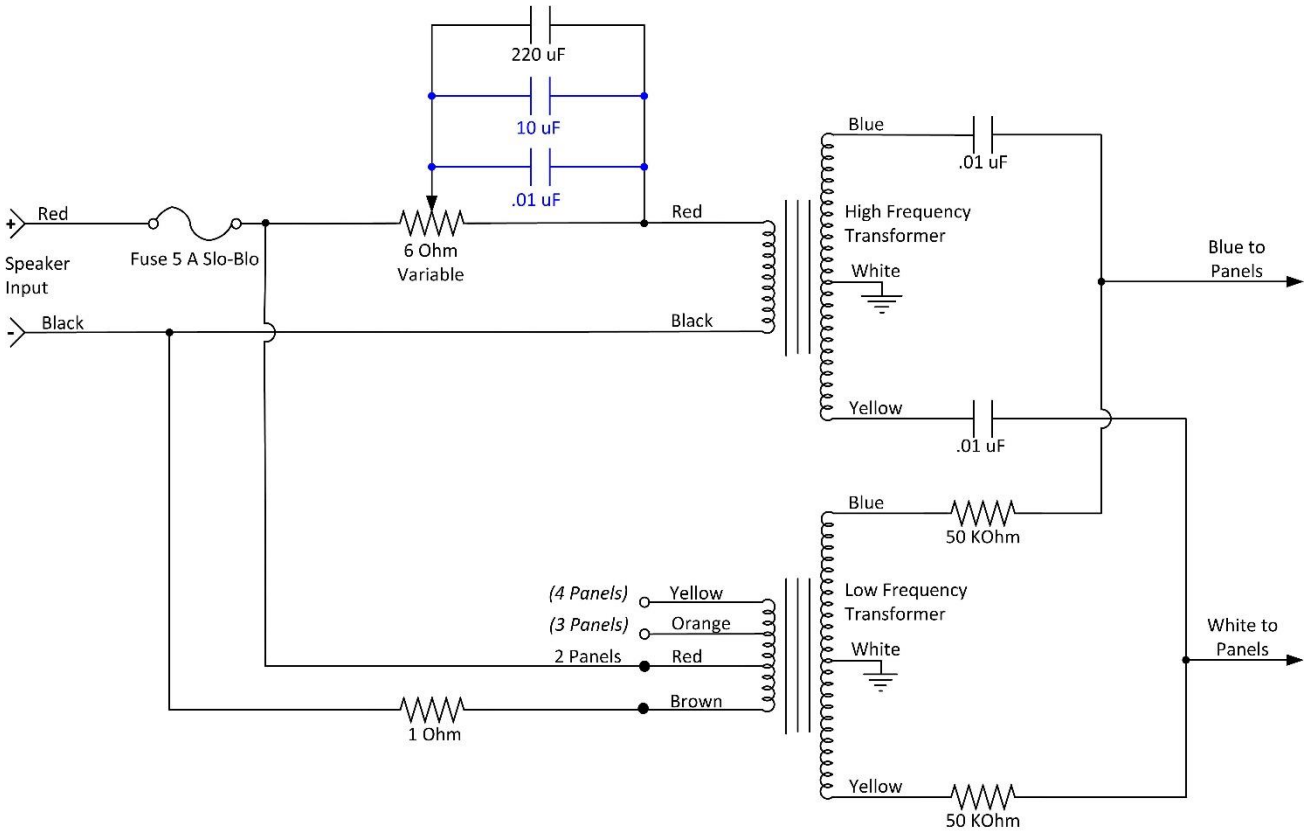


Figure 12. High-frequency input enhanced with added capacitors *(blue colour)* **- 1982.**

- After the input capacitor enhancement (Fig. 12), no other work was done to these electrostatic speakers between 1982 and 2022.
- While the original 5-Amp slo-blo audio input fuse gave no problems, based on the recommendation from Andy Szabo on the diyAudio site, for safety I changed to a 3-Amp slo-blo (Fig. 13). Pleased to report no issues using this lower rated fuse, even at high sound volumes.

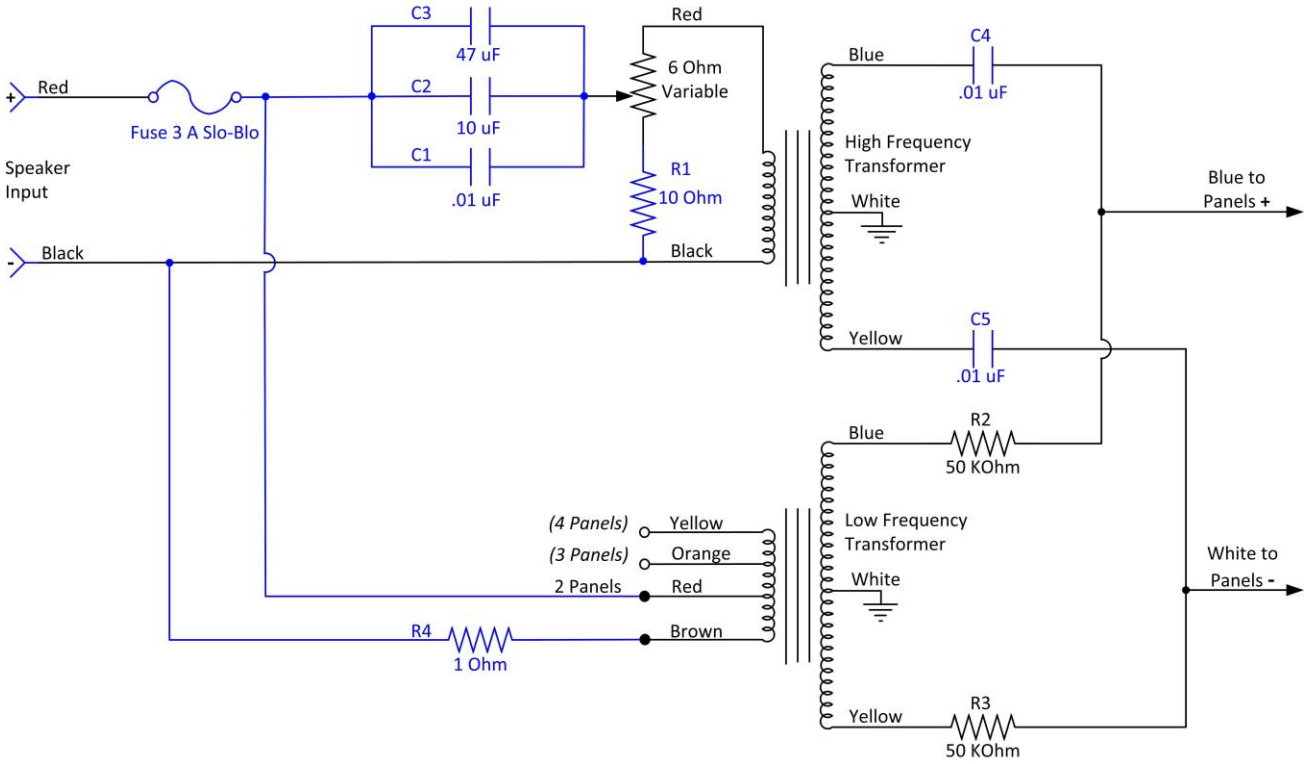


Figure 13. Final configuration of audio circuit, 2023 *(component changes coloured in blue).*

High-Voltage Audio Capacitors replacement

- The original high-voltage audio capacitors that leaked oil I replaced with 0.01 uF, 6 kV polypropylene capacitors (FKP1Y021006F00JSSD, WIMA). While the DC voltage rating of these capacitors is 6 kV, I was concerned about the lower AC voltage rating of 700 VAC RMS (Fig. 14).

Figure 14. WIMA high-voltage capacitors, type FKP1Y021006F00JSSD

- To double the voltage rating and achieve a wider safety margin, capacitors C4 and C5 were configured as a set of 4 (total 8 for one board) in a series/parallel configuration (Fig. 9), providing 0.01 uF with effective voltage rating of 12 kV DC and 1400 VAC RMS.
- With these new polypropylene capacitors installed in the audio section there was a noticeable improvement in sound quality, clearer signal with reduced distortion.

Implementation of C-Mod

- Following the detailed circuit documentation (AJS 6-03-2003) described on the diyAudio site by Andy Szabo, I replaced the high-frequency input capacitors with the following types and quantities (Table 1). Fortunately there is adequate space within the MK-121-2 interface chassis for mounting all components.

Qty (per interface)	Value	WIMA Part Number	Capacity
1	0.01 uF, 250 VDC / 180 VAC	FKP3F021003F00KI00	0.01 uF
2	1.5 uF, 100 VDC / 63 VAC	MKP1D041506B00KSSD	3 uF
1	10 uF, 250 VDC / 180 VAC	MKP1F051007H00KSSD	10 uF
2	22 uF, 100 VDC / 63 VAC	MKP1D052207J00MSSD	44 uF
		Total	**57 uF**

Table 1. Description of WIMA polypropylene capacitors used in the C-Mod.

- These WIMA capacitor voltage ratings are not critical, 100 VDC / 63 VAC rated capacitors are sufficient.
- To minimize transmission of vibrations with the metal chassis, the base and side of the WIMA capacitors were isolated using foam sheeting (Fig. 15).
- The original 6-ohm potentiometer was retained, adding a 10-ohm 50W metal clad resistor to achieve a combined resistance of 16-ohms.

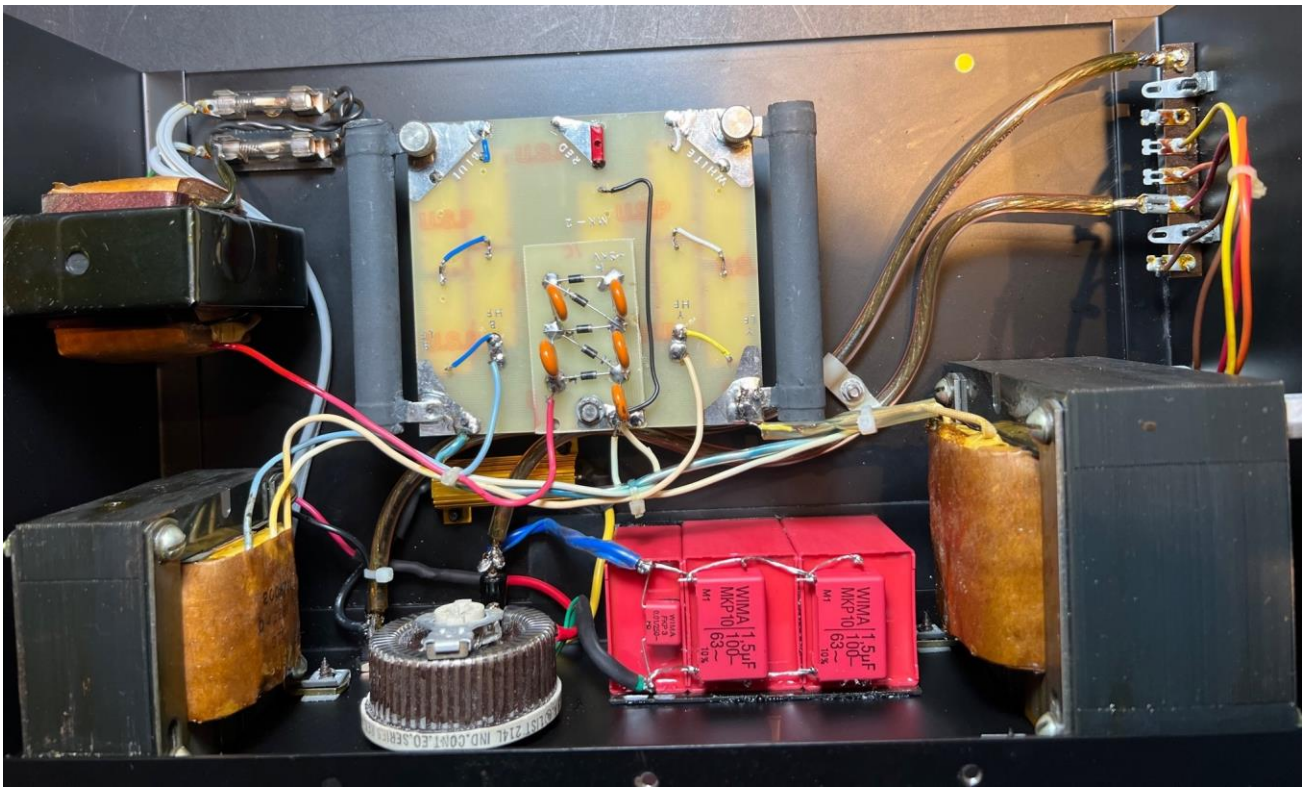


Figure 15. C-Mod with WIMA polypropylene capacitors and 10-ohm 50W metal clad resistor – *before Low Frequency repair*.

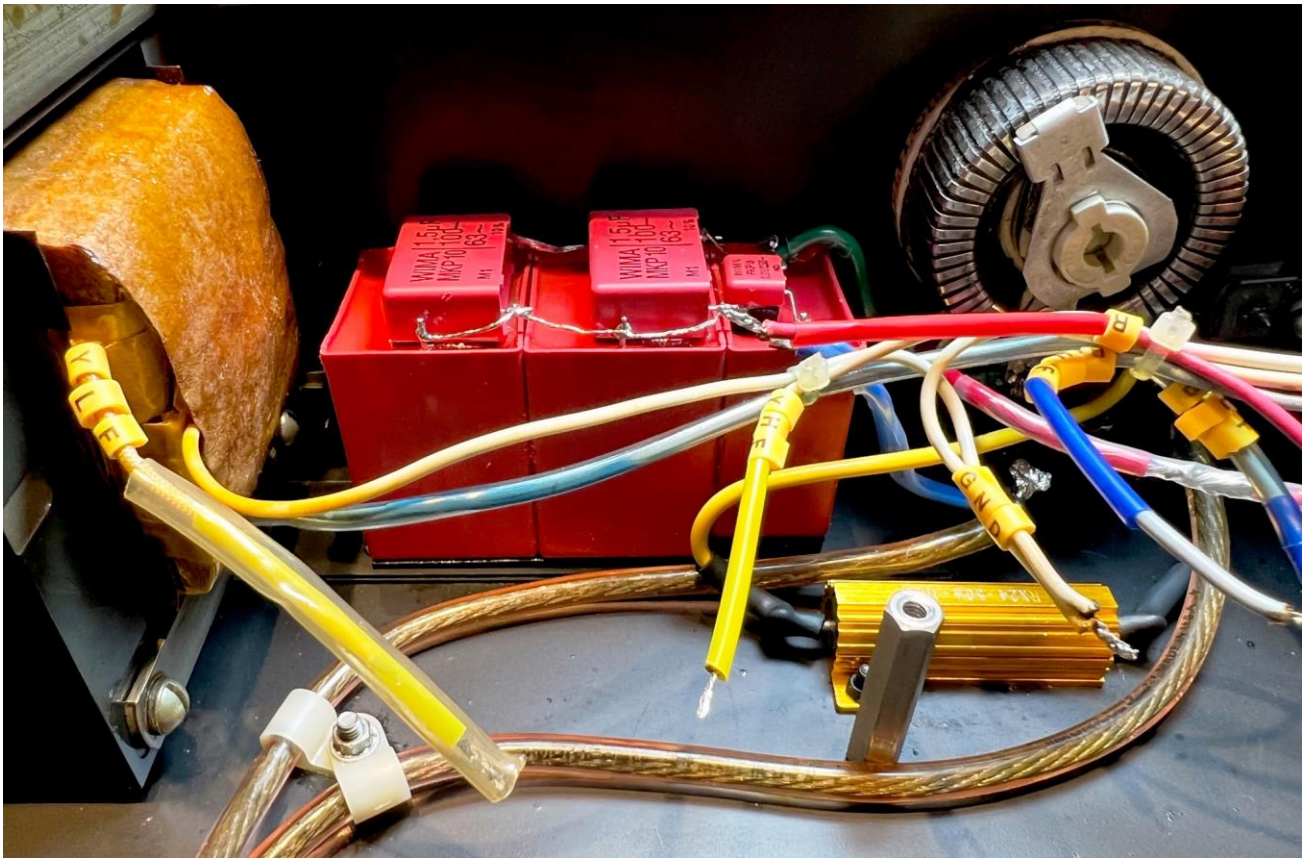


Figure 16. High-voltage board temporarily removed to show fastening of power resistor – *before Low Frequency repair*.

Low-frequency Circuit Updates

- Although both original 1-ohm 10W power resistors tested fine, as precaution I replaced them with new 1-ohm 20W bifilar type (Fig. 17).

Figure 17. Original Huntington Electric 1-ohm 10W resistor *(top),* **Mundorf MResist Supreme 1-ohm 20W resistor** *(bottom).*

- The corroded low-frequency wiring was replaced with new Oxygen Free Copper (OFC) speaker cable that I had spare from another project (Fig. 18).

- The 2-panel Red wire from the low-frequency transformer was removed from the terminal strip and soldered directly to the low-frequency cable, with the redundant 3-panel Orange and 4-panel Yellow wires disconnected from the terminal strip and tied back. All terminal strip connections can be returned to original if desired.

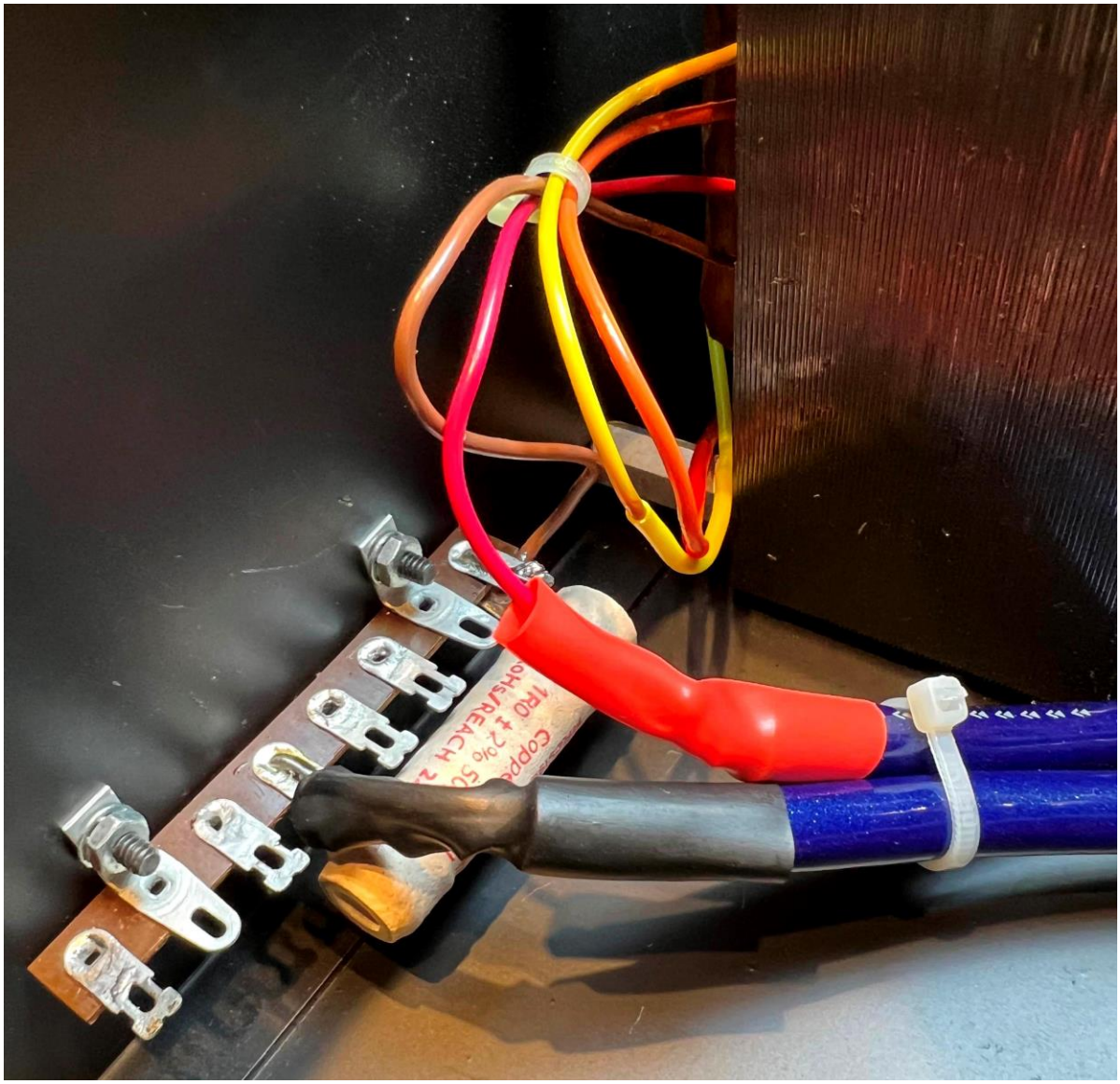


Figure 18. Terminal strip connections for low-frequency wiring and new 1-ohm resistor.

Minimization of 50 Hz induced hum noise

- As luck would have it, minimizing the annoying 50 Hz noise was an inexpensive and straightforward remedy.
- A sheet of thick 3~5 mm synthetic rubber sheeting (Fig. 19) simply laid on the top surface of the interface significantly reduced the hum vibrations. To supplement this another sheet can be laid on top, and as colour of the sheeting material is black, same colour as the chassis, it's hardly noticeable.

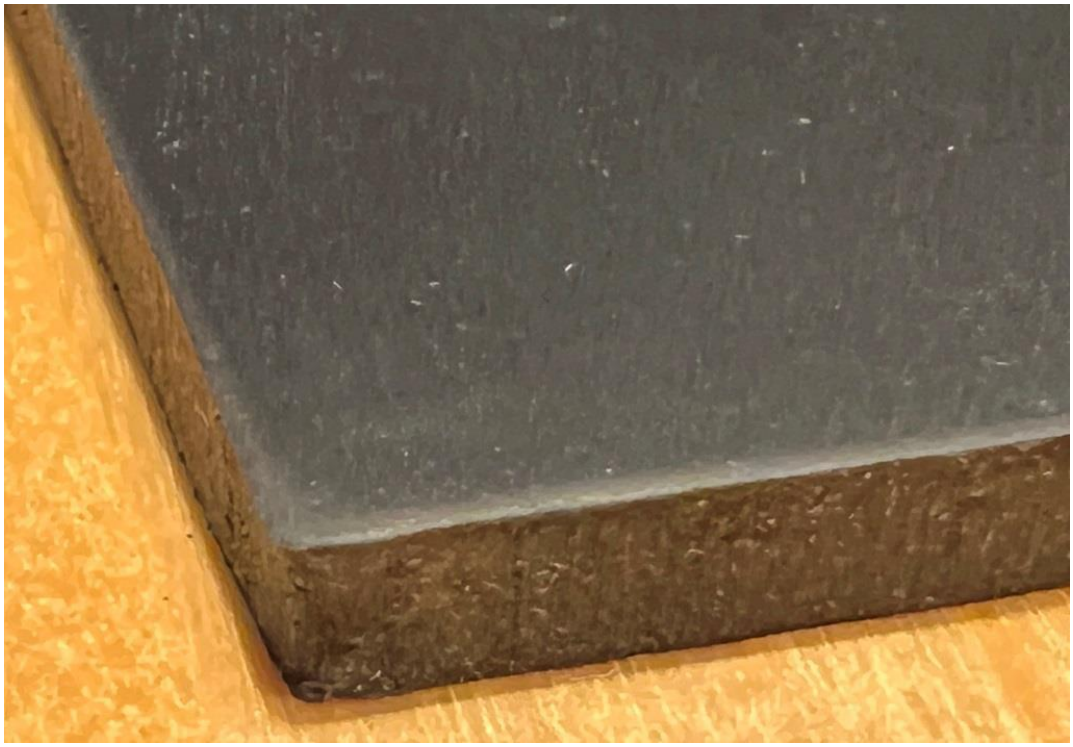


Figure 19. Thick synthetic rubber sheet to lay on top of the interface chassis.

- For attaching to the underside and internal sides of the chassis, I used INOAC's 0.5 mm self-sticking dampening sheet "CALMFLEX" (Fig. 20). https://www.inoac.co.jp/en/solution/calmflex.html

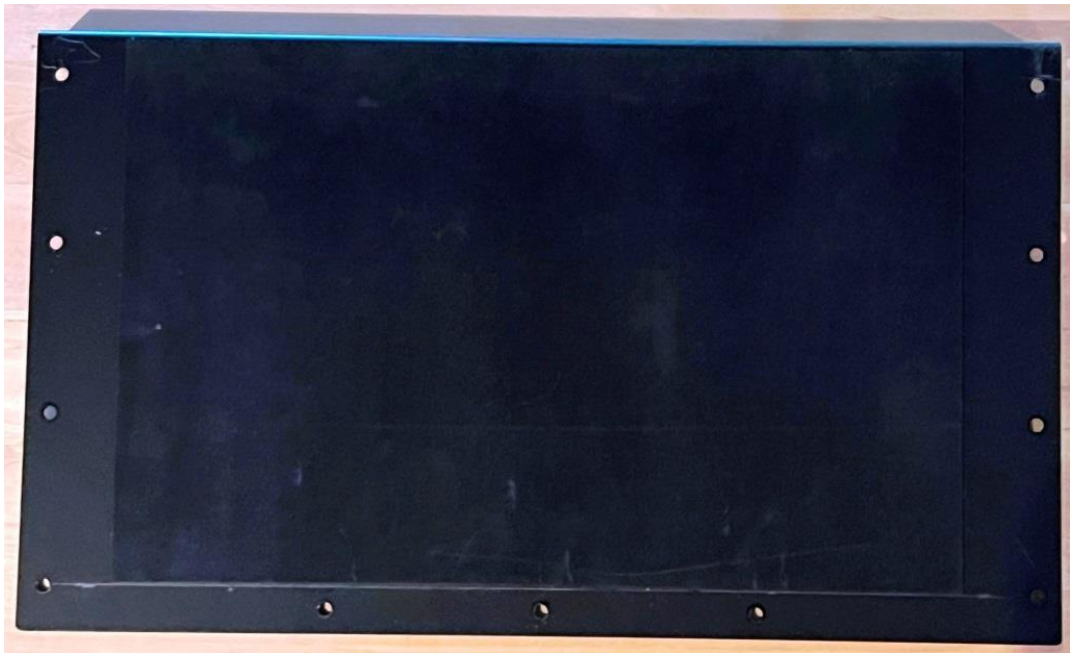


Figure 20. Self-sticking dampening sheet attached to the underside of top chassis plate.

- For such a straightforward and relatively inexpensive fix, transitioning from an initial annoying hum noise to being almost inaudible was remarkable.

Wood Frame Repair

- Both speakers suffered from a slight sideways tilt with uneven levelling, caused by splits in the particle board wooden frame (Fig. 21). Although not directly related to this interface restoration, with the interface detached from the speaker's frame it's an opportunity to carefully inspect each wooden frame's condition.

Figure 21. Underside of wooden frame base showing split in the particle board.

- Using wood glue and C-clamps the repair is not difficult (Fig. 22), for my first attempt I used a general-purpose wood glue but after a few months a split reappeared. For my second attempt at repair, I used a stronger brand of glue "Gorilla", and as of this writing the repair has remained intact. Both speakers now align level when viewed from the front.

Figure 22. Clamping of wooden frame base – *a spacer board helps even the c-clamp force.*

Support Legs

- There are 4 support legs for each speaker, thread type ¼ inch diameter with pitch 20 threads per inch, with 2 support legs on the front that screw into the base of the speaker frame (Fig. 21), and 2 on the back that screw into the chassis of the Magne-Kinetic Interface.
- Perhaps from uneven levelling caused by the broken wooden frames, the support legs had become twisted and stuck within the base feet (Fig. 23).

Fig. 23. Original threaded support leg (4 pieces per speaker)

- While there are many aftermarket brands to choose from, I replaced the original support legs with IsoAcoustics GAIA IIs, the GAIA II series being suitable for speaker weights up to 120 lbs. (54 kg). You can see a partial view of these in Figure 1.
- Whichever brand and model you choose, ensure they support the weight of your speakers and are supplied with the common thread size of ¼ inch - 20.

Speaker Cable Connections

- I have had different speaker cables fitted with banana pins that did not mate securely with the MK-121-2 interface banana sockets, and in worst cases the speaker cables worked loose.
- While other contributors have kindly shared their experiences of machining the interface chassis to install heavy duty banana sockets, one of my goals was to preserve the Acoustat original external appearance.
- In keeping with the original sockets, what worked for me was the Furutech FP-202 series banana connector (Figs. 24, 25). With the thumb screw fully tightened to expand the locking spades, I was unable to pull it out from the interface socket.

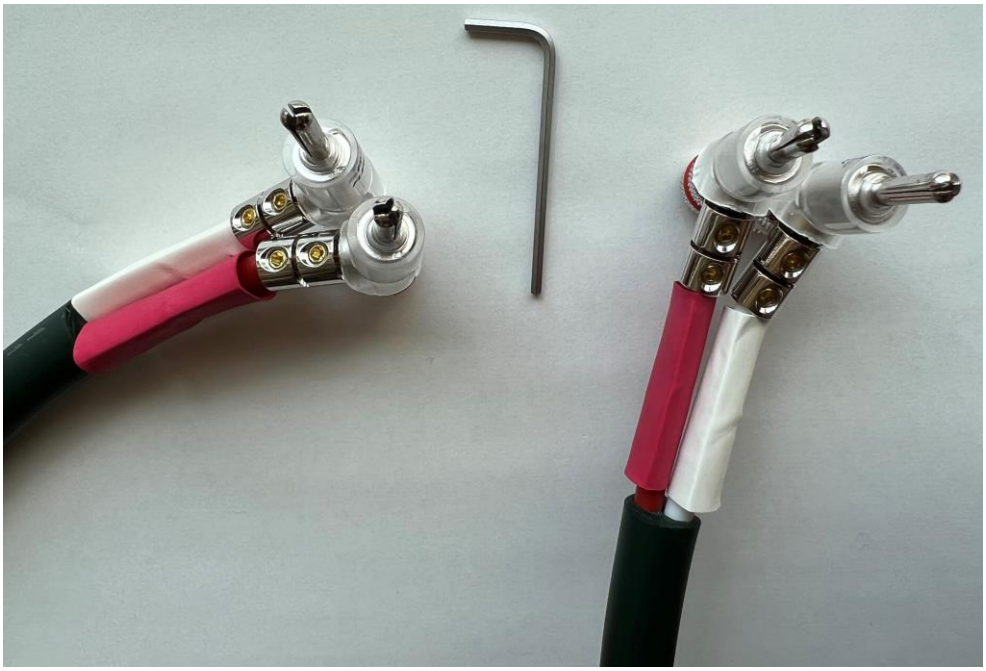


Figure 24. Assembly of Furutech FP-202(R) connectors with Furutech u-2T speaker cable.

Figure 25. Completed FP-202(R) connectors with u-2T speaker cable.

Measurements after Restoration completed

- For the following tests the input AC Voltage was maintained at 115 VAC, 50 Hz.
- AC voltage measured at output of the step-up transformer exhibited a clean sine wave ~720 VAC RMS (Fig. 26).

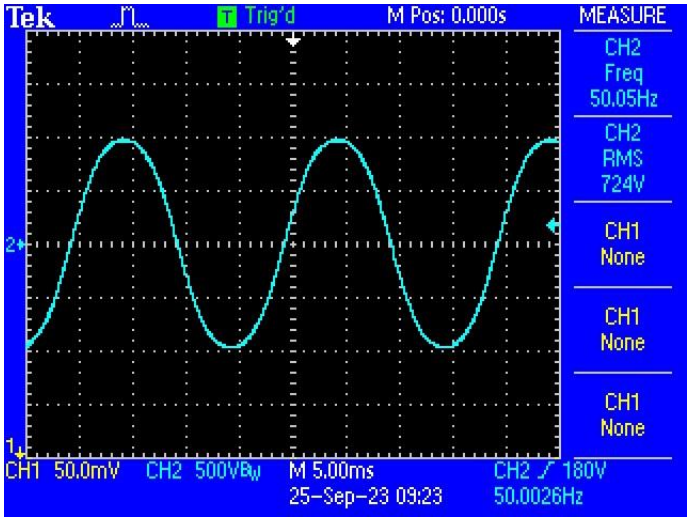


Figure 26. Measured output of AC step-up transformer.

Voltage loading on the WIMA high-voltage audio capacitors

- As mentioned, to double the voltage rating and achieve a wider safety margin, the WIMA high-voltage audio capacitors rated 6 kV DC and 700 VAC RMS were configured as a set of 4 (total 8 for one board) in a series/parallel configuration (Fig. 9), providing 0.01 uF with effective voltage rating of 12 kV DC and 1400 VAC RMS.
- With my version of Acoustat speaker, measuring the actual RMS voltage across this capacitor configuration while playing loud music revealed there was enough safety margin.

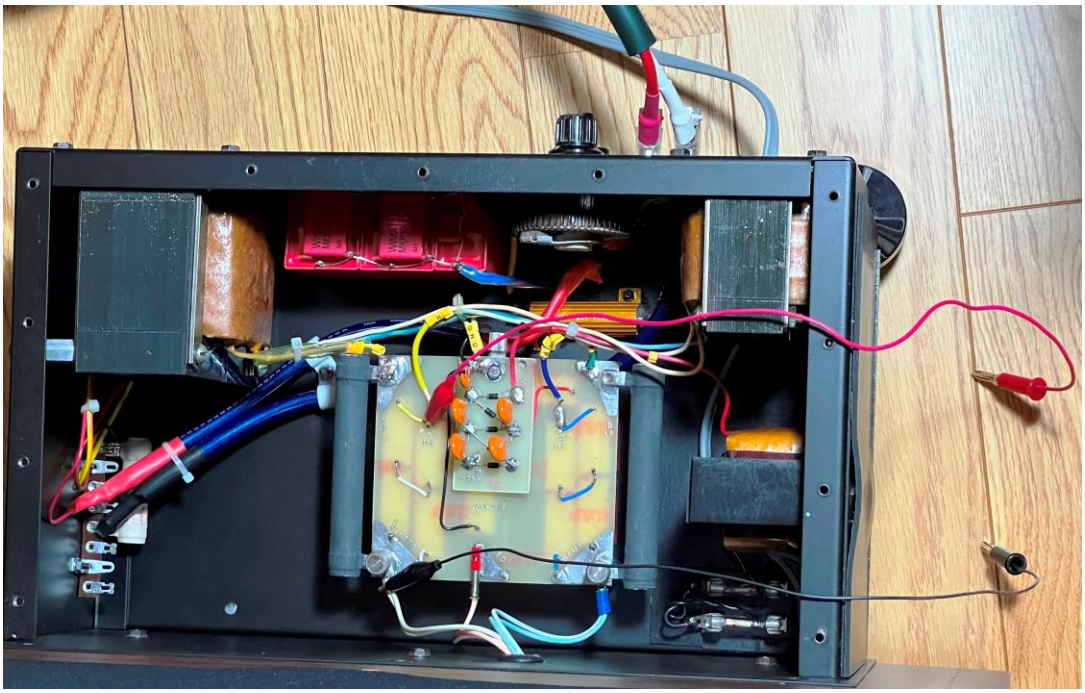


Figure 27. Test leads connected across WIMA capacitor configuration *(test repeated for configuration on opposite side).*

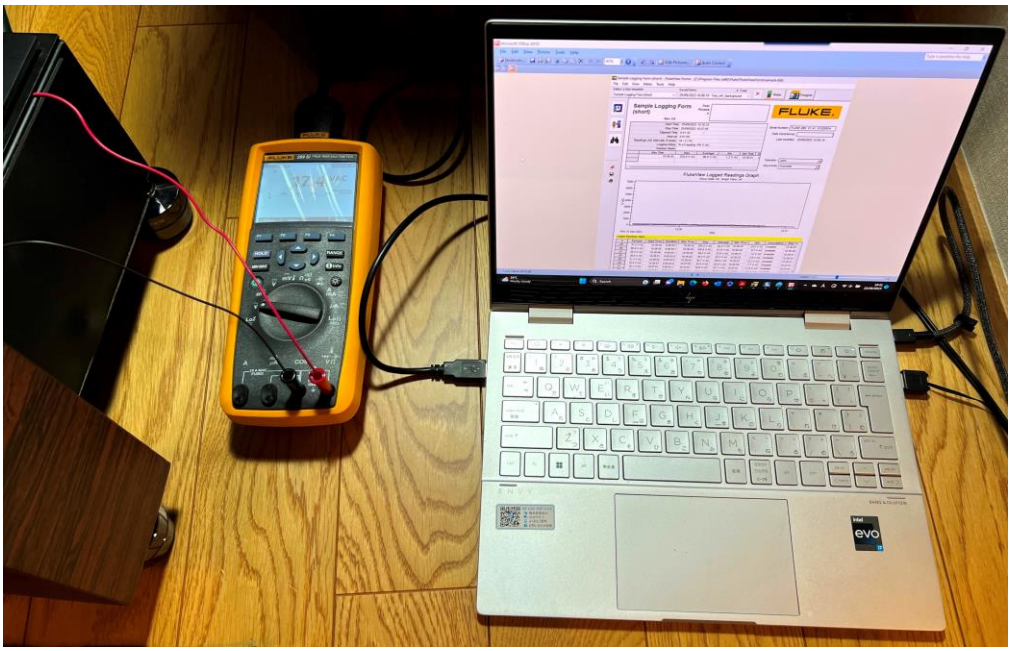


Figure 28. PC setup for logging AC voltages from True RMS Multimeter.

- Playing loud music through one channel into a single speaker produced sound pressure levels ~85 dB C-weighted as measured on my mobile phone app (Fig. 29), while the maximum True RMS voltage measurements peaked between 250 and 300 VAC (Fig. 30). Depending on your model and version of Acoustat your results could be different from mine.

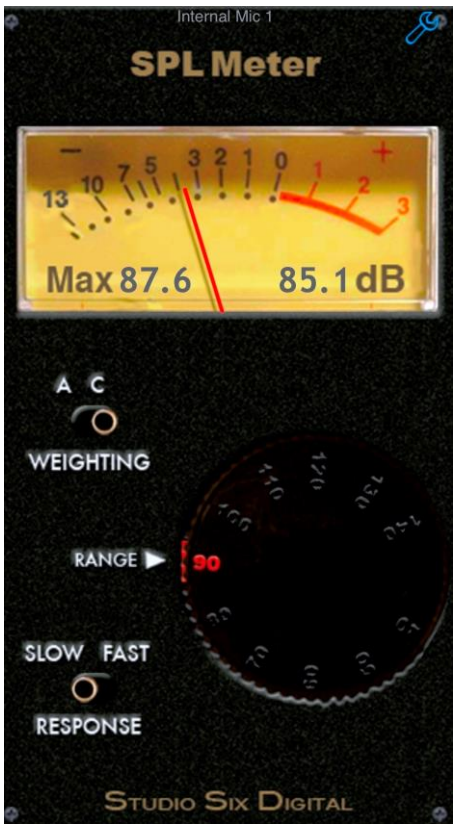
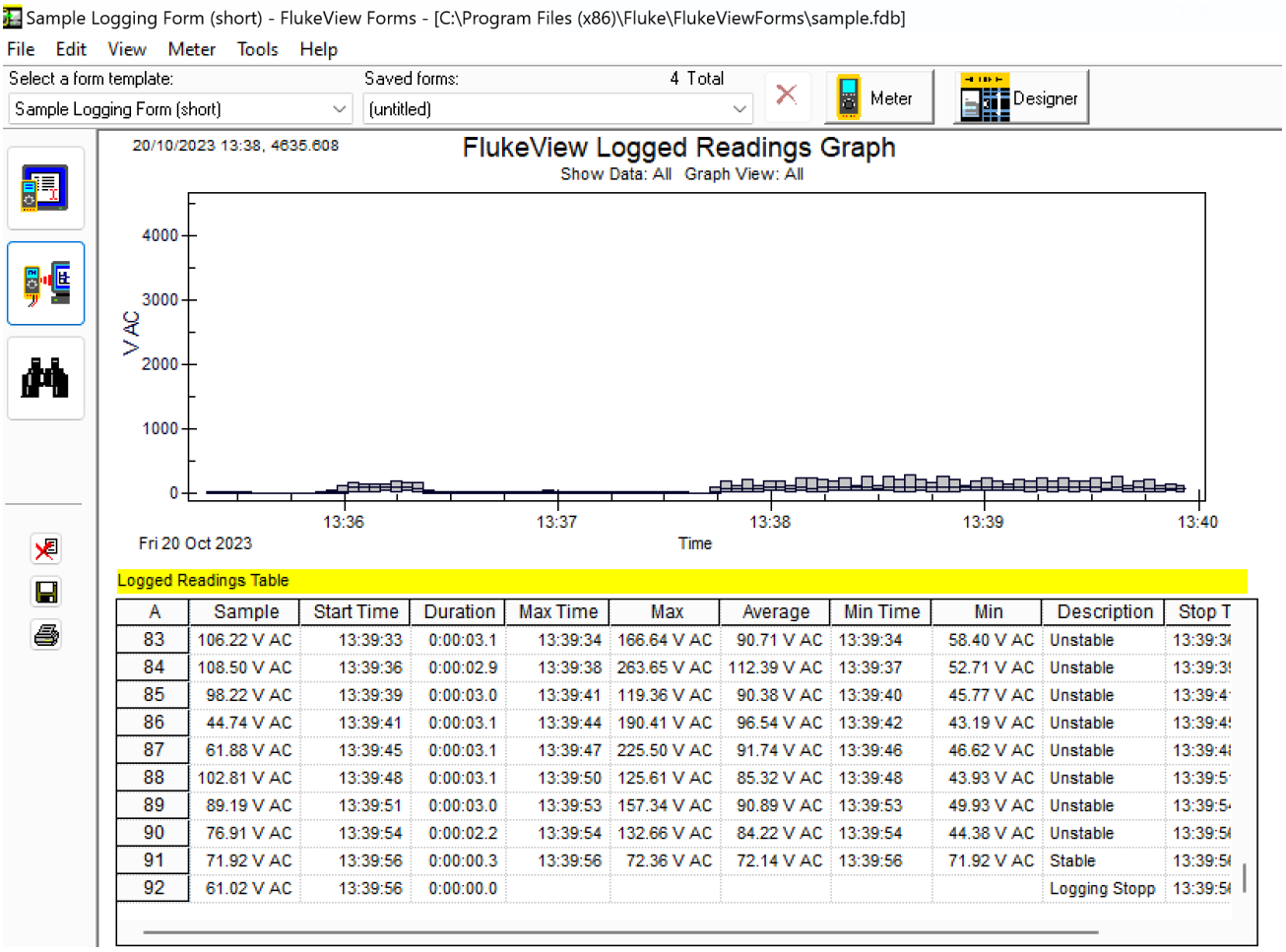


Figure 29. Measurement of sound pressure level during loud music volumes, one channel feeding single speaker.



A	Sample	Start Time	Duration	Max Time	Max	Average	Min Time	Min	Description	Stop T
83	106.22 V AC	13:39:33	0:00:03.1	13:39:34	166.64 V AC	90.71 V AC	13:39:34	58.40 V AC	Unstable	13:39:3
84	108.50 V AC	13:39:36	0:00:02.9	13:39:38	263.65 V AC	112.39 V AC	13:39:37	52.71 V AC	Unstable	13:39:3
85	98.22 V AC	13:39:39	0:00:03.0	13:39:41	119.36 V AC	90.38 V AC	13:39:40	45.77 V AC	Unstable	13:39:4
86	44.74 V AC	13:39:41	0:00:03.1	13:39:44	190.41 V AC	96.54 V AC	13:39:42	43.19 V AC	Unstable	13:39:4
87	61.88 V AC	13:39:45	0:00:03.1	13:39:47	225.50 V AC	91.74 V AC	13:39:46	46.62 V AC	Unstable	13:39:4
88	102.81 V AC	13:39:48	0:00:03.1	13:39:50	125.61 V AC	85.32 V AC	13:39:48	43.93 V AC	Unstable	13:39:5
89	89.19 V AC	13:39:51	0:00:03.0	13:39:53	157.34 V AC	90.89 V AC	13:39:53	49.93 V AC	Unstable	13:39:5
90	76.91 V AC	13:39:54	0:00:02.2	13:39:54	132.66 V AC	84.22 V AC	13:39:54	44.38 V AC	Unstable	13:39:5
91	71.92 V AC	13:39:56	0:00:00.3	13:39:56	72.36 V AC	72.14 V AC	13:39:56	71.92 V AC	Stable	13:39:5
92	61.02 V AC	13:39:56	0:00:00.0						Logging Stopp	13:39:5

Figure 30. Logging of AC RMS voltages measured across a 0.01 uF capacitor configuration.

- Even allowing for some averaging, the maximum RMS voltage levels measured during this operational test fall safely within a single WIMA high-voltage capacitor's rating of maximum 700 VAC RMS.
- Side comment regarding the sound pressure levels of ~85 dB C-weighted when measured in front of a single speaker driven by one channel, had I conducted this test with two speakers in stereo mode it would have made for very high sound levels, enough to me get thrown out of the house!

How did this MK-121-2 Interface Restoration Impact the Sound Quality?

- In the absence of professional audio measurement equipment, to discuss three modifications that gave a clear noticeable improvement in sound quality and listening pleasure. To put this in perspective, the original Acoustat speaker already produced exceptionally clear sound, with these changes it became even better.

1. Rebuild of High-Voltage Board

- Changing all components on this board for newer or higher rated components produced a clearer sound across the full audio frequency range. Difficult to say what made the biggest impact, one theory could be the original high-voltage audio capacitors that had leaked oil being replaced with new high-voltage polypropylene capacitors.
- Also on this board is the high-voltage polypropylene capacitor added to the output stage of the high-voltage ladder, which gave a substantial improvement in bass frequencies delivering more punch.

2. C-Mod Implementation

- I concur with others who have previously commented on improved clarity in the upper frequency range this modification brings.

3. Vibration Absorbing Sheets

- Applying these vibration absorbing sheets produced a welcome reduction in 50 Hz hum noise, important when listening to quiet music passages.

Parts Replaced

Figure 31. Original components replaced.

- Top bin: HV audio capacitors, HV diodes, HV ceramic disc capacitors, HV audio capacitors.
- Lower bin: 10 uF and 0.01 uF capacitors, 220 uF bipolar capacitors, 500 M-ohm resistors, cable clamps and 1 ohm power resistors.
- Not shown: 5-A slo-blo fuses, speaker support legs, low-frequency cabling.

Final notes

- Although there's a lot of detail in this writeup, when detached from the speaker frame the MK-121-2 Interface components were straightforward to access and not difficult to work on. There is also sufficient space inside the chassis for installing the C-Mod components.
- The reason for this writing is to share my experience restoring the MK-121-2 interfaces in my beloved Acoustat electrostatic speakers. It's not an endorsement of any component supplier, just to share what worked for me.
- If I was to do another MK-121-2 interface restoration, what might I do differently? As this was my first experience working on an electrostatic speaker I proceeded slowly with extreme caution, but knowing what I know now with the measurements made, I believe it would be safe to stay with single WIMA 0.01 uF high-voltage audio capacitors rated 6 kV DC and 700 VAC on the HV board (rather than the set of four I configured in a series/parallel configuration). However, as the circuitry is performing flawlessly and has a wide safety margin, I'm happy to leave my configuration as is.
- At time of this writing pleased to report both MK-121-2 interfaces have been operating without issue, now enjoying listening to my restored Acoustat 2s with their superb sound quality.

Appendix

Referencing the setup displayed in Figure 1 "**Acoustat Model 2 home setup**", to share restoration projects of other vintage/classic audio equipment.

- Left side, below top shelf, "*ReVox B739 FM Tuner Preamplifier restoration*" https://www.audiocircle.com/index.php?topic=184978.0
- Left side, middle shelf driving the Acoustat Model 2 speakers, "*Bryston 3Be Power Amplifier repair - Hints and Lessons Learned*". https://www.audiocircle.com/index.php?topic=184960.0
- Right side, top shelf, "*Oracle Premiere Turntable: A Successful Restoration*". https://www.audiocircle.com/index.php?topic=186862.0
- Right side, below top shelf, "*Spectral Model DMC-10 Preamplifier - A Successful Repair*". https://www.audiocircle.com/index.php?topic=186474.0
- Right side, middle shelf, "*Krell CD-1 Player: Successful repair of Remote Control unit*". https://www.diyaudio.com/community/threads/krell-cd-1-player-successful-repair-of-remote-control-unit.402329/
- Right side, lower shelf driving an Acoustat Model SPW-1 Woofer (not shown), "*Bryston 2B Power Amplifier repair - Hints and Lessons Learned*". https://www.audiocircle.com/index.php?topic=184949.0