



Introduction and Modification Goals

This document describes the modification experience of the budget DAC SMSL SU-1, carried out within a minimal budget and preserving the device's stock appearance. The goal was to improve sound quality without significant financial investment, staying within the original board and enclosure.


I purchased this DAC for personal use — mostly for occasional music playback through small studio monitors. Later, I became curious: how much quality can be extracted from such an affordable device without turning it into a Frankenstein and without spending more than its cost? This became a personal challenge to test my skills in circuit design and precision soldering, while squeezing the most out of this compact unit.


 Project constraints:

- Budget: up to \$20–25
- All modifications fit within the stock PCB
- No exotic or expensive components used
- Device remains visually stock with clean implementation

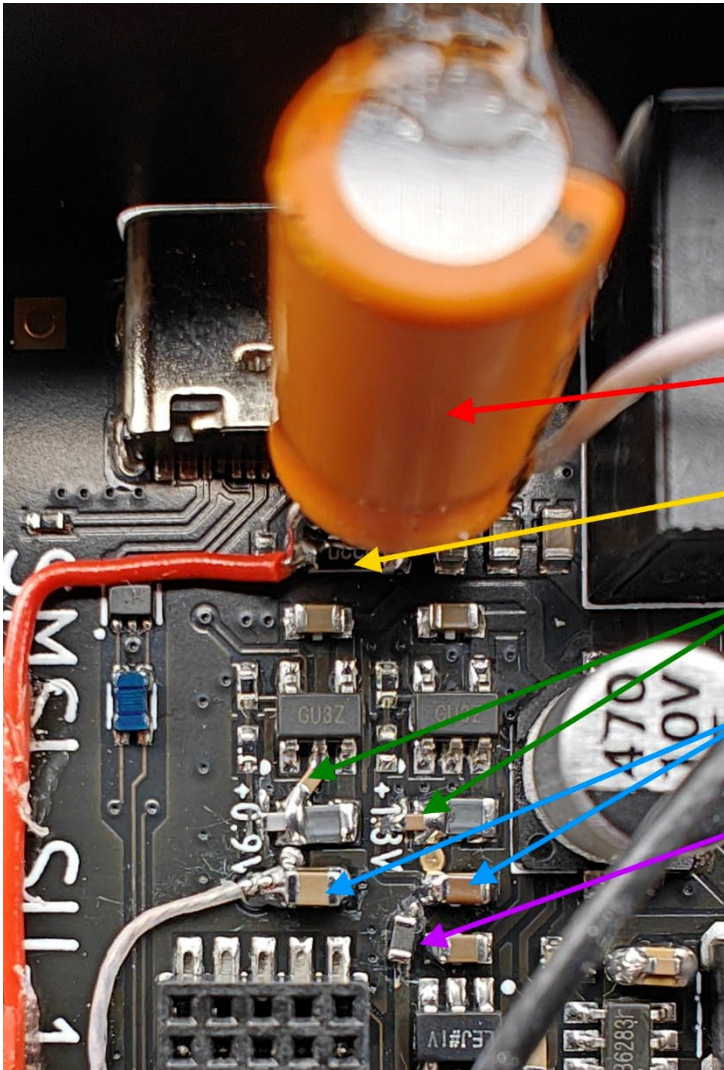
 Who this guide is for: This guide is intended for hobbyists and enthusiasts experienced with soldering 0402 components and familiar with basic electronics. You'll need:

- A soldering iron with a fine tip (e.g., T210)
- Microscope or binocular magnifiers
- Precision tweezers
- Steady hands and patience

 Disclaimer: All modifications are at your own risk. You will void your warranty, and may damage the device — either reversibly or irreversibly. Evaluate your skills, tools, and motivation before proceeding. Keep removed components in case you want to restore the device to stock condition.

 Subjective nature of evaluation: All changes are based on subjective listening. Individually, some modifications may have subtle effects, but together they can bring a noticeable improvement. You can skip or substitute certain steps — feel free to experiment. It's recommended to test the sound after each step to evaluate whether the change suits your preferences.

DC/DC Converter Section



1) Add a 220–470 μF capacitor near the USB-C.

2) Short the 0.2 Ohm resistor.

3) Add 0.1 μF capacitors.

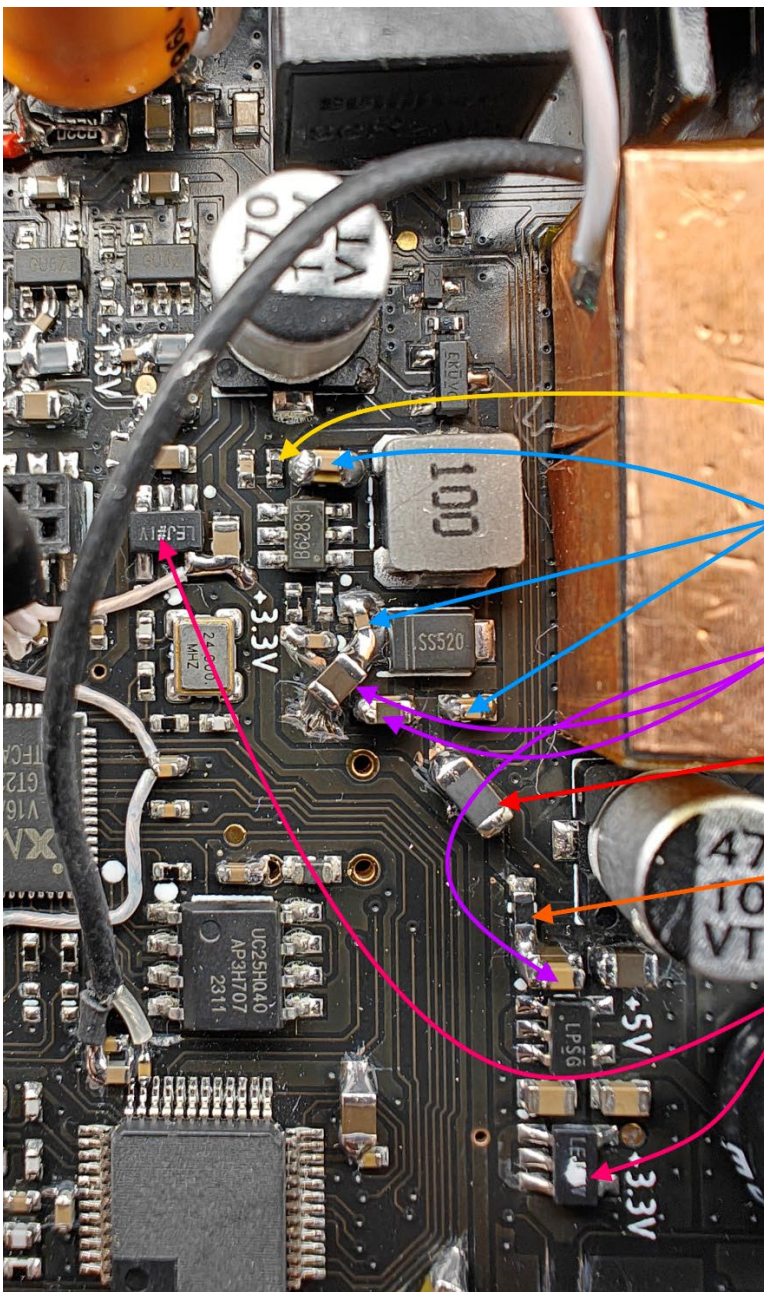
4) Add 22 μF capacitors.

5) Add a 300 Ohm ferrite bead.

The SMSL SU-1 uses DC/DC converters to generate internal voltages. Below are steps aimed at improving power purity, which positively affects overall performance.

✦ Importance is rated from ☆ to ★★★★★

- 1) Add 220–470 μF 10–16V electrolytic capacitor near the Type-C input to stabilize the power. ★★
- 2) Bypass the 0.2 Ω resistor to reduce voltage drop. ☆
- 3) Add 0.1 μF 0402 ceramic capacitors (low ESR) to reduce HF ripple at converter outputs. ★★
- 4) Add 22 μF 16–25V 0603 ceramic capacitors (low ESR) at converter outputs. ★★
- 5) Insert 300 Ω 0603 ferrite bead into the 1.8V rail to suppress HF noise from the DC/DC converter. ★★
- 6)



7) Replace the resistor with a 1 k Ω resistor.

8) Add 0.1 μ F capacitors.

9) Add 22 μ F capacitors.

10) Install a ferrite bead.

11) Replace the ferrite bead.

12) Replace the linear voltage regulators.

7) Replace EN pull-up resistor with 1–4.7k Ω for better control and reduced ripple. ★★★★★

8) Add 0.1 μ F 0402 ceramics close to converter outputs for local HF filtering. ★★★

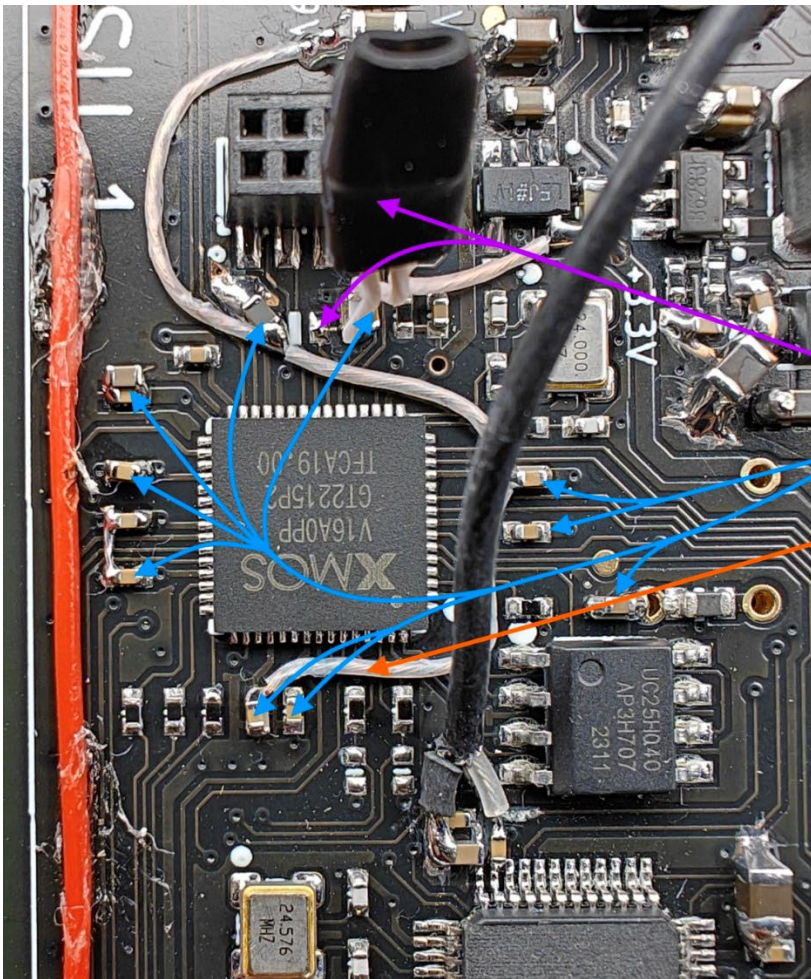
9) Add 22 μ F 16–25V 0603 ceramics to further smooth output voltage. ★★★★★

10) Insert 300–600 Ω >2A 1206 ferrite bead into 5.5 V rail for HF suppression. ★★

11) Replace ferrite with 100 Ω 1–2A 0603 bead to eliminate unwanted oscillation at regulator input. ★★★★★

12) Replace linear regulators with TPS7A2033 or similar high-PSRR, low-noise LDOs. ★★★★★

XMOS Power Improvements



13) Add a separate voltage regulator.

14) Add a 10 μ F capacitor.

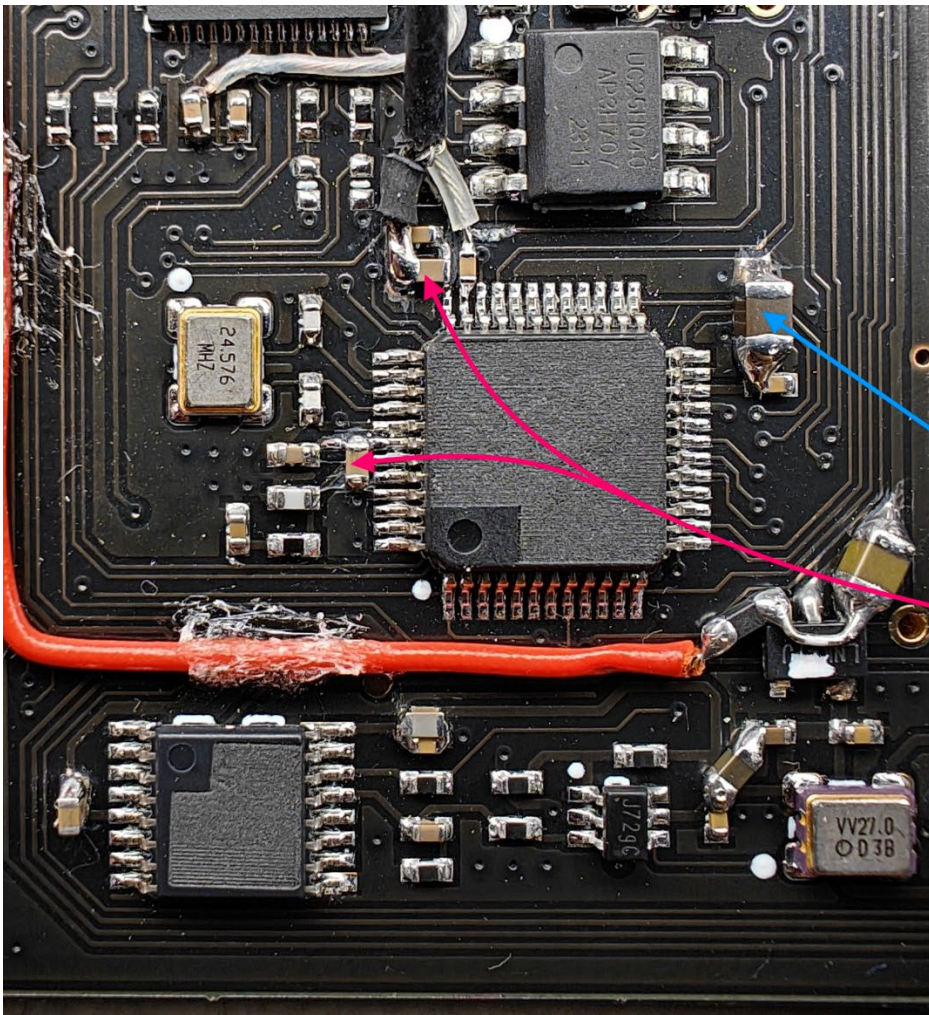
15) Add a duplicate (parallel) wire.

13) Add dedicated low-noise 0.9V regulator for XMOS PLL (e.g., TPS7A2009, LT3042). ★★★★★

14) Add 10 μ F 0402 ceramic caps in parallel with existing ones near XMOS. ★★★★★

15) Duplicate 0.9V supply via additional wire as shown in photos to reduce voltage drop. ★★

⚙️ PCM9211 Power Improvement

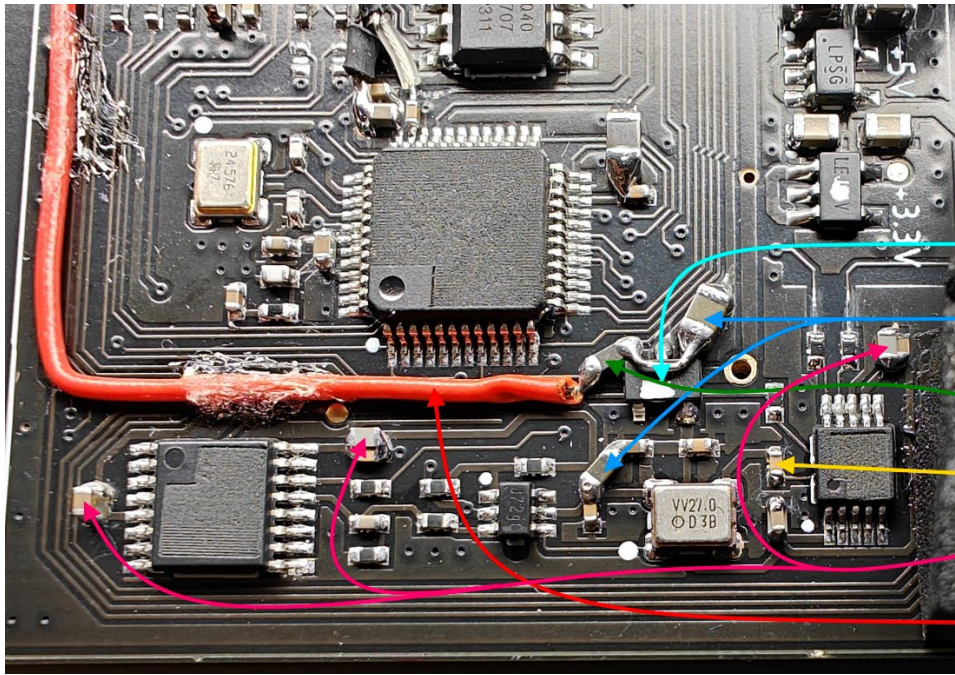


16) Add 22 μ F capacitor for local supply filtering. ★★★

17) Add 10 μ F 0402 ceramics near the chip to reduce noise and ripple.

★★★★★

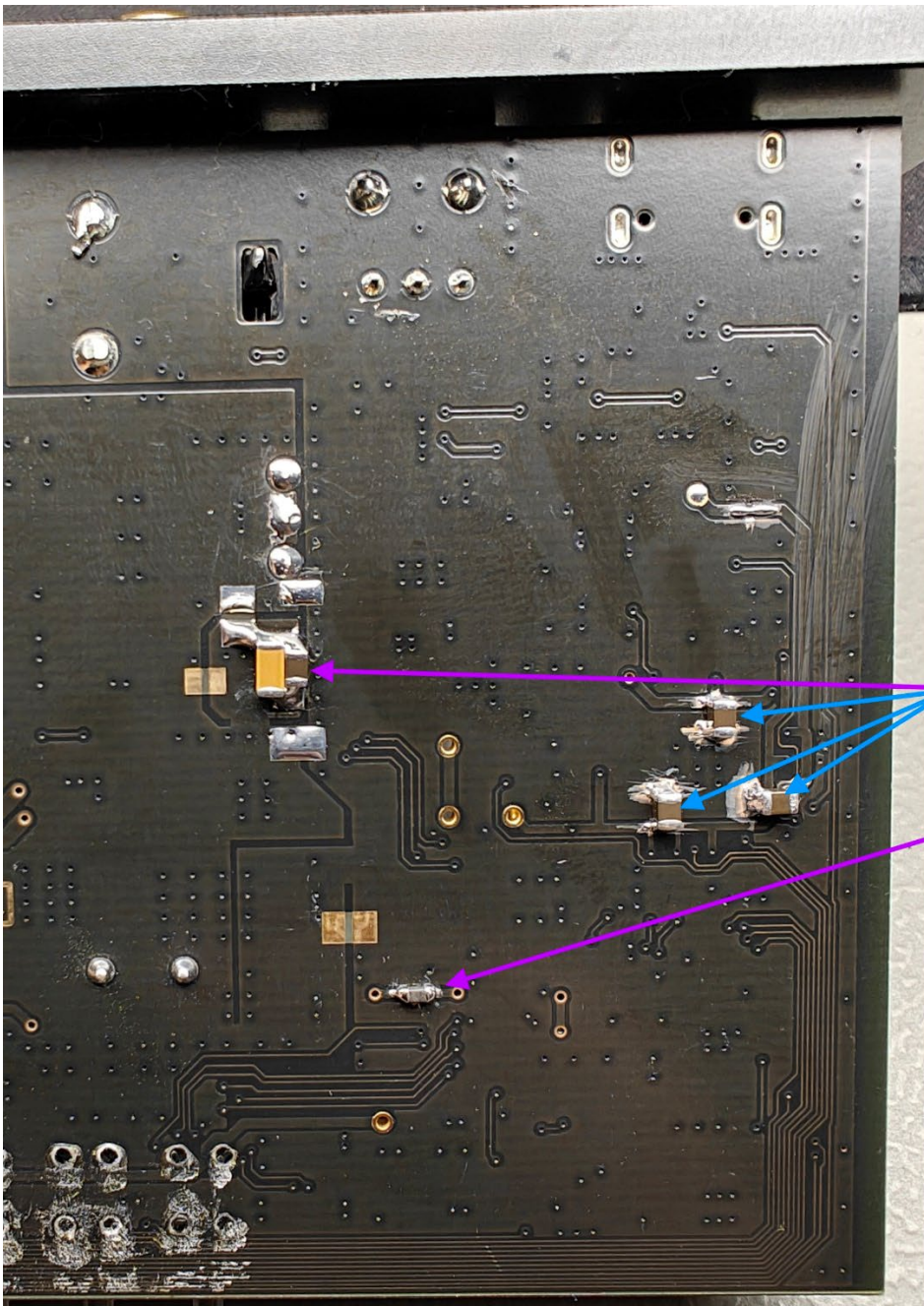
Clock Section Improvements



- 18) Add a separate voltage regulator.
- 19) Add a 22 μ F capacitor.
- 20) Add a ferrite bead.
- 21) Replace the capacitor with a 220 pF capacitor.
- 22) Add 10 μ F capacitors.
- 23) Solder a wire to the 5V line.

- 18) Add dedicated low-noise regulator (TPS7A2033, LT3042, etc.) for clock generator. ★★★★★
- 19) Add 22 μ F 16–25V 0603/0805 ceramic capacitor at the regulator input. ★★★★★
- 20) Feed the regulator through a 300–600 Ω 1–2A 0603 ferrite bead for additional HF filtering. ★★★★★
- 21) Replace clock coupling capacitor with 220–330pF C0G for cleaner clock signal. ★★★★★
- 22) Add 10 μ F 0402 ceramics near clock-related chips for local filtering. ★★★★★
- 23) Power the regulator directly from the USB Type-C port. ★★★★★

⚡ Additional Power Rail Filtering



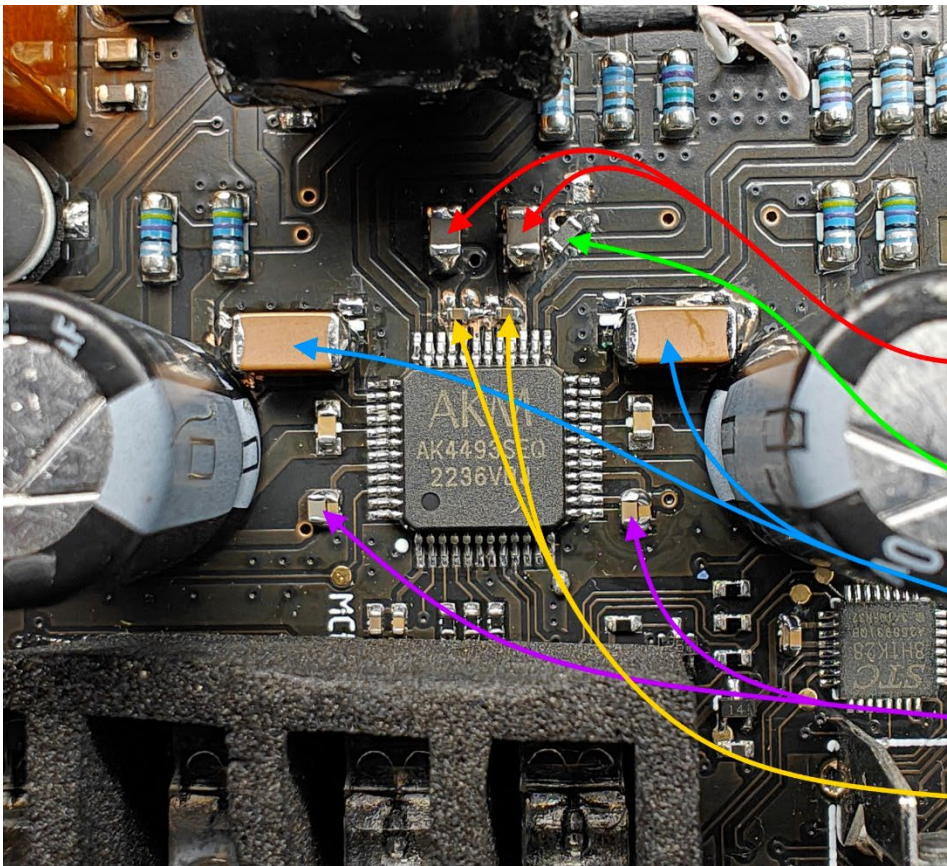
24) Add 22 μ F capacitors.

25) Add a ferrite bead.

24) Add 22 μ F 16–25V 0603/0805 ceramics on each XMOS power rail for local filtering. ★★★★★

25) Add 600–1000 Ω 1-2A 0603 ferrite bead in AK4493 power rail for HF noise suppression (listening test). ★★★★★

🎵 AK4493 DAC Power Enhancements



26) Add a 22 μF capacitor.

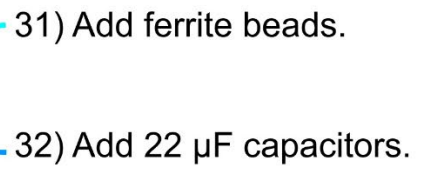
27) Add a ferrite bead.

28) Add a 1 μF capacitor.

29) Add 10 μF capacitors.

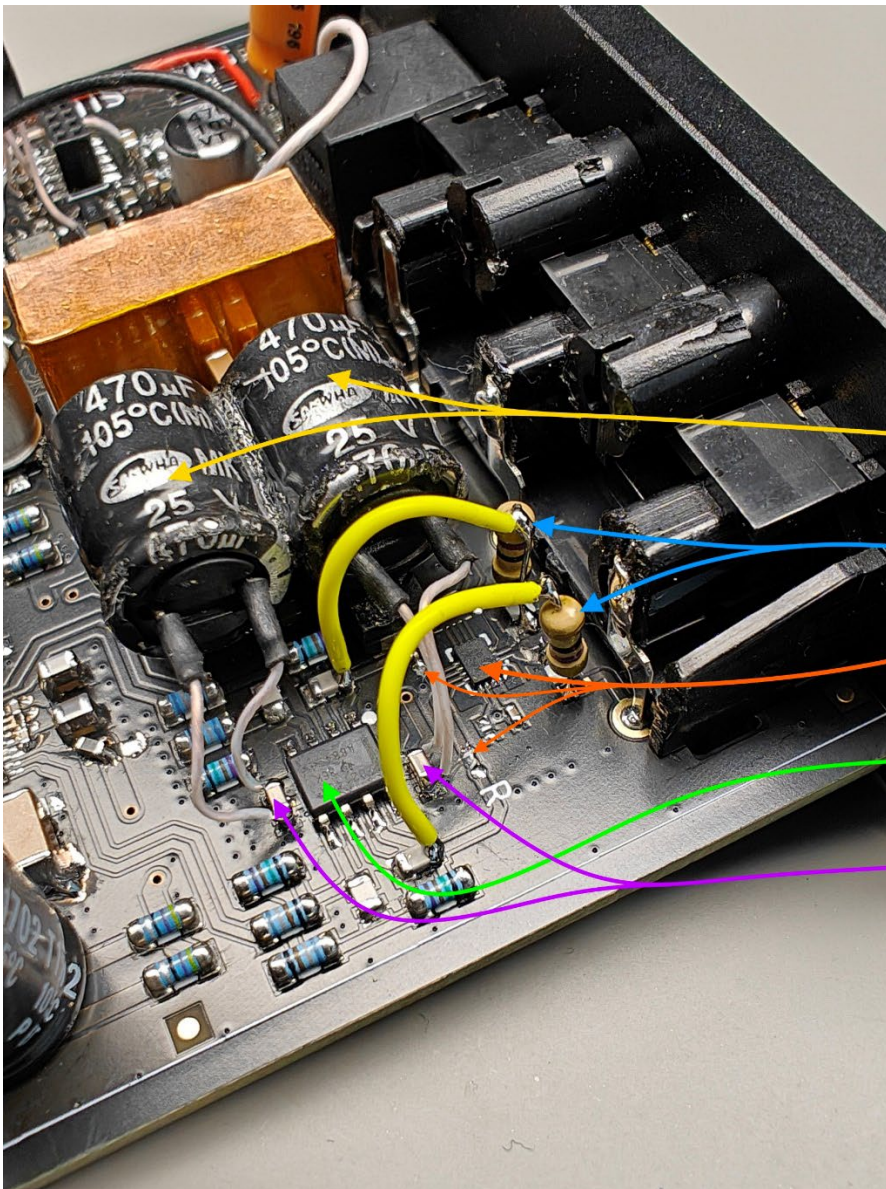
30) Add 0.1 μF capacitors.

- 26) Add 22 μF LOW ESR 0805/0603 capacitors near the chip. ★★★★★
- 27) Add 600–1000 Ω 1-2A 0603 ferrite bead in DAC power rail for HF noise suppression (listening test). ★★★★★
- 28) Replace reference voltage filtering caps with 1 μF 50–100V 1206 X7R LOW ESR/ESL types — limit to 1 μF . Different capacitors may differently affect the sound (listening test). ★★★★★
- 29) Add 10 μF 0402 ceramics in parallel with existing ones for better local filtering. ★★★★★
- 30) Add 0.1 μF 0402 LOW ESR ceramics for local HF filtering. ★★★★★



- 31) Insert 100–300Ω 1–2A 0603 ferrite beads in op-amp power rails. ★★
- 32) Add 22μF ceramic capacitors for ±12V rail filtering. ★★★

Analog Section Enhancements



33) Add 470 μ F 25V capacitors.

34) Replace the 47 Ohm resistors.

35) Disable the mute switch

36) Replace the operational amplifier

37) Add 22 μ F capacitors.

33) Add 470 μ F 16–25V LOW ESR electrolytics directly at op-amp power pins. ★★★★★

34) Replace output resistors with CFR16J47R or others (audible results may vary) or keep the stock ones. ★★★★★

35) Disable mute switch by removing the chip or cutting its I/O traces — slight gain in transparency. ★★★

36) Replace op-amps according to personal taste — OPA1612 boosts low mids; OPA2140 is dynamic and detailed but slightly analytical, or other. ★★★★★

37) Add 22 μ F 0603 ceramic capacitors for extra local op-amp filtering. ★★★★★

Conclusion and Listening Impressions

I did not perform any high-frequency spectrum measurements or capture DAC output waveforms — everything is based solely on subjective listening. The main system used consisted of a Vioelectric V222 amplifier with Burson V6 Vivid op-amps and Austrian Audio Hi-X60 headphones (balanced connection). For comparison, the Gustard X26 Pro was used as a reference.

The device requires warm-up — after 30–40 minutes of playback, the sound becomes slightly smoother, more stable, and better balanced. Overall, I'm satisfied with the result — the improvements in sound quality are comparable to devices in the \$300–500 range.

Replacing the op-amps provided deeper bass, reduced excessive treble brightness, and added resolution and accuracy to the midrange. Improving the op-amp power supply made the sound more dynamic and controlled. Replacing the output resistors subtly affected tonal naturalness, detail, and bass texture. Removing the MUTE switch didn't bring dramatic changes, but slightly improved signal path transparency.

Some components don't directly affect the audible sound, but their effectiveness can be seen on an oscilloscope as a reduction in ripple. One of the most noticeable improvements came from upgrading the power supply for the AK4493 DAC and filtering its reference voltages — the soundstage became wider, imaging more precise, and the overall sound more natural. There is potential to go even further: for example, separating analog and digital power supplies as recommended by other specialists, and implementing a dedicated source for VREF. This would require a significant redesign and likely wouldn't fit in the original enclosure, but it remains a promising idea.

The clock and buffer sections also significantly benefit from high-quality power — source positioning improves, and overall clarity increases. Powering the PCM9211 had an audible, albeit less pronounced, effect — in the future, it would make sense to supply a separate voltage to its PLL input. PCM9211 plays a key role not only in SPDIF handling but also as an I²S pass-through chip, so it affects the entire digital signal path.

I didn't go into detail about the SPDIF input, as not all users rely on it and the audible improvements were moderate. However, if you plan to use this input, it's recommended to replace the coupling capacitor with a 220–330 pF C0G 0402 and, even better, place it closer to the chip and route the signal through a separate coaxial cable (e.g., from a Wi-Fi antenna).

For USB playback, the XMOS PLL and core power supply have a significant impact — improving them enhances clarity, dynamics, and bass, while reducing treble harshness. Additional filtering on power rails reduces ripple and increases overall power stability throughout the system.


I chose not to install a dedicated external power connector, since I use the DAC via the coaxial input and power it with a short Type-C cable from an external linear low-

noise power supply. During testing, I damaged the isolated ± 12 V module and replaced it with a 2W Murata unit. I also tried shielding it, but didn't observe any noticeable improvement. The Murata module may introduce slightly more noise than the stock one, but it should handle current pulses better. The choice depends on your priorities — the stock module isn't bad for its price, especially if you add large filter capacitors for the op-amp power lines.

I intentionally avoided expensive or bulky upgrades — in my opinion, the budget of the base device defines the limits of reasonable investment. Still, the SU-1 has surprisingly good modification potential, and it might be worth revisiting in the future.

Overall Sound After Modifications:

- The sound became punchy and dynamic, with impactful, slightly rounded bass and improved texture — electronic music is now engaging to listen to.
- The midrange is detailed and textured, though still slightly lacking in natural tone and microtexture.
- Spatial rendering is impressive: reverbs and subtle nuances are now more noticeable, and source positioning has improved.
- Depth and 3D imaging still lag behind more expensive DACs, but for its class, the results are outstanding.
- Treble is slightly forward (possibly due to the OPA2140), but is no longer harsh or sibilant, and retains good detail.
- USB performance is noticeably influenced by cable quality — I recommend using a good Type-C cable, such as one from DigiKey or a high-quality audiophile version.
- If using the SPDIF input, it's best to power the DAC from a linear power supply via an adapter and use a good 1-meter coaxial cable.

 Everything above reflects my personal experience, the result of several weeks of experimentation, and an approach based on my preferences.

If you enjoyed modding the SU-1, got ideas for your own modifications, or simply want to say “thanks” — you can buy me a coffee:

 PayPal: topaloff6@gmail.com

Best regards,
Ihor Topalov