ryanj “D3” Tda1541 board population guide

Warning and some notes to the hobbyist using the guide:

I, (ggetzoff), am not qualified to provide educational or practical guidance in the use of any materials or processes presented in the guide. I studied computer science and EE in school, but I’ve never used that education in my career, therefore, I’m not a professional or technical expert in anything except what I do for a living. Furthermore, the SMDs that are employed in both the audio and power supply circuits are tiny and some of them are damaged very easily by heat. Having said this, I will tell you that if you follow this guide you have a high chance of success in completing this project! Furthermore, this is a wonderful and excellent sounding dac and is worth the effort!

Recommendation If you have never soldered SMDs you need to practice on an easier project first. You’ve lived this long without this dac, you can live a bit longer while you practice for the “big” game. Pick a simple board, any project, from an online source of your choosing. Once complete and successful, immediately begin populating this board while your skills are still “hot”. If you want to proceed without taking this recommendation at least watch videos on SMD soldering at get some practice prior to attempting this one.

Difficulty level: Moderate

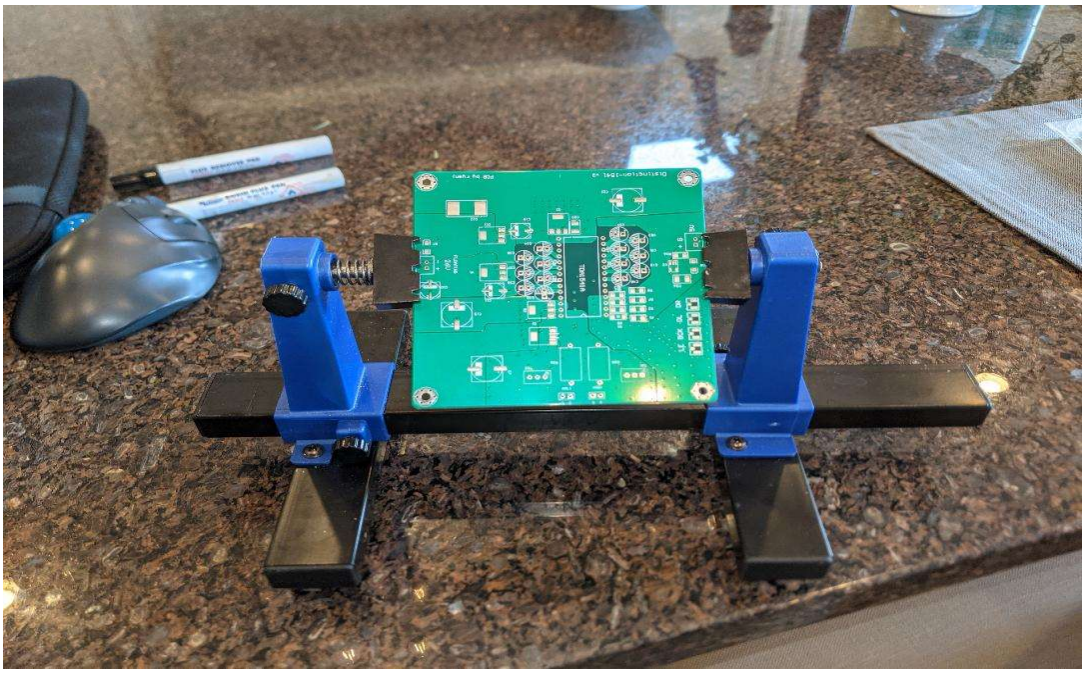
Tools and supplies

1. Hot air rework station (there are many affordable stations available. I solder at no more than **176 degrees C / 350 degrees F**) I paid $60 USD for mine and it works great.
2. **Low temperature, no-clean tacky, solder flux**
3. **Low temperature (~137 degrees C / 278 degrees F) no-clean, solder**
4. Flux remover pen (even with no-clean solder, you will need to clean)
5. Acetone, Vinegar, alcohol or soap and water (for cleaning the board)
6. Magnifying head band or hands-free magnifying loop
7. Tweezers
8. Toothbrush
9. Cotton swabs
10. PCB jig (see the image below. Extremely helpful for this project)

Recommendation: Order multiple spare Shunt Vreg TL431’s (**X1, X2, X3**) and spare transistor **Q1, Q2, Q3**. You will very likely need them. They are inexpensive and are easily damaged by heat. I would order at least 10 of the TL431s.

Recommendation: This PCB is a thick, multi-layer board with wide vias, therefore It sinks a lot of energy. When you populate the large capacitors, **Q1, Q2, Q3, CC1, V1, R22, ect.**, try first using an iron.

Recommendation: When you order the BOM, you must first decide if you are using the onboard I/V or not. Order accordingly. The you can try values between 10R-50R for the I/V resistor. Wire wound would be preferred. Order multiple values. Many have used I/V resistors up to 200R. This is up to you and not part of this guide to address which value you work with your needed gain.



<u>Voltages</u>:

Main Supply: **26VDC** floating (neither output terminal is connected to earth). If you are employing separate supplies (13 positive, 13 negative) simply connect the 0V reference together, NOT to ground. **Check the output voltage of your supplies after they have heat stabilized before connecting it to the board**

For those of you who always want to deviate from recommended voltages, here is what Ryan has to say:

"The voltage input limitations are set by the amount of heat dissipated by CC1 and V1. I usually aim between 26V and 27V, but I have used up to **28V** with no issues as long as the temp on CC1 and V1 are not too far above around 55 Celsius. I would not recommend going lower than 26V - as this was the voltage that I used in the simulation to get good performance, anything lower than 25.5V may affect performance".

<u>Warning</u>: **Failure to load the supply with either a dummy load or TDA chip will destroy the Vregs in a matter of moments. Furthermore, a damaged Vreg can and will overvolt the TDA chip. The Maximum voltages are listed below.**

Attenuator voltage input: 5V-6V

Chip reference Voltages and current draw:

1. **-5VDC**. Applied at Pin 26**, (-4.5)-(-5.5)** and **27mAh (40 max)**
2. **+5VDC** Applied at pin 28, **4.5-5.5** and **37mAh (50 max)**
3. **-15VDC** Applied at pin 15, **14.0-16.0 25mAh (35 max)**

Now that we have gone over the **Do's and Don'ts** let's begin!

1. Wash the board with your preferred cleaner. Let dry completely!
2. Inspect the board carefully. Become familiar with how the pads are oriented and how close they are to other pads. Watch for solder bridging and solder balls connecting components / pads together.
3. Set your work area up to be clean, and well lit. You will mistake some of these SMDs for debris on our work surface if the surface is not clean. Your work surface should be of light color, white being preferable.
4. Carefully preheat the board, especially when soldering larger SMDs. You can do localized heating (carefully with your heat gun) or generalized heating with an oven.
5. Begin by **ONLY populating the minimum number of devices to get the three reference supplies working**: **X1, X2, X3, C5, C13, C21, R19, R20, R18, R24, R23, R25, R28, R30, R27, R29, R21, R17, R16, Q3, Q2, Q1, CC1, V1, R22**. **You should measure ~2.5vdc across the reference to anode pins on each of the three regulators. This ensures that the regulators are working.**
6. Solder X1-X3 with low temp paste and do it quickly! If you do not get the ~2.5 volts across the ref. and anode pins then it is probably damaged.
7. Load the supplies with resistors across pins **15, 26, 28**.
    1. **Choose resistors that fit into the socket holes. In this case use ¼ - 1/2 watt resistors. You can mount the chip socket at this time for ease of insertion.**
    2. **We calculate the load as follows:**
        a. **Pin 26 = 185R (5 / .027) (1/4w)**
        b. **Pin 28 = 135R (5 / .037) (1/4w)**
        c. **Pin 15 = 600R (15 / .025) (1/2w)**
    3. Insert each of these resistors into their respective pins and tie them together at pin 14. Power up the 26v floating supply and check each voltage.
    4. **DO NOT proceed until supply voltages at pins 28, 26, and 15 are correct under load. <u>I cannot stress this enough.</u> You will have to look at everything in this part**

8. If you've made this far, then proceed to populate the board, **except the bias section.** By this point you have already made a decision to use the onboard I/V or not. If you are not going to be using the onboard I/V then you leave all of the components off of the starting with the smallest resistors and capacitors first.
9. **Input Data selection**: read the legend on the bottom of the pcb. Select the correct data input for your build. I built Ryan's I2s to Simultaneous board, therefore, I shunted J2.
10. Wash the board thoroughly. Inspect it for resin goo, dirt, contamination, and solder balls. They will all be present.
11. Connect your data cables to the U.fl connectors.
12. Supply data (music or tones) to the board.
13. Power the board up.
14. Measure the offset and dial it out with TR1 and Tr2 (If using the onboard I/V). If you cannot dial the offset check these things:

a. Is data flowing to the TDA chip?
b. Are your supply voltages correct?
c. Did you select the data input on the underneath side of the board?

Q AND A:

Can I use a different capacitor for C6, C14, and C22 then the one listed in the BOM (16MU226md35750)?

A: You can but you will not get the same performance sonically. This is an SMD film cap and it performs significantly better in this position then any other type. Furthermore, it is the only product available in these values. There are no alternative film substitutes.

Can my supply voltages deviate from stipulated?

A: Please refer to the voltages section of the guide.

Do different grades of the TDA1541 chips make a difference?

A: They absolutely sound different. Whether they are worth it to you, that is something that cannot be answered by me. I find as I move from each grade (non-A, A, S1) that distortion lowers. They simply sound cleaner, with better delineation of instruments in space. This is simply to a product of lower distortion. They all sound very good.

Does Simultaneous mode sound better then straight I2s mode?

A: I think so, but you will need to answer that for yourself.

Why aren't the board LED lit upon power up?

A: You've mounted them backwards.

This guide is only overview of this project, and of course does not cover every aspect of this build. It really was written to cover the troublesome steps and areas. Enjoy!

ggetzoff