Assembly instructions AMP1-B

Thank you for choosing an audio kit from 41hz.com!

On delivery, check that all components have been included. If something is missing, let us know immediately. A bill of material (BOM) is included as APPENDIX 1

Tools needed

Assembly of the kits requires the usual set of electronics working tools; soldering iron, wire cutter etc.

Optional components

The following will at some stage be needed to complete the amplifier, but is not included in the kit:

- Heat sink. Screws and heat conductive paste to mount the heat sink.
- It is recommended that you solder hookup wires to the board. Optionally you can fit screw / solder terminals.
- Mute / un-mute jumper. You can wire this to a switch on your panel. Optionally use a 2.5 mm jumper (50 mil) on the board. This is the same size of jumper that is commonly used in computers.

Soldering

If you are not familiar with soldering surface mount components, I recommend you to do some test soldering on a separate scrap piece of material.

The boards for AMP-1 are double weight, double sided copper. Even if the PCB and components are small, quite a powerful soldering iron is very helpful. Especially components and pads connected to the ground plane require significant heating. A temperature controlled 50W soldering iron is the minimum recommended. At the same time, applying excessive heat may damage the FRP plastic of the board, causing the copper pads to come off. Preheating the board to around 100ºC will make work easier and allows using a lower solder iron temperature which decreases the damage risk. Increasing the solder iron temperature is NOT recommended as it increases the risk of damaging the board. A discussion on how to solder SMT components is available in the forum on http://www.41hz.com

Further documentation

The AMP1-B schematic is identical to the Tripath evaluation board for the TA2022. Some components values may be slightly different and generally, the components from 41Hz Audio are of higher rating or better quality than those suggested in the Tripth data sheets. The data sheet for the TA2022 chip and the Tripath evaluation board can be downloaded from the website at www.41Hz.com or from Tripath, www.tripath.com

There is also a lot of discussions on the 41hz audio web site forum.

Some considerations

Selecting the gain

The amplification, or gain, of the amplifier is set in two stages: Input stage gain and power stage gain. Optimally you should match the input gain to your signal source signal level and the power stage gain to your supply rail voltage. Just remember that music signals are very dynamic by nature, signal levels are approximate and impossible to predict accurately.

Input stage gain

In *table 1* you can see some typical input signal sources and gains you can set with the supplied components. The maximum recommended voltage *out* of the input stage is +/-2V peak to peak (1.41 VRMS), including some margin. At higher output signals, the input stage may clip.

The amplifier input stage in the Tripath chip is of the inverted operational amplifier type. The gain is calculated as:

Gain = -1 * Rfeedback/Rin

On the board, R51 and R32 are the R_{in} and R43 and R44 are the $R_{feedback}$. With the kit, there are four 20 KΩ resistors and two 36 KΩ. With these resistor values, you can choose one of three different input gains/sensitivities as shown in table 1. If you use other input resistor values, they should be of a low noise type and of the 0805 size.

Table 1. Input stage gain setting recommendations

R_{in}	**$R_{feedback}$**	**Gain [V/V]**	**Suitable signal source**
20 KΩ	36 KΩ	-1.8	Direct connection of portable MP3/CD player with built in volume control or via a passive volume pot.
20 KΩ	20 KΩ	-1	General use
36 KΩ	20 KΩ	-0.56	Preamplifier with fairly high output signal

Modulator gain

The "modulator gain" is the power stage voltage gain. You can select this to match your power supply voltage, by selecting the value of the modulator feedback resistors R31 and R52. *Table 2* gives the values for modulator feedback resistors and the rail voltages they are suitable for. The negative sign for the gain implies the signal is inverted.

Table 2. Modulator / power stage gain

R_{mfb}	**Gain [V/V]**	**Suitable rail voltage**
8.2 KΩ	16	+/-24V to +/- 30V
10 KΩ	19.3	+/-28V to +/- 35V

The total gain is the input stage gain multiplied by the modulator gain. If we assume you have selected the input stage gain, as you normally should, for a maximum +/-2V output, then the maximum output voltage to the speakers will be 2 x the modulator gain. For example with 10 kOhm feedback resistors, and +/-2V from the input stage, you would have +/- 38.6V out maximum. You can see that the calculated maximum output can be higher than the rail voltage. In reality, the output voltage can only be as high as the rail voltage. Therefore there will be some clipping of the highest peaks at the maximum input signal. This is quite OK and assures you can reach maximum output power at near the maximum input volume setting. If you decrease the modulator gain, you will not reach maximum power/clipping even at maximum input signal.

Table 3. Gain setting; summary

Input stage gain	**Result**
Input Gain to low	Maximum output is to low. Power stage not fully used.
Input Gain correct	Output from input stage is +/-2V peak to peak at full input volume
Input gain to high	Input stage clips before maximum output power is reached
Power stage gain	
Modulator gain to low	Output never reaches maximum power, even with maximum input signal
Modulator gain correct	Output clips slightly with maximum input signal
Modulator gain to high	Output clips excessively at full volume. Input stage is operating at low voltage; increased THD+N at low power

In the data sheet for the Tripath TA2022 chip there are more details on how to calculate the gain.

Power supply

AMP1 requires a dual rail power supply plus a stabilized +5V 100 mA supply. In the “toolbox” section of the web site, there are some recommendations for power supplies but below is a summary.

The rail voltages could be +/-20V to +/-35V. Higher voltage gives a higher possible maximum power output. With 4 ohm speakers or 8 ohm bridged mono, +/- 31V is the maximum recommended, to avoid over-current shutdown at high power. The VA rating depends on your application. It could range from 80VA for a +/-24V supply connected to an 8 ohm speaker to 300VA or more for a bridged 8 ohms subwoofer.

The rail supply does not need to be stabilized. Bulk capacitors of at least 10.0000 uF per side are recommended.

The +5V is used for the analogue input amplifier and the in-chip digital parts of the TA2022. It needs to be well stabilized and well bypassed. You can use a 7805 voltage regulator or similar by tapping current from the positive main supply. You can use a separate transformer supply to feed the 7805 The +5V should be connected using shielded cable, to prevent it from picking up noise. The +5V will not draw more than about 60 mA.

Hookup and shielding.

Switched mode amplifiers are a bit noisy by nature, in the sense that they emit EMI that is generated by the high power, high frequency output transistors. This can be transmitted via cabling or as radiated in the atmosphere and picked up by other equipment like radios, preamplifiers etc or by the amplifier inputs. It is therefore recommended that some precausions are taken. The most important is that the amp is housed in a metal/shielded casing.

Proper grounding is also important. Note that input ground should be taken to the board J2 connector ground, not to the housing or power supply ground. The speaker returns should lead to J3 ground, not to the casing or power supply ground.

It is recommended that hookup cable for the signal input and +5V is shielded and as short as possible so that it does not pick up noise from the outputs. Input cables and +5V cables should lead away from the outputs as far as possible.

Speaker cable and power cables can be twisted. All cables should lead the shortest way out of the casing.

For most users, using shielded cables and a metal housing provides sufficient EMI damping. If this is not the case for you, for example if you get disturbances on radio receivers, damping can be used on the cables. Typically, the amplifier inputs can be decoupled with 100pF capacitors on the RCA connectors, between “ground and live” or using two 100 pF capacitors, from each leader to the housing. On the speaker outputs, capacitors of 4700pF can be placed between ground and live on the speaker connectors or from each lead connector to the metal housing. There are some Tripath application notes available on the download page of the 41Hz Audio web site dealing with EMI and how to deal with it.

Mounting the components

1. First, solder all surface mount components. They are all placed on the “bottom” side of the board. A sketch of how the components are placed is included below. It is usually best to work in the order resistors – capacitors – diodes. The diodes have a line across them on one end of the component. This should be in the direction of the mitered corner on the PCB symbols.
2. Optionally solder board connectors. If you do not use these, save cabling until last.
3. Solder the conventional resistors and trim of excess wire. When through hole components are soldered properly on the back of the board, there should be solder right through the board holes and solder should be coming out on the front side, covering all round the component legs.
4. Solder the film capacitors. Some legs are soldered to the ground plane. Again, preheating the board helps.
5. Solder electrolytic capacitors. Respect the polarity as marked on the PCBs.
6. Solder the smaller vertical inductor, L4
7. Solder the trough hole diodes. The two zener diodes are marked with their voltage.
8. Solder transistors and DILs for the automatic balancing. Note there are two types of transistors.
9. Wind the toroid inductors. You should use 44 turns of wire. Wind as tight as you can. Tight winding minimizes any signal leakage from the inductors. If wound tightly you can get about 38 turns on wire before coming back to the starting point, so about 6 turns will have to overlap

if you use 0.6 mm (AWG 22) wire. It is not so good to let the last turns overlap the first, so you can use "bank winding" as follows: Wind about six turns, then wind back one overlapping turn, do six more turns, one overlapping etc. In this way, you will have the overlapping turns evenly distributed around the toroid. When you have completed the winding, leave a bit of wire so you can pull the toroids snugly to the board. In one of the Tripath datasheets, the winding is described as follows: *It should be noted that when multiple layers are used there may be an increase in winding capacitance, which can cause ringing and increased radiated emissions. Winding techniques, such as bank winding, can minimize this effect. It is important that the initial windings not be crossed over by the last few windings. If a few windings more than the single layer are required it is best to wind the core with a full single layer, back off a number of turns, and rewind over the last few windings.* If your application is not going to use high currents, for example if you use 8 ohm speakers, and/or lower supply voltages than 30V, you can also use slightly thinner wire. Using 0.5 mm wire will let you wind all turns without overlapping.

10. Scrape the enamel off the wires where they will be soldered and solder the wires
11. Solder the TA2022 chip in place. The board holes are fairly large compared to the leg diameters so take care getting the chip straight.

Last connect signal and power connectors. Note the signal source must be grounded to J2 and the speakers must be grounded to J3. The J1 jumper or wires with a toggling switch are used to mute and turn on the amplifier. If you do not use an external switch, you can permanently put a jumper from the middle hole of J1 to the Awake side of J1

Trimming and testing

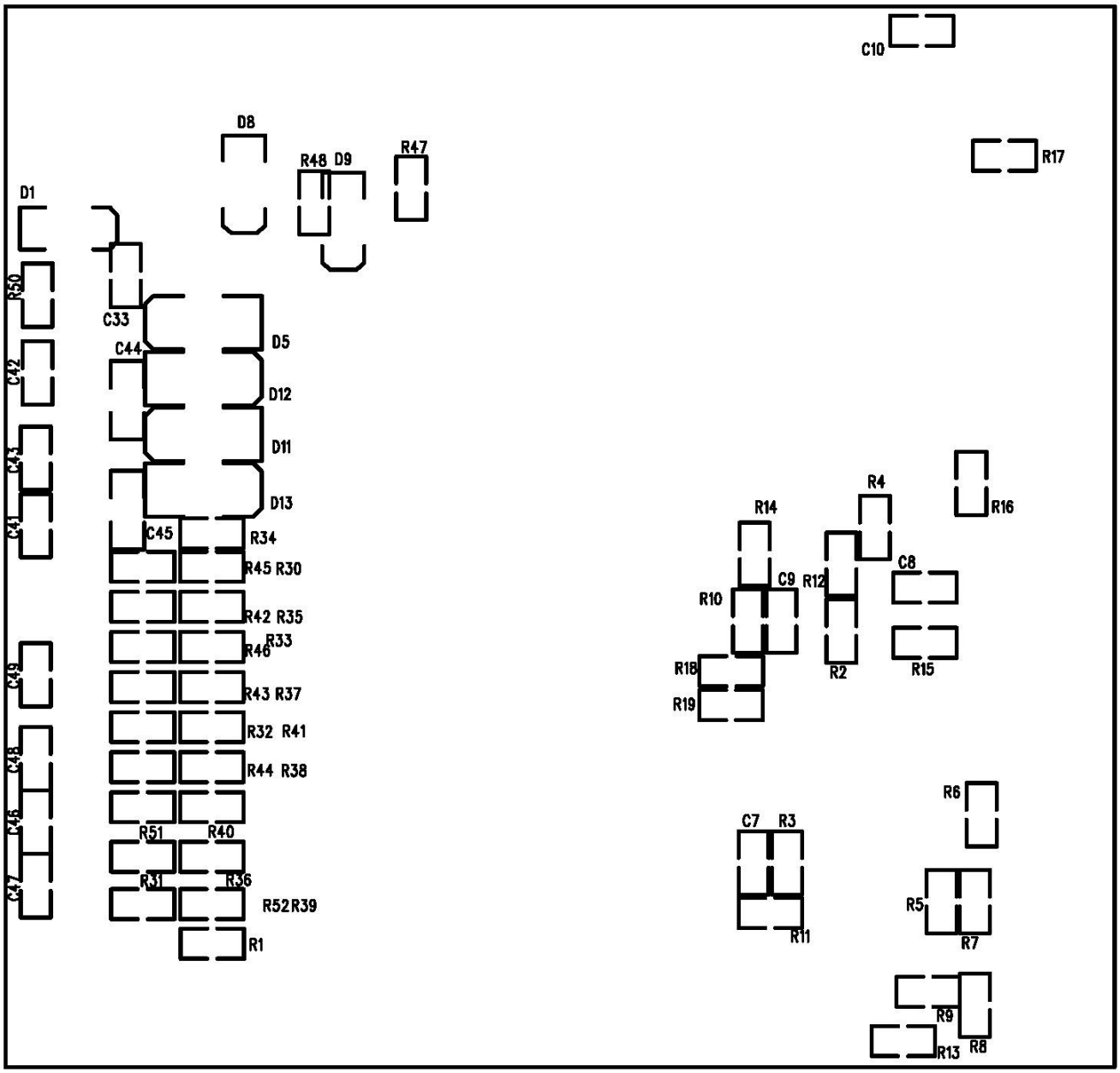
- Before connecting power, inspect the soldering closely, so that there are no shortcuts or solder splatter on the PCB.
- Put the jumper J1 to Mute
- Ground the signal inputs (connect IN1 and IN2 to AGND on connector J2). Do NOT connect speakers yet.
- For testing, use 300 mA slow blow fuses on the power supply. Note that you should only use these for low power testing. It is best to have the fuse on the AC side in such a way that both rails de-power in case the fuse blows. In this way, you will not subject the chip to power on one rail only. You may need slow blow fuses in case you have big bulk capacitors.
- Connect a +5V stabilized supply and its ground with a shielded wire to J2. ***Wrong polarity or voltages above +6V will permanently damage the chip***. A 100 mA fast fuse, placed before the voltage regulator, is recommended. If you have big bulk capacitors for your +5V supply, you may need a slow blow fuse.
- Connect you signal connections with shielded wires to J2
- Turn on the +5V and the main power. The amp should now draw about 25 mA from the +5V and about 0.5 to 2 mA per rail from the main supply.
- Move the J1 jumper from Mute to Awake.
- The LED should go after off and after a second or two you should hear a click from the relay.
- The 5V supply should draw about 50 mA when the amplifier is operating.
- Check the fuses. If they have blown, disconnect the board and check all components and solders.
- If the fuses are OK, shut of the power and connect the speaker wires

- Connect a signal source
- Set the volume very low, turn on the amplifier and check if you get any sound.
- If everything seems OK, switch off power, replace the power supply fuses for larger fuses and try again (The 5V fuse should remain 100mA)
- For testing at low power no heat sink is required. For low to medium power applications the amplifier housing may be sufficient as a heat sink. The amplifier may dissipate 20W of heat at full power into 4 ohm speakers. Then, a 2ºC/W heat sink is reasonable.
- The heat slug on the back of the chip is connected to the chip ground and does not require electrically insulated mounting. However, insulation decreases the emitted EMI/RFI from the heat sink.
- Enjoy the music!

If you have any questions, write any questions on the forum on our web site http://www.41hz.com , as the questions may be of general interest.

For any questions please do not hesitate to contact us at support@41hz.com .

Bottom side component placement



Top side component placement