AMP-6-Basic / -Sneaky Assembly Instructions

Related Sub-Forum: AMP-6.

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Introduction

Thanks for selecting the AMP6-BASIC kit from 41Hz Audio.
This document will help you build the kit. It has been updated for revision 1.1 boards only.
Amp6x is now at Rev. 1.2 , but is not completely covered here yet.

(If you think you cannot build it (this kit is very easy to build), then just get yourself an assembled+tested one in The Shop)

Needed documents, available under Downloads tab in your Shop account.

- The schematics
- BOM (Bill Of Materals) for Basic or SNEAKY
- The Tripath TA2020 chip datasheet for your kit (TA2020)

Considerations before building

- On the board there are two signal input capacitors, C14 and C15.

These are required, as the amplifier is internally biased to about +2.5V. Two 3.3uF capacitors are provided with the kit. The board provides space for RM 2.54 (100 mil) and RM5 (200 mil) lead spacing capacitors.
The input capacitors form a high-pass filter together with the input resistor Rin.
The cutoff frequency is F=1/(2*π* Rin*Cin) For example, with Rin = 22kΩ (determined when you set the input-gain, below) and Cin = 3.3 uF, the cutoff frequency is F=1/(2*3.14*22*0.0033) ≈3 Hz.
The cutoff frequency is best kept at least two octaves below the lowest frequency expected. Note that a big input capacitor may contribute to startup thumps. Smaller input capacitors can be used at the expense of low frequency damping.
If there is a separate woofer in your system, you could use input capacitors of 1uF or even smaller (down to 100nF. ed.)

- The amplifier input stage, inside the Tripath chip

Is of the operational amplifier type. The maximum possible voltage the input stage should handle is about +/-2V peak to peak (4Vpp=1.41 Vrms). You can set the gain of the input stage so that it matches your signal source.
The gain is calculated as for a normal inverting operational amplifier: Input Gain=-1*Rfeedback/Rin V/V. The minus sign is due to the fact that the input stage is inverting (ignore).
On the board, R2 + R4 are the Rin and R5 + R6 are the Rfeedback. With the kit, there are four 22kΩ resistors and two 56kΩ (and/or 82kΩ). With these resistor values, you can choose one of three different input sensitivities as shown in table 1 below.
If you use other input resistors, they should be of a low noise (metal film) type.

R-in, R2+R4	R-feedback, R5+R6	Input-gain	Suitable signal source

22 kΩ	82 kΩ	3.7	Even more sensitive input (Ipod)
22 kΩ	56 kΩ	2.5	For older type portable MP3/CD player with built in volume control.
22 kΩ	22 kΩ	1	General use
56 kΩ	22 kΩ	0.4	(Pro) preamplifier with fairly high output signal
82 kΩ	22 kΩ	0.27	Even less sensitive if needed

Table 1: Input stage gain setting recommendations

The total gain of the whole amplifier (volt-out/volt-in) is 12 times the input gain.
If Input gain is 1 (Ri+Rf), 'general' use, then with 0.7Vrms input, the output voltage will be ~9Vrms which results, with a 4Ωspeaker, in 20Wrms output.
With a 8Ω speaker, current will halve, so power will halve; 10Wrms.
0.7Vrms=2Vpp but input can take max. 4Vpp so gain can, if needed, be pushed up.

- Will you use a volume control/pot?

If you have a preamplifier or sound source with its own volume control, it may be best to leave out the volume pot. If not, a volume pot of 50kΩ pot would be suitable.
With a volume pot, there will be some signal damping so you may need to increase the gain a little. Some examples of gain settings are given in table 1.
Note that some portable players will clip badly at full volume; that is the signal source output clips, even if the power amp does not clip. In that case increase the power amp input gain.

- Sleep/mute.

The chip has a sleep and a mute function. Both can shut down the amplifier. You can reach both via the jumper J2. In sleep mode the chip draws less than 0.3 mA. If you use a power breaker or a power supply with an on/off switch, you may permanently close the J2 jumper (rev. 1.1: the two pins closest to the TA2020), but there may be turn on thumps. (only rev. 1.0: Therefore, using a switch for the mute function is recommended rather than using a power switch)

- The chip mute input is also hard wired to the chip error/over-temperature sensing output on the PCB.

In case a too high temperature is reached this mutes the amp. It automatically un-mutes again when the chip has cooled down a bit. In case of over-current the amp is muted in a latched way and must then be power toggled off/on to be restarted.

- You can use the supplied terminals, screw terminals or solder hookup wire to the PCB.

Soldering is generally the best connection from an electrical/signal point of view but may be unpractical. Note that you should avoid soldering on/off the cables, especially the power and speaker cables. As these cables are usually quite thick, they will require substantial heating.
So repeatedly soldering these may cause the copper tracks to come off, lift, because the FRP below them is beginning to deteriorate. It is then better to unsolder/cut the "other" end of the cable or use a board connector.

- Power supply.

For testing at moderate power any 12V supply rated 200 mA or more should work. For final use, at least 25W and for 4Ω speakers, at least 50W is recommended for high power use. The transformer/power supply would normally determine the fuse rating, if the power supply does not have built in protection.
If the power supply has its own protection, the default 4A slow fuse is suitable. For a power supply without a fuse/protection, the fuse on the PCB should not be higher rated than recommended for the power supply.

Building/Assembly instructions

IMPORTANT Components packaged in a shielded, aluminized bag should be considered ESD sensitive and should be handled with ESD care. The Tripath chips use MOSFET outputs which by nature are sensitive to ESD (Electro Static Discharge). Use ESD precautions. Preferably work on a conductive, grounded "ESD mat", and avoid touching the chip leads with your fingers. Discharge yourself before working with the components.

First, check the parts:

(pictures here are from PCB rev. 1.0, now PCB rev. 1.2 is sent out. SNEAKY contains fewer parts)

NOTE 1
There are two 100nF capacitors, C6, and C7, in bag 5, which should be mounted and soldered into the holes together with the TA2020 chip. These are **critical** to the function of the amplifier. The locations of these are printed on the bottom side of the PCB.
Solder these capacitors when you fit the TA2020 chip, which is the last step of mounting parts.

NOTE 2
Revision 1.1

- Has three things/components that are not visible on the photos.
These are R3 and C21 and a jumper pair more on J2 (Mute+Sleep). They are described in the AI
- There is R1 thru R10, but **R8** does NOT exist.

Revision 1.2

- There is R1 thru R11, and new: D2.
- R8 and R11 are protection resistors to new connections for the 'overloadb' and 'fault' signals (read bottom line: Revision History)
- D2 (between C15 and L2) is for a better fault/mute circuit

NOTE 3
R5 + R6 are now delivered with extra values of 82kΩ (next to 22kΩ)

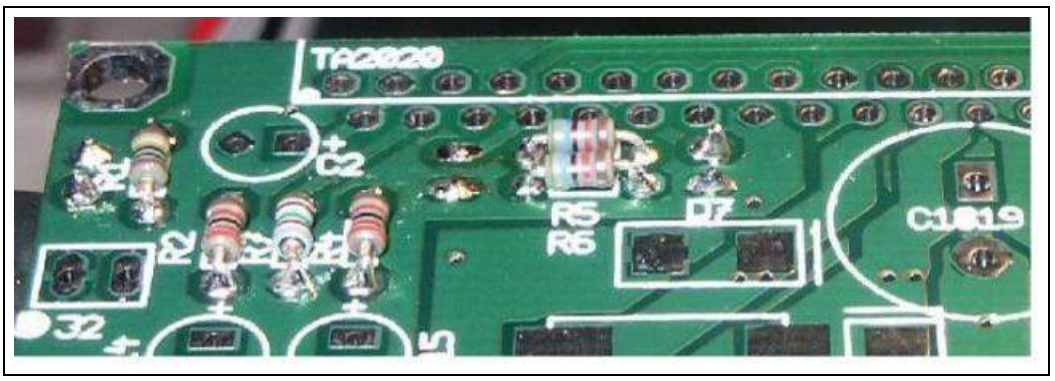
NOTE 4
The SNEAKY does NOT have connectors, fuse holder, screws/nuts/spacers, jumpers, LED plus it's R931.

For rev. 1.2 PCB: R8, R11 and D2 can be soldered in at any time.

You might want to start (recommend by builders) to do steps 1+2 of 'BAG 5' first, then continue here.

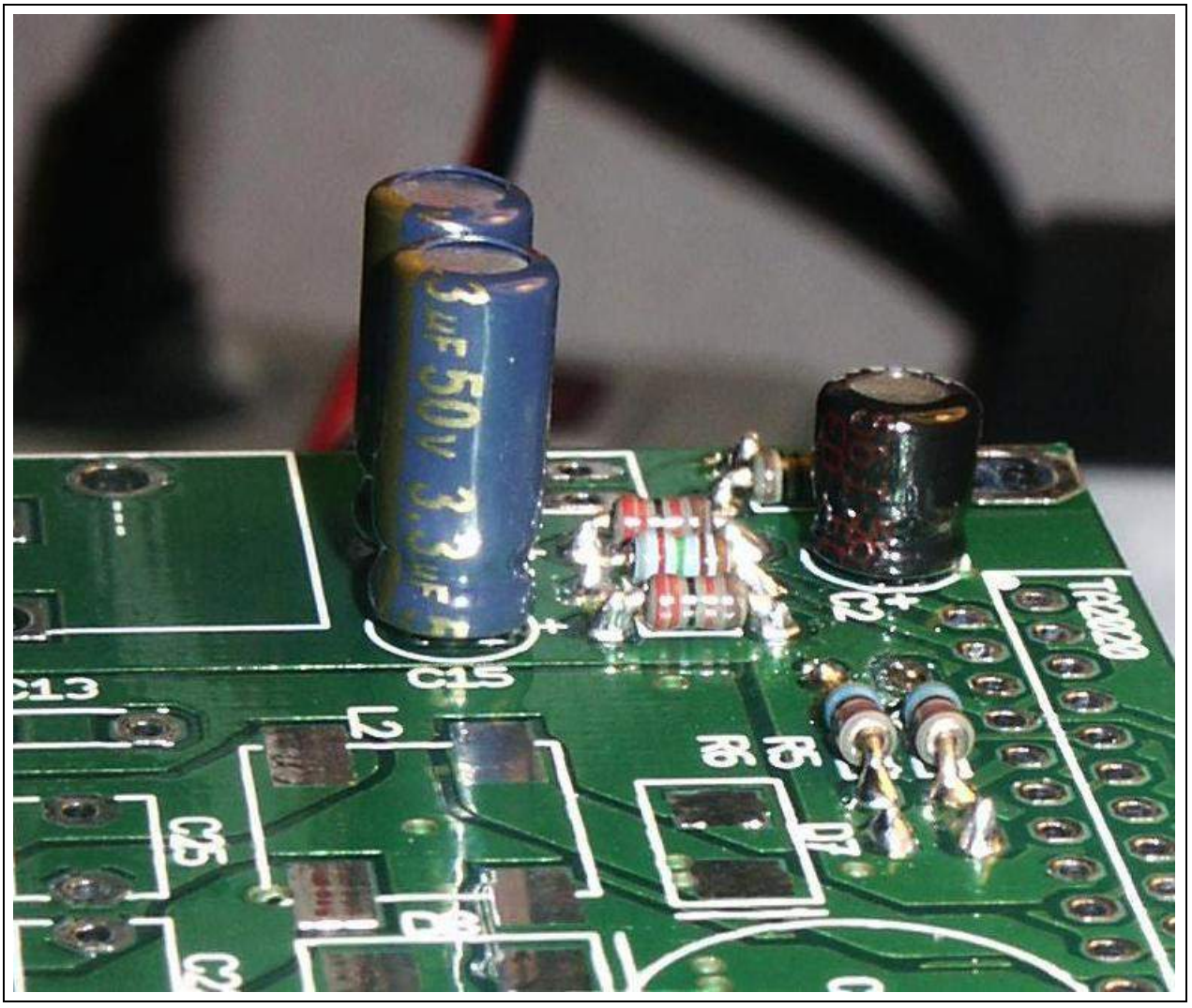
BAG 1, So here we go with the first components.

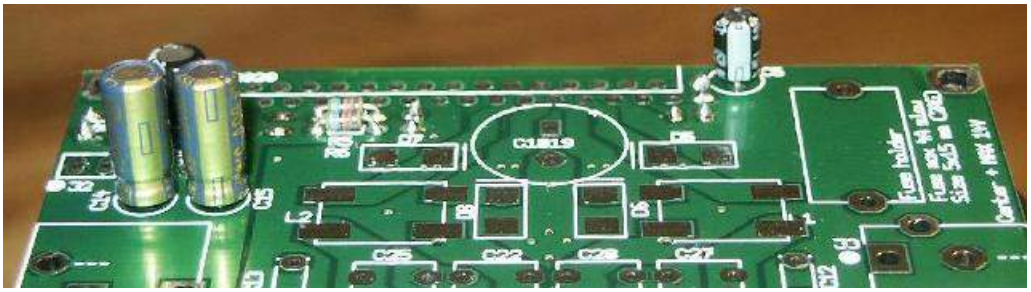
1. (not with Sneaky) First mount the four nylon spacers.
   One in each corner of the board, with the supplied screws. If you are working with a vice, you can leave the standoffs until later.
2. Solder C16, C17, C20, C21, C26, C50, small capacitors.
   On the bottom side of the board.
   A picture of how the components are placed is included under COMPONENT PLACEMENT (there it is rev. 1.1, pictures here are 1.0. ed.).
3. Solder R3, R7, 8.2kΩ in place
4. Solder R2, R4, the two input resistors 22kΩ in place



BAG 2, More components.

1. Solder R1, the Sleep pull-up resistor, 1MΩ in place
2. Solder R5, R6, the feedback resistors in place.
   These are (were) nominally 22kΩ or 56 kΩ but now 22kΩ or 82kΩ, but check!, see above Considerations on setting the input gain/sensitivity.
3. Solder C5, the charge pump capacitor well: critical.
   As with all electrolytic capacitors it is important to mount the leads the right way; the longer lead is positive, the shorter negative. Polarity is marked on the PCB with signs and with square pads for positive. C5 has the positive side towards the board edge. It may be safer to look in the component placement drawings.
4. Solder C14 and C15, they are the signal input capacitors.
   Also, these, and the other round cans, are electrolytic and have to be mounted in the right direction, like diodes, with the right polarity.
5. Solder C2,
   Cap for decoupling of the internal +5V circuit.



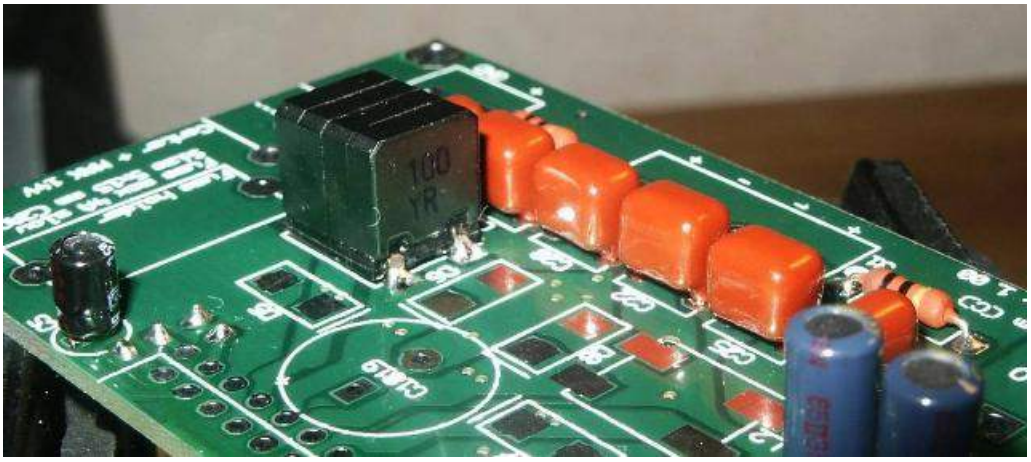


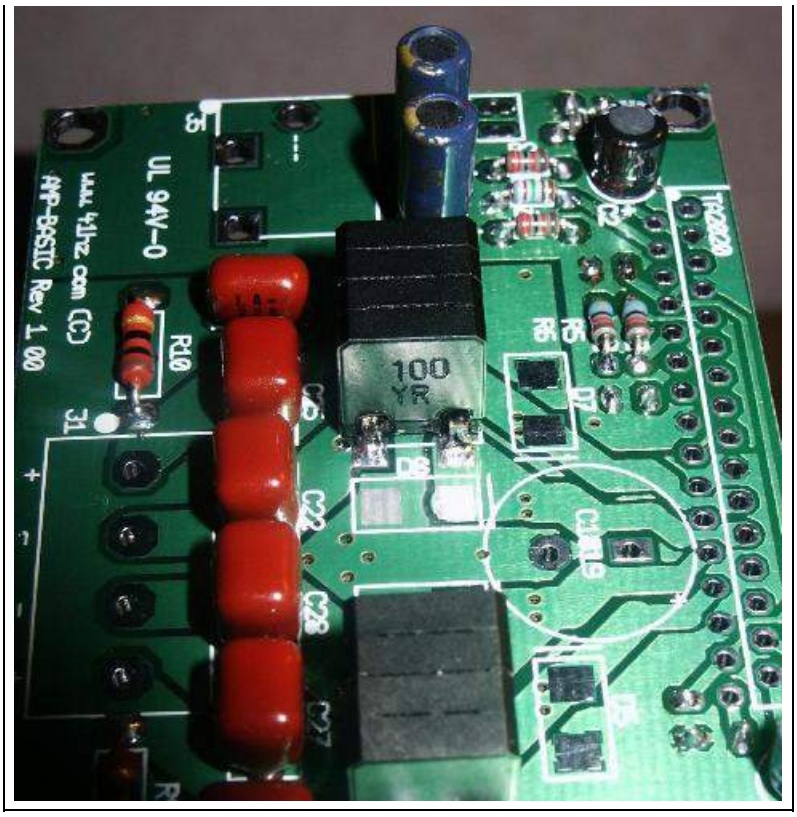
BAG 3, Containing all the output filter components.
These remove high frequency noise from the outputs and are all mounted near the speaker connections.

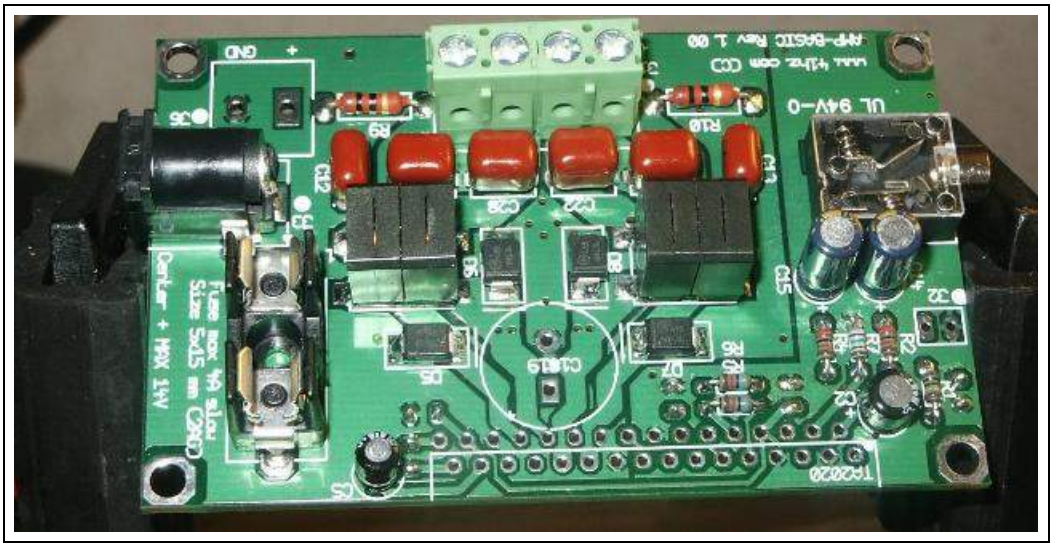
1. Solder R8, R10 resistors
2. Solder C12, C13
3. Solder C22, C25, C27, C28
4. Solder the (dual-) output-inductors L1 + L2.
   They are the ferrite cubes. Make sure they are aligned on the solder pads before soldering.

BAG 4, Contains connectors and close-up bulk capacitor.

1. (not with Sneaky) Mount F1, the fuse holder
   It is of USA AG2 size, 15x5 mm in Europe. This is a bit smaller than the more common size 5x20mm. Use a slow blow fuse, 4A. For testing a smaller fuse can be used.
2. (not on Sneaky)Solder J1, the speaker connector header
   Aligned such that you can fit the cables!
3. (not with Sneaky) Solder J3, the power connector.
   It is of size 2.5 mm center pin and 5 or 5.5 mm sleeve. This size connector is common for more powerful external power supplies.
4. (not with Sneaky) Solder J5 for signal input.
   It is a stereo 3.5 mm jack type, of the same size as the headphone connectors for PCs, MP3-players, portable CDs, headphones etc.
5. (not with Sneaky) PCB-1.0: Solder the two pins header of J2. (long pins+plastic on top of PCB).
   PCB-1.1/1.2: Solder the four pins header of J2. (long pins+plastic on top of PCB)
6. Save C1819 for later (Bag 5, step 4).



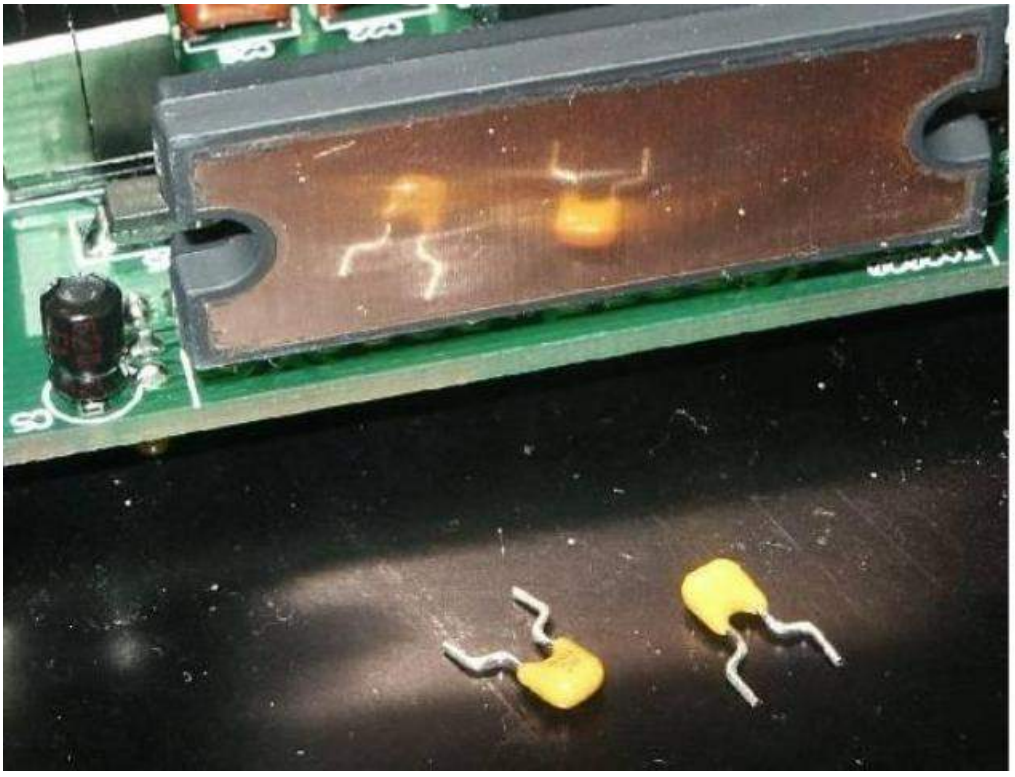


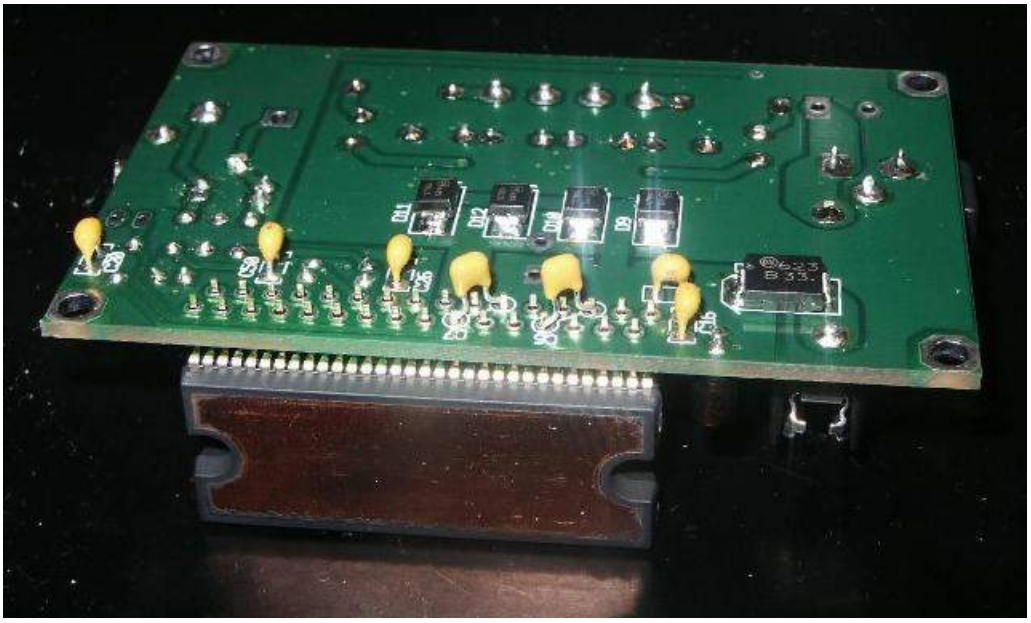


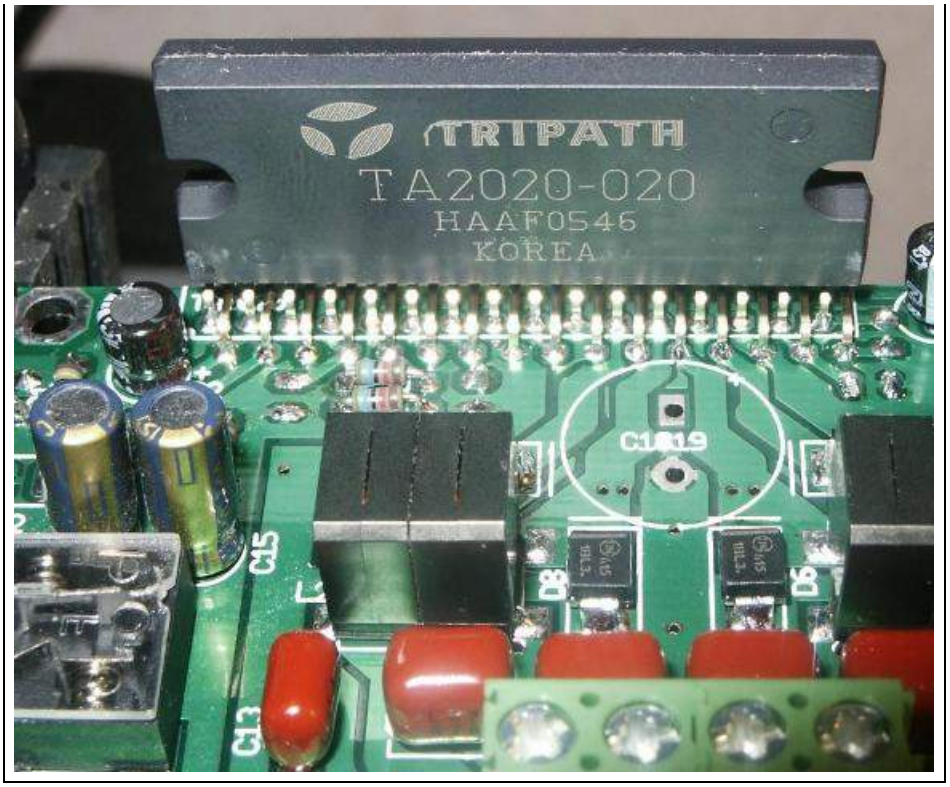
BAG 5, Contains all the components that should be handled with some ESD care.
(steps 1+2 might have been done at start, remember?)

So please discharge yourself before touching any of them. Avoid touching any of the Tripath chip leads with your hands.

1. Solder the 8 diodes in place (4x bottom, 4x top).
   These have a polarity as marked by a band across them. They MUST be mounted in the right direction or there will be a short circuit.
2. Solder D1 on bottom side (right direction!)
   It provides polarity protection for the power supply connection.
3. Almost done, now Solder the TA2020 chip in place.
   Take care getting the chip straight and orthogonally to the PCB. Solder a few of the leads lightly and mount C6 + C7 in the holes indicated on the bottom side of the board.
   You need to cut the leads of these capacitors before mounting them. It is essential to mount these capacitors as close as possible to the PCB. You will need to push them gently into place and then solder all of the TA2020 leads.
   TIP
   If space is too tight for you, you can solder the front row of pins of the TA2020 from the TOP of PCB side.
   Make sure the solder flows well around the pins, so it comes out the other side of PCB.
4. Solder the C1819 capacitor from bag 4.
   Make sure it is pushed right to the board so that the leads can not work loose.







Lastly, solder the loudspeaker connector block (not with Sneaky) and you are ready for testing.
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. For high power use like at full power into 4 ohm speakers, the amplifier can dissipate upto/abs.max. 10W of heat.
Then, a 3 or 4ºC/W heat sink is reasonable (check pictures in amp6 forum). Running at medium or low power the amp will not dissipate a lot of heat. The heat slug of the TA2020 chip is connected to ground and does not require electrically insulated mounting (but recommended). Silica heat transfer compound or similar should be used to improve cooling (good connect to heatsink).

The mounting holes on the PCB are NOT connected to the ground plane (but check!). Pin 1 of J6 is grounded.

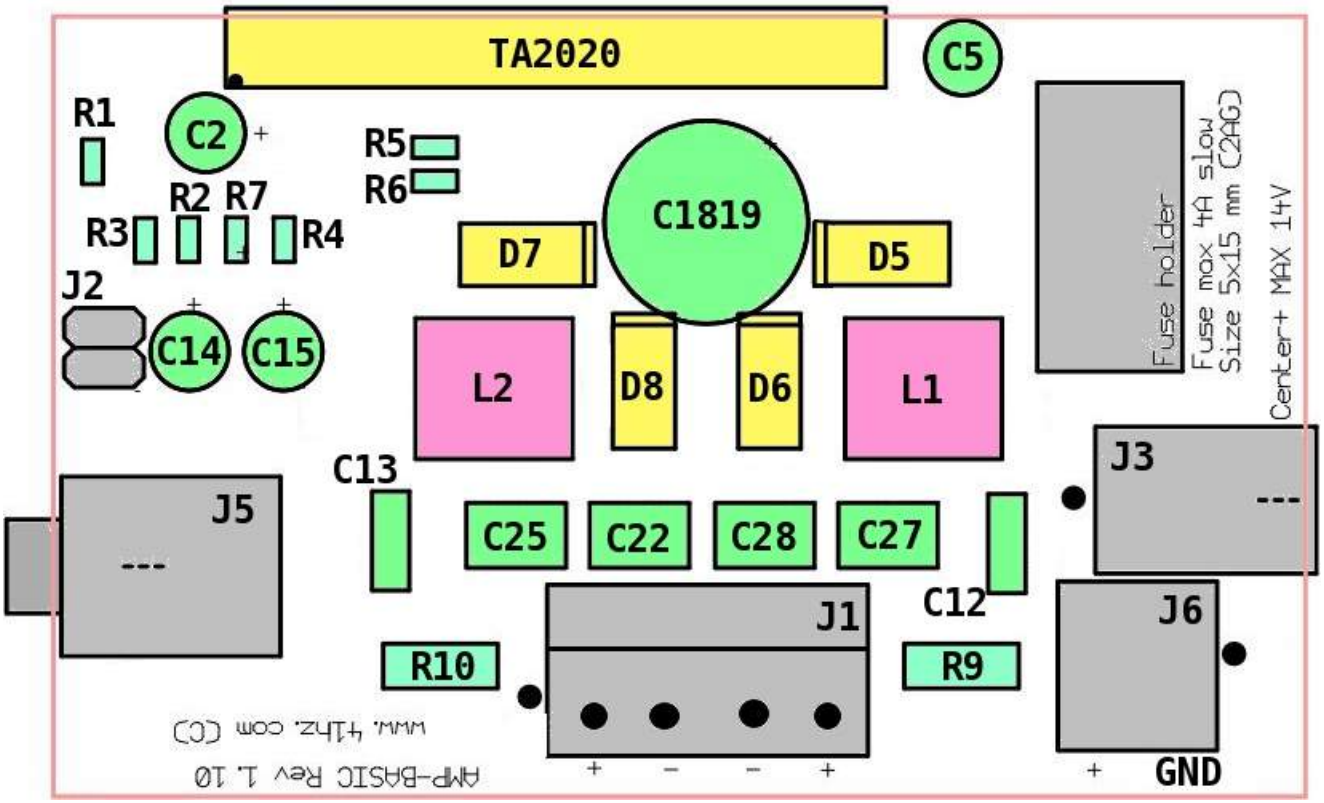
Powering up for the first time
Always de-power the amp before doing any work! Never connect or disconnect signal connector or speaker cables with power connected as this can damage the amp. The Sleep/mute jumpers are the ONLY exception.

The Tripath TA2020 chip is rated 16V absolute maximum.
About 14.0V is a reasonable maximum (and wise) in real life, to allow for fluctuations. The center pin of the power supply connector J3 is positive (the 'plus').

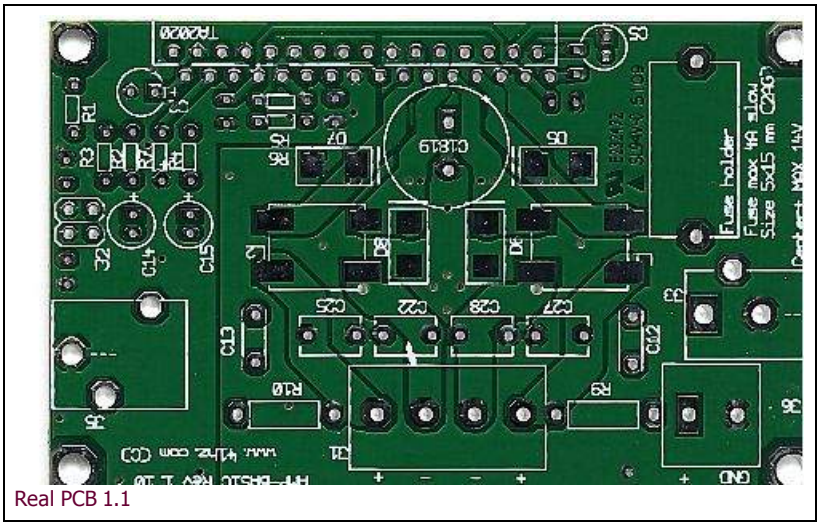
- Before connecting the power, inspect the board closely for any solder splutter or other contaminations/dirt. Clean off everything that looks suspicious. Re-do any solder joint that does not look perfect.
- Remove the jumper from J2 (PCB 1.1 : closest two pins (line around them) to TA2020), if it is on there, to put amp in sleep mode.
- Connect the power supply. When in sleep mode, the amp should draw less than one mA.
- If all seems OK, connect the J2 jumper (rev. 1.1+1.2: closest two pins to TA2020) to Awake the AMP. Rev. 1.1+1.2: If all is OK, connect the MUTE jumper, J2, (the two pins closest to the output connections) as well (better is to mount a switch on your amp front panel instead of this jumper, but that can be done later).
- Check the fuse. If it has blown, shut of the power, disconnect the board and check all components and solder connections. Check that the Tripath chip heat slug is not hot.
- If all seems OK, switch-off power.
- Connect the speaker wires to J1. Important: the output is bridged, so each speaker should connect ONLY to its own respective plus and minus. The minus is NOT ground and negative is NOT common for the two channels and NOT common to the power supply minus/ground.
- Connect a signal source with its ground leads to J5, the 3.5mm jack
- Connect a signal source and set the volume very low
- Turn on the power, awake the amp and check if you get any sound.
- If everything seems OK, you can slowly increase the power. If all is OK, switch off power, replace the power supply fuse for a larger one, rated as for your transformer and try again with higher volume. For testing at higher power, the chip should be mounted on a heat sink.
- Enjoy the music!
- (sound should be OK, but will even improve after some (5-30) hours of playing time, don't push it hard in the first hour)

Also read Troubleshooting

Component placement and PCB. Rev. 1.1
Top view

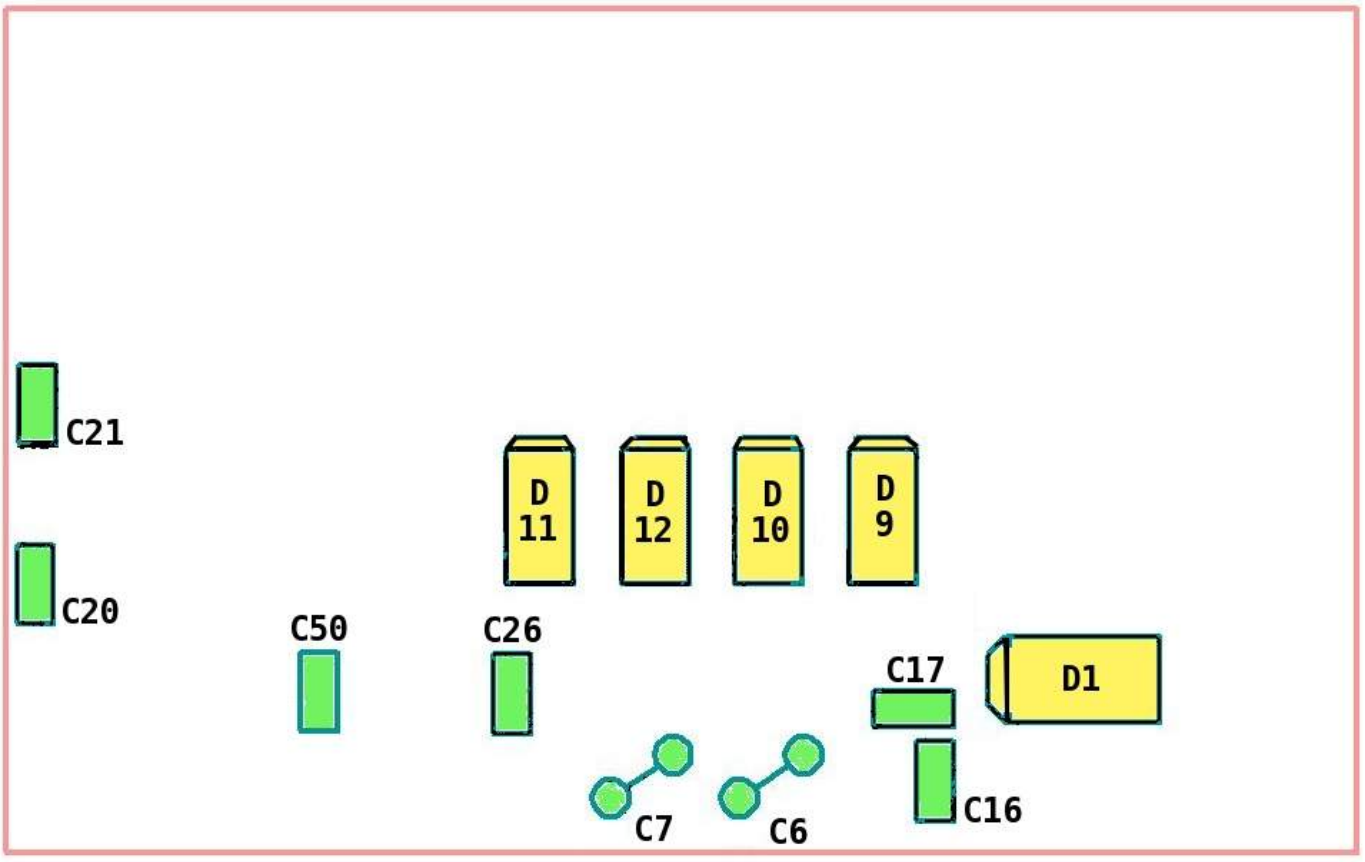


Real PCB:

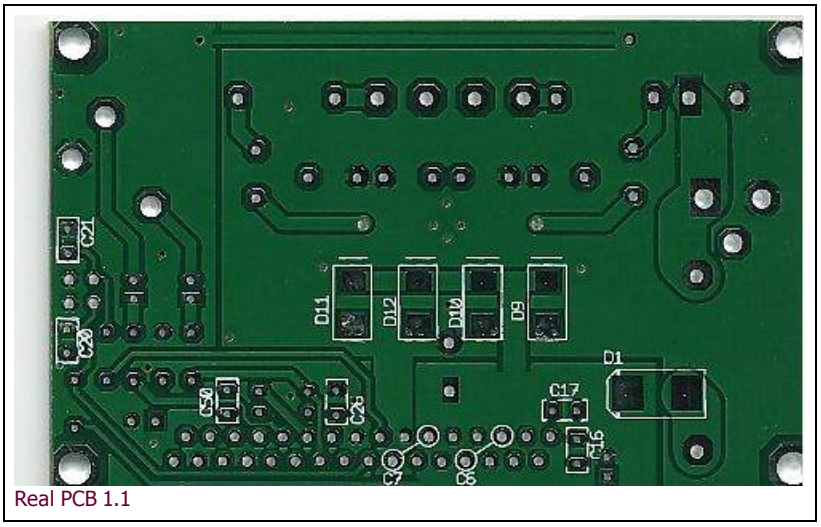


Real PCB 1.1

Bottom view



Real PCB:



Real PCB 1.1

Connections

A 'Jx' is a jumperblock, can be 2 to 20 pins (1 to 10 pairs). So 'J2' has two pins on rev. 1.0, but four pins on rev. 1.1/1.2.

- J1, The Speakers connector block (not with Sneaky)
  - Pin 1 Out 1 +
  - Pin 2 Out 1 -
  - Pin 3 Out 2 -
  - Pin 4 Out 2 +

- J2 on PCB rev. 1.0, Place the jumper from J2 to Awake, otherwise amp is in Sleep mode (overrides un-mute)
- J2 on PCB rev. 1.1 + 1.2
  - it has 4 pins (sticking up from board), a line around each two pins (a pair)
  - ----1st pair-------
  - the two pins closest to the TA2020 (the BIG chip) refer to Sleep, an input
  - when pins are connected (jumper on/placed), AMP is 'Awake', active/working (very low-power mode)
  - -----2nd pair------
  - the two pins closest to the J1 (output-connections, for the speakers) refer to Mute, an input
  - when pins are connected (jumper on/placed), AMP is UN-muted = active/working (unless still 'sleeping')
  - It is NOT recommended to place/remove jumpers when the amp is powered: use a switch (or two). Switching Mute and Sleep/Awake is not useful; just leave on Awake and switch Mute.

- J3, Power connector. 5/5.5mm sleeve, 2.5mm center pin (not with Sneaky)

- J4, Not there.....
- J5, Signal input. Stereo 3.5 mm jack. (not with Sneaky)
- J6, Parallel to J3, cable/wire power connection/input

J1, J3, J5 'blocks/connectors' are not supplied with Sneaky, but connections ('pads') on PCB are there of course.

Rev. 1.2 PCB has new connection pads:
- 3pins within J5 'space' for a neat wire connection of input signals
- 4pins next to J5 for using the Overloadb + Fault status signals

Minimum requirements to build a working amplifier
There are some essential parts needed to turn this kit into a working amplifier:
- A suitable power supply, typically 12-14Vdc/4A, toroid 2x9Vac/60VA (2Adc or 30VA will suffice mostly on average)
- Heat sink (small), connectors

Additional 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.
In most cases, if you mount the Tripath chip to an aluminum amplifier casing, this is sufficient to cool the chip. The Tripath chip does not need to be insulated, as the back of the chip is internally connected to ground.
- Mute/un-mute switch.
A jumper on the board can be used to mute/un-mute the amplifier. Preferably wire this to a switch on your casing panel. Muting the amp before power on minimizes the turn on thump and is recommended.
- A power supply.
AMP6-BASIC is intended to be used with an external power supply or a 12V battery. The maximum recommended voltage is 14.5Vdc, with 12 to 14Vdc being more comfortable values. The recommended power rating (total) is at least 25W with 8Ω speakers and at least 50W with 4Ω speakers. The amplifier works with voltages down to about 9Vdc.
You can use power supplies with lower power rating, but the amplifier may not perform as well and the power supply may get overloaded.

Tweaks, Tips, Mods
Please be advised that this amplifier module is a 'core' module. So secondary circuits should be added, like a power-supply, input protection, output-speaker protection, volume control, etc.

Troubleshooting
Please read Troubleshooting article under Tech Info, Building Kits.

AMP6-BASIC revision history
- 1.0
- 1.1
  - Change in J2 (Mute+Sleep) + See notes at beginning of Building/assembly section.
- 1.2
  - A diode has been added to make the sleep mode work properly, so you can use both sleep and mute. In sleep mode, it uses less than 1mA
  - Output and LED for error added. It turns high/on, on errors like overtemperature, overload etc.
  - Input overload pin (ovrldb) added. It turns LOW if the analogue input signal is too high. This output can not directly drive a LED, you would need to add one transistor to drive a LED. A P-channel logic MOSFET can easily be used to invert the logic, turning ON a LED when input is too high. One LED, one small MOSFEt and one resistor is needed to implement this. (like 5.6k+2N7000 ed.)
  - Another type of fuse holder is used, that can take both US 2AG sizes and European 5mm size fuse.
  - Polarity protection diode footprint now allows both SMC and D-Pak diode sizes.
  - Various drill hole sizes are now better adapted to fit the actual components.

Categories: AMP6x

3 Comments

RalpH_himself - 12-Oct-10, 15:06 Reply

R1.2:
* what about J10?
* where to place the included LED?
* C21 apparently has become C200

FFF - 12-Oct-10, 16:06 Reply

Gimme some time please? ed.
For now: only Fault-pin can pull a LED, trace an outer pin to the TA2020, to see where it is connected.
If R8 and R11 (for J10) really are 930k ohm and not 930 ohm, then a LED won't light up. Check those first.
When 930k ohm, you need a driver circuit...like with a 2N7000. For both Fault and Overloadb.

Jan - 12-Oct-10, 16:12 Reply

Please see the latest schematic, uploaded a day or two ago. Fault can drive a LED (one) directly, but then remove the one on the board just in case.