TA2022SMPS Audio Amplifier Module v1.3

TA2022SMPS Powered Amplifier Module is Mains-Powered Class T Stereo Audio Amplifier based on TA2022 audio power amplifier IC made by formerly Tripath® Company and has the Switched-Mode Power Supply on board. The **TA2022SMPS** Powered Amplifier module is the most compact amplifier based on TA2022 IC and integrates all the functional blocks required for a medium power switched amplifier from mains to speaker. PCB size is just 100x100mm and the overall size including the onboard heatsink is just 112x100x38mm (without considering the potentiometer and mains switch axle protruding size). It can be used both in stereo mode, or BTL mode without any modification. The left channel input is 180° inverted within the TA2022 IC and the right channel is 360° inverted (180° within preamplifier stage and 180° within TA2022 IC) thus the left speaker negative terminal must be connected to Left output and the left speaker positive terminal must be connected to GND. For BTL connection the speaker must be connected across left output which will become negative output and right output which will become positive output. No GND connection is required or allowed in BTL mode. Input signal will be supplied to both Inputs connected together.

Amplifier Features:

- 120V/230V jumper selectable mains voltage compatible, default set for 230V mains
- Output Power: 2x90W at 4Ω, or 55W at 8Ω, with max. 0.1% THD+N, at 115V or 225V mains Voltage.
- Output Power: 2x100W at 4Ω, or 60W at 8Ω, with max. 0.5% THD+N, at 120V or 230V mains Voltage.
- Output Power in Bridge mode: 180W at 8Ω, with max. 0.1% THD+N, at 115V or 225V mains Voltage.
- Audiophile sound Quality: 0.02% THD+N at 68W at 4Ω or 42W at 8Ω.
- Minimum and maximum mains voltage for safe and reliable operation: 98V to 132V 195V to 265V.
- Overall efficiency from mains to speaker: Up to 86% at 2x60W at 8Ω or up to 82.5% at 2x100W at 4Ω.
- Output over-current and short-circuit protected, speaker protection circuit and click-pop free start.
- On board Mains power switch, volume potentiometer and status LED's for Power, Mute and speaker OFF.
- Compact size 112x100x38mm including heatsink and lightweight, just 250 grams.

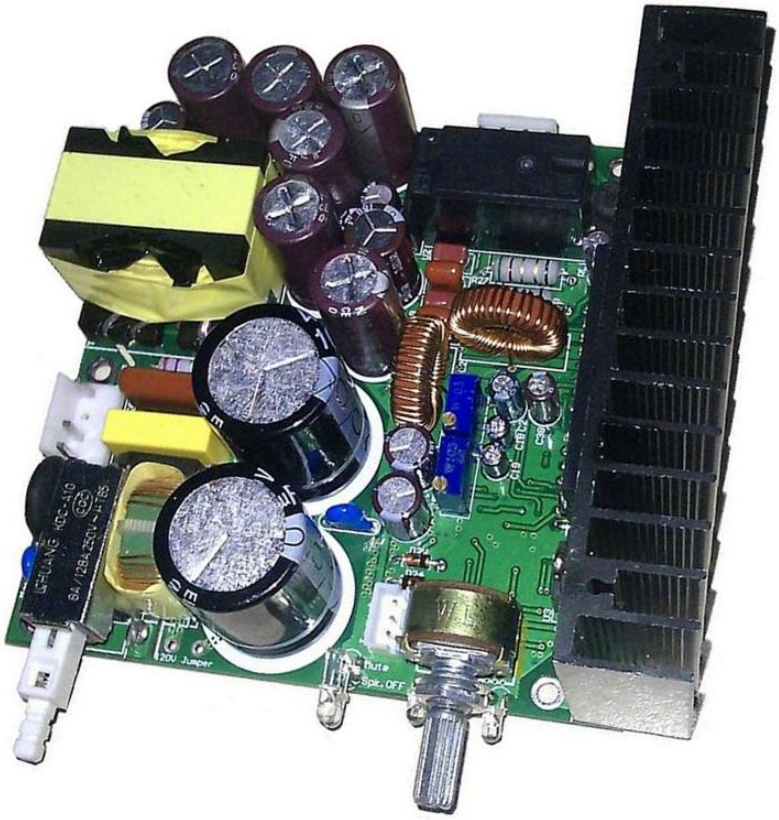


Figure 1: TA2022SMPS Audio Amplifier Module

Amplifier Description:

TA2022SMPS Class T Stereo Audio Amplifier is built around **TA2022SMPS**, dedicated digital audio power amplifier. The main blocks of this amplifier are: Input stage which has the role to adapt the impedance of the amplifier, amplify and invert the input signal to match the level required by the TA2022 IC, TA2022 Power amplifier stage which is the main stage of the board, Switched-Mode power supply, which supply power for the TA2022 Power stage, Input stage, and housekeeping and protection circuits which include the Speaker delay connect and protection circuit, Mute stage and Status LED's.

The audio input signal is provided to the **TA2022SMPS** Powered Amplifier Board through the small 3 pin plug-in type connector called **Input** at pin 3 for the Left channel and pin 1 for the Right channel. As can be seen from the board layout diagram, the input is placed next to the volume potentiometer to minimize the length of the noise susceptible traces leading to better S/N ratio. The audio signal is 180° inverted for left channel only in within the TA2022 IC, amplified and input impedance matched to 10KΩ. The audio signal on the Right channel is twice 180° inverted, once in the input stage and then again 180° inverted in the TA2022 IC, bringing the output signal for the Right channel in phase with Input signal. The Left speaker negative terminal must be connected to Left output and the Left speaker positive terminal must be connected to GND. There are two main reasons for driving the TA2022 amplifier left channel 180° out of phase: to avoid bus pumping phenomenon, which otherwise would compromise the sound quality and could affect reliability if the amplifier would be extensively used with high power low frequency content, such as for subwoofer applications, then easy and straightforward BTL implementation without any other changes, setting or modification required to the TA2022 Powered amplifier. For BTL connection the speaker must be connected across left output which will become negative output and right output which will become positive output. No GND connection is required or allowed in BTL mode. Input signal will be supplied to both Inputs connected together.

The **TA2022SMPS** amplifier Gain is equal with the product of TA2022 power stage gain and the input preamplifier stage. The TA2022 power stage gain is 18.6 V/V and the input preamplifier stage gain is 2. The overall gain is 37.2 V/V or 31.4 dB. To achieve the rated power or 90W per channel on 4Ω impedance the input signal amplitude must be **500mV**. The input signal amplitude required for BTL operation will be the same, 500mV but the Input impedance will be just half, 5KΩ because both Left and Right Inputs must be paralleled. This is a fairy sensitive input amplifier and allows all kind of sources including latest mobile devices (Smartphone, tablet computers) which have very low output signal level to drive this amplifier without requiring an additional preamplifier or buffer stage. If the signal source output lever is found to be too high (severe distortion and clipping before reaching the maximum level of the volume potentiometer) a very simple attenuator can be introduced, by just connecting one 10-20KΩ resistor in series with each signal input.

The TA2022 amplifier section operation was explained in very similar TA2022 Amplifier manual, which can be downloaded from here: http://www.connexelectronic.com/documents/TA2022_Audio_Amplifier_Module.pdf

Amplifier Efficiency:

The on-board Switched Mode Power Supply is resonant half bridge type, operating at very high switching frequency allowing maximum efficiency and lowest EMI. Although is just few cm distance from the amplifier and preamplifier stage, it operates so quiet that there is no audible difference if the amplifier is powered from the on-board SMPS or a remotely placed high performance low-noise power supplies. The total efficiency from mains to speaker is up to 86% when using 8Ω speakers and up to 82.5% when using 4Ω speakers. The SMPS efficiency alone is over 93% from 40 to 70% load. The total idle power consumption of **TA2022SMPS** Powered amplifier module is just below 8W. The idle power consumption of the SMPS alone is around 2W, another watt is consumed by the speaker protection circuit and the voltage regulators and preamplifier stage and the rest of ~ 4.5W is the idle power consumed by the TA2022 amplifier stage and auxiliary circuits. This is the lowest power consumption possible to achieve with TA2022 IC based amplifier and one of the lowest idle power consumption among any 50-200W per channel class D powered amplifiers available on the market. For comparisons, if the TA2022 IC based amplifier would be supplied from a linear power supply consisting of mains power transformer, Rectifier Bridge and capacitors, the idle power consumption would be at least 15-20W because the bulky mains transformers waste about 5-10% of their rated power as idle power loss. The maximum overall efficiency reached with a TA2022 IC based amplifier supplied from a linear power supply stage is around 72-77% far below the efficiency of the current Powered Amplifier module. Not to mention about heavy weight and poor mains voltage regulation.

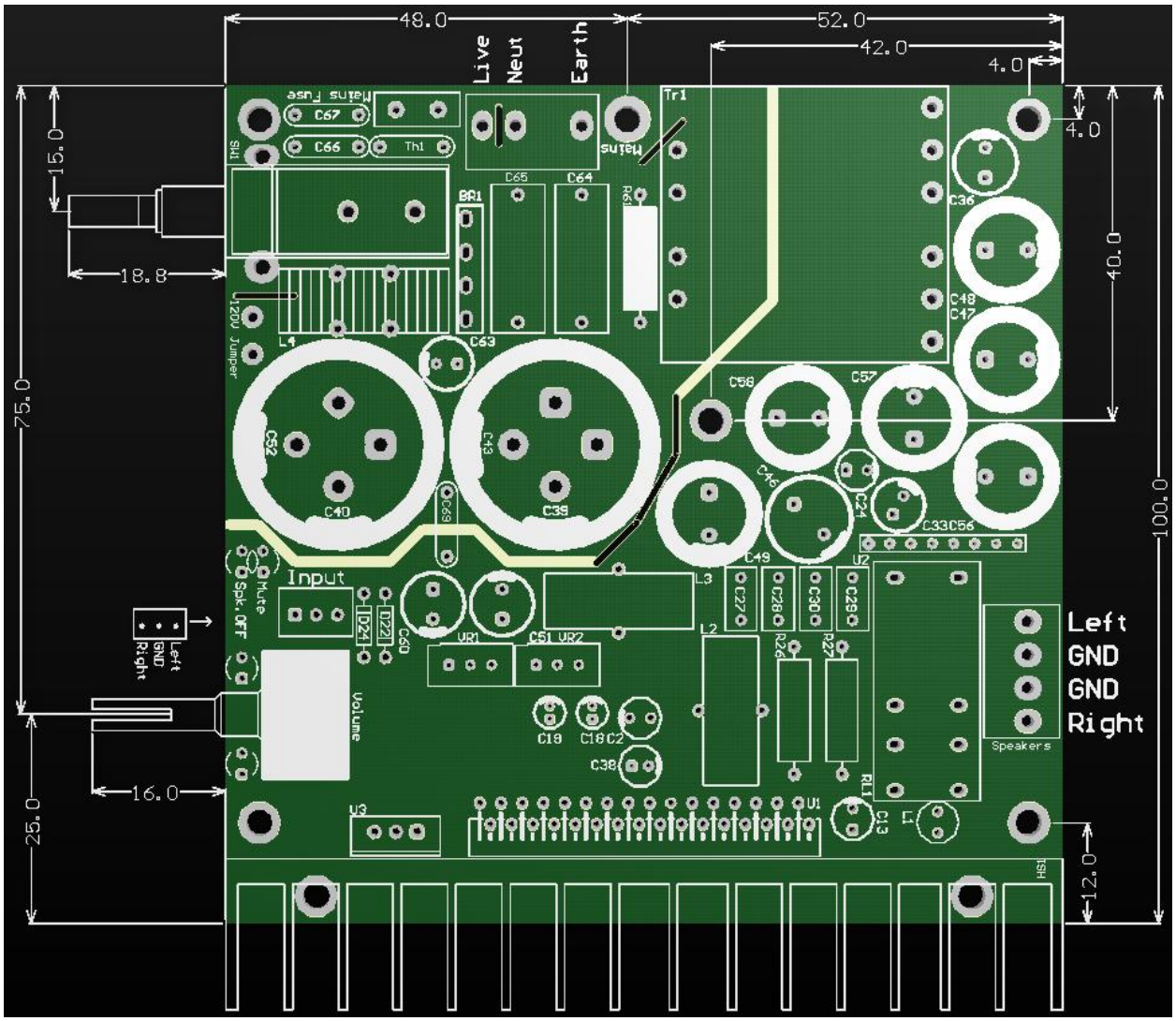
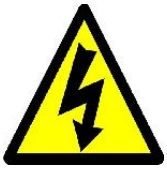


Figure 1: TA2022SMPS Audio Amplifier Module PCB Layout, mounting holes, potentiometer and switch position.



Warning:

Before you proceed with installation, make sure you have read this warning:

The TA2022SMPS is powered from the mains voltage and the primary side of the amplifier board where the SMPS section is located has hazardous voltages up to 340V DC and up to 500V AC. This voltage levels are present on the top and bottom of the board, and during installation and operation should never touch any part of the SMPS while it is connected to the mains and at least 5 minutes after complete disconnect from mains. The mains live connected area is indicated by an island perimeter drawn on the bottom of the board, where the clearance is at least 6mm to any adjacent components from the low voltage secondary side. If any adjustment or reconnection needs to be done, disconnect the unit from the mains and allow all capacitors to discharge for at least 5 minutes before handling it. Any ignorance of this warning will be made on user's responsibility, and can lead to serious injuries and possible death by electrocution if is handled improperly. This product has no serviceable parts. There is only one on-board type mains fuse which only serves as protection against further damage. In case of blown fuse, the TA2022SMPS Amplifier must be returned for service. Do not attempt to replace it or any other component because it can extend the damage.

A safety clearance of at least 6mm must be kept between the tallest component from the board and the case, or any conductive part of the amplifier. The heat transfer between the heatsink and ambient must not be obstructed for proper operation. Use proper wire gauge wires for interconnection, with intact isolation, and as thick and short as possible. Use different colors for different polarities, respecting the standards and never touch the wires by hand or tools. Ignoring this recommendation can cause power supply failure, injuries or fire !!!

TA2022SMPS Powered Audio Amplifier Module was efficiently and ergonomically designed to allow easiest integration in any kind of product, either DIY built or small batches OEM product. It contains all key components and stages needed to build a complete high performance, medium power amplifier. It only requires an aluminium case with enough space inside to fit the board properly while allowing at least 7mm space under the board and another 5-6 mm from the top of the tallest component to the top cover. On the right side where the heatsink is located, venting holes must be drilled both on top and bottom side of the enclosure. The total area of the venting holes must be at least 40 sq cm (6 sq inch). The holes must have minimum diameter of 3mm (1/8 inch) and maximum diameter of 6 mm (1/4 inch) for safety reasons. If possible, slotted holes 3mm wide and 10-15mm long aligned with heatsink fins and extend about 5-10mm more than the heatsink size on each of the 4 directions. To avoid damaging the amplifier by accidentally dropping any small foreign objects, a thin net with at least 1mm space between wires can be added on the inside part of the housing right on the venting holes area.

The amplifier must be installed in the enclosure using 6 M3 screws and 7mm tall spacers. All the 4 mounting holes located at the corners of the **TA2022SMPS** board must be installed as well as the top center mounting hole which allows connection from Mains Earth to chassis. This is very important and must not be neglected. Make sure the potentiometer and mains switch access holes were drilled in the front panel with enough clearance on each side to allow operation without being stuck or jammed on the panel. There are 4 Status LED's on the board two of them indicating presence of power, on the left and right side of the potentiometer axle. These LED's are intended to illuminate the backside of the potentiometer knob offering a spectacular effect especially with lower ambient light. The speaker and Mute LED's must be mounted on the front panel in pre-drilled holes.

If the **TA2022SMPS** Powered Amplifier Module will be operated in countries with 230V (208 to 240V) mains voltage, the 110V jumper must **NOT** be installed otherwise the power supply section can be damaged. Make sure about the mains voltage in your place when order the **TA2022SMPS** amplifier. The design of the board allows using two types power supply capacitors, 200V and 400V types. If the amplifier will be used in countries with 230V mains voltage only, 400V capacitors will be used. If the amplifier will be used in countries with 110V mains voltage, or countries with 110V and 230V mains voltage, 200V capacitors will be used. The boards which use 200V capacitors allow operation by default on 230V mains voltage and 110V mains voltage when the jumper is placed. To avoid mistakes, by default the mains voltage will be left for 230V. There are two reasons why not all the boards use 200V capacitors: the 400V capacitors have better volumetric efficiency, store more energy for a given size, and using the 400V capacitors will render the 110V jumper change useless, avoiding possible mistakes from inexperienced users or tempted to "over-clock" and burn the board.

Connecting the **TA2022SMPS** Powered Amplifier Module to the enclosure backside connectors is simple and straightforward. Use the provided Signal Input and Speaker matting Connectors with cable. The wires are long enough to allow connection within any decent size enclosure. Measure the distance from the connector to actual point of connection. Cut the wire ~2cm longer (make sure you measured the correct length, once the wire is cut there's no way to glue-it back) Add one 10-15mm long thermo-contracting tube on each wire, un-sleeve the wire, solder the wires properly to the backside panel connectors and check the integrity of the solder joint. Pull the thermo-contracting tube over the solder joint and use a hot air blower (not a metal welding torch) to shrink the tub around the connection. Make sure the connectors were all in place when this operation was done, further changing their position might not be so easy once the wires are soldered in place.

What is provided when purchasing the **TA2022SMPS** Powered Audio Amplifier board:

- The **TA2022SMPS** Powered Audio Amplifier same as can be seen on the picture from the first page
- Signal Input connector header with 4 ~20cm long wires
- Speaker output Connector header with 4 ~25cm long wires
- Mains Power Connector header with 3 ~25cm long wires.
- On-board heatsink

Notes:

- All the above mentioned cables and heatsink are provided with the latest board version only.
- This manual refers was updated when the latest board version was released and refers to latest version.
- To be environmental friendly and save paper, this Manual is available only in electronic format and can be downloaded from the following address: http://www.connexelectronic.com/documents/TA2022SMPS.pdf

The current manual refers to latest version, 1.3 released in September 2013. Previous versions are slightly different from the performance point of view and use similar or identical pinout for mains, Signal Input and speaker output. To avoid confusions, we only post the information referring to latest available boards. For details regarding older versions, contact us.

Disclaimer:

The **TA2022SMPS** Audio Amplifier Module shall be used according with the instructions provided in this document. The user should NOT attempt to modify or change any of the parameters of this product, which can lead to malfunction. The designer and manufacturer of the product, **Connexelectronic**, and the official distributor, **Connexelectronic**, will not be liable for any kind of loss or damage, including but not limited to incidental or consequential damages. Due to the high voltage levels found on this board, the user should take all the caution measures needed when working with medium voltage levels, should not touch any unisolated part of the board or connectors, or short-circuit any part of the board or connectors. Any misusage will be made on user responsibility.

The designer and manufacturer **Connexelectronic** reserve the right to make changes or modifications on both the product functions and performances without notice. The **TA2022SMPS** Audio Amplifier Module schematic and PCB design is **Connexelectronic** proprietary and shall not be distributed, copied or published without the **Connexelectronic** written agreement. **Connexelectronic** and **Connexelectronic** reserve the right to offer limited support for discontinued boards purchased directly from **Connexelectronic**, and no support at all for the similar boards which aren't purchased directly from **Connexelectronic** or authorized resellers, and from various reasons they look or pretend to be similar, exactly same, or improved version products. Purchasing the product means that you are aware and agree with all this conditions.

Distribution network:

We are continuously striving to offer the best product quality and availability for our products and part of our policy, however, since the shipping and delivery time becomes more and more a burden, we have decided to provide our products through our distributor networks as well. The current distributors are shown below, and the list will be updated.

- **Audiophonics**, France, and near European Countries: http://www.audiophonics.fr
- **Enigma**, UK, and near European Countries: http://www.enigma-shop.com
- **Hifimediy** China, worldwide reseller: www.hifimediy.com
- Medianet, Germany, Austria and near European Countries: http://www.medianet-shop.de