SMPS300R single and dual output

The SMPS300R Switched Mode Power Supply (SMPS) is specially designed to be used for Audio Amplifiers, both Linear Amplifiers such as class AB Amplifiers or Switched Amplifiers such as Class D or Class T which are rated for an output power up to 300W and have a crest factor of at least 3:1. SMPS300R use state of the art, very efficient LLC Series Resonant Converter Topology. Due to the soft-switched topology used, the SMPS300R has very low EMI noise, lower losses and is more compact than a similar power rating classic hard-switched SMPS. Eight output voltage ranges are available for stock SMPS300R, plus any other custom output voltage, in range of 12V to 180V. The output voltage is regulated, and adjustable within +-5 to 10% limits, making the SMPS300R suitable to be used with most of the Audio Amplifiers from the market, not just with the Connexelectronic ones.

SMPS300R Features:

- LLC Series Resonant Converter Topology for high efficiency, up to 94% and lowest EMI.
- 230V AC and 120V AC models available.
- 300W Continuous Output Power with cooling, 380W Peak Output Power, 420W Short-Time Peak Power.
- Eight output voltages versions available from stock: SMPS300R differential output: ±24V ±30V ±36V ±45V and SMPS300R single Output: 24V 30V 36V 48V all adjustable within ±5 to 10%.
- Differential Auxiliary Voltage available, with voltage choice in range of ±10V to ±20V at max. 500mA.
- Complete protection set, Under-voltage, Over-voltage, Over-current, and Over-temperature Protection.
- Burst-Mode operation at low load or no-load for high efficiency.
- No heatsinks are used for power devices, due to high efficiency.
- Compact size, 100x100x36mm, lightweight, less than 300 grams.

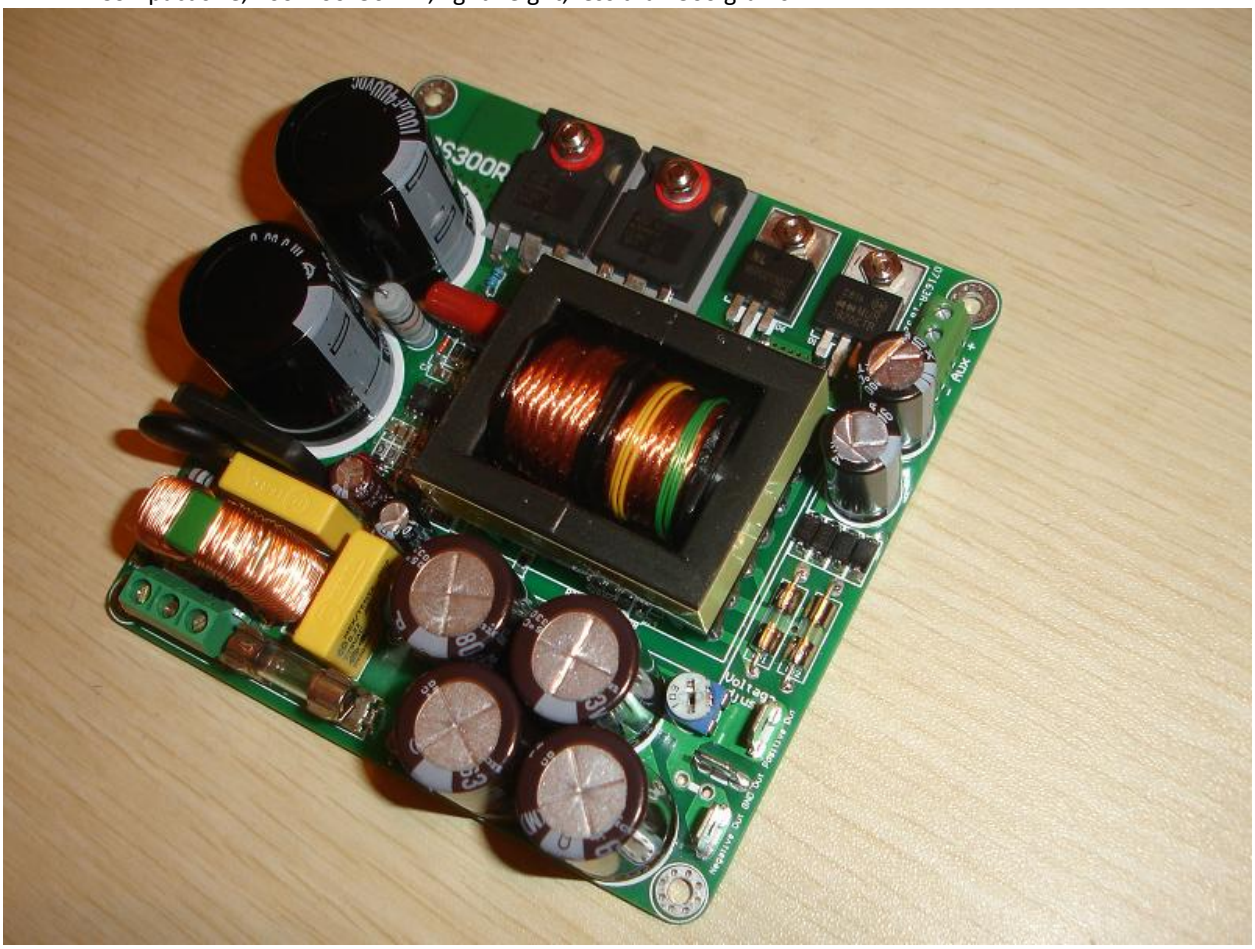

Fig.1 SMPS300R picture

SMPS300R Description: The current for the audio amplifiers producers, both in HI-FI or Pro-Audio field, is to use a hard-switching unregulated SMPS or at most a Quasi-Resonant unregulated SMPS. The main reason behind this is the cost, which is much lower for such power supplies than for a regulated one; another reason is for easier synchronization of the power supply switching frequency with the half of the amplifier switching frequency to avoid beating. In some cases, is either not possible, or unnecessary. For example the Class T Audio Amplifiers, where the amplifier run at variable switching frequency, which depends on the input signal (spread spectrum modulation) and have value in range of 500 KHz to 1.5 MHz, for each channel independently, The LLC Series Resonant Converter also run at variable frequency, depending on the load value, typically in range of 110KHz to 250KHz. Being soft commutated, the SMPS intermodulation noise which might occur has very low value, below the S/N ration threshold, thus inaudible. The third reason for using unregulated SMPS for those amplifiers is that most of the class AB amplifies have high power supply rejection ratio which allows using an unregulated power supply without degrading their performances. But for the class D and class T amplifiers, this might be not enough, especially if Audiophile Sound Quality is required. Unlike many other amplifiers which are using SMPS, this Power Supply has regulated output voltage, providing a constant output voltage, from zero load to full load which translates in cleaner sound, without peaks and drops, without hard clipping and distortions and true, real deep bass, transparent and clean medium and high frequencies.

The topology used for the SMPS300R is Series Resonant Converter or LLC Converter. It was chosen due to its many advantages compared with all other topologies. Among the advantages, we consider that the most important are superior efficiency, up to 94% lower EMI and noise, compact size and reasonable complexity. The operation principle of this converter was described in many papers, application notes, and reference designs. Although is not a relatively new technology, being discovered more than 15 years ago, until recently, the lack of knowledge, documentation and availability of good characteristic electronic components such as high-speed MOS-FET's or IGBT's prohibited this topology to spread like other hard switched topologies. Only after the LCD and Plasma TV's came-up and initiatives to increase efficiency of the consumer products such as 80+, 90+ were imposed, engineers had to look towards other solution than the current, mature hard-switched topologies, which can't break the 90% efficiency barrier without significant cost increase and size. For an LLC resonant converter, efficiencies greater than 92% are common and even 95-96% can be achieved if the DC-DC converter is supplied from the output of an PFC pre-regulator capable to supply a constant 400V DC. In our case, the PFC stage is not required, due to the purpose of the application and because similar efficiencies can be achieved without using a complicated PFC circuitry which would increase the size of the SMPS board, EMI, and decrease the performance due to the fact that the available space is limited and the PFC inductor might interfere with other circuits operation.

An important aspect which must be considered when the SMPS300R is powered ON, the initial current drawn from the mains is few times higher than the average operating current. The reason for this is that the filter capacitors are completely discharged, and act as a short circuit for a brief period. The current is higher as the capacitors capacity and voltage is higher, and is proportional with the capacitor stored energy ($CU^2/2$). To prevent harmful effects which this high value inrush current might have to the Power Supply components, a thermistor was used to limit the inrush current to a lower value than the mains fuse will trip or might damage any components from the Amplifier Power Supply. This thermistor is a passive component which has the property to decrease its resistance when the temperature increases. It has higher electrical resistance at low temperature, thus reducing the inrush current, and when the current which passes through, will heat-up the thermistor, the resistance will decrease, and the dissipated power will be reduces. One drawback might be the increased operating temperature, especially when the SMPS300R delivers high output power. The thermistor is placed on the edge of the board close to the Mains input connector, this avoiding heating-up other temperature sensitive components. Note that there is no need to use any other external power soft-start circuit when the SMPS300R is powered from standard mains supply voltage of 110 or 220V AC.

The SMPS300R features a soft-start characteristic, which allows progressive charge of the output filter capacitors, with a controlled charging current, without tripping over-current protection. The value and the working voltage of the output capacitors depend on the type of the SMPS, single or dual voltage, and the value of the output voltage. These capacitors have enough capacitance for most stringent applications, adding extra capacitors are not necessary or recommended, because if the capacitance is too high, the over-current protection might trip during power ON. Although the soft-switching characteristic allows the SMPS300R to run cooler than similar power hard-switched SMPS's, over-temperature protection was added. This consists of a circuit which monitors the temperature of the primary MOS-FET's and disables the power supply when the operating temperature reach 90˚C.

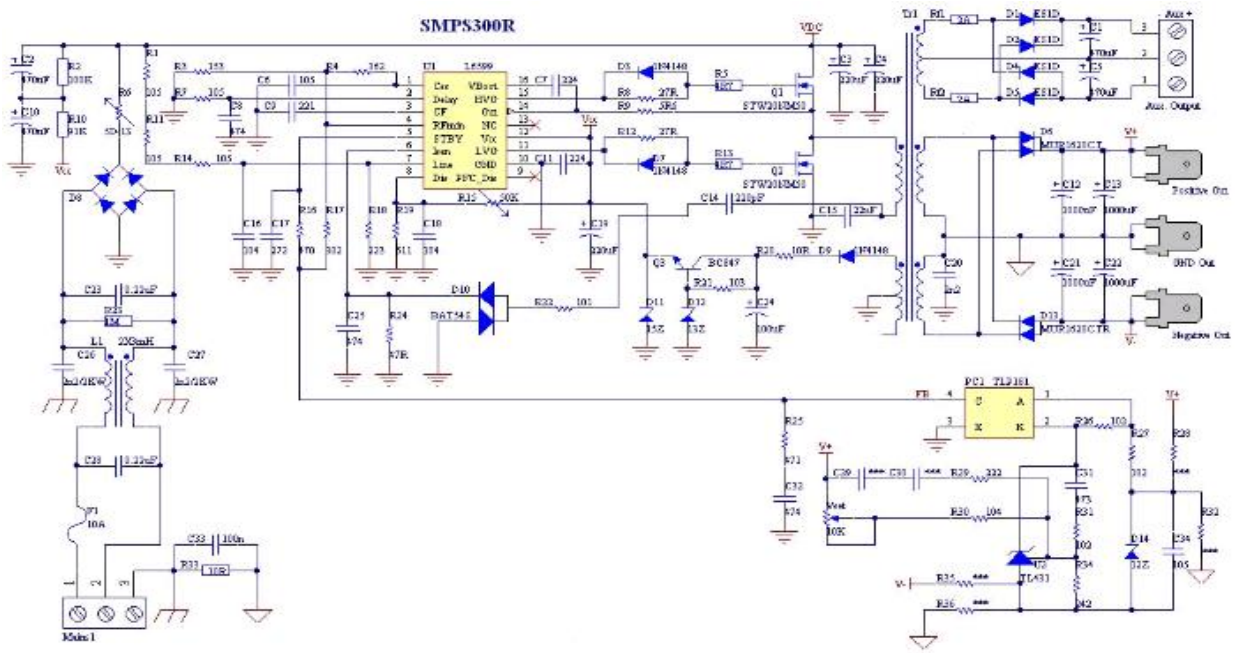

Fig.2 SMPS300R schematic

Warning:

Before you proceed with installation, make sure you have read this warning SMPS300R:

The SMPS300R is powered from the mains voltage and the primary side of the SMPS 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. 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 other than the on-board mains fuse. In case of blown fuse, only replace the fuse with the same type and rating. Do not attempt to change any other component from the SMPS300R. A safety clearance of at least 6mm must be kept between the board and the case, or any conductive part of the amplifier. The heat transfer between the board and ambient must not be obstructed for proper operation.

SMPS300R characteristics:

Model: Parameters:	SMPS300R±24V	SMPS300R±30V	SMPS300R±36V	SMPS300R±45V	SMPS300R 24V	SMPS300R 30V	SMPS300R 36V	SMPS300R 48V
Main Output Voltage:	Minimum:±22V Maximum:±27V	Minimum:±27V Maximum:±33V	Minimum:±33V Maximum:±39V	Minimum:±42V Maximum:±48V	Minimum: 22V Maximum: 27V	Minimum:27V Maximum:33V	Minimum:33V Maximum:39V	Minimum:68V Maximum:76V
Aux. Output Voltage:	Minimum:±10.5 Maximum:±13V	Minimum:±11V Maximum:±14V	Minimum:±11V Maximum:±14V	Minimum:±10.5 Maximum:±13V	Minimum:±10.5 Maximum:±13V	Minimum:±11V Maximum:±13V	Minimum:±10.5 Maximum:±13V	Minimum:±10.5 Maximum:±13V
Mains input voltage:	110V: 100-127V 230V: 200-250V	110V: 100-127V 230V: 200-250V	110V: 100-127V 230V: 200-250V	110V: 100-127V 230V: 200-250V	110V: 100-127V 230V: 200-250V	110V: 100-127V 230V: 200-250V	110V: 100-127V 230V: 200-250V	110V: 100-127V 230V: 200-250V
Main Output Current:	Nominal: 6A Peak: 7.2A	Nominal: 5A Peak: 6.2A	Nominal: 4A Peak: 5.2A	Nominal: 3.3A Peak: 4A	Nominal: 12A Peak: 14A	Nominal: 10A Peak: 12A	Nominal: 8A Peak: 10.5A	Nominal: 6A Peak: 7.2A
Aux. Output Current:	Nominal: 0.25 A Peak: 0. 5A	Nominal: 0.25 A Peak: 0. 5A	Nominal: 0.25 A Peak: 0. 5A	Nominal: 0.25 A Peak: 0. 5A	Nominal: 0.25 A Peak: 0. 5A	Nominal: 0.25 A Peak: 0. 5A	Nominal: 0.25 A Peak: 0. 5A	Nominal: 0.25 A Peak: 0. 5A
No-Load power cons.	Min: 1.4W Max: 2.2W	Min: 1.4W Max: 2.3W	Min: 1.6W Max: 2.4W	Min: 1.4W Max: 2.3W	Min: 1.1W Max: 1.7W	Min: 1.2W Max: 1.9W	Min: 1.6W Max: 2.4W	Min: 1.3W Max: 2.1W
Efficiency at 50% load	110V: 89.4 % 230V: 90.7%	110V: 90.1 % 230V: 91.4%	110V: 90.7 % 230V: 92.0%	110V: 92.2 % 230V: 93.7%	110V: 90.3 % 230V: 90.9%	110V: 90.5 % 230V: 91.2%	110V: 91.1 % 230V: 92.3%	110V: 92.7 % 230V: 94.1%
Max. Output Ripple mV	23mV – 1A 67mV – 5A	26mV – 1A 71mV – 5A	31mV – 1A 86mV – 4A	40mV – 1A 97mV – 3A	19mV – 1A 59mV – 10A	23mV – 1A 68mV – 8A	26mV – 1A 77mV – 7A	35mV – 1A 89mV – 5A

Two types of power supplies are configured using the same PCB Layout, single main output voltage or dual output voltage, by choosing the proper set of components for each type. This setup is done during manufacturing and cannot be easily changed by user, causing loss of warranty if modifications are done without approval. Make sure you chose the proper version while placing the order! For other applications than audio, where the power supply must deliver more than 100W for long term, the SMPS300R must be fitted with a heatsink or active cooling should be used. The SMPS300R Auxiliary output can be used to supply power for other stages of the amplifier, such as preamplifier, speaker protection, cross-over, etc. the SMPS300R dual output version provide a differential auxiliary output voltage in range of ±10 to ±14V, depending on the main output voltage. The auxiliary output voltage depends on the number of turns of the auxiliary winding, which is a fraction of the number of turns of the main output winding. The auxiliary output voltage is not regulated, but the value is kept tight within 10% limits due to the good magnetic coupling with the main output winding. For noise sensitive applications further regulation is recommended. The GND of the auxiliary output is isolated from the main output GND.

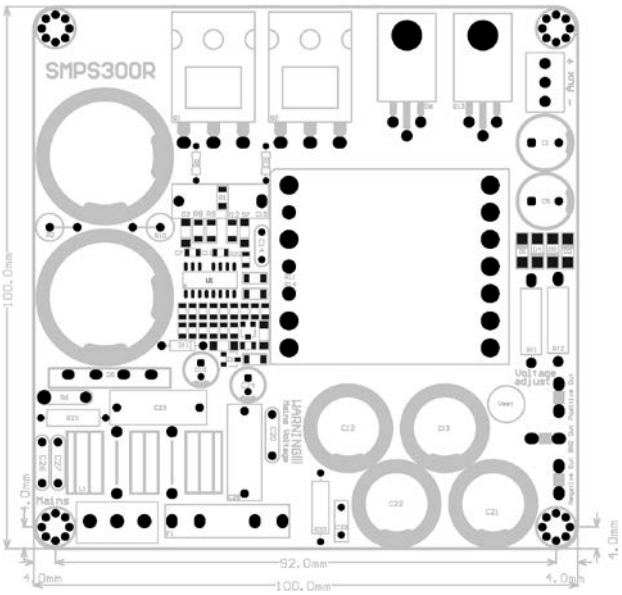

Fig.3 SMPS300R board layout and size

The SMPS300R size is 100x100mm and 36mm tall with the default capacitors. It has 4 mounting holes at the corners of the board, 4mm distance from each edge. The mains voltage must be supplied to the board on the 3 pin terminal block connector from the lower left side. The signification of the pins is as follows:

- Pin1: Protective Earth connection
- Pin2: Neutral Mains connection
- Pin3: Live Mains connection

For safe and reliable operation, the SMPS300R board must be earthed. If noise or hum is experienced due to the incorrect GND connection, the GND loop breaker circuit made of R33 and C33 (can be seen in the right side of the mains fuse) should be connected using the dedicated solder pads on the bottom of the PCB.

The output voltage wires should be connected using isolated faston clips, on the faston blade terminals placed on the lower bottom of the PCB. Make sure there is enough clearance between faston clips while operates.

Note that for single voltage version, the Positive and Negative output are connected together to increase the output current capability, and either Positive or Negative Output will be used as Positive only Output, GND Output being the same for both cases.

Disclaimer:

The **SMPS300R** 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, **PCBstuff**, 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 mains voltages of this board, the user should take all the caution measures needed when working with mains voltages, 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. Purchasing the product means that you are aware and agree with all terms and conditions.

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- **Hifimediy** China, worldwide reseller: www.hifimediy.com
- **Audiophonics** France, Europe and worldwide reseller: www.audiophonics.fr