SMPS300RS

SMPS300RS is a single Main Output plus differential aux. voltage dedicated SMPS for Class D or T Switched Audio Amplifiers, which are rated for an output power up to 300W and have a crest factor of at least 3. The SMPS300RS use state of the art, highly efficient LLC Series Resonant Converter Topology. Due to the soft-switched topology used, the SMPS300RS has very low EMI noise, lower losses and is more compact than a similar power rating classic hard-switched SMPS. Several output voltage are available in range of 24V to 48V plus custom output voltages. The output voltage is regulated, and adjustable within approx 10% limit, making the SMPS300RS suitable to be used with most of the Audio Amplifiers from the market, not just with the Connexelectronic ones.

SMPS300RS Features:

- LLC Series Resonant Converter Topology for high efficiency, up to 94% and lowest EMI.
- 230V AC and 120V AC models available.
- 300W Output Power with crest factor at least 3. 330W Peak Output Power 350W Short-Time Peak Power.
- Several output voltages versions available: 24V 30V 36V 48V, and custom voltages up to 160V.
- Differential Auxiliary Voltage available, typical aux. voltage value is around ±18V (±15 to ±20V) at 250mA.
- Complete protection set, Under-voltage, Over-voltage, Over-current, and Over-temperature Protection.
- No heatsinks are used for the power devices, except for the 24V version output rectifier diodes.
- Compact size, 100x100mm, typically 27mm to 36mm tall, depending on the capacitors choice.

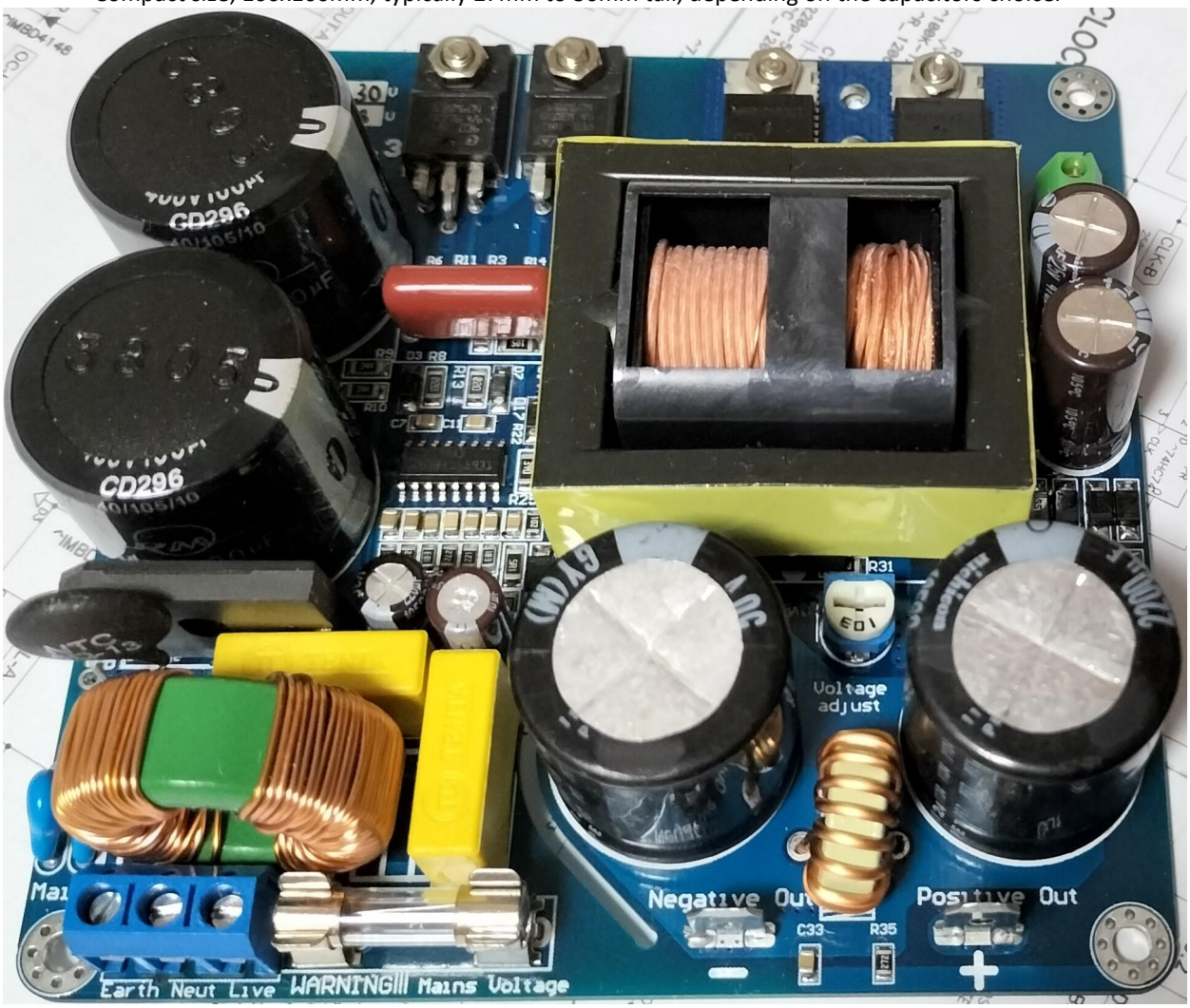


Fig.1 SMPS300RS picture

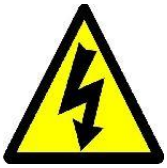
SMPS300RS Description:

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. Since the Audio-amplifiers SMPSs are not yet widely accepted, mainly from subjective reasons such as “sound quality degradation” which was a direct effect of the early poorly designed SMPSs, and the lower cost of classic, old type transformers when purchased in mass-production quantities beats the cost of developing and producing a good performance SMPS for audio applications, many companies which produce audio equipment, both for consumer and pro-audio are still using old type mains transformers and some, still use the old, hard-switched type SMPS mainly because most of the SMPS designers came from consumer products field where product cost stays ahead performance. 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 100KHz to 200KHz. Being soft commutated, the SMPS inter-modulation 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 SMPS300RS 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 30 years ago, until recently, the lack of knowledge, documentation and availability of good characteristic electronic components such as high-speed MOSFETs or SiC devices 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 SMPS300RS 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 SMPS300RS 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 SMPS300RS is powered from standard mains supply voltage of 110 or 220V AC.

The SMPS300RS 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 SMPS300RS to run cooler than similar power hard-switched SMPSs, over-temperature protection was added. This consists of a circuit which monitors the temperature of the primary MOSFETs and disables the power supply when the operating temperature reach 90˚C.



Warning:

Before you proceed with installation, make sure you have read this warning SMPS300RS: The SMPS300RS is powered from the mains voltage and the primary side of the SMPS has hazardous voltages up to 360V DC and up to 250V 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 SMPS300RS. 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.

SMPS300RS characteristics:

Model: Parameters:	SMPS300RS**24V**	SMPS300RS**30V**	SMPS300RS**36V**	SMPS300RS**48V**	SMPS300RS custom
Main Output Voltage:	Minimum:22V Maximum:26V	Minimum:28V Maximum:32V	Minimum:34V Maximum:38V	Minimum:46V Maximum:50V	Minimum:20V Maximum:160V
Aux. Output Voltage:	Minimum:±16V Maximum:±19V Typical:±18V	Minimum:±16V Maximum:±19V Typical:±18V	Minimum:±16V Maximum:±19V Typical:±18V	Minimum:±16V Maximum:±19V Typical:±18V	Minimum:±6V Maximum:±25V Typical:custom
Mains input voltage:	120V: 100-127V 230V: 208-246V	120V: 100-127V 230V: 208-246V	120V: 100-127V 230V: 208-246V	120V: 100-127V 230V: 208-246V	120V: 100-127V 230V: 208-246V
Main Output Current:	Nominal: 12A Peak: 14A	Nominal: 10A Peak: 12A	Nominal: 8A Peak: 9.5A	Nominal: 6.5A Peak: 7.2A	Max: 12A Peak: 15A
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
Zero-Load power cons.	Min: 1.4W Max: 1.7W	Min: 1.4W Max: 1.7W	Min: 1.6W Max: 1.8W	Min: 1.4W Max: 1.9W	Min: 1.3W Max: 2.8W
Efficiency at 50% load	120V: 89.4 % 230V: 90.7%	120V: 90.1 % 230V: 91.4%	120V: 90.7 % 230V: 92.0%	120V: 91.4 % 230V: 92.1%	120V: 92.7 % 230V: 94%
Max. Output Ripple mV	23mV – 1A 67mV – 5A	26mV – 1A 71mV – 5A	31mV – 1A 86mV – 4A	40mV – 1A 97mV – 3A	TBD

The PCB Layout is optimized for best performance in the lowest footprint and 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 100-120W for long term, consider using the SMPS300RSh which is the rugged version of the SMPS300RS fitted with a heatsink as a baseplate underneath the PCB to transfer the heat to a larger heatsink or the amplifier metallic enclosure. The SMPS300RS Auxiliary output can be used to supply power for other stages of the amplifier, such as preamplifier, speaker protection, cross-over, etc. the SMPS300RS dual output version provide a differential auxiliary output voltage of around ±18V (±15 to ±20V) at 250mA. The auxiliary output voltage varies with the main output value as it 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.

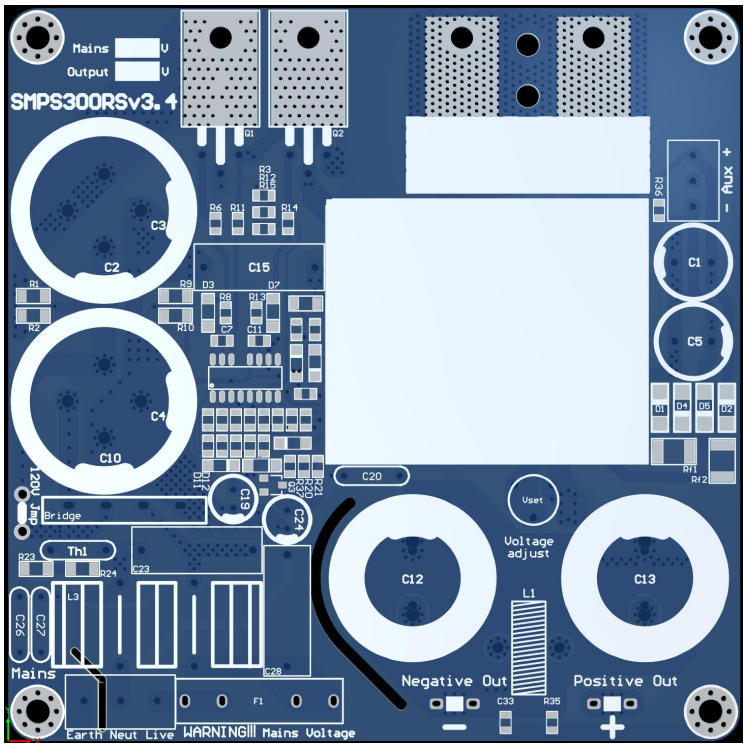


Fig. 2 SMPS300RS board layout and size

The SMPS300RS size is 100x100mm and 27 to 36mm tall depending on the capacitors choice. 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 SMPS300RS board must be earthed.

SMPS300RS uses a GND loop breaker circuit made of C34 and R45 visible on the bottom right side between two of the output capacitors. These two components connect the Output GND and mains Earth.

The output voltage wires should be connected using isolated fast-on clips, on the fast-on blade terminals. Make sure there is enough clearance between fast-on clips while operates.

Disclaimer:

The SMPS800RE 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**, will not be liable for any kind of loss or damage, including but not limited to incidental or consequential damages. Due to the high level of voltages on this board, the user should take all the caution measures needed when working with high voltage levels, should not touch any unisolated part of the board or connectors, or short-circuit any part of the board or connectors. Any misuse 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 prior notice. **Connexelectronic** can offer limited support for the boards purchased directly from **Connexelectronic**, and no support at all for the similar boards which aren't purchased directly from and **Connexelectronic**, or listed resellers, and from various reasons they look or pretend to be similar or exactly the same products.

Purchasing the product means that you are aware and agree with all this conditions.