

SMPS800RE

The SMPS800RE Switched Mode Power Supply (SMPS) delivers a differential output voltage in range of $\pm 32V$ to $\pm 90V$ and two separate regulated auxiliary voltages. It is designed to be used with class AB, H, D or T Audio Amplifiers making the SMPS800RS suitable to be used with most of the Audio Amplifiers from the market both from our product portfolio and other suppliers which can fit the specifications. The SMPS800RE use state of the art, High efficiency LLC Series Resonant Converter Topology. The SMPS800RE output voltage is tightly regulated and adjustable, it has very low EMI noise, lower losses and is more compact than a similar power rating classic hard-switched SMPS. Most commonly used Output voltages versions of the SMPS800RE are: $\pm 40V$, $\pm 50V$, $\pm 60V$ and $\pm 72V$, Other voltage versions can be configured on request, in range of $\pm 32V$ to $\pm 90V$.

SMPS800RE Features:

- LLC Series Resonant Converter Topology for high efficiency, up to 95.2% and lowest EMI.
- 230V AC (208-246V) and 120V (98-127V) AC compatible.
- 800W Output Power, 860W Peak Output Power, 940W Short-Time Peak Power with >2.5 Crest factor.
- Most commonly used Output voltages versions of the SMPS800RE are: $\pm 40V$, $\pm 50V$, $\pm 60V$ and $\pm 72V$.
- Two independent regulated Auxiliary Voltages: $2 \times 12V$ or $2 \times 15V$ at 200-500mA. (min $2 \times 5V$ and max $2 \times 24V$)
- 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 with under 2W consumption at no load.
- On-board Soft Start for very smooth turn ON without current peaks or breaker tripping.
- Compact size, 100x150x38mm, can fit inside a 1RU case, lightweight, ~ 560 grams.
- Optional On-board variable speed fan controller and cooling fan, over-temperature shut-down.
- Optional IEC type Connector for Mains Input voltage, LED light for power ON.



Fig.1 SMPS800RE picture

SMPS800RE Description: Most of the current audio amplifiers manufacturers are still using the bulky mains transformers, Rectifier Bridges and large capacitors because it saves R&D and manufacturing costs for some “innovative” companies which fill the market corroborated with the lack of trust of most of the customers in this well established technology called SMPS. The market is very slow to adapt to new technology and the old solution is still heavily promoted. Although we are using in our homes at least a few dozens of SMPS without even noticing them. Almost all the electronic appliances are using SMPS nowadays. Imagine a flat screen LCD or LED TV without SMPS. However, if a SMPS is being used in a commercial audio amplifier or even PA amplifier, is likely to be a hard-switched unregulated SMPS or at most a Quasi-Resonant unregulated SMPS to save production cost and development cost which is higher for a regulated SMPS. While most of the class AB or H amplifiers have high power supply rejection ratio they can tolerate an unregulated power supply without degrading their performances, but with the spread of the class D amplifiers, which require tighter regulated voltages, this might be not enough, especially if Audiophile Sound Quality is required. For this reason, the output voltage of the SMPS800RE is regulated, providing a precise constant output voltage, independent of mains or load conditions 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 without the need to add any extra large electrolytic capacitors.

The SMPS800RE features a **soft-start** characteristic, which slowly charge of the output filter capacitors, with a controlled charging current, without tripping over-current protection. The capacitors are optimized for most stringent applications, and adding extra capacitors is **not** necessary and **not** recommended, a higher capacitance might trip the over-current protection during power **ON** and will also affect the transient response and output voltage regulation performance. Do not add any extra-capacitance in excess of 50% of the existing capacitance.

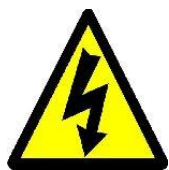
The topology used for the SMPS800RE is Series Resonant Converter or LLC Converter. It was chosen due to its many advantages compared with other topologies: superior efficiency, up to 95.2% lower EMI and noise, compact size and reasonable complexity. Although is not a very new technology, until recently, the lack of knowledge, documentation and availability of good characteristic electronic components such as high-speed Silicon MOS-FETs or SiC MOS-FETs prohibited this topology to spread like other hard switched topologies. Only after the LCD, Plasma, LED TV's and more recently Electric Vehicles with their high-power high-density and high-efficiency chargers 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 95-97% 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, the power range into which the SMPS800RE fits does not require PFC. In addition, all the home-users are not billed for reactive power. For any other application where PFC is required, the user should consider the SMPS800RE-PFC version which is also available as of Q2 2024.

When the SMPS800RE is powered ON, the initial current drawn from the mains is few times higher than the average operating current. Because the mains side electrolytic 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. To prevent harmful effects which this high value inrush current might have to the Power Supply components, an NTC thermistor was used to limit the inrush current to avoid the mains fuse trip or any damage to components from the Power Supply or even the Amplifier. The thermistor has higher electrical resistance at high temperature, reducing the inrush current. When the current which passes through, will heat-up the thermistor, the resistance will decrease, and the dissipated power will be reduced. As soon as the SMPS800RE starts and work normally, with a load of at least 2-3W a relay closes and shunt the thermistor to reduce the power dissipation and temperature increase even more. Due to use of on-board soft-start, there is no need to use any other external power soft-start circuit when the SMPS800RE is powered from standard mains supply voltage of 110 or 220V AC.

If the SMPS800RE is used at its rated output power levels as for most of audio amplifiers application, natural convection cooling is used. If the SMPS800RE is installed into a sealed enclosure where the ambient temperature might rise above 50°C, or for applications, where the long term average power is higher, a variable speed fan and over-temperature protection circuit can be chosen optionally. This monitors the temperature of the components and start the fan when reaches ~50°C and increase the speed till about 80°C when the maximum speed is reached, and disables the power supply when the operating temperature reaches 90°C requiring shut-down and wait 2-3 min for the temperature to drop to a safe value before the power supply can be restarted.

The SMPS800RE has and on-board Mains IEC connector, which allows safe and easy integration into the amplifier housing. An ON/OFF switch must be added using the connector called **Switch** on the bottom left side of the board, right next to the EMI filter. A 10A 250V AC rated switch must be used in order to connect or disconnect the mains voltage from the SMPS800RE. When the SMPS800RE will be switched ON, the power supply will start with a delay of about one second due to the soft-start start-up circuit, and then the ON LED placed on the secondary side, near the output voltage connector will lit. When the power supply is working in burst mode due to low load, or no-load, the LED light will flash as well as the mains soft start relay might turn Off to save power, especially when minimum voltage was set at no load or low load. The output load must be connected to the Output Fast-on Connectors, placed on the upper right side. Proper wire gauge should be used, and NEVER use thin wires, or with damaged isolation as this can lead to safety hazards including fire and electrocution.

The **auxiliary output voltage** output is available on the smaller terminal block connector, placed at the bottom right of the board. For reliable operation, never short-circuit the outputs, and never connect them to other power supply outputs, except the Aux. GND which can be referenced to any other polarity main output. Use this feature with extreme care, if the Aux. GND is referenced to negative main output or positive main output and a short-circuit between any auxiliary output and positive or negative main output will damage the power supply !!!



Warning:

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

SMPS800RE: The SMPS800RE is powered from the mains voltage and the primary side of the SMPS has hazardous voltages up to 340V DC and up to 300V 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 re-connection 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 SMPS800RE. 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 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 !!!

SMPS800RE characteristics:

Model: Parameters:	SMPS800RE $\pm 40V$	SMPS800RE $\pm 50V$	SMPS800RE $\pm 60V$	SMPS800RE $\pm 72V$	SMPS800RE custom voltage
Main Output Voltage ¹ :	Minimum: $\pm 37.6V$ Maximum: $\pm 42.8V$	Minimum: $\pm 47.2V$ Maximum: $\pm 53.1V$	Minimum: $\pm 57.4V$ Maximum: $\pm 62.6V$	Minimum: $\pm 68.2V$ Maximum: $\pm 74.7V$	Min: $\pm 32V$ Max: $\pm 90V$
Aux. Output Voltage ² :	Chose between 2x5V 2x12V 2x15V	Chose between 2x5V 2x12V 2x15V	Chose between 2x5V 2x12V 2x15V	Chose between 2x5V 2x12V 2x15V	Chose between 2x5V 2x12V 2x15V or any combination of two
Mains input voltage ³ :	120V: 98-127V 230V: 208-246V	120V: 98-127V 230V: 208-246V	120V: 98-127V 230V: 208-246V	120V: 98-127V 230V: 208-246V	120V: 98-127V 230V: 208-246V
Main Output Current ⁴ :	Nominal: 12.5A Peak: 18A	Nominal: 10A Peak: 14.5A	Nominal: 8A Peak: 15A	Nominal: 6.5A Peak: 13A	Nominal: -- Version Dependent Peak: -- Version Dependent
Aux. Output Current ⁵ :	Nominal: 0.2-0.5 A Peak: 0.75A	Nominal: 0.2-0.5 A Peak: 0.75A	Nominal: 0.2-0.5 A Peak: 0.75A	Nominal: 0.2-0.5 A Peak: 0.75A	Nominal: 0.2-0.5 A Peak: 0.75A
No-Load power cons ⁶ :	Min: 1.2W Max: 1.9W	Min: 1.4W Max: 2.3W	Min: 1.6W Max: 2.4W	Min: 1.4W Max: 2.3W	Min: 1.2W Max: 1.9W
Efficiency at 50% load	110V: 92.3 % 230V: 92.9%	110V: 92.8 % 230V: 93.7%	110V: 93.3 % 230V: 94.5%	110V: 93.6 % 230V: 94.9%	110V: -- Version Dependent 230V: -- Version Dependent

- Notes:
1. The min. and max. voltages are relative and the values are ± 0.5 to 1V of those listed.
 2. Default values, for any combination of two chose "custom voltage" option when order.
 3. Voltages below the min values might affect the output voltage regulation at full load.
Voltages 20% more above maximum values might cause damage.
 4. Peak current during power ON sequence, useful when sizing the wiring and mains fuses.
 5. Output current available is output voltage dependent and with main output loaded with at least 0.3A
 6. Measured values at 110V/230V mains, no load with output voltage set to default 36V, 48V, 60V or 72V.

Avoid creating GND loops. The GND loop occurs when there is more than one ground path between two items of equipment. One path can be the screen of an audio cable connecting the two pieces of equipment and the other path is via their chassis safety earths in the mains plugs. Inside the equipment, the audio screen earth is often linked directly to the chassis earth, hence the possibility of a loop. If the two bits of equipment are plugged into the same mains socket, their chassis safety earths are effectively tied together at the same potential, and so there is unlikely to be any circulating ground current, despite the apparent ground loop. Never connect the Mains Earth to the amplifier GND directly. The Main Output GND is connected to mains Earth net through a 2.7K resistor in parallel with a 100nF capacitor for HF noise decoupling. All the mounting pads of the SMPS800RE must be connected together through a conductive surface such as the metallic enclosure mounting screws to allow continuity between Mains Earth and the rest of the pads.

If the SMPS800RE is installed into an isolated enclosure which doesn't allow continuity between all the mounting pads, it has provision for an Earth loop connection, on the upper right side of Figure 2 there is a small Pad where a Earth Jumping wire to the Mains IEC Connector Earth near the bottom left Pad can be installed.

The SMPS800RE board size is 100x150mm, and the height is about 38mm from the bottom of the PCB to the tallest component, the power transformer. Under the PCB, stand-offs must be used to keep proper clearance for safety reasons. With 5mm tall stand-offs, the SMPS800RE PCB can reach a total height of 42mm, which makes it suitable to be installed into a 1RU case. An insulated sheet should be installed under the PCB and the PCB should be mounted at the back side of the case, allowing the IEC connector to be accessible through a special cut window. The mains ON/OFF switch should be proper voltage and current rated, installed on the front panel and the power supply must be turned OFF whenever is not used, and should NEVER be left working without surveillance.

The output electrolytic capacitors are optimized and matched for each particular output voltage version. Since the output voltage range is so wide, each particular version will use different capacitors values, which are optimal for the overall performance and reliability. Any well designed amplifier would work well with the available capacitance on the SMPS800RE. If you consider that the amplifier requires more capacitance, it might instead require a higher power rating SMPS. If for any other reason higher capacitance is needed, you can use our add-on capacitor boards such as the LPS212 series capacitor boards upon consultation with us. Increasing or changing the capacitors without our confirmation is not allowed, especially adding ridiculous amounts of capacitance without a clear reason. Large capacitors store dangerous amount of energy which create fire hazards if the amplifier fails.

On the Mains input side, to optimize performance and increase reliability, two types of mains side electrolytic capacitors are available. For the 230V version, HV capacitors are used, (typically 375-400V 270-330uF) connected in parallel while for the 120V version, LV capacitors are used, (typically 180-220V 1000-1200uF) connected in series to allow operation at 120V Mains voltage.

For either version, the Mains voltage is set by default to 230V to prevent any possible faults if wrong voltage version is ordered, for example 120V version for countries where 230V is also available. In this case, the user must connect the 120V jumper IF and ONLY the mains voltage is within 100-120V interval otherwise damage might occur. A 230V configured power supply won't work at 120V and no damage can occur. But if is 120V configured and powered at 230V there are chances to damage the power supply unit.

Due to countless requests from customers regarding all the products which use IEC Connectors for mains voltage, not to be soldered on the PCB because some of them are willing to install the board elsewhere in the enclosure where the access to the back wall is impeded, the SMPS800RS Mains IEC Connector can be installed on the PCB board without being soldered, leaving the choice for user to solder it or remove it.

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.