SMPS2000RxE

The **SMPS2000RxE** Switched Mode Power Supply (SMPS) is specially designed for use with Audio Amplifiers, with a peak to average power (crest factor) ratio of 3 or more. Both Linear Amplifiers such as class AB Amplifiers or Switched Amplifiers such as Class D or Class T can be powered from the SMPS2000RxE power supply. The **SMPS2000RxE** uses state of the art, high efficiency LLC Series Resonant Converter Topology. The output voltage is fully regulated and adjustable within a 10% range depending on the output voltage version. Due to the soft-switched topology used the **SMPS2000RxE** produces very low EMI, lower losses and is more compact than any similarly rated classic hard-switched SMPS. Several output voltage ranges are available for the stock **SMPS2000RxE** making it suitable for use with most audio amplifiers from the market, not just with the Connexelectronic ones.

SMPS2000RxE Features:

- LLC Series Resonant Converter Topology for high efficiency, up to 96.2% and lowest EMI specially designed for high-performance and high-power Audio Amplifiers.
- 230V AC and 120V Mains AC Voltage compatible.
- 2000W Output Power with adequate cooling, 2250W Peak Output Power, 2400W Short-Time Peak Power.
- Four different output voltages available from stock: SMPS2000RxE differential output: ±60V ±75V ±84V ±92V as well as any other custom voltage in the range of ±40V to ±180V all adjustable within ~10% range.
- Dedicated single output voltage, high current version available with default output voltage 48V suitable for RF transmitters, high-power Constant-Voltage LED lighting or other non-audio applications.
- Differential Regulated Auxiliary Voltage available, with default value of ±12V or ±15V at 500mA.
- Complete protection set: Under-voltage, Over-voltage, Over-current, Short-circuit and Over-temperature Protection.
- Burst-Mode operation at low load or no-load for high efficiency and low idle power consumption.
- On-board Soft Start for smooth turn ON without current peaks or breakers tripping.
- Compact size, 120x200x42mm, lightweight, 980 grams.

Fig.1 SMPS2000RxE

Introduction: The current trend for audio amplifier manufacturers both in HI-FI and in the Pro-Audio field is to use a classic mains transformer with bridge rectifier and capacitors. The main advantage of this implementation is simplicity; no extra time and cost is needed to design a power supply using these components which are easy to find and in most cases are reliable for most applications if proper sized components are used. In addition to this, there is a strong current which tries to convince the audience that even these days the classic power supply is still the best solution. Since their beginning, not many things have changed regarding these power supplies, the mains transformers have used the same topology and construction for at least the last 50 years, rectifier diodes had improved and capacitors have made some progress but the transformer still dictates the overall performance. We cannot say that the improvements were revolutionary but SMPS technology makes impressive progress every few years. Straight away, we can compare a classic power supply built in 70's with a recent one with the same ratings and notice that the differences are small. If we try the same comparison with two SMPS units (one made in the 90s and a recent one), the differences found will be much higher. Apart from these subjective reasons there are a few other disadvantages of using classic power supplies compared with modern SMPS solutions, the most obvious being size and weight, followed by cost (for the same power level), and overall efficiency. The cost of a classic unregulated power supply exceeds the cost of an equivalent unregulated (or even regulated) SMPS above a few hundred watts of power. **The average efficiency of a classic unregulated power supply is lower with at least 10% compared with a well-designed SMPS** of the same rated power in the hundred watts power range and even more inefficient for power levels below 50-100W. If regulated voltage is required, classic power supplies cannot be considered anymore for any device which require more than 20-50W output, due to very poor efficiency of the whole assembly, starting with mains transformer and ending with linear regulators. If low voltage and high current is needed classic power supplies become useless and cost prohibitive. Usually efficiency does not exceed 40 - 50% which is far behind any SMPS available.

Although Switched Mode Power Supplies have been commonly used in most electronic equipment available on the market (both appliances and industrial) since the mid 80's, it has taken nearly 20 years to convince the audio gear manufacturers that this is the way to go. There were some attempts of using SMPS for PA audio amplifiers during the 80s and 90s, and some companies released audio amplifiers using hard-switched regulated or unregulated SMPS, or at most using Quasi-Resonant unregulated designs. Most of these revolutionary products were received with skepticism mainly because of design pitfalls, huge EMI, noise, poor reliability, higher cost and difficulty of servicing the units in case of failure. After the mid-90s, switching semiconductors reached maturity and had decent characteristics and lower cost to be used in low-cost mass-production equipment, the PA amplifier industry saw a surge of products using SMPS being released (mostly in medium and high power PA amplifiers). At the same time raw materials and labor costs for mains transformers increased, making the SMPS technology more attractive. First units used extremely simple topologies; unregulated output voltage with minimal protection, or simply no protection at all. The main reason behind this was the cost which was lower for unregulated power supplies than for regulated ones, and added to that was a lack of knowledge and properly trained engineers who were able to design and build high performance SMPS. Most of the SMPS used in that period were similar to ATX power supplies used in computers, unsuitable for supplying audio amplifiers where the load is never constant.

SMPS2000RxE Description: The topology used for **SMPS2000RxE** is Series Resonant Converter, or the LLC Converter. This type of design was chosen due to its many advantages compared to other topologies. The most important advantage is superior efficiency which is up to 96.2% with lower EMI and noise, followed by compact size, low weight and reasonable complexity. Although it is not a relatively new technology (first attempts at using this topology were made more than 25 years ago) till recently the lack of knowledge, documentation and availability of suitable electronic components such as high-speed MOS-FETs or IGBTs prohibited this topology to spread like the other hard-switched topologies. Only after designers of LCD and Plasma TVs came up with initiatives to increase efficiency of consumer products (greater than 80-90%) engineers had to look towards other solutions than the current, mature, hard-switched topologies which were unable to break the 90% efficiency barrier without significant cost, size and complexity increases. 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 of supplying a constant 400V DC. In our case the PFC stage is not required for this application and because similar efficiencies can be achieved without using a complex PFC circuit which would increase the size of the SMPS board, increase EMI and decrease the performance due to the fact that the available space is limited and the PFC inductor might interfere with other parts of the circuit.

The LLC Series Resonant Converter also runs at variable frequency (depending on the load), typically in the range of 100-250 KHz. Being soft commutated, the SMPS intermodulation noise which might occur has a very low value (well below the S/N ration threshold), and is 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 performance. However for some 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 a regulated output providing a constant output voltage from zero to full load. This results in a cleaner sound without peaks and drops, without hard clipping and distortion, accurate real deep bass, transparent and clean mid and high frequencies all without the need to add any extra-large electrolytic capacitors or so called "audiophile capacitors" (which can cost up to 2-3 times more than the SMPS itself and strongly relying on the placebo effect while evaluating their performance).

An important aspect which must be considered when the **SMPS2000RxE** is first powered ON is that the initial inrush current drawn from the mains is a 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 inrush current is higher because the capacitors' capacitance and voltage are higher and therefore it is proportional to the capacitor's stored energy ($CU^2/2$). To prevent damage to the power supply components a thermistor was used to limit the inrush current to a low value (which also prevents the mains fuse tripping). This thermistor is a passive component whose properties decrease its resistance when the temperature increases. It has higher electrical resistance at low temperature which reduces the inrush current and when the current passing through heats up the thermistor the resistances decreases, and so the dissipated power will be reduced. Once the inrush current has fallen the thermistor is taken out of circuit by a relay which now allows the full current to pass. When the power supply is powered OFF the relay will open but will close again after the next inrush current cycle. Please note that there is no need to use any other external circuit to limit the inrush current such as Power Soft-Start circuit when the SMPS2000RxE is powered from standard mains supply voltage of 110 or 220V AC.

The **SMPS2000RxE** features another soft-start circuit which allows progressive charging of the output filter capacitors while limiting the maximum output power delivered during start-up sequence, all without tripping the on-board overcurrent protection or mains fuses. The value and the working voltage of the output capacitors depends on the type of the SMPS and the output voltage value. The on-board capacitors have enough capacitance for the most stringent applications; adding extra capacitors is not required or recommended because if the capacitance is too high the overcurrent protection might trip during power ON. The most important feature of the LLC resonant converter topology (which makes it the topology of choice for supplying audio amplifiers), is that the power is processed in a sinusoidal manner and the switching devices are soft commutated, which means that the voltage across each power transistor from the power stage drops to zero before it is switched on, minimizing switching and capacitive losses (now only conduction losses are dominant). Supplying the power stage of the LLC converter at a higher voltage means the conduction losses are reduced exponentially and high efficiency can be achieved while keeping the cost and complexity low. The **SMPS2000RxE** contains six main functional blocks: 1) Mains EMI filter stage: its role is to reduce the conducted EMI transmitted from power supply to the mains network. 2) Rectifier and filter stage: it rectifies the mains AC voltage and stores the energy in the large electrolytic capacitors allowing continuous operation and a hold-up time of up to 45mS under load without affecting the output voltage regulation. 3) Power stage: this is a variable frequency square wave generator that drives the resonant tank. 4) Resonant tank: consisting of resonant inductor, resonant capacitor and power transformer. 5) Secondary side rectifier and filter capacitors: these produce the DC output voltage which is used to supply the amplifier connected to **SMPS2000R**. 6) Control monitoring and protection circuit: this controls the output voltage and proper operation of **SMPS2000R**.

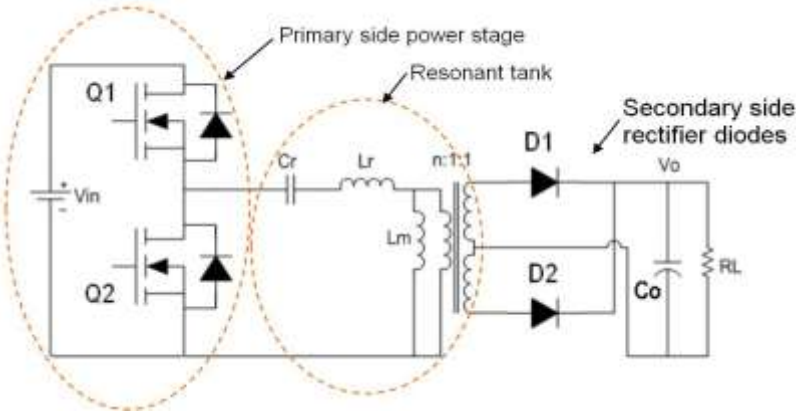

Fig.2 SMPS2000RxE simplified block diagram

Ripple and noise: An innovative high order low-pass output filter implemented on the PCB board (as well as using low-ESR electrolytic capacitors) is connected in a CLC configuration. This minimizes the switching noise by about 7dB so that the output ripple does not exceed 100mV pk-pk from zero to full load. Typical values measured for the **SMPS2000RxE** +-60V output version was 70mV and for the +-84V version was 90mV. Measured ripple frequency was 101 KHz, horizontal scale 5ns/div and vertical 100mV/div AC coupled. The green trace represents positive output, and the pink trace represents negative output. Measurements were done using a LeCroy LT344 scope with 200 MHz x 10 probes which were connected directly at the output voltage connector.

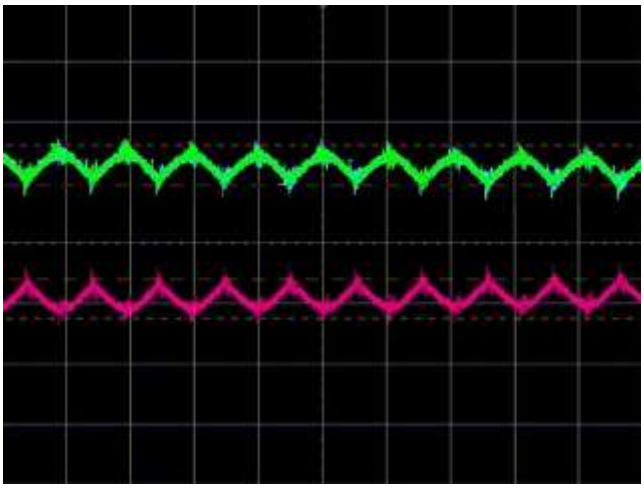

Fig.3 SMPS2000RxE output ripple ±84V output voltage version

A conducted emission test was performed to ensure compatibility with EN55022 Class-B standard and the preliminary results are shown below at low-power (100W) and at half-rated power (800W average power drawn by the amplifiers supplied by **SMPS2000R)**. It can be seen in the Fig.4 diagrams that the limits are not exceeded, with the peak and average values being at least 10dB below the limits. For the test purpose, SMPS2000RxE was powered at 230V mains voltage, through a **CW4L2-20A-T** (20A rated current) EMI mains filter and through a special device called LISN, used for measurements purpose only. If 120V mains voltage is used, the **CW4E-30A-S** (30A rated current) should be used. Lower current rating EMI filters such as **CW2A-10A** or **CW2A-10A-T** can be used only if the mains supply voltage is 230V and the average power supplied to amplifiers does not exceed 1600VA. Two **SMPS2000RxE** units installed in the same enclosure can be powered from mains through one single **CW4E-30A-S** from 230V mains supply voltage.

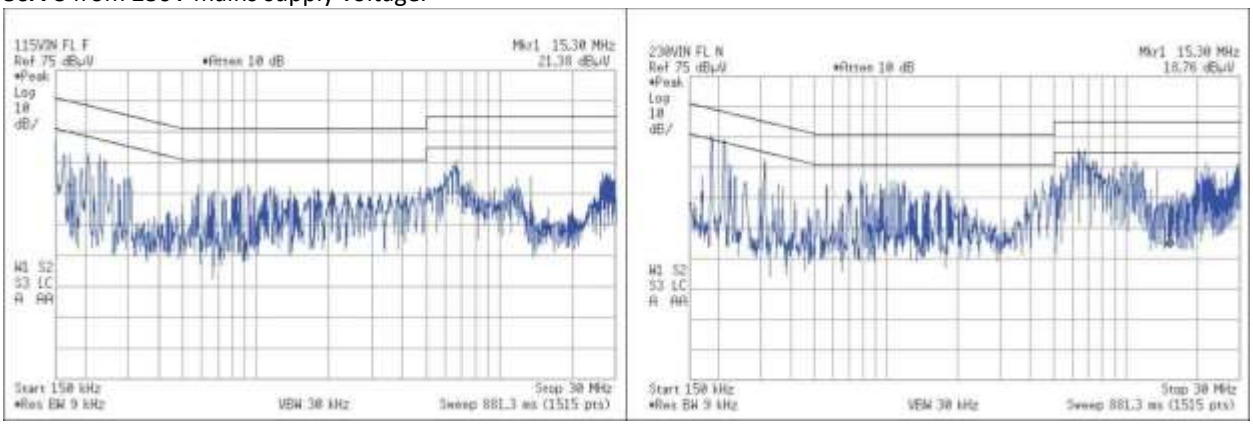

Fig.4 SMPS2000RxE conducted emissions pre-compliance tests at 100W load and 800W load

Radiated emissions are estimated to be within limits and no abnormal limits were detected by spectrum analyzer in the area where **SMPS2000RxE** was operating. Yet we still recommend that **SMPS2000RxE** to be installed in the amplifier enclosure as far as possible from signal sensitive boards or harnesses to prevent any kind of interference. Due to the high power and intense stray magnetic field around the power transformer and resonant inductor the **SMPS2000RxE** should not be installed directly on top or below any amplifier board and a distance of at least 50mm must be kept to prevent any interference. The magnetic field intensity decreases exponentially with the distance from the source and thus 10-15cm away would be low enough to not affect the other stages. Due to nature of operation, the switching frequency of the **SMPS2000RxE** varies in range of 100-250 KHz from no-load to full-load; the maximum switching frequency is at minimum load, while minimum switching frequency is at maximum load. Due to this reason, the switching frequency varies continuously, even with constant load, due to DC bus ripple, with 100 or 120Hz frequency (double the mains frequency) inherently obtaining what is called Spread spectrum (PWM frequency dithering) very useful for minimizing EMI signature of the **SMPS2000RxE**.

If the **SMPS2000RxE** will be used in mobile sound applications powered from generators, inverters or weak mains power installations, using long and thin wires (with relatively high impedance) the mains voltage must be monitored during operation of the **SMPS2000RxE** and any other equipment connected to the mains to make sure the peak average voltage values will remain within the required limits. In case of mains voltage values below 205V for 230V version or 103V for 120V version, the SMPS2000RxE output voltage might not be regulated at nominal value and drop under full-load or can enter in Under-Voltage protection mode if mains network impedance is higher than nominal because it can't sustain the full peak current required.

In the ideal layout arrangement the **SMPS2000RxE** would be fitted on one side of the amplifier enclosure (usually on the left side), using the enclosure wall as a heatsink which would transfer heat away from the heatslug. The mains connector will be on the back side of the enclosure near the back panel where the mains cable enters the enclosure, and the output connector will be on the front side of the amplifier enclosure right in front of the amplifier module power connector. In this way the wiring layout is optimised allowing neat, short straight wires to be used and without crossing over or under other modules installed in the enclosure.

Mains input should be supplied to SMPS2000RxE through a can type EMI filter such as **CW4L2-20A-T** or **CW4E-30A-S** type or at least **CW2A-10A** or **CW2A-10A-T** only if the mains supply voltage is 230V and the average power supplied to amplifiers does not exceed 1600VA. The DC output wires should use Ferrite beads to further reduce EMI. The wiring harness should cross through the ferrite core and we recommended the use of a 25-33mm diameter Hi-Freq ferrite core on which are wrapped an equal number or turns (2-4 for each wire).

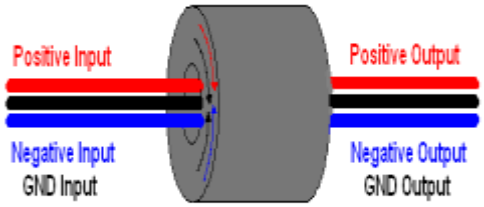

Fig.5 Ferrite bead installed on output wires

Thermal Management: SMPS2000RxE requires proper thermal management to keep the nominal temperature of all the components within their operating range. The electrical efficiency of SMPS2000RxE from 10% to 100% load is over 90% with peak efficiency over 96%. Efficiency and dissipated power is also related to output voltage setting. The efficiency is slightly higher if the output voltage is set to minimum voltage and the lowest value of efficiency is reached with the output voltage set for maximum value. The difference is up to 1.4%, or about ±20W total power loss. Although the soft-switching characteristic allows the **SMPS2000RxE** to run cooler than similarly rated hard-switched SMPS, the generated heat must be removed using a heatsink thermally connected to the heatslug placed on a side of the board, on which all the power devices are installed. If the **SMPS2000RxE** is installed in a tight enclosure along with other modules which generate heat, using a cooling fan is strongly recommended to keep the temperature of the whole board and components within normal operation limits, without affecting the reliability or trigger the Over-Temperature protection. The fan must be installed on the back side of the enclosure and absorb the hot air through the board from the upper right side (refer to board layout figure) where the rectifier bridge is installed, then the power inductor and power transformer and blow the air outside the enclosure. While the hot air is removed from the enclosure instead of blowing air inside, the average temperature of PCB and temperature sensitive components such as electrolytic capacitors is kept 15-20°C lower than if the air would circulate in opposite direction. The cooling fan must be 12V 80-120mA rated, 50x50mm or 60x60mm type, ball bearing. By default is not provided but can be supplied on request. The fan can be powered from the **SMPS2000RxE** directly, from the **FAN** dedicated connector, which can be found next to Rectifier Bridge. While the cooling fan is used, the rectifier bridge do not require a heatsink for normal operation, but in case the fan is not used, a <8°C /W heatsink must be attached on the rectifier bridge. By default, it is not installed.

6 pieces M4 Screws must be used to install the heatsink. The screws length must not protrude more than 5mm into the heatslug otherwise will damage the power devices and other components.

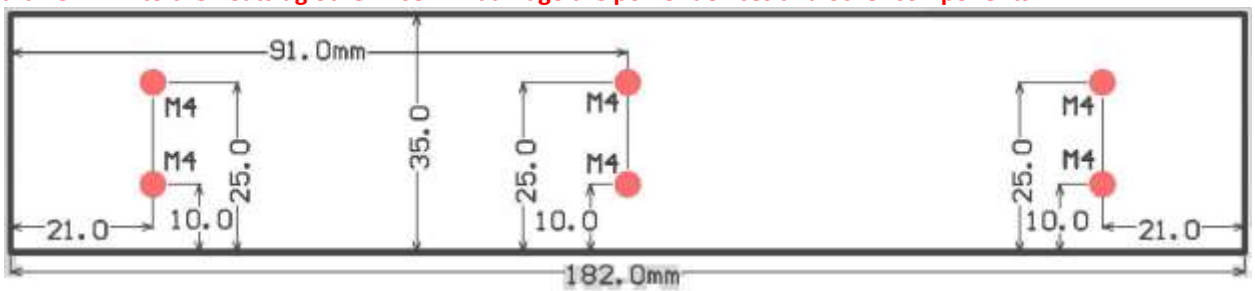

Fig.6 SMPS2000RxE heatslug size and drill pattern

Over-temperature protection was added to make sure that the **SMPS2000RxE** is fully reliable even under the most demanding conditions. This consists of a circuit which monitors the temperature of the primary MOS-FETs and disables the power supply when the operating temperature reaches 90˚C. To resume operation, the **SMPS2000RxE** must be completely disconnected from mains voltage for at least 10 min while the temperature drop and capacitors discharge. Same sensor is used to control the variable speed fan which is used to keep the power supply temperature within normal limits so correct ratings fan must be used to not affect the circuit operation.

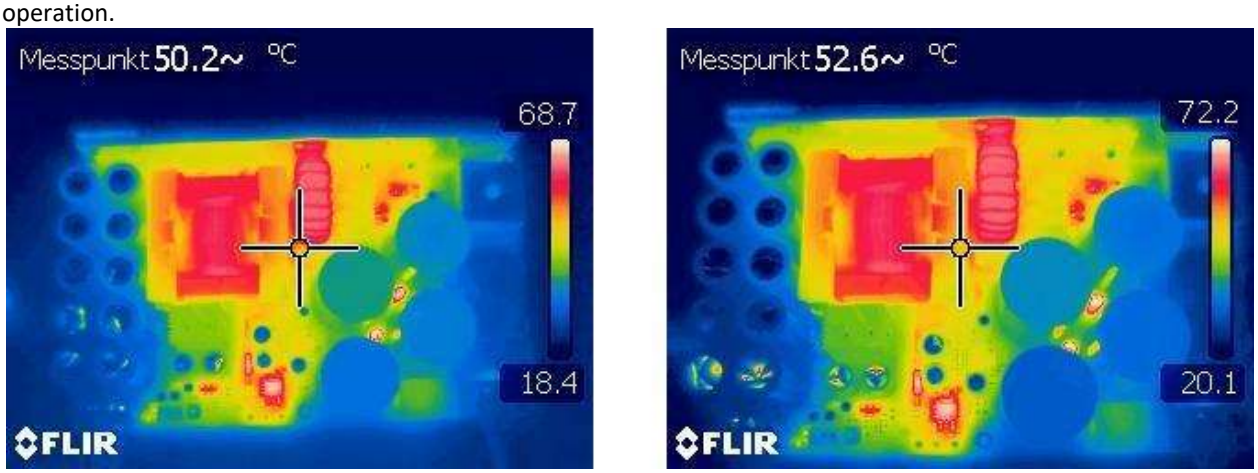

Fig.5 SMPS2000RxE thermal image after running 30min and 60min loaded with 2x800W class D amplifier as load

SMPS2000RxE characteristics:

Model: Parameters:	SMPS2000R±60V	SMPS2000R±75V	SMPS2000R±84V	SMPS2000R±92V	SMPS2000RxE custom voltage
Main Output Voltage:	Minimum:±57V Maximum:±63V	Minimum:±71V Maximum:±78V	Minimum:±80V Maximum:±88V	Minimum: ±88V Maximum: ±96V	Minimum: ±38V Maximum:±188V
Aux. Output Voltage:	Minimum:±16.5V Maximum:±20V	Minimum:±16.5V Maximum:±20V	Minimum:±16.5V Maximum:±20V	Minimum:±16.5V Maximum:±20V	Minimum:±10V (on request) Maximum:±30V (on request)
Mains input voltage:	120V range: 98-127V 230V range: 196-254V	120V range: 98-127V 230V range: 196-254V	120V range: 98-127V 230V range: 196-254V	120V range: 98-127V 230V range: 196-254V	120V range: 98-127V 230V range: 196-254V
Main Output Current:	Nominal: 16.7A Peak: 22A	Nominal: 13.3A Peak: 18.5A	Nominal: 11.9A Peak: 15.7A	Nominal: 10.8A Peak: 14.3A	Nominal: 5.5-33A Peak: 7-44A
Aux. Output Current:	Nominal: 0.2 A Peak: 0.5A	Nominal: 0.2 A Peak: 0.5A	Nominal: 0.2 A Peak: 0.5A	Nominal: 0.2 A Peak: 0.5A	Nominal: 0.2 A Peak: 0.5A
No-Load and low load power consumption:	2.4-5.3W DCM no-load 16W CCM 5.5W load *Mains V dependent*	2.7-5.8W DCM no-load 17W CCM 5.8W load *Mains V dependent*	2.9-6.3W DCM no-load 18W CCM 6.4W load *Mains V dependent*	3.4-6.7W DCM no-load 19W CCM 6.7W load *Mains V dependent*	2.1-7.7W DCM no-load 14-24W CCM 3.8-11W load *Mains V and Output V dependent*
Min. Load for CCM (no-burst):	Min: 5.5W Max: 7.7W	Min: 5.8W Max: 8.4W	Min: 6.4W Max: 9.3W	Min: 6.7W Max: 9.5W	Min: 4.4W (Voltage dependent) Max: 15W (Voltage dependent)
Efficiency at 40-60% load:	120V: 94.5 % 230V: 95.2%	120V: 95.1 % 230V: 95.7%	120V: 95.5 % 230V: 96.2%	120V: 95.4 % 230V: 96.1%	120V: 92.1-995.5 % 230V: 92.8-96.3%

Auxiliary output voltages: **SMPS2000RxE** has a differential output auxiliary voltage and one separate, isolated auxiliary voltage which can be connected with its negative output to main negative output to generate the Vdrive to V- voltage required by any class D amplifier output stage driver section. For maximum flexibility and to avoid efficiency decrease, the auxiliary output voltages are unregulated and the average value is around ±17V to ±20V at 200mA. The maximum available current for short period is 500mA. All auxiliary outputs are protected against overload and short-circuit using resettable PTC fuses which will disconnect the aux output once the maximum current of ~500mA is exceeded and will reconnect after the overload or short-circuit condition was cleared. Although the output is protected, for long time reliable operation do not use the **SMPS2000RxE** with aux. outputs shorted or overloaded. If the **SMPS2000RxE** auxiliary outputs are used to supply other circuits than the circuits contained on dedicated amplifier boards such as **CxD500** or **CxD250-HP** which have their own on-board regulators, is recommended to use linear voltage regulators such as 78xx and 79xx series after the auxiliary output to supply regulated voltage to other circuits such as preamplifiers. All he auxiliary voltages of the **SMPS2000RxE** are available on the four 8-pins 50mil pitch connectors along with two control signals described below. The pinout is written on the bottom of the **SMPS2000RxE** PCB and the significance is explained in the next section.

Control signals: **SMPS2000RxE** features three dedicated control signals: **Mute, Enable** and **F_SD** which are used in conjunction with the main and auxiliary voltages to power and control our dedicated class D amplifiers CxD series as well as other amplifiers from other vendors which use similar control signals to enable and control their amplifier modules.

- **Mute** signal: active Low, controls the Mute pin of the amplifier by holding the **Mute** pin low while the **SMPS** power **ON** and reach a stable operation mode, as well as monitors the mains supply voltage and pull the Mute pin low immediately after the mains power was disconnected and while the output DC voltages has not dropped yet to prevent possible noises which might appear during transients. Once the **SMPS** operation is steady, the **Mute** pin is pulled high to approx. 5V and normal operation starts.
- **Enable** signal: open collector active high, it is the inverted version of **Mute** signal, used for compatibility with amplifier boards supplied by other vendors. Same operation principle and timing applies as for Mute signal but with inverted polarity. This signal is not used for our **CxD** amplifiers series and the wire corresponding with this signal is not attached to the harness provided with the **SMPS2000RxE** when purchased in pair with any of **CxD** amplifiers. Available on custom version only.
- **F_SD** signal: or Fast_ShutDown: **DC speaker protection detection** pin. When is pulled low, it disables the **SMPS2000RxE** immediately and will only resume operation if the cause which has triggered the protection is removed and after disconnecting the mains power for at least 10 min allowing the mains side capacitors to discharge. During normal operation the voltage on this pin is approx. 17V because it is biased from the +Aux output. Any amplifier which controls this pin must use an active-low open-collector circuit which can withstand up to 20V DC applied directly to the trigger output.

Connectors pinout: Mains Voltage Input uses a 3 pins 6.3mm pitch screw type terminal block with the pinout written on the PCB as follows: The connector is located at the bottom right of the PCB then the first pin located on the left is **Live**, the middle pin is **Neutral** and the pin from the right side, next to the mounting hole is the **Protective Earth**. Make sure all the connections are correct and properly wired before power ON the **SMPS2000RxE.** The Main **DC output** is located on the bottom left side of the PCB. The terminals significance is as follows: The first pin located in the left side, next to the mounting hole is the Positive Output, V+ the middle pin is the GND Out and the right pin is the Negative Output, V-. The four small Aux. connectors uses 8 pin small pitch, 1.27mm or 50mils pins distance with the following pins significance from left to right, with the **SMPS2000RxE** board placed with the heatsink up the auxiliary connector at the bottom right corner:

Mains Input connector pinout: (from left to right)
Pin1: Live
Pin2: Neutral
Pin3: Protective Earth

Main Output connector pinout: (from left to right)
Pin1: Positive Output **V+**
Pin2: Ground **GND**
Pin3: Negative Output **V-**

Auxiliary Output connector pinout: (from bottom up) *All 4 Plug-in cables available on request.*
Pin1: Mute Signal
Pin2: Fast_ShutDown Signal
Pin3: +Aux output. Auxiliary positive voltage output
Pin4: GND. Auxiliary differential voltage Ground
Pin5: -Aux output. Auxiliary negative voltage output
Pin6: Enable Signal. Inverted Mute signal, not used for CxD amplifier series, used for third party amplifiers.
Pin7: Vbias. Positive output of the isolated output voltage used for driver stage.
Pin8: -Vcc. Negative output of the isolated output voltage used for driver stage. Must be connected to main –Vcc on the amplifier board to bring the Vbias to a potential 17-20V higher than –Vcc rail.

If the **SMPS2000RxE** output is left unconnected, or the load is below the threshold mentioned in the table above, will run in **Burst-Mode** to save power. This mode is indicated by the **Run LED** which will blink or light very dim. Once the output current drawn exceeds the burst mode current threshold, the SMPS2000RxE will run in continuous mode and the **Run LED** will light normal. During the burst-mode, the converter will enter a controlled intermittent operation, where a series of a few switching cycles at a nearly fixed frequency are spaced out by long idle periods when the power stage is shut-down. During burst mode operation, the SMPS2000RxE audible noise nearby transformer can be heard, as well as the output voltage ripple will be higher than nominal, and low frequency component of ripple (5-30Hz) will be dominant. Burst-mode of operation will not affect the load proper operation because nearly any amplifier has a quiescent current and idle power consumption which exceeds the burst-mode threshold.

Over-Current condition will be signaled by the **OC LED**. When the output power exceed the nominal power, at around 2100-2200W the **OC LED** will light dim, and its intensity will increase as the power increases. When the output power will reach ~2700W the output voltage will sag and if the Over-Current (OC) condition persist, the SMPS2000RxE will shut-down for about one second then try to restart if the OC condition was removed. Although SMPS2000RxE has short-circuit protection, under any circumstances the output voltage must not be shorted, because of the dangers associated with this actions, including risk of electrocution and risk of fire. The output power and current capability of SMPS2000RxE especially lowest voltage versions is high enough to melt and burn wires if they are not thick enough, and sparks can ignite nearby materials.

Dangerous high DC voltage is present on the board from the moment when is first powered ON till about 10min after is complete disconnected from mains voltage. To indicate the presence of the high-voltage, Power LED will light as long as the large capacitors hold dangerous high-voltage. For your own safety, never touch any component from the SMPS2000RxE board while is powered and at least 10 min after power OFF and complete disconnected from mains voltage.

Warning:

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

The SMPS2000RxE is powered from the mains voltage and the primary side of the SMPS has hazardous voltages of up to 340V DC and up to 400V AC. This voltage levels are present on the top and bottom of the board and during installation and operation you should never touch any part of the SMPS while it is connected to the mains, and at least 5 minutes after complete disconnection from the mains. If any adjustments or reconnections need to be done, disconnect the unit from the mains and allow all capacitors to discharge for at least 5 minutes before handling. Any ignorance of this warning is the user's responsibility and this can lead to serious injuries and possible death by electrocution if handled improperly. This product has no serviceable parts other than the on-board mains fuse. In case of a blown fuse, only replace the fuse with the same type and rating. Do not attempt to change any other component from the SMPS2000R. 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 power supply components and ambient must not be obstructed for proper operation. Use proper wire gauge wires for interconnection, with intact insulation, and as thick and short as possible. Use different colors for different polarities, respecting the standards, and never touch the wires with hands or tools. Never operate the SMPS2000RxE and any other electronic devices without supervising and monitoring its operation. Ignoring this recommendation can cause power supply failure, injuries or fire!!!

Mains voltage is set by default to 230V to prevent any possible faults if wrong voltage version is ordered, for example 110V version for countries where 230V is also available. In this case the user must connect the 110V jumper IF and ONLY the mains voltage is within 100-120V interval otherwise damage might occur. A 230V configured power supply won't start at 110V and no damage can occur. But if it is configured for 110V and powered with 230V there are many chances to damage the power supply. The SMPS2000RxE is designed to allow both 200V and 400V type capacitors to be installed in series or parallel connection allowing the most suitable configuration and highest total capacitance to be achieved. The type and values of electrolytic capacitors are chosen for best fit on each power supply voltage version.

Disclaimer:

The SMPS2000RxE 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 mains voltages of this board, the user should take all the measures needed when working with mains voltages, they should not touch any unisolated part of the board or connectors, or short-circuit any part of the board or connectors. Any misusage is the user's responsibility.

The designer and manufacturer reserve the right to make changes or modifications on both the product functions and the performance without notice. The schematic and PCB design is **Connexelectronic** proprietary information and shall not be distributed, copied or published without **Connexelectronic** written agreement. **Connexelectronic** reserve the right to 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 **Connexelectronic** or listed resellers, and from various reasons they look or pretend to be similar, exactly the same, or improved version products. Purchasing the product means that you are aware and agree with these conditions.

Distribution network:

We are continuously striving to offer the best product quality and availability for our products, and the SMPS2000RxE can be purchased either directly from our manufacturing site or through our distributor network as well. Distributors might not stock all the versions available, please contact them in advance to confirm availability prior purchasing. 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 surrounding European Countries: http://www.enigma-shop.com
- Medianet, Germany, Austria and near European Countries: http://www.medianet-shop.de
- Hifimediy China, worldwide reseller: http://www.hifimediy.com