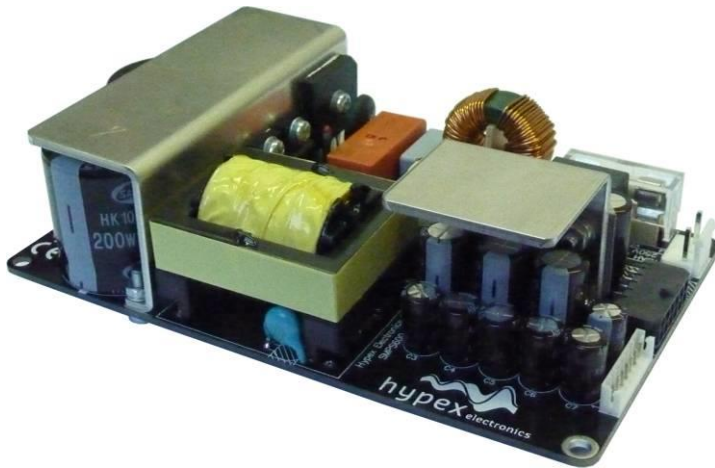


## High Efficiency Audio SMPS



### Highlights

- High efficiency
- Extremely small form factor
- Low EMI

### Features

- Advanced over current protection
- Remote controlled operation
- Low weight: 300gr.
- Compact: 140 x 85 x 50(45)mm
- Automatic input voltage selection

### Applications

- Supply for single or multiple NC400 amplifiers
- High-end audio amplification

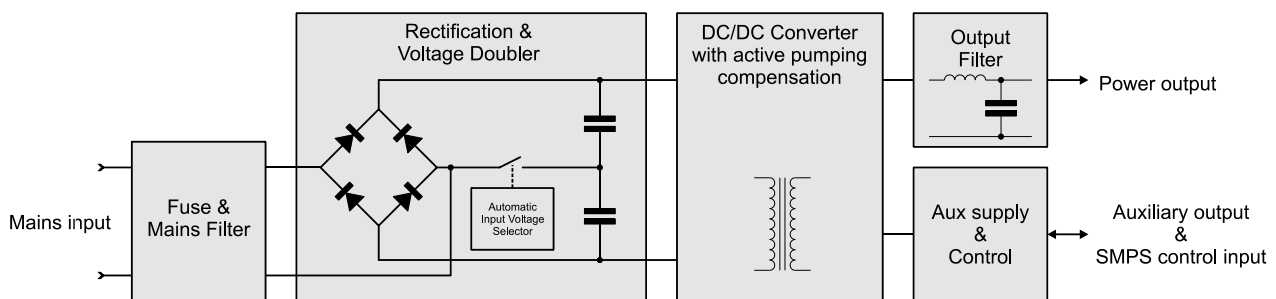
### Description

The SMPS600 is a high efficiency Safety Class 2 switch mode power supply specifically designed to be used in combination with our NC400 module. Key features include high efficiency over the entire load range, extremely small form factor, low weight and very low radiated and conducted EMI. The SMPS600 also features an upgraded over current protection which in case of temporary overload simply reduces the output voltage, only when the overload condition remains for a longer time the supply will enter hiccup mode until the overload condition disappears. This feature combined with large electrolytic buffer capacitors leads to the capability of delivering high dynamic headroom power to the connected amplifier. A new feature in this SMPS is the automatic input voltage selector which accommodates quasi universal mains capabilities. An auxiliary isolated supply to power possible user applications is also included. The supply is triggered for normal operation or latched off in case of a critical fault via in built-in actuators. The SMPS600 is optimized from the first phase of design to final implementation to realize the low EMI signature required of the most demanding audio applications.

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## 1 Principle of operation



Conventional Switch Mode Power Supplies are commonly unsuitable for audio purposes due to poor peak power capabilities and the inability to handle reversed currents generated by Class D amplifiers as a load. The Hypex SMPS600 achieves these things by using an advanced over current protection circuit, a highly efficient 2 quadrant DC/DC converter which is capable of handling reversed currents and has a peak power handling of many times its rated power.

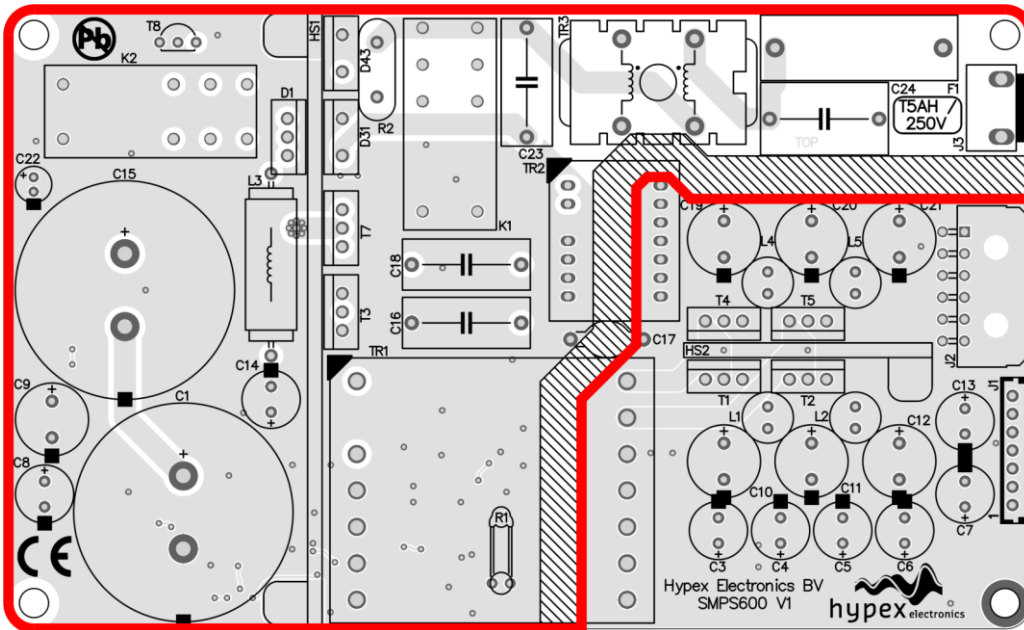
## 2 Safety precautions



**The SMPS600 operates at mains voltage and carries hazardous voltages at accessible parts. These parts may never be exposed to inadvertent touch. Observe extreme care during installation and never touch any part of the unit while it is connected to the mains. Disconnect the unit from the mains and allow all capacitors to discharge for 10 minutes before handling it.**

This product has no serviceable parts other than the on-board fuse. Replace the fuse only with the same type and rating (250V T5AL).

This is a Safety Class 2 device. It is very important to maintain a 6mm clearance with all possible conducting parts (housing etc.) and cables. All parts enclosed by the thick red line below carry hazardous voltages. This includes parts on the top and the bottom of the board. When the SMPS600 is mounted in a tight space there needs to be at least 6mm clearance or a layer of insulation with a minimum thickness of 0.5mm between the top of the transformer and the housing. Only use insulated spacers in the dotted area. The fourth hole should a conductive spacer to improve EMI performance.



Mounting the SMPS600 on the chassis can be done by using the 10mm spacers. This creates the mandatory 6mm clearance from the bottom side of the PCB to the chassis without the need for additional insulating material. However, if the enclosure is limited in height, one shall need to use smaller spacers and provide a layer of insulation both above and below the SMPS with a minimum thickness of 0.5mm in order to comply with the Class 2 Safety Directive. If these measures are taken into account, the maximum overall height can be reduced to 45mm.

### 3 Instructions for installation

**Warning:** To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture.

**Warning:** Disconnect the unit from the mains and allow all capacitors to discharge for 10 minutes before handling it. If the power supply has recently been operated without an amplifier attached, or if the amplifier module has been disconnected shortly after powering down the supply, a substantial charge may remain on the output capacitors. These must be discharged prior to connecting the amplifier module to prevent damage either to the connector or to the amplifier. A power resistor of 47 ohms or more may be used for this.



This symbol indicates the presence of hazardous voltages at accessible conductive terminals on the board. Parts that are not highlighted in red (picture above) may carry voltages in excess of 140VDC!

1. Read these instructions.
2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the application.
7. Only use attachments/accessories specified or approved by the manufacturer.
8. Unplug this apparatus during lightning storms or when unused for long periods of time.

9. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally or has been dropped.
10. This product is to be used with Hypex amplifier modules only.
11. Only the ready-made cable sets provided by Hypex may be used for external wiring of the SMPS600.
12. Don't run any cables across the top or the bottom of the SMPS600. Apply fixtures to cables to ensure that this is not compromised.
13. Observe a minimum distance of 6mm maintain clearance with all possible conducting parts (housing etc.). All parts enclosed by the dotted line below carry hazardous voltages. This includes parts on the top and the bottom of the board. When the SMPS600 is mounted in a tight space there needs to be at least 6mm clearance or a layer of insulation with a minimum thickness of 0.5mm between the top of the transformer and the housing.
14. Natural convection should not be impeded by covering the SMPS600 (apart from the end applications housing).

## 4 Absolute maximum ratings

**Correct operation at these limits is not guaranteed. Operation beyond these limits may result in irreversible damage**

Item	Symbol	Rating	Unit	Notes
Input voltage	V <sub>LINE</sub>	270	Vac	
Air Temperature	T <sub>AMB</sub>	50	°C	
Heat-sink temperature	T <sub>SINK</sub>	95	°C	<sup>1)</sup>

**Note 1:** Unit will shut down when T<sub>SINK</sub> exceeds 95° due to thermal protection

## 5 Recommended Operating Conditions

Item	Symbol	Min	Typ	Max	Unit	Notes
High Line Input Voltage	V <sub>B</sub>	180	230	264	Vac	
Low Line Input Voltage	V <sub>B,FP</sub>	90	115	132	Vac	
Line Input Frequency	f	47		63	Hz	

## 6 General Performance data

Item	Symbol	Min	Typ	Max	Unit	Notes
Output Current Aux	I <sub>OUT,AUX</sub>	500m	-	-	A	per rail
Max Output Power	P <sub>R</sub>	-	650	-	W	<sup>1)</sup>
Max Audio Output Power @ 20Hz into amplifier load	P <sub>RALF</sub>	-	600	-	W	<sup>2)</sup>
Efficiency	η		TBD		%	full power
Idle Losses	P <sub>0</sub>		7,5		W	
Standby Power	P <sub>standby</sub>		0,4		W	
Switching frequency	F <sub>SW</sub>	80	100	120	kHz	
Maximum power consumption	P <sub>max</sub>			1100	W	<sup>3)</sup>

**Note 1:** Output Power delivered to a resistive dummy load (generally the only specification supplied by other SMPS manufacturers).

**Note 2:** An audio amplifier actually draws twice the RMS power from the power supply. At high frequencies the secondary storage output caps are capable to provide this power. At very low frequencies however the SMPS is responsible for delivering this peak power to the amplifier.

**Note 3:** Limited by over current protection.

## 6.1 General Performance data

Item	Symbol	Min	Typ	Max	Unit	Notes
Output Voltage	V <sub>OUT</sub>	2 x 51	2 x 65	2 x 74	Vdc	<sup>1)</sup>
Max Output Short Circuit Current (Rail to rail)	I <sub>OUT,MAX</sub>	-	7	-	Adc	<sup>2)</sup>
Unregulated Output Voltage Aux	V <sub>OUT,AUX</sub>	2 x 14.3	2 x 18.6	2 x 21.5	Vdc	<sup>1)</sup>

**Note 1:** Output voltage is fixed by design and proportional to the mains line voltage (Min@180Vac, Typical@230Vac, Max@264Vac).

**Note 2:** Limited by over current protection.

## 6.2 Output Power Performance data

The SMPS600 is designed for music reproduction and is therefore not able to deliver its maximum output power long-term. The RMS value of any common music signal generally doesn't exceed 1/8<sup>th</sup> of the maximum peak power. The SMPS600 is therefore perfectly capable of driving the connected amplifier in clipping continuously with a music signal without the need of additional external cooling.

Unless otherwise specified. T<sub>a</sub> = 25°C. Connected amplifier: NC400, f = 1kHz.

SMPS600 is horizontally mounted in free air without additional external cooling. Measurements are done without preheating. Distortion figures (THD+N) at the stated power ratings are below 1%.

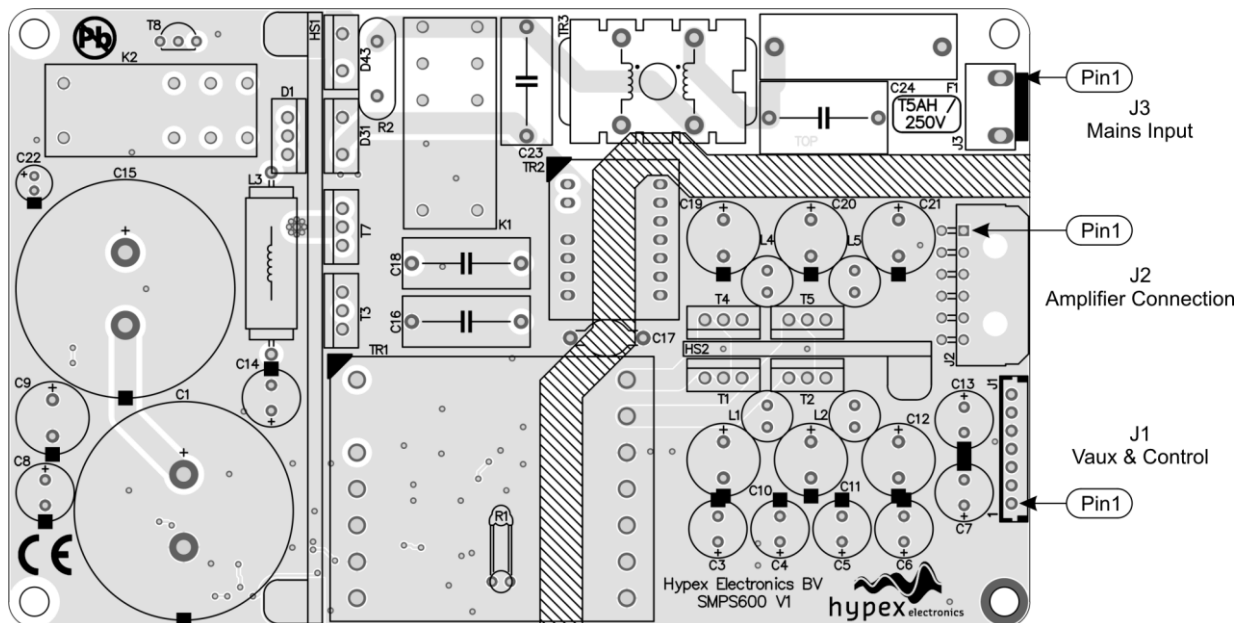
Item	Symbol	Conditions	Typ	Unit	Notes
Amplifier output power for 90sec.	P <sub>o</sub>	Load = 4Ω 120Vac/60Hz 230Vac/50Hz	575 550	W	2x NC400 in stereo mode
Amplifier output power for 5 min.	P <sub>o</sub>	Load = 4Ω 120Vac/60Hz 230Vac/50Hz	430 400	W	2x NC400 in stereo mode
Continuous output power.	P <sub>o</sub>	Load = 4Ω 120Vac/60Hz 230Vac/50Hz	275 240	W	

### 6.3 Output Power

Connected amplifier: NC400,  $f = 1\text{kHz}$ . Distortion figures (THD+N) at the stated power ratings are at 1%.

Item	Symbol	Conditions	Typ	Unit	Notes
Amplifier output power at different input voltages.	P <sub>o</sub>	240VAC Load = 2Ω Load = 4Ω Load = 8Ω	570 425 250	W	
		230VAC Load = 2Ω Load = 4Ω Load = 8Ω	570 390 235		
			120VAC Load = 2Ω Load = 4Ω Load = 8Ω		
	P <sub>o</sub>	100VAC Load = 2Ω Load = 4Ω Load = 8Ω	410 275 160	W	

## 7 Connector Pinout



### 7.1 J1: Aux & Control

Connector type: JST ([www.jst.com](http://www.jst.com)) B7B-EH. Matching cable part: EHR-7

Pin	Type	Function
1	Input	SMPS Standby
2	-	NC
3	Output	Unregulated Positive Auxiliary Output Voltage
4	-	NC
5	Output	Ground

6	-	NC
7	Output	Unregulated Negative Auxiliary Output Voltage

## 7.2 J2: Amplifier Connection

Connector type: 2x6 pin Molex Microfit header type 43045-1200. Mates with 43025-1200 cable part.

Pin	Type	Function
1, 2	Pwr	+HV: unregulated supply (nominally +64V)
3,4,9,10	Pwr	GND
5	o/c <sup>1)</sup>	nFATAL: Catastrophic fault indication, inverse of internal FATAL bit.
6	Pwr in	+ V <sub>SIG</sub> , positive supply for op amps.
7,8	Pwr in	-HV: unregulated supply (nominally -64V)
11	Pwr in	V <sub>DR</sub> , optional external driver supply connection. A floating unregulated 16V to 25V supply is connected between this pin and -HV.
12	Pwr in	- V <sub>SIG</sub> , negative supply for op amps.

**Note 1:** o/c=open collector.

## 7.3 J3: Mains Input

Connector type: JST ([www.jst.com](http://www.jst.com)) B2P3-VH. Matching cable part: VHR-3N

Pin	Function
1,3	Mains Input
2	NC

**Note:** As per Class 2 ground is NC and so unavailable for safety ground. You must follow Class 2 safety standards in implementing the SMPS600. Also read [http://www.hypex.nl/docs/appnotes/earth\\_appnote.pdf](http://www.hypex.nl/docs/appnotes/earth_appnote.pdf)

## 7.4 SMPS Standby Input Characteristics

Applying an external DC voltage to this input will put the SMPS in standby. Both main and auxiliary output voltages will drop gradually. Removing the standby voltage will result in a normal soft started start-up of the SMPS600.

Item	Type	Min	Typ	Max	Unit	Notes
DC voltage on J1:1	input	3,3		12	Vdc	

## 7.5 Unregulated Auxiliary Output Characteristics

The SMPS600 provides Unregulated Auxiliary Output Voltages that are available for external auxiliary purposes.

Item	Type	Min	Typ	Max	Unit	Notes
Positive DC voltage on J1:3	output	14.3	18.6	21.5	Vdc	1) 2)
Negative DC voltage on J1:7	output	-14.3	-18.6	-21.5	Vdc	1) 2)

**Note 1:** Output voltage is fixed by design and proportional to the mains line voltage (Min@180Vac, Typical@230Vac, Max@264Vac).

**Note 2:** These outputs are NOT shortcut protected.

## 7.6 Output Voltage Characteristics

Item	Type	Min	Typ	Max	Unit	Notes
Positive DC voltage on J2:1, J2:2	Output	-	65	-	Vdc	1) 2)
Negative DC voltage on J2:7, J2:8	Output	-	-65	-	Vdc	1) 2)

**Note 1:** Output voltage is fixed by design and proportional to the mains line voltage (Typical @230Vac).

**Note 2:** These outputs are fully long term shortcut protected: outputs to ground, output to output.

### 7.7 Output Grounds Characteristics

The Output Ground reference. Main Output Ground and Auxiliary Output Ground are connected together on the board.

### 7.8 DC Error Input Characteristics

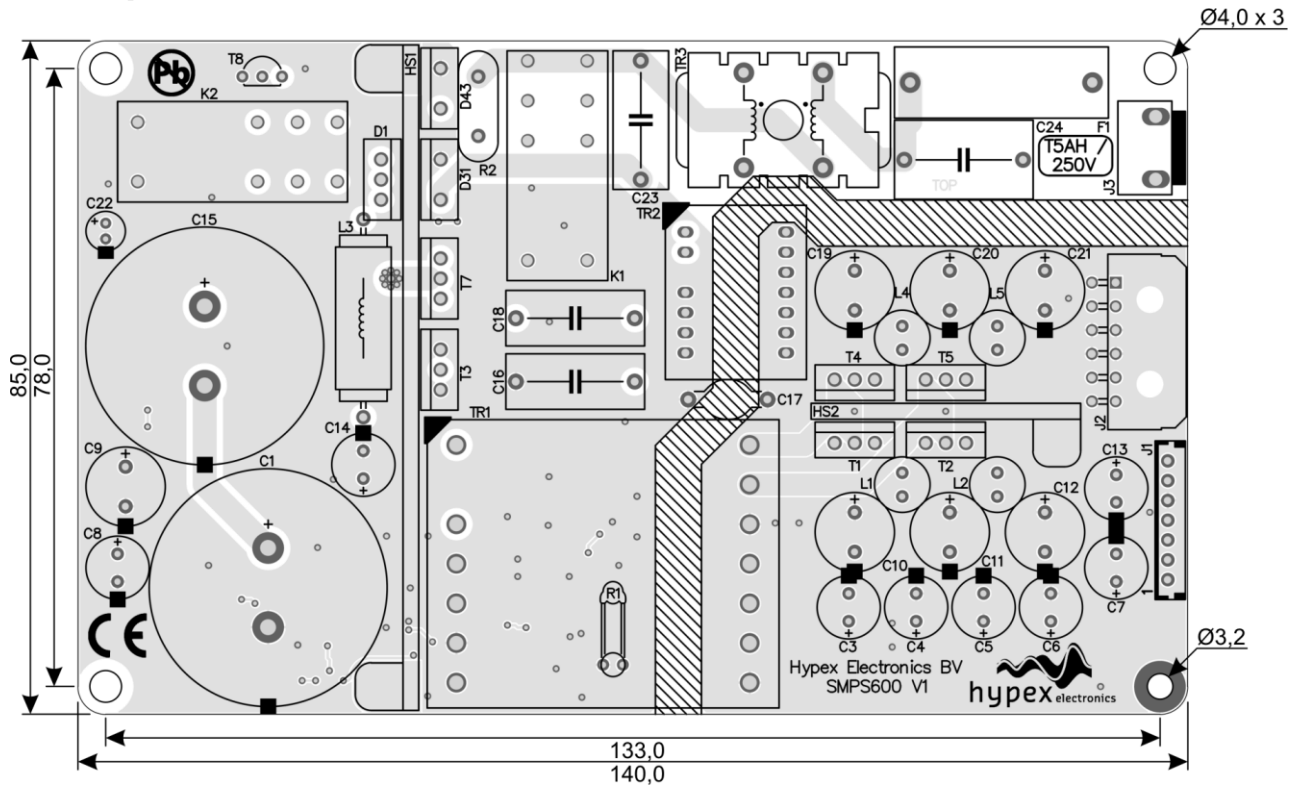
In the event of a critical failure occurring in the connected amplifier which may cause damage to the connected loudspeaker, the SMPS600 needs to be switched-off rapidly. The DC-Error Input is latched and will not auto-recover.

Item	Type	Min	Typ	Max	Unit	Notes
DC voltage on J2:5	Input				Vdc	* Use open collector



## 8 Dimensions

### 8.1 Top view



**DISCLAIMER:** This product is designed for use in sound reproduction equipment in conjunction with Hypex amplifier modules. No representations are made as to fitness for use in other applications. Except where noted otherwise any specifications given pertain to this subassembly only. Responsibility for verifying the performance, safety, reliability and compliance with legal standards of end products using this subassembly falls to the manufacturer of said end product.

**LIFE SUPPORT POLICY:** Use of Hypex products in life support equipment or equipment whose failure can reasonably be expected to result in injury or death is not permitted except by explicit written consent from Hypex Electronics BV.

Document Revision	PCB Version	Description	Date
R1	SMPS600 V1	Initial Draft.	19.12.2011
R2	SMPS600 V1	Instructions for installation added	13.02.2012
R3	SMPS600 V2	Discharge resistors added Improved AC-detection	02.03.2012
R4	SMPS600 V3	Format changed	17.01.2013
R5	SMPS600 V3	Unregulated Auxiliary Output Characteristics added	28.05.2015