

High Efficiency High Power Audio SMPS

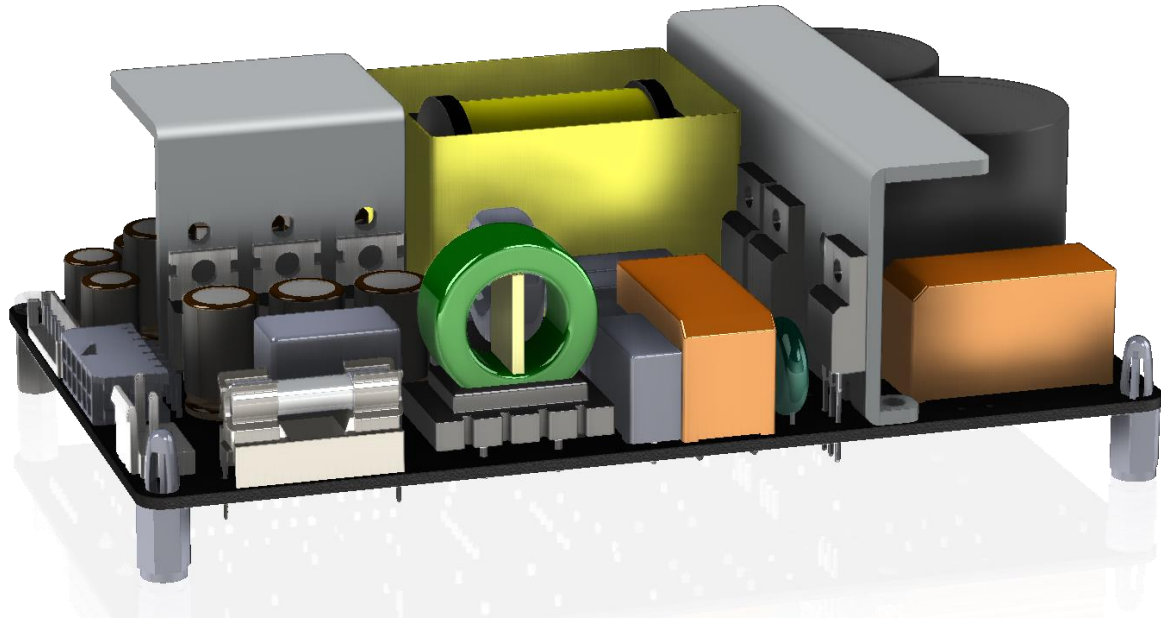


Image is for illustrative purposes only. Please refer to product description.

Highlights

- High efficiency
- Automatic input voltage selection
- Extremely small form factor
- Low EMI

Features

- Advanced over current protection
- Remote controlled operation
- Low weight: 360gr.
- Compact: 140 x 85 x 7.6mm

Applications

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

Introduction

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 are high efficiency over the entire load range, extremely small form factor, low weight and low radiated and conducted EMI. The SMPS600 also features an upgraded over current protection. When an overload condition remains for a longer period of time, the supply will enter hiccup mode until the overload condition disappears. This feature combined with large primary electrolytic buffer capacitors leads to the capability of delivering high dynamic headroom power to the connected amplifier. The SMPS600 is equipped with an automatic input voltage selector. This feature accommodates quasi universal mains capabilities. The SMPS600 also includes a symmetrical auxiliary output and a control circuit directly interfacing with our range of NCore amplifier modules. The supply is triggered for normal operation or latched off in case of critical fault via built-in actuators. The SMPS600 is optimized from the first phase of design to final implementation to realize the lowest possible EMI signature required of the most demanding audio applications.

Contents

Highlights	1
Features	1
Applications	1
Introduction	1
Contents	2
1 Safety precautions	3
1 Précautions de sécurité	3
2 Principle of operation	4
3 Electrical Specifications	5
3.1 Power Specifications	5
3.2 General Performance Data	5
3.3 Timing Specifications	5
4 Environmental Specifications	6
4.1 Heat dissipation	6
5 Product Markings	6
6 IO Specifications	7
6.1 SMPS Stand-by	7
6.2 DC-Error	7
6.3 Bootstrap Driver Voltage (V_{DR})	7
7 Connector Pinouts	8
7.1 Aux Voltage and PS Control	8
7.2 Main output connector	8
7.3 AC Connector Specification	9
8 Typical Performance Data	10
8.1 Output Power Examples	10
9 Dimensions	11
9.1 Ultra-low installation	11
9.2 Drill pattern	12
10 Safety compliance	13
11 Revisions	14
12 Disclaimer	14

1 Safety precautions



This module 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.



Attention: Observe precautions for handling electrostatic sensitive devices. This module uses semiconductors that can be damaged by electrostatic discharge (ESD).

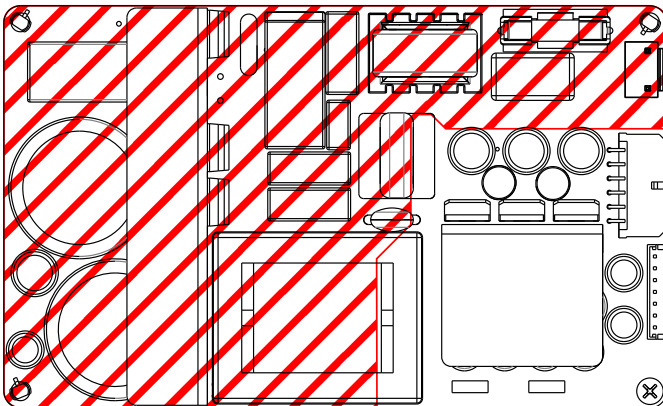
Damage due to inappropriate handling is not covered by warranty.

This product has no user-serviceable parts.



This symbol indicates the presence of hazardous voltages at accessible conductive terminals on the board. Parts that are not highlighted in red may also carry voltages in excess of 160 Vdc!

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



This is a Safety Class 2 device. When mounting the module in an enclosure, a minimum safety distance of 6mm from the SMPS to all possible conducting parts must be ensured to keep compliance with Safety Class 2. All parts enclosed by the red hatched area 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 red hatched area. The fourth hole should be a conductive spacer to improve EMI performance.

1 Précautions de sécurité



Ce module est sous tension secteur et certaines de ses pièces accessibles sont sous une tension dangereuse. Ces pièces doivent dans tous les cas être protégées contre contacts accidentels. Lors de l'installation, une prudence extrême s'impose. Ne jamais toucher les pièces du module quand celui-ci est relié au secteur. Isoler l'appareil du secteur et attendre 10 minutes pour laisser à tous les condensateurs le temps de se décharger avant de le manipuler.



Attention : Respecter les consignes de sécurité pour la manipulation d'appareils sensibles aux courants électrostatiques. Ce module est pourvu de semi-conducteurs qui peuvent être endommagés par les décharges électrostatiques (DES).

Les dommages causés par un usage non approprié sont exclus de la garantie.

Ce produit ne contient aucune pièce devant être entretenue par l'utilisateur.

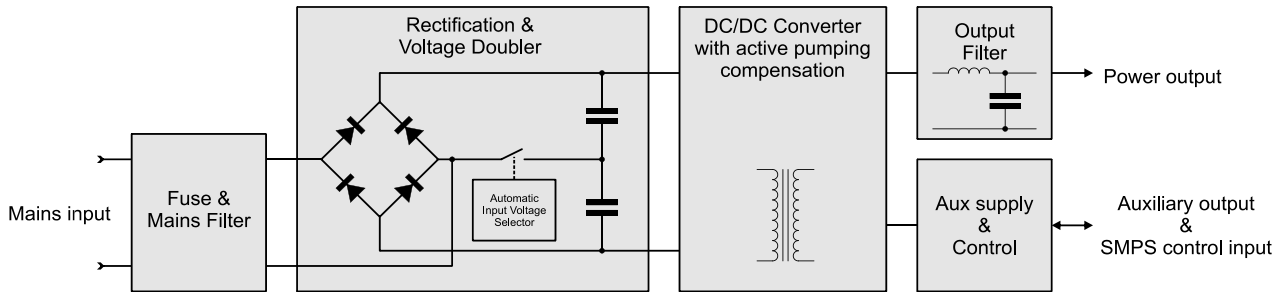


Ce symbole indique la présence de tensions dangereuses aux broches de raccordement accessibles sur la carte. Les pièces non marquées en rouge peuvent être elles aussi sous une tension supérieure à 160 VCC.

Avertissement: Pour réduire les risques de choc électrique, ne pas exposer cet appareil à la pluie ou l'humidité.

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. Don't run any cables across the top or the bottom of the module. Apply fixtures to cables to ensure that this is not compromised.
11. Observe a minimum clearance of 6mm with all possible conducting parts (housing etc.).
12. Natural convection should not be impeded by covering the module (apart from the end applications housing).
13. This product is to be used with Hypex amplifier modules only.
14. Before using this product, ensure all cables are correctly connected and the power cables are not damaged. If you detect any damage, do not use the product.
15. Changes or modifications not expressly approved by Hypex Electronics will void compliance and therefore the user's authority to operate the equipment.
16. Service or modifications by any person or persons other than by Hypex Electronics authorized personnel voids the warranty.

2 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.

3 Electrical Specifications

3.1 Power Specifications

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
High Line Input Voltage	-	V _B	200-240Vac ±10%			Vac	1)
Low Line Input Voltage	-	V _{B,FP}	100-120Vac ±10%			Vac	1)
Line Input Frequency	-	f	47		63	Hz	1)
Fuse rating	250Vac, slow blow, ceramic			8		A	2)

Note 1: Operation beyond these limits may result in irreversible damage.

Note 2: If fuse is blown, please consult a skilled technician to inspect your module. If applicable, replace the fuse with same type and rating.

3.2 General Performance Data

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Output Voltage Main	A400, symmetric	V _{OUT}	51	65	74	Vdc	1)
Max Output Short Circuit Current	Rail to rail	I _{OUT}		7		Adc	2)
Output Power	Resistive load	P _R	-	-	600	W	3)
Audio Output Power	20Hz into amplifier load	P _{RALF}	-	-	600	W	4)
Output Voltage Vaux	A400, symmetric	V _{AUX}	14.3	18.6	21.5	Vdc	1)
Output Current Vaux	Per rail	I _{AUX}	-	-	500	mA	5)
Output Voltage V _{DR}		V _{OUT,Vdr}	-	17	17.5	Vdc	
Output Current V _{DR}		I _{OUT,Vdr}	-	-	250	mA	5)
In-rush current	10Ω In-rush NTC, worst-case	I _{Inrush}			47	A	
Efficiency	230V 50Hz 300W output	η			92	%	
Power consumption	Depending on load	P _{max}			600	W	6)
	Idle losses (230V, 50Hz)	P ₀		8		W	
	In standby	P _{STB}		0.4		W	
Switching frequency		F _{SW}	70	90	110	kHz	

Note 1: Output voltage is proportional to the mains line voltage and load at output.

(Min@180Vac, Typical@230Vac, Max@264Vac measured at 0 load).

The typical value is not absolute but varies over production with 10%

Note 2: These outputs are fully long term short-circuit protected: outputs to ground, output to output.

Note 3: Output Power delivered to a resistive dummy load (generally the only specification supplied by other SMPS manufacturers). The DC output power is limited in time. Time depending on cooling of the total product.

Note 4: In the peak of a sine wave an audio amplifier actually draws twice the RMS power from the power supply. At high frequencies the secondary storage output caps are capable of providing this power. At very low frequencies however the SMPS is responsible for delivering this peak power to the amplifier.

Note 5: These outputs are **NOT** short-circuit protected.

Note 6: Measured with PF 0,55.

3.3 Timing Specifications

These timings are measured at room temperatures, approximately 21°C, 230Vac.

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Switching start up delay	Time to when all power supplies are within operational limits				6000	ms	
Shutdown delay	Supply failure or Standby pin	Depends on load and capacitor charge.					

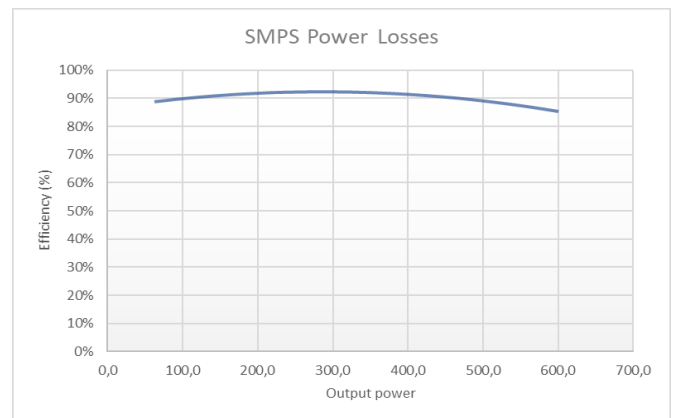
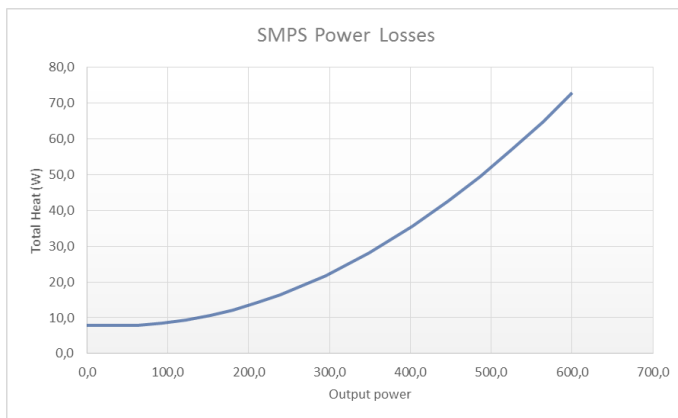
4 Environmental Specifications

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Ambient Temperature	Storage		-25	-	70	°C	
	Operation	T _{amb}	0	-	50	°C	
Heat-sink Temperature		T _{h,max}			90	°C	1)
Humidity	Max 85 percent relative humidity, non-condensing.						

Note 1: This module features a thermal shutdown mechanism to protect against over temperature. This mechanism is meant to be a final protection. Please apply adequate cooling measures to prevent over temperature.



4.1 Heat dissipation

Switch mode power supplies' known high efficiency often leads to a gross underestimation of the cooling required. Please apply adequate cooling to the module to ensure the module operates within specification. The following graphs provide an indication of the heat (in Watts) generated at different output levels. For more information regarding cooling, please refer to our application note "Thermal Design", available on our website. Defects caused by overheating due to poor thermal management are not covered by warranty.



5 Product Markings

This module has two marking stickers applied.

Model sticker example	Identification sticker example
<p>Hypex Electronics BV</p> <p>SMPS600 100-120V~ / 200-240V~ 50-60Hz 600W MAX</p> 	 <p>Hypex Electronics B.V. Kattegat 8, NL-9723JP</p> <p>WK/YR: wyyy</p> <p>H02U004726-0600A12345-0123 PCBA SMPS600N400</p>

6 IO Specifications

6.1 SMPS Stand-by

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-start of the SMPS600.

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
SMPS in standby	Logic High level		3,3	-	12	Vdc	1),
SMPS enabled	Logic Low level		-	-	0,8	Vdc	

Note 1: The current at the standby pin is limited to 10mA max.

6.2 DC-Error

In the event of a critical failure occurring in the connected amplifier, the SMPS600 needs to be switched off rapidly. The SMPS600 provides a single DC Error Input designated for UcD OEM/NCore series amplifiers. The DC Error Input is latched and will not auto-recover. To reset the DC Error the module must be disconnected from mains for at least 1 minute to allow the primary capacitors to drain.

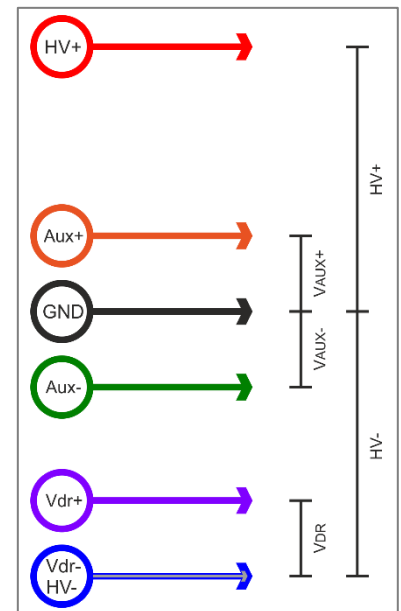
Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
No error condition	Use open collector		-	-	-	Vdc	1)
DC Error	Pull pin to Gnd		-	Gnd	-	Vdc	1), 2)

Note 1: DC-Error must be pulled to ground to activate. Hypex amplifier modules use open collector output (DC-Error pin) to achieve this.

Note 2: The current (A) can be calculated as follows: $(V_{aux} - 1.2) / 2200$

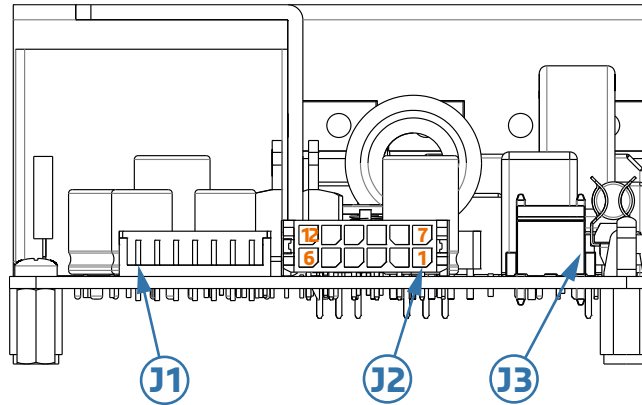
6.3 Bootstrap Driver Voltage (V_{DR})

The SMPS600 provides a regulated Bootstrap Driver Voltage (V_{DR}) which is used to power the driver circuit of an UcD or NCore series amplifier. Most Hypex amplifier modules need the V_{DR} voltage referenced to the negative supply rail (HV-). In order to achieve this, the V_{DR-} should be connected to the main negative supply rail (HV-) at the amplifier side. The V_{DR+} must be connected to the UcD/NCore series V_{DR} supply input.



7 Connector Pinouts

This chapter describes the functional connectors of the power supply module. A connector not stated in this chapter is only used for production or quality control and must remain unconnected in the end user appliance. The arrow point towards pin1 of the connector.



7.1 Aux Voltage and PS Control

Pin	Direction	Function	Remarks
J1.1	Input	SMPS Standby	
J1.2	-	NC	Do not connect
J1.3	Output	V _{AUX}	Positive Auxiliary Output
J1.4	-	NC	Do not connect
J1.5	-	GND	Ground
J1.6	-	NC	Do not connect
J1.7	Output	V _{AUX}	Negative Auxiliary Output

Connector type: B7B-EH-A(LF)(SN).

Matching cable part: EHR-7.

7.2 Main output connector

Pin	Direction	Function	Remarks
J2.1	Output	HV +	Positive power supply
J2.2	Output	HV +	Positive power supply
J2.3	-	GND	Ground
J2.4	-	GND	Ground
J2.5	Input	DC-Error	
J2.6	Output	V _{aux} +	Positive supply for op amps. (Formerly Vsig+)
J2.7	Output	HV -	Negative power supply
J2.8	Output	HV -	Negative power supply
J2.9	-	GND	Ground
J2.10	-	GND	Ground
J2.11	Output	VDR	VDR power supply
J2.12	Output	V _{aux} -	Negative supply for op amps. (Formerly Vsig-)

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

7.3 AC Connector Specification

Pin	Direction	Function	Remarks
J3.1	Input	Mains input	Phase AC
J3.3	Input	Mains input	Neutral AC

Connector type: B2P3-VH(LF)(SN).

Matching cable part: VHR-3N.

Note: As per Class 2 ground is not connected and so unavailable for safety ground. You must follow Class 2 safety standards in implementing the SMPS600.

Recommended reading: Application note - UcD and earth/Insulation

8 Typical 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 1/8th 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. $T_a = 25^\circ\text{C}$. Connected amplifier: 2x NC400 in stereo mode, $f = 1\text{kHz}$. SMPS600 is horizontally mounted in free air without additional external cooling. Distortion figures (THD+N) at the stated power ratings are below 1%.

Parameter	Conditions	Symbol	Typ	Unit	Note
Amplifier output power for 90sec.	120Vac/60Hz ¹⁾ 230Vac/50Hz	P _o	2x225 2x225	W	
Amplifier output power for 5 min.	120Vac/60Hz ¹⁾ 230Vac/50Hz	P _o	2x200 2x200	W	
Continuous output power.	120Vac/60Hz ¹⁾ 230Vac/50Hz	P _o	2x75 2x75	W	

Note 1: At low line input voltage the NTC is 'preheated' for 10 seconds at 2x 80W.

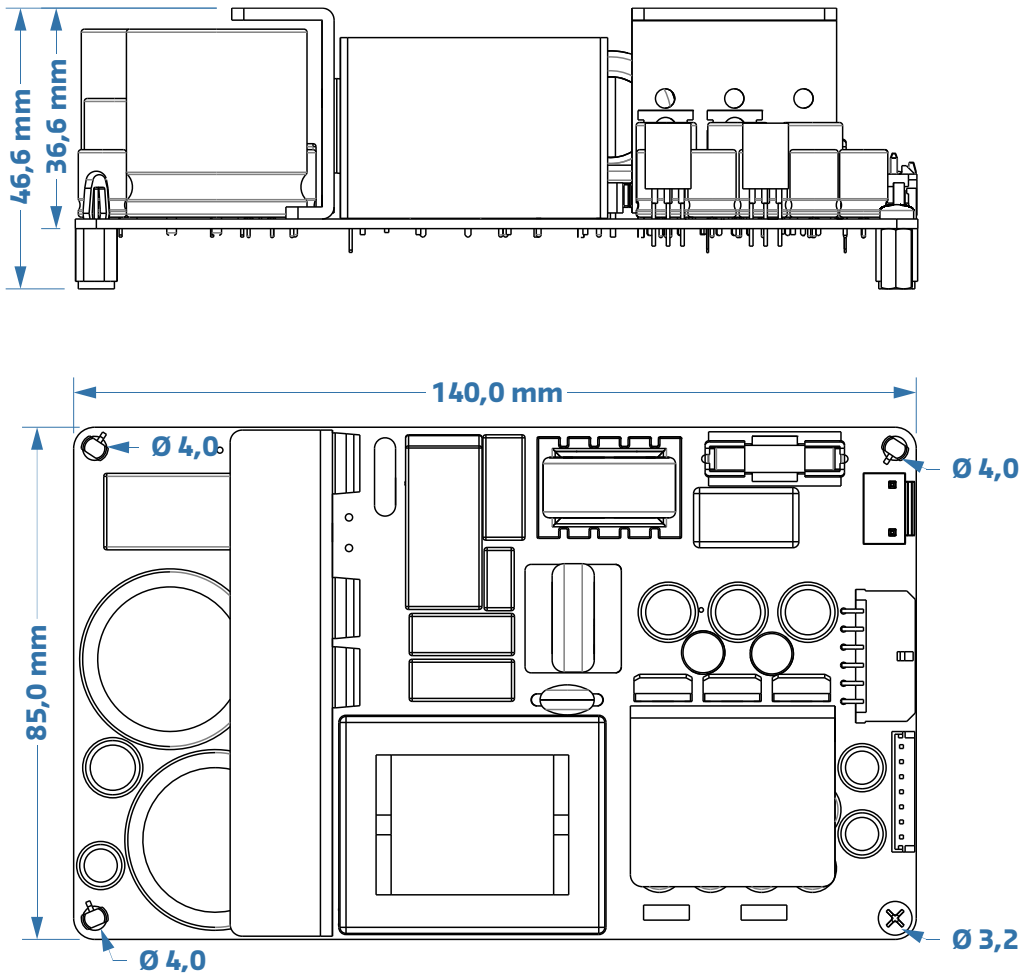
8.1 Output Power Examples

Connected amplifier: NC400, $f = 1\text{kHz}$. Distortion figures (THD+N) at the stated power ratings are at 1%. Thermal behaviour and limitations not taken into account in these measurements.

Parameter	Conditions	Symbol		Unit	Note
Total amplifier output power at different input voltages.	240Vac, Load = 2Ω, 2x NC400 ¹⁾	P _o	2x310	W	
	240Vac, Load = 2Ω, 1x NC400		1x450		
	240Vac, Load = 4Ω, 1x NC400		1x400		
	240Vac, Load = 8Ω, 1x NC400		1x220		
	230Vac, Load = 2Ω, 2x NC400 ¹⁾	P _o	2x300	W	
	230Vac, Load = 2Ω, 1x NC400		1x450		
	230Vac, Load = 4Ω, 1x NC400		1x360		
	230Vac, Load = 8Ω, 1x NC400		1x190		
	120Vac, Load = 2Ω, 2x NC400 ¹⁾	P _o	2x260	W	
	120Vac, Load = 2Ω, 1x NC400		1x450		
	120Vac, Load = 4Ω, 1x NC400		1x300		
	120Vac, Load = 8Ω, 1x NC400		1x170		

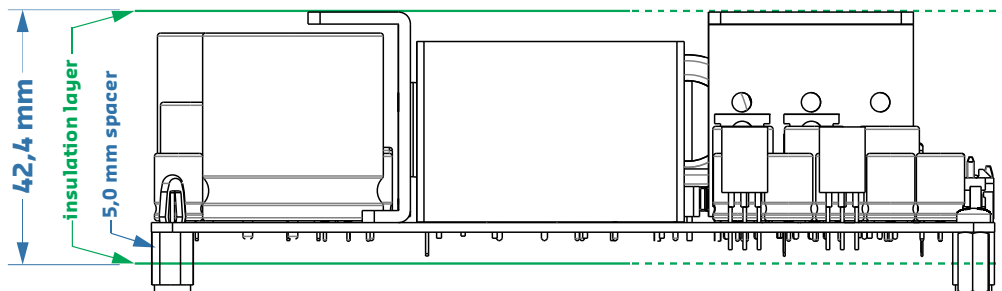
Note 1: In 2 Ohm, the NC400 is the limiting factor when only one NC400 is connected. This is due to the current limiter of the NC400. To get round this, two NC400 are connected with a 2 Ohm Load.

9 Dimensions



9.1 Ultra-low installation

When the SMPS600 is mounted in a tight space, smaller spacers (minimum height of 5mm) can be installed. Furthermore there needs to be a layer of insulation with a minimum thickness of 0.4mm between the top and bottom of the module (primary side) and the housing. Please pay attention to airflow and cooling capabilities. The drawing below is an example (and only an indication) on how this should be implemented. For exact application in compliance with Class II regulations, please consult the applicable standards (EN60065 / EN62368-1).



9.2 Drill pattern

Maximum allowed protruding depth inside each spacer is 6mm. Spacer threads are M3.

If printed correctly (scale 100%, A4), the scale of the image below should be 1:1. You may use it as a model to drill holes in your casing. Please verify before drilling!



10 Safety compliance

The SMPS600N400 revisions 0600 and higher is safety tested according to the following standards:

- IEC 60065:2014 + A11:2017
 - National deviations for CENELEC countries
 - National deviations for China
- IEC 62368-1:2014 + A11:2017
 - National deviations for CENELEC countries
 - National deviations for USA
 - National deviations for Canada
 - National deviations for New Zealand
 - National deviations for Australia
 - National deviations for Japan

Relevant standards

The SMPS600N400 revision 0600 and higher fulfils the requirements of:

- IEC60065:2014 + A11:2017
- IEC62368-1:2014 + A11:2017
- UL62368-1:2014 Ed.2
- CSA C22.2#62368-1:2014 Ed.2

Test procedure

- CB scheme IEC60065
 - Test laboratory: Intertek SEMKO
 - Ref. Certif. No: SE-101060
- CB scheme IEC62368-1
 - Test laboratory: Intertek SEMKO
 - Ref Certif. No: SE-101061

ETL listing

The SMPS600N400 is an ETL listed component for the USA (UL62368-1:2014 Ed. 2) and Canada (CSA C22.2#62368-1:2014 Ed.2).

11 Revisions

Document revision	Module revision	Change log	Date
01	SMPS600 01xx	Initial Draft.	19-12-2011
02	SMPS600 01xx	Instructions for installation added	13-02-2012
03	SMPS600 02xx	Discharge resistors added Improved AC-detection	02-03-2012
04	SMPS600 03xx	Format changed	17-01-2013
05	SMPS600 03xx	Unregulated Auxiliary Output Characteristics added	28-05-2015
06	SMPS600 05xx	Datasheet new layout Height of cooling profile changed	Oct '16
07	SMPS600 05xx	Typographical inaccuracies revised Module efficiency increased Safety compliance	June '17
08	SMPS600 05xx	Paragraph 6.1 corrected	June '19
09	SMPS600 06xx	Added safety approbations Updated ambient temperature for new approbation	May '20
10	SMPS600 06xx	Corrected typo in product markings	Dec '20

12 Disclaimer

All products, product specifications and data are subject to change without notice to improve reliability, function or design or otherwise.

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