

High Efficiency Audio SMPS



Image is for illustrative purposes only. Spacers not included. Please refer to product description.

Highlights

- High efficiency
- Selectable input voltage range
- Extremely small form factor
- Low EMI
- 3 variants available
- Can be fitted in 1 HE.

Features

- Advanced over current protection
- Remote controlled operation
- Low weight: 300gr.
- Compact design:
105 x 95 x 40mm

Applications

- Supply for single or multiple amplifiers of the UcD range
- Active loudspeakers

Introduction

The SMPS400 is a high efficiency Safety Class 2 switch mode power supply specifically designed for use with our range of UcD amplifier modules. Key features are high efficiency over the entire load range, extremely small form factor, low weight and very low radiated and conducted EMI. The SMPS400 also features an advanced 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. The SMPS400 also includes an auxiliary isolated supply and a control circuit directly interfacing with our range of (OEM and standard) UcD amplifier modules. The supply is triggered for normal operation or latched off in case of a critical fault via in built-in actuators. The SMPS400 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 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).

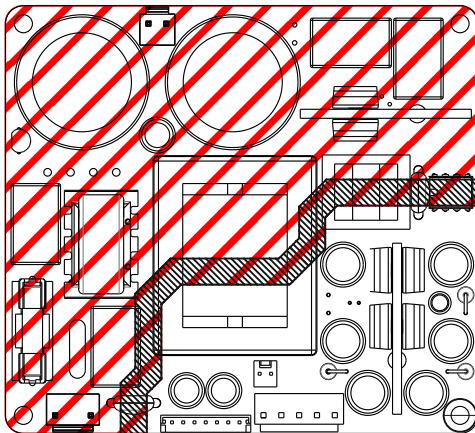
Damage due to inappropriate handling is not covered by warranty.

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 150 Vdc!

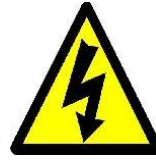
Warning: To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture.



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 line carry hazardous voltages. This includes parts on the top and the bottom of the board. Only use insulated spacers and fasteners in the red area.

If the enclosure is limited in height, for instance a 1HE 19" enclosure, one shall need to use smaller spacers and provide a layer of insulation both above and below the SMPS with a minimum thickness of 0.4 mm in order to comply with the Class 2 Safety Directive. For more information, see dimensions.

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 150 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 prolonged 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.

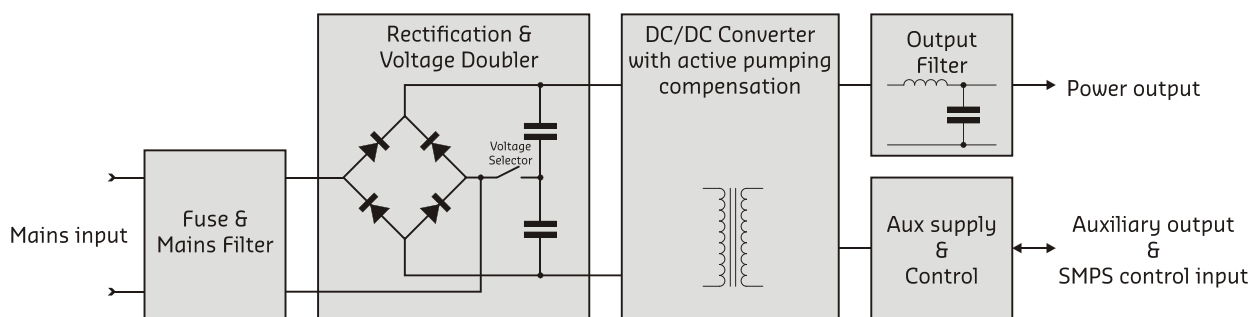
2 The SMPS400 Series

The SMPS400 series is a range of Switch Mode Power Supplies. In the next table, there is an overview of the different models, their output voltages and application.

Model	Main rails output	For use with amplifiers (examples)
SMPS400A100	2x 37Vdc	UcD102
SMPS400A180	2x 46Vdc	UcD180 Series,
SMPS400A400	2x 62Vdc	UcD250LP, UcD400 Series

Please refer to the amplifier's datasheet for more information.

2.1 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 SMPS400 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	180	230	264	Vac	1)
Low Line Input Voltage	With Low Line jumper placed	V _{B,FP}	90	115	132	Vac	1)
Line Input Frequency	-	f	47		63	Hz	1)
Fuse rating	250Vac, slow blow			5		A	2)

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

Note 2: If the fuse is blown, please have the module serviced by a skilled technician.

3.2 General Performance Data

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Output Voltage Main	A100, symmetric	V _{OUT}	2x29	2x37	2x43	Vdc	1), 2)
	A180, symmetric	V _{OUT}	2x35	2x46	2x53	Vdc	1), 2)
	A400, symmetric	V _{OUT}	2x48	2x62	2x72	Vdc	1), 2)
Short Circuit Current	A100, rail-to-rail	I _{OUT,MAX}	-	12.5	-	Adc	2)
	A180, rail-to-rail	I _{OUT,MAX}	-	10	-	Adc	2)
	A400, rail-to-rail	I _{OUT,MAX}	-	7	-	Adc	2)
Max Output Power	20Hz into amplifier load	P _{RALF}	400	-	-	W	3)
Output Voltage Vaux	A100, A180, symmetric	V _{AUX}	2x16	2x21	2x24	Vdc	1), 4)
	A400, symmetric	V _{AUX}	2x15	2x20	2x23	Vdc	1), 4)
Output Current Vaux	All versions, per rail	I _{AUX}	-	-	500	mA	
In-rush current	5Ω In-rush NTC, worst-case	I _{Inrush}			75	A	
Efficiency	Full power	η	-	92	-	%	
Idle Losses	230 Vac, 50 Hz	P ₀	-	-	7.5	W	
Power consumption	Depending on load	P _{max}			470	W	
Standby power		P _{standby}		450		mW	
Switching frequency		F _{SW}	80	100	120	kHz	

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

Note 2: Limited by over current protection. These outputs are fully long term short circuit protected: outputs to ground, output to output.

Note 3: 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 4: These outputs are not short circuit protected.

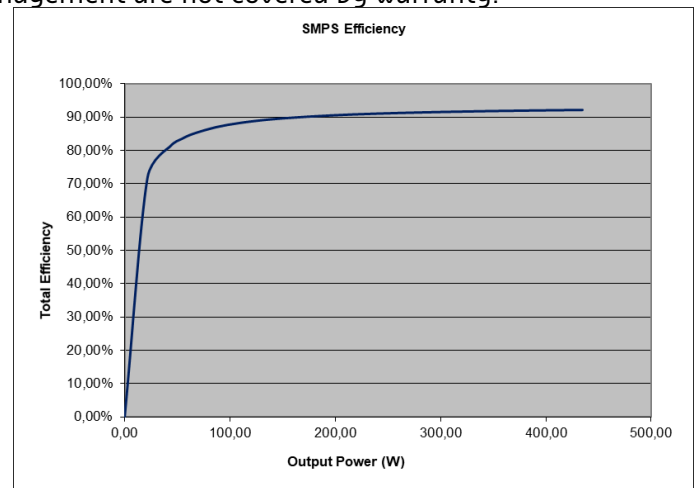
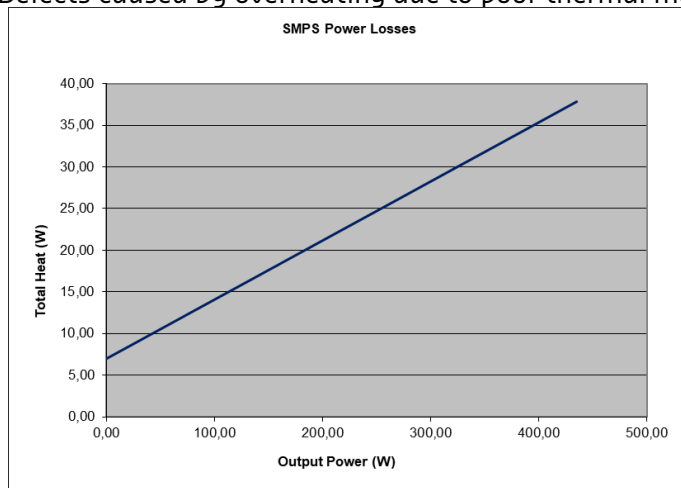
4 Environmental Specifications

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Ambient Temperature	Storage		-25	-	70	°C	
	Operation		0	-	50	°C	
Heat-sink Temperature		$T_{h,max}$			95	°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>SMPS400 100-120V~ / 200-240V~ 50-60Hz 470W MAX</p> 	 <p>Hypex Electronics B.V. Kattegat 8, NL-9723JP</p> <p>WK/RV: wwyy H02U004311-1500A12345-0123 PCBA SMPS400A100</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 started start-up of the SMPS400. Putting the SMPS in standby also automatically releases the Auto Amplifier Enable line guaranteeing pop-free shut down of the connected UcD amplifier. This is an opto-coupler input with a 470 ohm series resistor.

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: Current drawn MAX 15mA

6.2 Amp Standby

Applying an external DC voltage to the Amp Standby pin will put the amplifier in standby. The connected amplifier must be connected to Auto Amplifier Enable, described below, in order to use this option.

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

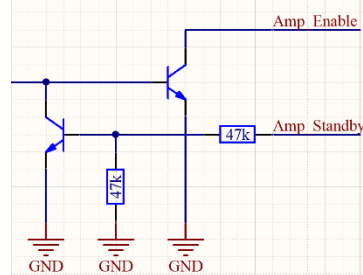
Note 1: The current (A) drawn can be calculated as follows: $(V_{pin} - 0.7) / 47000$

6.3 Auto Amplifier Enable

When the enable-line of a UcD/NCore series amplifier is connected to this pin, the amplifier will be enabled and disabled automatically when the SMPS400 is switched on and off. By doing so, it prevents unwanted audio artefacts during power cycles.

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Collector voltage	Open collector output		-	-	50	V	
Collector current	Open collector output		-	-	100	mA	

Using Amp Standby in combination with Amp Enable one can make a pop-free control of the SMPS and amplifier setup. This circuit illustrates a part of the internal circuit of the SMPS.



6.4 DC Error

In the event of a critical failure occurring in the connected amplifier, the SMPS400 needs to be switched off rapidly. The SMPS400 provides a single DC Error Input designated for UcD OEM series amplifiers. The DC Error Input is latched and will not auto-recover. To reset the DC Error The SMPS400 needs to be disconnected from the mains for at least 10 seconds to reset.

Application:

Pin 33 of the 36-pin connector on the UcD180OEM/UcD400OEM, pin 8 of the 14-pin connector on the UcD180LPOEM or pin 28 of the 36-pin connector on the UcD102OEM needs to be connected to this pin to enable this function. Multiple modules can be connected to this pin. This input is incompatible with UcD180HG and UcD400HG modules. Use DC Detect instead.

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: $(V_{aux} - 1.2) / 1000$.

6.5 DC Detect 1 & 2

In the event of a critical failure occurring in the connected amplifier which may cause damage to the connected loudspeaker, the SMPS400 needs to be switched off rapidly. The SMPS400 provides double generic DC Detect Inputs. If a DC voltage (>12Vdc) is detected on these pins, the DC Error circuit is triggered. The DC Error is latched and will not auto-recover. The SMPS400 needs to be disconnected from the mains for at least 10 seconds to reset. A total of two amplifier modules can be connected.

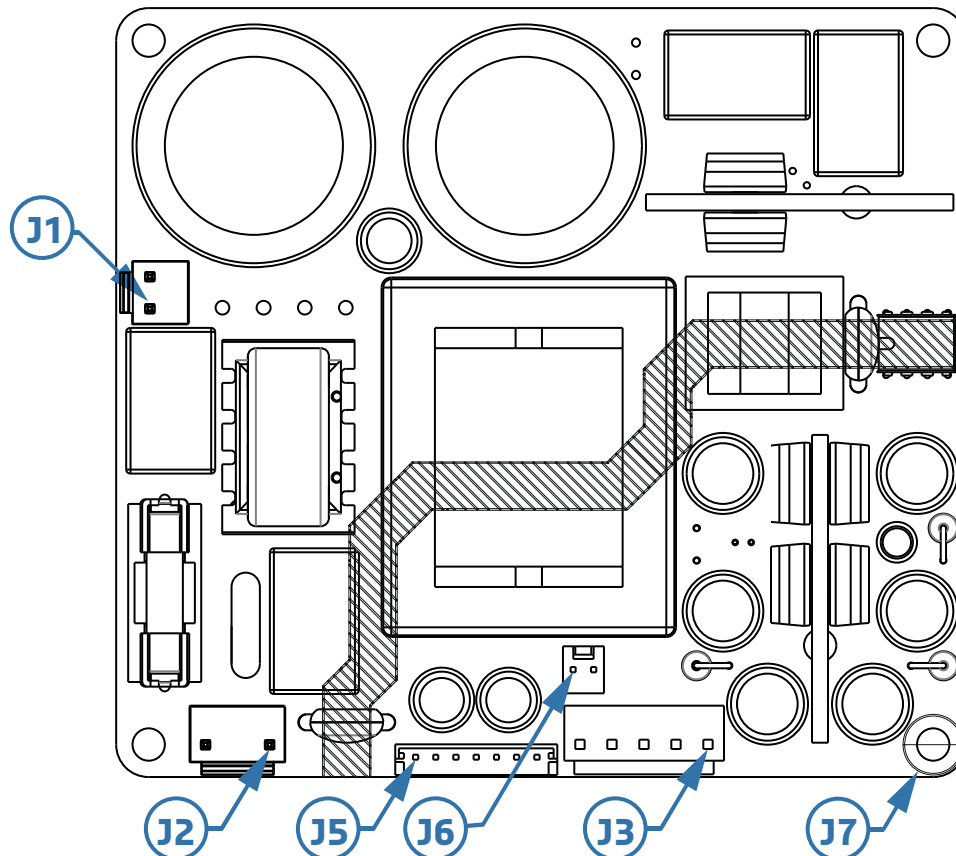
Application:

Connect the positive loudspeaker output of the amplifier to a DC Detect pin. DC Detect is specifically for the UCD HG modules and generic amplifiers which have no onboard DC Detect features.

If the connected amplifier has its own DC Detect circuit (DC Error output), using the DC Error input is preferred.

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 application. The arrow points towards pin1 of the connector.



7.1 Mains Voltage Selection

Pin	Direction	Function	Remarks
J1.1-2	Jumper	Input Voltage Select	Open = 230Vac; Closed = 115Vac.

Connector type: B2P-VH.

Matching cable part: VHR-2N.

7.2 AC Connector Specification

Pin	Direction	Function	Remarks
J2.1	Input	Mains input	Neutral AC
J2.3	Input	Mains input	Phase AC

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

Matching cable part: VHR-3N.

Note : As per Class 2 protective earth is not available for safety ground. One must follow Class 2 safety standards in implementing the SMPS400

Note : The use of a dual pole AC mains switch is recommended. When a single pole switch is used, it must be placed in series with J2.3 to ensure correct shutdown upon mains removal through this single pole switch.

7.3 Main output

Pin	Direction	Function	Remarks
J3.1	Output	HV+	Positive Output Voltage
J3.2	-	GND	Output Ground
J3.3	Output	HV-	Negative Output Voltage
J3.4	Input	DC Error	OEM amplifier series only
J3.5	Output	Auto Amplifier Enable	Amplifier enabled when low

Connector type equivalent: B5P-VH.

Matching cable part: VHR-5N.

7.4 Auxiliary output

Pin	Direction	Function	Remarks
J5.1	Input	SMPS Standby	
J5.2	Input	Amplifier Standby	
J5.3	Output	V _{AUX}	Positive Auxiliary Output Voltage
J5.4	-		Not connected
J5.5	-	Ground	
J5.6	-		Not connected
J5.7	Output	V _{AUX}	Negative Auxiliary Output Voltage

Connector type equivalent: B7B-EH.

Matching cable part: EHR-7.

7.5 DC Detect

Pin	Direction	Function	Remarks
J6.1	Input	DC Detect 1	UcD-series ST/HG or generic amplifier
J6.2	Input	DC Detect 2	UcD-series ST/HG or generic amplifier

Connector type: 2-pin MOLEX® KK® series 22-27-2021

7.6 J7: Chassis grounding

J7 is connected to secondary ground with a 100nF capacitor. Connect J7 to chassis with a metal spacer for optimum EMI performance.

8 Typical Performance Data

The SMPS400 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 SMPS400 is therefore perfectly capable of driving the connected amplifier in clipping continuously with a music signal without the need of forced cooling.

Unless otherwise specified. Ta = 25°C. Connected amplifier: UcD400OEM , f = 1kHz.

SMPS400 is horizontally mounted in free air without additional external cooling. Amplifier is driven till thermal protection comes in. Measurements are done without preheating. Distortion figures (THD+N) at the stated power ratings are below 1%.

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Amplifier output power for 90sec.	UcD400OEM BTL Load = 8Ω 120Vac/60Hz 230Vac/50Hz	P _o		400 400		W	
Amplifier output power for 5 min.	UcD400OEM BTL Load = 8Ω 120Vac/60Hz 230Vac/50Hz	P _o	-	300 330		W	
Continuous output power.	Load = 4Ω 120Vac/60Hz 230Vac/50Hz	P _o	-	100 100		W	

8.1 Output Power (SMPS400A100)

Connected amplifier: UcD102OEM , f = 1kHz.

Distortion figures (THD+N) at the stated power ratings are at 1%.

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Total amplifier output power at different input voltages.	240VAC Load = 4Ω Load = 8Ω Load = 8 Ω BTL	P _o		115 58 230		W	
	230VAC Load = 4Ω Load = 8Ω Load = 8 Ω BTL	P _o		110 56 224		W	
	120VAC Load = 4Ω Load = 8Ω Load = 8 Ω BTL	P _o		114 57 227		W	
	90VAC Load = 4Ω Load = 8Ω Load = 8 Ω BTL	P _o		74 42 139		W	

Note: Thermal behaviour and limitations not taken into account in these measurements.

8.2 Output Power (SMPS400A180)

Connected amplifier: UcD180OEM, $f = 1\text{kHz}$.

Distortion figures (THD+N) at the stated power ratings are at 1%.

Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Total amplifier output power at different input voltages.	240VAC Load = 4Ω Load = 8Ω	P_o		190 120		W	
	230VAC Load = 4Ω Load = 8Ω	P_o		185 115		W	
	120VAC Load = 4Ω Load = 8Ω	P_o		140 105		W	
	90VAC Load = 4Ω Load = 8Ω	P_o		90 65		W	

Note: Thermal behaviour and limitations not taken into account in these measurements.

8.3 Output Power (SMPS400A400)

Connected amplifier: UcD400OEM, $f = 1\text{kHz}$.

Distortion figures (THD+N) at the stated power ratings are at 1%.

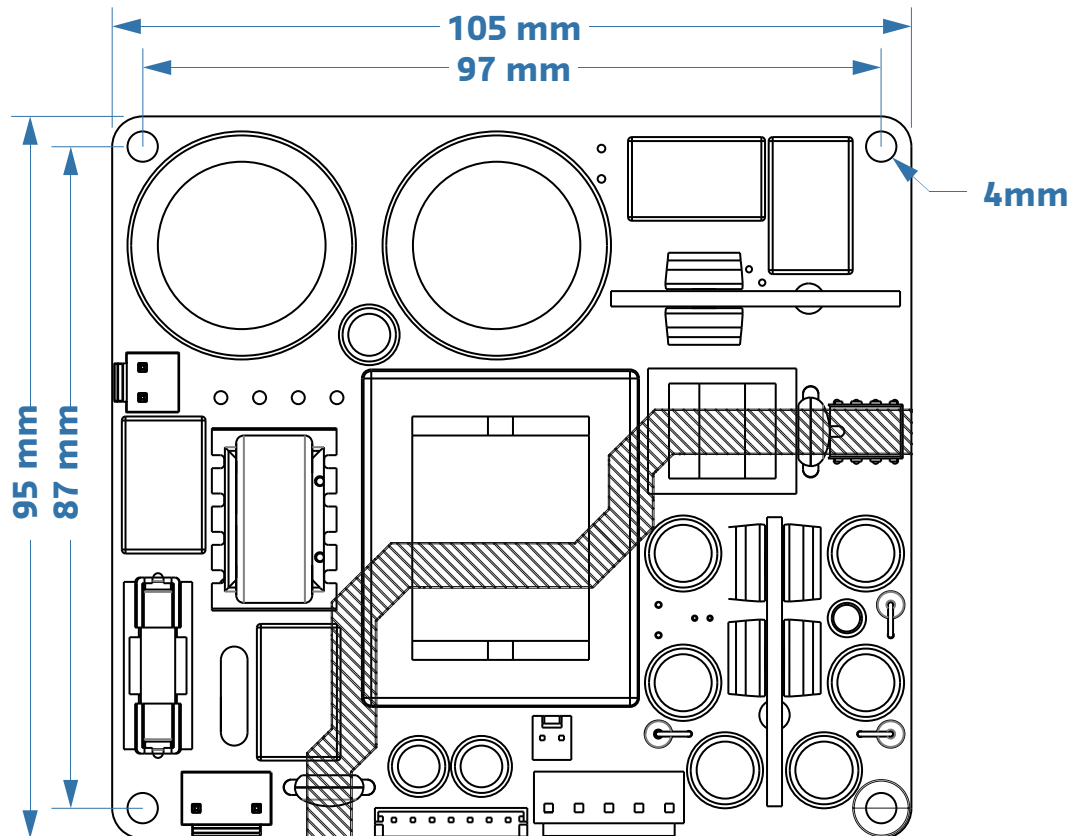
Parameter	Conditions	Symbol	Min	Typ	Max	Unit	Note
Total amplifier output power at different input voltages.	240VAC Load = 4Ω Load = 8Ω	P_o		410 235		W	
	230VAC Load = 4Ω Load = 8Ω	P_o		375 215		W	
	120VAC Load = 4Ω Load = 8Ω	P_o		345 220		W	
	90VAC Load = 4Ω Load = 8Ω	P_o		205 125		W	

Note: Thermal behaviour and limitations not taken into account in these measurements.

9 Dimensions and Drill pattern

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!

9.1 Top view

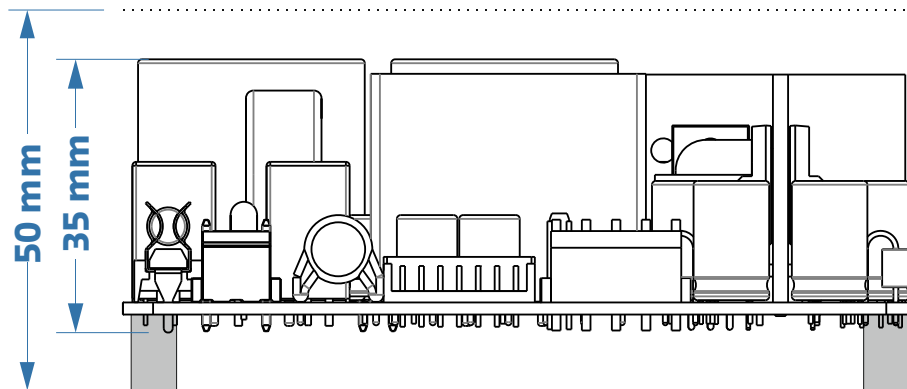


9.2 Side view

9.2.1 Normal installation

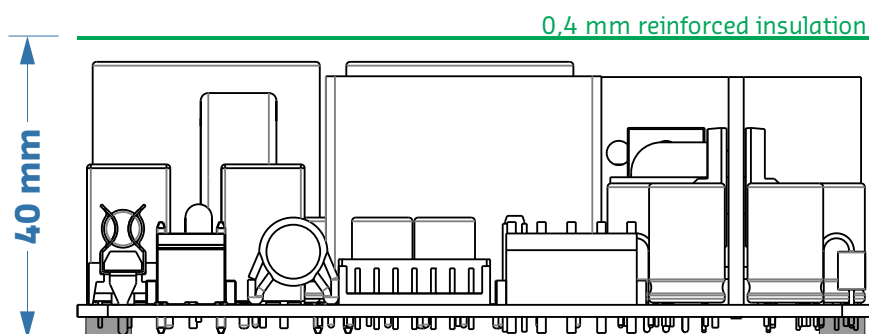
This is a Safety Class 2 device. When mounting the module in an enclosure, a minimum safety distance of 6mm from the SMPS to all possible conducting parts must be ensured to keep compliance with Safety Class 2. This includes parts on the top, the bottom and all sides of the board. For more information, refer to the applicable safety directives.

Spacers are not included with the module. Spacer sets can be ordered separately.



9.2.2 Low profile installation

If the enclosure is limited in height, for instance a 1HE 19" enclosure, one shall need to use smaller spacers and provide a layer of insulation both above and below the SMPS with a minimum thickness of 0.4 mm to comply with the Class 2 Safety directive. In the example given spacers of 3mm are used in combination with two sheets of insulation (green layers). For more information, refer to the applicable safety directives.



Note: In all cases, provide a minimum clearance of 3 mm over the primary capacitors, to avoid blocking the correct opening of the pressure relief vent.

10 Safety compliance

The SMPS400 revisions 1500 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 SMPS400 revision 1500 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-100158
- CB scheme IEC62368-1
 - Test laboratory: Intertek SEMKO
 - Ref Certif. No: SE-100159

ETL listing

The SMPS400 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
15	SMPS400 9xx	- Correct auxiliary output voltage ambiguity	June 2011
16	SMPS400 9xx	- Connector references corrected in description table - Format changed	June 2012
17	SMPS400 9xx	- Aux supply information changed	Dec 2012
18	SMPS400 13xx	- SMPS400A100 added	June 2013
19	SMPS400 13xx	- Output voltages corrected	Oct 2013
20	SMPS400 13xx	- Auxiliary output figures corrected	Feb 2015
21	SMPS400 14xx	- Datasheet format in line with new format. - Added ETL / CB certification required data. - Added several missing figures. - Corrected Vaux figure A180. - Corrected Typical Performance Data. - Renamed 'DC Error 1 & 2' to 'DC Detect' to clarify difference. - Added new drawing to clarify dimensions. - The module's behaviour and all functions are unchanged.	May 2017
22	SMPS400 15xx	Module updated to 15xx	Feb 2019
23	SMPS400 15xx	- Added mounting precautions to Chapter 1 - Updated marking labels - Added safety approbations	Feb 2020
24	SMPS400 15xx	- Added note regarding use of single pole mains switches under 7.2 AC Connector Specifications	Oct 2020

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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