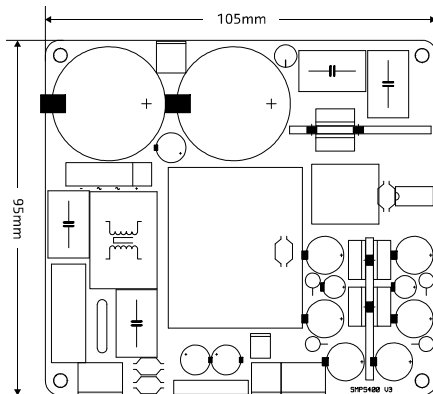


## High Efficiency Audio SMPS



### Highlights

- High efficiency
- Selectable input voltage range
- Extremely small form factor
- Low EMI

### Features

- Advanced over current protection
- Remote controlled operation
- Low weight: 300gr.
- Compact: 105 x 100 x 42(37)mm
- Fits in 1HE (with an extra shielding)
- Fixed output voltage (2 versions available)

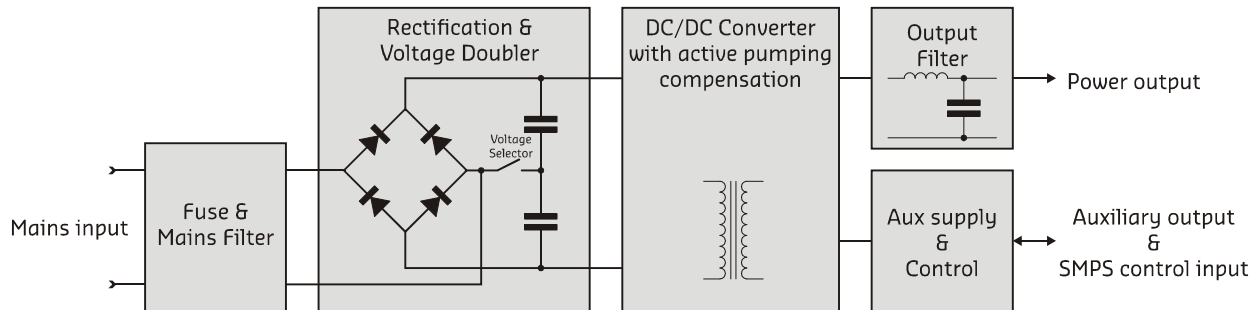
### Applications

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

## Description

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.

## 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.

## Safety precautions

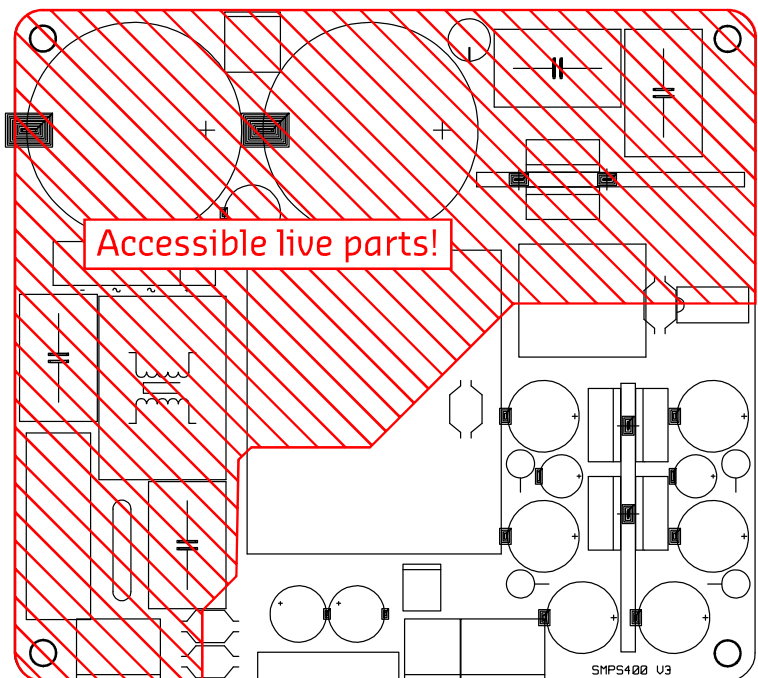


The SMPS400 operates at mains voltage and carries hazardous voltages at accessible parts. These parts may never be exposed to inadvertent touch. Observe extreme care during installation and never touch any part of the unit while it is connected to the mains. Disconnect the unit from the mains and allow all capacitors to discharge for 5 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 (T5,0H).

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 dotted line below carry hazardous voltages. This includes parts on the top and the bottom of the board. When the SMPS400 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.

Standard the SMPS400 is supplied with 10mm spacers to mount the SMPS onto the chassis. 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, for instance an 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 0.5mm in order to comply with the Class 2 Safety Directive. If these measures are taken into account, the maximum height can be reduced to 37mm.



## 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	$V_{LINE}$	270	Vac	
Air Temperature	$T_{AMB}$	50	°C	
Heat-sink temperature	$T_{SINK}$	95	°C	

## Recommended Operating Conditions

Item	Symbol	Min	Typ	Max	Unit	Notes
High Line Input Voltage	$V_B$	180	230	264	Vac	
Low Line Input Voltage	$V_{B,FP}$	90	115	132	Vac	

## General Performance data (All versions)

Item	Symbol	Min	Typ	Max	Unit	Notes
Unregulated Output Voltage Aux	$V_{OUT,AUX}$	2 x 20	2 x 21	2 x 22	Vdc	See Note 3
Output Current Aux	$I_{OUT,AUX}$	500m	-	-	A	per rail
Max Output Power	$P_R$	600	-	-	W	See Note 1
Max Audio Output Power @ 20Hz into amplifier load	$P_{RALF}$	400	-	-	W	See Note 2
Efficiency	$\eta$		TBD		%	full power
Idle Losses	$P_o$		2		W	
Standby Power	$P_{standby}$		TBD		W	
Switching frequency	$F_{SW}$		100		kHz	

## General Performance data (SMPS400A400)

Item	Symbol	Min	Typ	Max	Unit	Notes
Output Voltage	$V_{OUT}$		2 x 63	2 x 72	Vdc	See Note 3
Output Current	$I_{OUT}$				A	

## General Performance data (SMPS400A180)

Item	Symbol	Min	Typ	Max	Unit	Notes
Output Voltage	$V_{OUT}$		2 x 49	2 x 56	Vdc	See Note 3
Output Current	$I_{OUT}$				A	

**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:** Output voltage is proportional to the mains line voltage (Typical 230Vac).

## Output Power 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 1/8<sup>th</sup> 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 additional external cooling.

Unless otherwise specified.  $T_o = 25^{\circ}\text{C}$ . Connected amplifier: UcD400OEM<sup>®</sup>,  $f = 1\text{kHz}$ .

SMPS400 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 30 sec. until $T_{\text{MAX}} = 100^{\circ}\text{C}$	$P_o$	BTL Load = $8\Omega$ 120Vac/60Hz 230Vac/50Hz	600 650	W	2 x UcD400OEM <sup>®</sup> In BTL configuration
Amplifier output power for 1 min. until $T_{\text{MAX}} = 100^{\circ}\text{C}$	$P_o$	BTL Load = $8\Omega$ 120Vac/60Hz 230Vac/50Hz	500 550	W	2 x UcD400OEM <sup>®</sup> In BTL configuration
Amplifier output power for 5 min. until $T_{\text{MAX}} = 100^{\circ}\text{C}$	$P_o$	Load = $4\Omega$ 120Vac/60Hz 230Vac/50Hz	400 400	W	
Continuous output power. $T_{\text{MAX}}$ stabilized at $100^{\circ}\text{C}$	$P_o$	Load = $4\Omega$ 120Vac/60Hz 230Vac/50Hz	150 150	W	

### J1: Mains Voltage Input Selection. Connector type: JST-B2P-VH

Pin	Function
1,2	Not Connected = 230Vac Mains; Connected = 115Vac Mains

### J2: Mains Input. Connector type: JST-B3P-VH

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 SMPS400. Also read <http://www.hypex.nl/docs/earth.pdf>

### J3: Main Output Connections. Connector type: JST-B5P-VH

Pin	Type	Function
1	Output	Positive Output Voltage (Vcc)
2	Output	Output Ground
3	Output	Negative Output Voltage (Vee)
4	Input	DC Error Input (OEM amplifier series only)
5	Output	Auto Amplifier Enable

### J4: Amplifier Control. Connector type: JST-B2P-VH

Pin	Type	Function
1		
2		

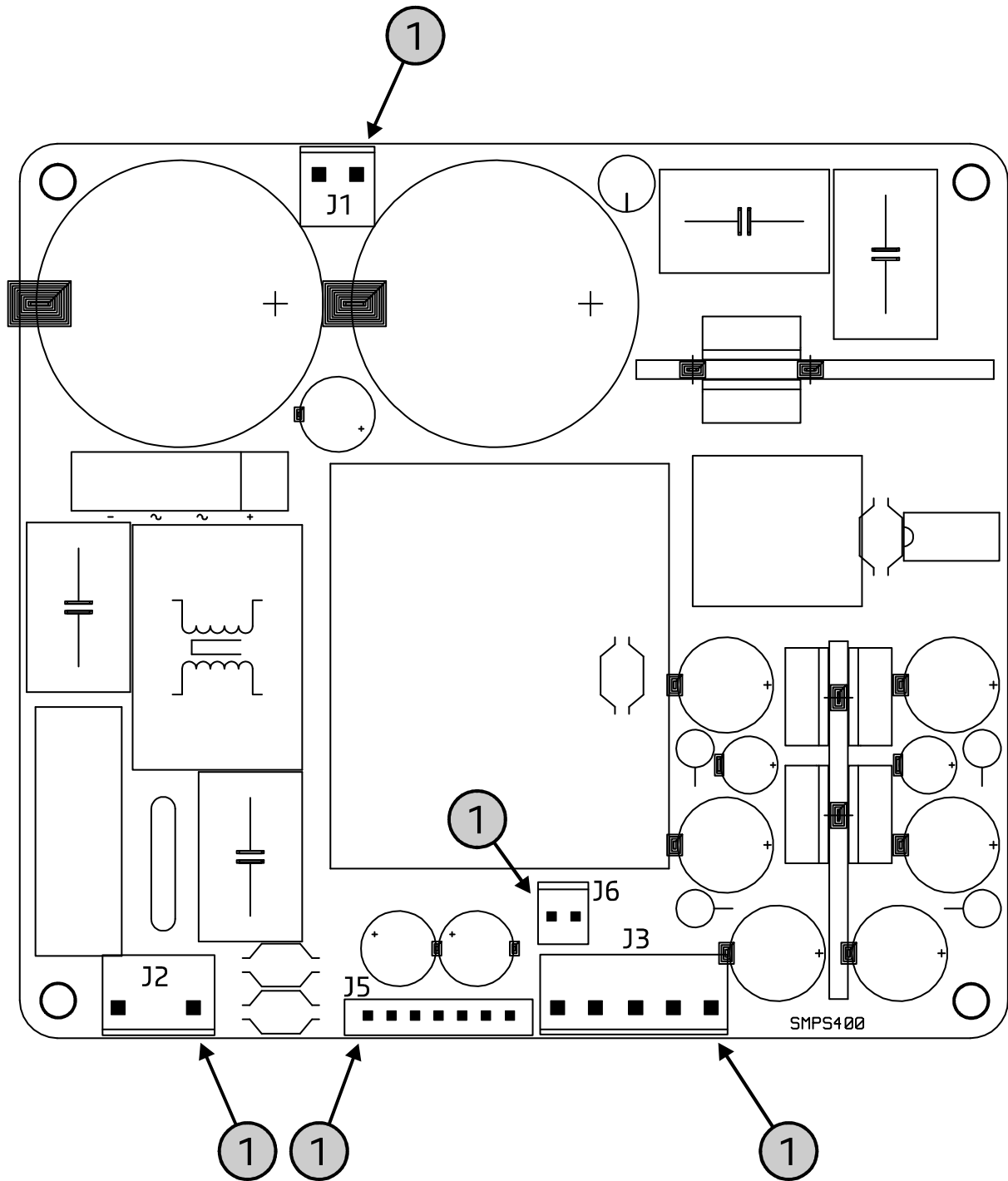
**NOTE:** Connectors J3 (3-pin) and J4 (2-pin) have been combined to a single 5-pin connector to avoid wiring mishaps.

### J5: Aux & Control. Connector type: JST-B7B-EHA

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

### J6: DC Error. Connector type: 2-pin MOLEX® KK® series

Pin	Type	Function
1	Input	DC Error Input 1 (UcD®-series ST/HG or generic amplifier)
2	Input	DC Error Input 2 (UcD®-series ST/HG or generic amplifier)



**Fig1.** Connector pinning SMPS400.

## 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 SMPS400. Putting the SMPS in standby also automatically release the Auto Amplifier Enable line guaranteeing pop-free shut down of the connected UcD® amplifier.

Item	Type	Min	Typ	Max	Unit	Notes
DC voltage on J5:1	input	3,3		12	Vdc	

## Amplifier Standby Input Characteristics

Applying an external DC voltage to the amplifier 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.

Item	Type	Min	Typ	Max	Unit	Notes
DC voltage on J5:2	input	0		Vcc	Vdc	

## Unregulated Auxiliary Output Characteristics

The SMPS400 provides Unregulated Auxiliary Output Voltages that are available for external auxiliary purposes.

Item	Type	Min	Typ	Max	Unit	Notes
Positive DC voltage on J5:3	output		21		Vdc	See note 1,2
Negative DC voltage on J5:7	output		21		Vdc	See note 1,2

**Note 1:** Output voltage is fixed by design and proportional to the mains line voltage.

**Note 2:** These outputs are short term shortcut protected (1 sec.)

## Output Voltage Characteristics SMPS400A400

Item	Type	Min	Typ	Max	Unit	Notes
Positive DC voltage on J3:1	Output		63		Vdc	See note 1,2
Negative DC voltage on J3:3	Output		-63		Vdc	See note 1,2

**Note 1:** Output voltage is fixed by design and proportional to the mains line voltage.

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

## Output Voltage Characteristics SMPS400A180

Item	Type	Min	Typ	Max	Unit	Notes
Positive DC voltage on J3:1	Output		49		Vdc	See note 1,2
Negative DC voltage on J3:3	Output		-49		Vdc	See note 1,2

**Note 1:** Output voltage is fixed by design and proportional to the mains line voltage.

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

## Output Grounds Characteristics

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

## 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 SMPS400 needs to be switched-off rapidly. The SMPS400 provides a single DC Error Input designated for a UcD<sup>®</sup> OEM series amplifier. The DC-Error Input is latched and will not auto-recover. The SMPS400 needs to be disconnected from the mains a couple of minutes to reset.

Item	Type	Min	Typ	Max	Unit	Notes
DC voltage on J4:1	Input				Vdc	* Use open collector

\* Pin 33 of the 36-pin connector on the UcD180OEM<sup>®</sup>/UcD400OEM<sup>®</sup> or pin 8 of the 14-pin connector on the UcD100OEM<sup>®</sup>/UcD180OEM<sup>®</sup> needs to be connected to this pin to enable this function. Multiple modules can be connected to this pin.

## Auto Amplifier Enable Characteristics

When the enable-line of a UcD<sup>®</sup>-series amplifier is connected to this pin the amplifier will be enabled and disabled automatically when the SMPS400 is switched on and off preventing unwanted audio artefacts during power-up and power-down.

Item	Type	Min	Typ	Max	Unit	Notes
DC voltage on J4:2	Output					Internal open collector

## DC Error Input 1 & 2 Characteristics

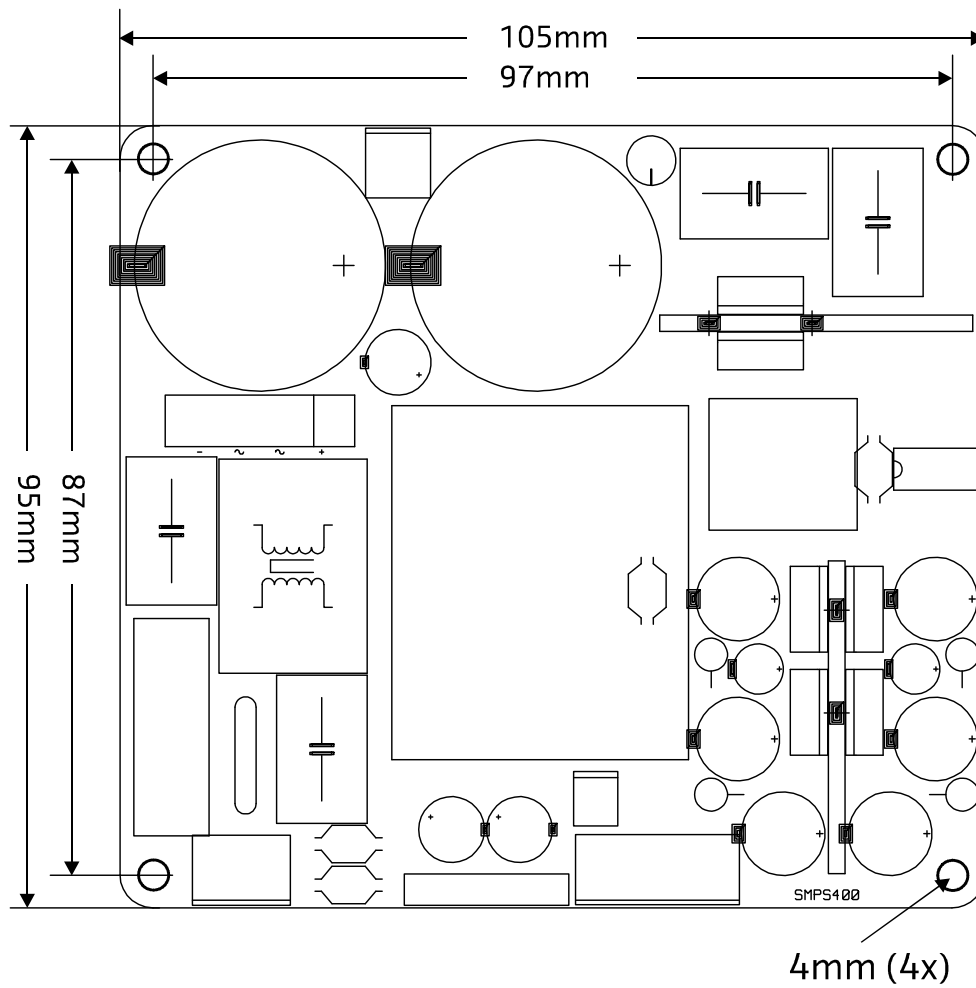
In the event of a critical failure occurring in the connected amplifier which may cause damage to the connected loudspeaker, the SMPS400 needs to be switched-off rapidly. The SMPS400 provides double generic DC-Error Inputs. These DC-Error Inputs are latched and will not auto-recover. The SMPS400 needs to be disconnected from the mains a couple of minutes to reset. A total of three modules can be connected.

Item	Type	Min	Typ	Max	Unit	Notes
DC voltage on J6:1,2	Input					See note 1

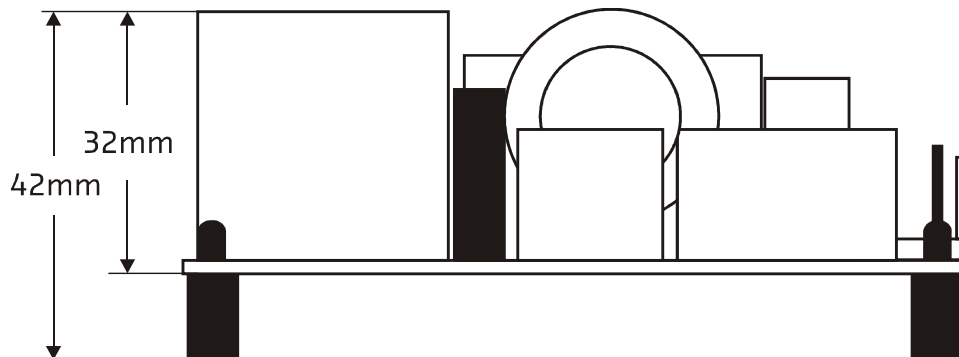
**Note 1:** The positive loudspeaker output of a UcD<sup>®</sup>-series ST/HG or generic amplifier needs to be connected to either J6:1 or J6:2 to enable this function.



Dimensions. Top view.



Dimensions. Side view.



Document Revision	PCB Version	Description	Date
R1	SMPS400V1	Initial Draft. Applicable to SMPS400/67/47/37 V1	26.02.2009
R2	SMPS400V2	- /37 version deleted. - /47 output voltage increased from 47V to 49V.	03.04.2009
R3	SMPS400V3	- Changed output connector style for compatibility reasons. - Current limiter further improved. - Transformer changed for better efficiency. - Audiophile performance improved.	04.05.2009
R4	SMPS400V4	TR3 moved for better fit.	
R5	SMPS400V4	- Auxiliary output voltage increased to 2 x 21V. - J3/J4 combined to a single 5-pin header to avoid wiring errors.	05.06.2009
R6	SMPS400V5	- Product names changed to indicate which amplifier should be used with the SMPS400 (.A180, .A400) - J3/J4 combined to J5. Connection tables adjusted. - Trademark signs (UcD™ into UcD®) - Several component changes in input and output stage.	10.02.2010
R7	SMPS400V6	- Output voltage reduced to comply to mains range. -	03.03.2010