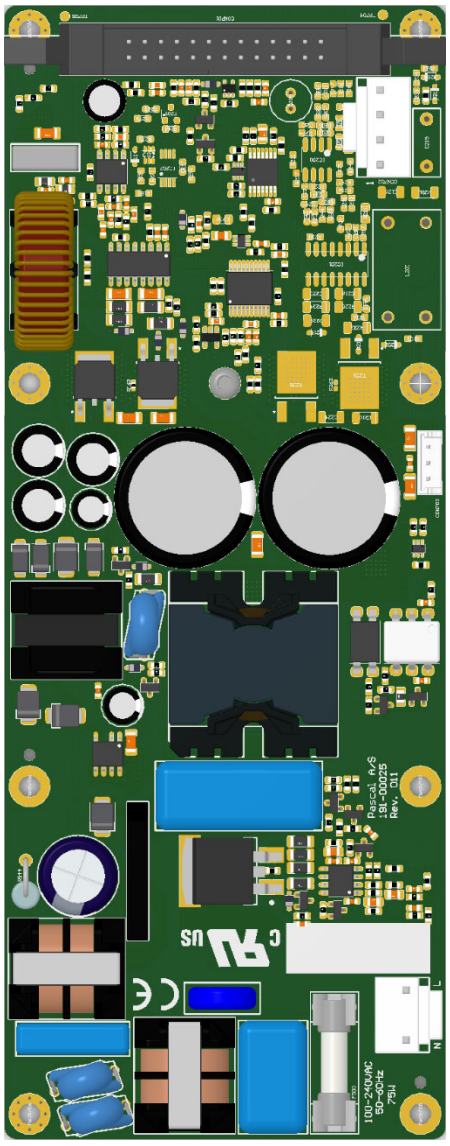
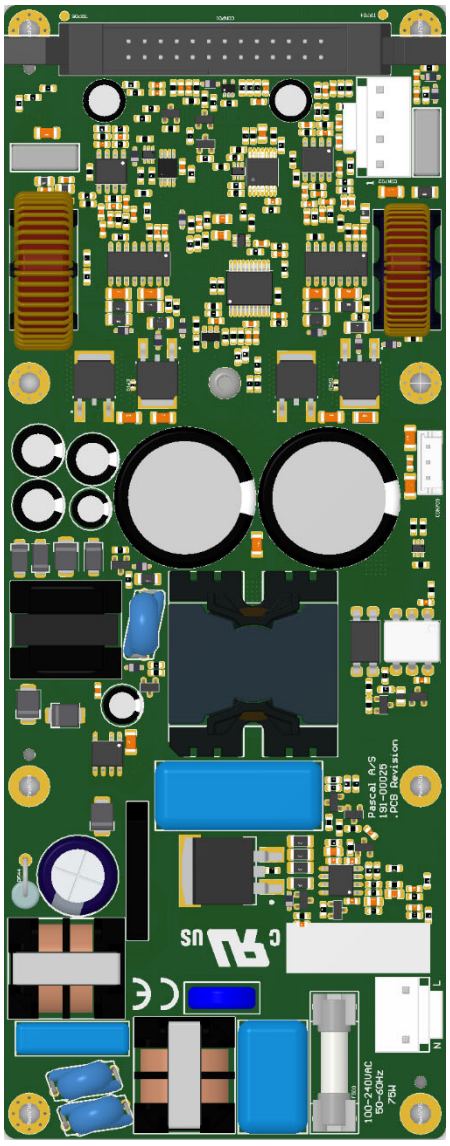
U-PRO1&2 Amplifier Module

Data Sheet



U-PRO1 Amplifier Module



U-PRO2 Amplifier Module

Content of this data sheet is subject to change without prior notice

Table of Contents

1 Features and description

Features

- 1 x 280W (U-PRO1) or 1 x 280W + 1 x 100W SE (U-PRO2) amplifier channel(s) using Pascal's UMAC™ technology for unmatched sonic performance.
- Universal mains regulated power supply with PFC using Pascal's UREC™ power supply technology
- Auxiliary power supply for external circuitry like DSP Front End solutions
- ErP (1275/2008/EC) & Energy Star compliant standby consumption of < 0.5W
- Wake on Music ready with selectable timing
- Full protection scheme
- Ultra-compact size
- Unmatched total system efficiency
- Multiple readouts (temperature, amplifier output voltage, clip monitor, amplifier protect/mute, VAC)
- Safety approved and verified for EMC compliance

Product summary

Parameter	Typical Value
Total Output power (1% THD+N, 1kHz @ 4Ω/8Ω)	280W + 100W
Total system efficiency (SE, 250 W @ 8Ω)	88 %
Peak output current (CH1) (CH2)	 25 A 10 A
THD+N (1kHz @ 1W)	0.003 %
Dynamic range	119 dB(A)
Idle noise	49 µV(A)
Output resistance (1kHz)	22.5 mΩ
Mains input voltage	$85V_{AC}$ – $265V_{AC}$
Standby consumption	0.23 W

Description

The U-PRO1/2 modules are 1 or 2 channel Class-D amplifiers with integrated universal mains power supply with PFC.

The U-PRO2 is an asymmetric 2 channel amplifier with a high-power channel intended for LF/MF drivers and a low-power channel intended for HF drivers.

The U-PRO1/2 offers an ultra-compact size with an unmatched total system efficiency to ease the integration of the U-PRO modules into any audio solution.

In addition, the U-PRO1/2 modules offer a number of readouts and controls, which allow for external DSP control of the modules. The built-in auxiliary power supply makes it easy to supply a DSP Front End.

Typical applications

- Professional Audio Solutions
- Self-Powered Loudspeakers
- Consumer Audio Solutions
- Hi-Fi Audio Solutions
- Installation Systems

2 General specifications

2.1 Audio specifications

Electrical Characteristics @ T_a = 25°C (unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{out,max}$	Peak output voltage Ch1 & Ch2	Unloaded	-	± 70	-	V
$I_{out,peak\_Ch1(LF)}$	Peak output current		-	25	-	A
$I_{out,peak\_Ch2(HF)}$	Peak output current		-	10	-	A
$P_{o,tot}$	Total module output power[1]	230V_{AC} 120V_{AC}	-	280 250	-	W
P_o	Output power @ 1% THD+N, 1kHz[2] Ch1(LF), single channel driven R_L=8Ω	230V_{AC} 120V_{AC}	-	245 245	-	W
P_o	Output power @ 1% THD+N, 1kHz[2] Ch1(LF), single channel driven R_L=4Ω	230V_{AC} 120V_{AC}	-	280 250	-	W
P_o	Output power @ 1% THD+N, 1kHz[2] Ch2(HF), single channel driven R_L=8Ω	230V_{AC} 120V_{AC}	-	175 175	-	W
P_o	Output power @ 1% THD+N, 1kHz[2] Ch2(HF), single channel driven R_L=4Ω	230V_{AC} 120V_{AC}	-	110 110	-	W
THD+N	THD+N @ 1W, 1kHz, R_L = 8Ω[2]			0.003		%
$V_{noise\ Ch1(LF)}$	Output idle noise - Ch1(LF)	Unweighted A-weighted	-	66 49	-	μV_{RMS}
$V_{noise\ Ch2(HF)}$	Output idle noise – Ch2(HF)	Unweighted A-weighted	-	66 49	-	μV_{RMS}
$DR_{Ch1(LF)}$	Dynamic Range - Ch1(LF)	Unweighted A-weighted	-	117 119	-	dB
$DR_{Ch2(HF)}$	Dynamic Range – Ch2(HF)	Unweighted A-weighted	-	117 119	-	dB
A	Voltage gain @ 1kHz, Ch1 & Ch2	SE	-	26	-	dB
$A_{var\_Ch1(LF)}$	Frequency response variance Ch1(LF) @ 20Hz – 20kHz	Open Load 8Ω 4Ω	-	0.3 0.1 0.3	-	dB
$A_{var\_Ch2(HF)}$	Frequency response variance Ch2(HF) @ 20Hz – 20kHz	Open Load 16Ω 8Ω	-	0.3 0.2 0.1	-	dB
BW_{up}	Upper bandwidth @ -3dB Ch1(LF)	R_L = 8Ω R_L = 4Ω	-	85 65	-	kHz
BW_{up}	Upper bandwidth @ -3dB Ch2(HF)	R_L = 16Ω R_L = 8Ω R_L = 4Ω	-	100 85 65	-	kHz
BW_{low}	Lower bandwidth @ -3dB Ch1 & Ch2	All loads	-	1.6	-	Hz
$R_{o\_Ch1(LF)}$	Output resistance[3]	1 kHz 20 kHz	-	22.5 256	-	mΩ
$R_{o\_Ch2(HF)}$	Output resistance[3]	1 kHz 20 kHz	-	35 245	-	mΩ
$V_{out,offset}$	Amplifier output DC Offset Ch1 or Ch2	8Ω	-	±7	-	mV
$IMD_{CCIF\_Ch1(LF)}$	Intermodulation distortion (CCIF), Ch1(LF)	18kHz & 19kHz Po = 10W, 8Ω	-	0.006	-	%
$IMD_{TIM\_Ch1(LF)}$	Transient Intermodulation distortion (TIM), Ch1(LF)	Po = 10W, 8Ω	-	0.003	-	%
$IMD_{CCIF\_Ch2(HF)}$	Intermodulation distortion (CCIF), Ch2(HF)	18kHz & 19kHz Po = 10W, 8Ω	-	0.0046	-	%
$IMD_{TIM\_Ch2(HF)}$	Transient Intermodulation distortion (TIM), Ch2(HF)	Po = 10W, 8Ω	-	0.0028	-	%

Table 2-1: Audio specifications

Note 1: Maximum total power is limited by the power supply.
Note 2: Measured using the Audio Precision AES-17 filter.
Note 3: Measured using “APx Output Impedance Utility” at the mating part of the output connector, thereby including contact resistance of the connectors.

2.2 Input & output loading

Electrical Characteristics @ T_a = 25°C (unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Z_{INPUT}	Input impedance	Balanced Unbalanced	-	7.2 3.6	-	kΩ
$Z_{L,Ch1(LF)}$	Loudspeaker nominal impedance range Ch1(LF) Single Ended (SE)	Ch1(LF)	4[1]	8	∞	Ω
$Z_{L,Ch2(HF)}$	Loudspeaker nominal impedance range Ch2(HF) Single Ended (SE)	Ch2(HF)	4[1]	8	∞	Ω
$Z_{L,BTL}$	Loudspeaker nominal impedance range Ch1 – Ch2 Bridge Tied Load (BTL)*	Ch1 – Ch2	*	*	*	Ω
$Z_{L,C}$	Maximum purely capacitive loading of amplifier output		-	-	1	µF

Table 2-2: Input and output loading

Note 1: U-PRO is fully protected for $Z_L < Z_L$ Min. Connection of loads < Z_L Min is not recommended as a low load impedance in combination with the amplifier current limit will limit maxim output power.

* Using the U-PRO2 Amplifier module in BTL mode (Bridge Tied Load) is not allowed, as the two output channels have asymmetrical power ratings, and current limits.

2.3 Audio input/output interfacing

Electrical Characteristics @ T_a = 25°C (unless otherwise specified)

Symbol	Parameter	Value	Unit
$In+_{max}$	Absolute maximum audio input voltage	±20	V_p
$In-_{max}$	Absolute maximum audio input voltage	±20	V_p
In+ In-	Audio input voltage (In+) – $(In-)_{max}$ for full output voltage swing	±3.5[1]	V_p

Table 2-3: Audio input voltage rating

Note 1: Internal input stage is supplied from an internal ±5V.

2.4 AC Mains & thermal specification

Electrical Characteristics @ T_a = 25°C (unless otherwise specified)
When values differ between U-PRO1 and U-PRO2, U-PRO2 data is added in parentheses.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{AC} Range	Operational voltage range	45Hz - 65Hz	85	-	265	V_{AC}
$P_{120VAC\ NS}$	Mains power input No signal applied Pascal U-PRO I/O-board attached	Standby Mute Idle	-	0.37 3.8 (4.4) 4.4 (6.1)	-	W_{RMS}
$P_{230VAC\ NS}$	Mains power input No signal applied Pascal U-PRO I/O-board attached	Standby Mute Idle	-	0.45 4.1 (4.5) 4.9 (6.8)	-	W_{RMS}
$P_{120VAC\ NS}$	Mains power input No signal applied	Standby Mute Idle	-	0.17 2.4 (2.9) 3.6 (5.3)	-	W_{RMS}
$P_{230VAC\ NS}$	Mains power input No signal applied	Standby Mute Idle	-	0.24 2.6 (3.0) 4.1 (5.9)	-	W_{RMS}
P_{AC_PN}	Mains power input 230V_{AC} U-PRO1. Pink Noise $P_{out,RMS}$ = 1/8th 250W for R_L = 8Ω $P_{out,RMS}$ = 1/8th 280W for R_L = 4Ω	R_L = 8Ω R_L = 4Ω	-	44 50	-	W_{RMS}
P_{AC_PN}	Mains power input 120V_{AC} U-PRO1. Pink Noise $P_{out,RMS}$ = 1/8th 250W for R_L = 8Ω $P_{out,RMS}$ = 1/8th 250W for R_L = 4Ω	R_L = 8Ω R_L = 4Ω	-	43 46	-	W_{RMS}
P_{AC_PN}	Mains power input 100V_{AC} U-PRO1. Pink Noise $P_{out,RMS}$ = 1/8th 250W for R_L = 8Ω $P_{out,RMS}$ = 1/8th 250W for R_L = 4Ω	R_L = 8Ω R_L = 4Ω	-	43 46	-	W_{RMS}
P_{AC_PN}	Mains power input 230V_{AC}, U-PRO2, Pink Noise, Load Ch1: 4Ω / Ch2: 16 Ω $P_{out,RMS}$ ch1 = 1/8th 224W @ 4Ω $P_{out,RMS}$ ch2= 1/8th 56W @16Ω	230V_{AC}	-	67	-	W_{RMS}
P_{AC_PN}	Mains power input 120V_{AC}, U-PRO2, Pink Noise, Load Ch1: 4Ω / Ch2: 16 Ω $P_{out,RMS}$ ch1 = 1/8th 200W @ 4Ω $P_{out,RMS}$ ch2= 1/8th 50W @16Ω	120V_{AC}	-	68	-	W_{RMS}
P_{AC_PN}	Mains power input 100V_{AC}, U-PRO2, Pink Noise, Load Ch1: 4Ω / Ch2: 16 Ω $P_{out,RMS}$ ch1 = 1/8th 200W @ 4Ω $P_{out,RMS}$ ch2= 1/8th 50W @16Ω	100V_{AC}	-	68	-	W_{RMS}
P_{Loss}	Module power loss at 230V_{AC} U-PRO1. Pink Noise $P_{out,RMS}$ = 1/8th 250W for R_L = 8Ω $P_{out,RMS}$ = 1/8th 280W for R_L = 4Ω	R_L = 8Ω R_L = 4Ω	-	11 15	-	W_{RMS}
P_{Loss}	Module power loss at 120V_{AC} U-PRO1. Pink Noise $P_{out,RMS}$ = 1/8th 250W for R_L = 8Ω $P_{out,RMS}$ = 1/8th 280W for R_L = 4Ω	R_L = 8Ω R_L = 4Ω		10 13		W_{RMS}
P_{Loss}	Module power loss at 100V_{AC} U-PRO1. Pink Noise $P_{out,RMS}$ = 1/8th 250W for R_L = 8Ω $P_{out,RMS}$ = 1/8th 280W for R_L = 4Ω	R_L = 8Ω R_L = 4Ω		10 13		W_{RMS}
P_{Loss}	Mains power input U-PRO2, Pink Noise, Load Ch1: 4Ω / Ch2: 16 Ω $P_{out,RMS}$ = 1/8th 200W for R_L = 4Ω $P_{out,RMS}$ = 1/8th 50W for R_L = 16Ω	230V_{AC}		17		W_{RMS}
P_{Loss}	Mains power input U-PRO2, Pink Noise, Load Ch1: 4Ω / Ch2: 16 Ω $P_{out,RMS}$ = 1/8th 200W for R_L = 4Ω $P_{out,RMS}$ = 1/8th 50W for R_L = 16Ω	120V_{AC}		15		W_{RMS}
P_{Loss}	Mains power input U-PRO2, Pink Noise, Load Ch1: 4Ω / Ch2: 16 Ω $P_{out,RMS}$ = 1/8th 200W for R_L = 4Ω $P_{out,RMS}$ = 1/8th 50W for R_L = 16Ω	100V_{AC}		15		W_{RMS}

$\eta_{tot,8\Omega}$	System efficiency @ 1 x 8Ω Ch1(LF) U-PRO1, (1x250W_{out} @ 1kHz)	230V_{AC} 120V_{AC}	-	88 84	-	%
$\eta_{tot,4\Omega}$	System efficiency @ 1 x 4Ω Ch1(LF) U-PRO1, (1x250W_{out} @ 1kHz)	230V_{AC} 120V_{AC}	-	84 82	-	%
$PF_{8\Omega}$	Power Factor @ 1 x 8Ω Ch1(LF) U-PRO1, (1x100W_{out} @ 1kHz)	230V_{AC} 120V_{AC}	-	0.92 0.97	-	
$PF_{4\Omega}$	Power Factor @ 1 x 4Ω Ch1(LF) U-PRO1, (1x100W_{out} @ 1kHz)	230V_{AC} 120V_{AC}	-	0.92 0.97	-	
T_{SD}	Temperature @ thermal shutdown Thermal hysteresis = 5°C[1]		-	85	-	°C

Table 2-4: AC Mains & thermal specifications

Note 1: 5°C but minimum 10s.

2.5 Auxiliary power supply specification

Electrical Characteristics @ T_a = 25°C (unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{+7.5V}$	+7.5V voltage			7.7		V
V_{+15V}	+15V voltage			15.5		V
V_{-15V}	-15V voltage			-15.5		V
V_{Drive}	Vdrive voltage	Ref. to -70V		12.4		V
$I_{+7.5V}$	+7.5V current rating[2]		0		800	mA
I_{+15V}	+15V current rating[2]		0		250	mA
I_{-15V}	-15V current rating[2]		-250		0	mA
I_{VDrive}	V_{Drive} current rating[2]		0		200	mA
P_{tot}	Maximum total output power[2]		0		9	W

Table 2-5: Auxiliary power supply specification

Note 1: For details see U-PRO Application Manual covering Powered Speaker
Note 2: The Auxiliary power supply cannot be loaded with the maximum rated load current for all four outputs simultaneously as this will violate the 9 Watt total output power limit. Use the typical Voltage levels from *Table 2-5* in combination with the actual load currents to calculate the total power consumption. The calculated total power consumption must comply with the 9 Watt total output power limit.

3 Audio measurements

3.1 Frequency response Ch1 (LF)

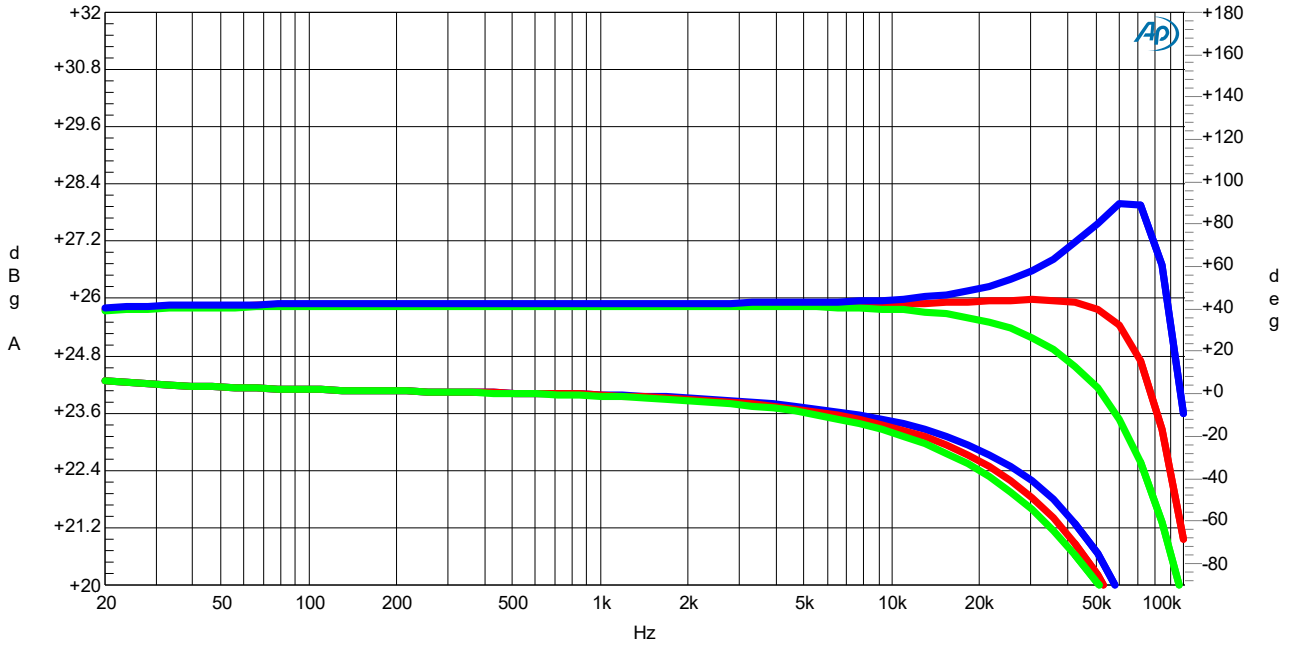


Figure 3-1: Frequency response (Top curves: Amplitude, Bottom curves: Phase)
4Ω (green), 8Ω (red) and Open Load (blue)

3.2 Frequency response Ch2 (HF)

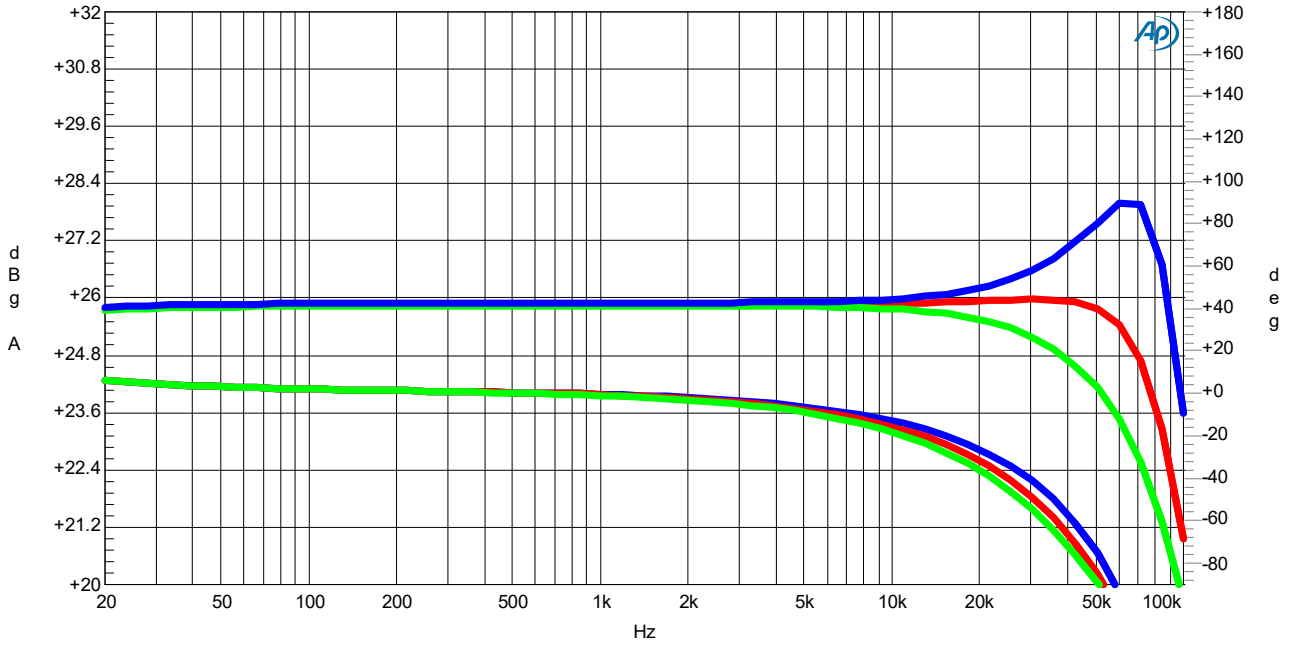


Figure 3-2: Frequency response (op curves: Amplitude, Bottom curves: Phase)
4Ω (green), 8Ω (red) and Open Load (blue)

3.3 Total Harmonic Distortion + Noise (THD+N) Ch1 (LF)

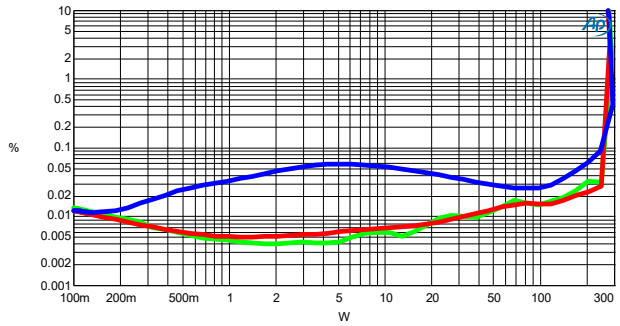


Figure 3-3 THD+N vs. Power @ 4Ω, 230V$_{AC}$
100Hz (green), 1kHz (red), 6.67kHz (blue)

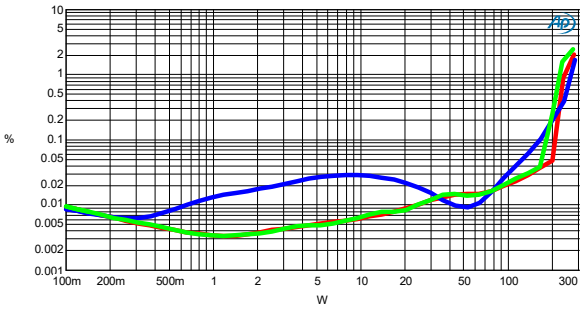


Figure 3-4 THD+N vs. Power @ 8Ω, 230V$_{AC}$
100Hz (green), 1kHz (red), 6.67kHz (blue)

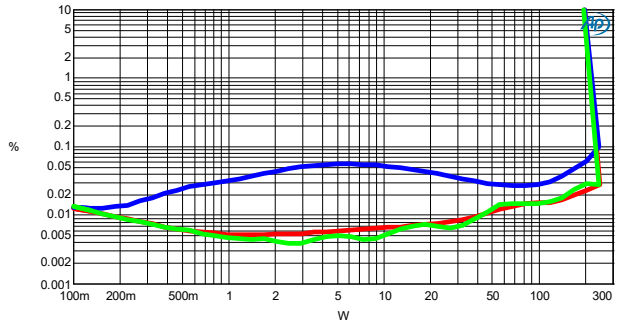


Figure 3-5 THD+N vs. Power @ 4Ω, 120V$_{AC}$
100Hz (green), 1kHz (red), 6.67kHz (blue)

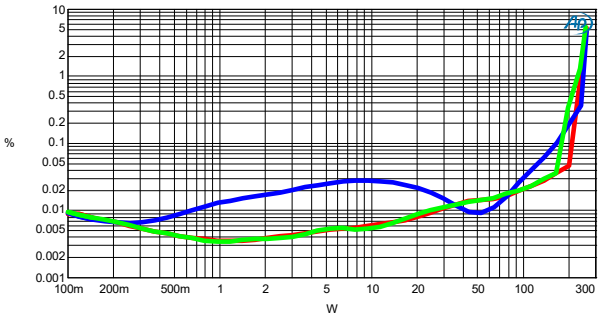


Figure 3-6 THD+N vs. Power @ 8Ω, 120V$_{AC}$
100Hz (green), 1kHz (red), 6.67kHz (blue)

3.4 Burst power Ch1 (LF)

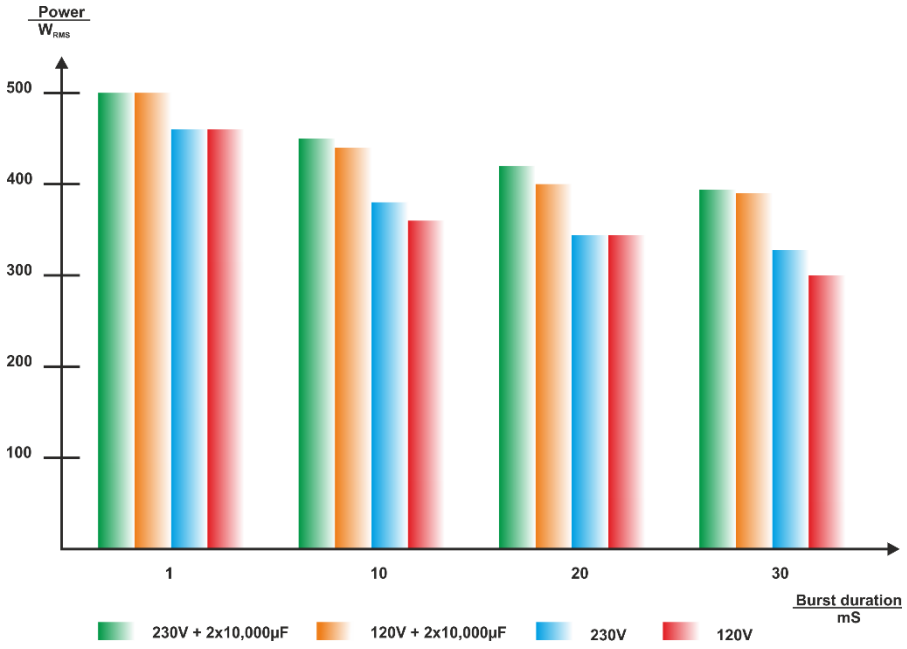


Figure 3-7: Burst power Ch1 (LF) @ 4Ω, 1kHz

Note: 2 x 10,000uF can optionally be connected to CON703 externally to stabilize the +/-70V supply.

3.5 Total Harmonic Distortion + Noise (THD+N) Ch2 (HF)

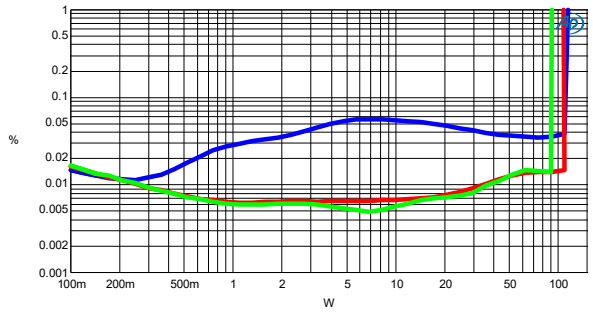


Figure 3-8: THD+N vs. Power@ 4Ω, 230V$_{AC}$
100Hz (green), 1kHz (red), 6.67kHz (blue)

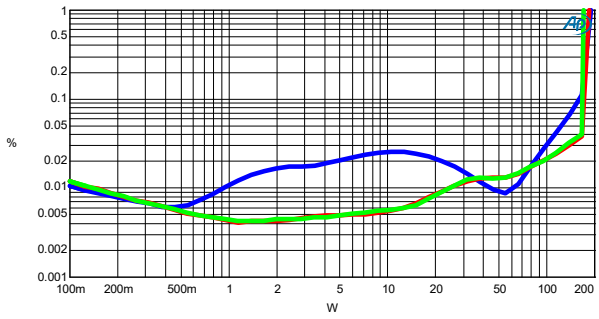


Figure 3-9: THD+N vs. Power @ 8Ω, 230V$_{AC}$
100Hz (green), 1kHz (red), 6.67kHz (blue)

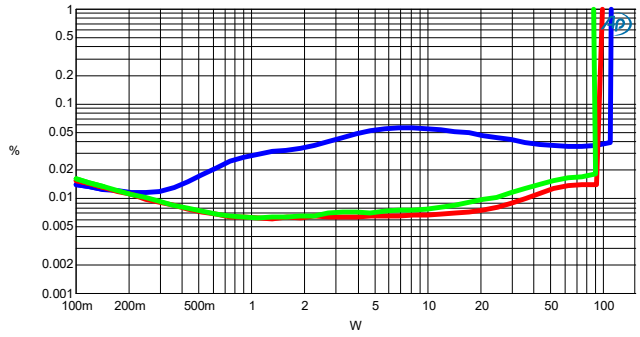


Figure 3-10: THD+N vs. Power@ 4Ω, 120V$_{AC}$
100Hz (green), 1kHz (red), 6.67kHz (blue)

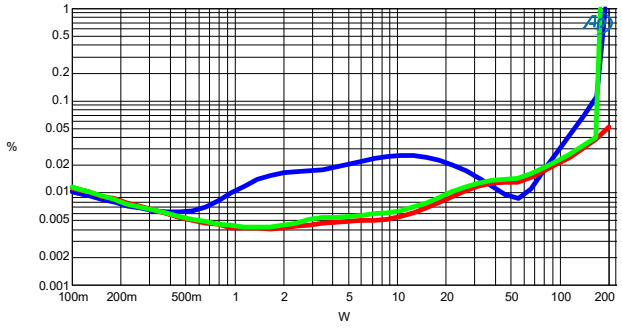


Figure 3-11: THD+N vs. Power @ 8Ω, 120V$_{AC}$
100Hz (green), 1kHz (red), 6.67kHz (blue)

3.6 Noise spectrum

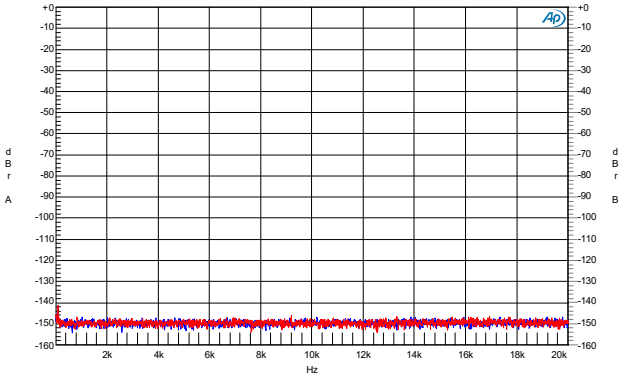


Figure 3-12: FFT idle - 8 Ω
Channel 1 (blue) & Channel 2 (red)

3.7 Intermodulation Distortion (CCIF, TIM) Ch1(LF)

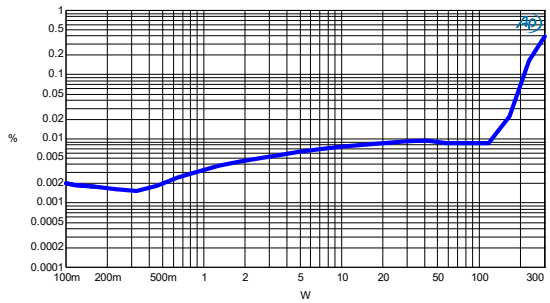


Figure 3-13: CCIF vs. Power - R_L=4Ω
Ch1(LF), f_1=18kHz, f_2 =19kHz

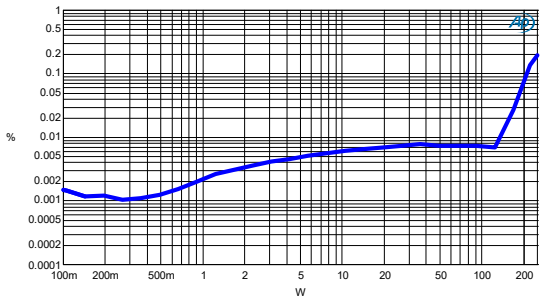


Figure 3-14: CCIF vs. Power - R_L=8Ω
Ch1(LF), f_1=18khz, f_2 =19khz

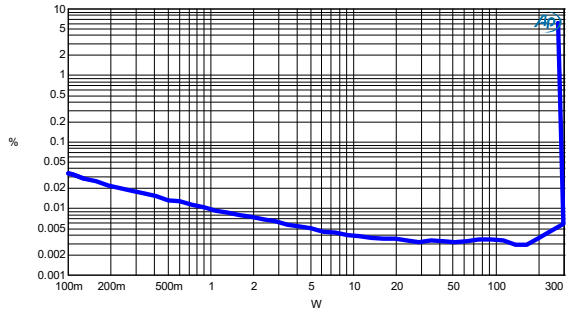


Figure 3-15: TIM vs. Power - R_L=4Ω
Ch1(LF)

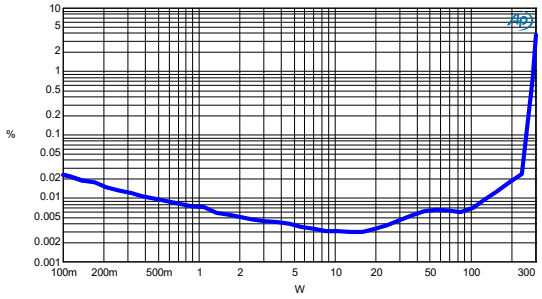


Figure 3-16: TIM vs. Power - R_L=8Ω
Ch1(LF)

3.8 Intermodulation Distortion (CCIF, TIM) CH2(HF)

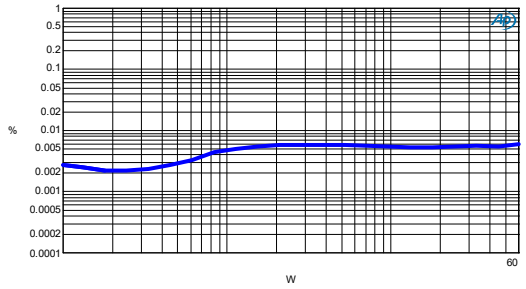


Figure 3-17 CCIF vs. Power - R_L=4Ω
Ch2(HF), f_1=18kHz, f_2 =19kHz

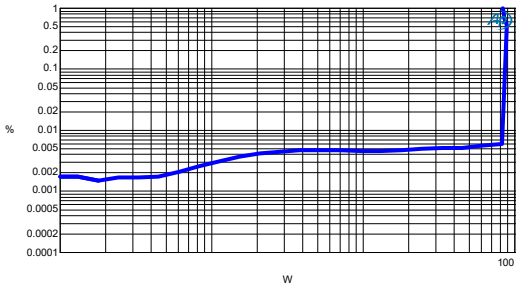


Figure 3-18 CCIF vs. Power - R_L=8Ω
Ch2(HF), f_1=18khz, f_2 =19khz

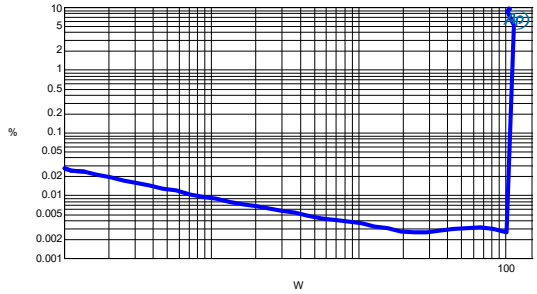


Figure 3-19 TIM vs. Power - R_L=4Ω
Ch2(HF)

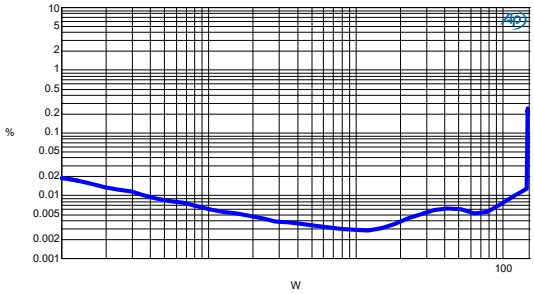


Figure 3-20 TIM vs. Power - R_L=8Ω
Ch2(HF)

3.9 Cross talk & output resistance

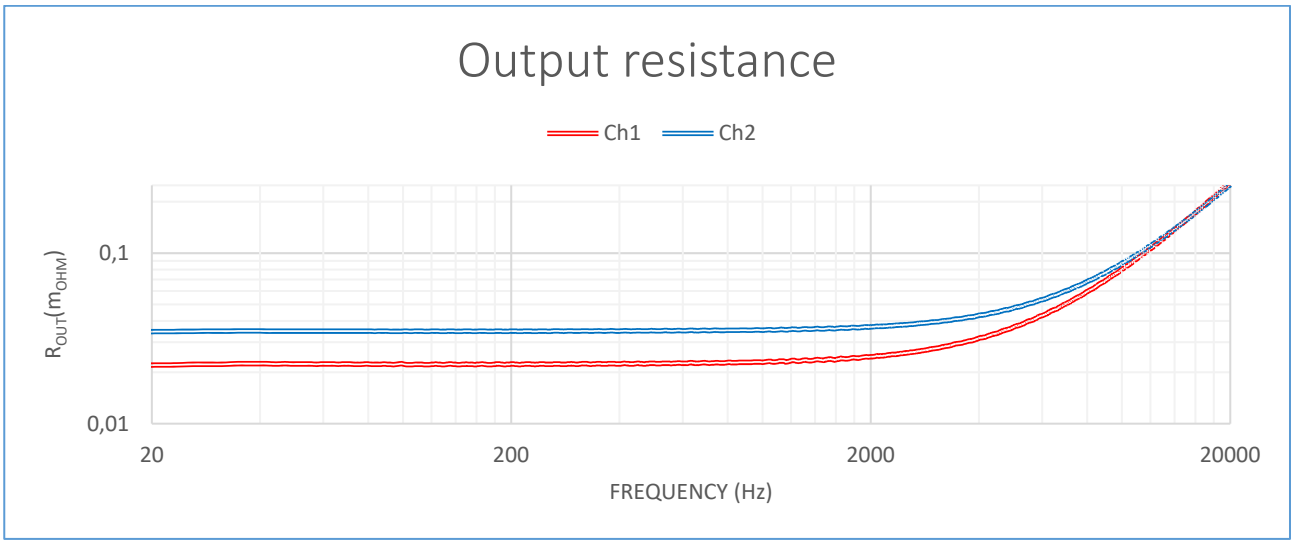


Figure 3-21: Output resistance[1] – Measurement made at the mating part of the output connector. Connector resistance thereby included. Ch1(LF) (red), Ch2(HF) (blue)

Note 1: Measured using "APx Output Impedance Utility" at the mating part of the output connector, thereby including contact resistance of the connectors.

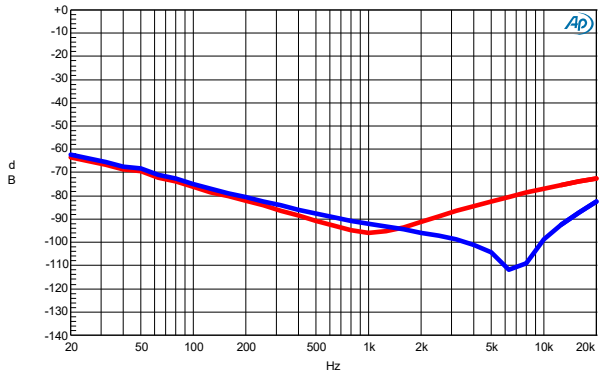


Figure 3-22: Cross talk - Ch.1 @ Po,ch2=50W 8Ω (red), Ch.2 @ Po,ch1=50W 8Ω (blue)

3.10 Output voltage vs. frequency

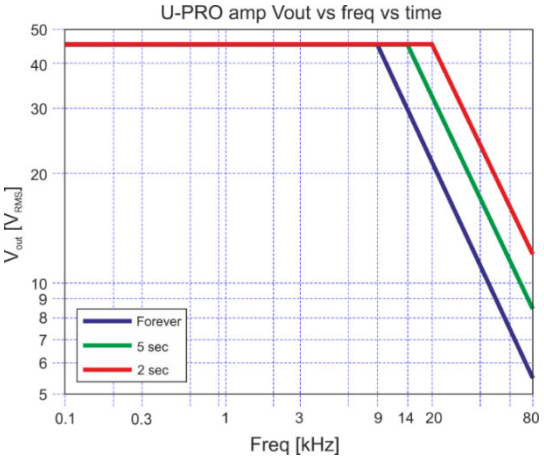


Figure 3-23: Max Vout vs. frequency vs. time

4 Control and readout specification

4.1 Control pins

$\overline{\text{Mute}}$ – When muting the U-PRO1/U-PRO2 module, the amplifier outputs will be disabled. It typically takes 0.5ms to disable and only 1ms to enable the amplifier.

The mute function may be used with an external wake-on-music circuit to lower the mains power consumption when the module is unused, but still with the module ready to play in typically 1ms – making it unnoticeable for the user.

$\overline{\text{Standby}}$ – With the U-PRO1/U-PRO2 module in standby the mains power consumption is put to a minimum. In standby it is possible to comply with the ErP directive (1275/2008/EC) & Energy Star specification with a total power consumption of less than 0.5W. This includes a current draw of up to 25 mA on the +7.5V supply for external standby control circuitry.

Signal_Present – This signal is part of the “Wake on Music” function built into the U-PRO1/U-PRO2 module. If left open the signal is internally pulled high and “Wake on Music” is not used. If pulled low continuously for a selectable amount of time set by the “Signal Time Out Select” the amplifiers will first be muted to save power but are still able to be un-muted within 1ms. If signal present continues to be low the U-PRO1/U-PRO2 module will enter standby mode. The U-PRO1/U-PRO2 module exits standby mode as soon as the signal present signal is released and is ready within typically 660ms.

A suitable circuit for sensing the audio with a sensitivity of $4mV_{rms}$ and controlling the Signal Present pin can be found in the U-PRO Series Application Manual.

Signal_TimeOut – This signal is part of the “Wake on Music” function built into the U-PRO1/U-PRO2 module. Placing a resistor from this pin to GND makes it possible to choose between 3 different timing settings. See the U-PRO Series Application Manual for details.

T-V_Sel/SMPS_OL – This pin can be either an input or an output depending on the selected timing resistor connected to Signal_TimeOut (pin 14) described above. In the Temp/VAC mode, it will be an input pin – possible to toggle – allowing to read out either the mains voltage or amplifier temperature in real-time. In the Low Rail mode, it is an output pin indicating whether the (+/-70V) rail voltages are below +/-50V, or not – useful for a Front End circuit to activate a limiter that prevents the rail voltages from being pulled below the level where sound will disappear temporarily.

4.2 Readout pins

The U-PRO1/U-PRO2 module has various readouts to monitor the state of the module.

Temp/VAC_Out – Amplifier temperature or mains voltage readout; by toggling a control-pin, either mains voltage, or amplifier temperature can be read real-time.

- *Amplifier temperature* – The output stage temperature from 0-100° is expressed as a DC voltage from 0-3.3V. When the module enters thermal protection at 85°C, equivalent to 2.805V, the voltage will jump to 3.3 V indicating thermal protection is active. This makes it possible to both read the live temperature and read when the module is disabled due to thermal protection. The module exits thermal protection when the temperature drops below 80°C and the voltage will return to a live readout of the actual maximum temperature.

- *Mains voltage* – The AC mains voltage from 85-265V_{AC} is expressed as a DC voltage from 0.213V to 2.925V. This readout may be used to adjust external limiters to match the mains voltage dependent output power.

Amplifier Output Voltage readout – There are two amplifier output voltage readouts Vout_Monitor_Ch1 and Vout_Monitor_Ch2, one for each channel. These readouts are voltage divisions of the output signals in the range of ±10 Vp corresponding to ±70Vp at the output.

Amplifier Clip readout – There is one amplifier clip readout, $\overline{\text{Clip\_1}}$ only. This readout is an open-collector output. The readout pin will be pulled low if the (audio) output voltage for Ch1 becomes too high compared to the internal rail voltages (Voltage Clipping), or if the Ch1 amplifier reaches internal current protection. This readout may be used for signal clip/limiting indications. There is no voltage clip readout for Ch2 since this is an HF channel not normally clipped and if clipped the distortion is less obvious. Current clipping on a HF driver is not normally reached but in case current clipping on Ch2 occurs, this event is shown as clip on the Ch1 clip readout - $\overline{\text{Clip\_1}}$.

$\overline{\textbf{Dis\_Read/Protect}}$ – This readout is an open-collector output which will be pulled low when the module is either muted or has entered an internal protection.

5 Protection features

The U-PRO1/U-PRO2 has built-in protection features to protect the amplifier module against abuse and/or extreme use scenarios, and to protect the speaker drivers from being damaged in case of a malfunction.

Temperature – Temperature protection of the power supply and amplifiers is implemented to prevent the module from thermal runaway. When thermal protection is engaged both amplifiers are muted until the temperature has dropped 5°C, or for a minimum of 10s.

Over Current – If an amplifier output is shorted or reaches its current limit, the clip readout will be activated to allow an external limiter/DSP to limit the input signal. If the limiter is not capable of limiting the signal, the module will enter over-current protection and mute the amplifier output(s) until the internal protection timing allows the module to re-enable the amplifier(s).

DC Protection – If DC-voltage is detected at one of the amplifier outputs, the U-PRO1/U-PRO2 mutes the outputs. If DC still is present after 3 cycles, the U-PRO1/U-PRO2 DC protection circuit switches off the +/- 70V power supply. Resetting of the latched protection circuit requires cycling of the AC mains.

HF Protection – A high frequency protection is implemented to protect the amplifier output filter components from overload – refer to *Figure 3-23*. If a high frequency (and high amplitude) signal is present for a longer period of time, the module will enter HF protection and mute (both) amplifier output(s) until the internal protection timing allows the module to re-enable the amplifier(s).

5.1 U-PRO functional blocks

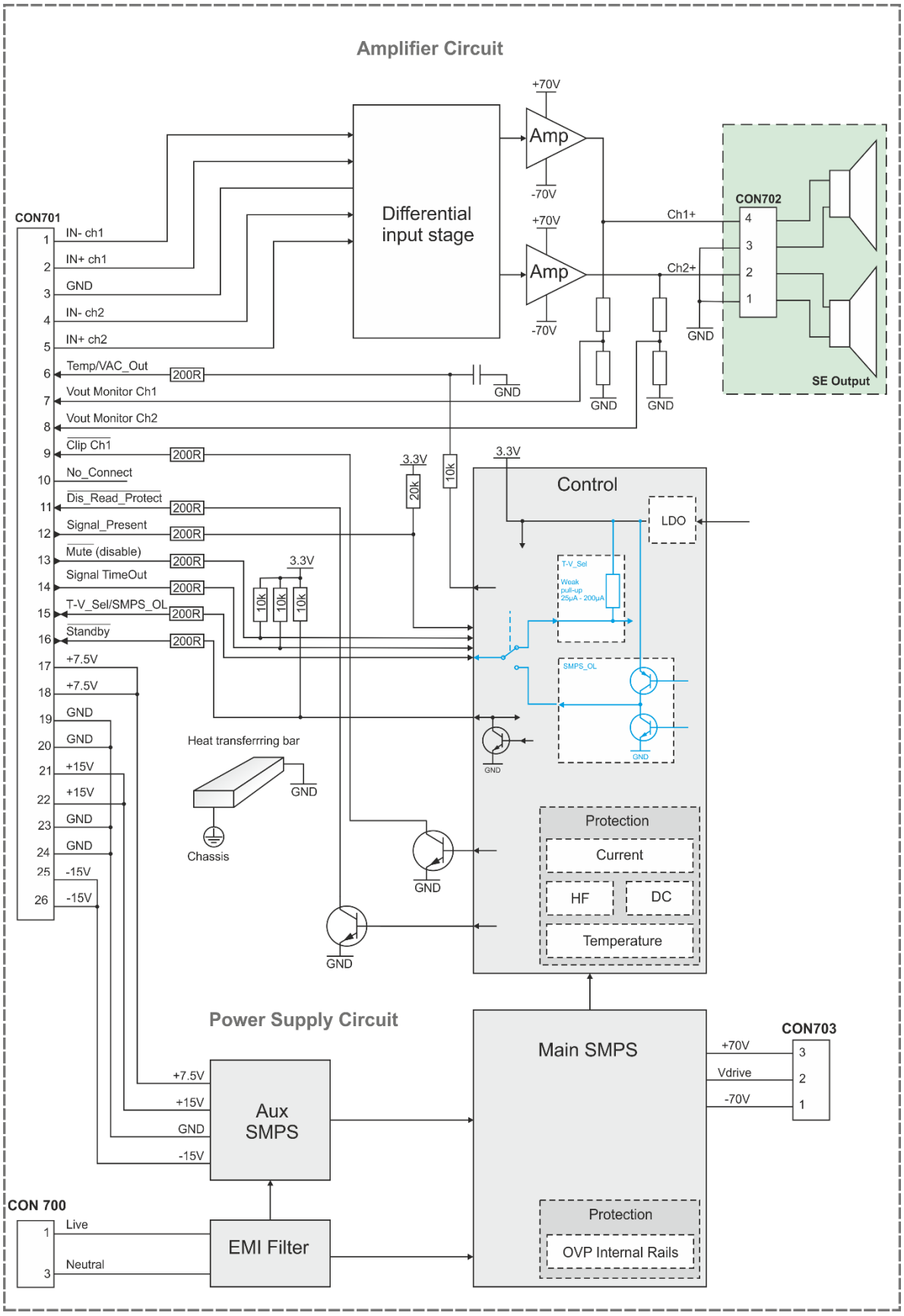


Figure 5-1: Block diagram showing U-PRO2 module functionality. For U-PRO: Channel 2 circuitry is eliminated

5.2 Single Ended (SE) 2 channel amplifier

The U-PRO2 Amplifier module consists of two (SE) single ended output channels, with channel 1 handling LF signals and channel 2 handling HF signals. This module is suitable for driving a woofer and a tweeter in an active two-way speaker.

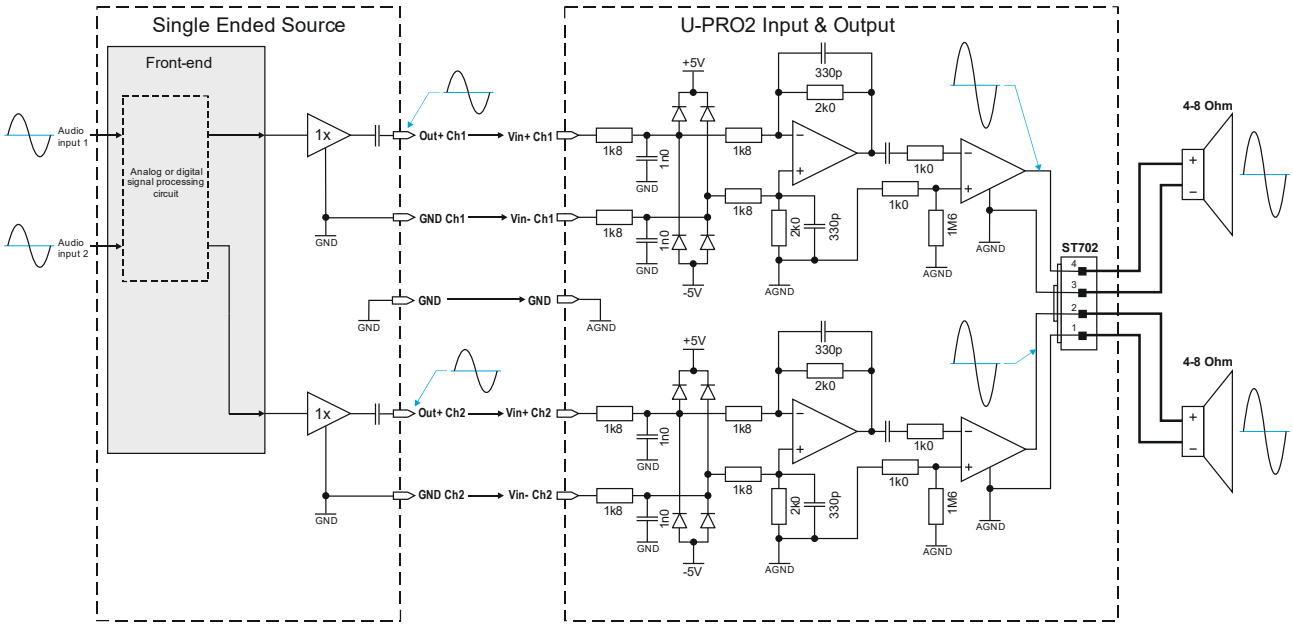


Figure 5-2: U-PRO2 Amplifier module with Single Ended (SE) outputs connected to woofer (LF) and tweeter (HF)

5.3 Single Ended (SE) 1 channel amplifier

The U-PRO1 Amplifier module consists of one (SE) single ended output channel. This module is suitable for Hi-Fi or studio subwoofers, musical instrument amplifiers, bass amplifier heads etc.

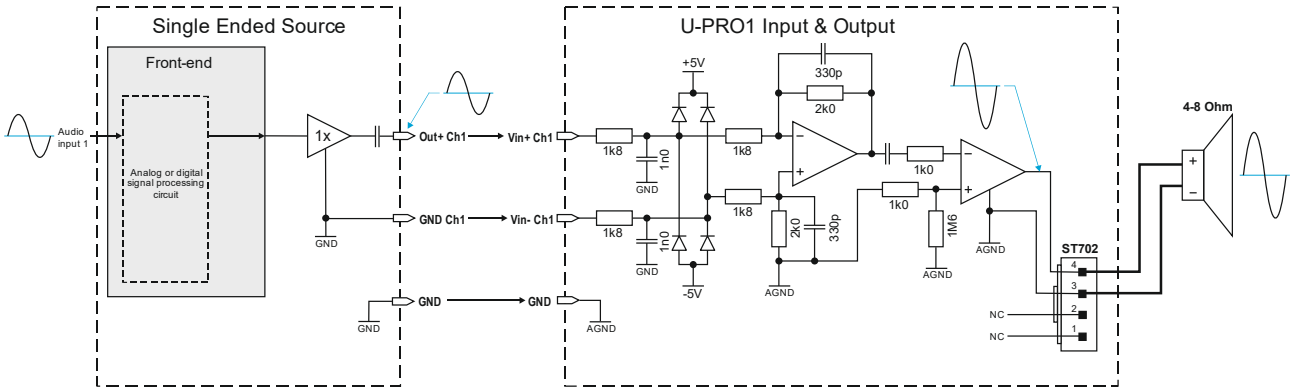


Figure 5-3: U-PRO1 Amplifier module with Single Ended (SE) output connected to a subwoofer (LF)

6 U-PRO1 and U-PRO2 connections

This section describes the signal, control and DC-supply connections for the U-PRO modules.

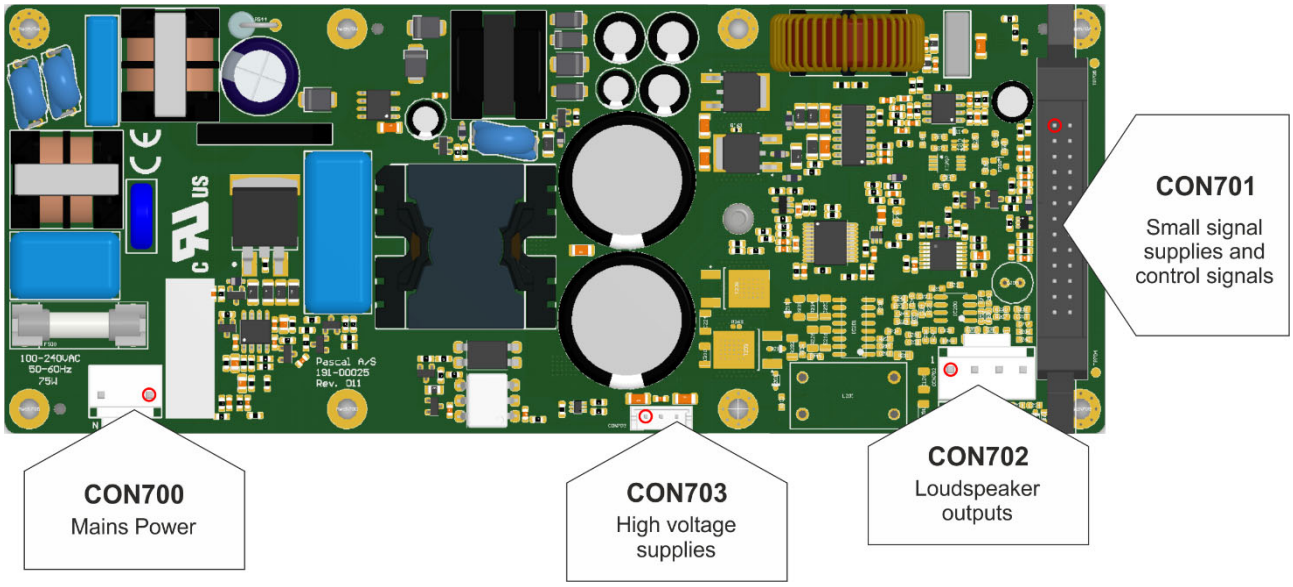


Figure 6-1: U-PRO1 Amplifier module connectors – red circle indicates pin 1

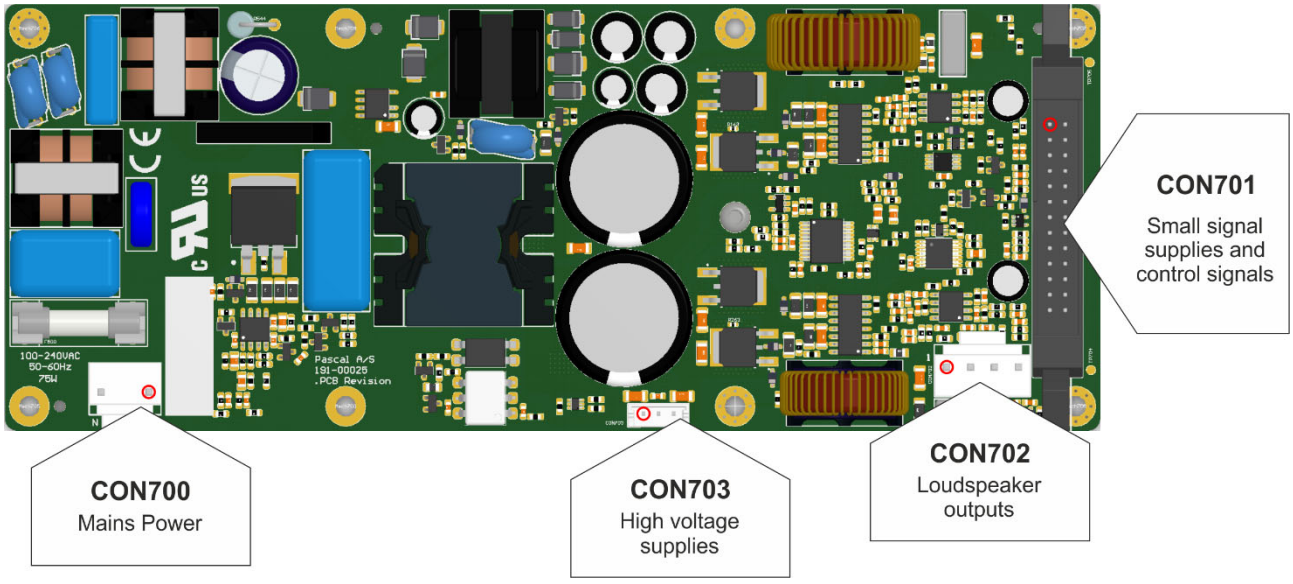


Figure 6-2: U-PRO2 Amplifier module connectors – red circle indicates pin 1

6.1 Mains Power connector

CON700			Description
Name	**Pin #**	**I/O**	
L	1	I	The mains input Live/Line wire must be connected to this terminal.
N	2	I	The mains input Neutral wire must be connected to this terminal.

Table 6-1: U-PRO Mains connector

6.2 Signal and Control connector

CON701			
Name	**Pin #**	**I/O**	
Ch1_In-	1	I	Ch 1 (LF) negative signal of the balanced audio input to the U-PRO1/U-PRO2 module. The maximum allowable signal on this pin is ±20V_p.
Ch1_In+	2	I	Ch 1 (LF) positive signal of the balanced audio input to the U-PRO1/U-PRO2 module. The maximum allowable signal on this pin is ±20V_p.
GND	3	-	This pin is a general-purpose GND. Shall be connected to Front End ground plane.
Ch2_In-	4	I[1]	Ch 2 (HF) negative audio input signal of the balanced input to the U-PRO2 module. The maximum allowable signal on this pin is ±20V_p.
Ch2_In+	5	I[1]	Ch 2 (HF) positive audio input signal of the balanced input to the U-PRO2 module. The maximum allowable signal on this pin is ±20V_p.
Temp/Vac_Out	6	O	This pin reads out by default, the highest temperature of the two amplifier channels or the +/-70V power supply rectifier diodes in the range of 0-3.3V corresponding to 0°C-100°C. The pin will read out 3.3V when in temperature protection. This pin can alternatively be used to read out the AC mains voltage from 85-265V_{AC} is expressed as a DC voltage from 0.213V to 2.925V. Temp/VAC_Set via pin 15 is used to select either temperature (default) or AC mains readout.
Vout_Monitor_Ch1	7	O	This pin reads out the amplifier channel 1 output voltage. The signal will be in the range ±10V_p corresponding to ±70V_p on the output of the amplifier. The signal has a high impedance and requires a buffer if used.
Vout_Monitor_Ch2	8	O[1]	This pin reads out the amplifier channel 2 output voltage. The signal will be in the range ±10V_p corresponding to ±70V_p on the output of the amplifier. The signal has a high impedance and requires a buffer if used.
$\overline{\text{Clip\_1}}$	9	O	This pin signals an active low whenever the amplifier Ch1(LF) is voltage clipping or current clipping or when Ch2(HF) is current clipping. Note there is no indication if Ch2(HF) is voltage clipping.
No_Connect	10	-	This pin has no internal connection.
$\overline{\text{Dis\_Read/Protect}}$	11	O	This pin signals an active low whenever the amplifier channel 1 and channel 2 are disabled or in protection.
Signal_Present	12	-	This signal is part of the “Wake on Music” function built into the U-PRO series modules. If left open the signal is internally pulled high and “Wake on Music” is not used. If pulled low continuously for a selectable amount of time set by the “Signal Time Out Select” the amplifier(s) will first mute to save power but still be able to un-mute within 1ms. If the signal present continues to be low the U-PRO series module will enter standby mode. The U-PRO series module exits standby mode as soon as the signal present signal is released and is ready within typically 660ms.
$\overline{\text{Mute}}$	13	I	An open-collector must be used to actively pull this pin low whenever the module must disable/$\overline{\text{Mute}}$. When released the module is ready within (typically) 1 ms.
Signal_TimeOut	14	I	3 different power safe mode timings can be selected by connecting a resistor of a specified value from the Signal_TimeOut pin to GND. See *Table 6-3* for a list of resistor values and corresponding timings. If the Signal Present input is not used the Signal_TimeOut pin can be left unconnected.
T-V_Sel/SMPS_OL	15	I/O	This pin can be either an input or an output depending on the selected timing resistor connected to Signal_TimeOut (pin 14).

			If timing resistor T1, T2 or T3 is selected (see *Table 6-3*) it will be an input pin where it is possible to select either temperature or AC mains readout for the signal Temp/Vac_Mon (pin 6). If pin 15 is left un-connected, the internal pull-up will by default select temperature as the read out on pin 6. If pin 15 is actively pulled low by an open-collector, the mains RMS voltage will be the read out on pin 6. If timing resistor T1(Low Rail), T2(Low Rail) or T3(Low Rail) is selected (see *Table 6-3)* it will be an output pin that indicates whether the (+/-70V) the rail voltage is below +/-50V.
$\overline{\text{Standby}}$	16	I/O	An open-collector must be used to actively pull this pin low whenever the module must enter standby mode. When released the module is ready within a few seconds.
+7.5V	17,18	O	This pin may be used to supply external circuitry.
GND	19,20	-	This pin is the +7.5V ground return.
+15V	21,22	O	This pin may be used to supply external circuitry.
GND	23,24	-	This pin is the ±15V ground return.
-15V	25,26	O	This pin may be used to supply external circuitry.

Table 6-2: U-PRO signal and control connector

Note 1: For U-PRO1 these pins have no internal connection

It is possible to select one of 3 different Mute/Standby timings by connecting a resistor of a specified value between Signal_TimeOut (pin 14) and a GND pin. See Table 6-3 to select a resistor value that corresponds with the standby time you want.

Timing ID	Resistor (Ω)	Mute time	Standby time	T-V_Sel/SMPS_OL function
T1	≥ 150K	2 min mute	10 min standby	Input – Temp/VAC selection
T2	100k	10 min mute	Never enters standby mode	Input – Temp/VAC selection
T3	68k	10 min mute	25 min standby	Input – Temp/VAC selection
T1(Low Rail)	47K	2 min mute	10 min standby	Output – Low Rail indication
T2(Low Rail)	33K	10 min mute	Never enters standby mode	Output – Low Rail indication
T3(Low Rail)	24K	10 min mute	25 min standby	Output – Low Rail indication

Table 6-3: Mute/Standby timing and Temp–VAC/Low Rail indication resistor selection

6.3 Speaker Output connector

CON702			Description
Name	**Pin #**	**I/O**	
Ch2_Out-	1	O[1]	This pin is used for the GND signal of the channel 2 speaker.
Ch2_Out+	2	O[1]	The amplified speaker signal of channel 2 is available on this pin.
Ch1_Out-	3	O	This pin is used for the GND signal of the channel 1 speaker.
Ch1_Out+	4	O	The amplified speaker signal of channel 1 is available on this pin.

Table 6-4 U-PRO speaker connector overview

Note 1: For U-PRO1 these pins have no internal connection

6.4 DC-Supply connector

CON703			Description
Name	**Pin #**	**I/O**	
-70V	1	O	The negative rail voltage for U-A Series Extension Module is available on this pin.
V_{drive}	2	O	The V_{drive} voltage for U-A Series Extension Module is available on this pin.
+70V	3	O	The positive rail voltage for U-A Series Extension Module is available on this pin.

Table 6-5 U-PRO's U-A Series Extension Module connector overview

7 Mechanical specifications

This section contains mechanical outlines and specifications of the U-PRO1 and U-PRO2 module.

Item		Min	Typical	Max
(A) Top side components		-	31.75mm	32.50mm
(B) PCB		1.50mm	1.60mm	1.70mm
(C) Heat transferring bar		3.95mm	4.00mm	4.05mm
Module weight (inclusive heat transferring bar)	U-PRO1		220g	
	U-PRO2		229g	

Table 7-1: U-PRO1 and U-PRO2 mechanical specifications

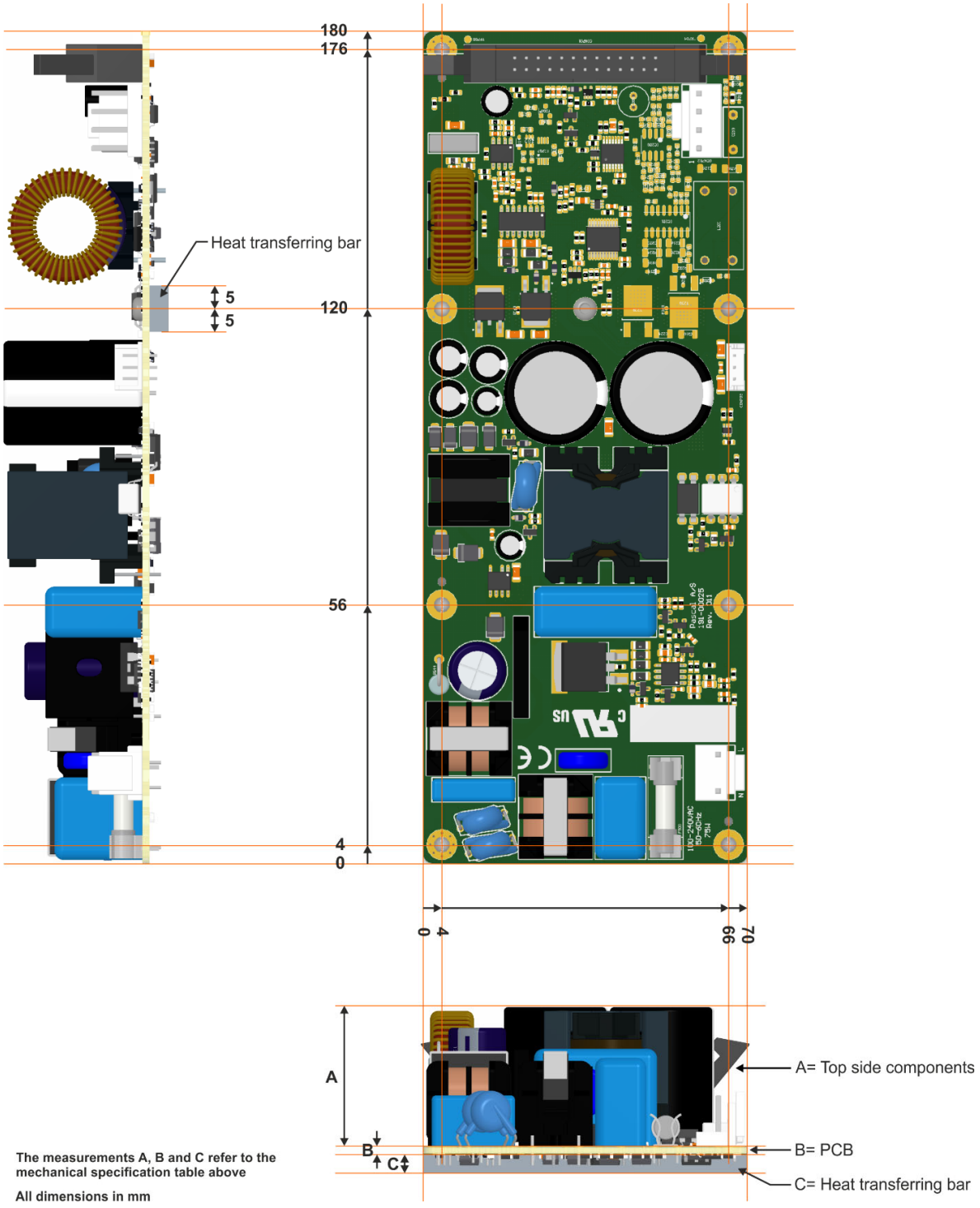


Figure 7-1: Mechanical outline and specifications for the U-PRO1 module

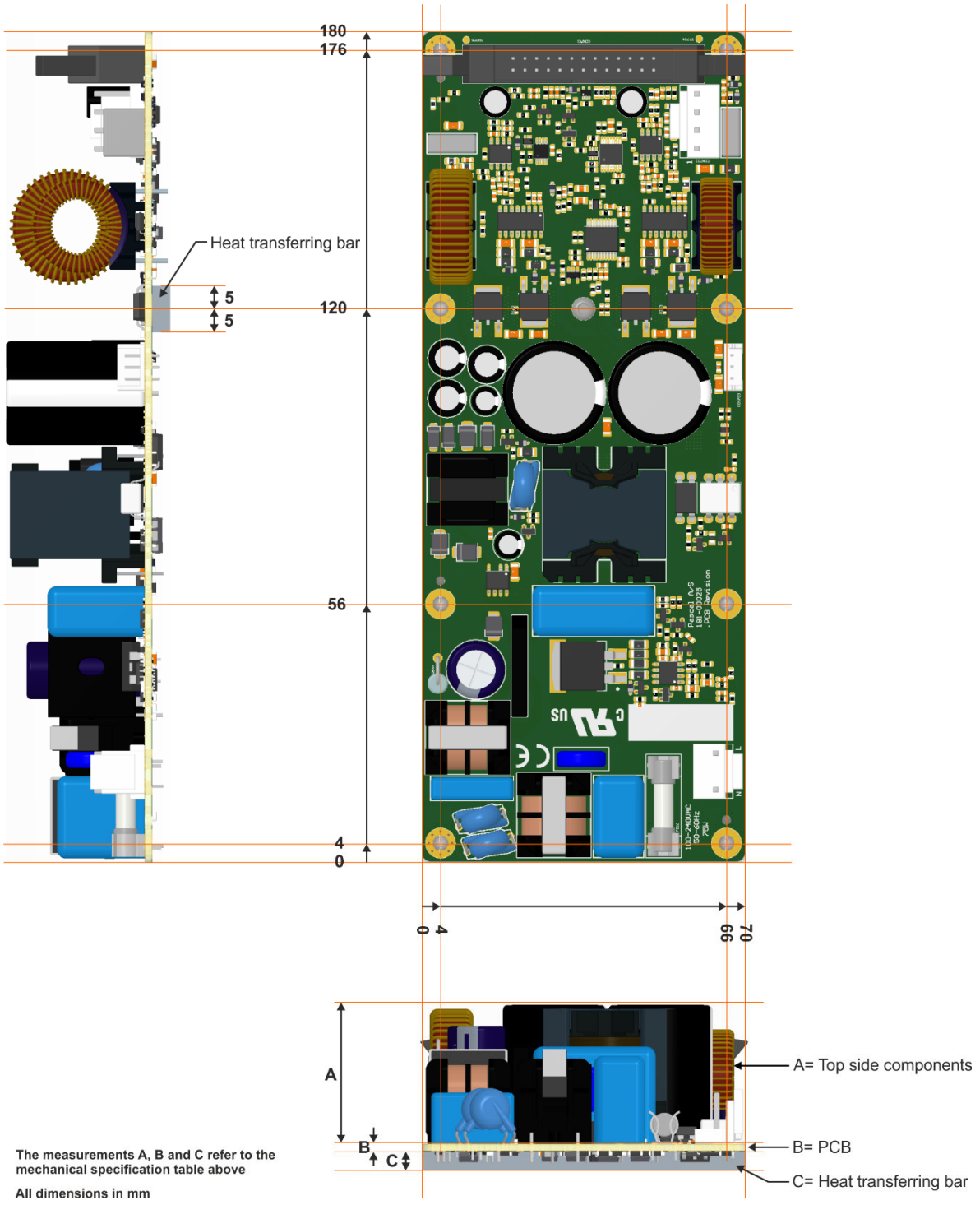


Figure 7-2: Mechanical specifications for U-PRO2 module

8 Regulatory compliance

8.1 Safety compliance

Safety Standards:
The U-PRO series is safety tested according to the following standards:

- IEC/EN 60065:2001(7th E) + A1:2005 + A2:2010
- IEC/EN/UL 62368-1:2014 (2nd E)

The U-PRO series fulfills the requirements of:

- EN 60065:2002 + A1:2006 + A11:2008 + A2:2010 + A12:2011
- EN 62368-1:2014
- CSA C22.2 NO. 62368-1-14:2014
- UL 62368:2014

The U-PRO series is evaluated against and complies with the regulations of the following countries:

60065 AR, AT, AU, BE, BY, CA, CH, CN, CZ, DE, DK, ES, EU, FI, FR, GB, GR, HU, IE, IT, JP, KR, MY, NL, NO, NZ, PL, PT, RO, SE, SG, SI, SK, UA, US

62368-1 CA, DK, FI, DE, IE, IT, NO, SE, GB, US, CENELEC common modifications

(Countries outside the CB Scheme membership may also accept the reports.)

Test procedure:

60065 U-PRO CB certificate no. E470499-A6. (UL International Demko A/S)

62368-1 U-PRO CB certificate no. E470499-D1 (UL International Demko A/S)

c UL us UL recognized under file no. E470499

(Full reports are available for download on Pascal Extranet)

Product safety category:
Class II *(Not earthed equipment)*

Special Notice:
The U-PRO series are tested as components – the final product should always be evaluated against applicable standards.

8.2 Electro Magnetic Compliance

Pascal amplifier modules are EMI compliance tested according to the following standards:

Emission:
EN 55032:2012 with EN 55032:2012 AC 2013
EN 61000-3-2:2014
EN 61000-3-3:2013

Immunity:
EN 55103-2:2009

FCC part 15 subpart B

Special Notice:
EMI verification measurements of the final product should be carried out in order to secure compliance of the final product.

8.3 ESD precautions

In order to retain the right to Pascal warranty on products, precautions on ESD must be taken when handling Pascal products. Handling of Pascal products should comply with the following standards:

IEC 61340-5-2: Protection of electronic devices from electrostatic phenomena. User Guide.
IEC 61340-5-1: Protection of electronic devices from electrostatic phenomena. General. Requirements.

ANSI/ESD-S20.20: Protection of Electrical and Electronic Parts, Assemblies and Equipment.

8.4 Changes

Pascal Products are continuously undergoing smaller changes to improve the performance or to comply with manufacturing and quality requirements. Therefore, specifications in this data sheet are subject to change.

8.5 CE marking

See *EC Declaration of Conformity*, available from www.pascal-audio.com/extranet

For further information:
www.pascal-audio.com

Or contact us at:
Info@pascal-audio.com
Phone: +45 3699 1944

Pascal A/S
Ellekaer 6
2730 Herlev
Denmark