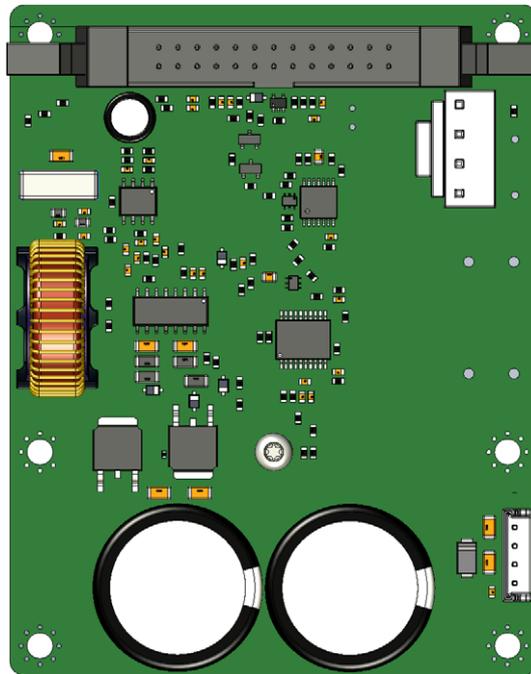


# U-A1D

## Extension Amplifier Module

### Data Sheet



U-A1D Extension Amplifier module

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# 1 Features and description

## Features

- Extension Amplifier module using Pascal's UMAC™ technology for unmatched sonic performance.
- U-A1D output power: 1 x 140W
- Full protection scheme
- Ultra-compact size
- Unmatched total system efficiency
- Multiple readouts (temperature, amplifier output voltage, clip monitor, amplifier protect/mute)
- Safety approved and verified for EMC compliance

## Product summary

Parameter	Typical Value
Total Output power (1% THD+N, 1kHz @ 8Ω)	140W
Total system efficiency U-A1D (SE, 140W @ 8Ω)	88 %
Peak output current CH1	10 A
THD+N (1kHz @ 1W)	0.003 %
Dynamic range	119 dB(A)
Idle noise	49 μV(A)
Output resistance (1kHz)	35 mΩ

## Description

U-A1D Extension Amplifier module is a 1 channel Class-D amplifier containing a single high-power channel.

The U-A Extension Amplifier module does not contain onboard power supply, and must be supplied externally from a U-PRO Series module.

The U-A Extension Amplifier module offers an ultra-compact size with an unmatched total system efficiency, to ease the integration of U-A modules into any audio solution.

In addition, the U-A Extension Amplifier module offers several readouts and controls, allowing external DSP control of the modules.

## Typical applications

- Professional Audio Solutions
- Self-Powered Loudspeakers
- Installation Systems

## 2 General specifications

Data listed in the following tables are measured with the U-A extension amplifier module powered from the integrated power supply on the U-PRO Series amplifier module.

### 2.1 Audio specifications

Electrical Characteristics @  $T_a = 25^\circ\text{C}$  (unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{out,max}$	Peak output voltage Ch1	Unloaded	-	$\pm 70$	-	V
$I_{out,peak}$	Peak output current		-	10	-	A
$P_{o,tot}$	Total module output power <sup>3</sup>	230V <sub>AC</sub> 120V <sub>AC</sub>	-	140 130	-	W
$P_o$	Output power @ 1% THD+N, 1kHz <sup>1</sup> Ch1, single ended $R_L=8\Omega$	230V <sub>AC</sub> 120V <sub>AC</sub>	-	140 130	-	W
$P_o$	Output power @ 1% THD+N, 1kHz <sup>1</sup> Ch1, single ended $R_L=4\Omega$	230V <sub>AC</sub> 120V <sub>AC</sub>	-	95 95	-	W
THD+N	THD+N @ 1W, 1kHz, $R_L = 8\Omega$ <sup>1</sup>			0.003		%
$V_{noise SE}$	Output idle noise - Ch1	Unweighted A-weighted	-	66 49	-	$\mu\text{V}_{RMS}$
$DR_{SE}$	Dynamic Range - Ch1	Unweighted A-weighted	-	117 119	-	dB
A	Voltage gain @ 1kHz, Ch1	SE	-	26	-	dB
$A_{var}$	Frequency response variance Ch1 @ 20Hz - 20kHz	$R_L = \text{Open Load}$ $R_L = 8\Omega$ $R_L = 4\Omega$	-	0.3 0.1 0.3	-	dB
$BW_{up}$	Upper bandwidth @ -3dB Ch1 SE	$R_L = \text{Open Load}$ $R_L = 8\Omega$ $R_L = 4\Omega$	-	105 85 65	-	kHz
$BW_{low}$	Lower bandwidth @ -3dB Ch1 SE	All loads	-	1.6	-	Hz
$R_o$	Output resistance <sup>2</sup>	SE 1 kHz SE 20 kHz	-	35 245	-	m $\Omega$
$V_{out,offset}$	Amplifier output DC Offset	SE 4 $\Omega$	-	$\pm 7$	-	mV
IMD <sub>CCIF</sub>	Intermodulation distortion (CCIF), Ch1 SE	18kHz & 19kHz $P_o = 10\text{W}, 8\Omega$	-	0.0046	-	%
IMD <sub>TIM</sub>	Transient Intermodulation distortion (TIM), Ch1 SE	$P_o = 10\text{W}, 8\Omega$	-	0.0028	-	%

Table 2-1: Audio specifications

Note 1: Measured using the Audio Precision AES-17 filter.

Note 2: Measured using "APx Output Impedance Utility" at the mating part of the output connector, thereby including contact resistance of the connectors.

Note 3: Maximum total power is limited by the U-PRO Series power supply.

## 2.2 Input & output loading

Electrical Characteristics @  $T_a = 25^\circ\text{C}$  (unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$Z_{\text{INPUT}}$	Input impedance	Balanced Unbalanced	-	7.2 3.6	-	k $\Omega$
$Z_{\text{L,SE}}$	Loudspeaker nominal impedance range Ch1 Single Ended (SE)	Ch1	4 <sup>1</sup>	8	$\infty$	$\Omega$
$Z_{\text{L,C}}$	Maximal purely capacitive loading of amplifier output		-	-	1	$\mu\text{F}$

Table 2-2: Input and output loading

Note 1: U-A1D is fully protected for  $Z_L < Z_L \text{ Min}$ . Connection of loads  $< Z_L \text{ Min}$  is not recommended as a low load impedance in combination with the amplifier current limit will limit maximum output power.

## 2.3 Audio input/output interfacing

Electrical Characteristics @  $T_a = 25^\circ\text{C}$  (unless otherwise specified)

Symbol	Parameter	Value	Unit
$I_{n+\text{max}}$	Absolute maximum audio input voltage	$\pm 20$	$V_p$
$I_{n-\text{max}}$	Absolute maximum audio input voltage	$\pm 20$	$V_p$
$I_{n+}$ $I_{n-}$	Audio input voltage ( $I_{n+}$ ) - ( $I_{n-}$ ) <sub>max</sub> for full output voltage swing	$\pm 3.5^1$	$V_p$

Table 2-3: Audio input voltage rating

Note 1: Internal input stage is supplied from an internal  $\pm 5\text{V}$ .

## 2.4 Thermal specification

Electrical Characteristics @  $T_a = 25^\circ\text{C}$  (unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$T_{\text{SD}}$	Temperature @ thermal shutdown Thermal hysteresis = $5^\circ\text{C}^1$		-	85	-	$^\circ\text{C}$

Table 2-4: AC Mains & thermal specifications

Note 1:  $5^\circ\text{C}$  but minimum 10s.

## 2.5 Auxiliary power supply specification

Electrical Characteristics @  $T_a = 25^\circ\text{C}$  (unless otherwise specified)

The U-A1D extension module must be powered from the U-PRO module, or a module with an equivalent power supply.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$I_{+7.5\text{V}}$	+7.5V current			11		mA
$I_{+15\text{V}}$	+15V current			16		mA
$I_{-15\text{V}}$	-15V current			11		mA
$I_{\text{drive}}$	$V_{\text{Drive}}$ current			31		mA
$P_{\text{tot}}$	Maximum total power			0.86	TBD	W

Table 2-5: Auxiliary power supply specification for U-A1D

### 3 Audio measurements

#### 3.1 Frequency response Ch1 (SE)

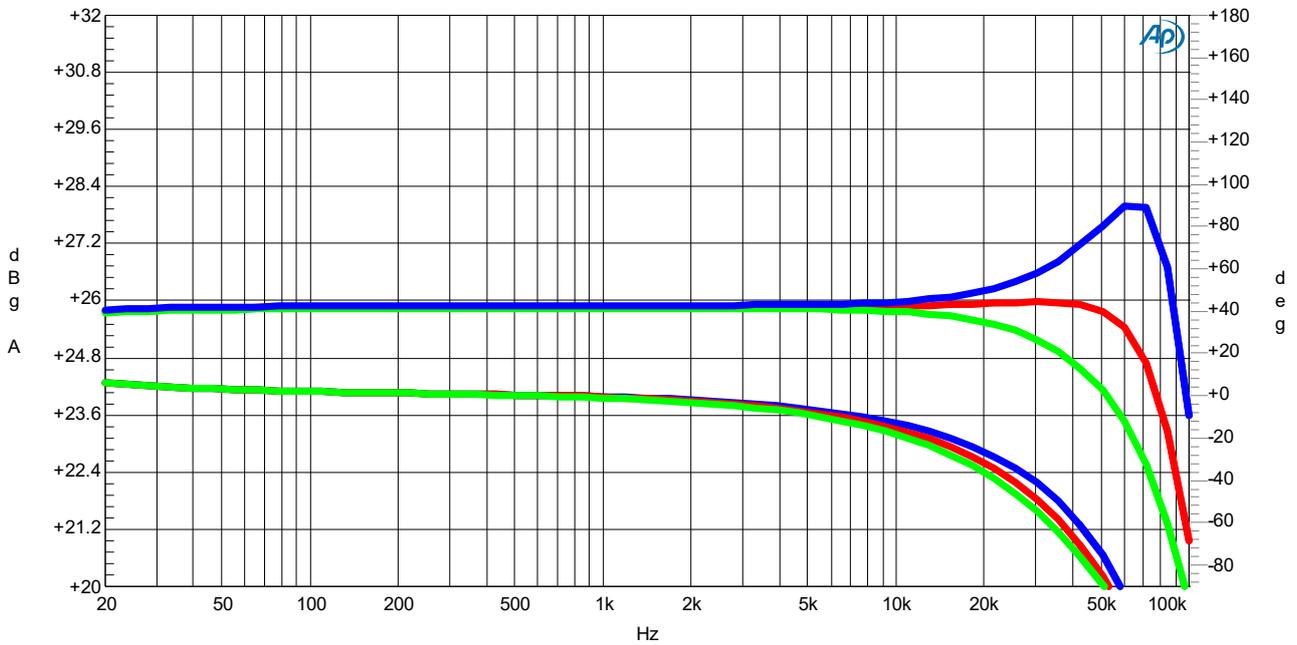


Figure 3-1: Frequency response (Top curves: Amplitude, Bottom curves: Phase)  
 4Ω (green), 8Ω (red) and Open Load (blue)

### 3.2 Total Harmonic Distortion + Noise (THD+N) Ch1 (SE)

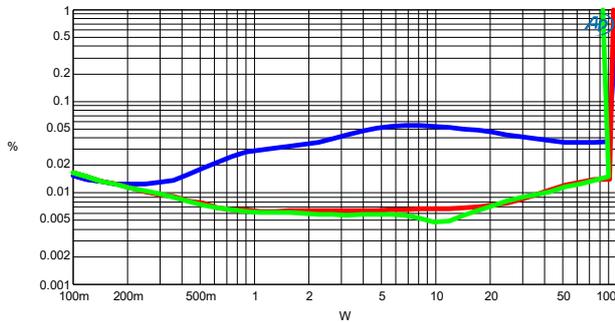


Figure 3-2 THD+N vs. Power @ 4Ω, 230V<sub>AC</sub>  
100Hz (green), 1kHz (red), 6.67kHz (blue)

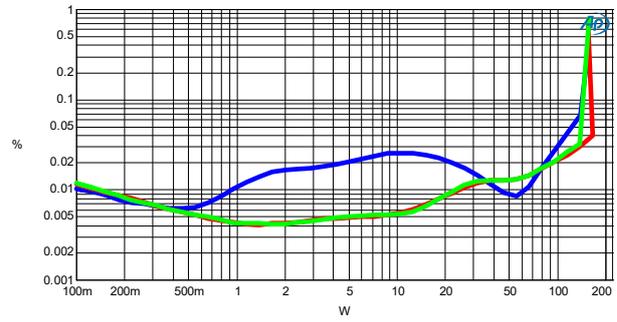


Figure 3-3 THD+N vs. Power @ 8Ω, 230V<sub>AC</sub>  
100Hz (green), 1kHz (red), 6.67kHz (blue)

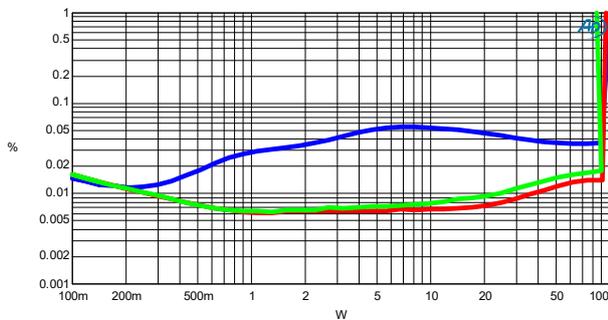


Figure 3-4 THD+N vs. Power @ 4Ω, 120V<sub>AC</sub>  
100Hz (green), 1kHz (red), 6.67kHz (blue)

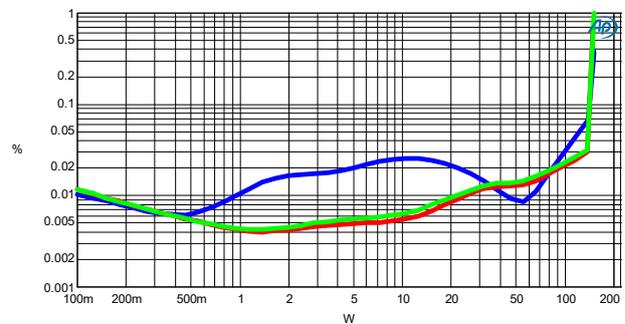


Figure 3-5 THD+N vs. Power @ 8Ω, 120V<sub>AC</sub>  
100Hz (green), 1kHz (red), 6.67kHz (blue)

### 3.3 Noise spectrum

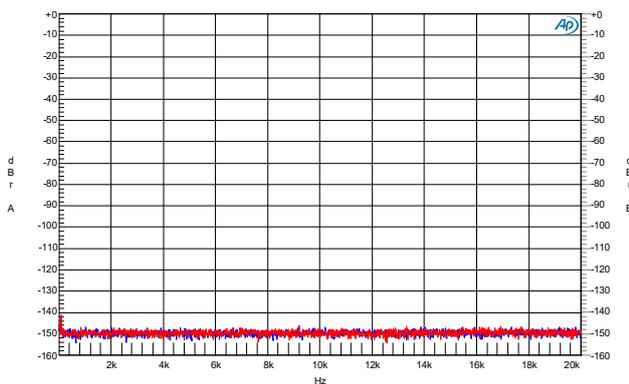


Figure 3-6: FFT idle - 8Ω SE, Ch1 (red)

### 3.4 Intermodulation Distortion (CCIF, TIM) Ch1 (SE)

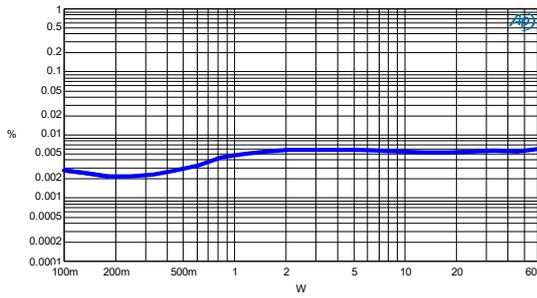


Figure 3-7: CCIF vs. Power -  $R_L=4\Omega$   
 $f_1=18\text{kHz}$ ,  $f_2=19\text{kHz}$ ,  $230V_{AC}$  Ch1 (blue)

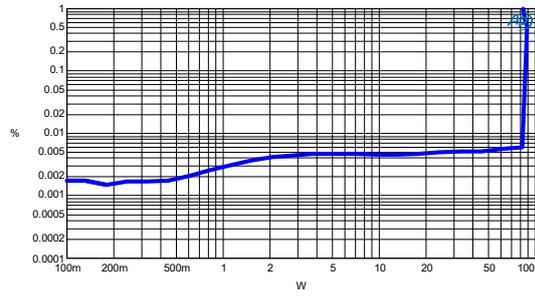


Figure 3-8: CCIF vs. Power -  $R_L=8\Omega$   
 $f_1=18\text{kHz}$ ,  $f_2=19\text{kHz}$ ,  $230V_{AC}$  Ch1 (blue)

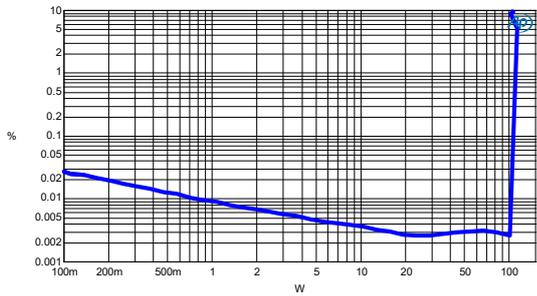


Figure 3-9: TIM vs. Power -  $R_L=4\Omega$ ,  $230V_{AC}$  Ch1 (blue)

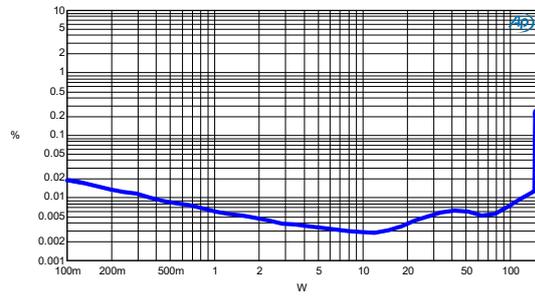


Figure 3-10: TIM vs. Power -  $R_L=8\Omega$ ,  $230V_{AC}$  Ch1 (blue)

### 3.5 Cross talk & output resistance

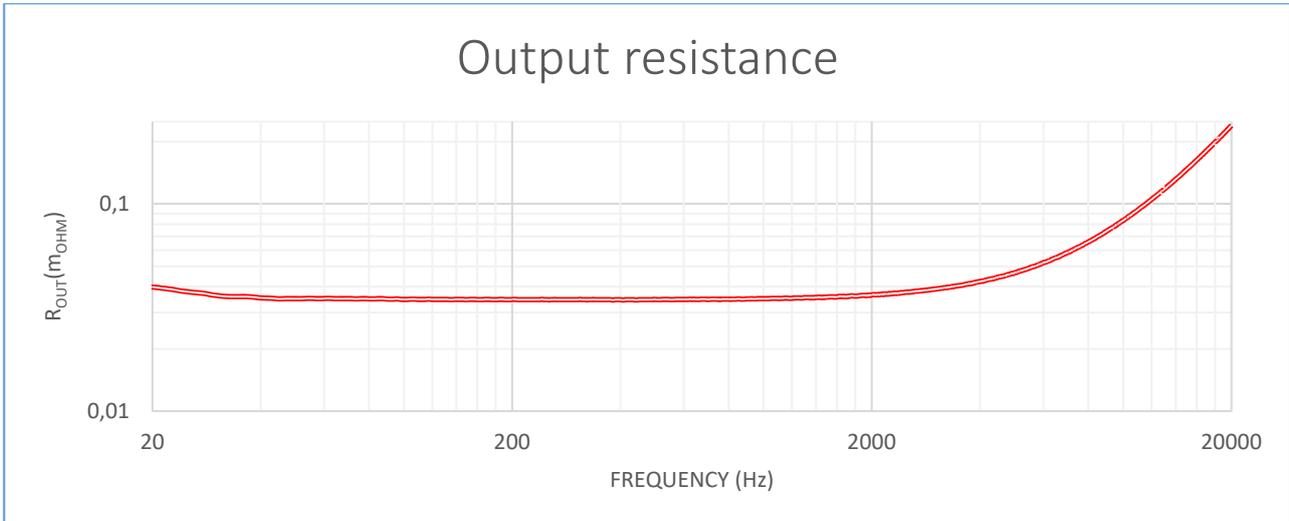


Figure 3-11: Output resistance - Measurement made at the mating part of the output connector. Connector resistance thereby included.

### 3.6 Output voltage vs. frequency

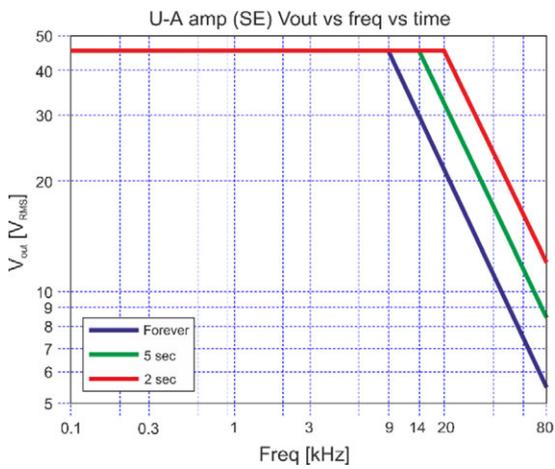


Figure 3-12: Max (SE) Vout vs. frequency vs. time

## 4 Control and readout specification

### 4.1 Control pins

**Mute** - When muting the U-A module, the amplifier output 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 circuitry 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.

**Standby** - With the U-A Series module in standby the power consumption is reduced.

### 4.2 Readout pins

The U-A1D has various readouts to monitor the state of the module.

**Temp** - Amplifier temperature can be read real-time. 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° 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° and the voltage will return to a live readout of the actual module temperature.

**Amplifier Output Voltage readout** - This is the amplifier output voltage readout Vout\_Monitor\_Ch1. This readout is voltage division of the output signal in the range of  $\pm 10$  Vp corresponding to  $\pm 70$ Vp at the output.

**Amplifier Clip readout** - The readout - Clip\_1 is an open-collector output. The readout pins will be pulled low if the audio output voltage for Ch1 becomes too high, compared to the internal rail voltages, or if the Ch1 amplifier reaches internal current protection. This readout may be used for signal clip/limiting indication.

**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.

**DC Fault** - This readout is an open-collector output. If the U-A1D module is used together with a U-PRO1/U-PRO2SD module, then the DC\_Fault (pin 15, CON701) on U-A1D must be connected to the Signal TimeOut (pin 14, CON701) on U-PRO1/U-PRO2SD.

## 5 Functionality & configuration

### 5.1 Protection features

The U-A1D module has built-in protection features which protect the module and speaker from malfunctioning.

**Temperature** - Temperature protection of the amplifier is implemented to prevent the module from thermal runaway. When thermal protection is engaged the amplifier is muted until the temperature has dropped 5°C or minimum 10s.

**Over Current** - If the 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 external amplifier output, until the internal protection timing allows the module to re-enable the amplifier.

**DC Protection** - If a DC-voltage is detected at the U-A amplifier output, the module will mute the output. If the DC-voltage is reoccurring the module will attempt to restart maximum 3 times before it via the connection between the DC\_Fault (pin 15, CON701) on U-A1D and the Signal TimeOut (pin 14, CON701) on U-PRO1/U-PRO2SD, enters a latching shutdown of the +/-70V power supply to protect the connected loudspeaker from being damaged.

**HF Protection** - A high frequency protection is implemented in order to protect the amplifier output filter components from overload - refer to *Figure 3-12*. If a high frequency (and high amplitude) signal is present for a longer period, the module will enter HF protection and mute the U-A amplifier output, until the internal protection timing allows the module to re-enable the amplifier.

## 5.2 U-A1D functional blocks

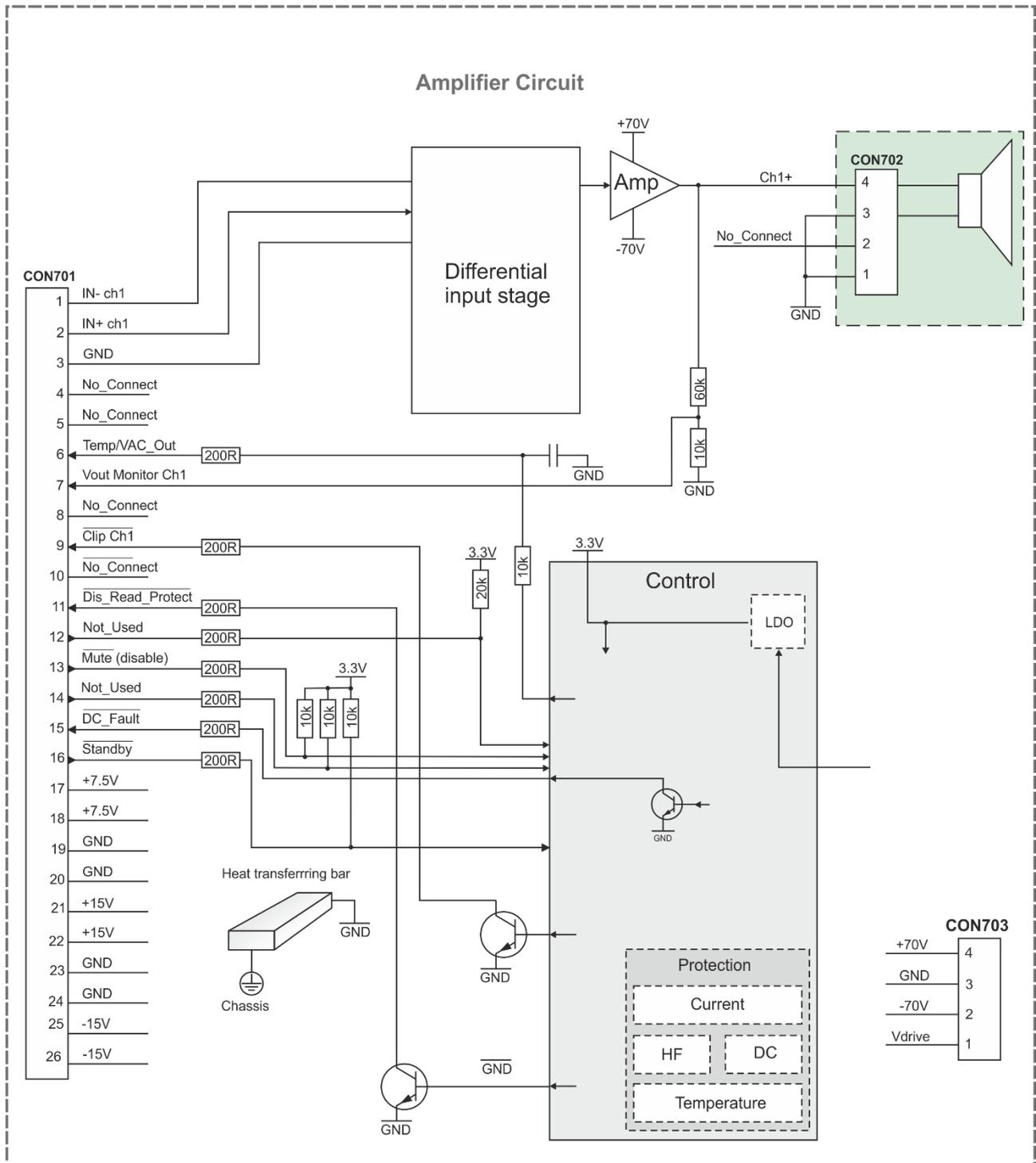


Figure 5-1: Block diagram showing U-A1D module functionality

### 5.3 Single Ended (SE) 1 channel configuration

The single amplifier channel available on the U-A1D.

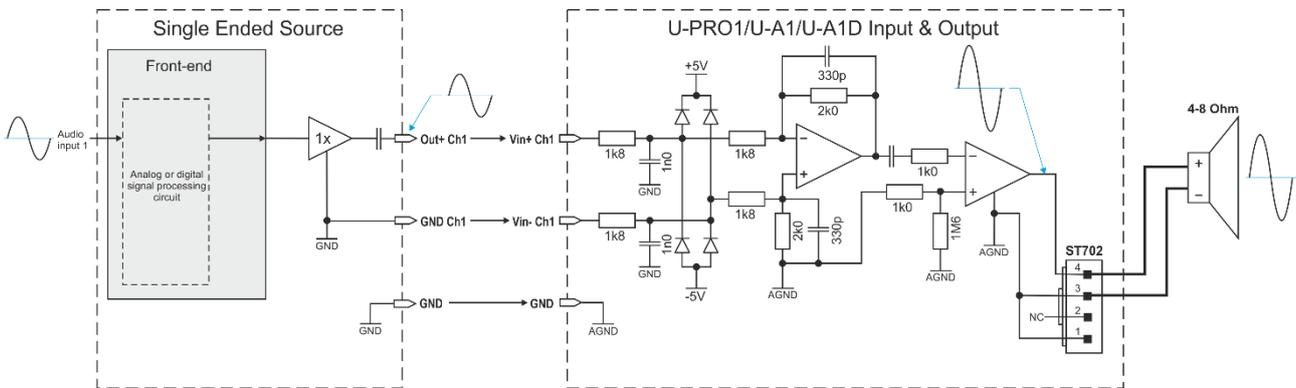


Figure 5-2: U-A1D Extension Amplifier module shown in Single Ended (SE) configuration driving e.g. subwoofer (LF)

## 6 Module connections

This section describes the signal, control and DC-supply connections of the U-A1D Extension Amplifier module.

### 6.1 U-A1D connections

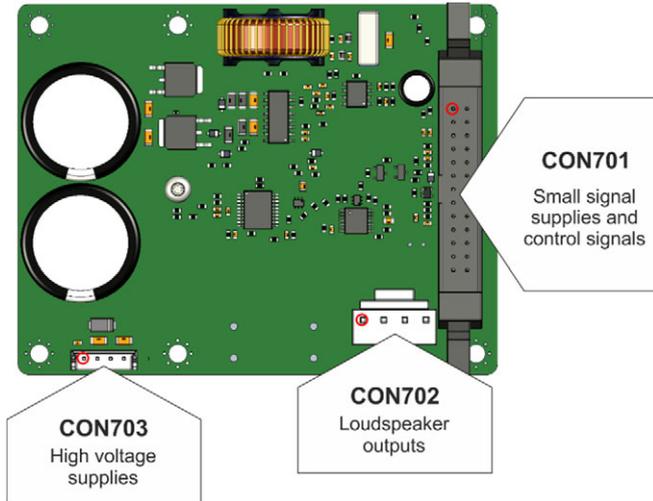


Figure 6-1: U-A1D Extension Amplifier module connectors - red circle indicates pin 1

## 6.2 Signal and Control connector

CON701			
Name	Pin #	I/O	
Ch1_In-	1	I	Ch 1 negative audio input signal of the balanced input to the U-A1D module. The maximum allowable signal on this pin is $\pm 20V_p$
Ch1_In+	2	I	Ch 1 positive audio input signal of the balanced input to the U-A1D module. The maximum allowable signal on this pin is $\pm 20V_p$
GND	3	-	GND
No Connect	4	-	This pin has no internal connection
No Connect	5	-	This pin has no internal connection
Temp_Out	6	O	This pin reads out the amplifier temperature corresponding to 0°C-100°C. The pin will read out 3.3V when in temperature protection
Vout_Monitor_Ch1	7	O	This pin reads out the amplifier channel 1 output voltage. The signal will be in the range $\pm 10V_p$ corresponding to $\pm 70V_p$ on the output of the amplifier. The signal is high impedance. Loading the output is allowed but will reduce the Vout_Monitor signal according to the load impedance
No Connect	8	-	This pin has no internal connection
$\overline{\text{Clp}}_1$	9	O	This pin signals an active low whenever the amplifier Ch1 is voltage clipping or current 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 are disabled or in protection
Not Used	12	-	This pin is not used, but may be internally connected
$\overline{\text{Mute}}$	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) 1ms
Not Used	14	-	This pin is not used, but may be internally connected
$\overline{\text{DC\_Fault}}$	15	I	If the U-A1D module is used together with a U-PRO1/U-PRO2SD module, then the DC_Fault (pin 15, CON701) on U-A1D must be connected to the Signal TimeOut (pin 14, CON701) on U-PRO1/U-PRO2SD
$\overline{\text{Standby}}$	16	O <sup>1,2</sup>	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	Connection for +7.5V supply from U-PRO Series module
GND	19,20	-	GND
+15V	21,22	O	Connection for +15V supply from U-PRO Series module
GND	23,24	-	GND
-15V	25,26	O	Connection for -15V supply from U-PRO Series module

Table 6-1: U-A1D and U-A2SD signal and control connector

Note 1: Normally, it is not recommended to connect the extension amplifier module U-A1D pin 16 to the amplifier module U-PRO pin 16, as this may cause logic hazard in some configurations.

Note 2: Do not activate pin 16 on the U-A module(s) for standby power reduction, interrupt +7.5V instead.

## 6.3 Speaker Output connector

CON702			Description
Name	Pin #	I/O	
No Connect	1	-	Internally connected to GND
No Connect	2	-	No internal connection
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 6-2 U-A1D speaker connector overview

## 6.4 DC-Supply connector

CON703			Description
Name	Pin #	I/O	
V <sub>drive</sub>	1		The V <sub>drive</sub> voltage signal input for U-A Series Extension Amplifier module
-70V	2	O	The negative rail voltage for U-A Series Extension Amplifier module
GND	3	O	GND
+70V	4	O	The positive rail voltage for U-A Series Extension Amplifier module

Table 6-3 U-A1D extension amplifier module connector overview

# 7 Mechanical specifications

This section contains mechanical outlines and specifications concerning the U-A1D module.



The mechanical outlines and specifications concern standard versions only. In case you are using other versions than the standard i.e. versions containing the extension letter *B* or *HV*, please contact Pascal Application Support.

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
U-A1D module weight (inclusive heat transferring bar)		82g	

Table 7-1: U-A1D mechanical specifications

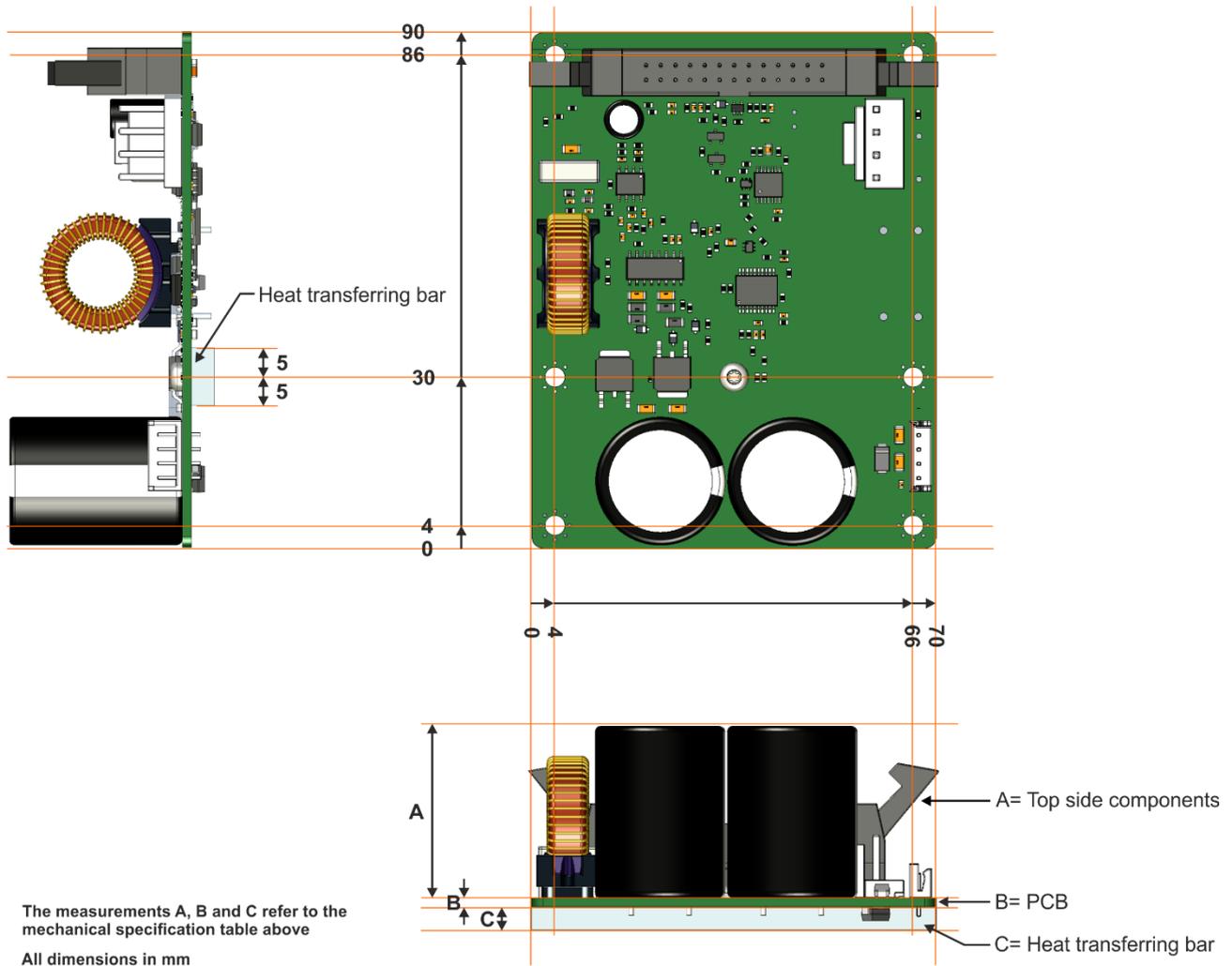


Figure 7-1: Mechanical outline and specifications for the U-A1D Extension Amplifier module

## 8 Regulatory compliance

The U-A series is designed for fast-track compliance when used in Pro Audio products marketed in EU, North America, and East Asia Region.

Whenever possible the product is pre-certified to save valuable testing time in the end-product. When pre-certification is not possible, extensive testing has been conducted to ensure that the end-product can easily apply for the following marks:

EU	CE Mark
USA + Canada	cULus listing
China	CCC mark
Korea	KC mark
Japan	PSE mark

### 8.1 Safety compliance

#### Safety Standards:

The U-A series is safety tested, according to the following standards:

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

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

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

 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-A 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.

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 might be subject to change.

## 8.5 CE marking

See *EC Declaration of Conformity*, available from [www.pascal-audio.com/extranet](http://www.pascal-audio.com/extranet).

**For further information:**

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