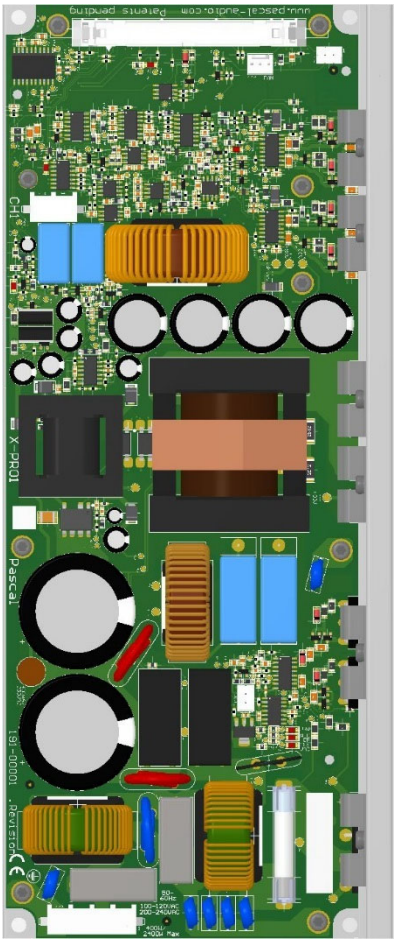
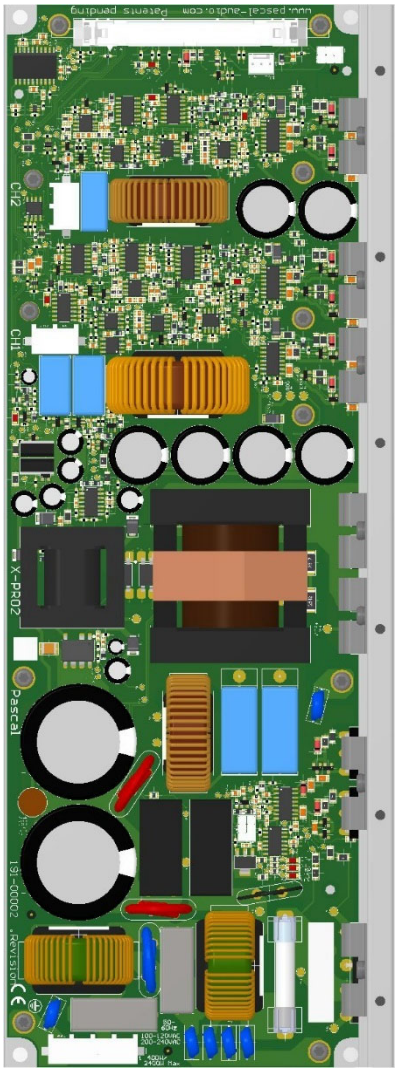
PASCAL

X-PRO Series

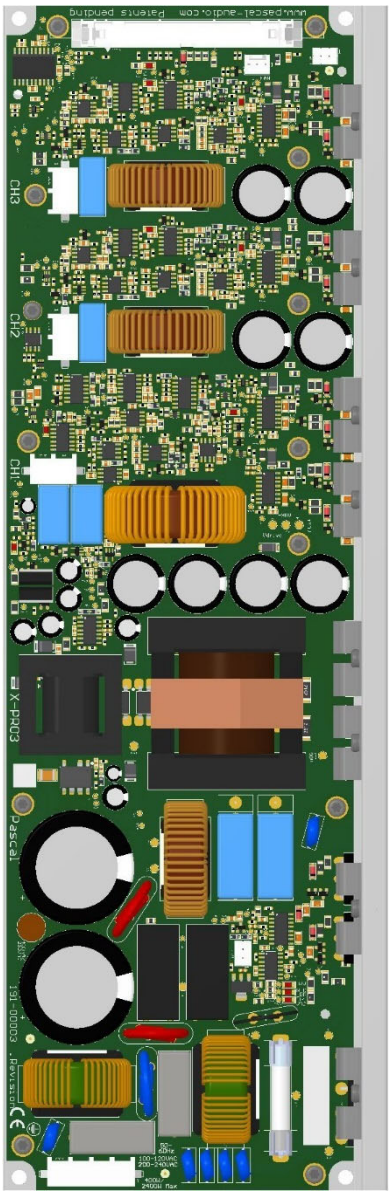
Data Sheet



X-PRO1



X-PRO2



X-PRO3

Table of Contents

1 Features and Description

Features

- Plug-and-play integrated power package complete with all readout- and protection features for Professional applications, such as subwoofers, high power monitors and line arrays or small speaker systems. The complete integration secures optimal performance and reliability as well as shortened time to market.
- Fully protected high efficiency UREC™ switch mode power supply with auto selectable mains, enabling hassle free worldwide operation.
- Pascal proprietary UMAC™ Class D optimized amplifier power stages, with leading Power performance specification and market acknowledged audio specifications.
- Complete interface, including extensive readouts and high Auxiliary power for the most advanced DSP solutions.
- EMI and Safety compliant design.

Product Summary

Parameter	Typical Value
Output power (total module output power)	2200 W
Peak output current	30 A / 21 A
THD+N (1kHz @ 1W)	0.0045% / 0.003%
Dynamic range	120 dB(A)
Idle noise	110 µV(A) / 55 µV(A)
Output impedance (1kHz)	11 mΩ / 6 mΩ

Description

The X-PRO Series is a true application dedicated series of complete “power packs” for the most demanding and powerful professional speaker applications, requiring high-end sonic quality as well as true professional reliability under any condition.

The X-PRO Series includes three different versions (X-PRO1, X-PRO2 and X-PRO3) each including a fully integrated universal mains power supply and up to 3 high performance Class D amplification stages.

Typical Applications

- Professional Audio Solutions
- Self-Powered Loudspeakers
- MI Audio Solutions
- Consumer Audio Solutions
- Hi-Fi Audio Solutions

2 General specifications

2.1 Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{ACmax}	Maximum operational off-line voltage	265	V_{AC}
V_{ACmin}	Minimum operational off-line voltage	85	V_{AC}
f_{AC}	AC Mains frequency range	45 - 65	Hz
$I_{+15Vmax}$	Maximum +15V current draw[1]	150	mA
$I_{-15Vmax}$	Maximum -15V current draw[1]	-150	mA
I_{+7Vmax}	Maximum +7V current draw[2]	1000	mA
I_{Fan_max}	Maximum Fan current draw[2]	500	mA
$V_{in\_p\_max}$	Maximum peak input voltage, all channels	+/-15	V_p
	Minimum loudspeaker impedance ch1	4	Ω
$R_{load\ SE}$	Minimum loudspeaker impedance ch2, ch3 (SE-mode)	4	Ω
$R_{load\ BTL}$	Minimum loudspeaker impedance ch2, ch3 (BTL-mode)	8	Ω

Table 2-1: Absolute maximum ratings

Note[1]: Ratings are given for an X-PRO3 module.
The +/- 15V supply on the X-PRO2 module can deliver 50mA more on each supply rail.
The +/- 15V supply on the X-PRO1 module can deliver 100mA more on each supply rail
Note[2]: The sum of I_{+7Vmax} and I_{Fan_max} must not exceed 1000 mA.

The measurements for Channel 2 and Channel 3 in the following sections are only applicable for X-PRO2 and X-PRO3, respectively.

2.2 Audio specifications

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{outmax_Ch1}	Peak output voltage Ch1	R_L = 8Ω R_L = 4Ω		160		V
$V_{outmax\_Ch2/Ch3}$	Peak output voltage Ch2, Ch3	R_L = 8Ω R_L = 4Ω		80		V
I_{outmax_Ch1}	Peak output current			30		A
$I_{outmax\_Ch2/Ch3}$	Peak output current			21		A
P_{o_tot}	Total module output power[1] (power supply limited)	230V_{AC} 120V_{AC}		2200 2100		W
P_o	Output power Ch1 @ 1% THD+N 1kHz (AES17 filter)	R_L = 8Ω 230V_{AC} 120V_{AC}		1550 1500		W
P_o	Output power Ch1 @ 1% THD+N 1kHz (AES17 filter)	R_L = 4Ω 230V_{AC} 120V_{AC}		2000 2000		W
P_o	Output power CH2/Ch3 @ 1% THD+N 1kHz (AES17 filter)	R_L = 8Ω 230V_{AC} 120V_{AC}		400 400		W
P_o	Output power CH2/Ch3 @ 1% THD+N 1kHz (AES17 filter)	R_L = 4Ω 230V_{AC} 120V_{AC}		800 800		W
THD+N	THD+N (AES17 filter)	1kHz, 1W, R_L = 8Ω		0,003		%
V_{noise_Ch1}	Output idle noise Ch1	Unweighted A-weighted		140 110		uV_{RMS}
$V_{noise\_Ch2/Ch3}$	Output idle noise CH2/Ch3	Unweighted A-weighted		75 55		uV_{RMS}
DR_{ch1}	Dynamic Range Ch1	Unweighted A-weighted		118 120		dB
$DR_{ch2/ch3}$	Dynamic Range Ch2	Unweighted A-weighted		118 120		dB
A_{ch1}	Voltage gain Ch1	1kHz		32		dB
$A_{ch2/ch3}$	Voltage gain Ch2/Ch3	1kHz		26		dB
A_{var_Ch1}	Frequency response variance Ch1	20Hz – 20kHz All loads		+/-0.2		dB
$A_{var\_Ch2/Ch3}$	Frequency response variance Ch2/Ch3	20Hz – 20kHz All loads		+/-0.1		dB
$BW_{up\ ch1}$	Upper bandwidth Ch1 (-3dB)	R_L = 8Ω R_L = 4Ω		70 60		kHz
$BW_{low\ ch1}$	Lower bandwidth Ch1 (-3dB)	All loads		0.5		Hz
$BW_{up\ ch2/ch3}$	Upper bandwidth Ch2/Ch3 (-3dB)	R_L = 8Ω R_L = 4Ω		70 65		kHz
$BW_{l\ ch2/ch3}$	Lower bandwidth Ch2/Ch3 (-3dB)	All loads		0.5		Hz
Z_{o_Ch1}	Absolute output impedance Ch1	1kHz		11		mΩ
$Z_{o\_Ch2/Ch3}$	Absolute output impedance Ch2/Ch3	1kHz		6		mΩ
$IMD_{CCIF\ ch1}$	Intermodulation distortion (CCIF)	18kHz and 19kHz Po = 10W 8Ω		0.001		%
TIM_{Ch1}	Transient Intermodulation distortion (TIM)	Po = 10W 8Ω		0.003		%
$IMD_{CCIFch2/ch3}$	Intermodulation distortion (CCIF)	18kHz and 19kHz Po = 10W 8Ω		0.0008		%
$TIM_{Ch2/Ch3}$	Transient Intermodulation distortion (TIM)	Po = 10W 8Ω		0.002		%

Table 2-2: Audio specifications

2.3 Input & Output loading

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Z_{INPUT}	Input impedance	Ch1, Ch2, Ch3	-	1.88	-	kΩ
Z_L	Loudspeaker nominal impedance range	Ch1, Ch2 (SE), Ch3 (SE)	4		∞	Ω
Z_L	Loudspeaker nominal impedance range	Ch2 + Ch3(BTL)	8		∞	Ω
$Z_{L,C}$	Maximal purely capacitive loading of amplifier output	SE BTL	-	-	1	µF

Table 2-3: Input & output loading

2.4 AC Mains & Power Loss specification

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$P_{AC\ PN\ X\text{-}PRO1}$	AC mains power input, 230V (Pink Noise)	R_L = 8Ω R_L = 4Ω R_L = 4Ω Nominal[1] (RMS output = 1/8 of rated power) ($P_{out, RMS}$ = 1/8th 1550W for R_L = 8Ω) ($P_{out, RMS}$ = 1/8th 2000W for R_L = 4Ω)		323 411 228		W_{RMS}
$P_{AC\ PN\ X\text{-}PRO2}$	AC mains power input, 230V (Pink Noise, all channels)	R_L = 8Ω R_L = 4Ω R_L = 4Ω Nominal[1] (RMS output = 1/8 of rated power) ($P_{out, RMS}$ = 1/8th 1550W+400W for R_L = 8Ω) ($P_{out, RMS}$ = 1/8th 2000W+800W for R_L = 4Ω)		396 556 335		W_{RMS}
$P_{AC\ PN\ X\text{-}PRO3}$	AC mains power input, 230V (Pink Noise, all channels)	R_L = 8Ω R_L = 4Ω R_L = 4Ω Nominal[1] (RMS output = 1/8 of rated power) ($P_{out, RMS}$ = 1/8th 1550W+2x400W for R_L = 8Ω) ($P_{out, RMS}$ = 1/8th 2000W+2x800W for R_L = 4Ω)		480 685 459		W_{RMS}
$P_{120VAC\ NS\ X\text{-}PRO1}$	AC mains power input (No signal applied)	Standby Mute Idle		3 10 18		W_{RMS}
$P_{120VAC\ NS\ X\text{-}PRO2}$	AC mains power input (No signal applied)	Standby Mute Idle		3 12 25		W_{RMS}
$P_{120VAC\ NS\ X\text{-}PRO3}$	AC mains power input (No signal applied)	Standby Mute Idle		3 16 32		W_{RMS}
$P_{230VAC\ NS\ X\text{-}PRO1}$	AC mains power input (No signal applied)	Standby Mute Idle		6 12 19		W_{RMS}
$P_{230VAC\ NS\ X\text{-}PRO2}$	AC mains power input (No signal applied)	Standby Mute Idle		6 14 27		W_{RMS}
$P_{230VAC\ NS\ X\text{-}PRO3}$	AC mains power input (No signal applied)	Standby Mute Idle		6 18 34		W_{RMS}
$V_{AC\_Range\ 1}$	Operational voltage range $120V_{AC}$		85		138	V_{AC}
$V_{AC\_Range\ 2}$	Operational voltage range 230_{AC}		170		265	V_{AC}
$P_{LOSS\ X\text{-}PRO1}$	Module power loss at $230V_{AC}$ Pink Noise	R_L = 8Ω R_L = 4Ω R_L = 4Ω Nominal[1]		123 160 85		W_{RMS}

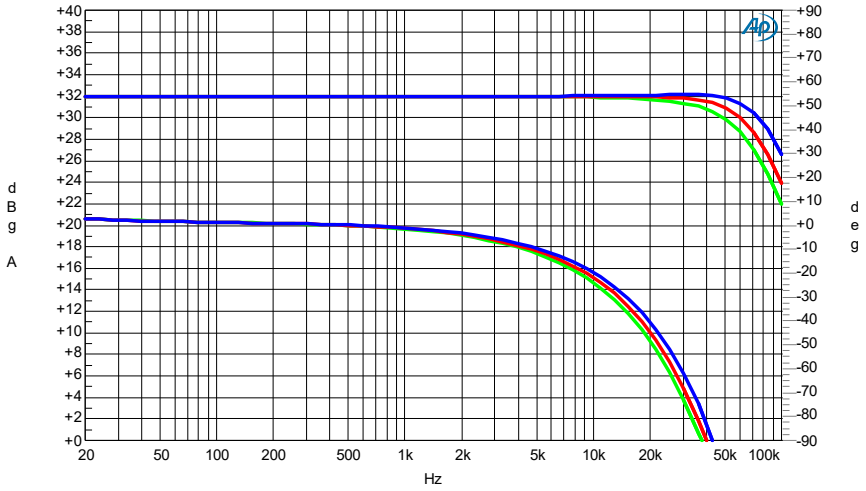
		($P_{out, RMS}$ = 1/8th 1550W for R_L = 8Ω) ($P_{out, RMS}$ = 1/8th 2000W for R_L = 4Ω)				
$P_{LOSS\ X\text{-}PRO2}$	Module power loss at 230V_{AC} Pink Noise	R_L = 8Ω R_L = 4Ω R_L = 4Ω Nominal[1] ($P_{out, RMS}$ = 1/8th 1550W+400W for R_L = 8Ω) ($P_{out, RMS}$ = 1/8th 2000W+800W for R_L = 4Ω)		147 206 117		W_{RMS}
$P_{LOSS\ X\text{-}PRO3}$	Module power loss at 230V_{AC} Pink Noise	R_L = 8Ω R_L = 4Ω R_L = 4Ω Nominal[1] ($P_{out, RMS}$ = 1/8th 1550W+2x400W for R_L = 8Ω) ($P_{out, RMS}$ = 1/8th 2000W+2x800W for R_L = 4Ω)		180 235 166		W_{RMS}
$P_{PROTECTION}$	Temperature @ thermal limiting		-	85	-	°C
T_{SD}	Temperature @ thermal shutdown	Thermal hysteresis = 10°C	-	95	-	°C
I_{INRUSH}	Peak Inrush Current	100V_{AC} 120V_{AC} 230V_{AC}		14.1 17.0 32.5		A_{PEAK}

Table 2-4: AC Mains & power loss specifications

Note[1]: Ch1 loaded with ”4 Ohm SUB” which refers to a dual 18” driver bandpass subwoofer with a nominal impedance of 4 Ohm. Input signal filtered to 25Hz – 200Hz. Ch2/3 loaded with 4 Ohm resistive loads.

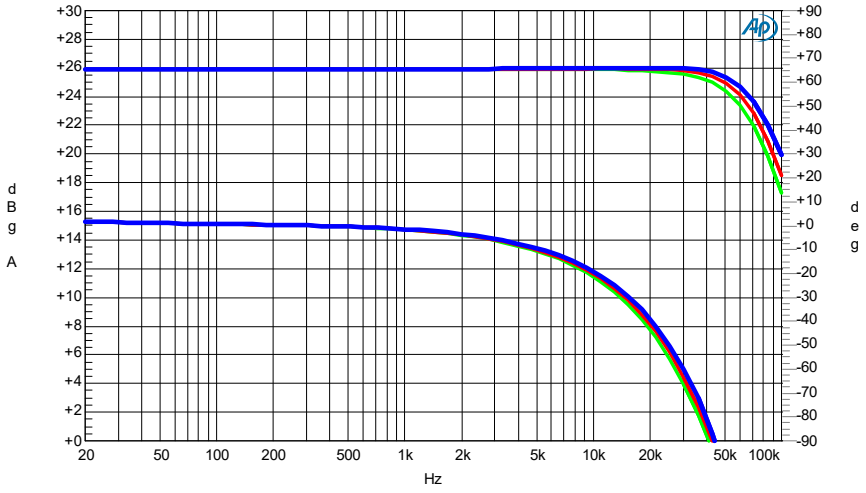
3 Audio measurements

3.1 Frequency response channel 1



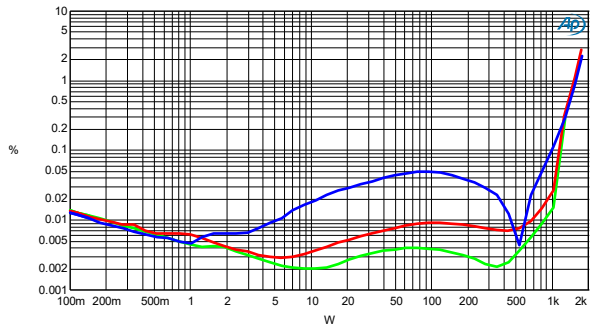
Frequency response, 4Ω (green), 8Ω (red) and open load (blue). Top – amplitude. Bottom – phase.

3.2 Frequency response channel 2 & 3

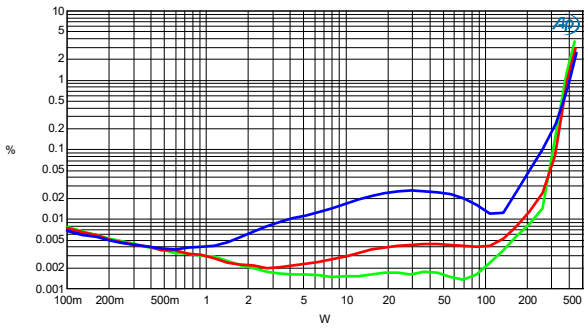


Frequency response, 4Ω (green), 8Ω (red) and open load (blue). Top – amplitude. Bottom – phase.

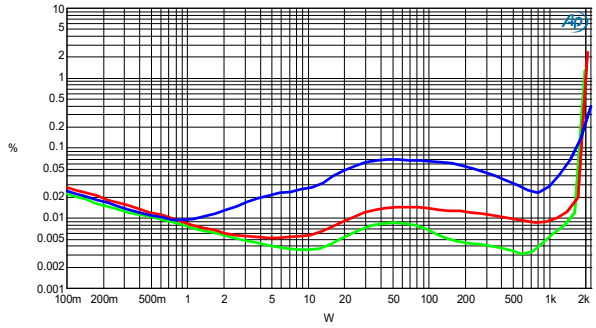
3.3 Total Harmonic Distortion + Noise



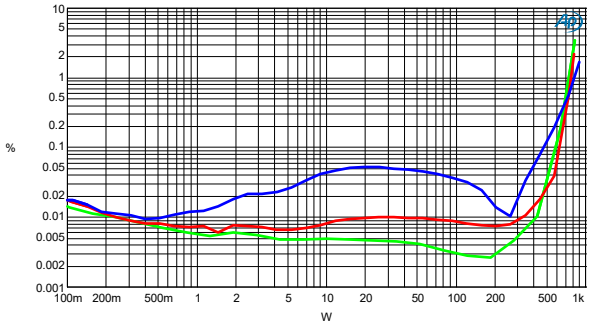
THD+N vs. Po, Channel 1, 100Hz (green), 1kHz (red), 6,67kHz (blue), 8Ω



THD+N vs. Po, Channel 2 & 3, 100Hz (green), 1kHz (red), 6,67kHz (blue), 8Ω



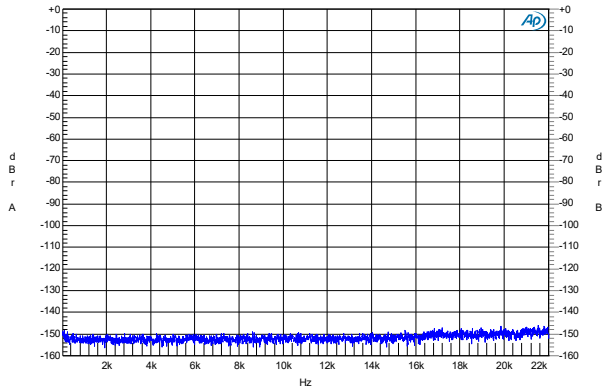
THD+N vs. Po, Channel 1, 100Hz (green), 1kHz (red), 6,67kHz (blue), 4Ω[1]



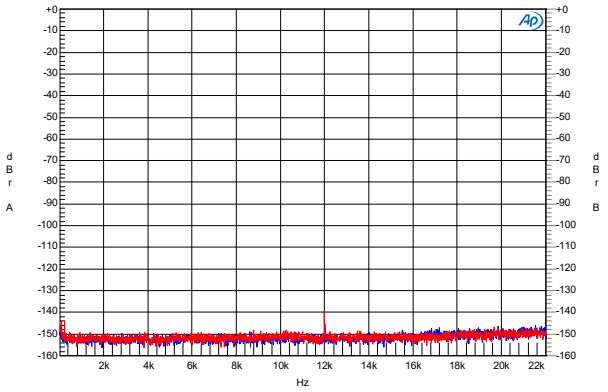
THD+N vs. Po, Channel 2 & 3, 100Hz (green), 1kHz (red), 6,67kHz (blue), 4Ω

Note[1]: Above measurement is made by disabling the internal fuse protection – which cannot normally be disabled. Normal power measurements should be done by using AP burst signals.

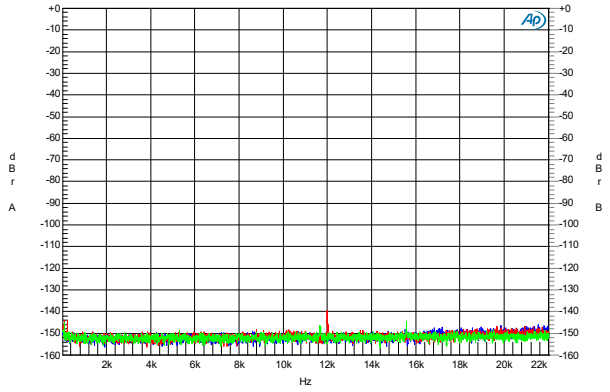
3.4 Noise Spectrum



FFT, Channel 1, 4 Ohm, Idle

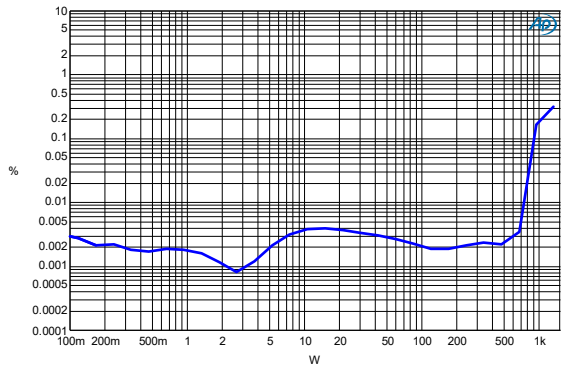


FFT, Channel 1 (Blue) & 2 (Red), 4 Ohm, Idle

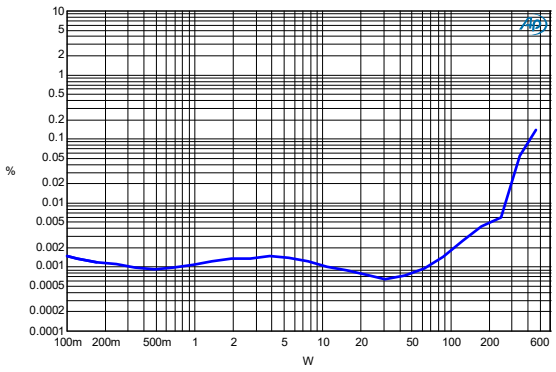


FFT, Channel 1(Blue), 2(Red) &3(Green), 4Ohm, Idle

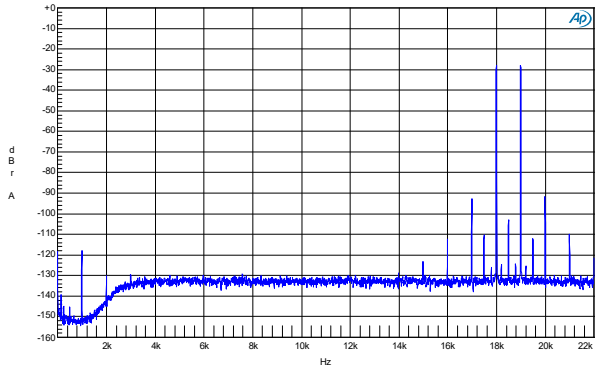
3.5 Intermodulation Distortion (CCIF, TIM)



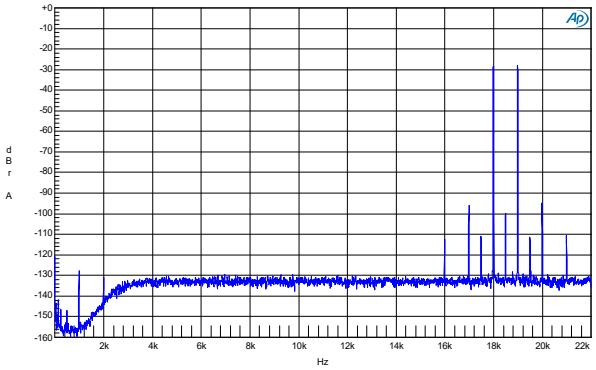
CCIF vs power R_L=4 ohm, channel 1, f_1=18khz, f_2 =19khz



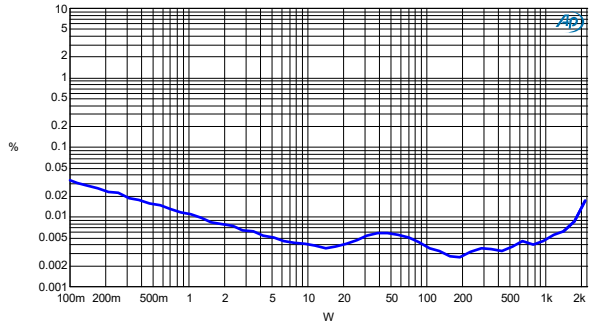
CCIF vs power R_L=4 ohm, channel 2/3, f_1=18khz, f_2 =19khz



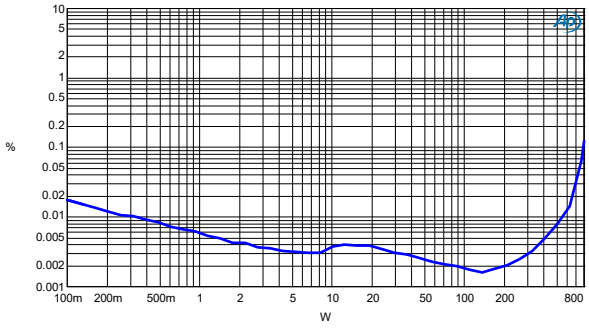
CCIF FFT, Channel 1, f_1=18khz, f_2 =19khz R_L=4 Ohm, P_O =10W.



CCIF FFT, Channel 2/3, f_1=18khz, f_2 =19khz R_L=4 Ohm, P_O =10W.



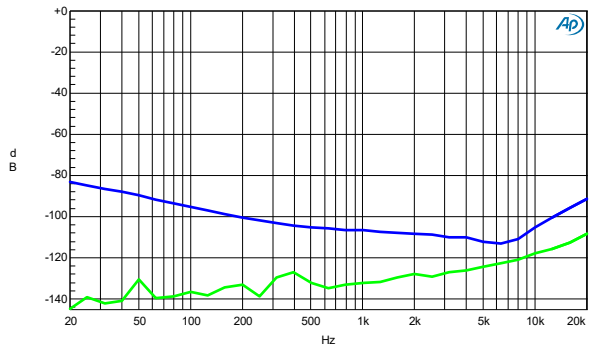
TIM vs. power, RL=4 Ohm channel 1



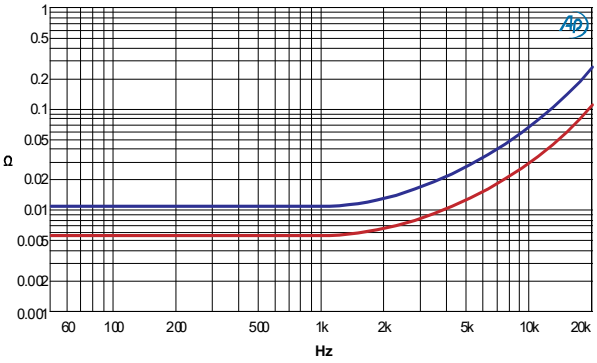
TIM vs. power, R_L=4 Ohm channel 2/3

Note 1: Above measurement is made by disabling the internal fuse protection – which cannot normally be disabled. Normal power measurements should be done by using AP burst signals.

3.6 Cross Talk & Output impedance



Cross talk, Channel 3, $P_{o,ch1}$=100W (green), Channel 3, $P_{o,ch2}$=100W (blue)



Output impedance, Channel 2/3, I_{out}=1A_{RMS}, Channel 1, I_{out}=1A_{RMS}

4 LED indicators and cable connectors

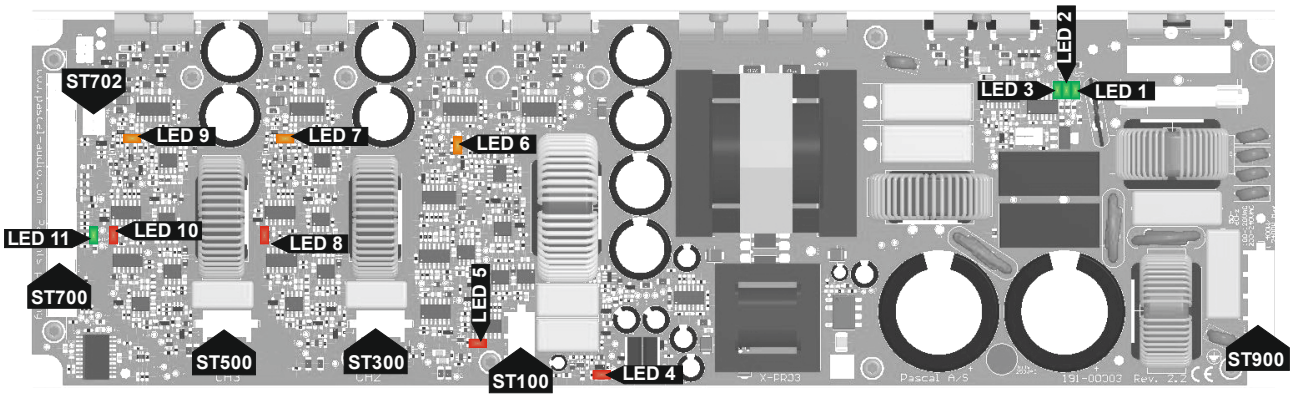


Figure 4-1: X-PRO3 connectors and LEDs

4.1 LED Functionality

LED No.	Function	Normal Operation	LED Indication	LED Indication Result
LED1	Relay state	ON OFF		Mains AC voltage: 120V_{AC} Mains AC voltage: 230V_{AC}
LED2	Relay state	ON		Inrush limiter bypassed
LED3	Amplifier drive voltage (Mains SMPS ON)	ON	ON, Permanent Flashing	Amplifier drive voltage present, SMPS ON Main SMPS disabled (standby mode)
LED4	RMS Limiting	OFF	Flashing (without audio input) Flashing (with audio input) On, Permanent	AC mains 120V/230V detection failed $P_{AC\ Mains}$ = 1kW, periodical RMS limiting $P_{AC\ Mains}$ > 1kW, permanent RMS limiting
LED5	Clip Limiter $_{CH1}$		ON OFF	Channel 1, Clip limiting Channel 1, Not clipping
LED6	Disable $_{CH1}$	OFF	ON OFF	Channel 1, Disable (Mute) or protection mode Channel 1, Enabled
LED7	Disable $_{CH2}$	OFF	ON OFF	Channel 2, Disable (Mute) or protection mode Channel 2, Enabled
LED8	Clip Limiter $_{CH2}$	OFF	ON OFF	Channel 2, Clip limiting Channel 2, Not clipping
LED9	Disable $_{CH3}$	OFF	ON OFF	Channel 3, Disable (Mute) or protection mode Channel 3, Enabled
LED10	Clip Limiter $_{CH3}$	OFF	ON OFF	Channel 3, Clip limiting Channel 3, Not clipping
LED11	Auxiliary 7V	ON	ON OFF	Auxiliary 7V present Auxiliary 7V not present

Table 4-1: LED functionality

4.2 LED timing during start-up & shut-down

During normal start-up and shut-down of the amplifier modules the LEDs will show the following timing.

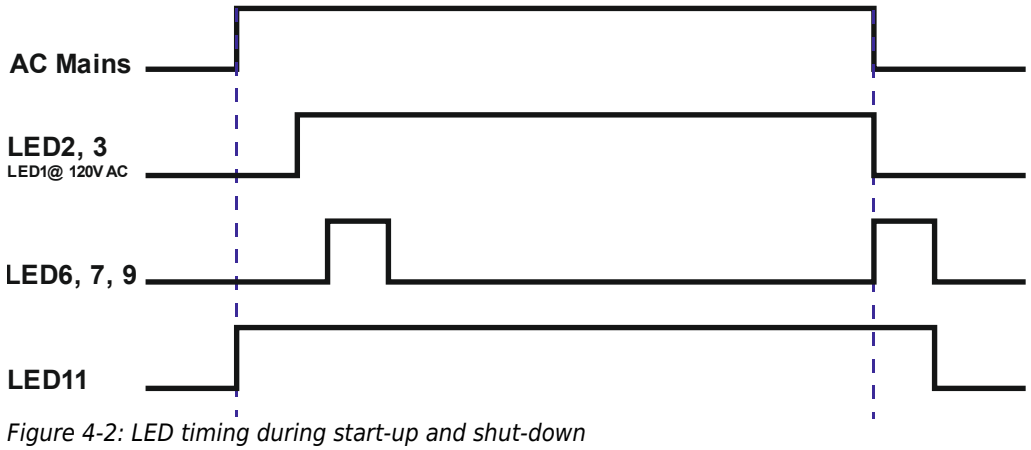


Figure 4-2: LED timing during start-up and shut-down

4.3 X-PRO1, X-PRO2 and X-PRO3 connectors

4.3.1 AC Mains (ST900)

ST900			**Description**
Name	**Pin #**	**I/O**	
AC Live	Pin 1		AC mains Live input
AC Neutral	Pin 2		AC mains Neutral input
	Pin 3		No connection
Earth	Pin 4		Earthing of module, electrical contact to heat sink

Table 4-2: AC Mains (ST900) Connector

4.3.2 Speaker output connector (ST100)

ST100			**Description**
Name	**Pin #**	**I/O**	
$+Ch1_{Out}$	Pin 1	Output	Amplifier channel 1, Out+
$- Ch1_{Out}$	Pin 2	Output	Amplifier channel 1, Out-

Table 4-3: Speaker output (ST100) Connector

4.3.3 Speaker output connector (ST300)

ST300			**Description**
Name	**Pin #**	**I/O**	
$+Ch2_{Out}$	Pin 1	Output	Amplifier channel 2, Out+
$- Ch2_{Out}$ (GND)	Pin 2	(GND)	Amplifier channel 2, GND

Table 4-4: Speaker output (ST300) Connector

4.3.4 Speaker output connector (ST500)

ST500			**Description**
Name	**Pin #**	**I/O**	
$+Ch3_{Out}$	Pin 1	Output	Amplifier channel 3, Out+
$- Ch3_{Out}$ (GND)	Pin 2	(GND)	Amplifier channel 3, GND

Table 4-5: Speaker output (ST500) Connector

4.3.5 Fan output connector (ST702)

ST702			**Description**
Name	**Pin #**	**I/O**	
GND	Pin 1	GND	
Fan output	Pin 2	Output	Output for 5V fan, Max 500mA[1]
GND	Pin 3	GND	

Table 4-6: Fan output (ST702) Connector

Note[1]: The sum of I_{+7Vmax} and I_{Fan_max} must not exceed 1000 mA.

4.3.6 Signal input and output connector (ST700)

ST700			Description
Name	**Pin #**	**I/O**	
Signal Shield	Pin 1		Connect to analog GND at DSP-board
Signal return Channel 1	Pin 2	Input, SGND	Connect to ch1 signal source GND at DSP-board[3]
Signal input channel 1	Pin 3	Input	4 V peak correspond to full output voltage, 32dB gain[3]
Signal Shield	Pin 4		Connect to analog GND at DSP-board
Signal return Channel 2	Pin 5	Input, SGND	Connect to ch2 signal source GND at DSP-board[3]
Signal input channel 2	Pin 6	Input	4 V peak correspond to full output voltage, 26dB gain[3]
Signal Shield	Pin 7		Connect to analog GND at DSP-board
Signal return Channel 3	Pin 8	Input, SGND	Connect to ch3 signal source GND at DSP-board[3]
Signal input channel 3	Pin 9	Input	4 V peak correspond to full output voltage, 26dB gain[3]
Signal Shield	Pin 10		Connect to analog GND at DSP-board
V Out monitor channel 1	Pin 11	Output	+/- $10V_p$ correspond to +/- 160V on output
V Out monitor channel 2	Pin 12	Output	+/- $10V_p$ correspond to +/- 80V on output
V Out monitor channel 3	Pin 13	Output	+/- $10V_p$ correspond to +/- 80V on output
I Out monitor channel 1	Pin 14	Output	+/- $10V_p$ correspond to +/- 30A on output
I Out monitor channel 2	Pin 15	Output	+/- $10V_p$ correspond to +/- 20A on output
I Out monitor channel 3	Pin 16	Output	+/- $10V_p$ correspond to +/- 20A on output
Temp monitor	Pin 17	Output	0-10V correspond to 0 – 100 Degrees Celsius
GND (ref +/-15V)	Pin 18	GND	
GND (ref +/-15V)	Pin 19	GND	
Clip channel 1	Pin 20	Output, Active low	Open collector[2]
Clip channel 2	Pin 21	Output, Active low	Open collector[2]
Clip channel 3	Pin 22	Output, Active low	Open collector[2]
GND (ref +/-15V)	Pin 23	GND	
Dis read/Protect	Pin 24	Output, Active Low	Indicates amp channels switched off Open collector[2]
GND (ref +/-15V)	Pin 25	GND	
Disable (Mute)	Pin 26	Input, Active low	Switches all amp channels off[2]
Not used (Do not connect)	Pin 27		Floating (Do not connect)
SMPS Limit	Pin 28	Output, Active Low	Indication before SMPS limiting Open collector[2]
Temp reduction off	Pin 29	Input, Active low	Disables soft volume reduction at high temp[2]
Sleep mode	Pin 30	Input, Active low	Shuts down all power circuitry - except +7V[2]
+7V	Pin 31	Output	Maximum current 1.0A[1] (available also in sleep mode)
+7V	Pin 32	Output	
GND (ref +/-15V)	Pin 33	GND	
GND (ref +/-15V)	Pin 34	GND	
+15 V	Pin 35	Output	+15V (not available also in sleep mode)
+15 V	Pin 36	Output	
GND (ref +/-15 V)	Pin 37	GND	
GND (ref +/-15 V)	Pin 38	GND	
-15 V	Pin 39	Output	-15V (not available also in sleep mode)
-15 V	Pin 40	Output	

Table 4-7: Input & output connector

Note[1]: The sum of I_{+7Vmax} and I_{Fan_max} must not exceed 1000 mA.
Note[2]: See section 4.4 for details.
Note[3]: See section 5 for details

4.4 Open Collector input and outputs

All inputs and outputs are implemented as shown on the figures below.

The 470Ω resistor is inserted to protect the open collector transistor and the 47pF capacitor has been implemented as EMI filtering.

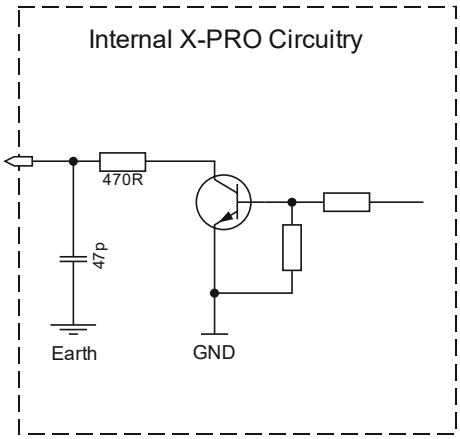


Figure 4-3: Open Collector output

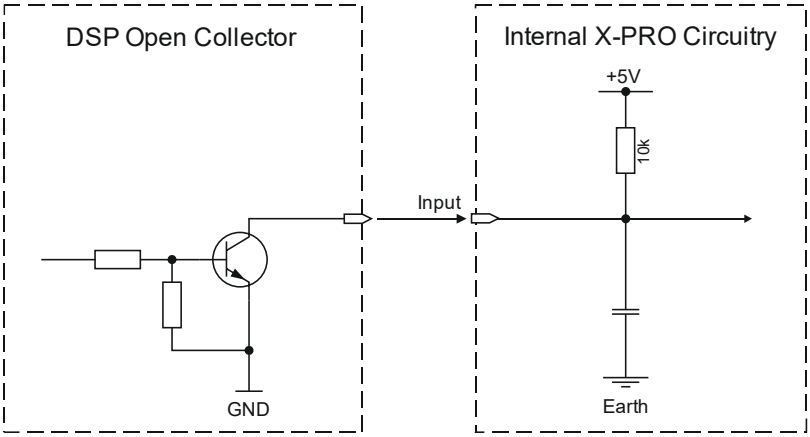


Figure 4-4: Input for Open Collector control

Definition of High and Low states from the Open Collector Control are shown as voltage levels below.

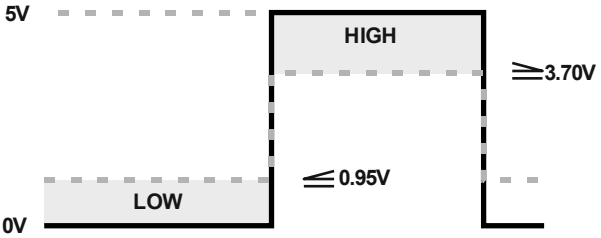


Figure 4-5: High and Low voltage levels for logic input

4.5 Fan Control

The fan control thermal limits can be seen from the table below. The fan control signal can be used for a 5V fan or as a control signal for a $230V_{AC}$ fan.

Fan threshold		
Parameter	**T_{ON} (°C)**	**T_{Off} (°C)**
$T_{Powerstage}$	60	50

Table 4-8: Fan control

4.6 Power Up/Down timing diagram

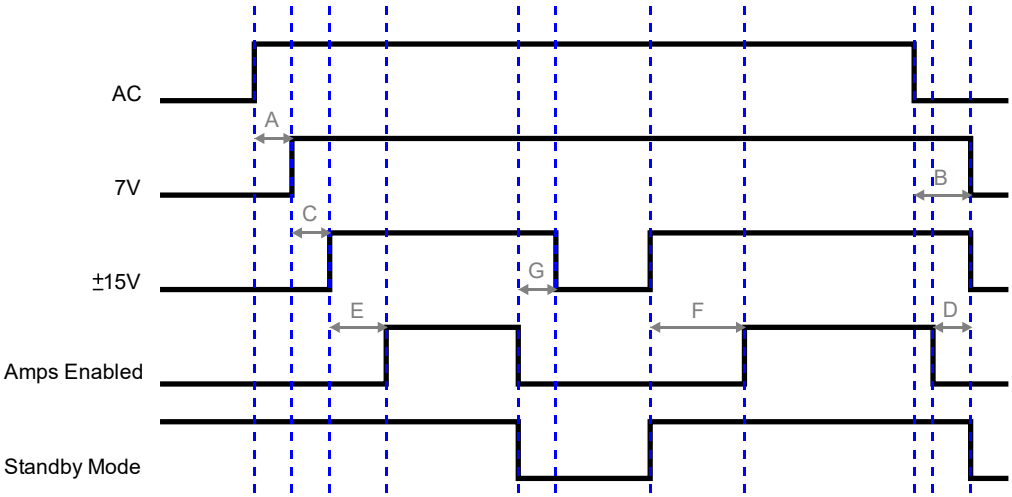


Figure 4-6: Power up/down timing diagram

Parameter	**Min**	**Typ**	**Max**	**Condition**
A	100ms	160ms	700ms	+/-15V and +7V, loaded with DEMO I/O board
B	0ms	3500ms		+/-15V and +7V, loaded with DEMO I/O board
C	2000ms	2300ms	2700ms	+/-15V and +7V, loaded with DEMO I/O board
D	0ms	2000ms		+/-15V and +7V, loaded with DEMO I/O board
E	2000ms		4500ms	+/-15V and +7V, loaded with DEMO I/O board
F	4000ms	4800ms	6500ms	+/-15V and +7V, loaded with DEMO I/O board
G	135ms		180ms	+/-15V and +7V, loaded with DEMO I/O board

Table 4-9: Power up/down timing specifications

5 Single Ended & Bridge Tied Load configuration

Channel 2 and channel 3 of the X-PRO2 and X-PRO3 Amplifier module can be operated in either SE or BTL mode.

5.1 Single Ended (SE) configuration

The figure below shows the three channel amplifier X-PRO3 configured in SE mode.

X-PRO2 has an identical channel 1 and channel 2, and X-PRO1 has an identical channel 1.

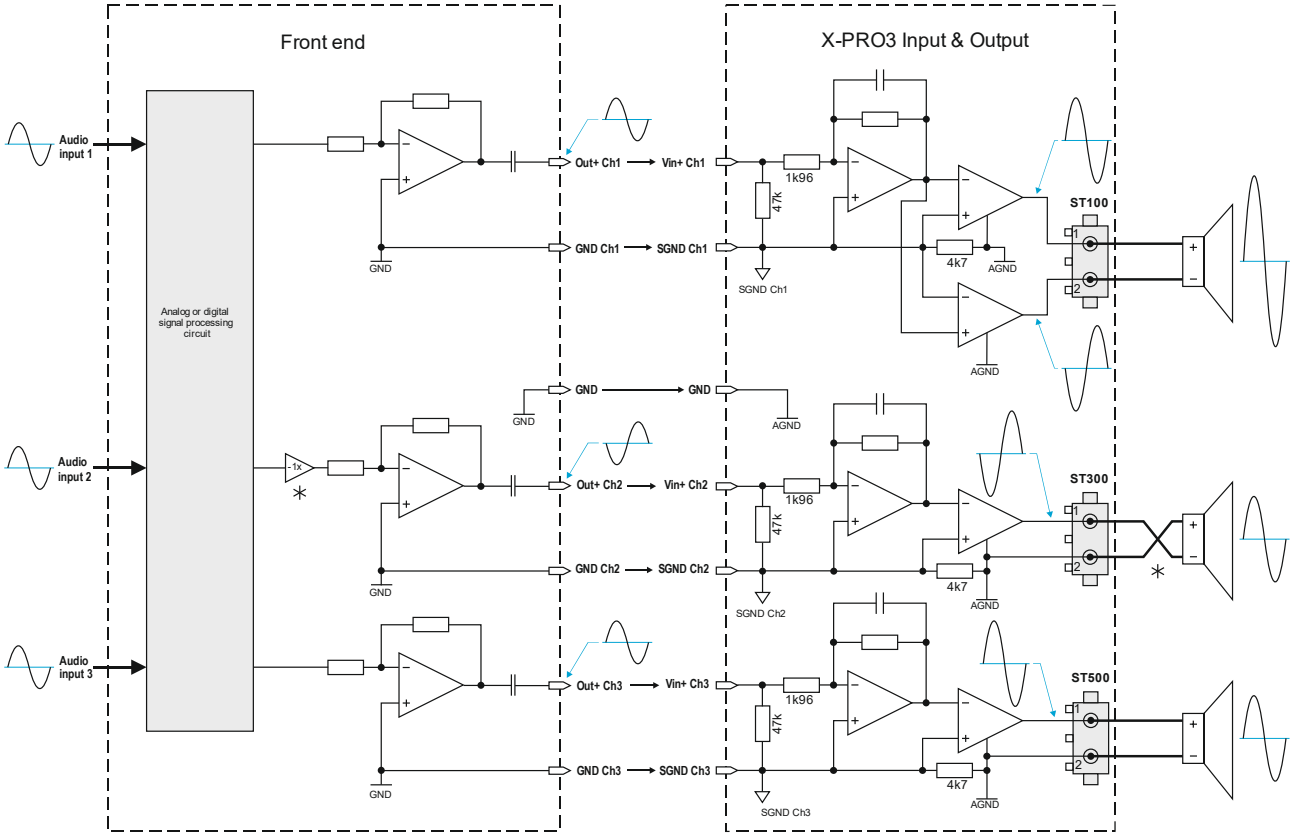


Figure 5-1: X-PRO in SE configuration

NOTICE

The * marking in *Figure 5-1*, indicates that to reduce pumping the channel 2 signal must be inverted in the Front end and the polarity of the speaker output on the X-PRO3/X-PRO2 Amplifier module must be inverted too.

Regarding the amplifier output loading in SE mode, please refer to *Input & Output loading, section 2.3.*

5.2 Bridge Tied Load (BTL) configuration

The figure below shows the three channel amplifier X-PRO3 configured in BTL mode.

X-PRO2 has an identical channel 1 and channel 2, and X-PRO1 has an identical channel 1.

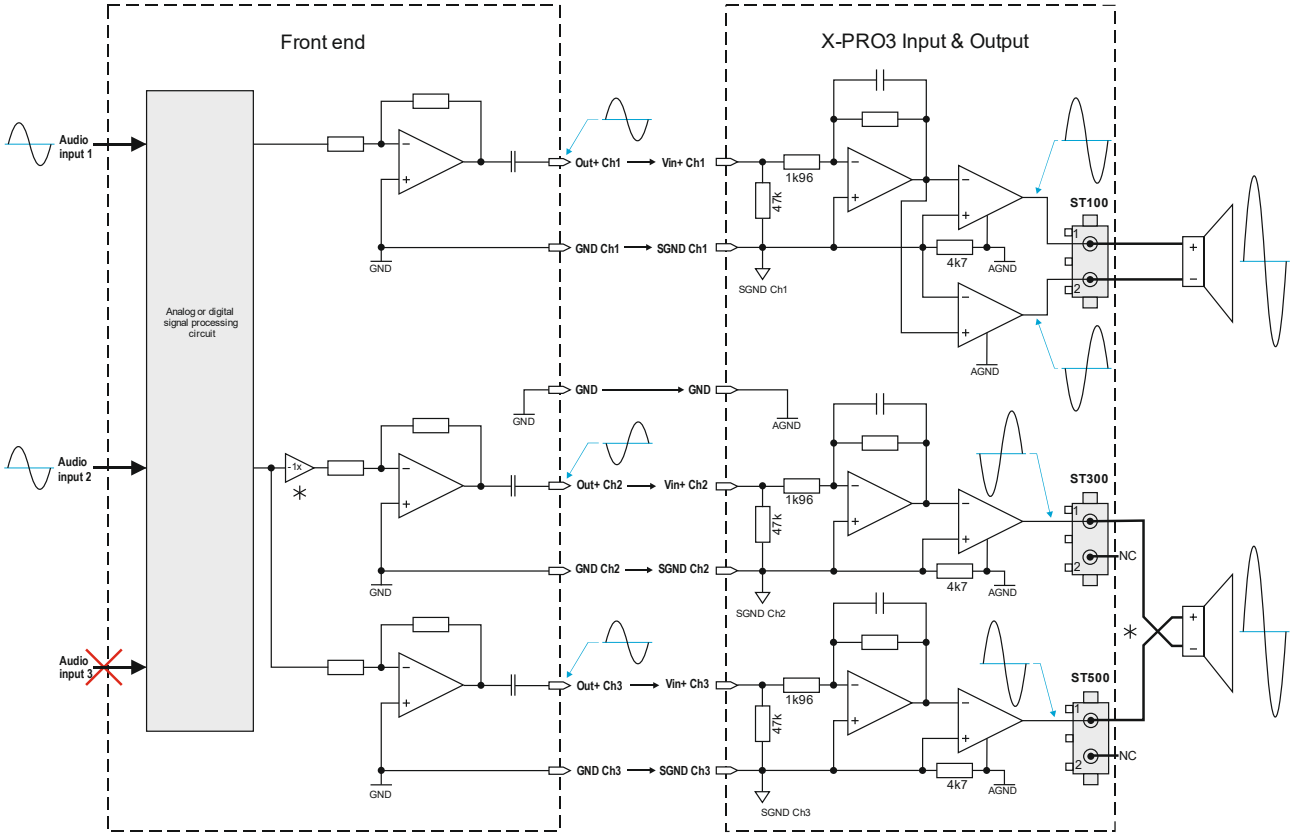


Figure 5-2: X-PRO in BTL configuration

NOTICE

The * marking in *Figure 5-2* indicates that channel 2 and 3 on the X-PRO3/X-PRO2 Amplifier module are fed with the same input signal, although input to channel 2 is inverted to produce the negative voltage swing needed for BTL operation of the speaker. The two channels with opposite phase, produces in conjunction the doubled voltage swing over the speaker.

Regarding the amplifier output loading in BTL mode, please refer to *Input & Output loading, section 2.3.*

6 Protection features

6.1 Over current protection

All amplifier output channels are over current protected. Current clipping is engaged when the amplifier channels exceed their specified peak current output[1]. When the current protection is active, it can be seen as the output voltage of the amplifier being clipped.

If the current output of an amplifier channel exceeds its specified peak current, e.g. in case of a short circuit of the output, the amplifier will protect itself by muting (disabling) the output. The muting (disabling) state will typically last for 1 second. Hereafter – it automatically restarts, if the reason that activated the protection is ceased.

Note[1]: Please see section *2.2, Audio specifications*.

6.2 DC protection

The X-PRO Series has a built-in DC protection circuit that will attenuate any DC signals on the amplifier outputs, either produced by an input signal containing a DC signal or by malfunction of the amplifier.

In case of an input signal containing a DC, or if an amplifier is malfunctioning, the DC protection circuit will prevent the loudspeakers connected to the output from damage. If the DC-protection circuit cannot attenuate an amplifier DC output signal sufficiently, the amplifier module will then Mute (Disable) and restart 3 times before latching. When the module is in latching mode, the main power supply is locked in standby mode – and the power must be switched off and on again in order to power up the product.

6.3 Over-/under voltage protection

The X-PRO Series has a built-in over- and under voltage protection, that monitors whether the offline voltage exceeds or drops below the specified upper and lower operational AC voltages. Exceeding $265V_{AC}$ for a longer period of time may damage the power supply permanently.

6.4 Mains fuse protection

A circuitry protecting the product's Mains power fuse is implemented in the X-PRO module. The fuse protection circuit monitors and regulates the RMS current, so that it never will exceed the fuse breaking current.

The existence of the Mains power fuse protection also removes the risk of compromising safety in situations of overload.

Under normal circumstances the Mains power fuse should never be replaced. In case the Mains power fuse is blown – the product shall be returned to Pascal A/S, according to Pascal RMA procedures.

6.5 Excessive Power Control (XPC)

The internal amplifier power stage overload protection ensures fast attenuation of signals in situations of amplifier overload. On real speaker applications power outputs are increased compared to resistive loads.

6.6 Temperature protection

Temperature protection of power stages, transformers and heatsinks can be used in two different configurations:

1. Thermal limiter “ON”: Limiting is engaged after the power stage, transformer or heatsink temperature has reached its specified thermal limiting temperatures.

   After limiting is engaged, the amplifier will find its thermal equilibrium.

2. Thermal limiter “OFF”: The amplifier Mutes (Disables) for a period of time and automatically restarts, after the power stage, transformer or heat sink temperature have reached the specified thermal start-up temperature.

6.7 Standby Mode

This function is designed as a special feature for installation purposes.

When the amplifier is put into Standby Mode (Sleep Mode), major circuitry parts are powered down, which leads to the low AC mains power input specification of only a few Watt.

The +7V supply rail is still active, which enables a possible network/DSP to remotely power up the amplifier again.

6.8 High frequency protection

A high frequency protection is implemented in order to protect filter components from overload.

The high frequency protection algorithm has been implemented to protect the amplifier from excessive HF signals on the amplifier outputs.

The amplifiers have a full power bandwidth of 20kHz, which will be allowed for unlimited time, 30kHz full power is allowed for 2 seconds before protection becomes active.

7 Readouts

7.1 Clip

When the amplifier output peak voltage or current exceeds the specified values, the amplifier channel will start clipping the Voltage/Current. Clipping indication has been implemented for each amplifier channel. Clip indication for channel 1, 2 and 3 can be monitored from ST700, Pin 20, 21 and 22.

7.2 Dis read/Protect

The Dis read/protect indication is based on an open collector, indicating if any of the amplifier channels or the power supply is in Muted (Disabled) Mode or in protect mode. This indicates either an external shutdown or an on-board protection condition. Dis Read/Protect can be monitored from ST700 pin 24.

7.3 SMPS Limit

In order to protect the power supply from overload, a power supply limiter is set. SMPS limit indication is based on an open collector and can be monitored from ST700 pin 28. The timing of the SMPS limit engagement can be seen below:

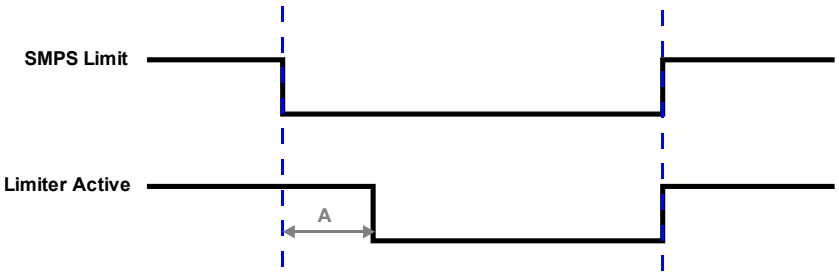


Figure 7-1: SMPS limit, A = Typically 1 sec.

7.4 Output voltage

Output voltage is measured on channel 1, 2 and 3 and supplied as a bi-directional sinusoidal voltage output. Output voltage for channel 1, 2 and 3 can be measured on ST700 pin 11, 12 and 13.

7.5 Output current

Output current is measured on channel 1, 2 and 3 and supplied as a bi-directional sinusoidal voltage output. Output current for channel 1, 2 and 3 can be monitored on ST700 pin 14, 15 and 16.

7.6 Temp Monitor

Temperature monitoring is made at several points in the amplifier and power supply. The maximum temperature of any measurement point is provided as the Temp Monitor, which can be monitored on ST700 pin 17.

8 Mechanical specifications X-PRO Series

8.1 Mechanical specifications X-PRO1

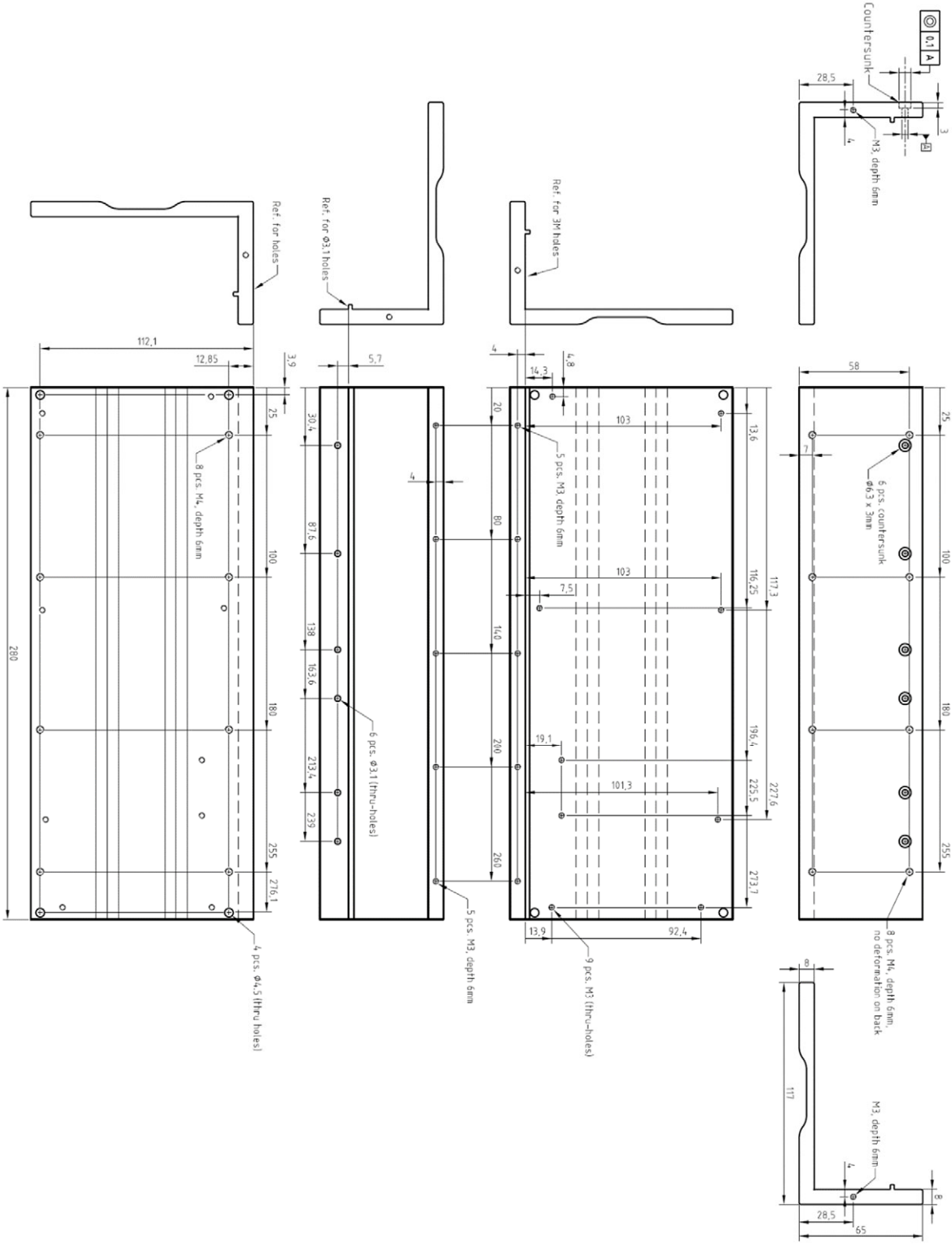


Figure 8-1: Mechanical dimensions of the X-PRO1 heat sink – All dimensions in mm

8.2 Mechanical specifications X-PRO2

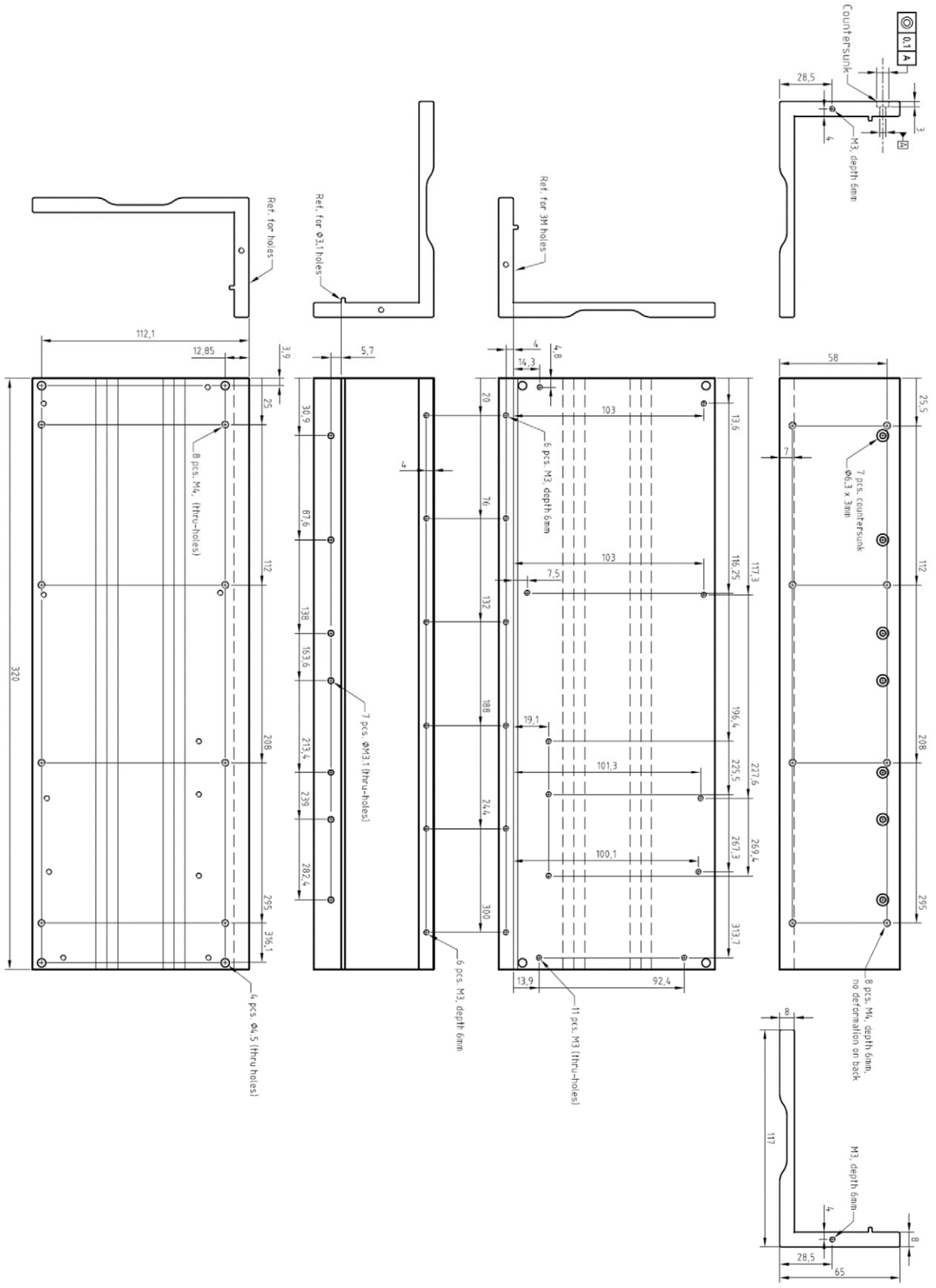


Figure 8-2: Mechanical dimensions of the X-PRO2 heat sink – All dimensions in mm

8.3 Mechanical specifications X-PRO3

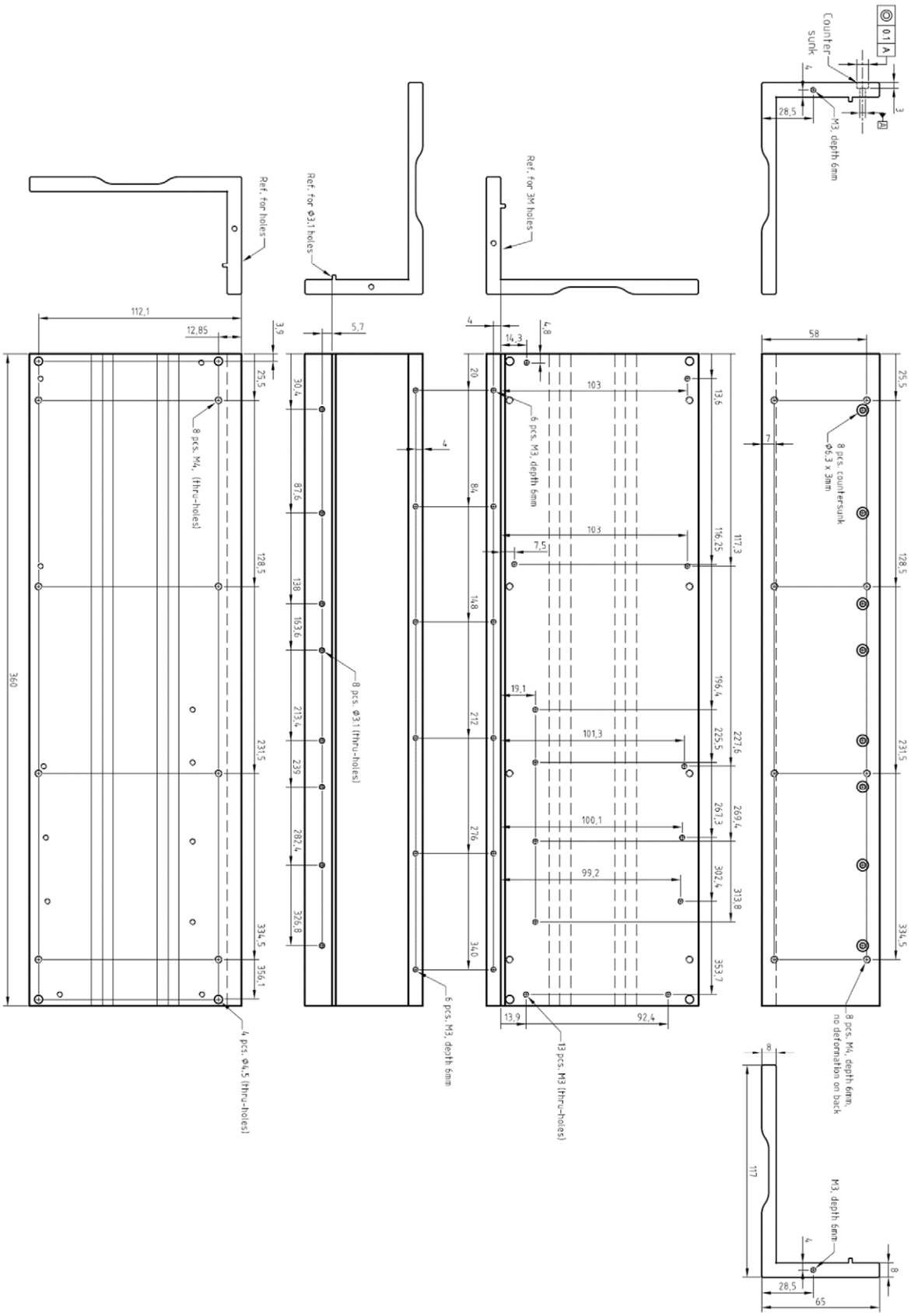


Figure 8-3: Mechanical dimensions of the X-PRO3 heat sink – All dimensions in mm

9 Compliance Standards

9.1 Safety Compliance

The X-PRO Series is safety tested, according to the following standards:

IEC 60065:2001(7th E) + A1:2005 + A2:2010

The X-PRO Series fulfill the requirements of:

UL 60065 7th Ed. Revised 2007-12-11, CAN/CSA C22.2 No. 60065-03, EN 60065:2002 + A1:2006 + A11:2008 + A2:2010 + A12:2011

The X-PRO Series are evaluated against and comply with the regulations of the following countries:
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 *(Countries outside the CB Scheme membership may also accept this report.)*

Test procedure:

CB Scheme
X-PRO Series CB certificate no. E470499-A4. (UL International Demko A/S). *(Full report is available for download on Pascal Extranet)*

Product safety category:
Class 1 *(Earthed equipment)*

The X-PRO Series are tested as a component – the final product should always be evaluated against applicable standards.

IEC 62368-1 information:

When approving a final product to IEC/UL/EN 62368-1 2nd E. It is possible to use components approved to IEC 60065 8th E. For the M-PRO2 there is no difference in requirements between 60065 7th and 8th E.

9.2 Electro Magnetic Compliance

Pascal amplifier modules are EMI compliance tested according to the standards below.

Emission:
EN 55032:2012 with EN 55032:2012 AC 2013

Immunity:
EN 55103-2:2009

Flicker:
EN61000-3-3

The X-PRO Series complies with A-limits on radiated and conducted emission when installed properly as described in the Application Manual covering the M-PRO & X-PRO Series.

If you decide to have your end-product complying with A-limits – then it is mandatory that you insert a notification, displaying this type of compliance in the user manual for the end-product. See M-PRO & X-PRO Series Application Manual for example on such notification.

If you decide that your end-product should comply with B-limits, this is possible, although compliance may require additional engineering and EMC measures to fulfil the B-limits. In case your end-product complies with B-limits – there will be no need for notification in the user manual.

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

9.3 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-S20.20-1999: Protection of Electrical and Electronic Parts, Assemblies and Equipment.

9.4 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.

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