S-PRO2 Datasheet

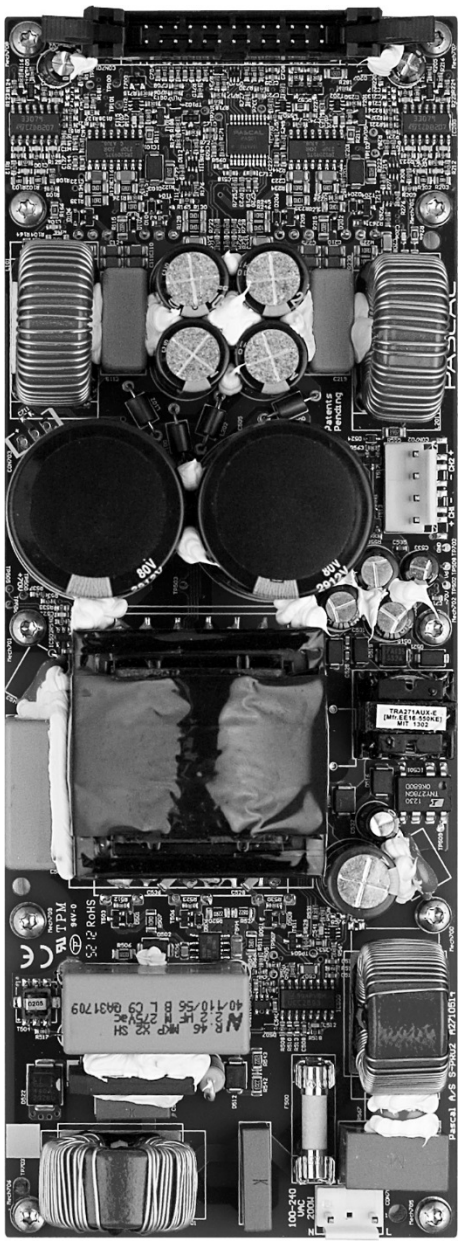

Table of Contents

1 Features and Description

Features

- 2 x 500W (SE) or 1000W (BTL) amplifier channels using Pascal's UMAC™ technology for un-matched sonic performance and full power bandwidth up to 35kHz.
- 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) compliant standby consumption < 0.5W
- Full protection scheme
- Ultra compact size
- Un-matched total system efficiency
- Multiple readouts (temperature, amplifier output voltage, clip limiter, amplifier protect/mute, $V_{AC,peak}$)
- Safety approved and verified for EMC compliance

Product Summary

Parameter	Typical Value
Output power (1% THD+N, 1kHz @ 4Ω)	1000 W
Total system efficiency (2 x 250W @ 8Ω)	89 %
Peak output current	30 A
THD+N (1kHz @ 1W)	0.003 %
Dynamic range	120 dB(A)
Idle noise	40 µV(A)
Output impedance (1kHz)	14 mΩ
Mains input voltage	$85V_{AC}$ – $265V_{AC}$
Standby consumption	0.3 W

Description

The S-PRO2 module is a 2 channel Class-D amplifier with integrated universal mains power supply with PFC.

It offers an ultra compact size with an un-matched total system efficiency, to ease the integration of the S-PRO2 module into any audio solution.

In addition the S-PRO2 module offers a number of readouts and controls, which allow for external DSP control of the module. The built-in auxiliary power supply makes it easy to supply the DSP front-end.

Typical Applications

- Professional Audio Solutions
- MI Audio Solutions
- Consumer Audio Solutions
- HiFi Audio Solutions
- Self-Powered Loudspeakers
- 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, SE Unloaded, BTL	-	± 70 ± 140	-	V
$I_{out,peak}$	Peak output current		-	30	-	A
$P_{o,tot}$	Total module output power[1]	$230V_{AC}$ $120V_{AC}$	-	1000 700	-	W
P_o	Output power @ 1% THD+N, 1kHz[2] Ch1 & Ch2 - Single ended (SE), single channel driven R_L = 8Ω	$230V_{AC}$ $120V_{AC}$	-	245 245	-	W
P_o	Output power @ 1% THD+N, 1kHz[2] Ch1 & Ch2 - Single ended (SE), single channel driven R_L = 4Ω	$230V_{AC}$ $120V_{AC}$	-	490 490	-	W
P_o	Output power @ 1% THD+N, 1kHz[2] Ch1 & Ch2 - Single ended (SE), single channel driven R_L = 2.7Ω	$230V_{AC}$ $120V_{AC}$	-	725 600	-	W
P_o	Output power @ 1% THD+N, 1kHz[2] Ch1-Ch2 - Bridge Tied Load (BTL) - R_L = 8Ω	$230V_{AC}$ $120V_{AC}$	-	900 700	-	W
P_o	Output power @ 1% THD+N, 1kHz[2] Ch1-Ch2 - Bridge Tied Load (BTL) - R_L = 4Ω	$230V_{AC}$ $120V_{AC}$	-	1050 700	-	W
THD+N	THD+N @ 1W, 1kHz, R_L = 8Ω[2]	SE BTL	-	0.003	-	%
$V_{noise\ SE}$	Output idle noise - Ch1 & Ch2 - SE	Unweighted A-weighted	-	60 40	-	μV_{RMS}
$V_{noise\ BTL}$	Output idle noise - Ch1 - Ch2 - BTL	Unweighted A-weighted	-	75 55	-	μV_{RMS}
DR_{SE}	Dynamic Range - Ch1 & Ch2 - SE	Unweighted A-weighted	-	118 120	-	dB
DR_{BTL}	Dynamic Range - Ch1 - Ch2 - BTL	Unweighted A-weighted	-	122 124	-	dB
$V_{noise\ SE,IO}$	Output idle noise - Ch1 & Ch2 SE. Pascal S-PRO2 I/O-board attached.	Unweighted A-weighted	-	70 55	-	μV_{RMS}
$V_{noise\ BTL,IO}$	Output idle noise - Ch1 - Ch2 BTL. Pascal S-PRO2 I/O-board attached.	Unweighted A-weighted	-	120 95	-	μV_{RMS}
$DR_{SE,IO}$	Dynamic Range - Ch1 & Ch2 SE. Pascal S-PRO2 I/O-board attached.	Unweighted A-weighted	-	116 118	-	dB
$DR_{BTL,IO}$	Dynamic Range - Ch1 - Ch2 BTL. Pascal S-PRO2 I/O-board attached.	Unweighted A-weighted	-	118 120	-	dB
A	Voltage gain @ 1kHz, Ch1 & Ch2 SE / Ch1 – Ch2 BTL	SE BTL	-	26 32	-	dB
A_{var}	Frequency response variance Ch1 & Ch2 SE @ 20Hz – 20kHz	Open Load 8Ω 4Ω 2.7Ω	-	0.15 0.25 0.45 0.65	-	dB
BW_{up}	Upper bandwidth @ -3dB Ch1 & Ch2 - SE	R_L = 8Ω R_L = 4Ω	-	70 60	-	kHz

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
BW_{low}	Lower bandwidth @ -3dB Ch1 & Ch2 - SE	All loads	-	1.6	-	Hz
Z_o	Absolute output impedance[3]	SE 1 kHz SE 20 kHz BTL 1 kHz BTL 20 kHz	-	14 175 25 300	-	mΩ
$V_{out,offset}$	Amplifier output DC Offset	SE 4Ω BTL 8Ω	-	±0.5 ±1.0	-	mV
IMD_{CCIF}	Intermodulation distortion (CCIF), Ch1 & Ch2 - SE	18kHz & 19kHz Po = 10W, 8Ω	-	0.0015	-	%
IMD_{TIM}	Transient Intermodulation distortion (TIM), Ch1 & Ch2 SE	Po = 10W, 8Ω	-	0.0035	-	%

Table 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 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	Ch1 & Ch2	-	2.2	-	kΩ
$Z_{L,SE}$	Loudspeaker impedance range Single Ended (SE)	Ch1 & Ch2	2	4	∞	Ω
$Z_{L,BTL}$	Loudspeaker impedance range Bridge Tied Load (BTL)	Ch1-Ch2 (BTL)	4	8	∞	Ω
$Z_{L,C}$	Maximal purely capacitive loading of amplifier output	SE BTL	-	-	1	µF

Table 2 Input & Output Loading.

2.3 AC Mains & Thermal specification

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

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 S-PRO2 I/O-board attached.	Standby Mute Idle	-	0.23 6.8 9.2	-	W_{RMS}
$P_{230VAC\ NS}$	Mains power input No signal applied Pascal S-PRO2 I/O-board attached.	Standby Mute Idle	-	0.33 8.9 11.2	-	W_{RMS}
$P_{120VAC\ NS}$	Mains power input No signal applied	Standby Mute Idle	-	0.19 5.7 8.3	-	W_{RMS}
$P_{230VAC\ NS}$	Mains power input No signal applied	Standby Mute Idle	-	0.29 7.8 10.5	-	W_{RMS}
P_{AC_PN}	Mains power input 230V_{AC} Pink Noise - both channels driven ($P_{out,RMS}$ = 1/8th of rated power)	R_L = 8Ω R_L = 4Ω $R_{L,BTL}$ = 8Ω	-	93 173 173	-	W_{RMS}
$P_{Heatsink}$	Heatsink power dissipation 230V_{AC} Pink Noise - both channels driven ($P_{out,RMS}$ = 1/8th of rated power)	R_L = 8Ω R_L = 4Ω $R_{L,BTL}$ = 8Ω	-	27 42 42	-	W_{RMS}
$\eta_{tot,8\Omega}$	System efficiency @ 2 x 8Ω SE, (2x250W_{out})	230V_{AC} 120V_{AC}	-	89 88	-	%
$\eta_{tot,4\Omega}$	System efficiency @ 2 x 4Ω SE, (2x350W_{out} or 2x500W_{out})[1]	230V_{AC} 120V_{AC}	-	84 81	-	%
$PF_{8\Omega}$	Power Factor @ 2 x 8Ω SE, (2x250W_{out})	230V_{AC} 120V_{AC}	-	0.97 0.98	-	
$PF_{4\Omega}$	Power Factor @ 2 x 4Ω SE, (2x350W_{out} or 2x500W_{out})	230V_{AC} 120V_{AC}	-	0.92 0.97	-	
T_{SD}	Temperature @ thermal shutdown Thermal hysteresis = 5°C		-	85	-	°C

Table 3 AC Mains & Thermal specifications.
Note 1: Maximum total power is limited by the power supply.

2.4 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 variation	Module ON[1]	7.0	7.5	8.5	V
V_{+15V}	+15V voltage variation	Module ON[1]	14	15	16.5	V
V_{-15V}	-15V voltage variation	Module ON[1]	-16.5	-15	-14	V
$I_{+7.5V}$	+7.5V current rating		-	-	500	mA
I_{+15V}	+15V current rating		-	-	100	mA
I_{-15V}	-15V current rating		-	-	-100	mA

Table 4 Auxiliary power supply specification
Note 1: For conditions in standby – see S-PRO2 Application Manual

3 Audio measurements

3.1 Frequency response

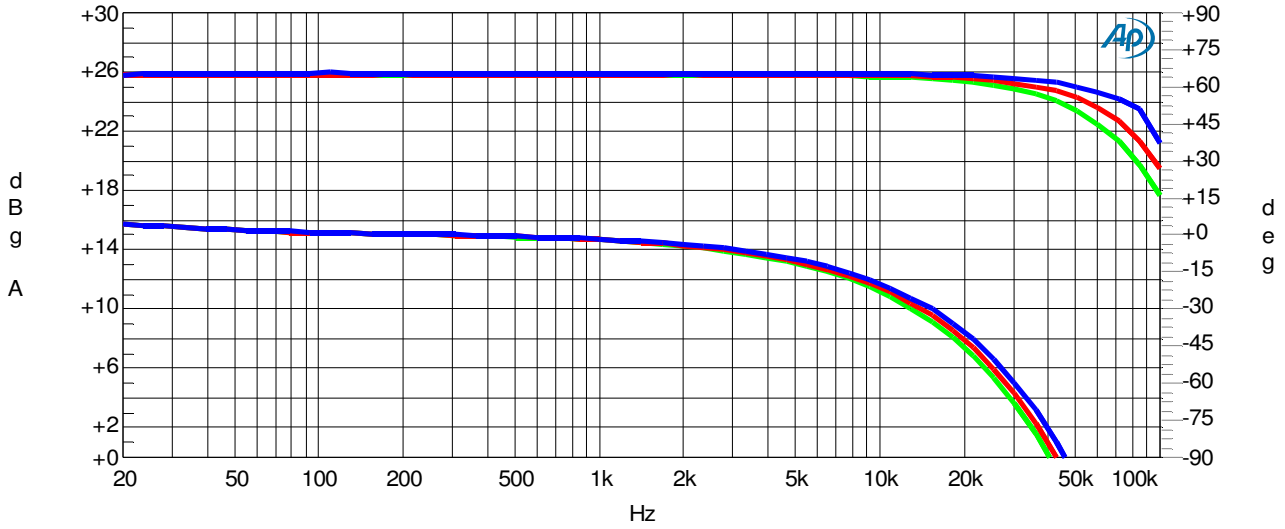

Figure 3-1 Frequency response (Top curves: Amplitude, Bottom curves: Phase)
4Ω (green), 8Ω (red) and Open Load (blue).

3.2 Total Harmonic Distortion + Noise (THD+N)

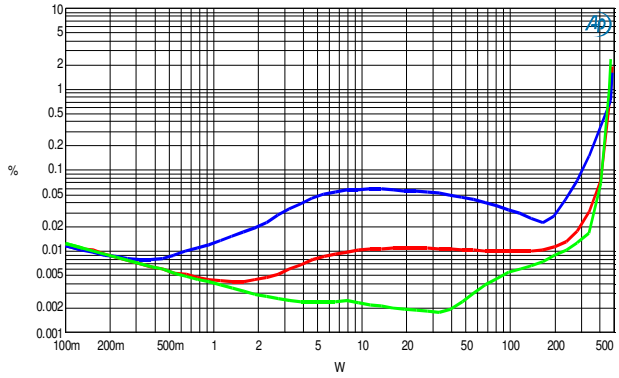

Figure 3-2 THD+N vs. Power @ 4Ω
100Hz (green), 1kHz (red), 6.67kHz (blue).

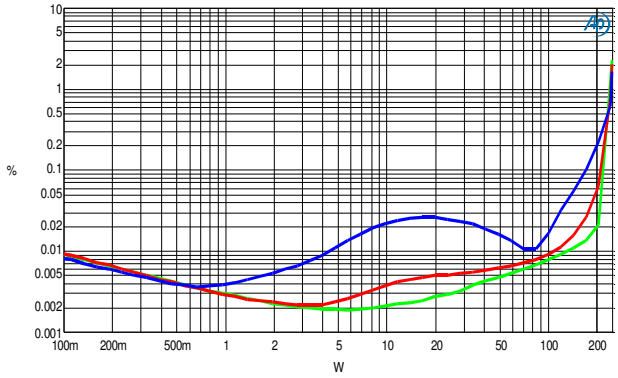

Figure 3-3 THD+N vs. Power @ 8Ω
100Hz (green), 1kHz (red), 6.67kHz (blue).

3.3 Noise Spectrum

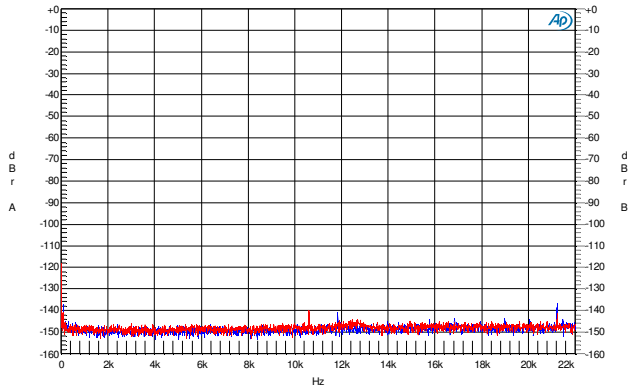

Figure 3-4 FFT idle - 4Ω SE
Channel 1 (blue) & Channel 2 (red).

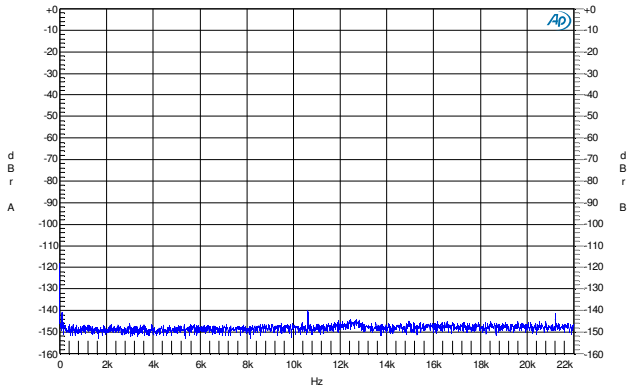

Figure 3-5 FFT idle - 4Ω BTL
Channel 1&2 BTL.

3.4 Intermodulation Distortion (CCIF, TIM)

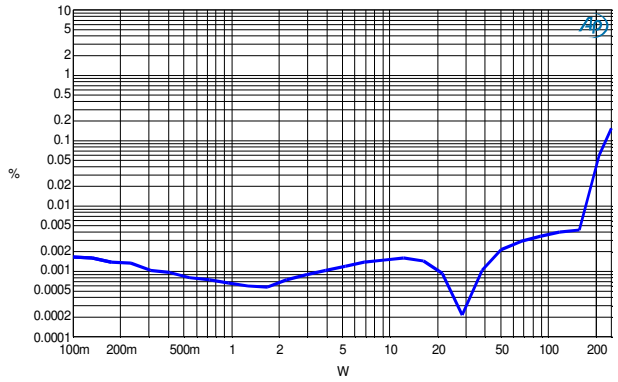

Figure 3-6 CCIF vs. Power - R_L=4Ω
Channel 1/2, f_1=18kHz, f_2 =19kHz.

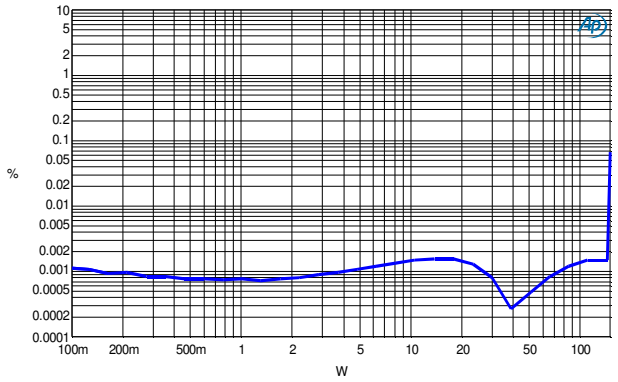

Figure 3-7 CCIF vs. Power - R_L=8Ω
Channel 1/2, f_1=18khz, f_2 =19khz.

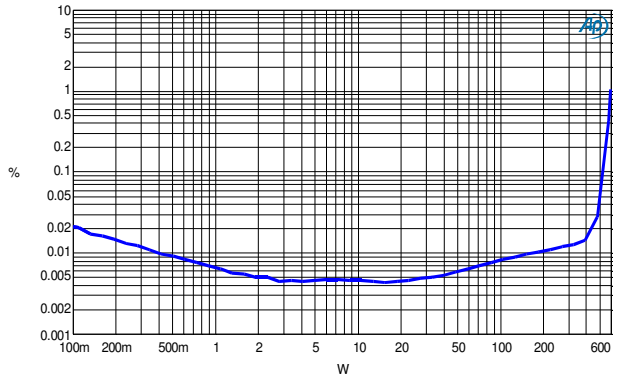

Figure 3-8 TIM vs. Power - R_L=4Ω
Channel 1/2.

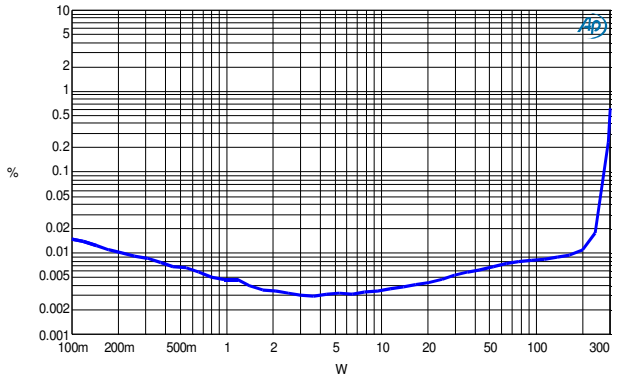

Figure 3-9 TIM vs. Power - R_L=8Ω
Channel 1/2.

3.5 Cross Talk & Output Impedance

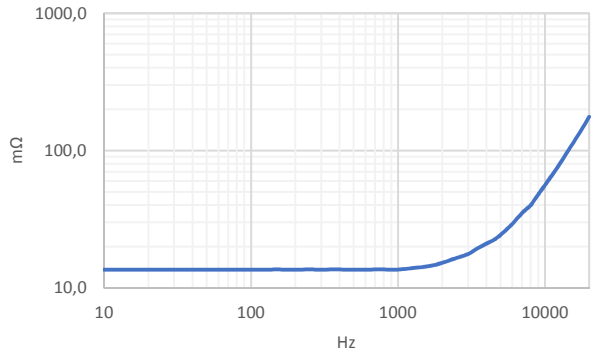

Figure 3-10 Output impedance SE - Measurement made at the mating part of the output connector. Connector resistance thereby included.

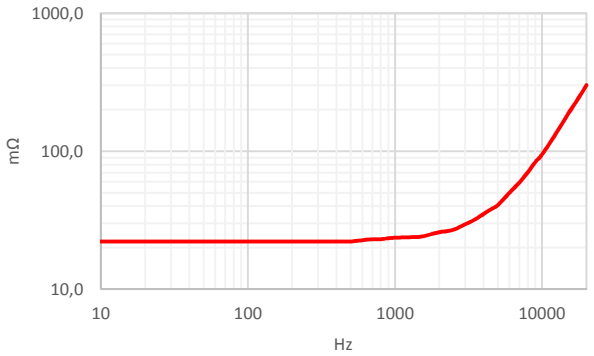

Figure 3-11 Output impedance BTL - Measurement made at the mating part of the output connector. Connector resistance thereby included.

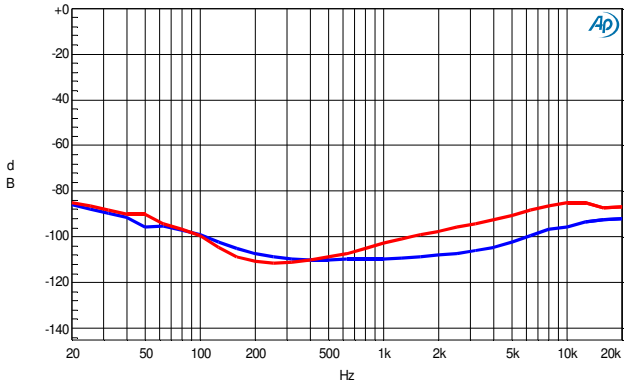

Figure 3-12 Cross talk - Ch.1 @ Po,ch2=100W 4Ω (red), Ch.2 @ Po,ch1=100W 4Ω (blue)

3.6 Output Power vs. Frequency

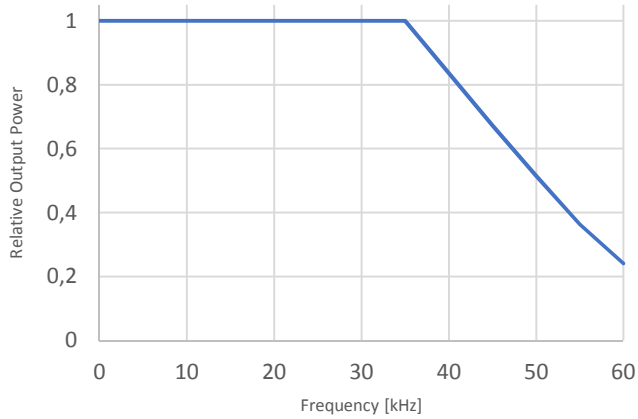

Figure 3-13 Output Power vs. Frequency

4 Control and Readout specification

4.1 Control pins

Mute – When muting the S-PRO2 module, the amplifier outputs will be disabled. It typically takes 1 ms to disable and only 2 ms 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 2 ms – making it unnoticeable for the user.

Standby – With the S-PRO2 module in standby the mains power consumption is put to a minimum. In standby it is possible to comply to the ErP (1275/2008/EC) 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.

4Ω BTL Mode – Out-of-the-box the S-PRO2 module is optimized for loads from 4 ohm SE (8 ohm BTL) and up. Still it is possible to use the S-PRO2 module with a 4Ω speaker in BTL operation by setting the module into "4Ω BTL Mode".

Temp/Vac select – By toggling the Temp/Vac select pin it is possible to read both the mains voltage and amplifier temperature real-time. By default the amplifier temperature is selected.

4.2 Readouts

The S-PRO2 has various readouts to monitor the state of the module.

- **Amplifier temperature or mains voltage readout** – By toggling a control-pin, both mains voltage and 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° 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.
    - *Mains voltage* – The AC mains voltage from 85-265VAC is expressed as a DC voltage from 0-3.3V. 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 - 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. This may be used for signal presence indication.
- **Amplifier Clip readout** – There are two amplifier clip readouts - one for each channel. These readouts are open-collector outputs. The readout pins will be pulled low if the audio output voltage becomes too high, compared to the internal rail voltages, or if the amplifier reaches internal current protection. These readouts may be used for signal clip/limiting indications.
- **Disable/Protect readout** – This readout is an open-collector output which will be pulled low when the module is either muted or has entered an internal protection.

For further details see the S-PRO2 Application Manual.

5 Protection features

The S-PRO2 has built-in protection features which protect the module and speaker from malfunctioning.

- **Clip limiter** – The clip limiter prevents excessive clipping of the output stage by limiting the input signal.

- **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.

- **Over Current** – If an amplifier output is shorted or reaches its current limit, the built-in clip limiter will try to limit the input signal. If the limiter isn't capable of limiting the signal the module will enter over-current protection and mute the outputs until the over-current is no longer present and the internal protection timing allows the module to re-enable.

- **DC Protection** – In case of a DC at one of the outputs the amplifiers are first muted. If the DC is still present, after 3 cycles, the module is switched off and requires an AC re-cycling to reset.

- **HF Protection** – A high frequency protection is implemented in order to protect the output filter components from overload above 35 kHz. If a high frequency signal is present for a longer period of time the module will enter HF protection and mute the outputs until the high frequency signal is no longer present and the internal protection timing allows the module to re-enable.

For further details see the S-PRO2 Application Manual.

6 Mechanical specifications