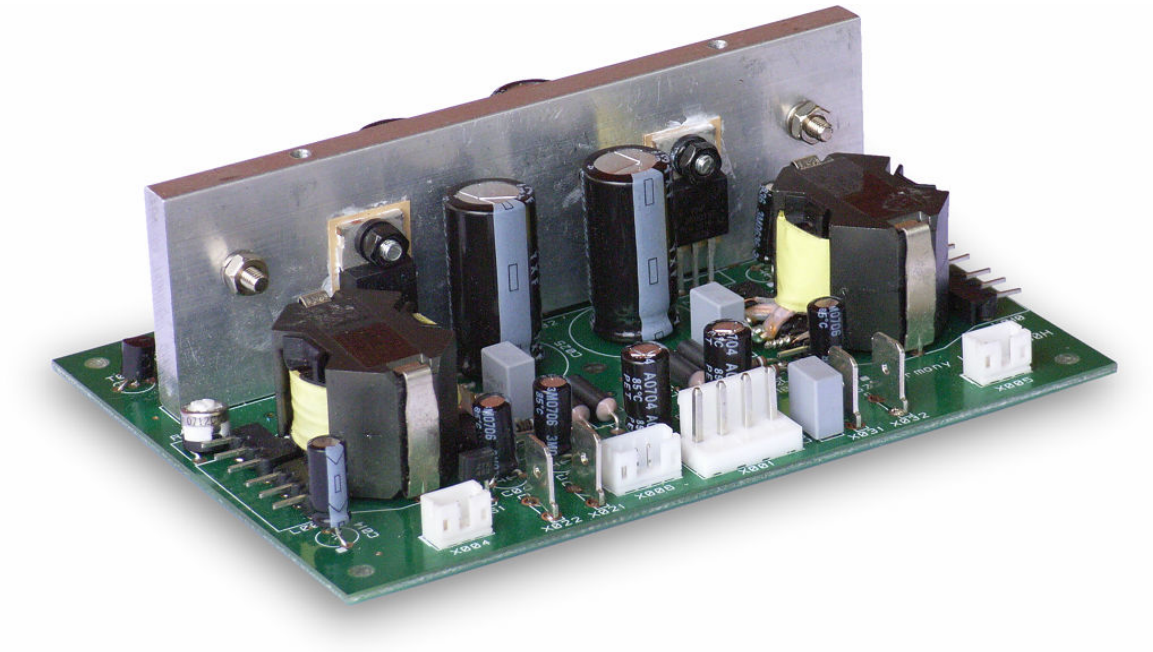
heliox

*high performance power conversion*

# DATASHEET



## 2x250W or 1x500W Class D Amplifier

### Type: AMP 2x250H/4 or AMP 1x500F/8

- Class-D audio amplifier based on the patented UCD technology
- 2 Channels Half Bridge (2x250H/4) or 1 channel Full Bridge (1x500F/8)
- Transparent sound reproduction
- Constant audio performance over frequency, output power and load impedance
- Capable of driving complex loads

Revision: March 10, 2009

## General description

This is a two channel High Efficiency Half Bridge Class-D amplifier module based on the patented UCD modulation technique.

## UCD amplifier

UCD is an analog modulation technique for class-D amplifiers based on a free running oscillator. The oscillation conditions are created by a phase shift in the feedback loop between the output terminals to the input of the amplifier.

The UCD technique is characterized by four features:

*Feedback directly from the output terminals*

The feedback signal is taken directly from the output terminals of the amplifier, thereby including the output filter in the control loop, virtually eliminating the influence of the filter on the audio performance. Advantages are a very low output impedance, a stable operation over a broad range of load impedances from 2Ω to ∞ and the absence of a Zobel network, so that there is no restriction to output power and duration in the high audio frequency range.

*Proportional feedback loop*

The feedback loop of the UCD amplifier is proportional in the range of audio frequencies, as opposed to the often-applied integrating feedback. This gives the UCD amplifier an excellent audio performance over the full audio bandwidth.

*No active analog amplification*

There is no active (linear) analog amplification in the UCD amplifier cell. All active components in the signal path operate in on-off mode. Also the feedback loop consists of only passive components, minimizing the coloring of the sound and insuring maximum transparency.
This opens possibilities to shape the character and quality of the sound by the signal processing in the end application.

*Excellence by simplicity*

The high performance of the UCD amplifier is not realized by complex control and compensation circuits. The strength of this concept lies in its simplicity. Only a bare minimum of carefully selected components and materials are used.

The combination of these features give the UCD amplifier its transparent character and offers outstanding Value for Money.

## OUTPUT SPECIFICATIONS

| Parameter | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| AC Output in 4Ω, per channel | | | | | |
| Power | | | 250 | $W_{RMS}$ | < 5 min. (FTC) |
| Power | | | 63 | $W_{RMS}$ | continuous, both channels driven |
| AC Output in 8Ω, per channel | | | | | |
| Power | | | 125 | $W_{RMS}$ | < 5 min. (FTC) |
| Power | | | 63 | $W_{RMS}$ | continuous, both channels driven |
| Peak output current | | | 16 | $A_{PK}$ | protection level, AMP mutes for 250msec when triggered. |
| Load impedance | | | | | |
| $Z_L$ | 2 | 4 ÷ 8 | ∞ | Ω | |
| Output impedance | | | | | |
| $Z_O$ | | 20 | | mΩ | @ 100Hz |
| $Z_O$ | | 170 | | mΩ | @ 20kHz |
| Output voltage offset | –30 | | 30 | mV | shorted input |

note: it is recommended to mount the amplifier on a heatsink to fulfill the power specifications.

## AUDIO SPECIFICATIONS

| Parameter | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Voltage gain | 27 | 27.5 | 27.9 | dB | gain doubled in BTL operation |
| Audio frequency range | | | | | |
| $f_L$ | 0 | | | Hz | DC coupled |
| $f_U$ | | 45k | | Hz | –3dB |
| $f_{AUDIO}$ | 10 | | 20k | Hz | ± 0.1dB |
| Input impedance $Z_{IN}$ | | | | | |
| IN+ | | 50 | | kΩ | NON-INV input to GND |
| IN̄ | | 1.8 | | kΩ | INV input to GND |
| Input voltage | | | | | for rated power in 4Ω |
| $V_{IN}$ | | 1.3 | 2.5 | $V_{RMS}$ | differential input |
| Dynamic range | 110 | | | dB | |
| Idle noise | | 90 | | $\mu V_{RMS}$ | 10Hz ÷ 20kHz, AES17 |
| THD+N @ 10Hz < f < 20kHz | | | | | |
| | | | 0.02 | % | @ 1W in 8Ω |
| | | | 0.05 | % | @ 10mW ÷ 125W in 4Ω |

## CONTROL CHARACTERISTICS

| Parameter | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Mute control | | | | | ENABLE – pin X006.1 |
| ON | | | 0.8 | V | |
| MUTE | 4 | | | V | |
| Temperature sensor output | | | | | max. current 1mA |
| $R_{NTC,25°C}$ | | 10 | | kΩ | heatsink @25°C |
| $R_{NTC,60°C}$ | | 2.5 | | kΩ | heatsink @60°C |
| $R_{NTC,100°C}$ | | 0.68 | | kΩ | heatsink @100°C |
| DC error output | | | | | open collector output |
| $V_{OUT,DC}$ < 0.5V | 4 | | | V | with 10kΩ pull up to +5V |
| $V_{OUT,DC}$ > 0.5V | | | 0.8 | V | |
| Start time | | 2 | | sec | MUTE to ON |

## SUPPLY CHARACTERISTICS

| Parameter | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| DC Input | | | | | |
| $+V_{AMP}$ | 30 | 45 | 50 | $V_{DC}$ | |
| $-V_{AMP}$ | –30 | –45 | –50 | $V_{DC}$ | |
| $+V_{DR}$ | 17 | 18 | 27 | $V_{DC}$ | floating, with minus tied to $-V_{AMP}$ |
| Allowed supply ripple on $V_{AMP}$ | | | | | All conditions |
| $V_{RIPPLE,100Hz}$ | | | 3 | $V_{PP}$ | |
| $V_{RIPPLE,HF}$ | | | 50 | $mV_{PP}$ | |
| Quiescent current | | | | | |
| $+I_{AMP}$ | | 55 | | mA | Mode = ON |
| $-I_{AMP}$ | | –105 | | mA | includes return of $+I_{DR}$ |
| $+I_{DR}$ | | 60 | | mA | |
| $+I_{AMP}$ | | 9 | | mA | Mode = MUTE |
| $-I_{AMP}$ | | –4 | | mA | |
| $+I_{DR}$ | | 2 | | mA | |
| Capacitance on $+V_{AMP}$ and $-V_{AMP}$ | | 1000 | | µF | low ESR, per supply rail |

note 1: a minimum of 4700µF per supply rail is recommended for the PSU
note 2: $V_{DR}$ must be present before AMP mode is switched to ON

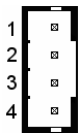
## CONNECTOR PIN-OUT

**X001**
JST B4B-VH
(counterpart: JST VHR-4)

| PIN | DESCRIPTION |
|---|---|
| 1 | $+V_{AMP}$ |
| 2 | GND |
| 3 | $-V_{AMP}$ |
| 4 | $V_{DR}$ |

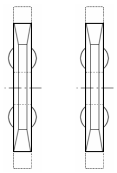

**X006**
JST B4B-PH
(counterpart: JST PHR-4)

| PIN | DESCRIPTION |
|---|---|
| 1 | ENABLE |
| 2 | GND |
| 3 | NTC |
| 4 | DCERR |



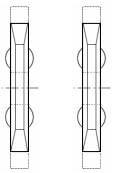

**X021/022**
Faston ¼”

| PIN | DESCRIPTION |
|---|---|
| + | OUT1 |
| – | GND |



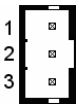
**X031/032**
Faston ¼”

| PIN | DESCRIPTION |
|---|---|
| + | OUT2 |
| – | GND |



**X004**
JST B3B-PH
(counterpart: JST PHR-3)

| PIN | DESCRIPTION |
|---|---|
| 1 | IN1– |
| 2 | GND |
| 3 | IN1+ |




**X005**
JST B3B-PH
(counterpart: JST PHR-3)

| PIN | DESCRIPTION |
|---|---|
| 1 | IN2– |
| 2 | GND |
| 3 | IN2+ |

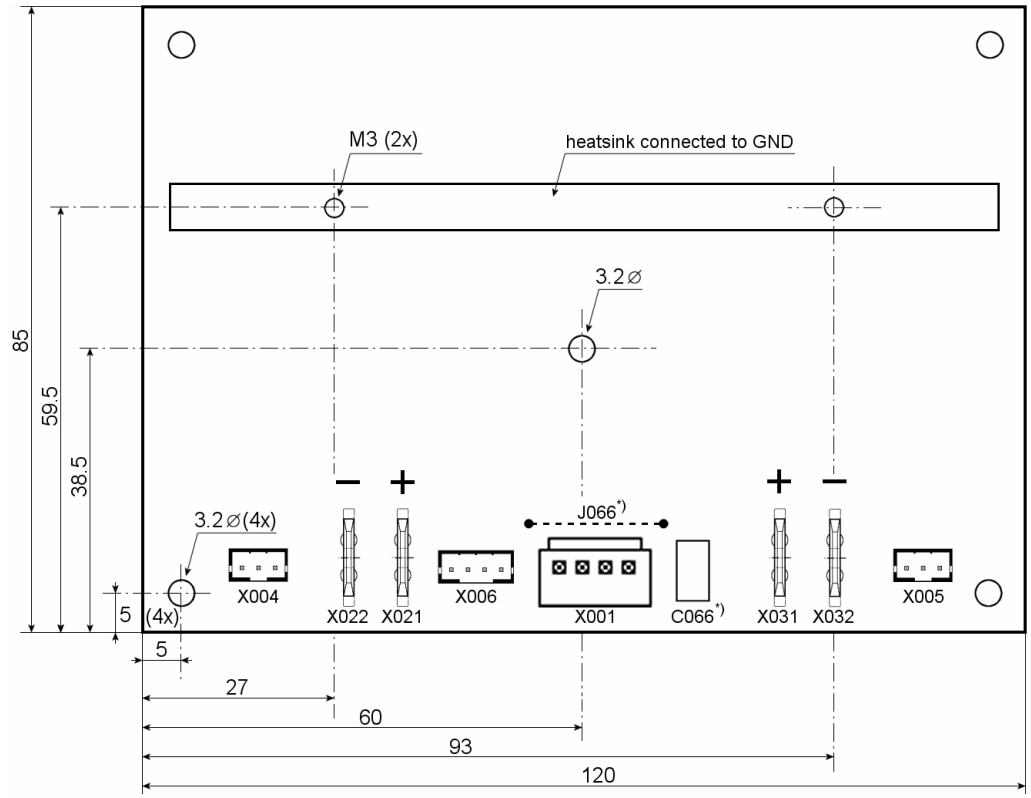
## GENERAL SPECIFICATIONS

| Parameter | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Temperature range | | | | | |
| Storage | –25 | | 70 | ºC | |
| Operating, ambient air | 10 | | 55 | ºC | Full specification |
| Operating, ambient air | 0 | | 65 | ºC | Functional |
| Safety Certifications | IEC/EN 60065:2001<br>+ Amd. 1:2005/EN60065:2002<br>CAN/CSA 60065-03<br>UL 60065-06 | | | | |

If the power supply has no overcurrent protection, the use of 5A slow fuses in the $+V_{AMP}$ and $-V_{AMP}$ lines are required to meet safety regulations.

## MECHANICAL CHARACTERISTICS

| Parameter | Typ | Units | Notes |
|---|---|---|---|
| Weight | 220 | g | |
| Overall Dimensions | 120 x 85 x 37 | mm | L x W x H |




*) see text page 6

All 5 mounting holes connected to GND, each with 1Ω in series for EMI reduction.

## ORDER INFORMATION

| Version | Product description | # Units per box |
|---|---|---|
| 2x250W in 4 Ohm | Amplifier Unit 225PS601/00 UCD Class D | 42 |
| 1x500W in 8 Ohm | Amplifier Unit 500PS601/00 UCD Class D | 42 |

**Protections**

To protect the amplifier against accidental abuse following protections are implemented:

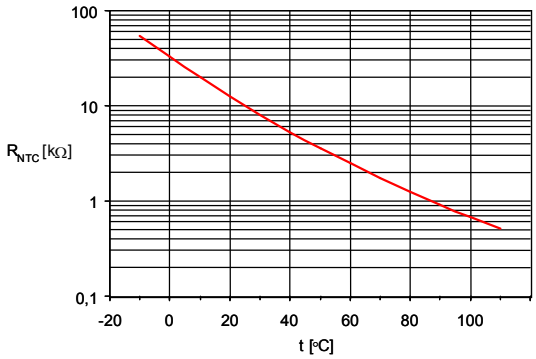
- DC error on the amplifier output (sensing only)
- Over temperature (sensing only)
- Over current / short circuit

*DC error*

When a DC voltage appears on the amplifier output, an open collector output pulls down. There is no internal circuitry in the module to act on this signal. It's up to the application to mute the amplifier or disconnect the speaker. Be aware that this is a DC coupled amplifier. A DC offset on the input is amplified and will cause a DC error signal.

*Over temperature*

The module contains an NTC resistor to sense the heatsink temperature. There is no internal circuitry in the module to act on over temperature. The resistor value can be used to either mute the amplifier or reduce the amplitude of the audio input signal (compression).
The graph shows the NTC characteristic.

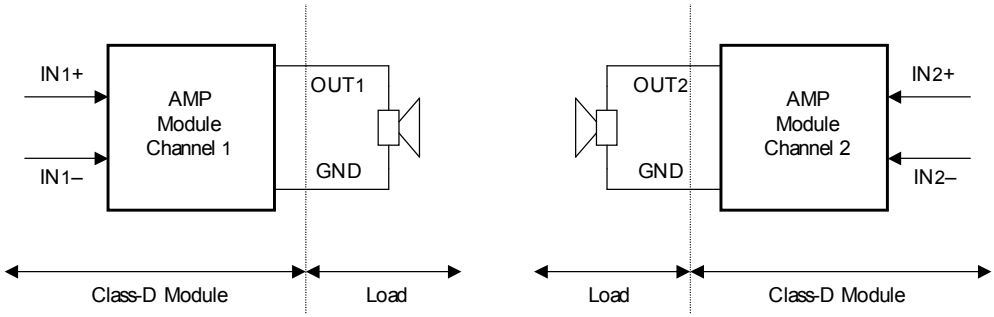



*Over current / short circuit*

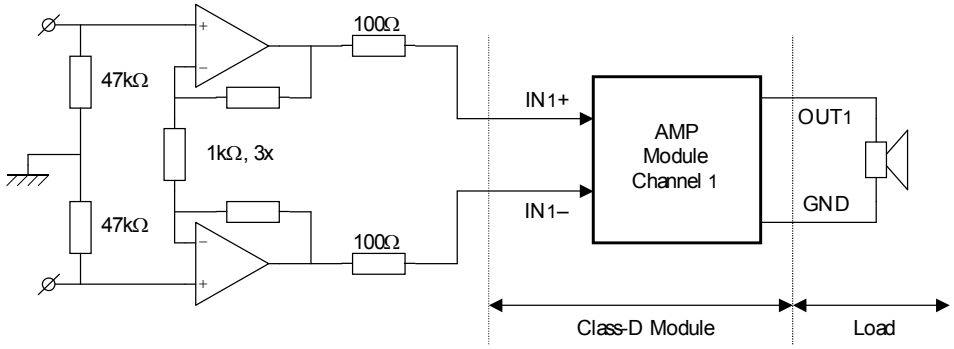
The output current of the amplifier is monitored. When exceeding a certain threshold for longer than 300ms the amplifier mutes. Restart occurs automatically. If the over current condition remains, the muting will cycle causing repetitive audio holes.

## Single Ended or Bridged Tied Load operation

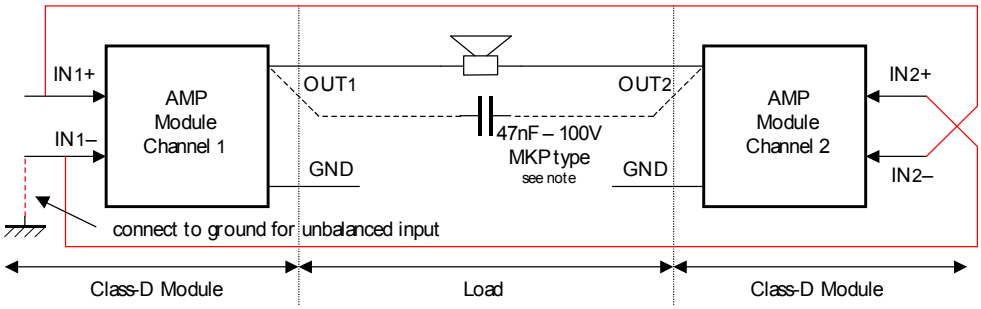
### STANDARD SINGLE ENDED CONFIGURATION




Amplifier inputs should be driven with a low impedance source (≤100Ω), preferably with the output of an Opamp. The circuit below shows an example. The use of a balanced input signal is not necessary but will offer an improved THD. For asymmetrical input, connect input IN– of the AMP module to GND and use only one Opamp.




### BRIDGED TIED LOAD (BTL) CONFIGURATION

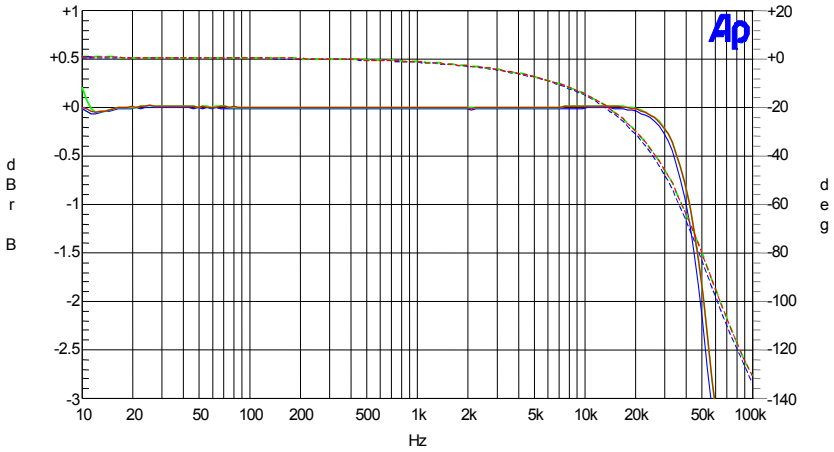



The amplifier can also be used in a Bridged Tied Load (BTL) configuration, delivering up to 500$W_{RMS}$ into 8Ω. Connect the inputs and outputs according to the diagram above. For an unbalanced input, connect one input to ground.

Note: to further improve the THD in a BTL configuration, add a jumper wire (J066) and a capacitor (C066) between the two outputs, as given in the diagram above. Positions for these components are foreseen on the amplifier module PCB.

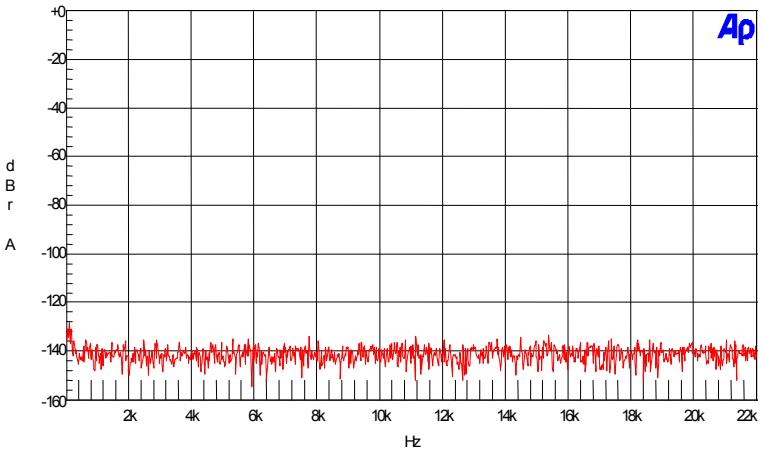
## Performance data

### *Frequency response*



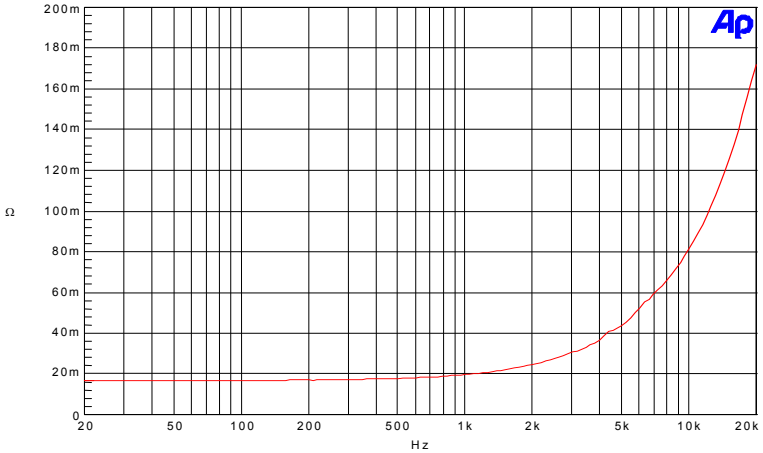

Frequency response in open load (red), 8Ω (green) and 4Ω (blue)

### *Idle noise*



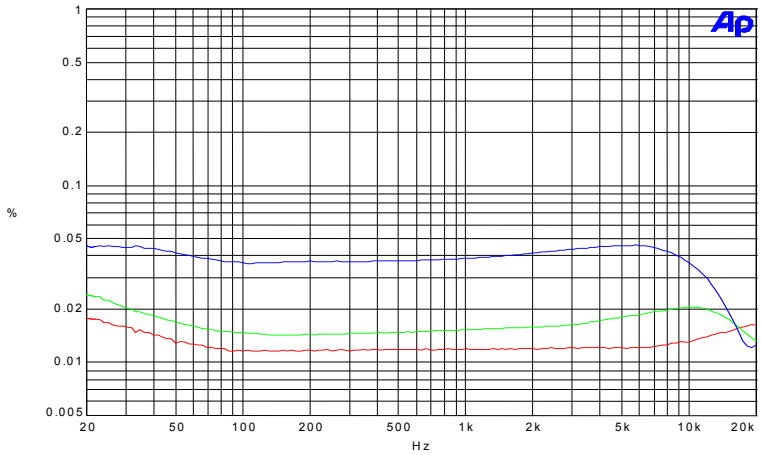

Idle noise, 0dB = 100W in 8Ω, residual = 90μ$V_{RMS}$

### *Output impedance*

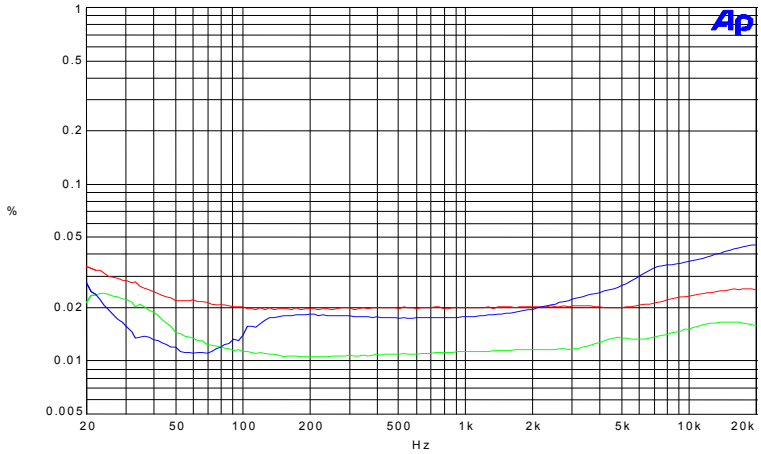



Output impedance vs. frequency

*THD+N vs. frequency*

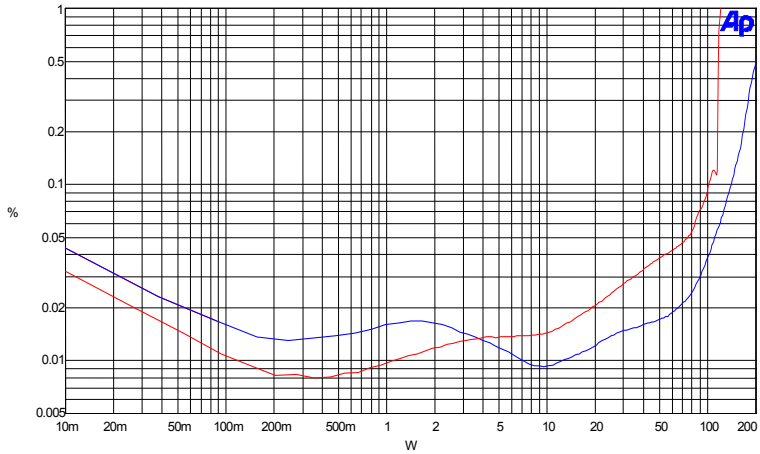



THD+N vs. frequency in 8Ω, 1W (red), 10W (green) and 50W (blue)




THD+N vs. frequency in 4Ω, 1W (red), 10W (green) and 50W (blue)

*THD+N vs. output power*




THD+N vs. $P_{OUT}$ @ 1kHz,  8Ω (red) and 4Ω (blue)

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