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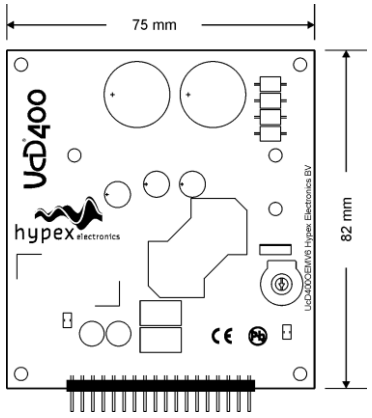
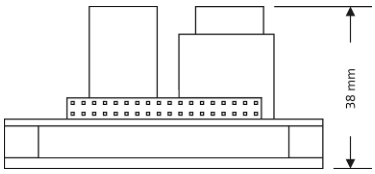
High Efficiency Power Amplifier Module (OEM Version)





Highlights

- Flat, fully load-independent frequency response
- Low output impedance
- Very low, frequency-independent THD
- Very low noise
- Fully passive loop control
- Consistent top performer in listening trials

Features

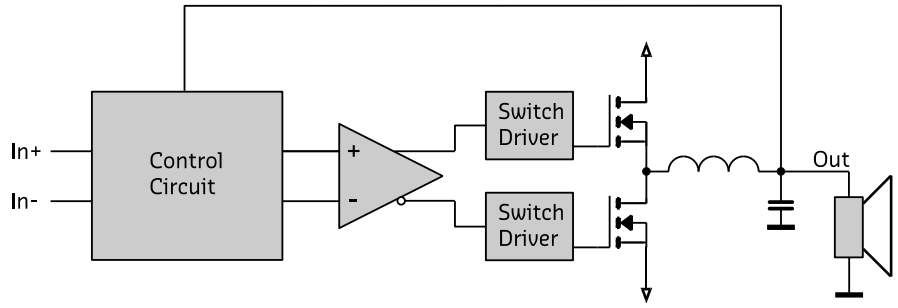
- Runs on unregulated +/- rails
- Pop-free start and stop control
- Differential audio input
- On-board clipping detection
- DC-fault detection
- Overcurrent and overvoltage protection
- Weight: 145g / Height: 38mm

Applications

- Monitor loudspeakers for recording and mastering studios
- Audiophile power amplifiers for professional and consumer use
- Public Address systems
- Home theatre systems
- Active loudspeakers

Description

The UcD400 (OEM version) amplifier module is a self-contained high-performance class D amplifier intended for a wide range of audio applications, ranging from Public Address systems to ultrahigh-fidelity replay systems for studio and home use. Chief distinguishing features are flat frequency response irrespective of load impedance, nearly frequency-independent distortion behaviour and very low radiated and conducted EMI. Control is based on a phase-shift controlled self-oscillating loop taking feedback only at the speaker output.



Contents

1 Performance data

Power supply = +/-65V, Load=4Ω, MBW=40kHz, unless otherwise noted

Item	Symbol	Min	Typ	Max	Unit	Notes
Output Power	P_R	400	-	-	W	THD=1%. Load=4Ω
	P_R	250	-	-	W	THD=1%. Load=8Ω
Distortion	THD+N	-	0.03	0.04	%	20Hz<f<20kHz [1] Pout<P_R/2
		-	-	0.005	%	20Hz<f<20kHz. Pout=1W
Output noise	U_N	-	-	80µ	V	Unwtd, 20Hz-20kHz
Output noise (UcD only)	U_N	-	-	20µ	V	Unwtd, 20Hz-20kHz
Output Impedance	Z_{OUT}	-	-	11m	Ω	f<1kHz
		-	-	35m	Ω	f<20kHz
Power Bandwidth	PBW		20-35k		Hz	[2]
Frequency Response		10	-	50k	Hz	+0/-3dB. All loads.
Voltage Gain	A_V	26	26.5	27	dB	
Supply Ripple Rejection	PSRR	-	65	-	dB	Either rail, all frequencies.
Efficiency	η	-	92	-	%	Full power
Idle Losses	P_0	-	4	-	W	With external VDR
		-	7	-	W	No external VDR
Standby Current	I_{STBY}	-	10m	-	A	
Current Limit	$I_{OUT.PK}$	18	20	-	A	hiccup after limiting 40ms
Ext. VDR current		-	25m	30m	A	

Note 1: At higher audio frequencies there are not enough harmonics left in the audio band to make a meaningful THD measurement. High frequency distortion is therefore determined using a 18.5kHz+19.5kHz 1:1 two-tone IMD test.
Note 2: Dielectric losses in the output capacitor limit long term (>30s) full-power bandwidth to 15kHz.

2 Audio Input Characteristics

Item	Symbol	Min	Typ	Max	Unit	Notes
Input Impedance (buffered)	Z_{IN}	-	100k	-	Ω	Either input to ground
Input Impedance (unbuffered)	Z_{IN}	-	1k8	-	Ω	Either input to ground
Common Mode Rejection Ratio	CMRR	-	75	-	dB	All frequencies

3 Absolute maximum ratings

Correct operation at these limits is not guaranteed. Operation beyond these limits may result in irreversible damage

Item	Symbol	Rating	Unit	Notes
Power supply voltage	V_B	+/-75	V	Unit shuts down when either rail exceeds 75V

Driver supply voltage	V_{DR}	+16	V	Referenced to -V_B.
Peak output current	$I_{OUT,P}$		A	Unit current-limits at 20A
Input voltage	V_{IN}	+/-12	V	Either input referenced to ground
Air Temperature	T_{AMB}	65	ºC	
Heat-sink temperature	T_{SINK}	90	ºC	User to select heat sink to insure this condition under most adverse use case

4 Recommended Operating Conditions

Item	Symbol	Min	Typ	Max	Unit	Notes
Power supply voltage	V_B	45 [1)]	64	73 [2)]	V	
Driver supply voltage	V_{DR}	-	15.5	-	V	Referenced to –V_B. [3)]
Load impedance	Z_{LOAD}	1			Ω	
Source impedance	Z_{SRC}			7k	Ω	Differential. Corresponds to 3dB noise increase.
Effective power supply storage capacitance	C_{SUP}	4700µ [4)]			F	Per rail, per attached amplifier. 4Ω load presumed.

Note 1: Reduced performance
Note 2: Unit shuts down when either rail exceeds 75V
Note 3: Previous versions of the UcD400OEM required a lower VDR voltage (13V).
Note 4: The effective power supply storage capacitance of Hypex SMPS is already in excess of 4700µF. Do not add supplementary capacitance.

5 Connections

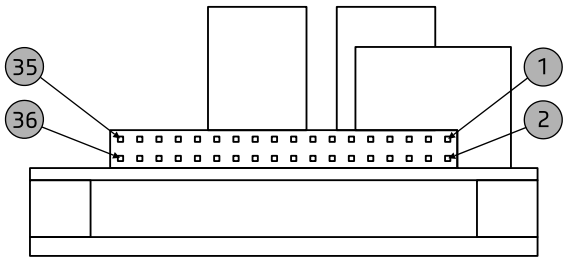


Fig1. Connector pinning UcD400 (OEM version).

5.1 J1

In order to ease connecting the amplifier, all necessary connections to operate the amplifier are grouped in one standard 2.54mm pitch dual row 36 pin header, current rating 3A minimum.

Pin	Type	Function
1, 2, 3, 4	Input	Positive power supply connection
5, 6, 7, 8	Input	Power supply ground connection[1)]
9, 10, 11, 12	Input	Negative power supply connection
13, 14, 15, 16, 18	Output	Loudspeaker connection (cold)[1)]
17	Input	Negative loudspeaker feedback
19	Input	Positive loudspeaker feedback
20, 21, 22, 23, 24	Output	Loudspeaker connection (hot)
25	Input	Buffered inverting audio input
26	Output	Buffered inverting audio output
27	Input	Unbuffered inverting audio input
28	Input	External driver supply
29	Input	Buffered non-inverting audio input
30	Output	Buffered non-inverting audio output

31	Input	Unbuffered non-inverting audio input
32	Output	Clipping detection output (open collector)
33	Output	DC-error output (open collector)
34	Input	ON/OFF control (active low)
35	Output	Amplifier Ready
36	Output	Current limiter monitoring.

Note 1: Physically connected to the same potential (ground).

5.2 External Driver Voltage Connection

Internal VDR supply is default set. In order to minimize dissipation in multi channel applications an external 15V VDR source can be connected. This will save typical 2W for each connected amplifier. The VDR reference must be connected to the negative supply rails(!).

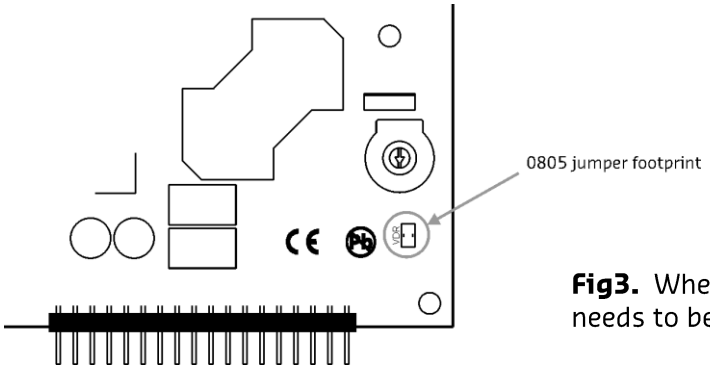


Fig3. When VDR is sourced externally solder jumper needs to be placed.

5.3 Clipping Detection Characteristics

The UcD400 (OEM version) has an integrated output clipping detection which will pull pin 32 low in case of such an event.

Item	Min	Typ	Max	Unit	Notes
Voltage on pin 32, clipping			1	V	Internal open collector[1)]

Note 1: Must be pulled to a positive voltage by means of an external resistor. Open collector maximum output current: 100mA. Maximum collector voltage: 65V.

5.4 DC-Fault Detection Characteristics

The UcD400 (OEM version) has an integrated DC-error detection which will pull pin 33 low in case of such an event. It is recommended to sense this fault condition and to interrupt both power supply lines in such an event.

Item	Min	Typ	Max	Unit	Notes
Voltage on pin 33, DC-error			1	V	Internal open collector[1)]

Note 1: Must be pulled to a positive voltage by means of an external resistor. Open collector maximum output current: 100mA. Maximum collector voltage: 65V.

5.5 Amplifier ON/OFF Characteristics

The UcD400 (OEM version) is enabled by pulling pin 34 low. Leaving pin 34 floating will put the amplifier in standby.

Item	Min	Typ	Max	Unit	Notes
Voltage on pin 34, left floating			6,5	V	Internally pulled up[1)]

Note 1: Must be pulled low by means of an open collector.

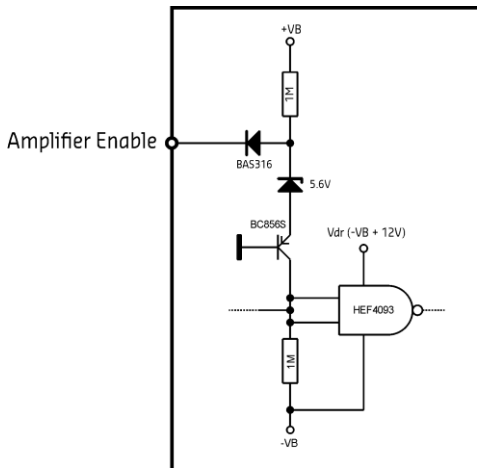


Fig4. Amplifier On/Off Control interface.

5.6 Amplifier Ready Characteristics

The UcD400(OEM version) has an integrated Amplifier Ready condition which will pull pin 35 high to indicate that the amplifier shut itself down due to an error. This error can be either an overvoltage event or a shorted output.

Item	Min	Typ	Max	Unit	Notes
Voltage on pin 35, error	-0,6		5,6	V	Internally pulled up

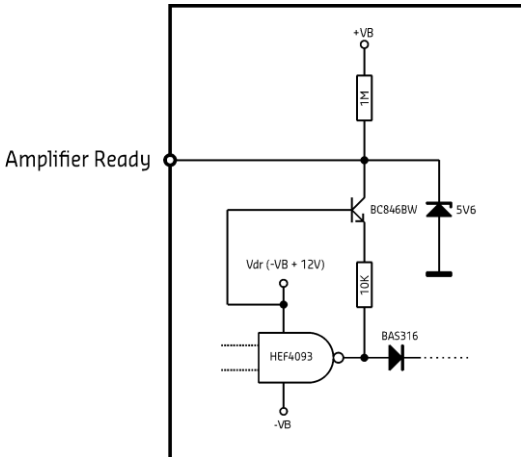


Fig5. Amplifier Ready interface.

5.7 Signal path characteristics

The UcD400 (OEM version) enables the user to choose between two different ways of input signal routing.

- In order to use the on-board buffer opamp (TL072) two external connections need to be made: pins 30, 31 and pins 26, 27 must be tied together. The amplifier is driven through both inputs 25 and 29.
- If the user desires to utilize his own input buffer circuitry no external connections need to be made. The amplifier is now driven through inputs 27 and 31. Customer needs to take into account that the input impedance of the UcD core is relatively low (1k8).

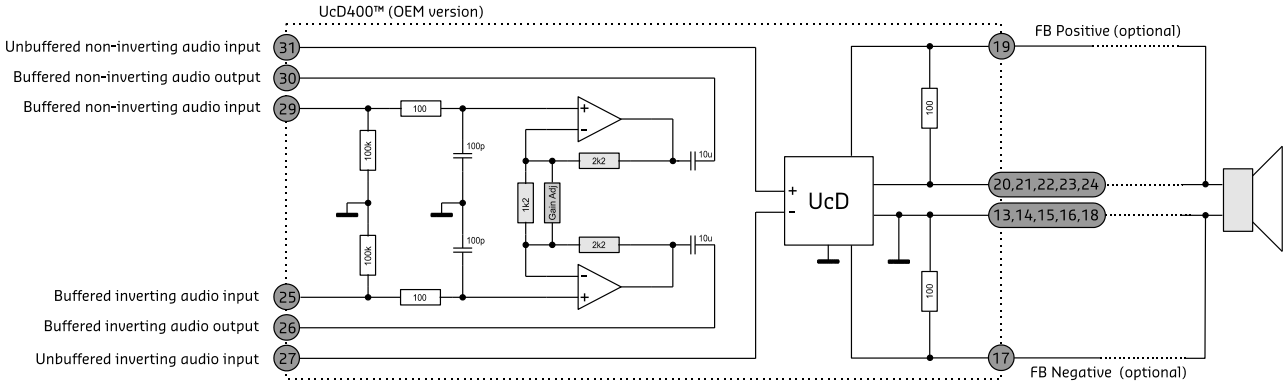


Fig2. UcD400 (OEM version) block diagram clearly showing the signal path routing and optional loudspeaker feedback connections.

5.8 Optional remote (kelvin) feedback

When maximum control of the loudspeaker is needed it is possible to include the loudspeaker cables in the UcD control loop thus eliminating all negative effects of long cables etcetera.
Connect both the positive feedback (pin 19) and negative feedback (pin 17) connections as close to the loudspeaker as possible. No extra connections are needed.

5.9 Current Limiter Monitoring

The UcD400 (OEM version) has a current limiter monitoring output which is pulled low in the event of an output current limiting situation. This is output is not latched/delayed and is therefore only active when the limiter is active.

Item	Min	Typ	Max	Unit	Notes
Voltage on pin 36, Current limiting	-0,7			V	Internally pulled up

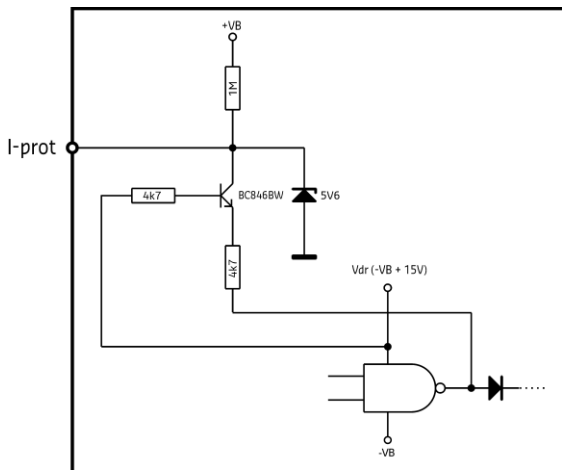


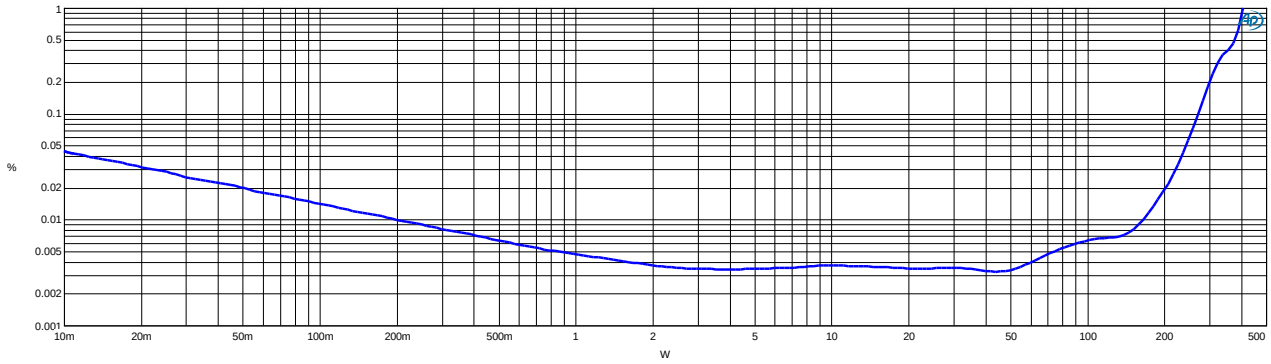
Fig6. Current limiter monitoring.

5.10 Amplifier start-up delay

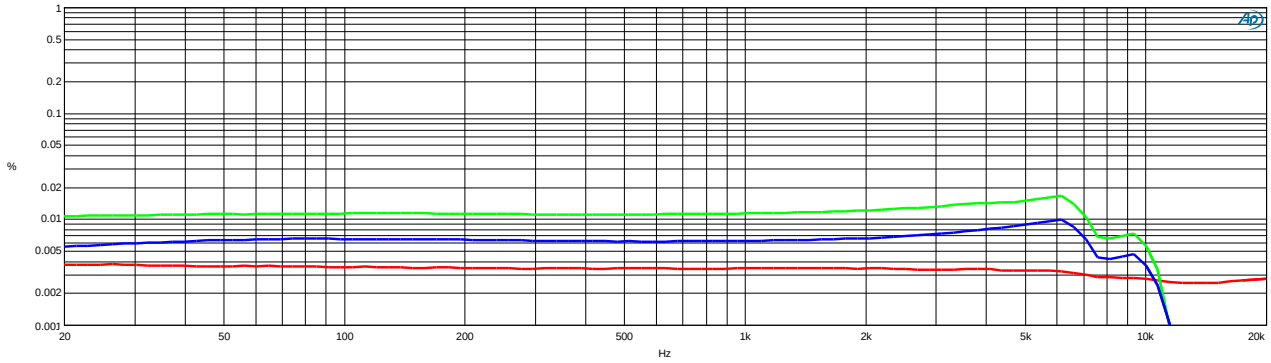
During initial power up the amplifier is disabled for approx. 1.5s regardless of the state of pin 34. Once powered up there is no start or stop delay. Pin 35 (Amplifier Ready) remains high during the initial power up.

6 Typical Performance Graphs

6.1 THD vs. Power (1kHz, 4Ω)

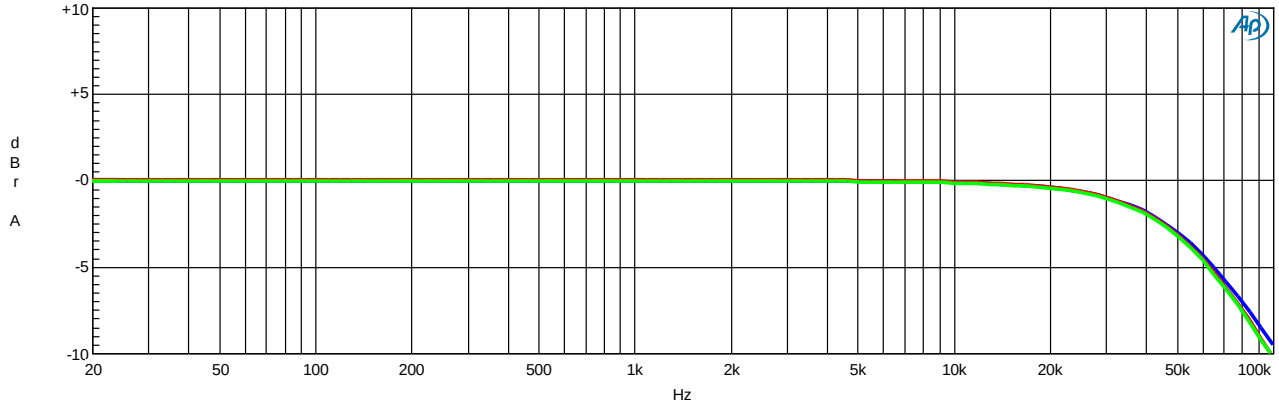


6.2 THD vs. Frequency (8Ω)



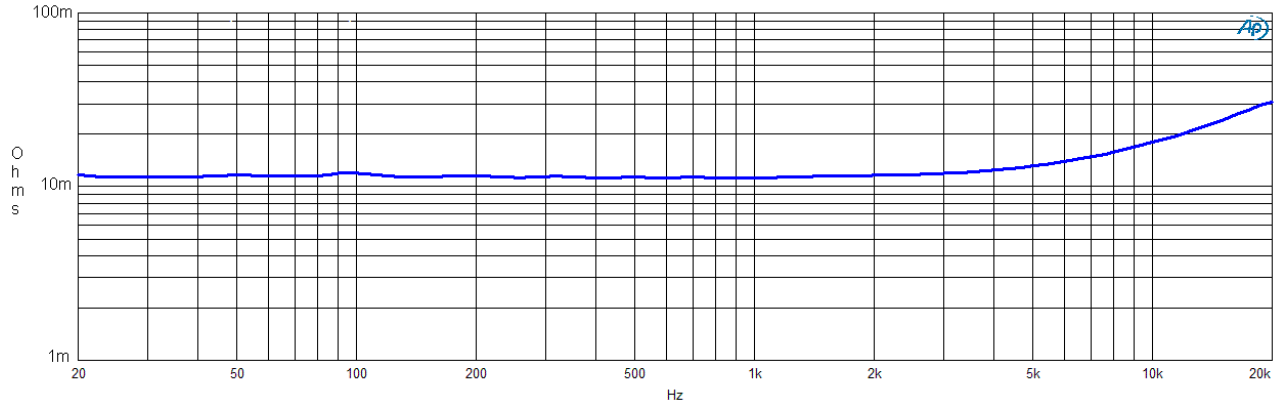
From top to bottom: 40W, 10W, 1W

6.3 Frequency Response (4Ω, 8Ω and open circuit)

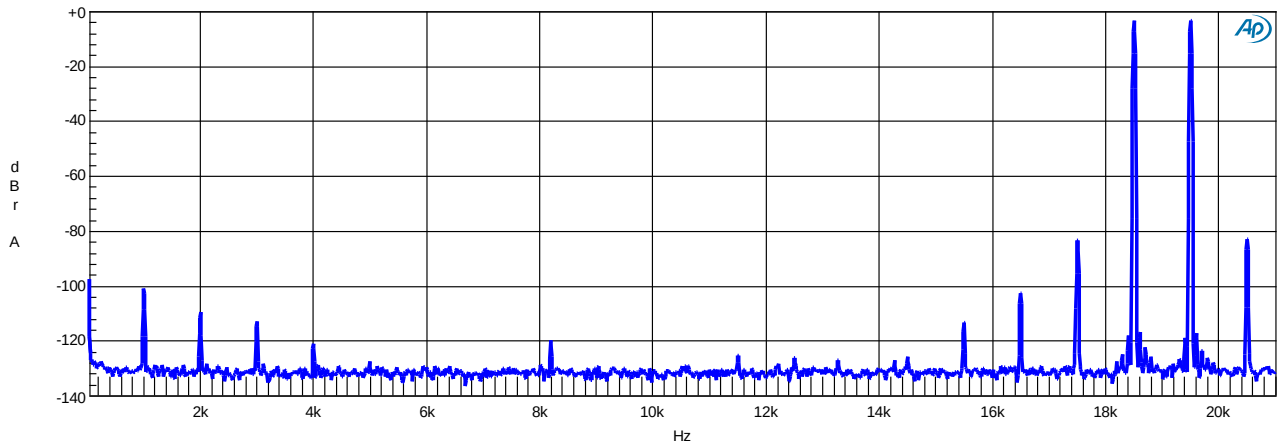


From top to bottom: open circuit, 8Ω, 4Ω

6.4 Output Impedance

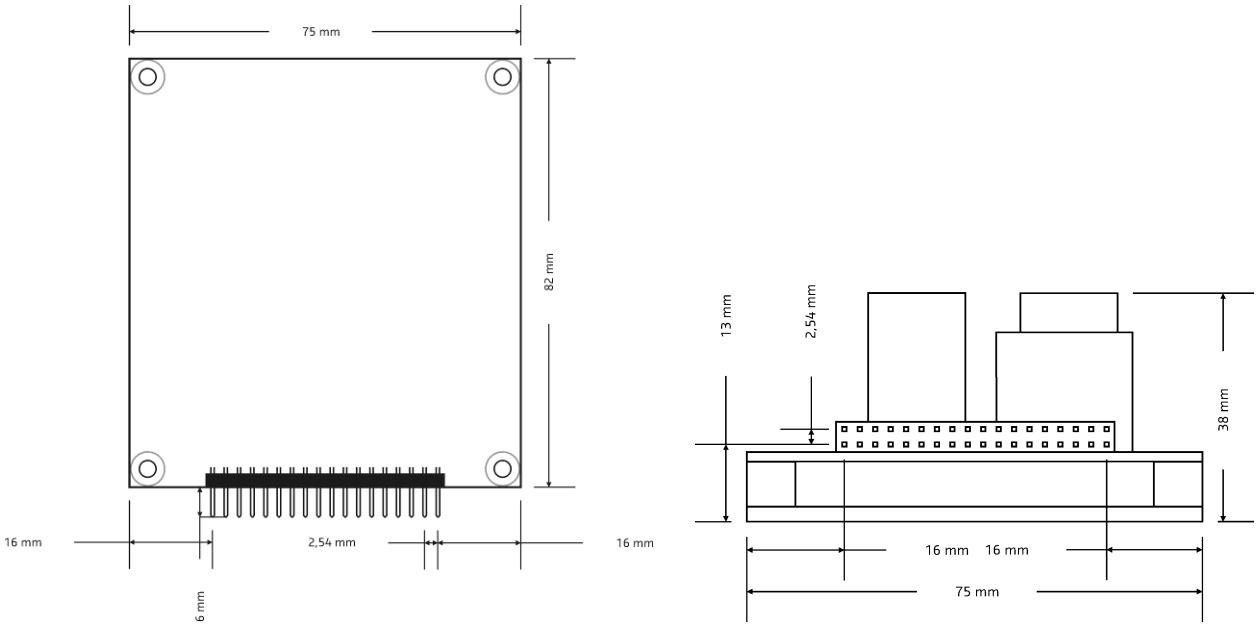


6.5 19+20kHz IMD (10W, 8Ω)

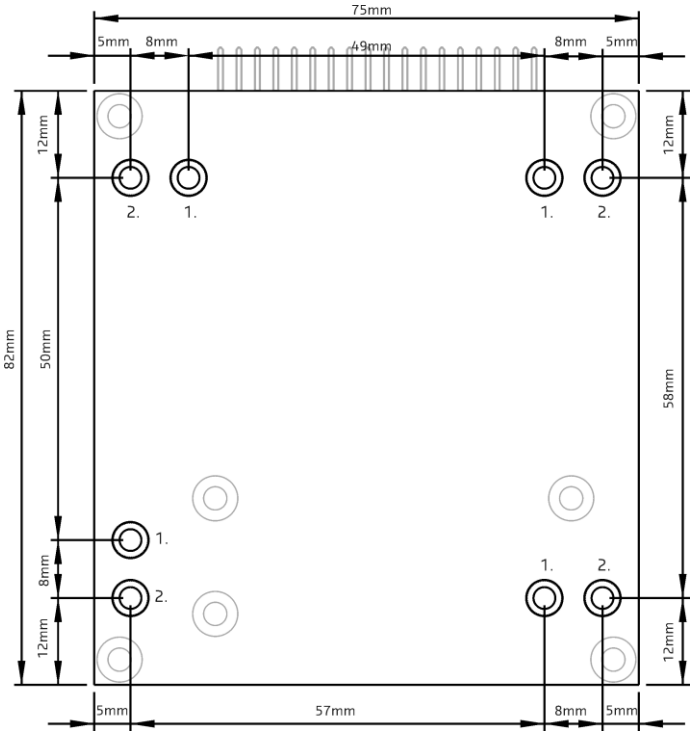


7 Dimensions

7.1 Connector layout. Top view / Frontview



7.2 Heatsink drill pattern. Bottom view.



1. Push-in nut UNC 6-32
2. Push-in nut Metric M3

DISCLAIMER: This subassembly is designed for use in music reproduction equipment only. No representations are made as to fitness for other uses. Except where noted otherwise any specifications given pertain to this subassembly only. Responsibility for verifying the performance, safety, reliability and compliance with legal standards of end products using this subassembly falls to the manufacturer of said end product.

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Document Revision	PCB Version	Description	Date
R5	UcD400OEMV3	-	25.07.2007
R6	UcD400OEMV4	- Footprint added on top layer to be able to adjust amplifier gain. This footprint is default left open for default gain. - Current limiter hiccup-mode improved. - UNC 6-32 heatsink mounting holes (4x) added.	06.04.2008
R7	UcD400OEMV4	- OVP level rectified (68V). Correct level is 75V	28.04.2009
R8	UcD400OEMV4	- Maximum output current corrected into 18A	22.09.2009
R9	UcD400OEMV5	- Asymmetrical current limiting issue solved. - Internal Vdr supply improved. - Kelvin sense feature improved. - Current limiter output monitor added. - Compatibility external Vdr improved. - Registered Trademark symbols added.	24.09.2009
R10	UcD400OEMV5	- External Vdr documentation added.	09.07.2010
R11	UcD400OEMV5	- Error table page 3 corrected.	19.10.2010
R12	UcD400OEMV6	- Functional data updated. - Improved overall performance. - Two-stage DC protection. - Lower idle dissipation.	04.09.2012
R13	UcD400OEMV7	- Improvements for multi-channel use.	13.08.2014