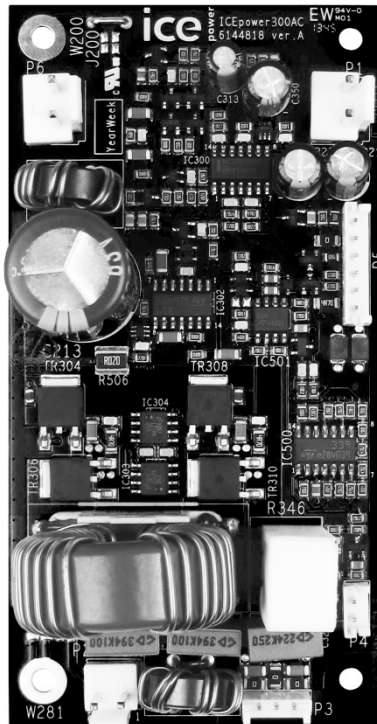


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ICEpower300A1

300W ICEpower Amplifier

Data Sheet

Version 1.2

Contents

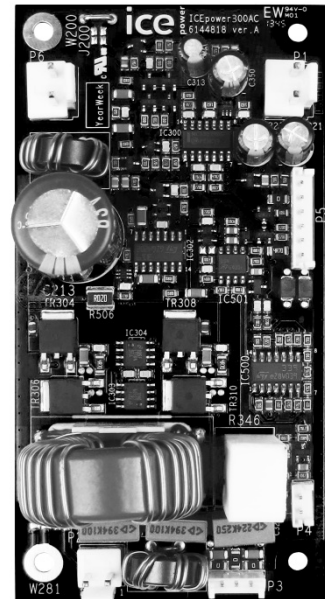
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General Description

ICEpower300A1 is a high performance 300W Class D amplifier designed particularly for highly competitive consumer and professional audio applications. It can be used as a stand-alone single channel amplifier module or with the 300AS1 or 700AS1 amplifier with integrated power supply to build multichannel systems. Both the 300AS1 and 700AS1 have all required supply voltages available for 300A1. It is pre-approved for EMC and safety for fast design-in and to minimize time to market. ICEpower300A1 is an integrated power solution, which eliminates the need for heat sinks and EMI shields.

Key benefits include:

- ICEpower's patented HCOM modulation and control techniques ensure excellent audio performance
- A comprehensive set of features for plug-and play implementation in a wide range of applications such as active speakers and subwoofers, HTIB, and A/V amplifiers and receivers
- Fully backwards compatible with ICEpower200AC module - same dimensions, mounting holes and connectors



Key Specifications

- 300W at 1% THD+N, 40hm
- 280W at 0.1% THD+N, 40hm
- Full power bandwidth (20Hz – 20kHz)
- 113dBA dynamic range (300W, 40hm)
- THD+N = 0.005% (1W, 40hm)
- Audio input impedance 47kOhm (fully balanced)
- High output current limit = 20A_p
- Low output impedance = 6mOhm
- Damping factor = 660, 40hm
- Power efficiency 90% (DC supplies to Audio Out)
- Idle power consumption 5.5W
- Disabled power consumption 1.2W

Key Features

- Rugged construction
- Disable and Mute control inputs
- Suitable for CE and FCC approved designs
- Thermal protection
- Over current and short circuit protection
- DC servo for low DC offset
- Designed as hanger for both 300AS1 and 700AS1
- EMI conforms to: EN55013 and others
- Safety conforms to: UL60065 and others

Release Notes

PCB Version	Data Sheet Version	Date	Revised by	Description
C	1.0	July 4, 2014	MPS/SMK	Datasheet created
C	1.1	January 6, 2016	MFM/SOL	Module name changed – product identical
C	1.2	June 1, 2017	TOC/DIT	Address updated Legal Notes updated

Table 1: Release notes

Block Diagram

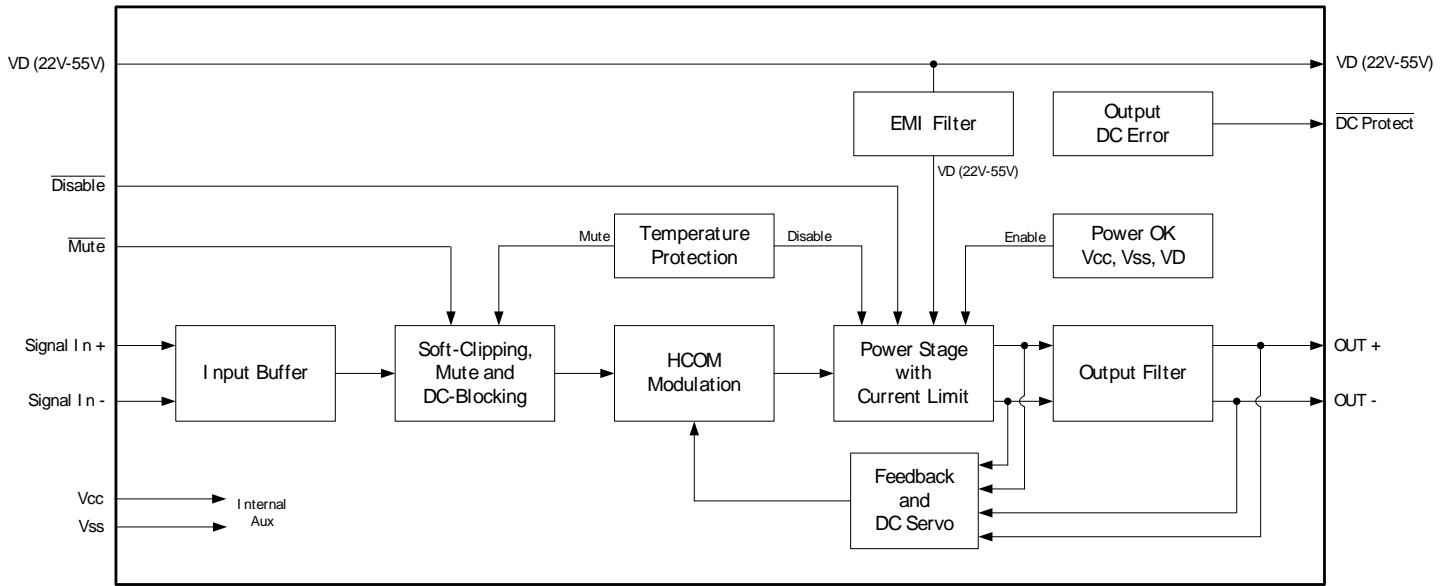


Figure 1: ICEpower300A1 block diagram

Connection Diagram

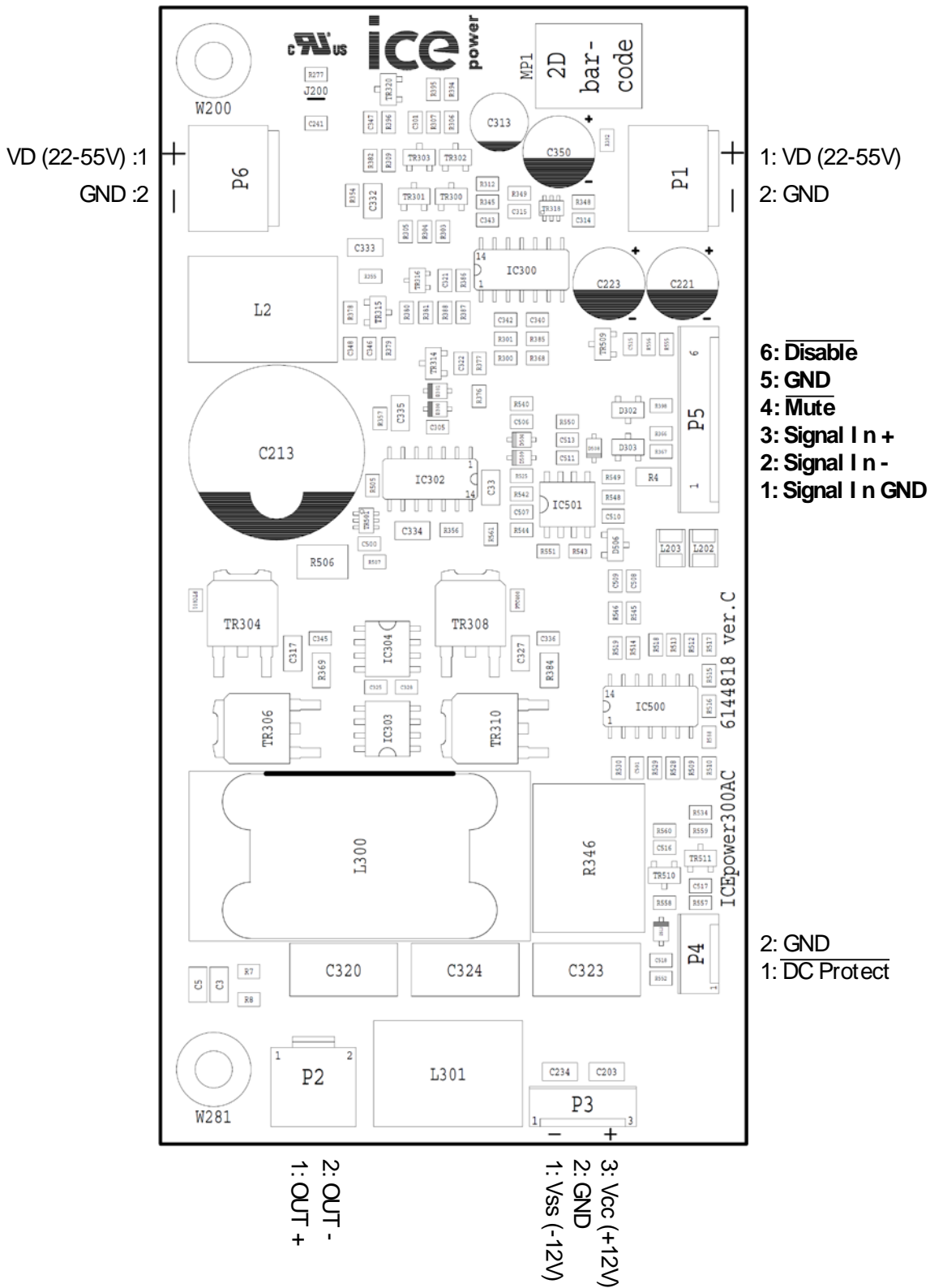


Figure 2: ICEpower300A1 connections

The plug interface of the ICEpower300A1 modules has six industry standard connectors selected for long-term reliability.

DC-bus Header Specification (P1 & P6)

Type: JST B 2P-NV			
PIN	Function	Description	Type
1	VD (+22-55V)	Power supply +22V to +55V	Input
2	GND	Ground terminal for the power section	GND

Table 2: DC bus connector specifications

Speaker Header Specification (P2)

Type: JST B 2P-VH			
PIN	Function	Description	Type
1	OUT+	Positive balanced audio power output terminal	Output
2	OUT-	Negative balanced audio power output terminal	Output

Table 3: Speaker connector specifications

Auxiliary Supply Header Specification (P3)

Type: JST B3B-EH-A			
PIN	Function	Description	Type
1	Vss (-12V)	Power supply -12V	Input
2	GND	Ground terminal for the auxiliary section	GND
3	Vcc (+12V)	Power supply +12V	Input

Table 4: Auxiliary supply specifications

Protection Header Specification (P4)

Type: JST B2B-EH-A			
PIN	Function	Description	Type
1	DC protect	Pulled low if DC is present on the amplifier output	Output
2	GND	Ground terminal for DC Protect	GND

Table 5: Signal Sense and Trigger Connector specifications

Signal Header Specification (P5)

Type: JST B8B-EH-A			
PIN	Function	Description	Type
1	Signal GND	Ground terminal for the input signal.	GND

2	Signal In -	Negative input (full balanced input buffer).	Audio Input
3	Signal In +	Positive input (full balanced input buffer).	Audio Input
4	Mute	Mute audio signal (active low)	Input
5	GND	Ground terminal for Mute and Disable	GND
6	Disable	Disable amplifier power stage (active low)	Input

Table 6: Signal In connector specifications

Absolute Maximum Ratings

Absolute maximum ratings indicate limits beyond which damage may occur.

Input Section

Symbol	Parameter	Value	Unit
VD	Maximum voltage from GND to pin	+55	V
Vcc	Maximum voltage from GND to pin	+16	V
Vss	Minimum voltage from GND to pin	-16	V
Vin+ , Vin-	Maximum voltage range on pin	Vss – Vcc	V
Mute	Minimum voltage from GND to pin	Vcc	V
Disable	Minimum voltage from GND to pin	Vcc	V

Table 7: Absolute maximum ratings, input section

Output Section

Symbol	Parameter	Value	Unit
R _{load} ³⁾	Minimum load	2.5	Ω
I _{out} ³⁾	Maximum current draw from amplifier output	20	Ap
C _L	Maximal pure capacitive loading	220	nF

Table 8: Absolute maximum ratings, output section

3) The overcurrent protection will act to protect the amplifier. (See "Protection features" page 23)

Thermal Section

Symbol	Parameter	Value	Unit
T _a	Max. operating ambient temperature	50	°C

Table 9: Absolute maximum ratings, thermal section

Power Specifications

Unless otherwise specified. $T_a=25\text{ }^\circ\text{C}$, $f=1\text{kHz}$, $\text{Load}=4\Omega$, $V_D=55\text{V}$, $V_{CC}=+12\text{V}$, $V_{SS}=-12\text{V}$

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_D	Normal operating DC supply voltage		+22	-	+55	V
V_{CC}	Normal operating pos. analog supply		+11	+12	+14	V
V_{SS}	Normal operating neg. analog supply		-14	-12	-11	V
t_{Pmax}	Time of maximum rated output power	300W out, no preheating.		120		s
P_T	Continuous output power without thermal shutdown	Thermal stab. at $T_a = 25\text{ }^\circ\text{C}$. Thermal stab. at $T_a = 50\text{ }^\circ\text{C}$.	- -	105 38	- -	W
P_{FTC}	FTC rated output power		-	130	-	W
I_q	Quiescent current consumption	V_D V_{CC} V_{SS}	- - -	75 75 30	85 85 40	mA
P_q	Total quiescent power consumption		-	5.4	6.2	W
$I_{disable}$	Disabled current consumption	V_D V_{CC} V_{SS}	- - -	5 50 25	10 60 35	mA
$P_{disable}$	Disabled power consumption		-	1.2	1.7	W
η	Total power efficiency	$P_o = 300\text{W}$, $R_L = 4\Omega$ $P_o = 200\text{W}$, $R_L = 4\Omega$ $P_o = 100\text{W}$, $R_L = 4\Omega$	- - -	90 89 87	- - -	%

Table 10: Power specifications

Audio Specifications

Unless otherwise specified. $T_a=25\text{ }^\circ\text{C}$, $f=1\text{kHz}$, $\text{Load}=4\Omega$, $\text{VD}=55\text{V}$, $\text{Vcc}=+12\text{V}$, $\text{Vss}=-12\text{V}$

Measurements are done using an Audio Precision AES17 20 kHz 7th order measurement filter unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
P _o	Output power at 1%THD+N f = 1kHz	VD=55V	-	310	-	W
		VD=43V	-	190	-	
P _o	Output power at 1%THD+N 20Hz < f < 20kHz	VD=55V	-	305	-	W
		VD=43V	-	180	-	
P _o	Output power at 0.1%THD+N 20Hz < f < 20kHz	VD=55V	-	280	-	W
		VD=43V	-	160	-	
P _o	Output power at 10%THD+N f = 1kHz NOTE: Exceeding 300W will trigger the thermal protection after a short period of time.	VD=55V	-	380	-	W
		VD=43V	-	250	-	

Table 11: Audio specifications

General Audio Specifications

Unless otherwise specified. $T_a=25\text{ }^\circ\text{C}$, $f=1\text{kHz}$, $\text{Load}=4\Omega$, $V_D=55\text{V}$, $V_{CC}=+12\text{V}$, $V_{SS}=-12\text{V}$

Measurements are done using an Audio Precision AES17 20 kHz 7th order measurement filter unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
THD+N	THD+N in 4Ω	$f = 100\text{Hz}$, $P_O=1\text{W}$	-	0.005	-	%
$V_{N,0}$	Output referenced idle noise	A-weighted Un-weighted, $\text{BW}=20\text{kHz}$	- -	75 105	- -	μV
A_V	Nominal Voltage Gain	$f = 1\text{kHz}$	28.0	28.15	28.3	dB
f	Frequency response	$20\text{Hz} - 20\text{kHz}$, $Z_L \geq 4\Omega$	-	± 0.5	± 1.0	dB
f_u	Upper bandwidth limit (-3dB)	$R_L = 8\Omega$ $R_L = 4\Omega$	- -	70 55	- -	kHz kHz
f_l	Lower bandwidth limit (-3dB)	$R_L = \text{All loads}$	-	2	-	Hz
R_i	Input impedance, Signal IN+ and IN-		-	47	-	$\text{k}\Omega$
Z_o	Absolute output impedance	$f = 100\text{Hz}$	-	6	-	$\text{m}\Omega$
Z_L	Load impedance range		2.5	4	∞	Ω
D	Dynamic range	A-weighted at 300W, 4Ω	-	113	-	dB
IMD	Intermodulation Distortion (CCIF)	$f = 18\text{kHz}$, 19kHz , $P_O = 10\text{W}$	-	0.0015	-	%
TIM	Transient Intermodulation Distortion (TIM)	$f_1 = 3.15\text{kHz}$ square, $f_2 = 15\text{kHz}$, $P_O = 10\text{W}$	-	0.0035	-	%

Table 12: General audio specifications

Electrical Specifications

Unless otherwise specified, $T_a=25\text{ }^\circ\text{C}$.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
f_o	Switching frequency, amplifier	Idle	-	480	-	kHz
f_s	Switching frequency range, amplifier	Idle to full scale variation	100	-	500	kHz
$V_{\text{OFF,Diff}}$	Differential offset on output terminals	Input terminated	-	± 5	± 20	mV
$V_{\text{OFF,CM}}$	Common mode offset on output terminals	Input terminated	-	$V_D/2$	-	V

Table 13: Electrical specifications

Timing Specifications

Unless otherwise specified, $T_a=25\text{ }^\circ\text{C}$.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{sd}	Switching delay at start up	Time from all power supplies are good to amplifier starts switching	-	220	-	ms
t_{audio}	Audio delay	Time from amplifier starts switching to audio is un-muted during start-up	-	2	-	ms
t_{mute}	Mute delay	Output mute delay from mute signal is pulled low	-	5	-	ms
$t_{\text{un-mute}}$	Un-mute delay	Output un-mute delay from mute signal is released	-	2	-	ms
t_{disable}	Disable delay	Delay from disable signal is pulled low to amplifier stops switching	-	0.1	-	ms
t_{enable}	Un-mute delay	Delay from disable signal is released to amplifier starts switching		0.02		ms

Table 14: Timing specifications

Mechanical Specifications

During development, the ICEpower300A1 has sustained tough mechanical tests to ensure high reliability.

Test	Acceleration	Amount
Unpowered tests: The unit is powered after the test to verify functionality.		
Random vibration	2,1G rms, random profile composed of 5 frequencies in the range 5 Hz to 275 Hz	3 perpendicular directions 3 x 20 min. + 3 x 10 min. + 3 x 10 min.
Bump	10G, 16 ms pulse, half sinusoidal	1000 bumps in 6 directions 2-4 bumps per second
Shock	40G/26ms to 70G/12ms in steps of 10G	6 directions, 3 shocks per direction
Powered tests: The unit is tested with power applied.		
Sinusoidal vibrations	5 - 10 Hz/2,5 mm 10 - 100 Hz/1 g	3 directions, 2 hours per direction
Random vibrations	10 - 20 Hz 0,01g ² /Hz 20 -150 Hz, - 3 dB/oct. 0,7 g RMS	3 directions, 2 hours per direction

Table 15: Mechanical tests

Other environmental testing

Extensive environmental testing is performed to ensure the module robustness. These tests include Highly Accelerated Life Test (HALT), thermal shock and cycling, moisture and mechanical shock and vibration.

Typical Performance Characteristics

All measurements in this section is done for VD=55V

Frequency Response

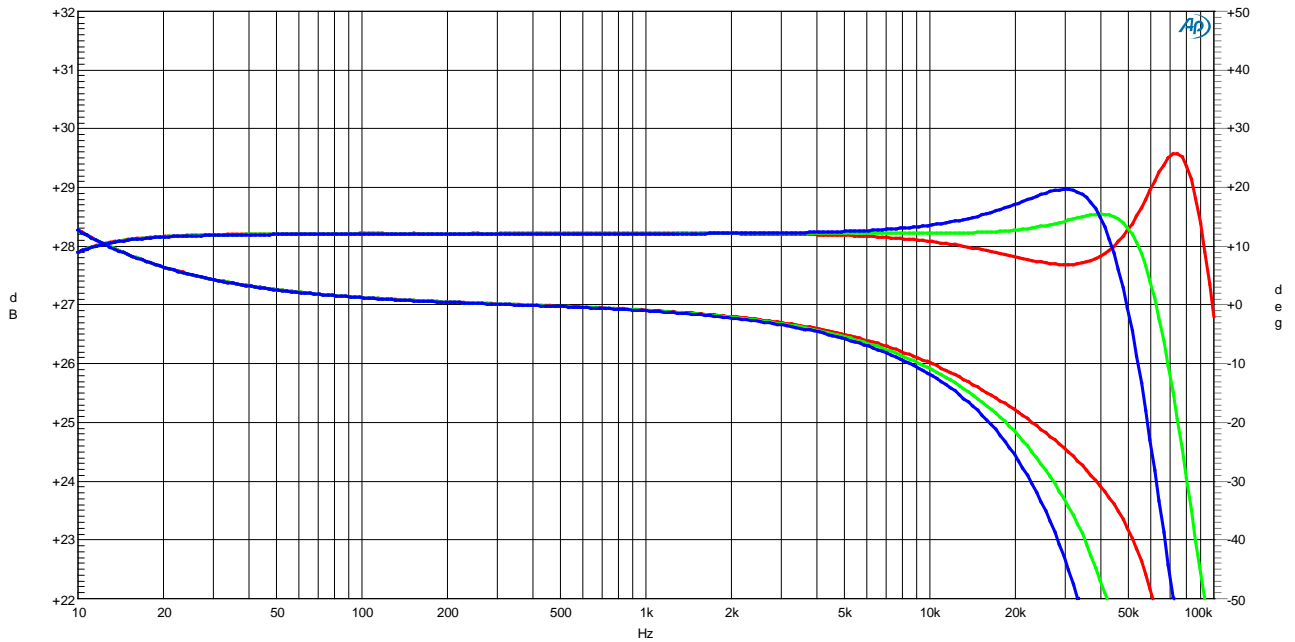


Figure 3: Frequency response in 4Ω (blue), 8Ω (green) and open load (red). Top – amplitude. Bottom – phase

Harmonic Distortion & Noise

All measurements are done with an Audio Precision AES17 20 kHz 7th order measurement filter.

THD+N vs. Power

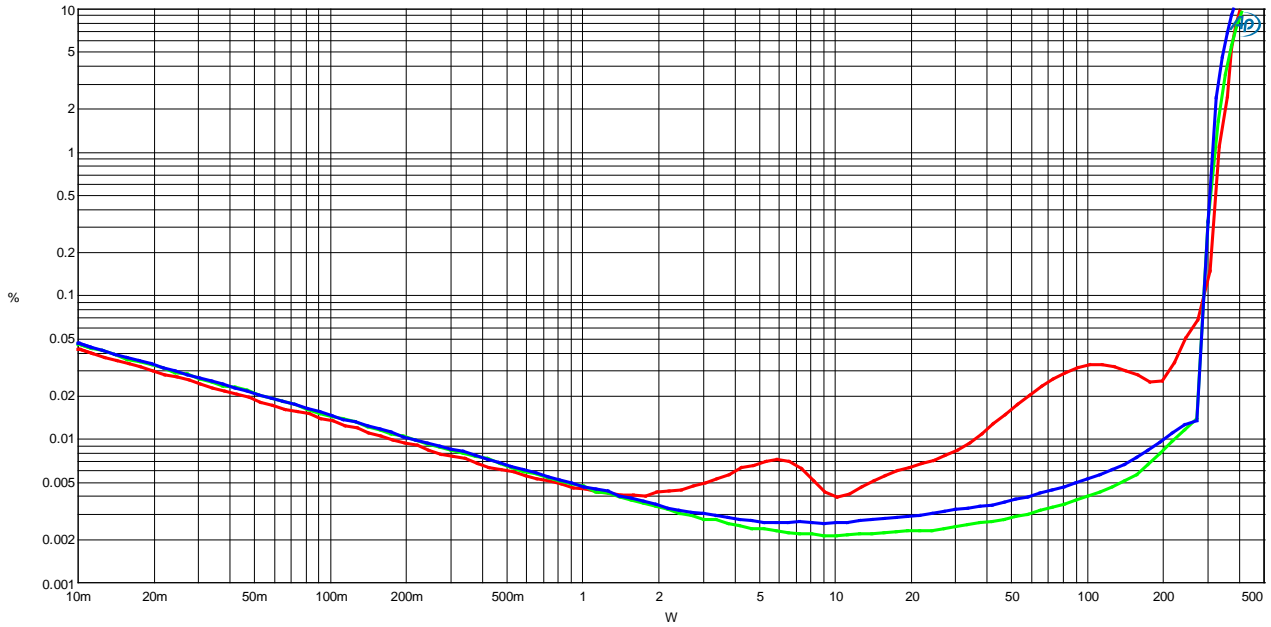


Figure 4: THD+N vs. Po at 100Hz (blue), 1kHz (green) and 6.67kHz (red), 4Ω

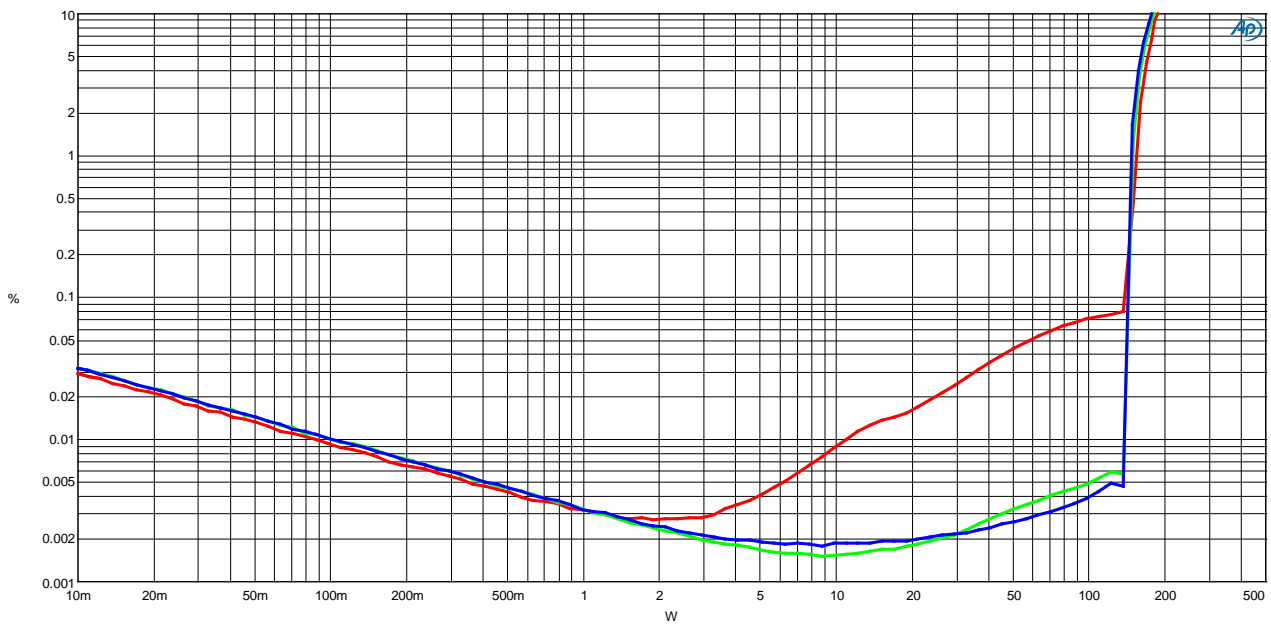


Figure 5: THD+N vs. Po at 100Hz (blue), 1kHz (green) and 6.67kHz (red), 8Ω

Spectral View (FFT)

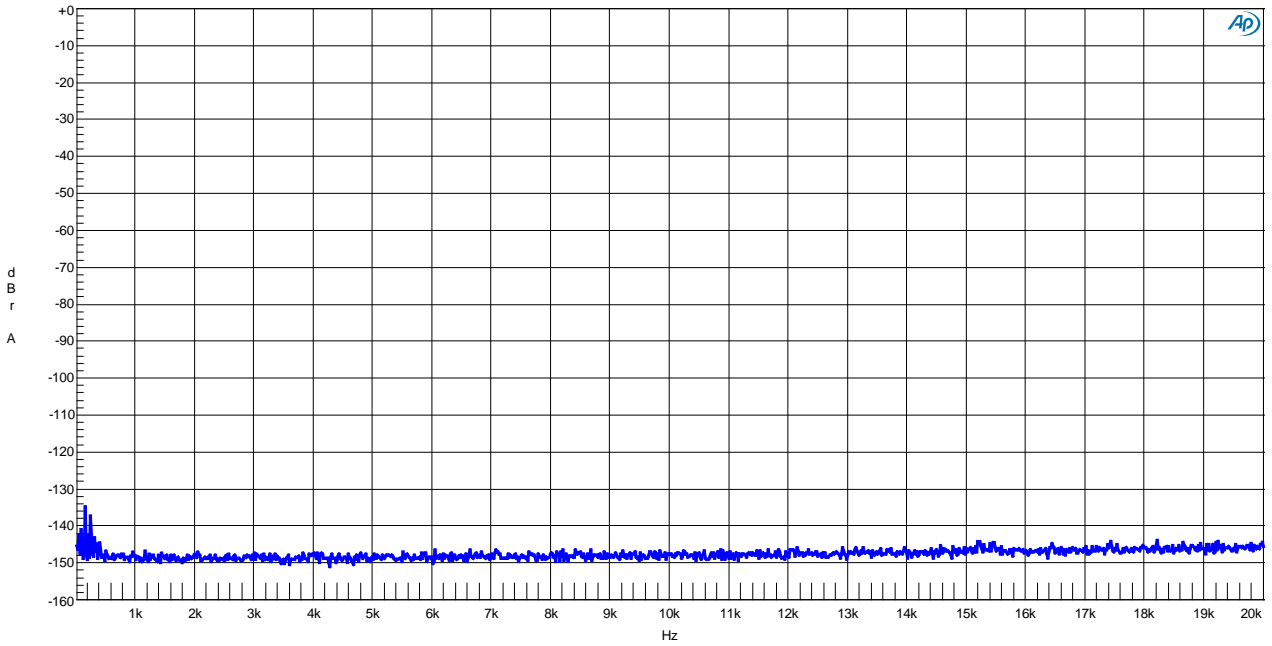


Figure 6: Idle noise (16K FFT). Residual = 75µV(A)

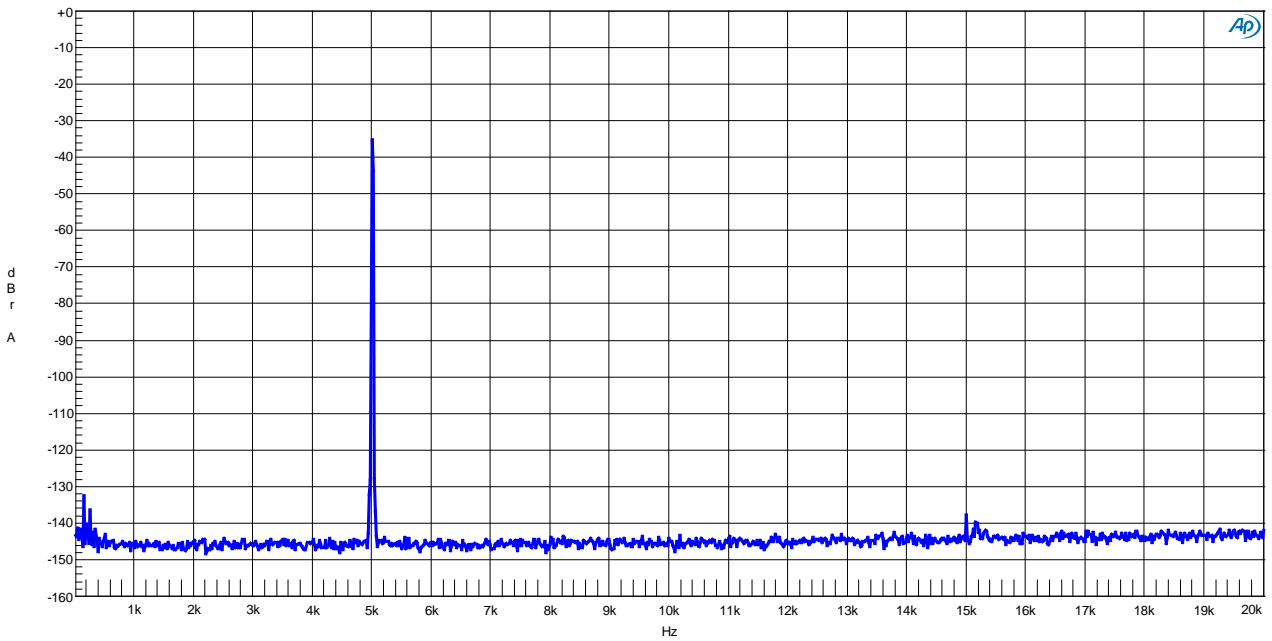


Figure 7: f = 5kHz. Po = 100mW, 4Ω

Intermodulation Distortion (CCIF & TIM)

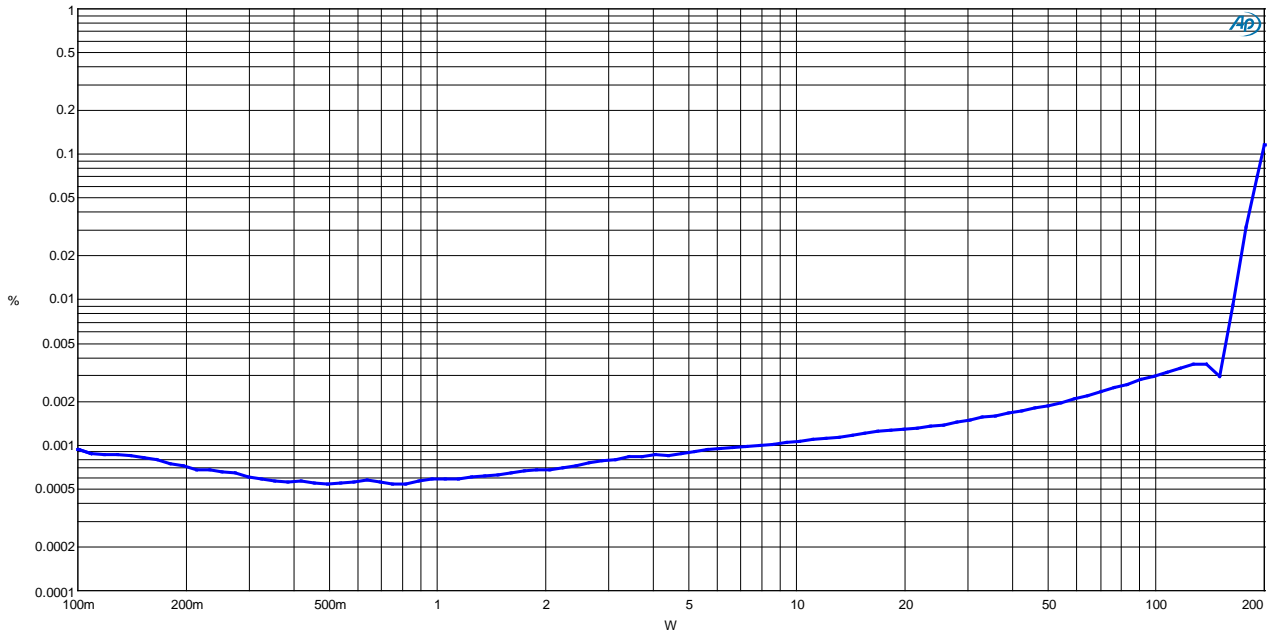


Figure 8: CCIF IMD vs. Output Power, $R_L = 4\Omega$, $f_1 = 18\text{kHz}$, $f_2 = 19\text{kHz}$, 1kHz

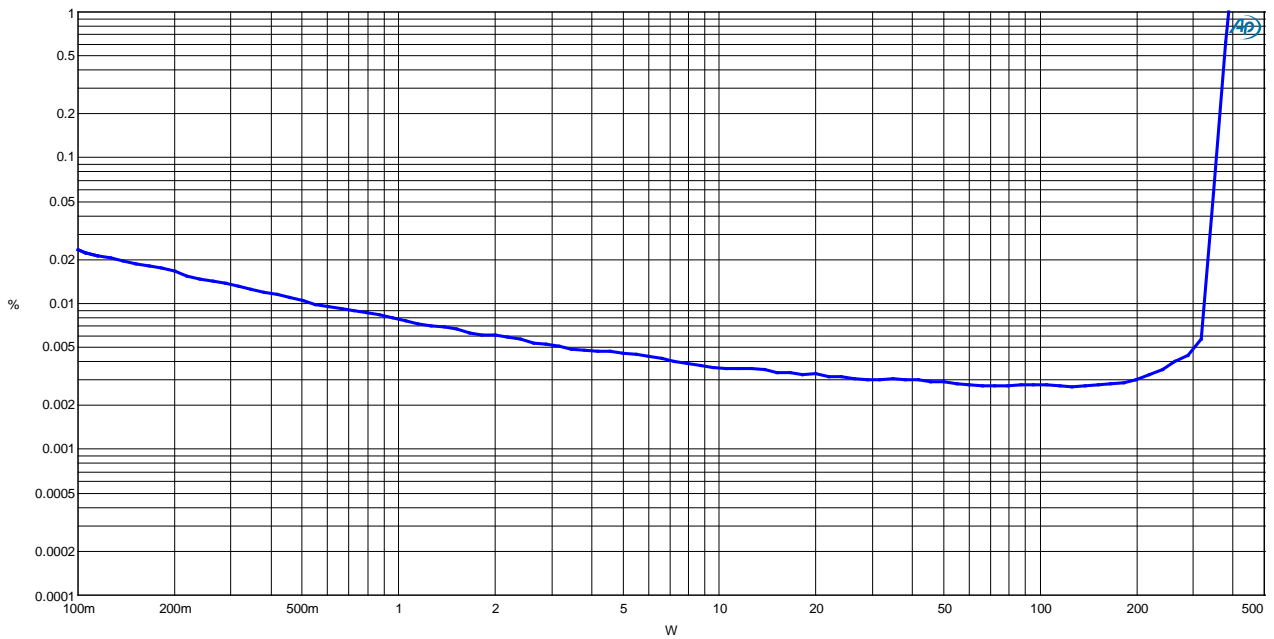


Figure 9: TIM vs. output power. $R_L = 4\Omega$

Output Impedance

The output impedance is measured using a delta load method where the difference in output amplitude at two different resistive loads is used to calculate the equivalent output impedance of the amplifier. The output impedance is measured directly at the terminals on the PCB.

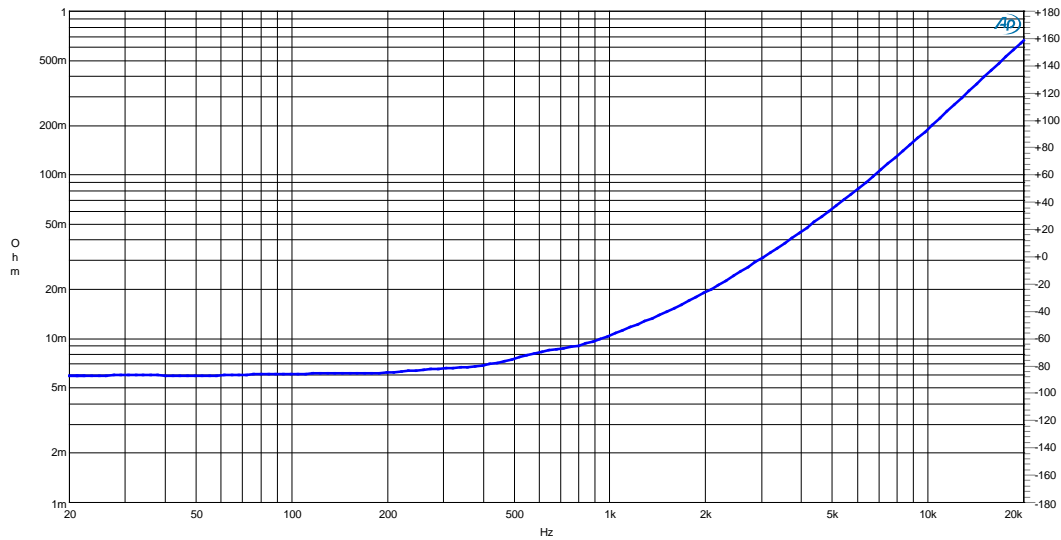


Figure 10: Output impedance at the output terminals

Damping Factor

The damping factor is calculated as the ratio between the output impedance of the amplifier and the load impedance.

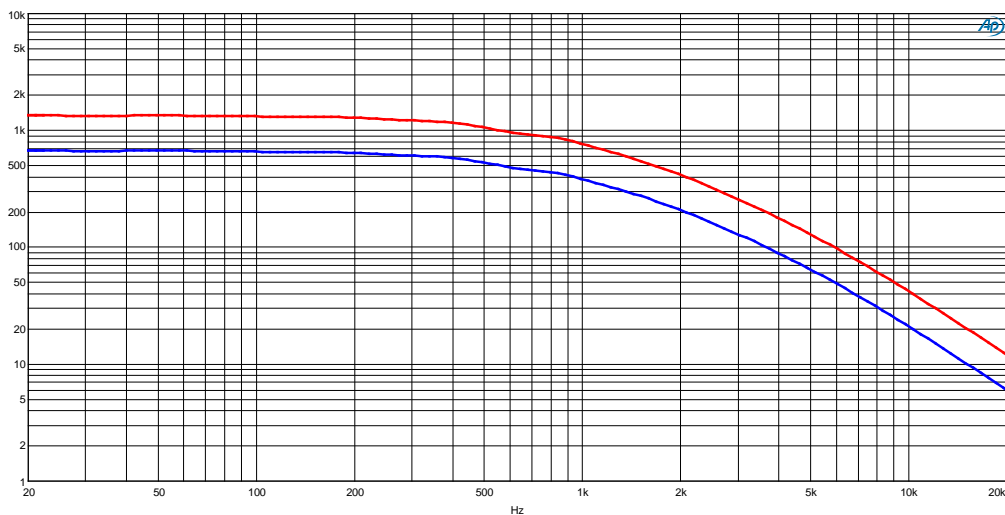


Figure 11: Damping factor vs. frequency 4Ω (blue) and 8Ω (red)

With its low output impedance, the ICEpower300A1 is designed to be unaffected by loudspeaker loading characteristics. However, care should be taken with purely capacitive loads.

The maximum purely capacitive load allowed is 220nF.

Power Efficiency

The total power efficiency from all DC supplies to amplifier output is given below.

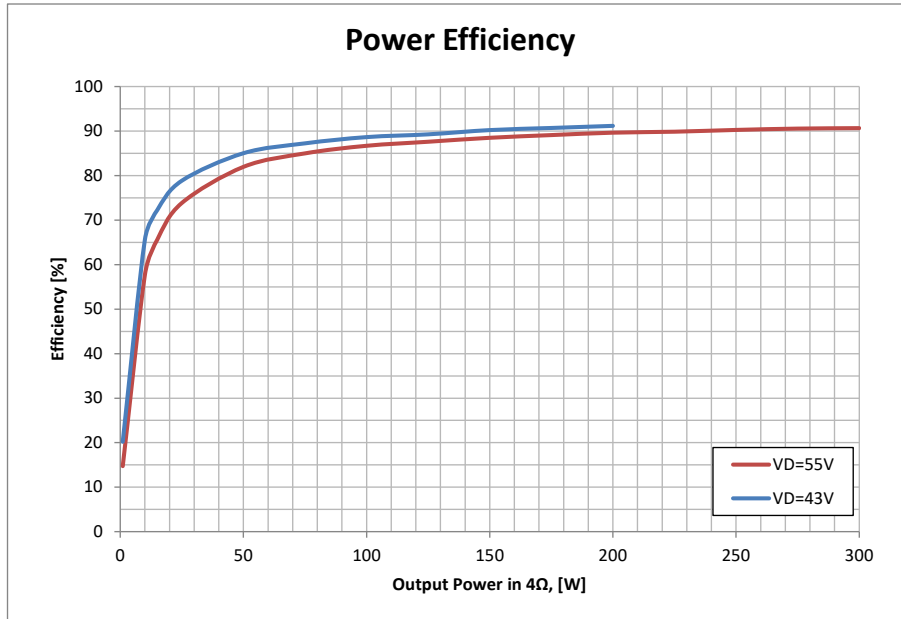


Figure 12: Efficiency vs. output power

Dissipated Power

The total dissipated power within the module from all DC supplies to amplifier output is given below.

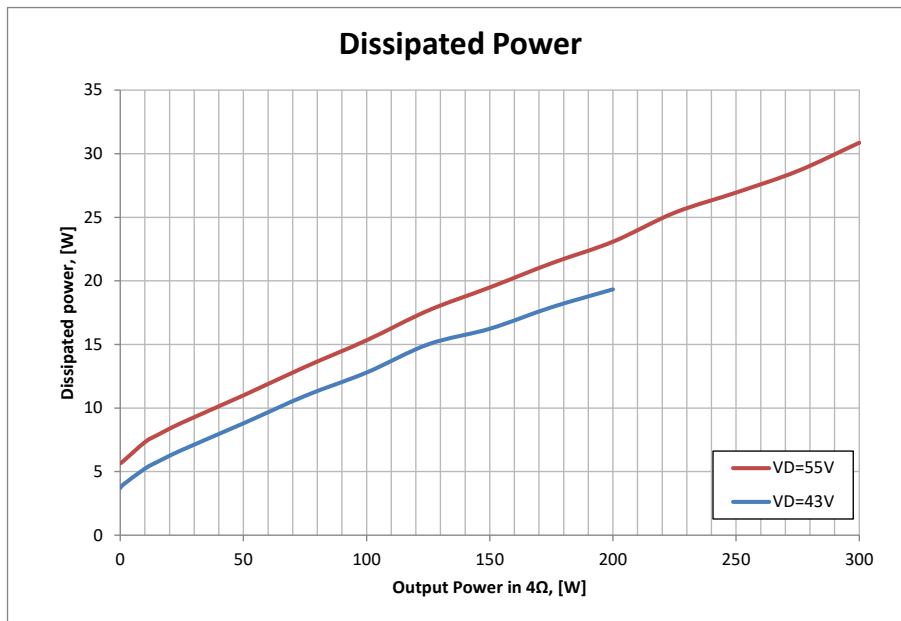


Figure 13: Dissipated power vs. output power

Input/Output Schematics and Features

Input Stage

The balanced input section provides signal buffering and anti-aliasing filtering. The balanced configuration helps to avoid hum and noise pick-up from poorly shielded cables. An unbalanced input can be obtained by applying a short between Signal In- and Signal GND. This does not affect the overall gain.

The input impedance is $R_i=47\text{kohm}$ at low frequencies and $|Z_i|>25\text{k}\Omega$ over the full audio band.

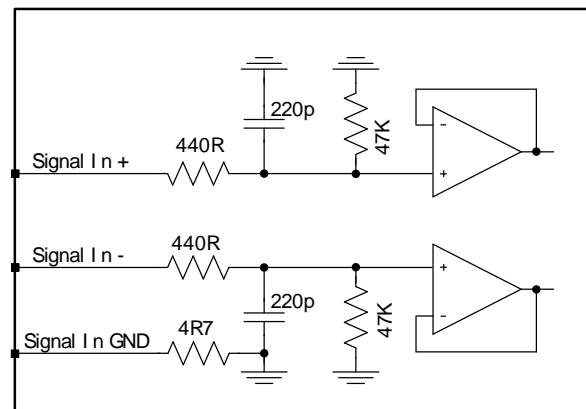


Figure 14: Balanced input buffer

Output Stage

The output stage is a full bridge topology with a 2nd order filter, thus the power output on the terminals Vo+ and Vo- is balanced. The filter design is a part of the proprietary MECC topology and has been chosen as a compromise between demodulation characteristics, efficiency and filter compactness.

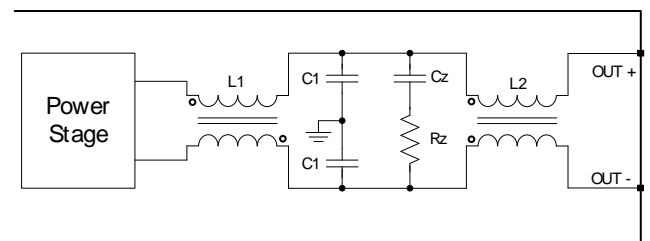


Figure 15: Output filter section with compensating Zobel network

Warning: The balanced speaker outputs are both "hot" with a common-mode DC level equal to $V_D/2$. Shorting one of the terminals to ground will cause high stress to the module and should be avoided. Balanced probes should always be used for monitoring and measurements.

VD (22-55V)

The high power DC input is looped through the module to allow daisy chaining. On-board EMI filtering ensures easy design-in of the 300A1 module.

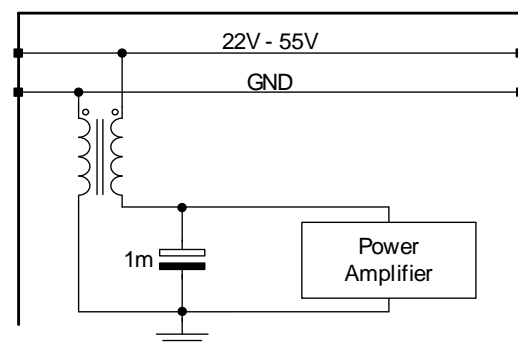


Figure 16: VD (22V-55V) input

±12V Auxiliary Input

The $\pm 12V$ inputs have on-board filtering to reduce EMI and provide low noise supplies for the signal circuitry.

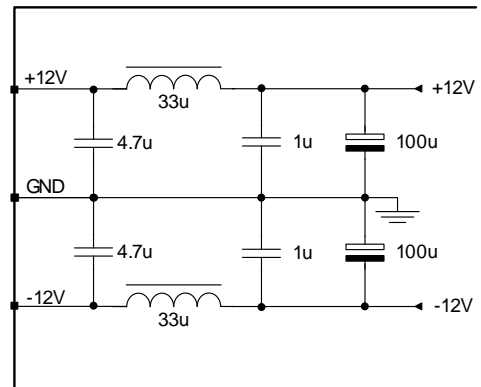


Figure 17: $\pm 12V$ Auxiliary input

Mute and Disable Control Signals

The mute and disable pin are active low and both have internal pull-up resistors. If the pins are left open, the 300A1 will power on and un-mute automatically.

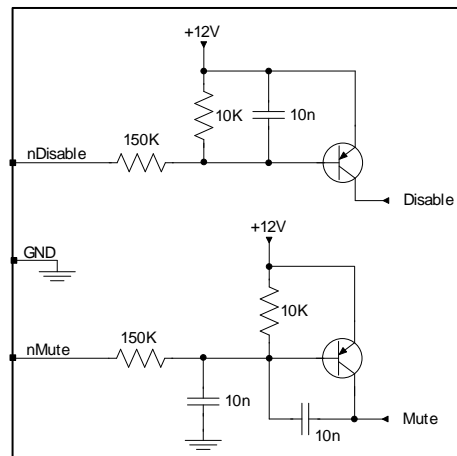


Figure 18: Mute and Disable input

DC Protect Status Signal

In the event that a differential DC voltage is present on the output terminals, the DC Protect output will go low. The internal pull-up resistor keeps the signal high during normal operation. This output is designed to drive the trigger inputs of e.g. the 300AS1 and thereby shut down the main power supply if there is a DC error on the 300A1 module.

When triggered the DCprotect signal will stay low until VD has been fully discharged and the module is powered up again.

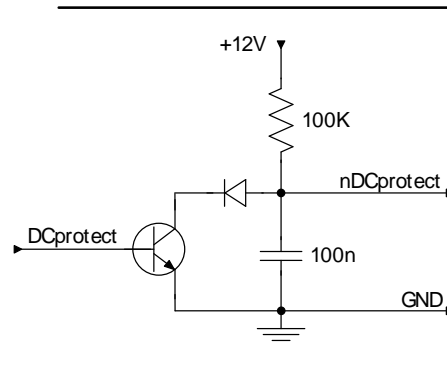


Figure 19: DC Protect output

Protection Features

The ICEpower300A1 is equipped with several protection features for surviving overload without damage.

The schematic below illustrates the different protection features.

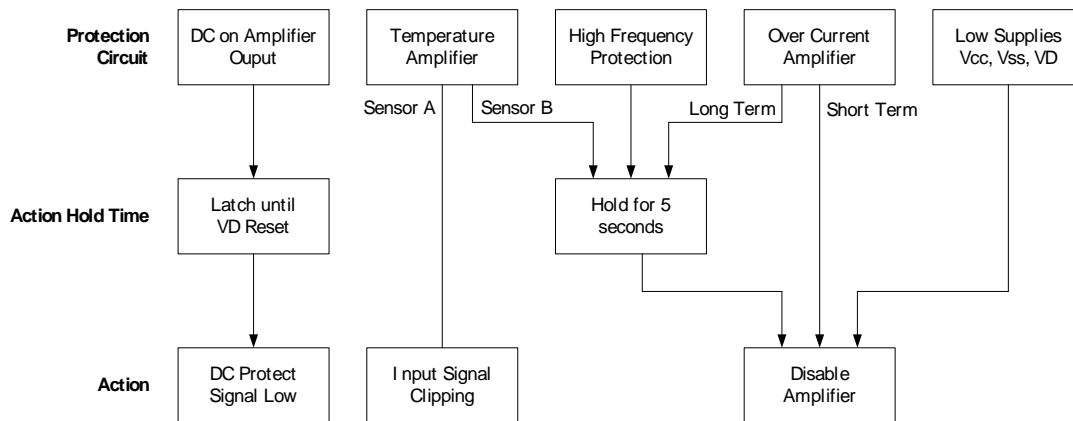


Figure 20: Block diagram of protection features

DC on Amplifier Output

The audio input itself is AC coupled and to further reduce DC offset on the amplifier output a DC servo acts to keep the DC voltage below $\pm 20\text{mV}$. However, if a differential DC voltage of more than 3V is present on the amplifier output, the DC protect signal will be driven low. This signal can be used externally to turn off a power supply such as the 300AS1.

Thermal Protection

The ICEpower300A1 is equipped with two thermal protection circuits to monitor the amplifier temperature. If the amplifier overheats, the first circuit acts by muting the input signal for a short duration and thereby reduce the overall output power. The second disables the amplifier switching completely for approximately 5 sec.

In both cases, the amplifier will return to normal operation automatically.

Thermal shut down is only expected to occur in case of abuse or under fault conditions.

High-Frequency Protection (Amplifier)

The amplifier has full power bandwidth from 20Hz to 20kHz. However, the output filter of the amplifier is not designed for long-term high frequency signals (>20kHz) with full amplitude. This is due to the power capabilities of the output Zobel-network. In such cases, the high-frequency protection circuit disables the amplifier for 5 seconds and then restarts.

Overcurrent Protection

This feature protects the amplifier in case the output current exceeds 20A. When the current reaches 20A, the amplifier power stage will be briefly disabled and then continue normal operation. This means that the amplifier will perform automatic current clipping.

If the output is shorted or is in continuous over current, the amplifier will shut down for 5 second before continuing operation.

Low Supplies (Vss, Vcc, VD)

Under voltage lockout is implemented to ensure that all supply voltages for the amplifier is within an acceptable range before the amplifier is enabled. If one of the low voltage supplies are below $\pm 10V$ or the VD supply drops below +18V, the amplifier is disabled.

Thermal Design

The ICEpower300A1 is a self-cooled module thus eliminating the need for special attention to thermal design.

If the average power exceeds 105W in 4Ω (typical) for a long period of time at 25°C ambient temperature, the module will reach its maximum allowable temperature and the temperature protection will be activated. At 50°C ambient temperature, more than 38W in 4Ω (typical) average power will activate the temperature protection.

To get optimal airflow and cooling of the module, vertical mounting is recommended.

Physical Dimensions

All dimensions are in mm.

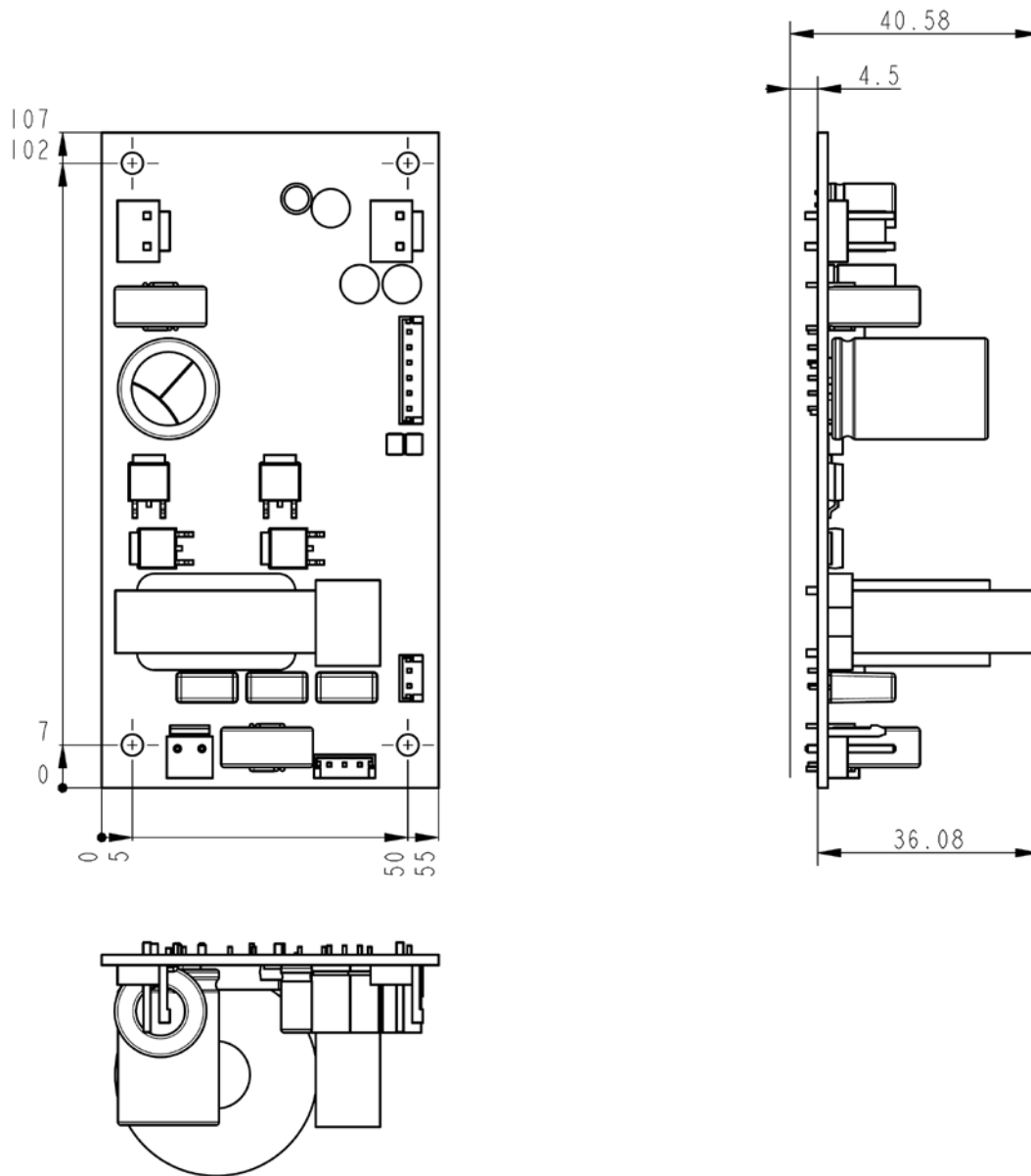


Figure 21: Physical dimensions in mm.

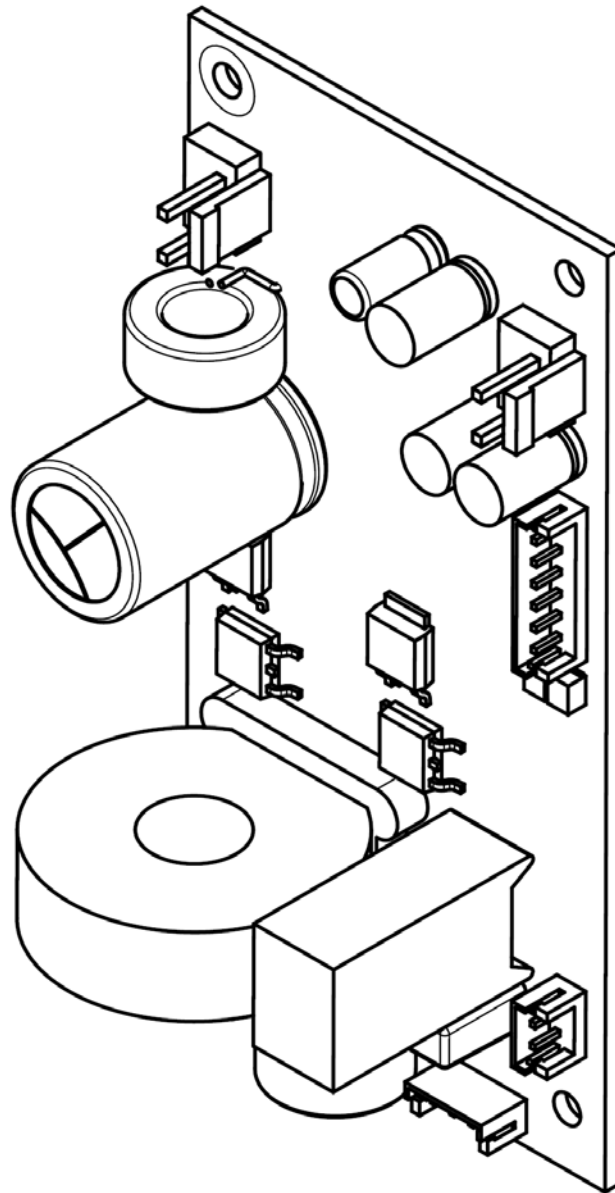


Figure 22: 3D view of the board.

Note: Always ensure sufficient clearance for insulation and to ensure adequate ventilation

Safety Standards

The ICEpower300A1 has been pre-approved for safety by UL to ease the design-in procedure and complies with the following standards:

Europe: IEC60065 7th ed.

US: UL60065 7^h ed.

CA: CSA-C22.2 No. 60065-3

Safety class: Class 2 (without earth)

EMI Standards

EMI Conforms to:

EN55013

EN55020

EN61000-3-2

EN61000-3-3

CISPR 13

CISPR 20

IEC 61000-3-2

IEC 61000-3-3

FCC part 15-B

ESD Warning

ICEpower products are manufactured according to the following ESD precautions:

- ANSI/ESD-S20.20-2007: Protection of Electrical and Electronic Parts, Assemblies and Equipment.

Further handling of the products should comply with the same standard.

The general warranty policy of ICEpower a/s does not cover ESD damaged products due to improper handling.

Packaging and Storing

Package	Dimensions (w x d x h)	Gross Weight
Carton (30 modules)	29 x 39 x 15 cm	3.8 kg
Pallet (12 cartons)	Tbd	Appr. 67.6 kg

Table 16: Package dimensions and weight

ESD safe cardboard is used for wrapping.

Storage humidity

Do not expose the pallets to rain or humidity levels higher than 85%.

Storage temperature

The pallets are to be stored at temperatures from 0°C to 70°C.

Stacking

Pallets may not be stacked on top of each other.

Further Information

For additional information about the ICEpower® technology from ICEpower a/s, please visit our web site or contact us.

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