ETS

CLASS D AUDIO AMPLIFIER
EVALUATION BOARD MODULE

SDV1042-300: 300W RMS, CLASS D,

AUDIO AMPLIFIER EVALUATION BOARD

FEATURES

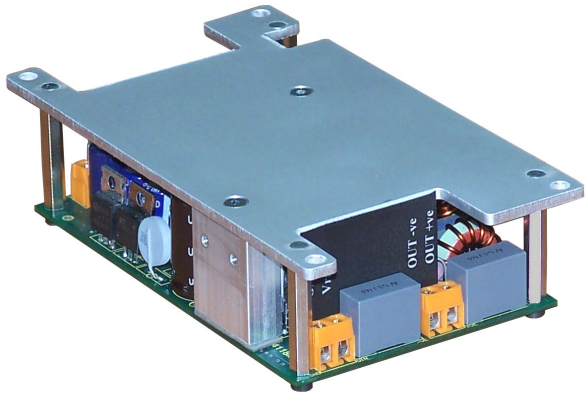
- **HIGH POWER: up to 300W RMS[1]**
- **HIGH EFFICIENCY >90%**
- **HIGH SWITCHING FREQUENCY: 330KHz.**
- **LOW DISTORTION: c. 0.5% THD OPEN LOOP[3]**
- **SIMPLE POWER SUPPLY REQUIREMENT[2]**
- **FULL SHORT-CIRCUIT PROTECTION**
- **THERMAL PROTECTION**
- **START-UP, SHUTDOWN SYCHRONISATION**
- **ONBOARD TEMPERATURE MONITOR**
- **FAN CIRCUTIRY INCLUDED**
- **DRIVES 16Ω, 8Ω, 4Ω and 2ΩSPEAKERS[5]**
- **COMPACT**
- **LOW COST**
- **LIGHTWEIGHT**
- **ALTERNATIVE CONFIGURATIONS AVAIALBLE[4]**
- **CUSTOM DESIGNS AVAILABLE**

NOTES

1) **Other power options include 600W and 150W. Alternately, custom power levels can be produced.**
2) **Companion switch-mode PSU unit available**
3) **Assumes minimisation of external noise coupling and measured in audio band only.**
4) **Contact EcoTec Systems Ltd Ltd. for more details of these options**
5) **Requires modification to standard layout for 2Ω operation.**

APPLICATIONS

- **AUDIO POWER AMPLIFIER**
- **ACTIVE SPEAKER SYSTEMS**
- **ACTIVE SONAR SYSTEMS**
- **NOISE CANCELLATION SYSTEMS**
- **MOTOR / MAGNET DRIVE MODULES**
- **POWER CONVERSION**
- **UPS - SINE WAVE INVERTER**



DESCRIPTION

The SDV1042-300 is a class D amplifier evaluation board, which contains the SDV1025-300 class D amplifier module. The board contains an input pre-amplifier, a sophisticated output filter; full short-circuit protection and turn-on/off synchronisation to prevent inadvertent outputs at start-up/shutdown. This interface board is designed to give a simple, user friendly introduction to the SDV1025-300 class D amplifier module. Apart from the interface PCB only a suitable power supply with a single positive output is required to complete a single channel amplifier design. The interface PCB is shown above. Details of the various interface board functions are described below.

Please contact EcoTec Systems Ltd. for a confidential discussion of your requirements and further application information.

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SPECIFICATIONS

Absolute maximum ratings

Rail voltage, V_{RS} …….…..... 60 V
Operating free air temperature, T_A …...…… -10°C to 40°C
Storage temperature range, T_{stg} …….. -40°C to 70°C

Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated "recommended operating conditions" is not implied.

Recommended operating conditions

	MIN	TYP	MAX	UNIT
RAIL VOLTAGE, V_{RS}	0	55	60	V
MODULATION FACTOR	0	0.95	1	
OPERATING FREE AIR TEMPERATURE, T_A	10		40	°C

Electrical characteristics at a free air temperature of 25°C

	PARAMETER	NOTES/TEST CONDITIONS	VALUE V_{RS} = 55 V MIN	VALUE V_{RS} = 55 V TYP	VALUE V_{RS} = 55 V MAX	UNIT
R_{IN}	AUDIO INPUT IMPEDANCE (Other input options available)		1			MΩ
I_{RS}	POWER RAIL CURRENT	R_L = 4Ω		6		Arms
P_{RR}	ALLOWABLE POWER RAIL RIPPLE	SEPARATE POWER SUPPLY MODULE AVAILABLE		2		%
r_O	OUTPUT RESISTANCE	R_L = 4Ω			100	mΩ
SNR	SIGNAL TO NOISE RATIO	R_L = 4Ω (in audio band)		-90		dB
f_{SW}	SWITCHING FREQUENCY			330		KHz
t_{PD}	PROPAGATION DELAY (POWER OUTPUT STAGE)	R_L = 4Ω		100		ns

OUTPUT POWER

When discussing the output power of a class D power amplifier an important distinction must be made between the power levels when the amplifier is run into clip or if the output is to be operated clean (un-distorted). The SDV1042-300 with a 55V supply rail will give 250Wrms clean into a 4 load. To achieve 300Wrms output the output level will just clip (flattening of the top of a sine wave signal).

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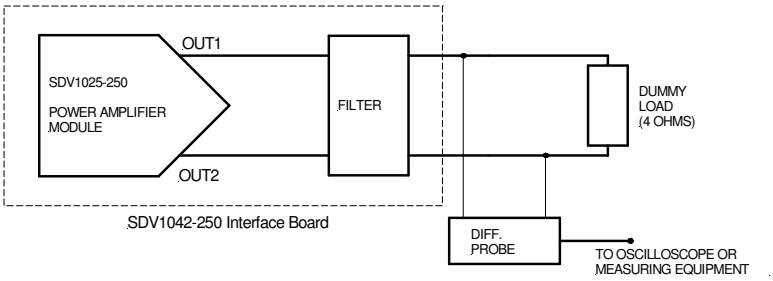
The output power from the SDV1042-300 evaluation board must be measured differentially across both of the amplifier outputs (see layout and connection details later). Failure to measure differentially will produce erroneous power level readings. A typical measurement scenario is shown opposite.



Best results are achieved using a battery powered differential probe, which can then be connected directly to an oscilloscope. A single ended probe connected to one output and the earth lead connected to the other output will trigger the protection circuitry of the unit which will shutdown the amplifier operation. Connecting a probe to one output and the earth lead to the amplifier ground will give erroneous readings, such that the measured power will be 25% of the actual power. The load shown in the measurements is a resistive 4-Ohm load rated at the power level for the amplifier.

The output power from the amplifier to the load is determined by three parameters. These are:

1. The input signal level with respect to the maximum input level (*Modulation factor*)
2. The *Inherent efficiency* of the amplifier module.
3. The attenuation of the audio signal by the output filter (*Filter attenuation*).

The measured output power (Wrms) can be expressed as:

$$P_{out} = \frac{(V_p)^2}{2R_{load}}$$

Where V_p is the peak output voltage

R_{load} is the output load

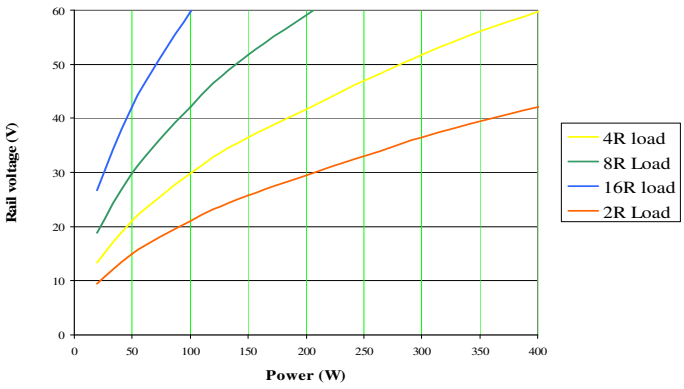
This can be compared with the theoretical maximum output power (Wrms), where:

$$P_{out\max} = \frac{MF * V_{rail}{}^2}{2 * R_{load}}$$

Where V_{rail} is the main rail voltage

MF is the modulation factor

For a modulation factor of 0.9, the power into various loads is shown below:



At low frequencies the filter attenuation should be minimal and hence, the inherent efficiency (%) can be determined from:

$$Eff = \frac{P_{out} * 100}{P_{out\max}}$$

For the amplifier module inherent efficiencies

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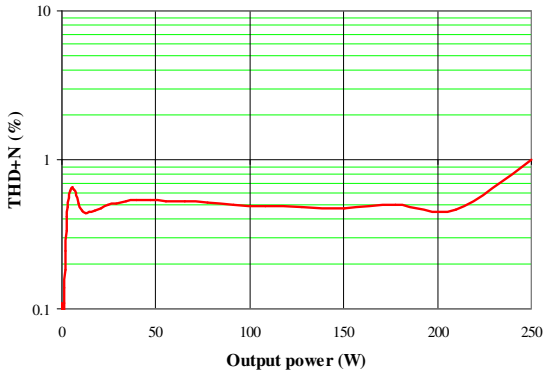
greater than 90% are possible. If the inherent efficiency measured is less than this value it is normally due to power supply droop.

The distortion present on the output signal varies with the output power level. A plot of distortion versus output power is shown opposite. At low power levels the distortion is due to noise in particular the residual noise from the amplifier filter. At higher output levels close to 250Wrms the distortion increases and approaches 1%. In the critical mid power range from 50W to 220W the distortion is about 0.5%.



THERMAL EFFICIENCY

The SDV1042-300 evaluation board is designed to be a compact power module for audio applications. Using a fan mounted onto the amplifier module heatsink it will run continuously at full power for a brief period of time typically 1- 2 minutes. If longer periods of operation at full power are required then alternative heatsinking methods must be used. EcoTec Systems Ltd has alternative heatsinking designs for operation at full power for in excess of 10 minutes. If you wish to explore these alternatives, please contact EcoTec Systems Ltd for a confidential discussion of your application.

INPUT CHARACTERISTICS

The input impedance of the standard amplifier module is in excess of 1MΩ. The input pre-amplifier is a differential configuration, although it can also directly accept single ended input signals. The basic unit ships without variable gain control. This feature can be added to the unit by connecting a variable resistor to the input stage. Provision has been made on the PCB layout for direct connection of a gain potentiometer if required. For discussion of other input circuitry options, please contact EcoTec Systems Ltd.

POWER SUPPLIES

The SDV1042-300 evaluation board requires a suitable power supply for correct operation. The evaluation board generates all of the necessary control voltage supplies from the main power supply. In addition, the evaluation board circuitry controls the sequencing of these supplies at turn-on and turn-off to avoid inadvertent signals from the amplifier; which would be manifested as clicks and other undesirable noises in any speaker connected to the amplifier. When using the evaluation board the user only needs to supply a single positive power supply, which can be in the range 35 to 55VDC.

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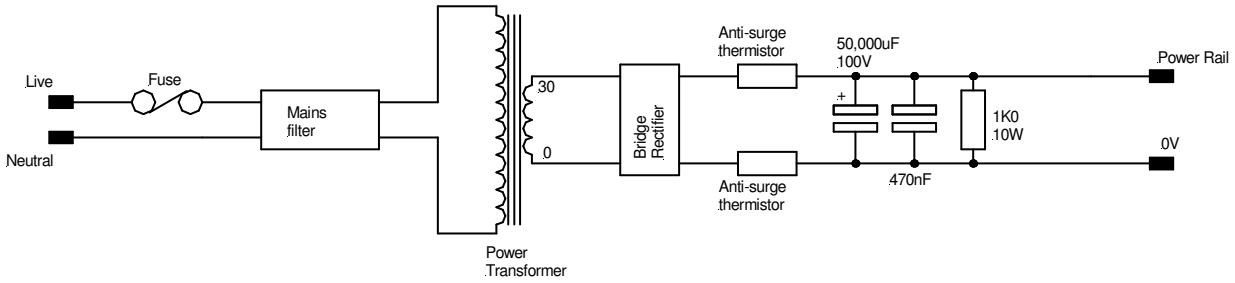
For maximum power use the higher voltage supply setting. For testing purposes the simplest approach is to build a simple linear power supply. A block diagram of a simple linear power supply is shown below.



For details of semi-regulated linear supplies, battery or switch-mode power supply operation of the interface board please contact EcoTec Systems Ltd Ltd.

MECHANICAL DETAILS

The evaluation board module has been designed such that the user can rapidly connect up the unit and begin an evaluation. The connector connections are described below (see layout overleaf):

Pin	Identifier	Function	Remarks
J1			
1	+5V	Aux power supply output	20mA max. capacity
2	-5V	Auxiliary power supply output	5mA max. capacity
J2			
1	IN-	Audio input low side	For single ended input connect to GND
2	IN+	Audio input high side	For single ended input connect to signal
3	GND	Audio GND	
4	FAN+	Fan connection	Connect to additional (if used) fan + connection
5	FAN-	Fan connection	Connect to additional (if used) fan - connection
6	GND	Fan supply GND	GND connection for option fan supply
7	+12V	Fan supply	Power supply input for option fan
8	SD	Shutdown	Shutdown power amplifier
9	PROTECT	Protect indicator	Protect circuitry output
J3			
1	GND	Power supply ground	POWER GND
2	VIN	Power supply main rail	+35VDV to +55VDC
J4			
1	OUT1	Power output 1	To load / Speaker
2	OUT2	Power output 2	To load / Speaker

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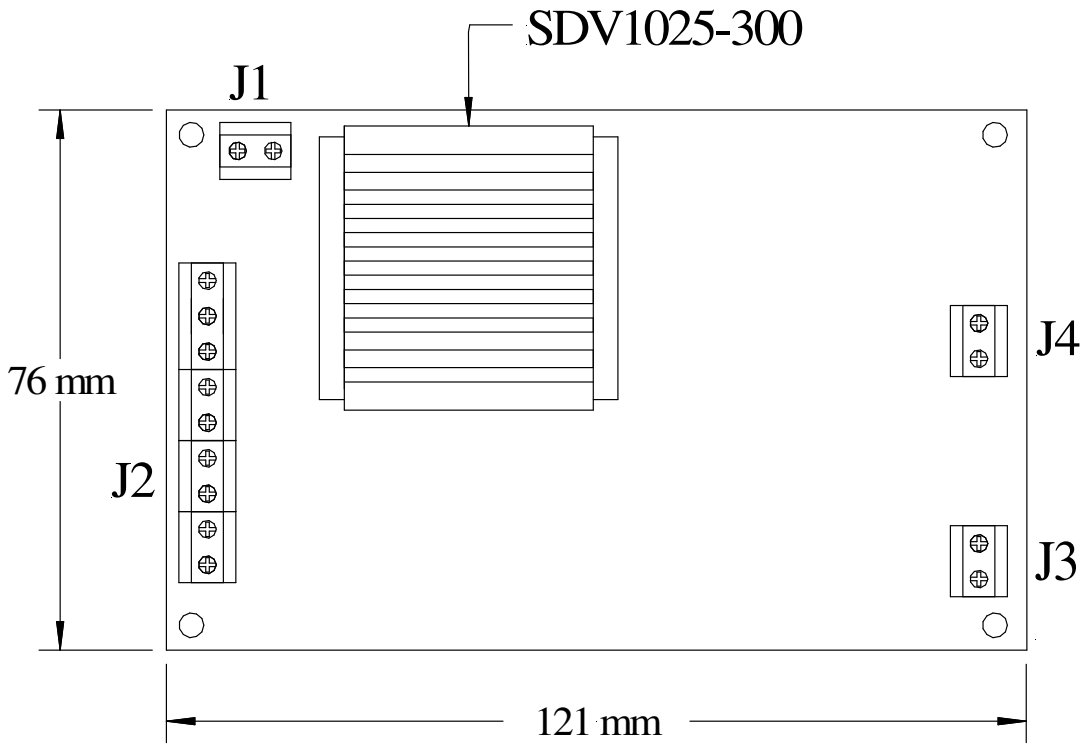
EVALUATION BOARD LAYOUT

The connector locations on the evaluation board are shown below.
Note top plate removed for clarity.



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GLOSSARY

Active speaker	Integrated loudspeaker and amplifier.
Audio passband	Audio spectrum from 20Hz to 20KHz.
Anti-clip	Circuit to correct for excessive input signals.
Class D	Amplifier using pulse width modulated output stage.
Decibel	Measure of relative power dB = 10logP1/P2
EMC	Electro magnetic compatibility
ESR	Equivalent series resistance
Filter attenuation	Performance of a filter at a specific frequency or band of frequencies.
Harmonic	Higher multiple of a frequency
(K)Hz	(Kilo) Hertz, frequency measure
Inherent efficiency	Measure of the efficiency of the amplifier module alone.
Input impedance	Impedance looking into the amplifier.
Latency	Description of the dynamic range of music
Modulation Factor	Ratio of input signal amplitude to maximum permissible signal amplitude.
Noise floor	Residual noise level of the amplifier expressed in dB.
Output impedance	Source impedance seen looking into the amplifier output.
PCB	Printed circuit board
PFC	Power factor corrected
p-p	Peak to peak measurement
PSU	Power supply unit
PWM	Pulse width modulation
Quiescent current	Current consumed by amplifier with no audio signal input.
Rms	Root mean square = Vp-p/(2√2)
Slave module	Additional power output stage driven from an optional master unit.
SNR	Signal to noise ratio
Switching frequency	Sample frequency of PWM.
THD	Total harmonic distortion - measure of the accuracy with which an amplifier replicates an input sine wave.
Theoretical output power	Maximum output power of amplifier module, alone assuming 100% efficiency.
Thermal resistance	Measure of heatsink efficiency
Total coupled power	Actual power coupled from amplifier to load (loudspeaker)
UPS	Uninterruptable power supply

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