CLASS D AUDIO AMPLIFIER MODULE

SDV1025-300: 300W RMS, CLASS D, AUDIO AMPLIFIER MODULE

FEATURES

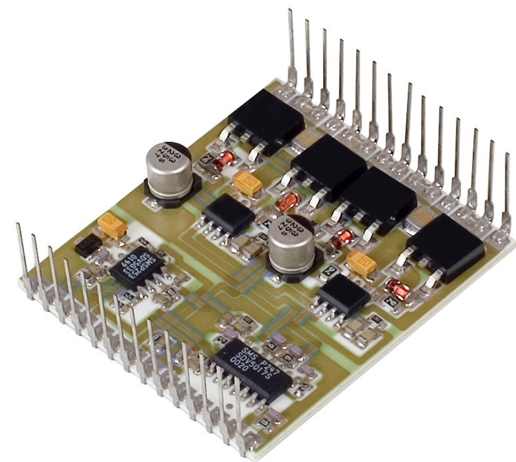
- HIGH POWER: 300W RMS[1]
- HIGH EFFICIENCY >90%
- HIGH SWITCHING FREQUENCY: 330KHz.
- LOW DISTORTION: c. 0.5% THD OPEN LOOP
- SIMPLE POWER SUPPLY REQUIREMENT[2]
- THERMALLY EFFICIENT PACKAGE:
- LOW NOISE: NOISE FLOOR typ. 90dB DOWN[3]
- ONBOARD TEMPERATURE MONITOR
- DRIVES 16Ω, 8Ω AND 4Ω SPEAKERS
- OTHER POWER OPTIONS AVAILABLE[1]
- LOW COST
- LIGHTWEIGHT
- CUSTOM AMPLIFIER 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. for more details of these options
5) 8Ω and 2Ω speaker variant available

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 SDV1025-300 is a complete audio power amplifier module. The module contains power transistors, drive electronics, and control circuitry. Only a power supply, decoupling capacitors and output filter must be added to produce a stand-alone audio amplifier. Modules can be combined together and operated from a suitable power supply to produce a stereo amplifier. The module is optimised to drive a 4Ω load (16Ω, 8Ω and 2Ω optimised versions are available).

The unit is available in the module format or mounted onto an interface PCB which includes the circuitry to derive the control voltages, the output filter, turn-on/turn-off controls and short-circuit protection.

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

SPECIFICATIONS

Absolute maximum ratings

Rail voltage, V_{RS} …………………………………………………………………...….... 60 V
Control voltage $+V_L$ ……………………………………………………………………… +5.5 V
Control voltage $-V_L$ ……………………………………………………………………… -5.5 V
Operating free air temperature, T_A …...…………………………………………… -10°C to 40°C
Storage temperature range, T_{stg} ………………………………………………….. -40°C to 70°C
PCB solder pad temperature for 30 secs ……..…………………………………………….. 260°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
POWER SUPPLY VOLTAGE, $+V_L$	4.75	5	5.25	V
POWER SUPPLY VOLTAGE, $-V_L$	-4.75	-5	--5.25	V
POWER SUPPLY VOLTAGE, Vdrv	10	12	18	V
AUDIO INPUT, S_2	0		± 3	Vp-p
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	TYP	MAX	UNIT
R_{IN}	AUDIO INPUT IMPEDANCE (Other input options available)			10K		KΩ
I_{L+}	POWER SUPPLY CURRENT $+V_L$	$R_L = 4\Omega$		10	15	mA
I_{L-}	POWER SUPPLY CURRENT $-V_L$	$R_l = 4\Omega$		5	10	mA
I_{drv}	POWER SUPPLY CURRENT V_{drv}			20	30	mA
I_{RS}	POWER RAIL CURRENT	$R_L = 4\Omega$		6		Arms
P_{RR}	ALLOWABLE POWER RAIL RIPPLE	SEPARATE POWER SUPPLY MODULE AVAILABLE		2		%
r_O	OUTPUT RESISTANCE	$R_L = 4\Omega$			100	mΩ
SNR	SIGNAL TO NOISE RATIO	$R_L = 4\Omega$ (in audio band)		-90		dB
f_{SW}	SWITCHING FREQUENCY			330		KHz
t_{PD}	PROPAGATION DELAY (POWER OUTPUT STAGE)	$R_L = 4\Omega$		100		ns

OUTPUT POWER and DISTORTION

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

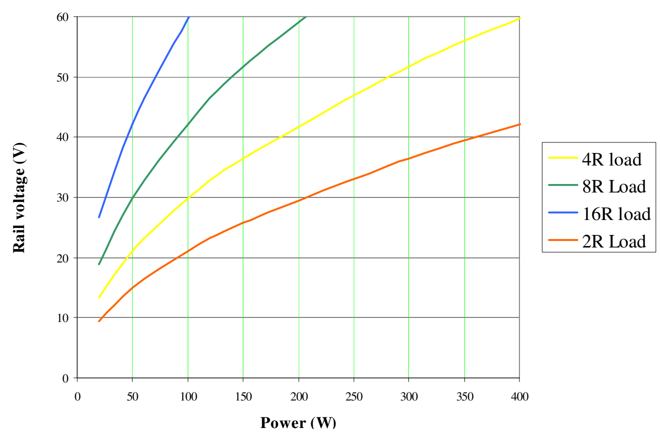
This can be compared with the theoretical maximum output power (Wrms), where:

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

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 are shown opposite:

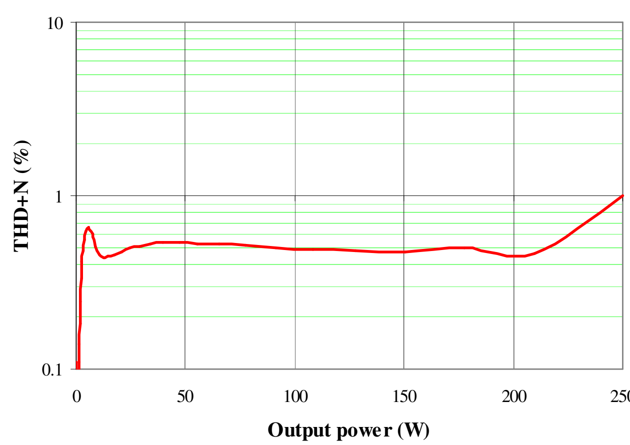


At low frequencies the filter attenuation should be minimal and hence, the inherent efficiency (%) can be determined from:

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

For the amplifier module inherent efficiencies 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 SDV1025-300 amplifier module is manufactured on a thermally conducting substrate. If the unit is to be run continuously i.e. sine wave input then additional heatsinking or forced air cooling will be required. The thermal resistance of the amplifier package in free air is 6°C/W (θ_a). The contact thermal resistance of the amplifier can be assumed to be 0.5°C/W (θ_c).

To decide whether additional heatsinking is required the power level and duty cycle of the music must be estimated. The power level should be determined from the maximum power the unit is asked to produce and is determined by the rail voltage (see above chart of rail voltage versus power into a 4Ω load). Assuming an *inherent efficiency* of 95% means that 5% of the rated power will be dissipated inside the amplifier module. For example, a maximum *theoretical output power* of 300W, 15W will be dissipated inside the amplifier unit. This assumes a continuous sine wave input at full *modulation factor*, somewhat unrealistic for audio signals with their associated *latency*. The actual power levels with audio signals would typically be 30% of the calculated value. If this figure is used then the power dissipation inside the module would be less than 4W.

Once the typical power dissipated inside the module is known the temperature rise using the module at this power can be calculated. The temperature rise is given by:

Temperature rise = θ_a * power dissipation (°C)

With the example above, the temperature rise would be 24°C above ambient temperature. The operational temperature of the module should not exceed 60°C. If the calculated temperature rise and the maximum ambient temperature for operation will exceed this figure, then additional heatsinking will be required. If heatsinking is required then the module can be mounted onto an additional heatsink. If the thermal resistance of the new heatsink is θ_h, then:

Temperature rise = (θ_c + θ_h) * power dissipation (°C)

If a heatsink with a thermal resistance of 3°C/W is selected, then in the above example the temperature rise above ambient would be 13°C.

INPUT CHARACTERISTICS

The input impedance of the standard amplifier module is 10KΩ. This value was chosen to provide the best balance between ensuring sufficient impedance to the audio source and minimising the affects of external interference. The amplifier input is single ended referenced to ground. The bandwidth of the input amplifier is 150KHz (3dB). This wide bandwidth is designed to afford maximum flexibility to the user. For purely audio applications, an input filter can be incorporated prior to the amplifier module. This additional circuitry can be incorporated as an option inside the amplifier package although for most applications the input filtering and conditioning is done most cost effectively external to the amplifier. For further discussions of these options, please contact EcoTec Systems Ltd.

MECHANICAL DETAILS

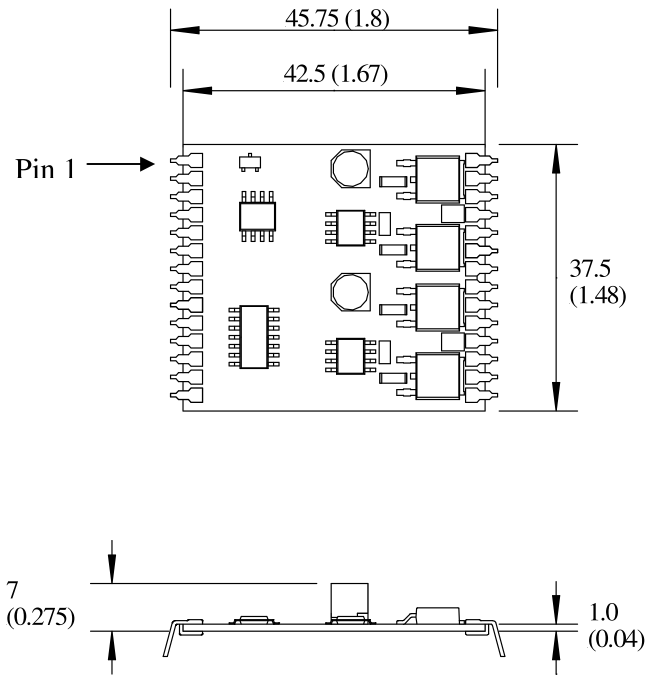
Connections

The amplifier module has been designed such that the module can mount down dirtectly onto a PCB motherboard with associated interface circuitry. The connector connections are (from upper left hand sign with power stage on right hand side) :

Pin	Identifier	Function	Remarks
1	GND	Signal ground	Connect to motherboard ground plane
2	V_{L-}	Negative supply	-5.25V to -4.75V
3	V_{L-}	Negative supply	-5.25V to -4.75V
4	V_{L-}	Negative supply	-5.25V to -4.75V
5	V_L+	Positive supply	+5.25V to 4.75V
6	V_L+	Positive supply	+5.25V to 4.75V
7	V_L+	Positive supply	+5.25V to 4.75V
8	GND	Signal ground	Connect to motherboard ground plane
9	Temp	Temp monitor	+2.5V to 0V
10	Temp	Temp monitor	+2.5V to 0V
11	Temp	Temp monitor	+2.5V to 0V
12	S1	Audio Input	$\pm$3Vfor full modulation
13	S1	Audio Input	$\pm$3Vfor full modulation
14	GND	Signal ground	Connect to motherboard ground plane
15	GND	Signal ground	Connect to motherboard ground plane
16	OUT2	Power output 2	To filter
17	OUT2	Power output 2	To filter
18	GND	Signal ground	Connect to motherboard ground plane
19	V_{RS}	Rail voltage	+1V to +55VDC
20	V_{RS}	Rail voltage	+1V to +55VDC
21	GND	Signal ground	Connect to motherboard ground plane
22	GND	Signal ground	Connect to motherboard ground plane
23	OUT1	Power output 1	To filter
24	OUT1	Power output 1	To filter
25	GND	Signal ground	Connect to motherboard ground plane
26	V_{RS}	Rail voltage	+1V to +55VDC
27	V_{RS}	Rail voltage	+1V to +55VDC
28	V_{drv}	Drive voltage	+12 to +15V

In addition to the above, it is recommended that a 1000µF, 63VDC electrolytic and a low ESR 0.47µF capacitor are connected across the ground and rail voltage terminations as close as possible to the terminations or connector.

Package dimensions
Dimensions in mm (in)



OPTIONS

Various options to the basic amplifier module are available. For a discussion of available options please contact EcoTec Systems Ltd. Custom requirements are subject to a minimum order quantity.

Switch-mode, universal input, PFC, PSU module

A companion switch mode power supply with a PFC pre-regulator is available. This option is a universal input 90 to 264Vac, 50/60Hz, power factor corrected pre-regulator, providing the rail voltage for the amplifier module. Using simple regulators the control voltages can be derived from the main rail voltage.

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 = $V_{p-p}/(2\sqrt{2})$
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