Dual Channel Filterless 2*10w Audio Amplifier

General Description

The LPA2102 is a dual channel 2*10W audio amplifier. It is capable of delivering 10W of continuous average power to dual 4Ω BTL load with less than 10% distortion (THD) with a 9V DC power supply. It offers low THD+N, allowing it to achieve high-quality Power Supply sound reproduction. The LPA2102 device is fully protected against faults with short-circuit protection and thermal protection. Faults are reported back to the processor to prevent devices form being damaged during overload conditions.

Order Information

LPA2102 □□ □

- F: Pb-Free
- Package Type SP: ESOP-16

Applications

- ✧ Mini-Micro Component, Speaker Bar, Docks
- ✧ After-Market Automotive
- ✧ Consumer Audio Applications, CRT TV
- ✧ Portable Bluetooth Speaker
- ✧ Square Speaker

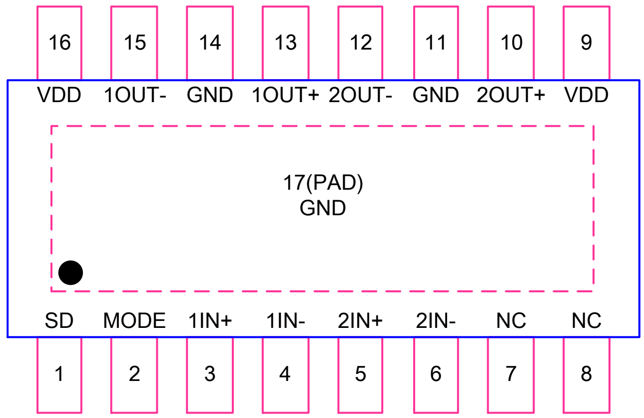
Features

- ◆ Wide voltage range: 4.3V~15.5V
- ◆ 550KHz fixed frequency switching for amplifier
- ◆ 2*10W Output at 10% THD with a 4Ω Load and 9V VDD for amplifier
- ◆ 2*10W Output at 1% THD with a 4Ω Load and 10V VDD for amplifier
- ◆ Integrated Self-Protection Circuits Including Under-Voltage, Over-Temperature, and Short Circuit
- ◆ High Efficient Class-D Operation: >86%
- ◆ Filterless, Low Quiescent Current and Low EMI
- ◆ Pb-Free Package

Marking Information

Device	Marking	Package	Shipping
LPA2102SPF	LPS LPA2102 YWX	ESOP-16	2.5K/REEL 50/Tube
Marking indication: Y:Production year W:Production week X: Series Number			

Functional Pin Description

<table>
<tr><th>Package Type</th><th>Pin Configurations</th></tr>
<tr><td>ESOP-16</td><td>

ESOP-16
(Top View)</td></tr>
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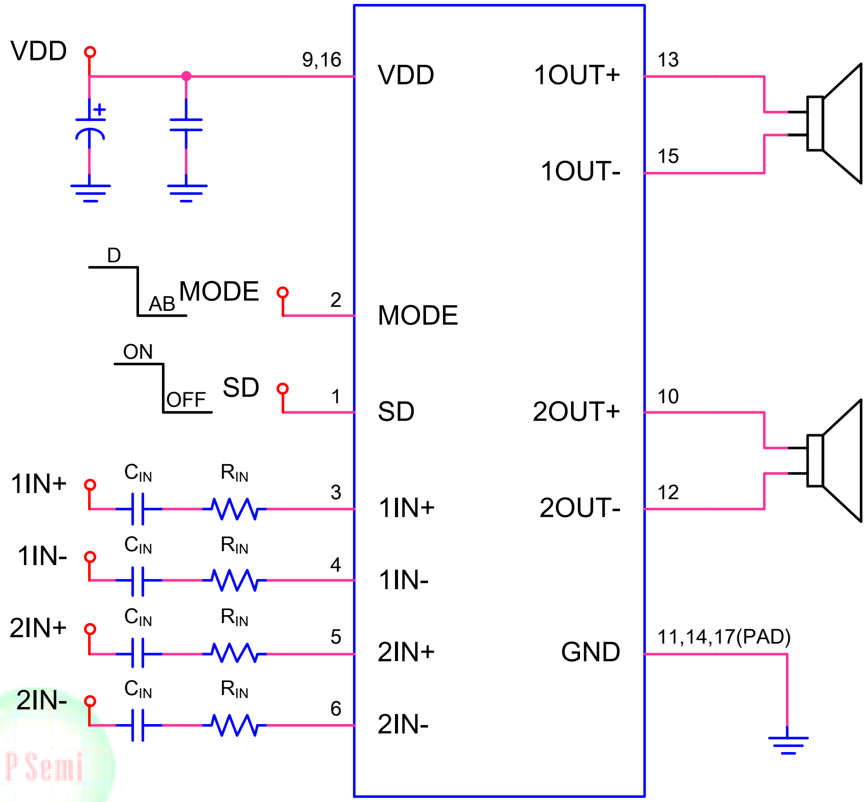
Pin Description

Pin No.	Name	Description
1	SD	Shutdown control. Shutdown: <0.5V
2	MODE	Class AB/D control. Class AB: <1.5V. Class D: >1.6V
3	1IN+	Positive input of amplifier channel 1.
4	1IN-	Negative input of amplifier channel 1.
5	2IN+	Positive input of amplifier channel 2.
6	2IN-	Negative input of amplifier channel 2.
7,8	NC	No Connection.
9,16	VDD	Voltage supply pin.
10	2OUT+	Positive output of signal channel 2.
11,14,17	GND	Ground.
12	2OUT-	Negative output of signal channel 2.
13	1OUT+	Positive output of signal channel 1.
15	1OUT-	Negative output of signal channel 1.

Typical Application Circuit



Absolute Maximum Ratings Note 1

- ✧ VIN to GND ---------- -0.3V to 18V
- ✧ OUT to GND ---------- -0.3V to 18V
- ✧ Other Pin to GND ---------- -0.3V to 9V
- ✧ Maximum Junction Temperature ---------- 155°C
- ✧ Operating Junction Temperature Range (T_J) ---------- -40℃ to 85°C
- ✧ Maximum Soldering Temperature (at leads, 10 sec) ---------- 260°C

Note 1. 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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Thermal Information

- ✧ Maximum Power Dissipation (P_D, T_A=25℃) ---------- 1.5W
- ✧ Thermal Resistance (θ_{JA}) ---------- 65℃/W

ESD Susceptibility

- ✧ HBM(Human Body Mode) ---------- 2KV
- ✧ MM(Machine Mode) ---------- 200V

Electrical Characteristics

(The specifications which apply over the full operating temperature range, otherwise specifications are at T_A=25℃, V_{DD} = 9V, unless otherwise noted.)

Parameter	Symbol	Condition		Min	Typ.	Max	Units
Supply power	V_{DD}			4.3		15.5	V
Output power	P_O	THD+N=10% f=1KHz R_L=4Ω Class D			2*10		W
		THD+N=10% f=1KHz R_L=8Ω Class D			2*5		W
		THD+N=1% f=1KHz R_L=4Ω Class D			2*8		W
		THD+N=1% f=1KHz R_L=8Ω Class D			2*4		W
Power supply ripple rejection	PSRR	INPUT ac-grounded with C_{IN}=0.47uF, V_{DD}=12V	f=100HZ		-73		dB
			f=1kHZ		-70		dB
Signal-to-noise ratio	SNR	V_{DD}=12V, P_O=12W, R_L=4Ω, f=1kHZ			95		dB
Output integrated noise	V_N	22Hz to 20kHz, A-weighted filter, THD=1%,RL=4Ω			130		uV
Efficiency	η	R_L=4Ω, P_O=10W, f=1kHZ			86		%
Quiescent current	I_Q	No Load			25		mA
Shutdown current	I_{SD}	V_{SD}=0V			12		uA
Shutdown voltage	V_{SD_H}					0.5	V
	V_{SD_L}			0.8			V
Class AB voltage	V_{MODE_AB}					1.5	V
Class D voltage	V_{MODE_D}			1.6			V
Offset output voltage	$\|V_{OS}\|$	V_{SD}=0V			6		mV
f_{OSC} oscillator frequency	f_{SW}				550		KHz
Start-up time	t_{ON}				180		mS
Thermal shutdown	T_{OTP}				155		℃
OTP hysteresis	T_{OTP_HYS}				135		℃

Application Information

Maximum Gain

The LPA2102 has two internal amplifier stages. The first stage's gain is externally configurable, while the second stage's is internally fixed. The closed-loop gain of the first stage is set by selecting the ratio of Rf to R_{IN} while the second stage's gain is fixed at 2x.The output of amplifier 1 serves as the input to amplifier 2, thus the two amplifiers produce signals identical in magnitude, but different in phase by 180°. Consequently, the differential gain for the IC is

$$A_V = 20\log\frac{2R_f}{R_{IN}+6}$$

$$R_f = 250K\Omega \pm 10\%$$

Shutdown operation

In order to reduce power consumption while not in use, the LPA2102 contains shutdown circuitry to turn off the amplifier's bias circuitry. This shutdown feature turns the amplifier off when logic low is applied to the SD pin.

Power supply decoupling

Power supply leads. For higher frequency transients, spikes, or digital hash on the line, a good low equivalent-series-resistance (ESR) ceramic capacitor, typically 1.0μF, works best, placing it as close as possible to the device VDD terminal. For filtering lower- frequency noise signals, a large capacitor of 20μF (ceramic) and a capacitor of 220uF(electrolytic) are recommended, placing them near the audio power amplifier.

Short Circuit Protection (SCP)

The LPA2102 has short circuit protection circuitry on the outputs to prevent damage to the device when output-to-output or output-to-GND short occurs. When a short circuit is detected on the outputs, the outputs are disabled immediately. If the short was removed, the device activates again.

Input Capacitor (C i)

C_{IN} for signal input. Large input capacitors are both expensive and space hungry for portable designs. Clearly, a certain sized capacitor is needed to couple in low frequencies without severe attenuation. But in many cases the speakers used in portable systems, whether internal or external, have little ability to reproduce signals below 100Hz to 150Hz. In the typical application, an input capacitor C_{IN} is required to allow the amplifier to bias the input signal to the proper dc level for optimum operation. Thus, using a large input capacitor may not increase actual system performance. In this case, input capacitor (C_{IN}) and input resistance (R_{IN}) of the amplifier form a high-pass filter with the corner frequency determined by equation below,

$$f_C = \frac{1}{2\pi R_{IN} C_{IN}}$$

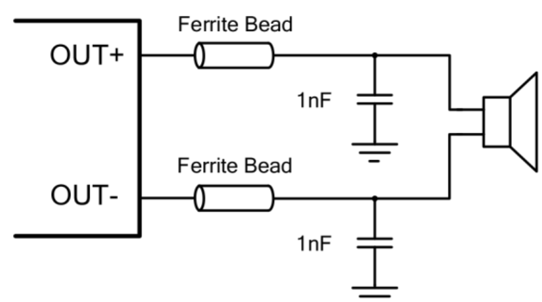
Over Temperature Protection

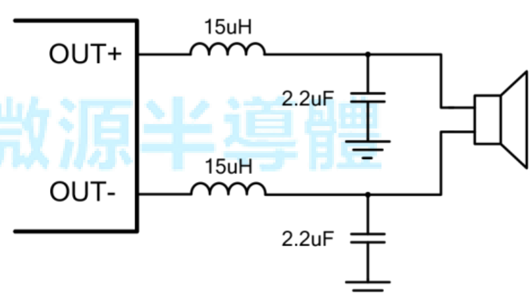
Thermal protection on the LPA2102 prevents the device from damage when the internal die temperature exceeds 155°C. Once the die temperature exceeds the thermal set point, the device outputs are disabled. This is not a latched fault. The thermal fault is cleared once the temperature of the die is reduced by 20°C. This large hysteresis will prevent motor boating sound well and the device begins normal operation at this point without external system intervention.

How to reduce EMI

A simple solution is to put an additional capacitor at power supply terminal for power line. The traces from amplifier to speakers should design as short as we can. The LPA2102 has been tested with a simple ferrite bead filter for a variety of applications. The LPA2102 EVM passes FCC class-B specifications under these conditions using twisted speaker wires. The size and type of ferrite bead can be selected to meet application requirements. Also, the filter capacitor can be increased if necessary with some impact on efficiency. There may be a few circuit instances where it is necessary to add a complete LC reconstruction filter. These circumstances might occur if there are nearby circuits which are sensitive to noise. In these cases a classic second order Butterworth filter similar to those shown in the figures below can be used.

Some systems have little power supply decoupling from the AC line but are also subject to line conducted interference (LCI) regulations. These include systems powered by "wall warts" and "power bricks." In these cases, LC reconstruction filters can be the lowest cost means to pass LCI tests. Common mode chokes using low frequency ferrite material can also be effective at preventing line conducted interference.





PCB Layout notices

1. In the path of the power supply, plus a 1uF and a 10uF to ground high-frequency filter capacitor. These caps can be connected to the thermal pad directly for an excellent ground connection. Consider adding a small, good quality low ESR ceramic capacitor may achieve better sound effects.

2. Large (470 μF or greater) bulk power supply decoupling capacitors should be placed near the LPA2102 on the VDD supplies. Local, high-frequency bypass capacitors should be placed as close to the VDD pins as possible.

3. The power line, ground line and filter capacitor and bypass capacitors as close to the chip's pins, remember not to put the capacitor on the back of the board, through tiny holes through the jumper even over. Keep the current loop from each of the outputs through the ferrite bead and the small filter cap and back to GND as small and tight as possible. The size of this current loop determines its effectiveness as an antenna.

4. Power, ground, and a large current line must try to be wide enough, if you want to add vias, the number of through-holes must be at least 6. The thermal pad must be soldered to the PCB for proper thermal performance and optimal reliability.

5. GND and VDD should be put independently, high-power signals to avoid interference.

6. If you want to pursue as large as the effect of power, a large selection of speakers or sound chamber with low resistance (such as 3.6Ω) speakers, or added to improve the supply voltage.

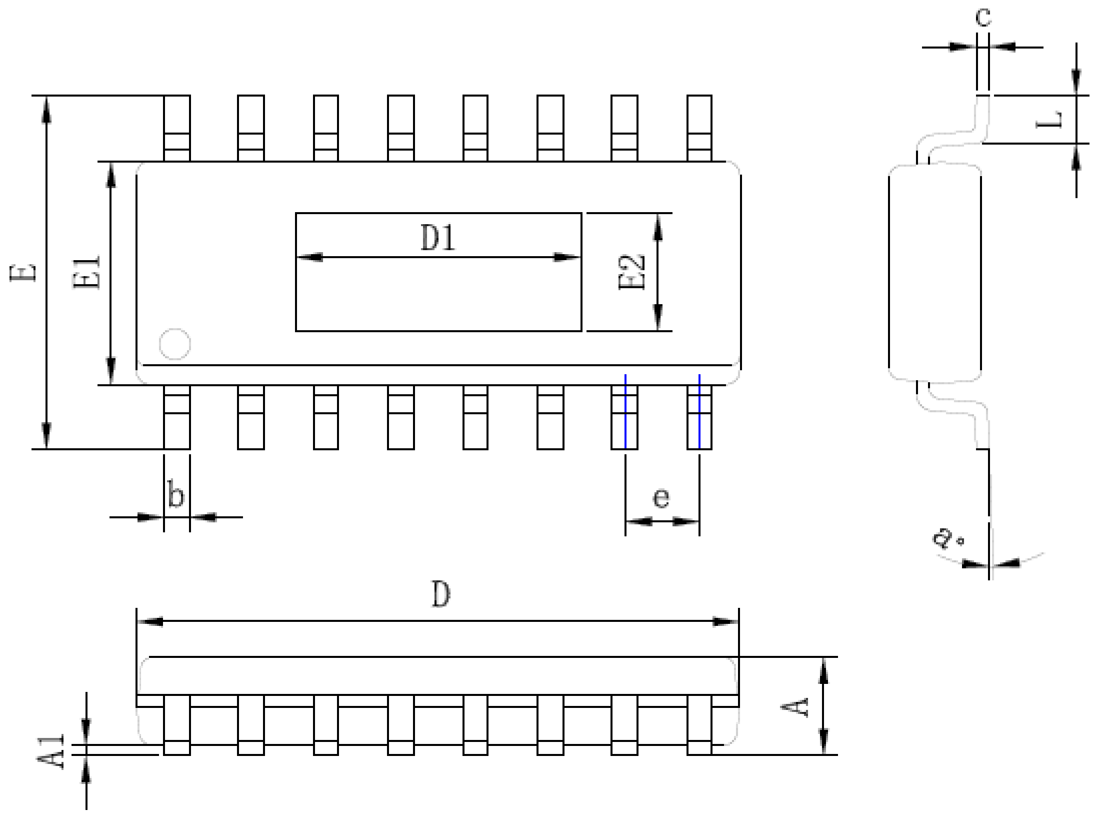
7. Including the line between large current cell and chip, the inductor should be as close and short as possible to chip for a high performance. Adding a coil to this pin would be helpful for EMI certification. If there is a high standards needed in LPA2102 application, we could add a coil and capacitor between chip and speaker constituting a LC filter which coil would be 100MHz, 600Ω and its DCI beyond 4A placing as close as possible to chip, the capacitor should be 1nF connecting the GND.

8. The position under the amplifier chip on the board must be added vents and large areas of exposed copper and tin to enhance heat dissipation.

9. In case of fixed gain and meeting demand, it should make CIN small as possible as we can because it constitute a high through filter with R_{IN} which cutoff frequency is $1/2*3.414*C_{IN}*R_{IN}$. A high capacitance cap could make POP worse.

Packaging Information

ESOP-16



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	--	--	1.75
A1	0	--	0.10
b	0.35	--	0.48
c	0.19	--	0.25
D	9.70	9.90	10.10
D1	--	4.826	
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
E2	--	2.54	--
e	1.27BSC		
L	0.40	--	0.80
a°	0°	--	8°

单击下面可查看定价，库存，交付和生命周期等信息

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