

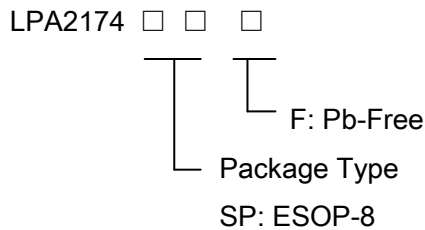


Filterless 6W Class- F Mono Audio Amplifier

General Description

The LPA2174 is a 6W, class-F audio amplifier with a mode pin for switch the work mode. It offers low THD+N, allowing it to achieve high-quality Power Supply sound reproduction. The new filterless architecture allows the device to drive the speaker directly requiring no low-pass output filters, thus to save the system cost and PCB area. The LPA2174 is available in ESOP-8.

Order Information



Applications

- ✧ Portable Bluetooth Speaker
- ✧ Cellular and Smart mobile phone
- ✧ Square Speaker

Marking Information

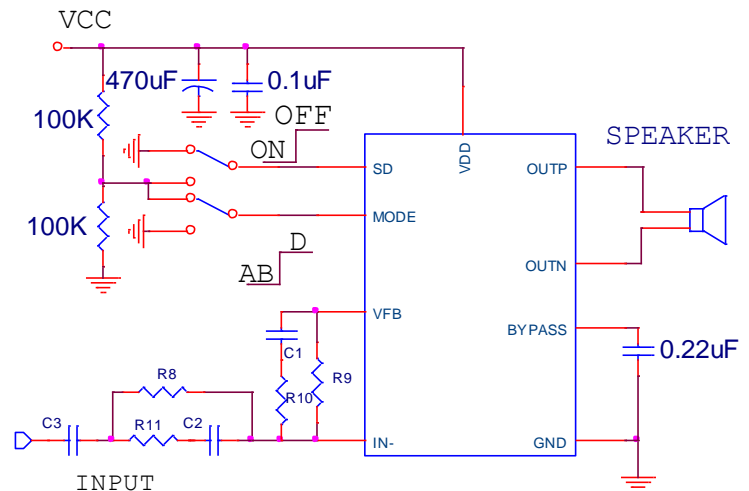
Device	Marking	Package	Shipping
LPA2174	LPS LPA2174 YWX	ESOP-8	3K/REEL

Y: Y is year code. W: W is week code. X: X is series number.

Features

- ◆ Shutdown current:<5uA
- ◆ 480KHz fixed frequency switching for amplifier 6W Output at 10% THD with a 4Ω Load and 6.5V PVDD for amplifier
- ◆ 3.2W Output at 10% THD with a 4Ω Load and 5V PVDD for amplifier
- ◆ 4W Output at 1% THD with a 2Ω Load and 5V PVDD for amplifier
- ◆ Filterless, Low Quiescent Current and Low EMI
- ◆ Amplifier Efficiency up to 85%
- ◆ Free LC filter digital modulation, direct-drive speakers
- ◆ Short Circuit Protection
- ◆ Thermal Shutdown
- ◆ Few external components to save the space and cost
- ◆ Pb-Free Package

Typical Application Circuit





Functional Pin Description

Package Type	Pin Configurations
ESOP-8	

Functional Pin Description

Pin	PIN No.	DESCRIPTION
BYP	1	Bypass pin. Connect a 0.22uF capacitor between this pin and gnd.
MODE	2	Mode control pin. High voltage with Class_D mode and low voltage with Class_AB mode.
FB	3	Negative output of amplifier. With resistor(R10) and capacitor(C1) in series between IN- and VFB, the high frequencies could be attenuated.
IN-	4	Negative input of amplifier. With resistor(R11) and capacitor(C2) in series between IN- and signal, the low frequencies could be attenuated.
VOP	5	Positive output of signal.
VDD	6	Voltage supply pin.
VON	7	Negative output of signal.
SD	8	Shutdown pin. Shutdown chip by a high voltage.
GND	9(PAD)	Ground pin.

Absolute Maximum Ratings

Supply Input Voltage range	2.7V to 7.5V
Input voltage	-0.3V to VDD+0.3V
Lead Temperature (Soldering, 10 sec.)	260°C
Storage Temperature Range	-65°C to 150°C
Operation Junction Temperature Range	-40°C to 125°C
Operation Ambient Temperature Range	-40°C to 85°C
Maximum Junction Temperature Range	150°C
Maximum Power Dissipation (PD, TA<40°C)	2.6W
Thermal resistance (junction to ambient)	45°C/W



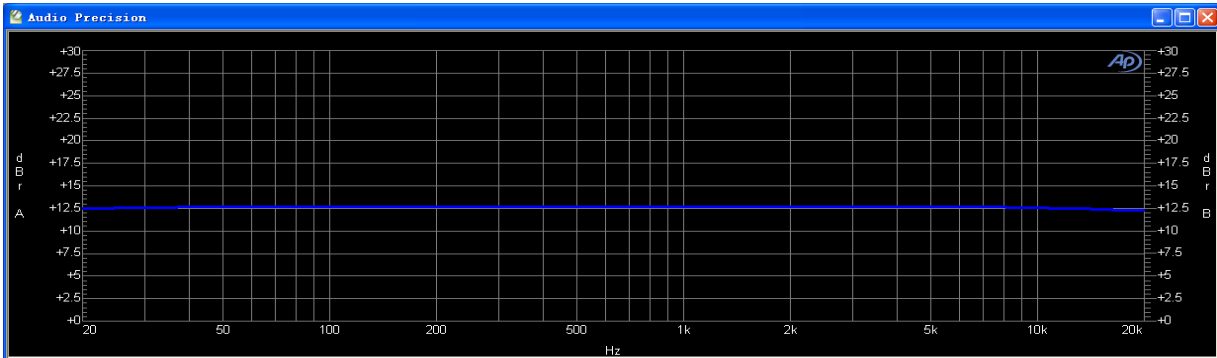
Electrical Characteristics For Amplifier

(VDD = 5V, GAIN = 24dB, RL=4Ω , TA = 25° C, unless otherwise specified)

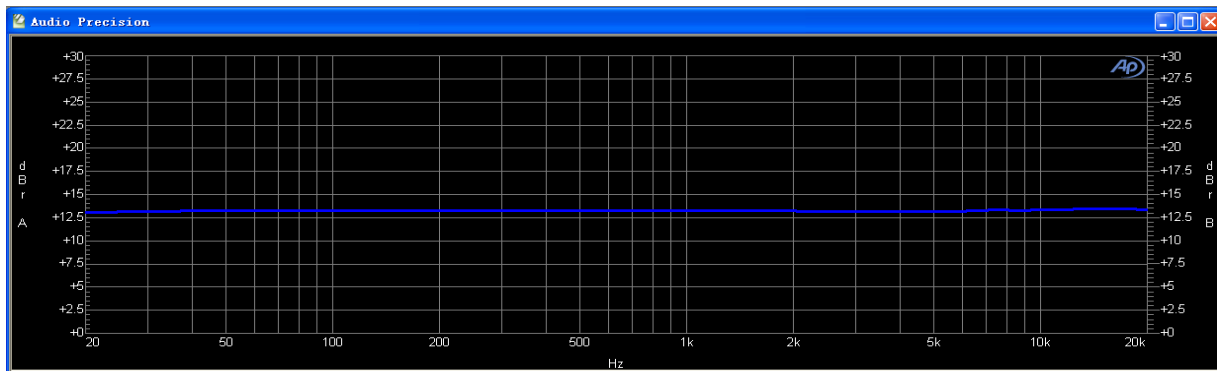
Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply power	VIN		2		6.5	V
Output power	Po	THD+N=10%, f=1KHz,RL=4Ω	VDD=6.5V		6	W
			VDD=5.6V		4	
		THD+N=10%, f=1KHz,RL=8Ω	VDD=5.0V		3.2	
			VDD=6.0V		2.5	
Total harmonic distortion plus noise	THD+N	VDD=5.0V,PO=1.5W,RL=8Ω	f=1KHz		1	%
		VDD=3.6V,PO=0.7W,RL=8Ω			1	
		VDD=5.0V,PO=2.6W,RL=4Ω	f=1KHz		1	%
		VDD=3.6V,PO=1.3W,RL=4Ω			1	
Gain	GV					dB
Power supply ripple rejection	PSRR	VDD=7.0V,INPUT ac-grounded with CIN=0.47uF	f=100HZ			dB
			f=1KHz			
crosstalk	CS	VDD=7V,VORMS=1V,GV=20 dB	f=1KHz			dB
Signal-to-noise ratio	SNR	VDD=5V,Class_AB	f=1KHz		89	dB
		VDD=5V,Class_D	f=1KHz		84	
Output noise	VN	VDD=7.0V,INPUT ac-grounded with CIN=0.47uF	Class_AB		120	μV
			Class_D		220	
Efficiency	η	RL=8Ω,THD=10%	f=1KHz			%
		RL=4Ω,THD=10%	f=1KHz			
IQ	Quiescent current	VDD=5.0V	No load		3	mA



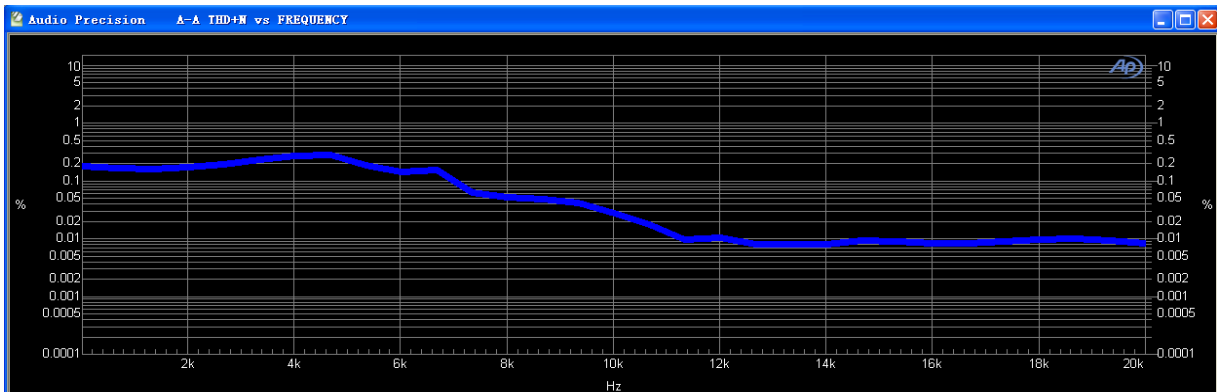
Typical Operating Characteristic



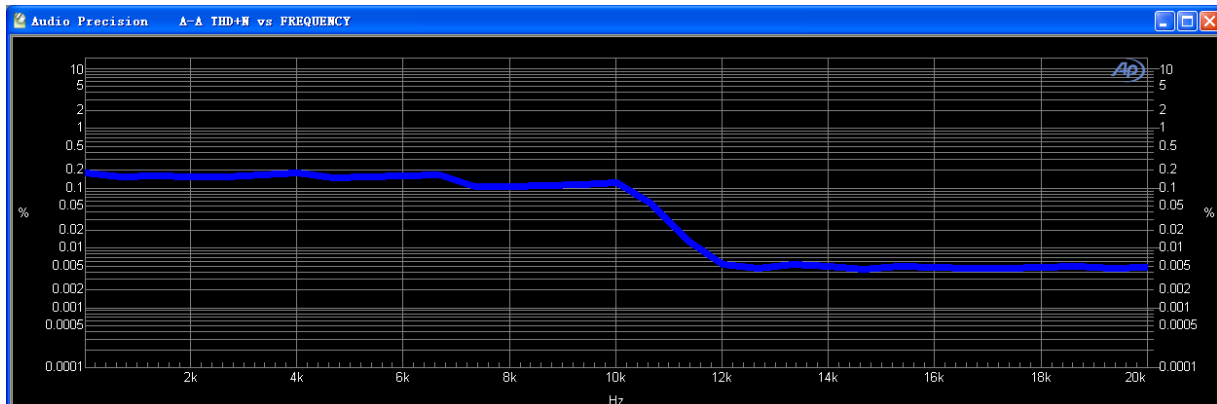
Frequency response characteristic at Class_D and Po=4.6W



Frequency response characteristic at Class_AB and Po=4.6W



THD+N vs FREQUENCY with Po=1W and Class_D



THD+N vs FREQUENCY with Po=1W and Class_AB



Applications Information

Maximum Gain

The LPA2174 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 Ri while the second stage's gain is fixed at 2x. The output of amplifier 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

$$A_v = 20 \cdot \log [2 \cdot (R_f/R_i)]$$

The LPA2174 sets maximum:

Rf= 280 k Ω±10%	Class-AB
Rf= 280 k Ω±10%	Class-D

Shutdown operation

In order to reduce power consumption while not in use, the LPA2174 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. By switching the SD pin connected to GND, the LPA2174 supply current draw will be minimized in idle mode. The SD pin can be left floating due to the internal pull-up.

Power supply decoupling

The LPA2174 is a high performance CMOS audio amplifier that requires adequate power supply decoupling to ensure the output THD and PSRR a low as possible. Power supply decoupling affects low frequency response. Optimum decoupling is achieved by using two capacitors of different types targeting to different types of noise on the 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) or greater is recommended, placing it near the audio power amplifier.

Short Circuit Protection (SCP)

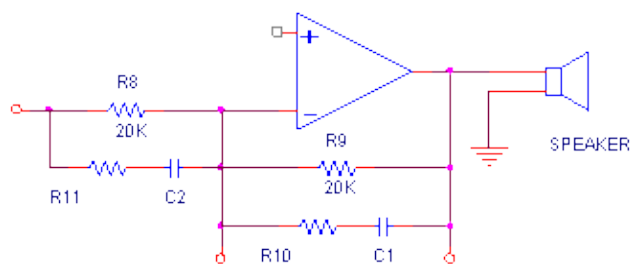
The LPA2174 has short circuit protection circuitry on the outputs to prevent damage to the device when output-to-output or output-to-GND short occurs. When a short circuit is detected on the outputs, the outputs are disabled immediately. If the short was removed, the device activates again.

Signal Frequency suppress

The LPA2174 has a VFB pin which is the negative output of amplifier as show below. With R10 and C1, we can suppress high frequency part of signal. And the low frequency part of signal could be attenuated by R11 and C2.

$$f_H = \frac{1}{\sqrt{2\pi R_{11} C_2}} ;$$

$$f_L = \frac{1}{\sqrt{2\pi R_{10} C_1}}$$



Over Temperature Protection

Thermal protection on the LPA2174 prevents the device from damage when the internal die temperature exceeds 150°C. There is a 15 degree tolerance on this trip point from device to device. 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 30°C. This large hysteresis will prevent motor boating sound well and



the device begins normal operation at this point without external system intervention.

Analog Reference Bypass Capacitor (C_{BYP})

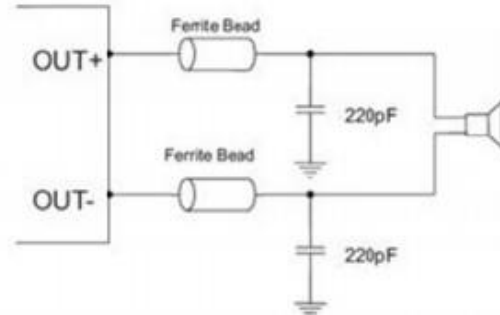
In addition to system cost and size, click and pop performance is affected by the size of the input coupling capacitor, C_{BYP} . A larger input coupling capacitor requires more charge to reach its quiescent DC voltage (nominally $1/2 V_{DD}$). This charge comes from the internal circuit via the feedback and is apt to create pops upon device enable. Thus, by minimizing the capacitor size based on necessary low frequency response, turn-on pops can be minimized.

The Analog Reference Bypass Capacitor (C_{BYP}) is the most critical capacitor and serves several important functions. During start-up or recovery from shutdown mode, C_{BYP} determines the rate at which the amplifier starts up. The second function is to reduce noise caused by the power supply coupling into the output drive signal. This noise is from the internal analog reference to the amplifier, which appears as degraded PSRR and THD+N.

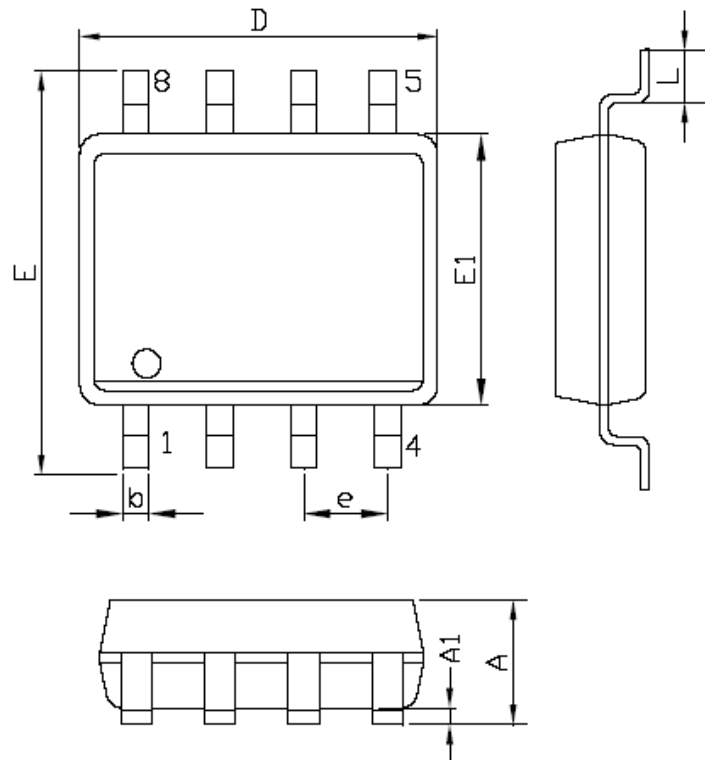
PCB Layout

How to reduce EMI

A simple solution is to put an additional capacitor 220pF at power supply terminal for power line. The traces from amplifier to speakers should design as short as we can.



Packaging Information



SYMBOLS	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	1.35	1.75	0.053	0.069
A1	0.10	0.25	0.004	0.010
D	4.90		0.193	
E	5.80	6.20	0.228	0.244
E1	3.90		0.153	
L	0.40	1.27	0.016	0.050
b	0.31	0.51	0.012	0.020
e	1.27		0.050	