

20W-Filter-free Stereo Class-D Audio Power Amplifier

Features

- 20-W/ch into an 4-Ω Loads at 10%THD+N From a 12-V Supply
- 15-W/ch into 8-Ω Loads at 10% THD+N From a 15-V Supply
- 33-W into a 4-Ω Mono Load at 10% THD+N From a 16-V Supply
- 92% Efficient Class-D Operation Eliminates Need for Heat Sinks
- Wide Supply Voltage Range Allows Operation from 5V to 18V
- Filter-Free Operation
- Fixed 40 times
- Differential Inputs

Description

The CS8676E is a 20-W (per channel) efficient, Class-D audio power amplifier for driving bridged-tied stereo speakers. Advanced EMI Suppression Technology enables the use of inexpensive ferrite bead filters at the outputs while meeting EMC requirements. The DC detect circuit measures the frequency and amplitude of the PWM signal and shuts off the output stage if the input capacitors are damaged or shorts exist on the inputs.

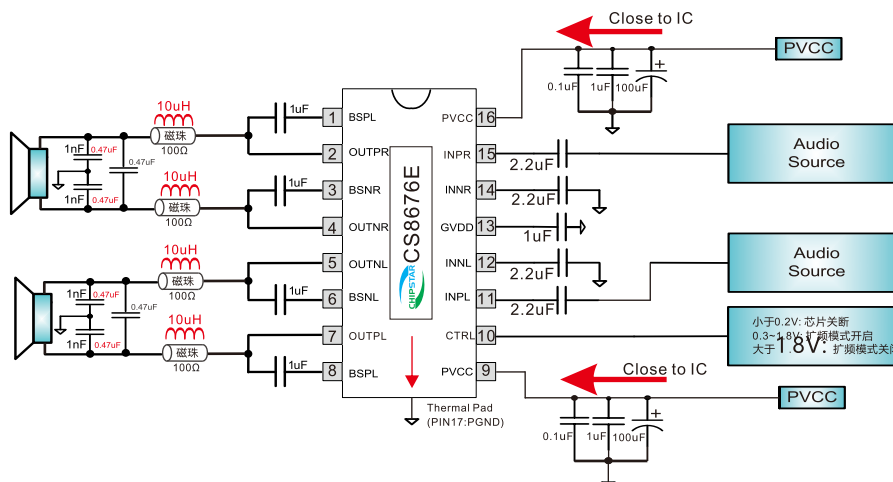
The CS8676E can drive stereo speakers as low as 4Ω. The high efficiency of the CS8676E, 92%, eliminates the need for an external heat sink when playing music.

The outputs are also fully protected against shorts to GND, VCC, and output-to-output. The short-circuit protection and thermal protection includes an auto-recovery feature.

Applications

- Televisions
- Consumer Audio Equipment

Typical application



Note: the power supply system below 12V, magnetic bead + 1nF and inductance 10uH + 0.47uF can pass the FCC class B test

Figure 1. CS8676E Simplified Application Schematic

Typical application

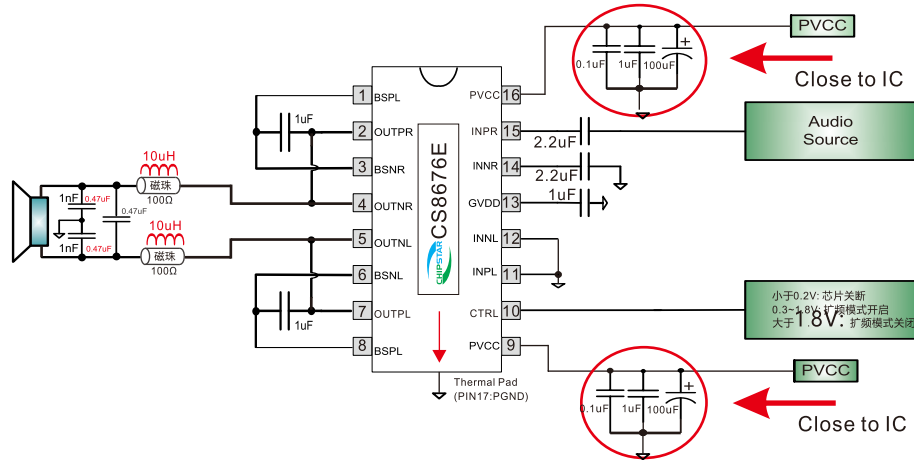
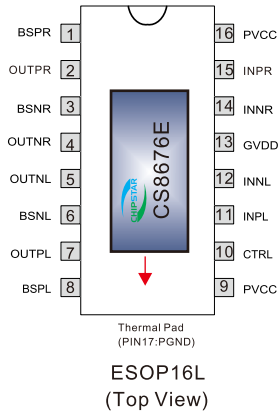


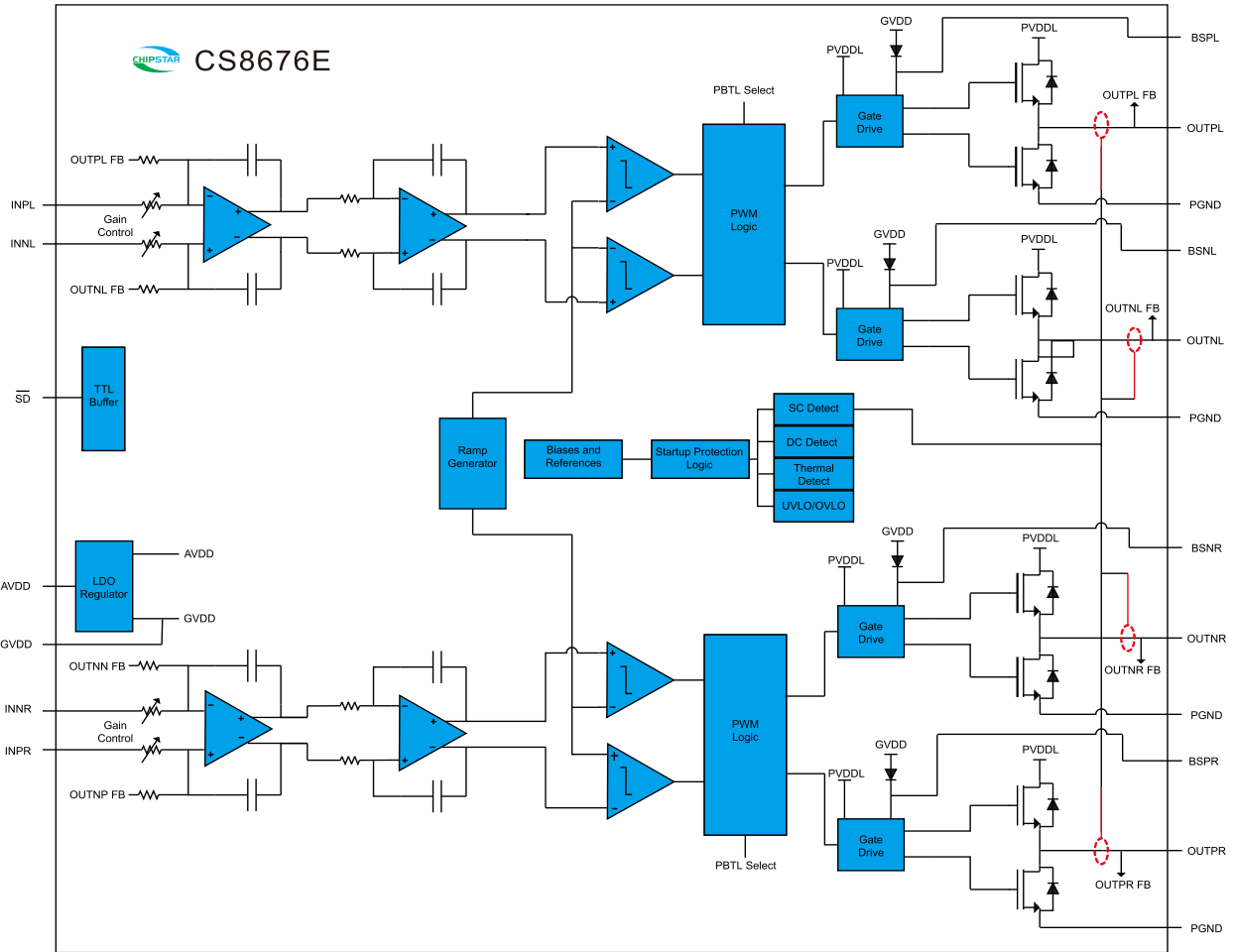
Figure 2: diagram of single - end input and PBT output monophonic channel

Pin Descriptions



NUMBER	NAME	I/O/P	DESCRIPTION
1	BSPR	I	Bootstrap I/O for right channel, positive high-side FET.
2	OUTPR	O	Class-D H-bridge positive output for right channel.
3	BSNR	I	Bootstrap I/O for right channel, negative high-side FET.
4	OUTNR	O	Class-D H-bridge negative output for right channel.
5	OUTNL	O	Class-D H-bridge negative output for left channel.
6	BSNL	I	Bootstrap I/O for left channel, negative high-side FET.
7	OUTPL	O	Class-D H-bridge positive output for left channel.
8	BSPL	I	Bootstrap I/O for left channel, positive high-side FET.
9	PVCC	P	Power Supply
10	CTRL	I	Standby logic and spread spectrum select control ; TTL logic voltage allowed to AVCC
11	INPL	I	Positive audio input for left channel.
12	INNLL	I	Negative audio input for left channel.
13	GVDD	P	High-side FET gate drive supply.
14	INNRR	I	Negative audio input for right channel.
15	INPR	I	Positive audio input for right channel.
16	PVCC	P	Power Supply
17	PGND	P	Power ground for the H-bridges.

Block Diagram




over operating free-air temperature range(unless otherwise noted)⁽¹⁾

			UNIT
V _{CC}	Supply voltage	PVCC	0.3V to19V
V _I	Interface pin voltage	CRTL	0.3VtoV _{CC} +0.3V
T _A	Operating free-air temperature range		-40°C to 85°C
T _J	Operating junction temperature range		-40°Cto150°C
T _{stg}	Storage temperature range		-65°C to150°C

Thermal information²

Symbol	Parameter	Value	Unit
θ_{JA}	Junction-to-ambient thermal resistance	45	°C/W
θ_{JC}	Junction-to-case (top) thermal resistance	10	°C/W
θ_{JB}	Junction-to-board thermal resistance	17.5	°C/W

Order Information

Device	Package	Making	Reel Size	Tape Width	Quantity
CS8676E	ESOP16L		Tube		50

ESD Range

ESD HBM mode ----- ±2kV
 ESD MM mode ----- ±400V

1, The ThermalPad on the bottom of the IC should soldered directly to the PCB's ThermalPad area that with several thermal vias connect to the ground plan, and the PCB is a 2-layer, 5-inch square area with 2oz copper thickness.

2, Stresses above those listed in Absolute Maximum Ratings may cause permanent damage to the device. Functional operation at conditions other than the operating conditions specified is not implied. Only one Absolute Maximum Rating should be applied at one time.

Recommended Operating Conditions

PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT
V_{CC} Supply voltage	PV _{CC}	5	18	V
V_{IH} High-level input voltage	CTRL	2		V
V_{IL} Low-level input voltage	CTRL		0.8	V
V_{OL} Low-level output voltage	R_{PULL-UP} = 100k, V_{CC} = 15V		0.8	V
I_{IH} High-level input current	CTRL, V _I = 2V, V _{CC} = 15V		50	uA
I_{IL} Low-level input current	CTRL, V _I = 0.8V, V _{CC} = 15V		5	uA
OVP			19	V

DC Characteristics

T_A = 25°C, V_{CC} = 12 V, R_L = 8 Ω (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V _{OS} Output offset voltage	V _I = 0V		1.5	15	mV
I _{CC} Quiescent supply current	CTRL = 1V, no load, PV _{CC} = 12V		6.5	9	mA
I _{CC(SD)} Shutdown current	CTRL = 0.2V, no load, PV _{CC} = 12V		20	50	uA
r _{DS(on)} Drain-source on-state resistance	V _{CC} = 12V, I _O = 500mA, T _J = 25°C	HighSide	80		mΩ
		Lowside	80		
t _{on} Turn-on time	CTRL = 2V		100		ms
t _{OFF} Turn-off time	CTRL = 0V		2		us
GVDD Gate Drive Supply	I _{GVDD} = 100 mA	4.0	4.5	5.0	V

T_A = 25°C, V_{CC} = 16 V, R_L = 8 Ω (unless otherwise noted)

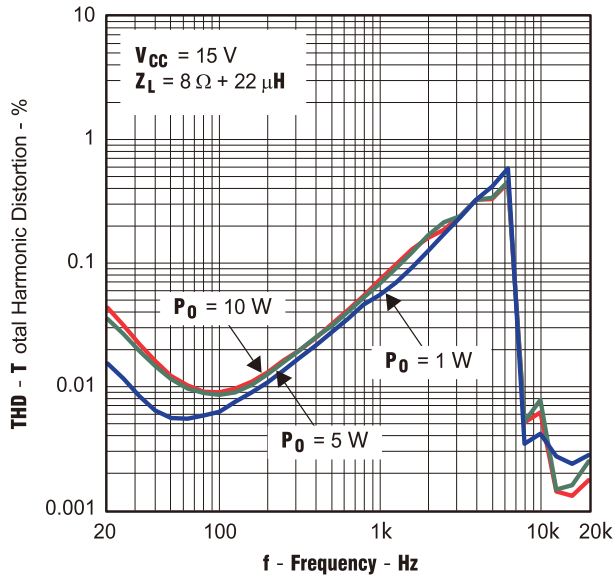
PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V _{OS} Output offset voltage	V _I = 0V		1.5	15	mV
I _{CC} Quiescent supply current	CTRL = 1V, no load, PV _{CC} = 16V		10	15	mA
I _{CC(SD)} Shutdown current	CTRL = 0.2V, no load, PV _{CC} = 16V		50		uA
r _{DS(on)} Drain-source on-state resistance	V _{CC} = 16V, I _O = 500mA, T _J = 25°C	HighSide	80		mΩ
		Lowside	80		
t _{on} Turn-on time	CTRL = 2V		110		ms
t _{OFF} Turn-off time	CTRL = 0V		2		us
GVDD Gate Drive Supply	I _{GVDD} = 2mA	4.0	4.5	5.0	V

AC CHARACTERISTICS
 $T_A=25^{\circ}\text{C}$, $V_{CC} = 14\text{ V}$, $R_L = 4\ \Omega$ (unless otherwise noted)

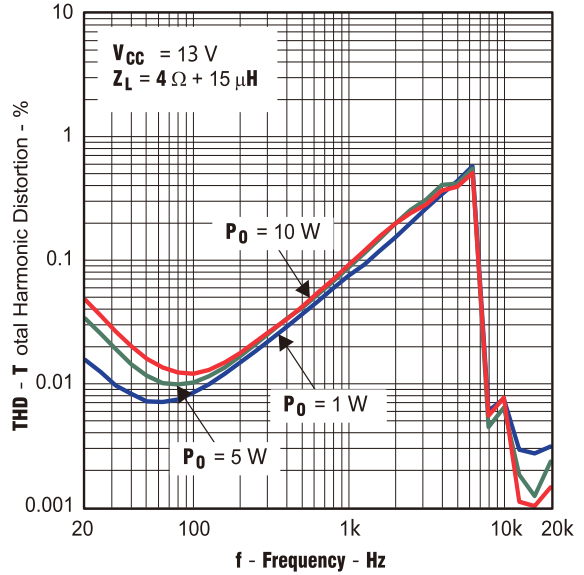
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
KSVR	Power Supply ripple rejection	1 kHz, 200 mV _{pp} ripple Gain=20dB, Inputs ac-coupled to AGND		70		dB
THD+N	Total harmonic distortion+noise	VCC=14V, f=1kHz Po=12W (half-power)		0.1		%
V _n	Output integrated noise	20~22kHz, A-weighted filter Gain=20dB		90		uV
				-80		dBV
	Crosstalk	Vo=1Vrms, Gain=20dB, f=1kHz		-90		dB
SNR	Signal-to-noiseratio	Gain=20dB, Maximum output THD+N < 1%, f=1kHz		102		dB
f _{OSC}	Oscillator frequency			300		kHz
	Thermal trip point			170		°C
	Thermal hysteresis			15		°C
P _o	STEREO OUTPUT	Continuous output power	PO at 10% THD+N, VDD = 15V@RL = 8 Ω	15		W
			PO at 1% THD+N, VDD = 15V@RL = 8 Ω	12		
			PO at 10% THD+N, VDD = 7.4V@RL = 4 Ω	7.2		
			PO at 1% THD+N, VDD = 7.4V@RL = 4 Ω	5.8		
			PO at 10% THD+N, VDD = 12V@RL = 4 Ω	20		
			PO at 1% THD+N, VDD = 12V@RL = 4 Ω	16		
			PO at 10% THD+N, VDD = 13V@RL = 4 Ω	22		
			PO at 1% THD+N, VDD = 13V@RL = 4 Ω	17.5		
			PO at 10% THD+N, VDD = 24V@RL = 8 Ω	42.5		
			PO at 1% THD+N, VDD = 24V@RL = 8 Ω	34.5		
PBTL MODE	Continuous output power	PO at 10% THD+N, VDD = 12V@RL = 4 Ω	22			
		PO at 1% THD+N, VDD = 12V@RL = 4 Ω	17.6			
		PO at 10% THD+N, VDD = 16V@RL = 4 Ω	33			
		PO at 1% THD+N, VDD = 16V@RL = 4 Ω	26			

(All Measurement taken at 1kHz, unless otherwise noted.)

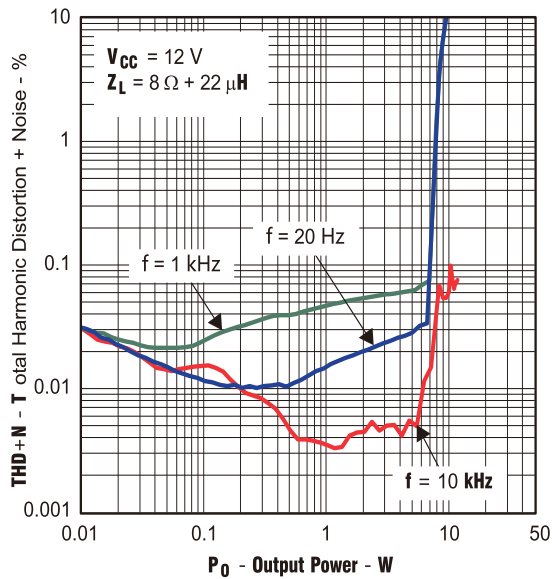
**TOTAL HARMONIC DISTORTION
vs
FREQUENCY (BTL)**



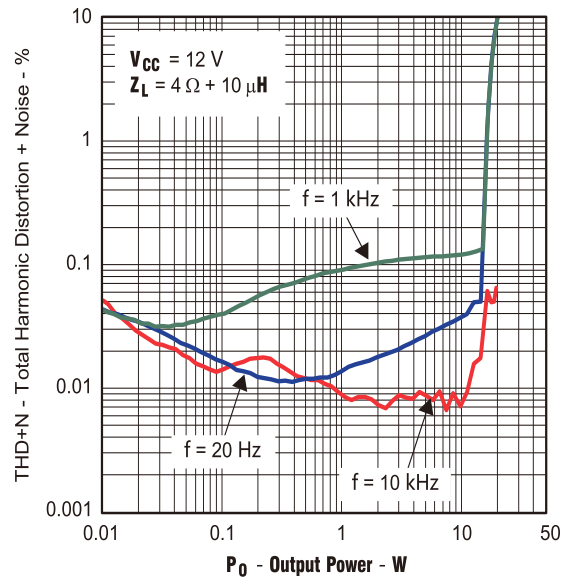
**TOTAL HARMONIC DISTORTION
vs
FREQUENCY (BTL)**

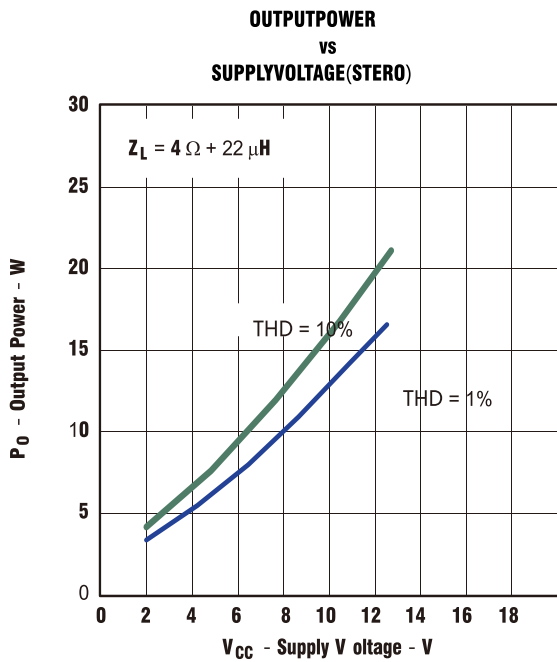


**TOTAL HARMONIC DISTORTION + NOISE
vs
OUTPUT POWER (BTL)**

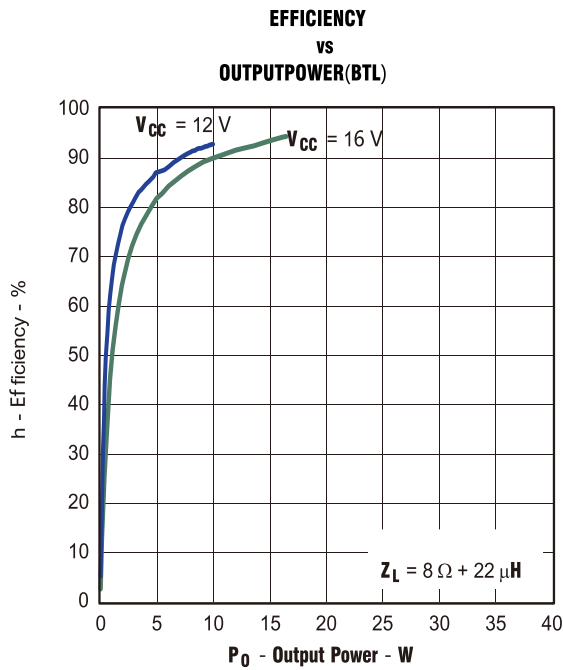
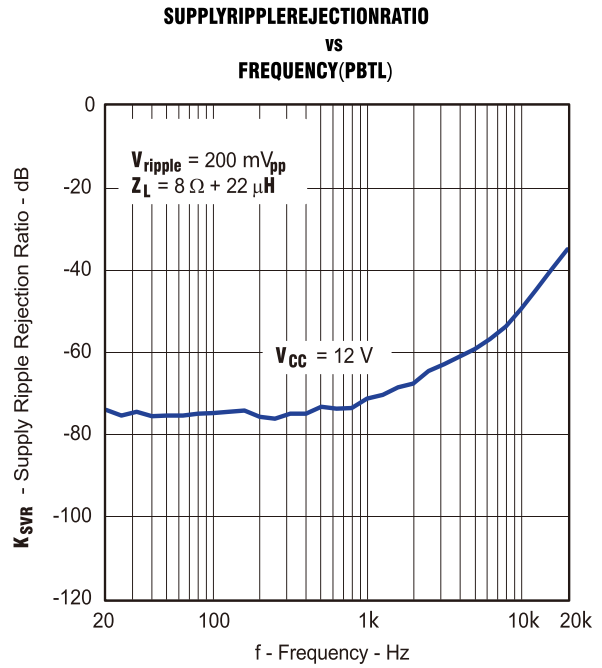


**TOTAL HARMONIC DISTORTION + NOISE
vs
OUTPUT POWER (BTL)**

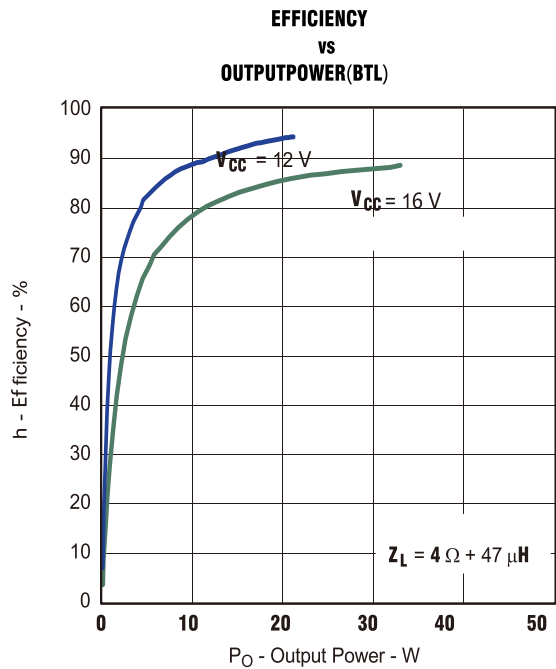




Note: Dashed Lines represent thermally limited regions.



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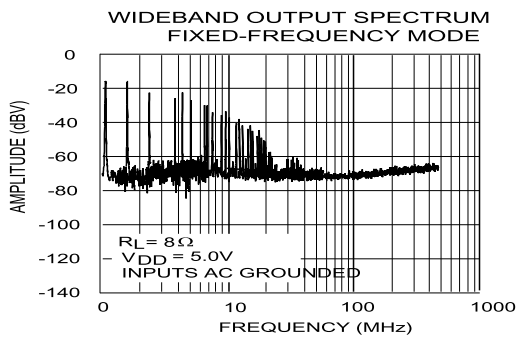
Application information

Standby mode and spread spectrum mode Settings

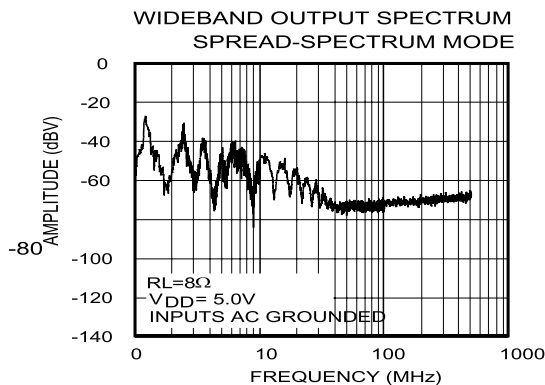
When the voltage of ctrl-pin is less than 0.2v, CS8676E will enter standby mode. When working normally, ctrl-pin should not be suspended without connection, because it will make the op amp appear unpredictable. In order to achieve the best turn-off performance, the operation is placed in standby mode before the power is turned off. When ctrl-pin voltage is between 0.3~ 1.8v, CS8676E works normally and enters spread spectrum mode. When ctrl-pin voltage is above 1.8v, CS8676E works normally and switches off spread spectrum mode.

CS8676E has a unique spread spectrum modulation mode, in which the spectrum components are spread over a wide range of frequency bands to effectively reduce EMI (see the spectrum energy diagram of fixed frequency and spectrum energy diagram of spread spectrum technology). Proprietary technology ensures that switching frequency changes with the period do not reduce the performance or efficiency of audio reconstruction. The switching frequency varies randomly within the range of $\pm 30K$ near the center frequency of 300K. At frequencies up to several MHz, EMI is equivalent to white noise at broadband frequencies (see EMI spectrum diagram).

CS8676E fixed frequency spectrum energy diagram



Spectrum energy diagram of CS8676E



Short-Circuit Protection And Automatic Recovery Feature

CS8676E protects the over-current state caused by short-circuit at the output end. When short-circuit occurs, CS8676E immediately shuts down the output. When short-circuit fault is eliminated at the output end, CS8676E only needs to wait for 110ms to recover itself.

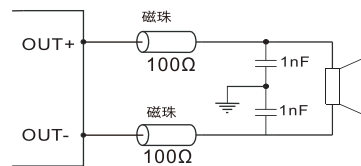
Temperature protection

The temperature protection of CS8676E is to prevent device damage when the temperature exceeds 150°C. There is a tolerance range of $\pm 15^\circ\text{C}$ between devices at this temperature point. Once the temperature exceeds the set temperature point, the device enters a closed state with no output. When the temperature drops 20°C, the temperature protection will be eliminated and the device starts to work normally.

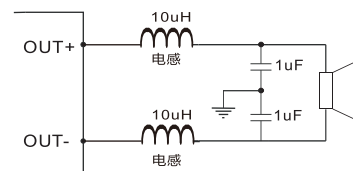
Inductance, magnetic bead and capacitance

The CS8676E module can pass the grade B test of FCC for the test of magnetic bead filter under various conditions such as high power and long output load line. The type and specification of magnetic bead can be selected according to actual use. The diagram below:

The analog input of CS8676E device is the standard differential input interface. In system design, it is recommended to use differential input to connect the audio output of the main chip. The differential input method can make the control of POP sound relatively simple and the signal anti-interference ability is strong. The comparison between the differential input mode and the single-terminal input mode is shown in the following table:

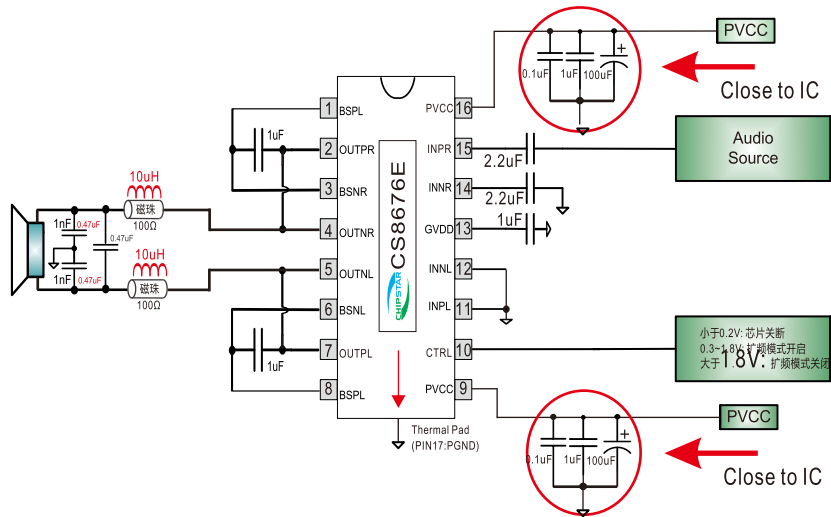


If the amplifier is used in the system with strict noise requirements, the output can consider serial LC filter. The relevant parameters of the filter are shown as follows:

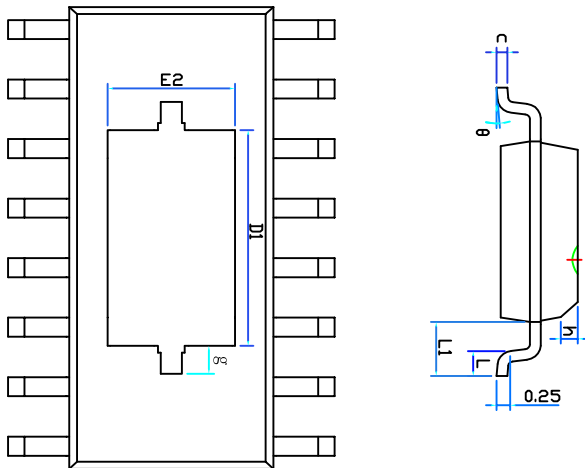
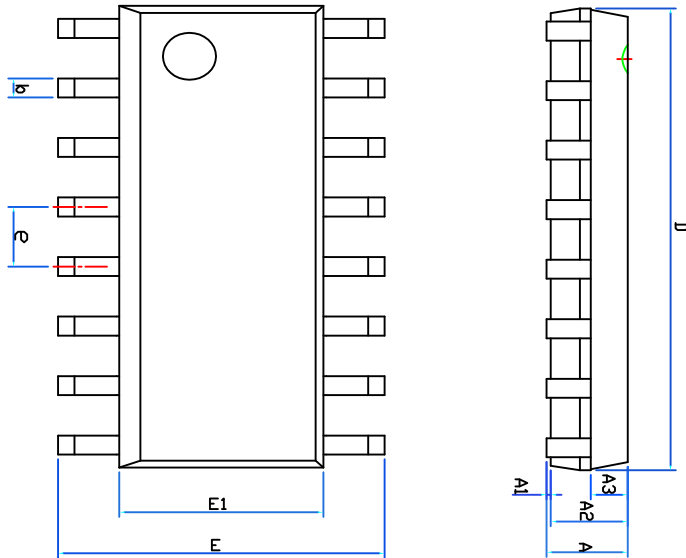


PBTL function

CS8676E have PBTL function, in the case of mono, CS8676E can drive load of low to $4\ \Omega$ in 24 v power supply situation, CS8676E can be on the premise of without heat sink can provide the contact more than 33 w power, in PBTL mode, needs to be INN1, IN1L two pin grounding can be directly, without the need to increase the coupling capacitance in front, as shown in the figure below:



Package Information
 CS8676E ESOP16L



SYMBOL	MILLMETER		
	MIN	NOM	MAX
A	—	—	1.55
A1	0.02	0.05	0.08
A2	1.40	1.45	1.50
A3	0.70	0.75	0.80
b	0.35	—	0.45
c	0.20	—	0.24
D	9.70	9.80	9.90
D1	4.60REF		
e	1.27BSC		
E	6.25	6.35	6.45
E1	3.70	3.80	3.90
E2	2.40REF		
L	0.50	—	0.70
L1	1.25REF		
h	0.25	0.35	0.45
θ	0	—	8°
g	0.60REF		