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矽源特科技
ChipSourceTek

5W, ultra-low EMI, mono class D with overheating protection

XS8302
User Manual

2020/10

XS8302

XS8302 General Description

The XS8302 is an audio power amplifier primarily designed for demanding applications in low-power portable systems. It is capable of delivering 5 watts of continuous average power to a 2Ω BTL load with less than 10% distortion (THD) from a 5.5V DC power supply.

The XS8302 does not require output coupling capacitors or bootstrap capacitors, and therefore is ideally suited for mobile phone and other low voltage applications where minimal power consumption is a primary requirement.

The XS8302 features a low-power consumption shutdown mode.

The XS8302 contains advanced pop & click circuitry which eliminates noise which would otherwise occur during turn-on and turn-off transitions. The XS8302 can be configured by external gain-setting resistors. The XS8302 integrates overheating protection mechanism, The XS8302 is unity-gain stable and can be configured by external gain-setting resistors. The XS8302 can provide your USB subwoofer, radio, MP3 player, and loudspeaker perfect solution.
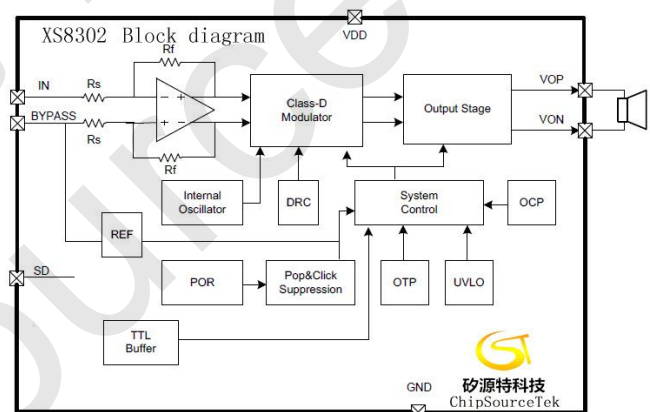
XS8302 Features

♦ Fully-differential class D audio power amplifier

♦Available in space-saving packages: SOP8, MSOP8

♦ 5W Output Power (10% THD, 2Ω load, 5.5V)

♦ Wide operating voltage range: 2.5V~6.5V

♦ Improved pop & click circuitry eliminates noise during turn-on and turn-off transitions

♦ Overheating protection

XS8302 Applications

·Card inserting speaker, Bluetooth speaker, Mobile phone

·Low voltage audio system,USB,2.1/2.0 multimedia

·Radio

·MP3/MP4/MP5/CD

·digital camera

·Tablet PC, Handheld game machine

Block diagram

XS8302

XS8302 Ordering Information

Part Number	Package Type	Shipping Package（PCS）	Note
XS8302M	MSOP8	3000 Units/real	
XS8302	SOP8	4000 Units/real	

XS8302 Typical Application Circuit

Picture 1. The XS8302 Typical Application Circuit

XS8302 Pin Distribution

MSOP8/SOP8 Pin Distribution

XS8302 Pin description (SOP8/MSOP8)

Pin Number	Symbol	Description
1	$\overline{\text{SD}}$	Shutdown Control Input(active low), the amplifier is turned off with a low level logic signal to the $\overline{\text{SD}}$ pin.
2	NC	
3	INBYP	The Bypass Input
4	INN	The negative phase Input
5	VON	The negative phase output
6	VDD	Power
7	GND	Ground
8	VOP	The positive phase output

XS8302 Absolute Maximum Ratings

Absolute Maximum Ratings

Name	Description	Parameter
VCC	Supply Voltage	2V~7V
V_I	Input voltage	$-0.3V\sim VCC+0.3V$
T_A	Operating free-air temperature range	$-40℃\sim+85℃$
T_J	Junction Temperature	$-40℃\sim+150℃$
T_{stg}	Storage Temperature	$-65℃\sim+150℃$
Tw	Welding temperature	260℃

Note: In any other conditions beyond the limit value, the performance is not guaranteed.

XS8302 Recommended operating conditions

● XS8302 Recommended operating conditions

Name	Test Conditions		Min	Max	Units
VDD，	Supply Voltage		2.5	6.5	V
VIH	High-level input voltage	$\overline{SD}$	1.3		V
VIL	Low-level input voltage	$\overline{SD}$		0.8	V
TA	Operating free-air temperature range		-40	85	℃

XS8302 Electrical Characteristics

		Chip characteristics TA = 25°C (Unless otherwise noted)					
Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
VDD	Input voltage range			2.5	6.0	6.5	V
Rdson	Drain-source on-state resistance	VDD=5V			150		mΩ
I$_{(Q)}$	Quiescent Power Supply Current	V$_{DD}$= 5V, no load			7		mA
I$_{(SD)}$	Shutdown Current	V$_{DD}$=2V to 5.5V			0.5		μA
VOS	Output Offset Voltage	VIN = 0V			10		mV
f$_{(sw)}$	Switching frequency	V$_{DD}$= 2V to 5.5V	frequency		350		kHz
			duty cycle		50		%
Po	Output Power	THD+N=10%,f=1kHz, R$_L$=2Ω	V$_{DD}$=5V	5.5V	5		W
		THD+N=1%,f=1kHz, R$_L$=2Ω	V$_{DD}$=5V		4		
		THD+N=10%,f=1kHz, R$_L$=4Ω	V$_{DD}$=5V	5V	3		
		THD+N=10%,f=1kHz, R$_L$=4Ω	V$_{DD}$=5V	3.7V	1.8		
THD+N	Total Harmonic Distortion+Noise	V$_{DD}$=5V,P$_O$=1W, R$_L$=8Ω, f=1kHz			0.08		%

XS8302 APPLICATION INFORMATION

The input resistance (Ri) selection

The XS8302 contains two stage gains, the first stage gain can be configured by an external input resistor, and the second stage gain is the internal fixation. By choosing the input resistance value can set the gain of the amplifier:

$$Gain = \frac{2 \times 200K\Omega}{6K\Omega + Ri}$$

(4)

Any mismatch between the resistors results in a differential gain error that leads to an increase in THD+N, decrease in PSRR and CMRR, as well as an increase in output offset voltage. Resistors with a tolerance of 1% or better are recommended. The gain setting resistors should be placed as close to the device as possible. Keeping the input traces close together can increases noise rejection in noisy environments. Noise coupled onto the input traces which are physically close to each other will be common mode and easily rejected. Low gain and high voltage signal can make the chip performance more prominent.

The input capacitor Ci selection

In the typical application, an input capacitor (Ci) is required to allow the amplifier to bias the input signal to the proper DC level for optimum operation. In this case, Ci and the input impedance of the amplifier (Zi) form a high-pass filter with the corner frequency determined in Equation 5.

$$f_c = \frac{1}{2\pi RiCi}$$

(5)

The value of Ci is important, as it directly affects the bass (low-frequency) performance of the circuit. Consider the example where Zi is 20kΩ and the specification calls for a flat bass response down to 20Hz. Equation 5 is reconfigured as Equation 6.

$$Ci = \frac{1}{2\pi Rifc}$$

(6)

In this example, Ci is 56.8nF, so one would likely choose a value in the range of 56nF to 1µF. A further consideration for this capacitor is the leakage path from the input source through the input network (Ci) and the feedback network to the load. This leakage current creates a DC offset voltage at the input to the amplifier that reduces useful headroom, especially in high gain applications. For this reason, a low-leakage tantalum or ceramic capacitor is the best choice. When polarized capacitors are used, the positive side of the capacitor should face the amplifier input in most applications as the DC level there is held at VDD/2, which is likely higher than the source DC level. Note that it is important to confirm the capacitor polarity in the application.

XS8302 When to use an output filter for EMI suppression

Design the XS8302 without the filter if the traces from amplifier to speaker are short (<10cm). Most applications require a ferrite bead filter. The ferrite filter reduces EMI around 1MHz and higher (FCC and CE only test radiated emissions greater than 30MHz).When selecting a ferrite bead, choose one with high impedance at high frequencies, but low impedance at low frequencies. Use an LC output filter if there are low frequency (<1MHz) EMI-sensitive circuits and/or there are long wires from the amplifier to the speaker. When both an LC filter and a ferrite bead filter are used, the LC filter should be placed as close as possible to the IC followed by the ferrite bead filter.
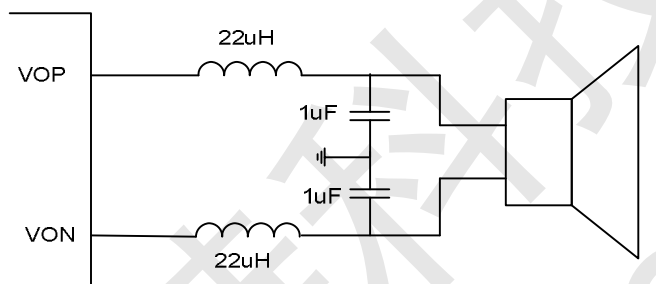
Typical Ferrite Chip Bead Filter
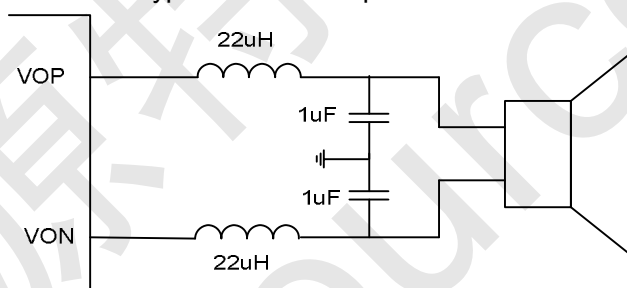
Typical LC Output Filter, Cutoff Frequency of 28 kHz

Protection function model

The overheating protection function is built in the XS8302, it can effectively protect the chip from be damaged under the abnormal working conditions.

Shutdown function

In order to reduce power consumption while not in use, the XS8302 contains shutdown circuitry that is used to turn off the amplifier's bias circuitry.
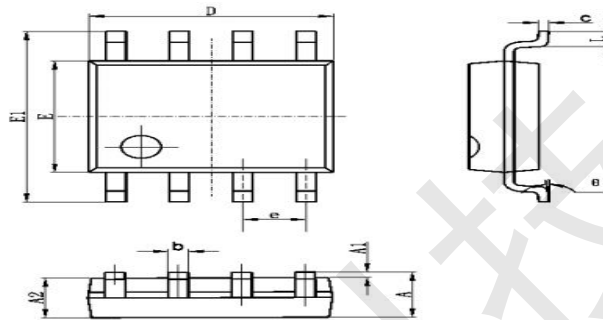
The $\overline{\text{SD}}$ pin controls the amplifier's shutdown mode, the amplifier can be shutdown with a low level logic

signal to the $\overline{\text{SD}}$ pin.
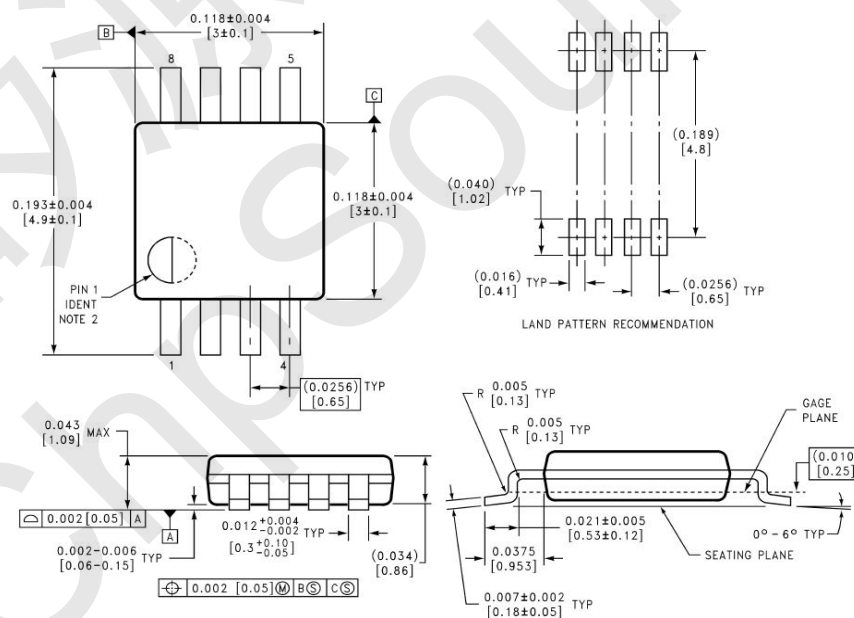
XS8302 Package Information

1、XS8302 SOP8

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

2、XS8302 MSOP8

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