矽源特科技
ChipSourceTek

XS9110A
User Manual

XS9110A

25W ultra-low EMI mono

class AB/D APA

2020/10

XS9110A

XS9110A General Description:

The XS9110A is a 25W, class AB/D mono audio amplifier. It is capable of delivering 25watts of continuous average power to a 4Ω BTL load with less than 10% distortion (THD) from a 14.4V DC power supply. It offers low THD+N, allowing it to achieve high-quality sound reproduction. The XS9110A device is fully protected against faults with short-circuit protection and thermal protection. Can prevent devices form being damaged during overload conditions.

The XS9110A features a low-power consumption shutdown mode.

The XS9110A contains advanced pop & click circuitry which eliminates noise which would otherwise occur during turn-on and turn-off transitions. The XS9110A can be configured by external gain-setting resistors.

The XS9110A integrates overheating protection mechanism, The XS9110A is unity-gain stable and can be configured by external gain-setting resistors. The XS9110A can provide your USB subwoofer, radio, Sound bar, and loudspeaker perfect solution.

XS9110A Features:

♦ Fully-differential class AB/D audio power amplifier

♦Available in space-saving packages: ESOP8

♦ 25W Output Power (10% THD, 4Ω load, 14.4V)

♦ 23.5W Output Power (10% THD, 3Ω load, 12V)

♦ 12.5W Output Power (10% THD, 2Ω load, 7.4V)

♦ Wide operating voltage range: 5V~15V

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

♦ Overheating protection

♦ Filterless, Low Quiescent Current and Low EMI

XS9110A Applications:

·Card inserting speaker, Bluetooth speaker

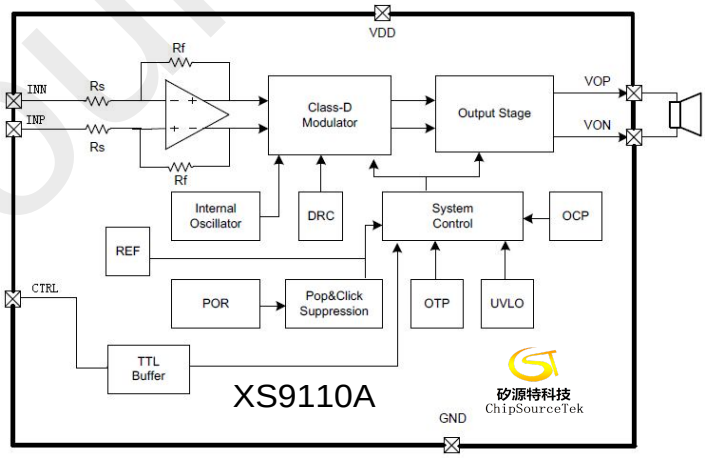
·Mini-Micro Component, Speaker Bar, Docks

·Sound Bar

·Square Speaker

Block diagram

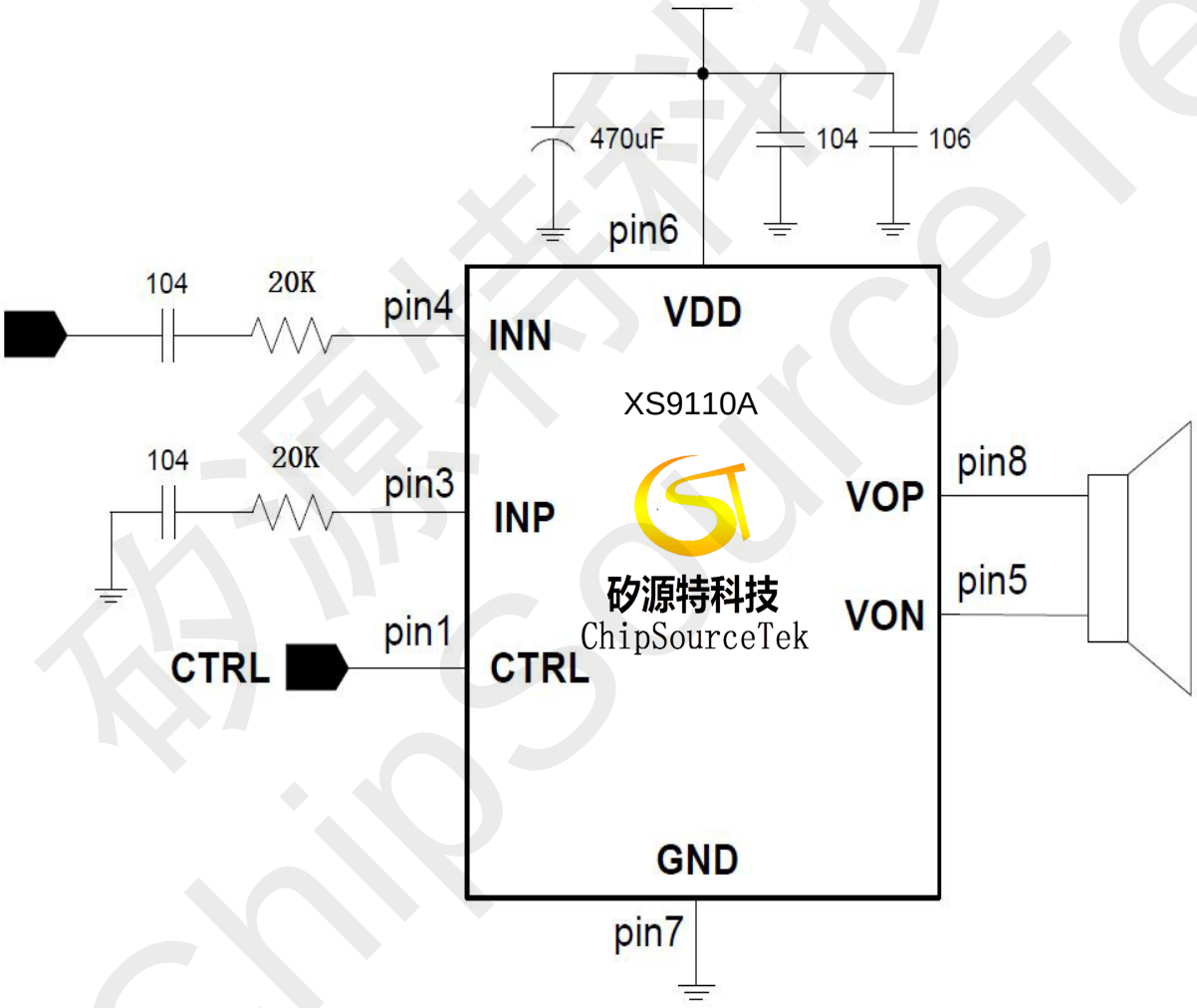
XS9110A



XS9110A Ordering Information:

Part Number	Package Type	Shipping Package（PCS）	Note
XS9110A	ESOP8	100 Units/Tube	

XS9110A Typical Application Circuit:



Picture 1. The XS9110A Typical Application Circuit

XS9110A Pin Distribution:

ESOP8 Pin Distribution

XS9110A Pin description (ESOP8):

Pin Number	Symbol	Description
1	CTRL	Shutdown Control Input(active low), the amplifier is turned off with a low level logic signal to the CTRL pin.
2	NC	
3	INP	The positive phase 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

XS9110A Absolute Maximum Ratings:

Absolute Maximum Ratings

Name	Description	Parameter
VCC	Supply Voltage	5V~16V
V_I	Input voltage	－0.3V~VCC＋0.3V
T_A	Operating free-air temperature range	－40℃~+85℃
T_J	Junction Temperature	－40℃~+150℃
T_{stg}	Storage Temperature	-65℃~+150℃
Tw	Welding temperature	260℃

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

XS9110A Recommended operating conditions:

- Recommended operating conditions

Name	Test Conditions		Min	Max	Units
VDD，	Supply Voltage		5	15	V
VIH	High-level input voltage	CTRL	1.3		V
VIL	Low-level input voltage	CTRL		0.5	V
TA	Operating free-air temperature range		-40	85	℃

XS9110A Electrical Characteristics:

Chip characteristics TA = 25°C (Unless otherwise noted)							
Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
VDD	Input voltage range			5	12	14.4	V
$I_{(Q)}$	Quiescent Power Supply Current	V_{DD}= 9V, no load			12		mA
$I_{(SD)}$	Shutdown Current	V_{DD}=12V			2		μA
VOS	Output Offset Voltage	VIN = 0V			10		mV
$f_{(sw)}$	Switching frequency	V_{DD}= 2V to 5.5V	frequency		330		kHz
			duty cycle		50		%
Po	Output Power	THD+N=10%,f=1kHz, R_L=2Ω	V_{DD}=7.4V		12.5		W
		THD+N=1%,f=1kHz, R_L=2Ω	V_{DD}=7.4V		10		
		THD+N=10%,f=1kHz, R_L=4Ω	V_{DD}=14.4V		25		
		THD+N=10%,f=1kHz, R_L=4Ω	V_{DD}=12V		19		
THD+N	Total Harmonic Distortion+Noise	V_{DD}=5V,P_O=1W, R_L=8Ω, f=1kHz			0.08		%

XS9110A APPLICATION INFORMATION:

The input resistance (Ri) selection

The XS9110A 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:

$$Gain = \frac{2 \times 450K\Omega}{12K\Omega + Ri} \quad (4)$$

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.

$$f_c = \frac{1}{2\pi RiCi} \quad (5)$$

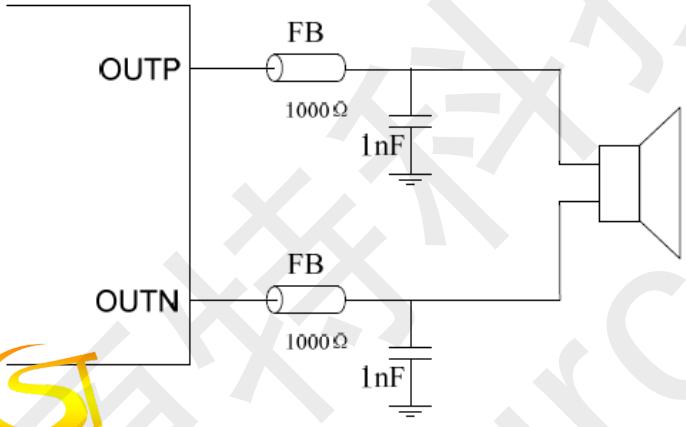
The value of Ci is important, as it directly affects the bass (low-frequency) performance of the circuit. Consider the example where Zi is 20kΩ and the specification calls for a flat bass response down to 20Hz. Equation 5 is reconfigured as Equation 6.

$$Ci = \frac{1}{2\pi Rifc} \quad (6)$$

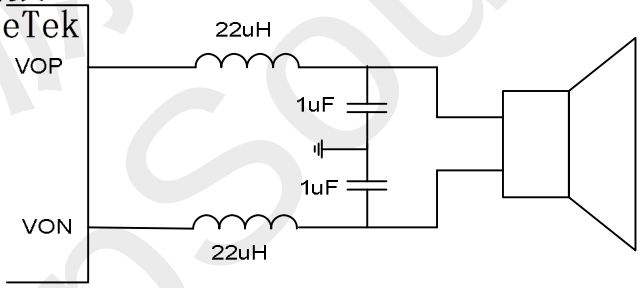
In this example, Ci is 56.8nF, so one would likely choose a value in the range of 56nF to 1μF. A further consideration for this capacitor is the leakage path from the input source through the input network (Ci) and the feedback network to the load. This leakage current creates a DC offset voltage at 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.

XS9110A When to use an output filter for EMI suppression :

Design the XS9110A 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

XS9110A Protection function model:

XS9110A is an AB/D audio power amplifier with built-in multiple protection functions such as undervoltage, overheating, overcurrent and short circuit protection. Effectively protect the chip from damage under abnormal working conditions.

XS9110A Shutdown function:

In order to reduce power consumption while not in use, the XS9110A contains shutdown circuitry that is used to turn off the amplifier's bias circuitry.

The CTRL pin can control the opening and closing of the power amplifier. At the same time, the power amplifier can be configured to work in class D or class AB mode through the level setting on the pin, and the

pin level can be controlled through the external voltage dividing resistor.

Table 6 Relationship between chip working mode and Ctrl pin voltage

CTRL pin voltage	Working Mode
-0.3V~0.5V	Low power shutdown mode
1.2V~2V	Class AB working mode
2.2V~VDD	Class D working mode

In practical application, it can be set through two GPIO ports and resistor network. As shown in the following figure, the level values of SD and AB/D ports are set to "H" (vio) or "L" (GND) through the GPIO interface .

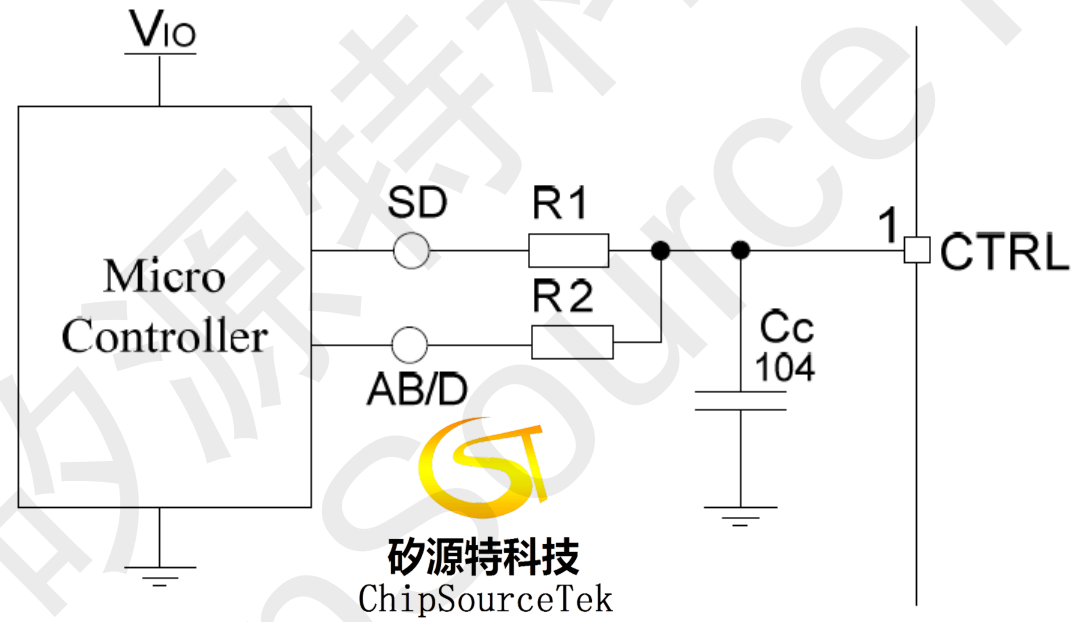


Figure 3 Ctrl pin external device settings

XS9110A PCB layout suggestions:

In most applications, the use of magnetic bead filters can meet EMC requirements. However, the switching edge of class D power amplifier changes very quickly, so it needs to be carefully considered in the process of PCB layout. For noise and electromagnetic compatibility (EMC) requirements of the system, the following suggestions are made:

1. The decoupling capacitor on the power supply should be as close to the ground pin of the power supply as possible. For different noise sources and corresponding power decoupling capacitors that interfere, patch positions should be reserved.

2. The output current loop should be as small as possible. Whether it is a filter composed of magnetic beads

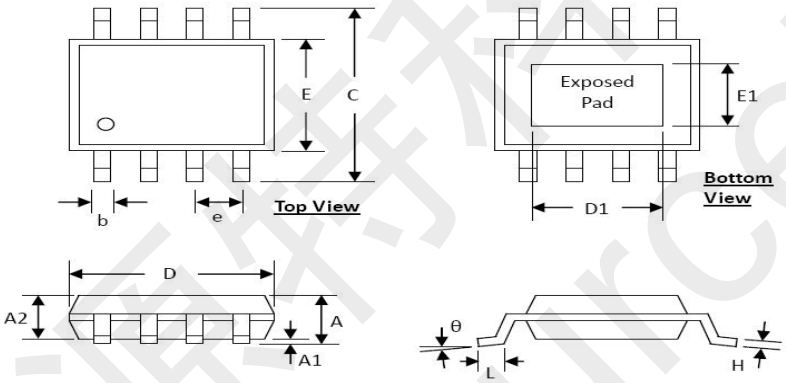
or inductors and capacitors, it should be as close to the output pin as possible. This part of the circuit shall be as far away from sensitive signal lines (such as audio input signal lines) and circuits as possible.

3. The ground wire and power line shall be as short as possible and the wiring shall be widened as much as possible.

4. The heat sink should be reasonably welded in the heat dissipation area of the PCB, and copper foil should be laid in the area near the chip to strengthen the heat dissipation of the chip and PCB.

XS9110A Package Information:

1、ESOP8



SYMBOLS	DIMENSION (MM)		DIMENSION (INCH)	
	MIN	MAX	MIN	MAX
A	1.30	1.70	0.051	0.067
A1	0.00	0.15	0.000	0.006
A2	1.25	1.52	0.049	0.060
b	0.33	0.51	0.013	0.020
C	5.80	6.20	0.228	0.244
D	4.80	5.00	0.189	0.197
D1	3.15	3.45	0.124	0.136
E	3.80	4.00	0.150	0.157
E1	2.26	2.56	0.089	0.101
e	1.27 BSC		0.050 BSC	
H	0.19	0.25	0.0075	0.0098
L	0.41	1.27	0.016	0.050
θ	0°	8°	0°	8°