NS4168user manualV0.9

TEL: 0755-82863877 13242913995 E-MAIL: panxia168@126.com http://www.szczkjgs.com

2015year03moon

revision history

date	Version	author	Modify the description

Table of contents

Figure catalog

table directory

1 Function Description

NS4168is a supportI2SDigital audio signal input, output with anti-distortion function,2.5WMonoD.Class audio power amplifier.NS4168Especially suitable for environments that are sensitive to power consumption and generate interference. such as bluetooth speakers,WiFiStereo, tablet, etc. In these application environments, system noise can corrupt small analog signals sent to the amplifier, whileI2SThe standard is digitally sent to the audio amplifier, which significantly reduces the influence of noise sources on the transmitted audio; in addition, it avoids theMCUThe main control chip has built-in audio decodingDACThe noise brought by it will eventually get a higher signal-to-noise ratio and less distortion; no need to use input coupling capacitors, throughCTRLThe pin detects one-line pulse to select the turning point of the internal input high-pass filter to match different speakers.layoutThere is no need to carefully consider the layout and wiring of the audio power amplifier, the periphery is more concise, and the debugging is more convenient.

NS4168Its unique anti-distortion function can effectively prevent output signal distortion caused by input signal overload and battery voltage drop, and can effectively protect the speaker from being damaged during high-power output.

NS4168Utilizes a high efficiency, low noise modulation scheme that requires no externalLCoutput filter. The closed-loop multilevel modulator design retains the high efficiency benefits of a purely digital amplifier while providing excellentPSRRand audio performance. with otherD.Using spread-spectrum pulse density modulation provides lower electromagnetic emissions compared to similar architectures.NS4168exist5Vworking voltage, able to4Ωload provided2.5Woutput power.

NS4168It is a mono audio amplifier. Left and right channel selection viaCTRLPin level setting. Stereo products can choose two chips, which is very flexible.

NS4168Built-in over-current protection, over-heat protection and under-voltage protection functions can effectively protect the chip from being damaged under abnormal working conditions. supplyeSOP8package, rated for the operating temperature range of -40°C to85℃.

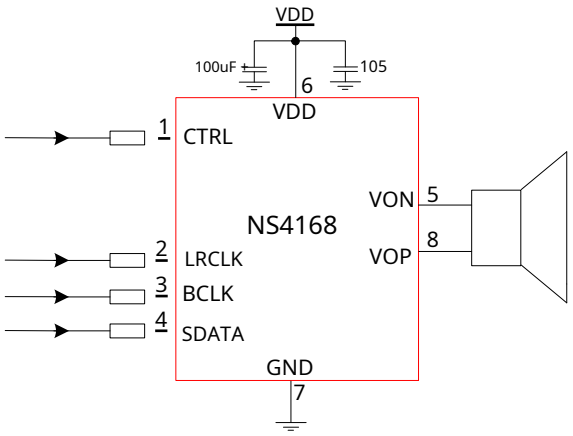
2 main features

- I2SSerial digital audio input interface
- Wide range of sample rates supported:8kHz~96kHz
- Automatic sampling rate detection, adaptive function
- Built-in digital high-pass filter, one-line pulse sets its turning point
- The left and right audio channels are optional, throughCTRLPin level setting
- anti-aliasingNCNFunction,
- without filterClass DAmplifier output power:2.5W
- (VDD=5V, RL=4Ω) Working voltage range:3.0V~
- 5.5V 0.2%THD(VDD=5V, RL=4Ω, Po=1W) 80%s
- efficiency(VDD=5V, RL=4Ω, Po=2.5W) Excellent
- "Power On, Power Down" Noise Suppression
-
- Overcurrent protection, overheat protection, undervoltage protection
- eSOP8encapsulation

3 Application field

- Bluetooth audio
- WiFiAudio
- Other portable audio

4 Typical Application Circuit



picture1 NS4168Typical Application Circuit

5 Limit parameter

surface1 The maximum physical limit of the chip

parameter	small value	large value	unit	illustrate
voltage	2.8	5.5	V	
CTRL	- 0.3	VDD	V	
LRCLK	- 0.3	VDD	V	
BCLK	- 0.3	VDD	V	
SDATA	- 0.3	VDD	V	
ResistanceESDVoltage	4000		V	
junction temperature	150		oC	
Recommended working temperature	- 40	85	oC	
Recommended working voltage	3	5.25		
thermal resistance				
-JC(eSOP8)		20	oC/W	
-JA(eSOP8)		80	oC/W	
Soldering temperature-		220	oC	15within seconds

Note: Operational performance of the chip is not guaranteed outside the limits or under any other conditions.

6 electrical characteristics

Restrictions: (TA=25°C,VDD=5.0V)

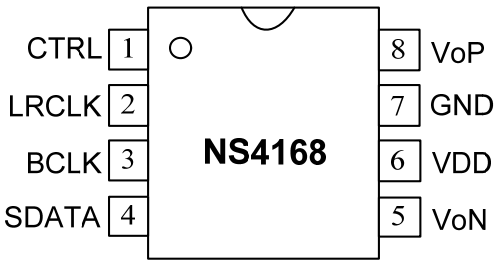
surface2 NS4168electrical characteristics

symbol	parameter	Test Conditions	small value	standard value	large value	unit
VDD	voltage		3		5. 25	V
IDD	Power Quiescent Current	VDD=5.0V, VIN=0V,no load		13		mA
ISD	OFF Leakage Current	VCTRL=0V		1		μA

V_{OS}	Output offset voltage			10	40	mV
PSRR	Power Supply Rejection Ratio	217Hz			- 80	dB
		20KHz			- 72	dB
CMRR	Common Mode Rejection Ratio			- 70		dB
f_{SW}	modulation frequency	V_{DD}=3V to 5.25V		430		kHz
n	efficiency	Po=2.5W,R_L=4Ω,		80		%
V_{CTRL}	CTRLThreshold	right channel input	1.5		VDD	V
		left channel input	0.9		1.15	
		ShutdownLow Power Shutdown			0.4	
T_{HI}	CTRLOne-line pulse high level time		1		12	us
T_{LO}	CTRLlow line pulse level time		1		12	us
T_{OFF}	CTRLoff time		100			us
t_{AT}	Attack time	V_{DD}=3.6V		10		ms
t_{RL}	Release time	V_{DD}=3.6V		1.1		the s
P_o	Output Power	V_{DD}=3.6V		1.2		W
		V_{DD}=5V		2.5		W
THD+N	Total Distortion + Noise	f=1kHz R_L=4Ω, P_o=1.0W		0.2		%
SNR	SNR	RL=4Ω, Po=2.0W		85		dB
A_{MAX}	Large attenuation gain			- 10		dB

7 Chip pin description

7.1 NS4168Package Pin Assignment Diagram



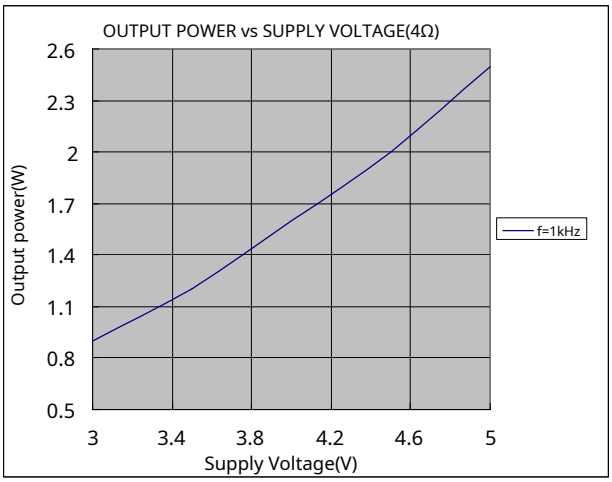
picture2 NS4168Package Pin Assignment Diagram (top view)

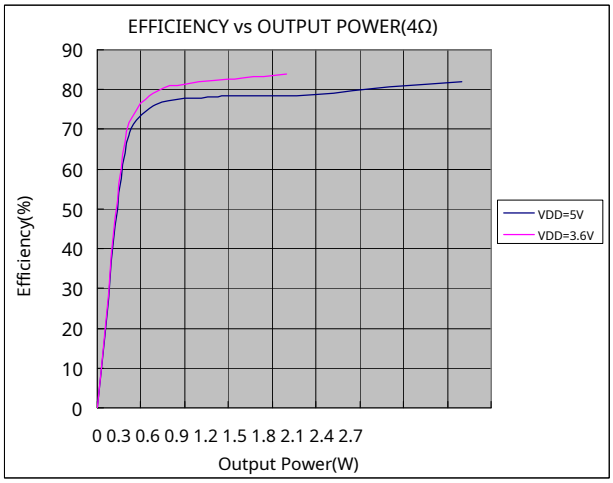
7.2 NS4168Pin function description

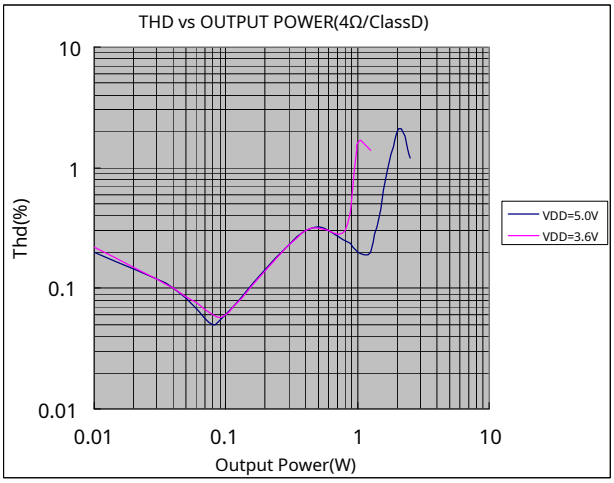
surface3 NS4168Pin Description

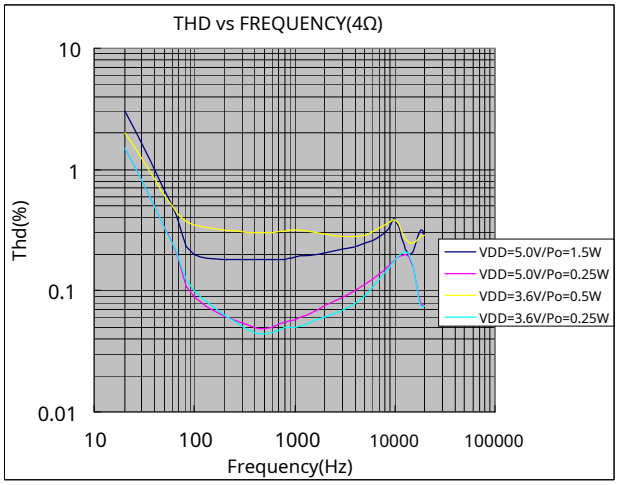
symbol	pin number	describe
CTRL	1	Control pins (see below for details)
LRCLK	2	I2SLeft and right channel frame clock
BCLK	3	I2Sbit clock
SDATA	4	I2Sserial data
VoN	5	Negative output
VDD	6	power input
GND	7	power ground
VoP	8	positive output

8 NS4168Typical Reference Characteristics





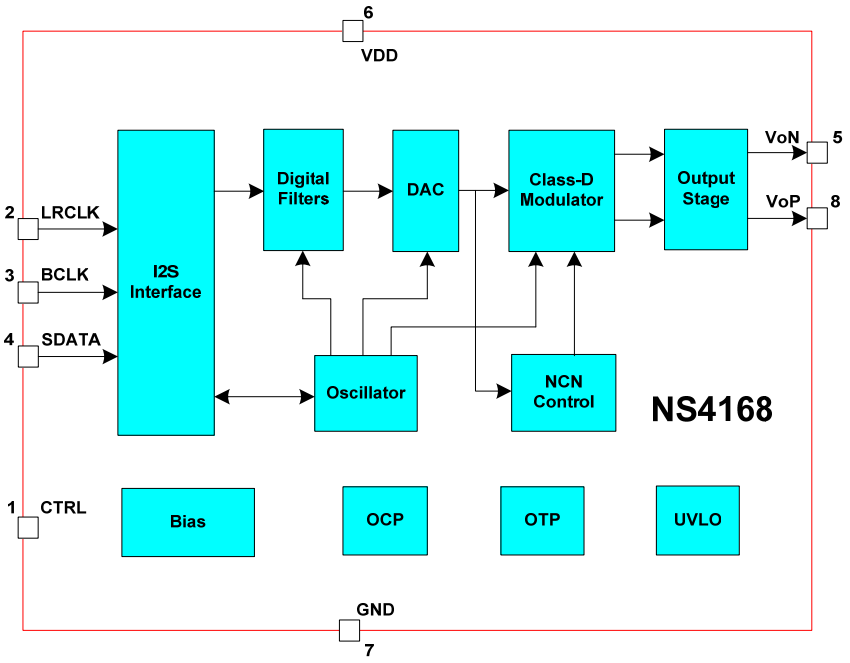




9 NS4168application note

9.1Chip basic structure description

NS4168is a supportI2SDigital audio signal input, output with anti-distortion function,2.5WMonoD.Class audio power amplifier, bridge output. Its principle block diagram is as follows:

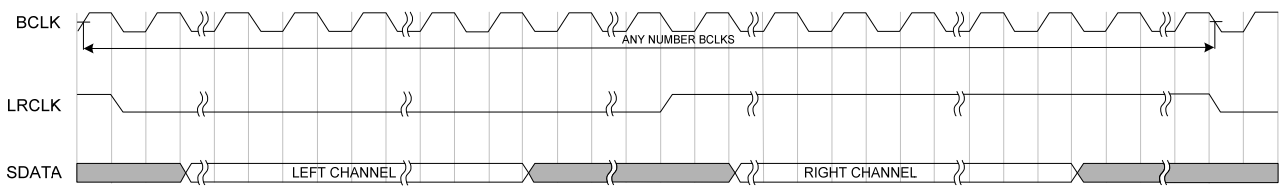


picture3 NS4168Principle block diagram

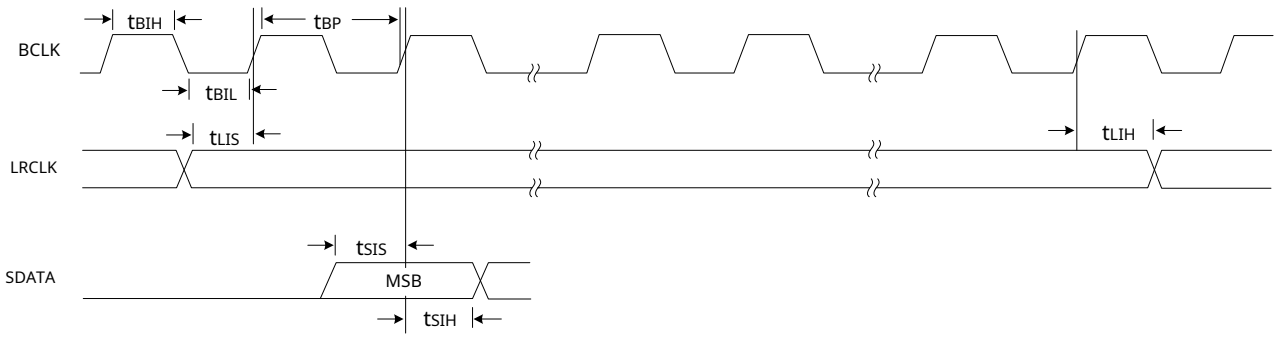
9.2 I2SDigital input serial audio interface

9.2.1 I2Sdigital audio format

NS4168supportI2SDigital audio signal input. standardI2SHave3main signal: serial clockBCLK, the frame clockLRCLK, serial dataSDATA. serial clockBCLK Also called bit clock, which corresponds to each bit of digital audio data. frame clockLRCLKThe data used to switch the left and right channels.LRCLKfor"1" Indicates that the data of the right channel is being transmitted, which is "0"It means that the data of the left channel is being transmitted,LRCLKThe frequency of is equal to the sampling frequency. serial dataSDATAIt is the audio data expressed in two's complement.I2SThe digital audio format is as follows:



picture4 I2Sdigital audio format



picture5 I2SDigital Audio Timing Diagram

surface4Timing parameter table

parameter	small value	unit	describe
t_{BIL}	40	ns	BCLKLow level pulse width
t_{BIH}	40	ns	BCLKHigh level pulse width
t_{LIS}	10	ns	LRCLKorSDATAedge toBCLKRising Edge Setup Time
t_{LIH}	10	ns	BCLKrising edge toLRCLKorSDATAedge hold time
t_{SIS}	10	ns	SDATAarriveBCLKRising Edge Setup Time
t_{SIH}	10	ns	BCLKrising edge toSDATAhold time

9.2.2 left and right channel settings

NS4168is a mono power amplifier, while the standardI2SThe protocol is to transmit left and right two-channel signals.NS4168passpin1(CTRL) pin level setting to select the left or right channel signal. See the relevant sections below for details.

9.3Input channel selection and input high-pass filter setting

NS4168Input channel selection and input high-pass filter turning point setting are all throughCTRLpin implementation.

9.3.1 Input channel selection

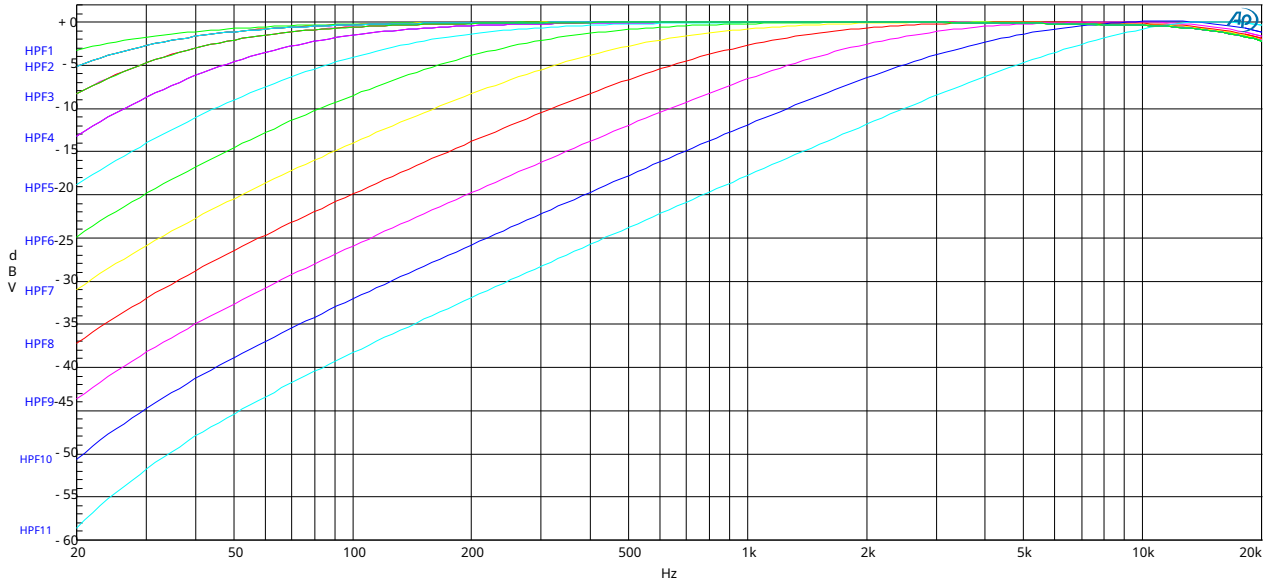
NS4168Input channel selection viaCTRLThe level setting of the pin.CTRLThe pin voltage is0.9V~1.15V, select the left channel; CTRLThe pin voltage is1.5V~VDD, select the right channel. As shown in the table below:

surface5Channel selection settings

CTRL pin voltage	sound track
0.9V~1.15V	left channel
1.5V~VDD	right channel

9.3.2 Enter the high-pass filter settings

NS4168The input has a high-pass filter, the corner frequency of the filter is passedCTRLPin line pulse setting, there are a total of11 optional, respectivelyHPF1~HPF11. As shown below(VDD=5V):

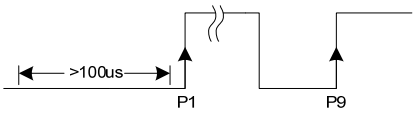
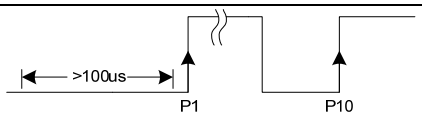
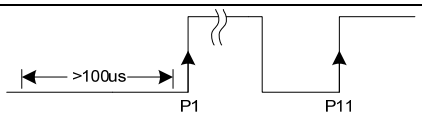


picture6 NS4168Input high-pass filter frequency response curve

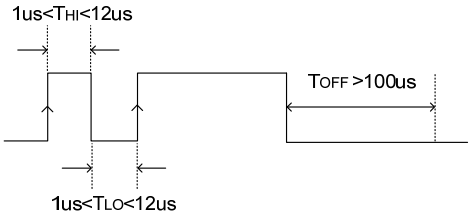
The number and waveform of corresponding one-line pulses are as follows:

surface6Correspondence between one-line pulse waveform and high-pass filter

CTRLPin line pulse waveform	Number of rising edges of one-line pulse	Corresponding high-pass filter	filter-3dBturning point (typical value)
>100us P1 P12	12	HPF1	20Hz
>100us P1	1	HPF2	28Hz
>100us P1 P3	3	HPF3	40Hz
>100us P1 P4	4	HPF4	65Hz
>100us P1 P5	5	HPF5	120Hz
>100us P1 P6	6	HPF6	240Hz
>100us P1 P7	7	HPF7	458Hz
>100us P1 P8	8	HPF8	910Hz

	9	HPF9	1.82kHz
	10	HPF10	3.5kHz
	11	HPF11	6.6kHz

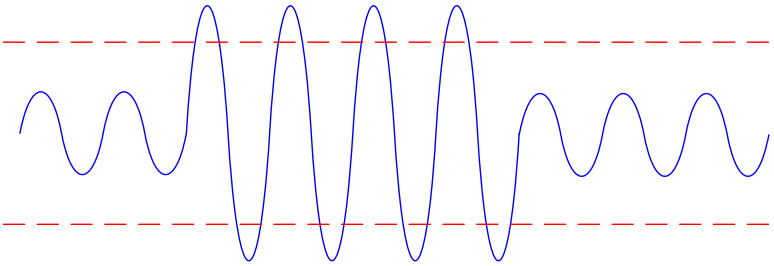
Add in toCTRLOne-line pulse high level width of the pin (T_{HI})Require1us<T_{HI}<12us. Low Width (T_{LO})Require 1us<T_{LO} <12us. EnterSHUTDOWNmode low hold time (T_{OFF})RequireT_{OFF}>100us. The timing diagram is as follows:



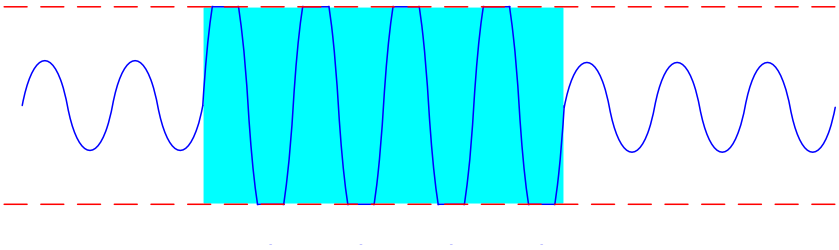
picture7One-line pulse timing diagram

9.4Anti-aliasing (NCN)Function

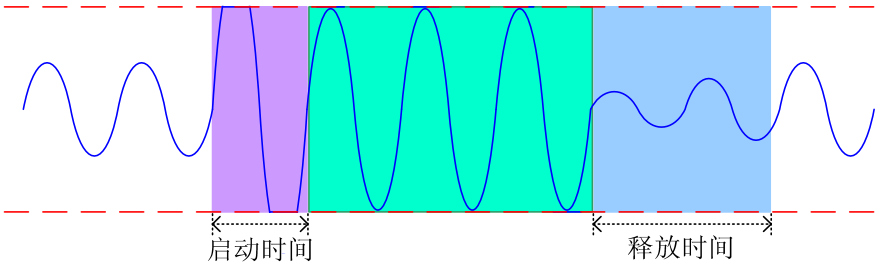
NS4168With anti-distortion function. The anti-distortion function can effectively prevent the output signal from being distorted due to input signal overload and battery voltage drop. It can effectively protect the speaker from being damaged during high power output. The principle is: the amplifier automatically detects the output clipping distortion, and automatically adjusts the amplifier Amplifier gain to achieve anti-distortion effect. As shown below:



picture8Audio output signal assuming no supply voltage limitation



picture9Audio output signal in normal working mode



picture10Audio output signal in anti-aliasing mode of operation

9.5Power filter capacitor selection

In the application of the amplifier, the bypass design of the power supply is very important, especially for the noise performance and power supply voltage suppression performance of the application scheme. The design requires that the filter capacitor be as close as possible to the power supply pin of the chip. Typical capacitance is100uFcapacitor and on1uFof ceramic capacitors.

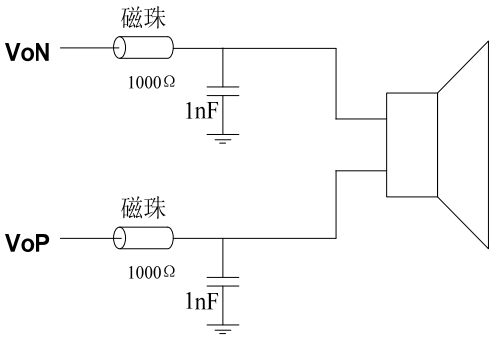
9.6protect the circuit

When the chip has a short circuit between the output pin and the power supply or ground, or a short circuit fault between the outputs, the overcurrent protection circuit will shut down the chip to prevent the chip from being damaged. After the short circuit fault is eliminated,NS4168Automatically resume work. When the chip temperature is too high, the chip will also be shut down. After the temperature drops,NS4168Continue to work normally. When the power supply voltage is too low, the chip will also be shut down, and after the power supply voltage recovers, the chip will start again.

9.7 layoutSuggest

NS4168 is a class D amplifier, EMI interference should be considered during layout. EMI interference can be minimized from the following aspects during application:

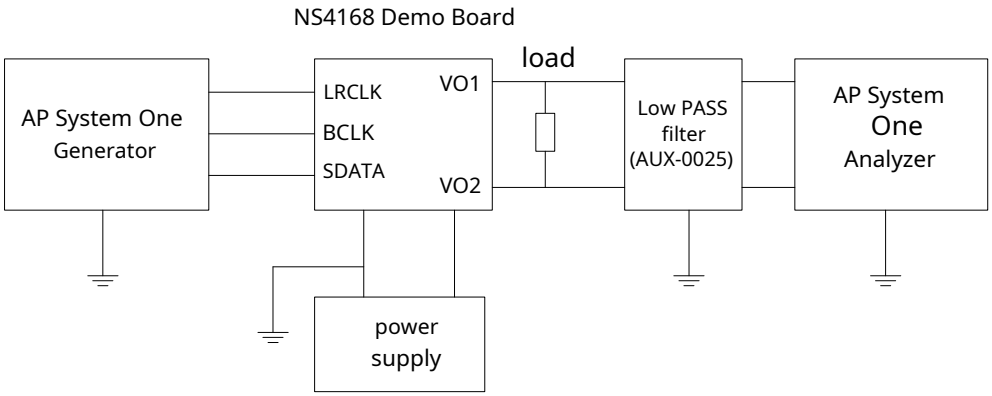
1. The wiring from the power amplifier output to the speaker should be as short and wide as possible, and the output wiring should be as far away from sensitive signal lines and circuits as possible.
2. The decoupling capacitor of the power amplifier power supply pin should be as close as possible to the chip pin. The power line and the ground wire are preferably star-connected.
3. Due to space constraints and other reasons, when the application environment is relatively harsh, adding magnetic beads and capacitors at the output end can effectively suppressEMIinterference. When using, the magnetic beads and capacitors should be as close as possible to the chip pins. The following isNS4168Application design reference circuit after adding magnetic beads and capacitors to the output:



picture11Application Diagram of Adding Magnetic Beads at the Output Terminal

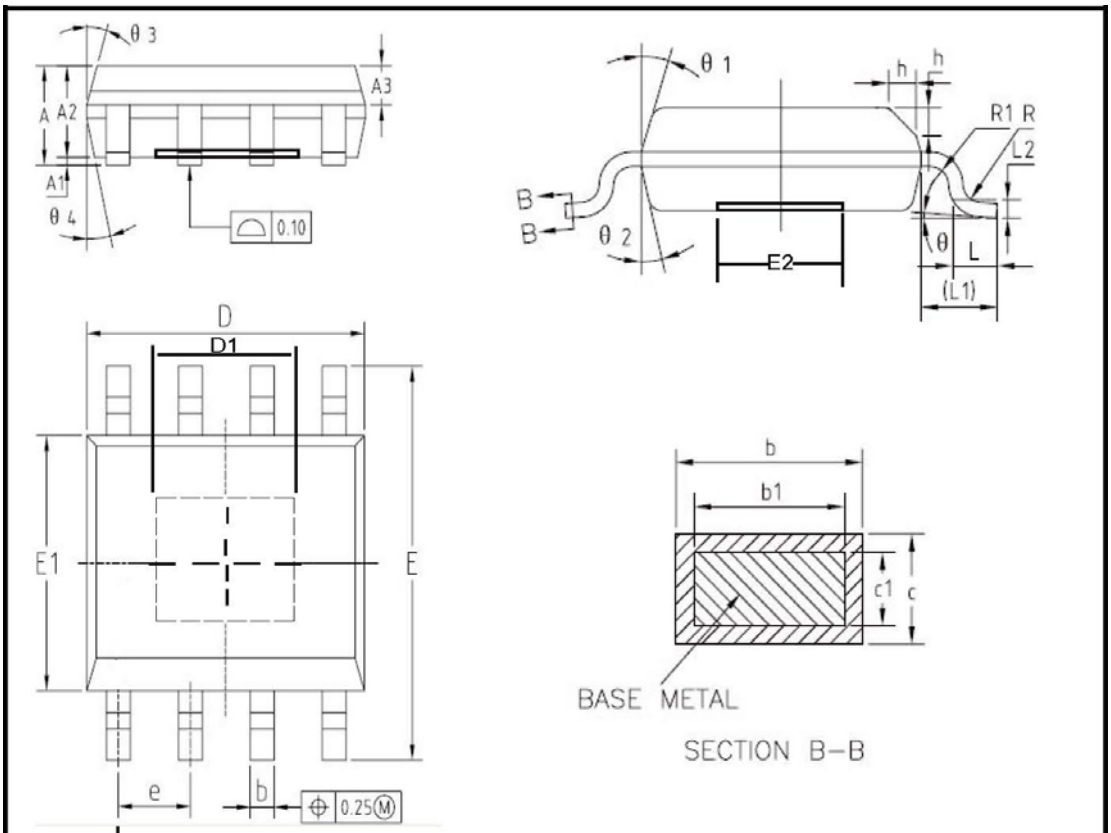
9.8test circuit

NS4168The test circuit is as shown in the figure below, and the measurementD.When using a class-mode power amplifier, the low-pass filter (Low PASS Filter)is required. can use two33uHThe inductance of the load resistor is connected in series to the equivalent speaker. If only pure resistance is used to replace the speaker load, the measured results will be worse than those when the speaker is used as the load, including power, efficiency, distortion and other indicators.



picture12 NS4168test circuit

10 Chip packaging



	MIN	NOM	MAX		MIN	NOM	MAX
A	1.450	1.550	1.650	e		1.270	
A1	0.100	0.150	0.200	L	0.450	0.600	0.750
A2	1.250	1.400	1.650	L1		1.040	
A3	0.550	0.600	0.650	L2		0.250	
b	0.380	–	0.510	R	0.070	–	–
b1	0.370	0.420	0.470	R1	0.070	–	–
c	0.170	–	0.250	h	0.300	0.400	0.500
c1	0.170	0.200	0.230	θ	0.000	–	6.000
D	4.850	4.900	4.950	θ1	15.000	17.000	19.000
E	5.850	6.000	6.150	θ2	11.000	13.000	15.000
E1	3.850	3.900	3.950	θ3	15.000	17.000	19.000
E2	1.9	2.0	2.2	θ4	11.000	13.000	15.000
D1	1.9	2.0	2.2				

picture13 eSOP-8Package Dimensions