



AiP9971 5W Class-AB /D Optional Audio Power Amplifier

Product Specification

Specification Revision History:

Version	Date	Description
2012-12-A1	2012-12	New
2019-12-A2	2019-12	Modify the ordering information
2022-02-A3	2022-02	Modify the content; Modify the ordering information
2022-11-B1	2022-11	Update the template
2023-12-B2	2023-12	Modify the title



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7.2、Notion.....	错误!未定义书签。



1、General Description

AiP9971 is an AB/D Type optional power amplifier. By controlling SD to enter the shutdown mode, power consumption can be reduced. The AiP9971 has an internal overheat protection mechanism and is unit gain stable. The application peripheral of the AiP9971 is simple. The output does not require external coupling capacitors, bootstrap capacitors or buffer networks. The feedback resistor is built-in. By configuring the peripheral parameters, the voltage gain and sound quality effect of the amplifier can be adjusted, which is convenient for application.

AiP9971 is mainly used in bluetooth speakers, smart speakers, navigators, portable game consoles, trolley speakers, smart homes and other audio products.

Features:

- Output power is high (THD+N<10%, 1kHz frequency):
ESOP packages are 5W (2Ω load), 3.5W (3Ω load) and 3W (4Ω load).
- Low leakage current in shutdown mode
- Adjustable external gain, integrated feedback resistor
- Wide operating voltage range: 2.0V to 5.5V
- No need to drive output coupling capacitor, bootstrap capacitor and buffer network
- Stable unity gain
- Package form: MSOP8/SOP8/DIP8/ESOP8



Ordering Information:

Tube packing specifications:

Part number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Notes
AiP9971SA8.TB	SOP8	AiP9971	100 PCS/tube	100 tube/box	10000 PCS/box	Dimensions of plastic enclosure: 4.9mm×3.9mm Pin spacing: 1.27mm
AiP9971DA8.TB	DIP8	AiP9971	50 PCS/tube	40 tube/box	2000 PCS/box	Dimensions of plastic enclosure: 9.2mm×6.4mm Pin spacing: 2.54mm
AiP9971SE8.TB	ESOP8	AiP9971	100 PCS/tube	100 tube/box	10000 PCS/box	Dimensions of plastic enclosure: 4.9mm×3.9mm Pin spacing: 1.27mm
AiP9971MA8.TB	MSOP8	AiP9971	100 PCS/tube	100 tube/box	10000 PCS/box	Dimensions of plastic enclosure: 3.0mm×3.0mm Pin spacing: 0.65mm

Reel packing specifications:

Part number	Packaging form	Marking code	Reel quantity	Boxed reel quantity	Notes
AiP9971SA8.TR	SOP8	AiP9971	4000 PCS/reel	8000 PCS/box	Dimensions of plastic enclosure: 4.9mm×3.9mm Pin spacing: 1.27mm
AiP9971MA8.TR	MSOP8	AiP9971	5000 PCS/reel	10000 PCS/box	Dimensions of plastic enclosure: 3.0mm×3.0mm Pin spacing: 0.65mm
AiP9971SE8.TR	ESOP8	AiP9971	4000 PCS/reel	8000 PCS/box	Dimensions of plastic enclosure: 4.9mm×3.9mm Pin spacing: 1.27mm

Note: If the physical information is inconsistent with the ordering information, please refer to the actual product.



2、Pin Description

2.1、Pin Configurations

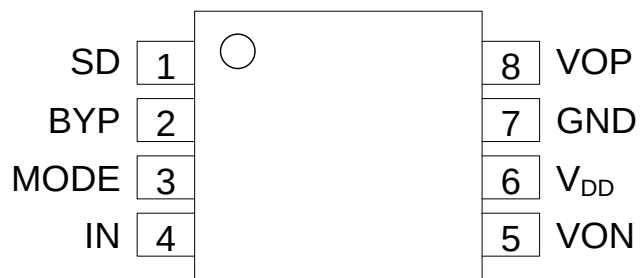


Figure 1. Pin Configuration

2.2、Pin Description

Pin	Symbol	Description
1	SD	Shut Down Control Pin, Active High
2	BYP	External built-in common-mode voltage bypass filter capacitor
3	MODE	AB/D Type Mode Selection, High level is D Type Mode; low level is AB Type Mode, built-in pull-down resistor
4	IN	Audio signal input
5	VON	Power Output Port Negative Pole
6	V _{DD}	Power Supply
7	GND	Ground
8	VOP	Power Output Port Positive Pole

3、Electrical Parameter

3.1、Absolute Maximum Ratings

(T_{amb}=25℃, unless otherwise specified.)

Parameter	Symbol	Value		Unit
Supply Voltage	V _{DD}	5.8		V
Input Voltage	V _I	-0.3 to V _{DD} +0.3		V
Ambient Temperature	T _{amb}	-40 to +85		℃
Storage Temperature	T _{stg}	-65 to +150		℃
Soldering Temperature	T _L	ESOP8/MSOP8/SOP8	260	℃
		DIP8	250	

3.2、Recommended Operating Conditions

Parameter	Symbol	Value			Unit
		Min.	Typ.	Max.	
Temperature Range	T _{amb}	-20	-	85	℃
Supply Voltage	V _{DD}	2.0	-	5.5	V



3.3、DC Characteristics

($T_{amb}=25^{\circ}\text{C}$, $V_{DD}=5.0\text{V}$, unless otherwise specified.)

Parameter		Symbol	Conditions		Min.	Typ.	Max.	Unit
Supply Voltage		V _{DD}	V _{IN} =1V _{pp} , f=1kHz		2	-	5.5	V
Quiescent Current		I _{DD1}	SD is set as “Low”, no load	D Type	-	8	-	mA
				AB Type	-	38	50	mA
Standby Current		I _{DD2}	SD is set as “High”		-	-	1	uA
Input High Level Voltage	SD	V _{IH}	V _{IN} =1V _{pp} , f=1kHz		0.7V _{DD}	-	-	V
	MODE				0.7V _{DD}	-	-	
Input Low Level Voltage	SD	V _{IL}			-	-	0.2V _{DD}	V
	MODE				-	-	0.2V _{DD}	
Input High Level Current	SD	I _{IH}	V _I =5.0V		-	-	20	uA
	MODE				-	-	20	
Input Low Level Current	SD	I _{IL}	V _I =0V		-	-	20	
	MODE				-	-	20	
IN Input Leakage Current		I _{SO}	To power supply		-	-	200	uA
			To GND		-	-	200	

3.4、AC Characteristics

($T_{amb}=25^{\circ}\text{C}$, $V_{DD}=5\text{V}$, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Impedance	Z_I	-	-	40	-	K Ω
Power Dissipation (AB Type)	P_o	THD=10%, $f=1\text{kHz}$, $R_L=2\Omega$	-	4	-	W
		THD=10%, $f=1\text{kHz}$, $R_L=3\Omega$	-	3.5	-	
		THD=10%, $f=1\text{kHz}$, $R_L=4\Omega$	-	3	-	
Distortion (Without Load)	THD+N	$f=100\text{Hz}$, 2V_{pp}	-	-	0.1	%
		$f=1\text{kHz}$, 2V_{pp}	-	-	0.1	
		$f=10\text{kHz}$, 2V_{pp}	-	-	0.1	
Output Noise Voltage	Noise	Input is suspended	-	-	10	mV
		Input is routed to the ground.	-	-	5	
Signal-Noise Ratio	SNR	$V_{IN}=2\text{V}_{rms}$, $f=1\text{kHz}$	-	60	-	dB
Power Dissipation (D Type)	P_O	THD=10%, $f=1\text{kHz}$, $R_L=2\Omega$	-	4	-	W
		THD=10%, $f=1\text{kHz}$, $R_L=3\Omega$	-	3.5	-	
		THD=10%, $f=1\text{kHz}$, $R_L=4\Omega$	-	3	-	
D Type Amplifier Efficiency	η	THD=10%, $f=1\text{kHz}$	-	80	-	%
D Type Amplifier Frequency	f	-	-	480	-	kHz



4、Function Description

4.1、General Information

The input signal is input from the IN terminal, and after amplification, it is differentially output by VOP and VON. The gain of the amplifier is 29 times, and the input signal at IN terminal is converted into a differential signal. By default, the amplitude of the effective input signal is not higher than 60mV.

4.2、Adjustable Gain

When IN port is serial connected to a resistor R_i , it is shown as Figure 2; the gain of AiP9971 is no longer 29 times, and the new gain is calculated by:

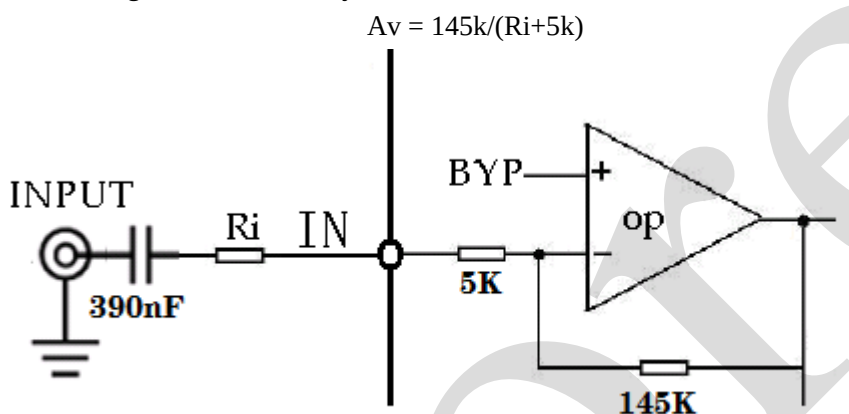


Figure 2 Gain Adjustable Diagram

4.3、Power Supply and Bypass

For any power amplifier, stable power supply and Bypass are critical for low noise operation. Capacitors on Bypass and power supply should be as close to chip pins as possible. Increasing the stability of power supply and larger Bypass capacitor can effectively improve THD+N. In a typical application circuit, a 470μF and a 1μF filter capacitor are added to the power supply port, which is helpful for the stability of power supply. The choice of filter, especially C_b , depends on the user's requirements for THD+N and is subject to the system cost and size requirements.

4.3、BYP Capacitance C_b

The selection of the C_b capacitor directly affects the popping sound during power-on/off. Generally, a ceramic capacitor between 0.1μF and 1μF is recommended. The larger the C_b capacitor, the more effective the popping sound suppression, but the longer the output delay. To achieve better suppression, a capacitor above 1μF can be selected.

4.4、Power Supply Bypass C_s

For power amplifiers, the design of the power supply bypass capacitance affects noise rejection and power supply rejection ratio. It is recommended to use a 470μF capacitor in parallel with a 1μF capacitor, and place the bypass capacitors as close as possible to the chip's power supply pins.



4.5、Shutdown Function

AiP9971 features an SD pin design where the chip enters shutdown mode when SD pin is HIGH.

Note: If there is sound like “POP” when switching SD port in AB Type MODE, it is recommended to set MODE to high level, switch the shut-down function in D Type mode, and finally switch back to AB Type mode, which can effectively reduce this sound.

4.6、Mode Selection

AiP9971 provides two operating modes: AB type amplification and D type amplification, and this selection is controlled by the state of the external pin MODE. When the logic of MODE port is low, AiP9971 selects AB Type amplification mode, which is also the default selection state of AiP9971. When the logic of MODE port changes from low to high, AiP9971 selects D Type amplification mode after a waiting time of about 46ms. The MODE port integrates a pull-down resistance, and the default selection for AiP9971 is AB type.

5、Typical Application Circuit And Application Note

In order to avoid the circuit damage caused by overshoot voltage at the output port when the chip operates in D Type mode. In typical applications, please add a 12nF capacitor between the output terminals VOP and VON.

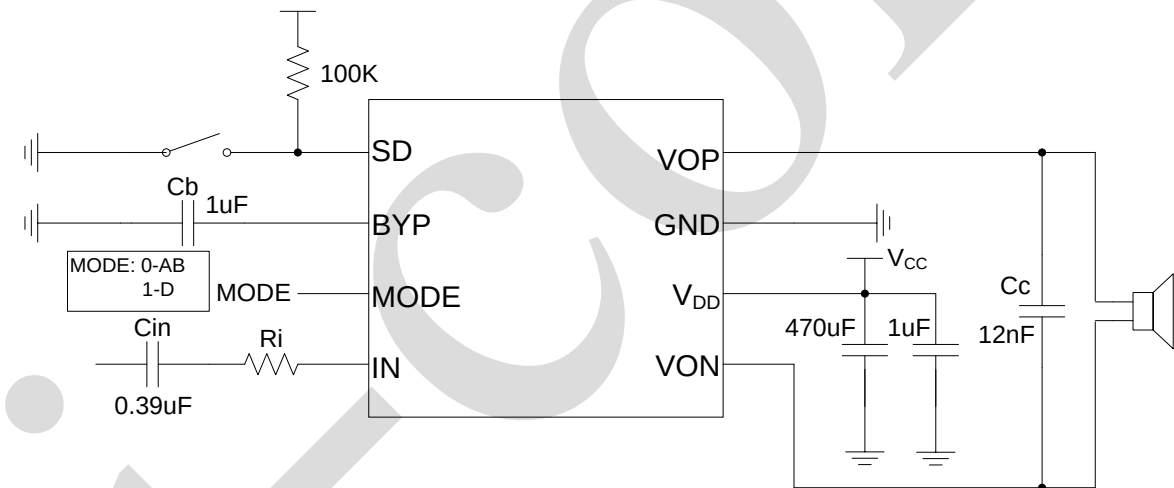
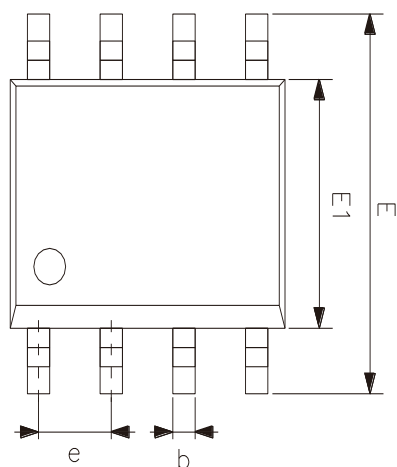
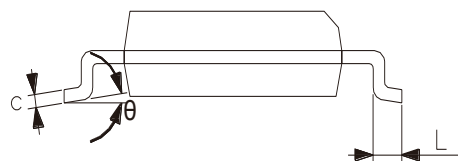
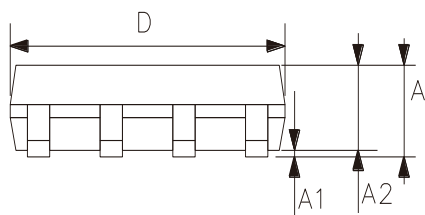


Figure 3. Typical Application Circuit



6、Package Information

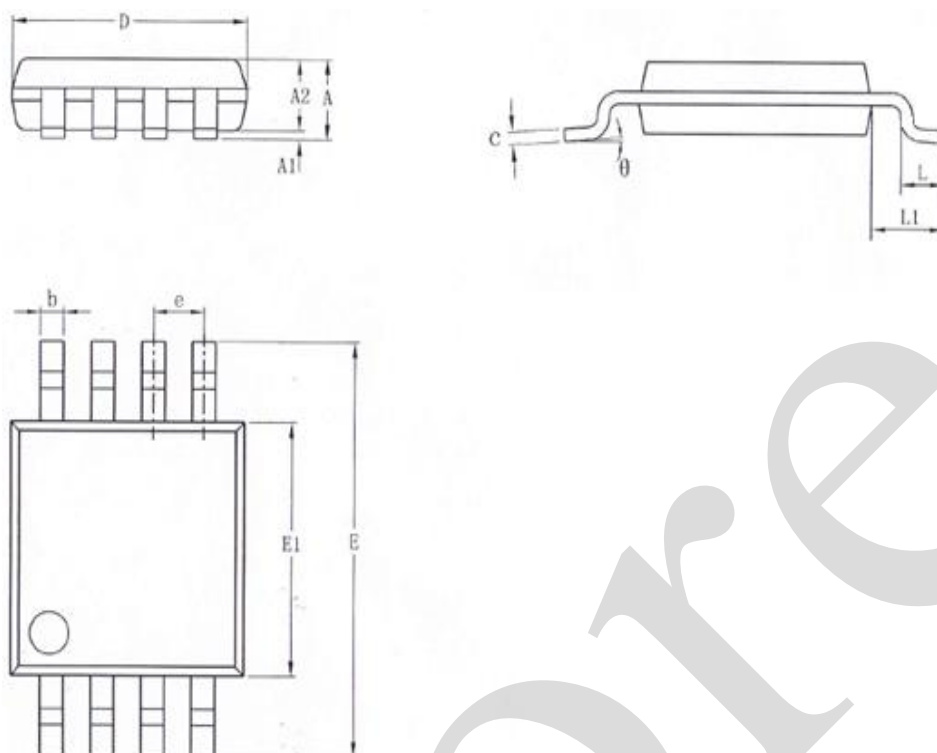
6.1、SOP8



2023/12/A	Dimensions In Millimeters	
Symbol	Min.	Max.
A	1.35	1.80
A1	0.05	0.25
A2	1.25	1.55
D	4.70	5.10
E	5.80	6.30
E1	3.70	4.10
b	0.306	0.51
c	0.19	0.25
e	1.27	
L	0.40	0.89
θ	0°	8°



6.2、MSOP8

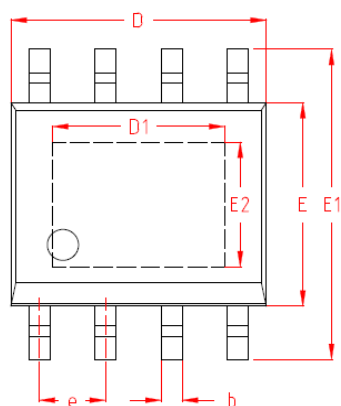


2023/12/A	Dimensions In Millimeters	
Symbol	Min	Max
A	—	1.10
A1	0.05	0.15
A2	0.75	0.95
b	0.22	0.38
c	0.08	0.23
D	2.90	3.10
E	4.70	5.10
E1	2.90	3.10
e	0.65	
L	0.40	0.80
L1	0.95	
θ	0°	8°

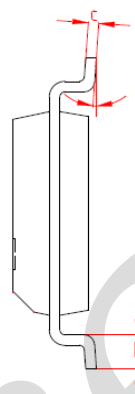


6.3、ESOP8

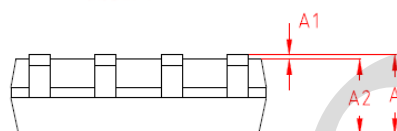
TOP VIEW
正视图



SIDE VIEW
侧视图



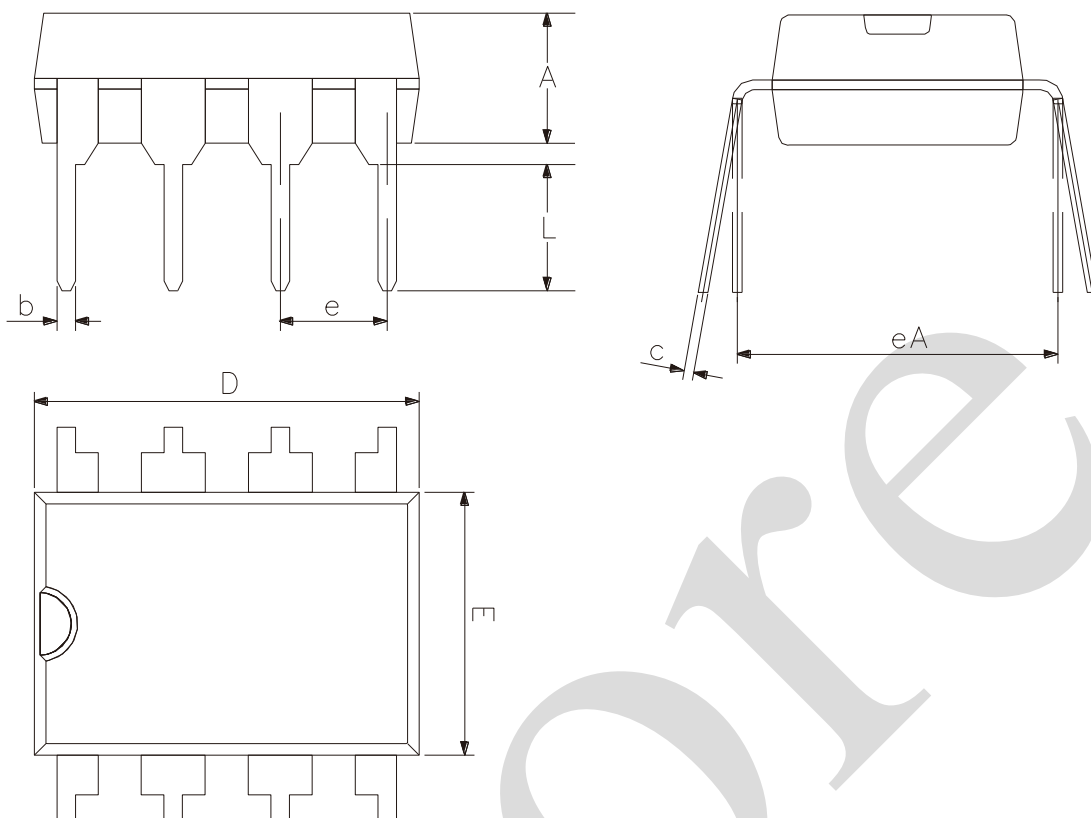
SIDE VIEW
侧视图



2023/12/A	Dimensions In Millimeters	
Symbol	Min	Max
A	1.42	1.70
A1	0.02	0.13
A2	1.30	—
b	0.31	0.51
c	0.19	0.25
D	4.70	5.10
D1	3.20	3.40
E	3.80	4.02
E1	5.80	6.25
E2	2.30	2.50
e	1.27	
L	0.40	0.90
θ	0°	8°



6.4、DIP8



2023/12/A	Dimensions In Millimeters	
Symbol	Min	Max
A	3.00	3.60
b	0.36	0.56
c	0.20	0.36
D	9.00	9.45
E	6.15	6.60
e	2.54	
eA	7.62	9.30
L	3.00	—



7、Statements And Notes

7.1、The name and content of Hazardous substances or Elements in the product

Part name	Hazardous substances or Elements									
	Lead and lead compounds	Mercury and mercury compounds	Cadmium and cadmium compounds	Hexavalent chromium compounds	Polybrominated biphenyls	Polybrominated biphenyl ethers	Dibutyl phthalate	Butylbenzyl phthalate	Di-2-ethylhexyl phthalate	Diisobutyl phthalate
Lead frame	○	○	○	○	○	○	○	○	○	○
Plastic resin	○	○	○	○	○	○	○	○	○	○
Chip	○	○	○	○	○	○	○	○	○	○
The lead	○	○	○	○	○	○	○	○	○	○
Plastic sheet installed	○	○	○	○	○	○	○	○	○	○
explanation	○: Indicates that the content of hazardous substances or elements in the detection limit of the following the SJ/T11363-2006 standard. ×: Indicates that the content of hazardous substances or elements exceeding the SJ/T11363-2006 Standard limit requirements.									

7.2、Notes

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