5.1W single-channel Class AB/D dual-mode audio

Feature

- XA9106B is a mono Class AB/D optional audio power amplifier circuit. Delivers a maximum of 5.1W of continuous power to a 2 Ohm load horn. Its low noise pulse width modulation architecture reduces the number of external components, the consumption of circuit board area, the cost of the system, and simplifies the design.
- XA9106B comes in an ESOP8 package and is ideal for use in high-volume, low-weight portable systems. XA9106B has an internal overheat automatic shutdown protection mechanism; Feedback resistor built-in, by configuring the perimeter parameters can adjust the amplifier voltage gain and the best sound quality effect, easy to use, is your USB subwoofer, radio, MP3 player, pull rod sound and amplifier perfect solution.

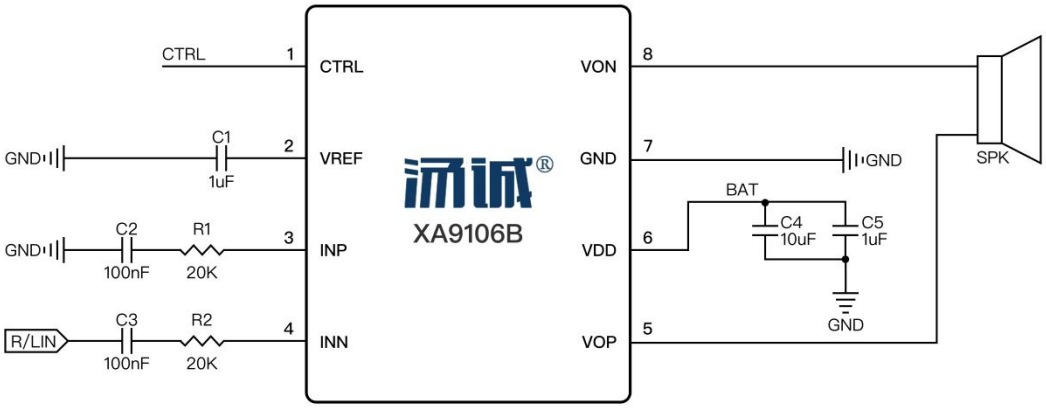
peculiarity

- Efficiency up to 90%
- No interference to FM, high efficiency, sound quality
- AB/D class switchover
- 5.1W output power (10%THD, 2Ω load)
- Wide operating voltage range: 2.5V-6V
- Excellent on-off pop acoustic suppression
- Differential input, common mode noise suppression
- No need to drive output coupling capacitors, bootstrap capacitors and buffering networks
- Overheat protection, overcurrent protection, and undervoltage protection
- ESOP8 package is adopted
- VDD=5V:
  R_L=4Ω, P_O=2.6W, THD+N≤1%
  R_L=4Ω, P_O=3.1W, THD+N≤10%
  R_L=2Ω, P_O=4.2W, THD+N≤1%
  R_L=2Ω, P_O=5.13W,THD+N≤10%
- VDD=3.7V:
  R_L=4Ω, P_O=1.4W, THD+N≤1%
  R_L=4Ω, P_O=1.7W, THD+N≤10%
  R_L=2Ω, P_O=2.28W, THD+N≤1%
  R_L=2Ω, P_O=2.74W, THD+N≤10%

Apply

- Loudspeaker, plug card sound, etc
- Low voltage audio system, USB, 2.1/2.0 multimedia audio
- Radio
- GPS
- MP3/MP4/MP5/CD
- Digital photo frame
- Tablet PC, palm game console

Typical application diagram



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Ordering information

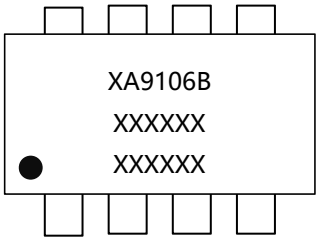
Chip type	Package type	Packaging type	Screen printing	Minimum packing quantity (pcs)
XA9106B_EH	ESOP8	braid	XA9106B XXXXXX XXXXXX	4000/Disc

Naming and rule explanation

XA 9106B _ EH

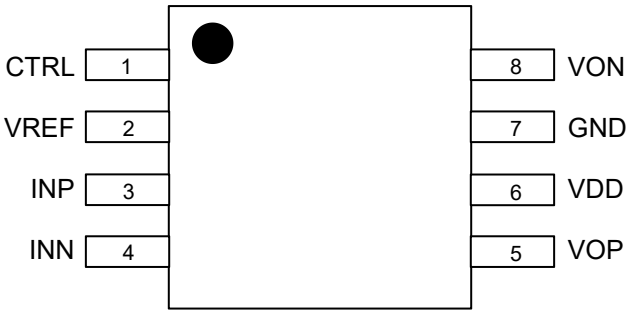
- EH — ESOP-8
- 9106B — Product model number
- XA — Hefei Tangcheng

Silk screen instruction



First line: -----Product model number
The second line: ------LOT number
The third line: -----Production lot number

Pin distribution diagram



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Chip limit value

Name	Description	parameter
VDD	Supply voltage	2.5V to +7V
T_A	Ambient operating temperature	-40℃ to +85℃
T_J	Junction operating temperature	-40℃ to +150℃
Tstg	Storage temperature	-65℃ to +150℃
	Welding temperature	260℃
HBM	ESD voltage resistance 1	6000V
MM	ESD voltage resistance 2	4000V

Note: The performance of the chip is not guaranteed under any other conditions other than the limit value.

Description of pin

Pipe foot number	Pipe foot name	I/O	Description
1	CTRL	I	D\AB and power down control
2	VREF	I	The internal reference voltage is connected to the decoupling capacitor
3	INP	I	Positive phase input
4	INN	I	Negative phase input
5	VOP	O	The output of power amplifier is positive
6	VDD	O	Power supply
7	GND	O	power groud
8	VON	O	Power amplifier output negative

Recommended working conditions

parameter	Description	Minimum value	Maximum value	unit
PVDD	Operating voltage	2.5	6	V
CTRL	High level input voltage	2	5.5	V
	Low level input voltage	0	0.2	V
T_A	Operating ambient temperature	-40	85	℃

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Chip performance index characteristics TA = 25℃ GND=0V，RL=4Ω+33uH, Fin=1kHz, Rin=20K Cin=0.1uF

Symbols	parameter	Test condition		The minimum value	Standard value		Maximum value	unit
					Class AB	D class		
VDD	The input voltage range			2.5			6	V
Fosc	CLASSD oscillator frequency					400		KHz
I_Q	Static current	VDD= 3.7V， no load			6.5	3.6		mA
ISD	Turn-off current	VDD= 3.7				0.1		μA
VOS	Output offset voltage	VIN = 0V			1	1		mV
Po	Output power	THD+N=10%	VDD=5V		2.8	3.1		W
			VDD=3.7V		1.5	1.7		
		THD+N=1%	VDD=5V		2.2	2.6		
			VDD=3.7V		1.2	1.4		
THD+N	Total harmonic distortion and noise	PO=1W, f=1kHz			0.07	0.13		%
η	efficiency	f=1kHz THD+N=10%				90		%
Vn	Output noise	f = 20Hz to 20kHz Input AC ground			90	94		uV
SNR	Signal-to-noise ratio	A The weighted, Av=20dB, THD+N = 1%			85	85		dB

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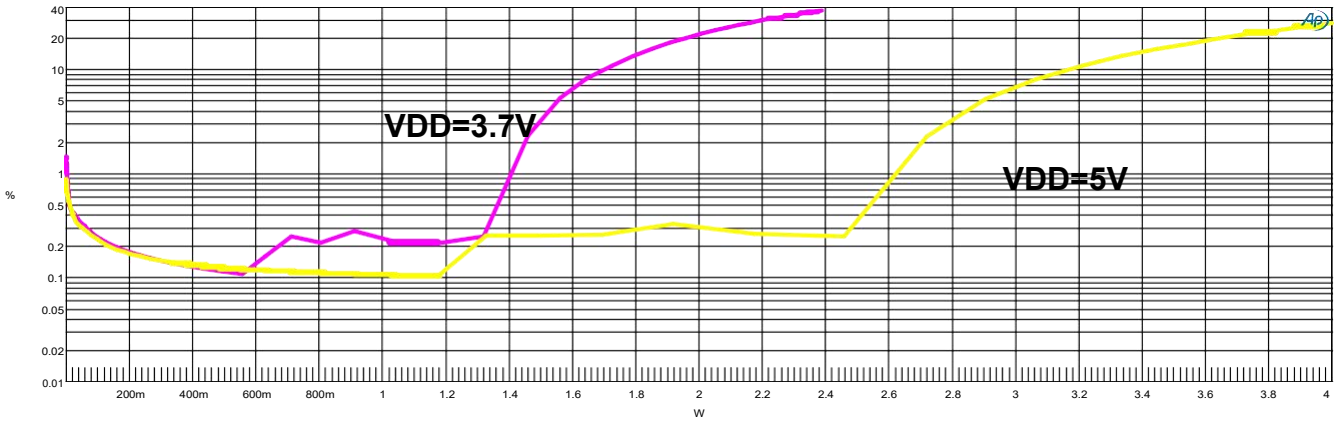
Typical characteristic curve

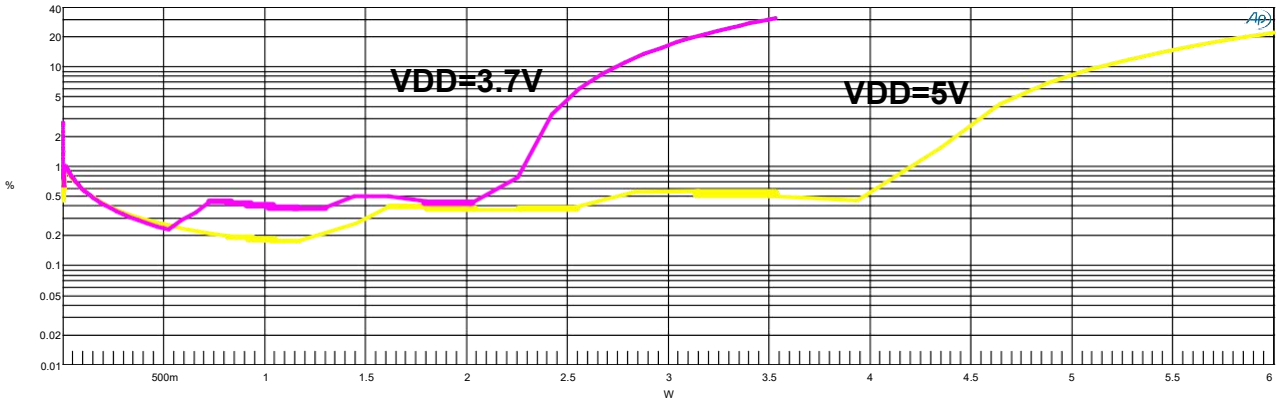
ClassD:

- **THD+N VS.Output Power**
  RL=33uH+4Ω，TA=25℃



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Yellow	Solid	5	Analyzer.THD+N Ratio A	Left	VDD=5V Po=3.16W10%2.62W1%
3	1	Magenta	Solid	5	Analyzer.THD+N Ratio A	Left	VDD=3.7V Po=1.7W10%1.4W1%

RL=33uH+2Ω，TA=25℃



Sweep	Trace	Color	Line Style	Thick	Data	Axis	Comment
1	1	Yellow	Solid	5	Analyzer.THD+N Ratio A	Left	VDD=5V Po=5.13W10%4.2W1%
3	1	Magenta	Solid	5	Analyzer.THD+N Ratio A	Left	VDD=3.7V Po=2.74W10%2.28W1%

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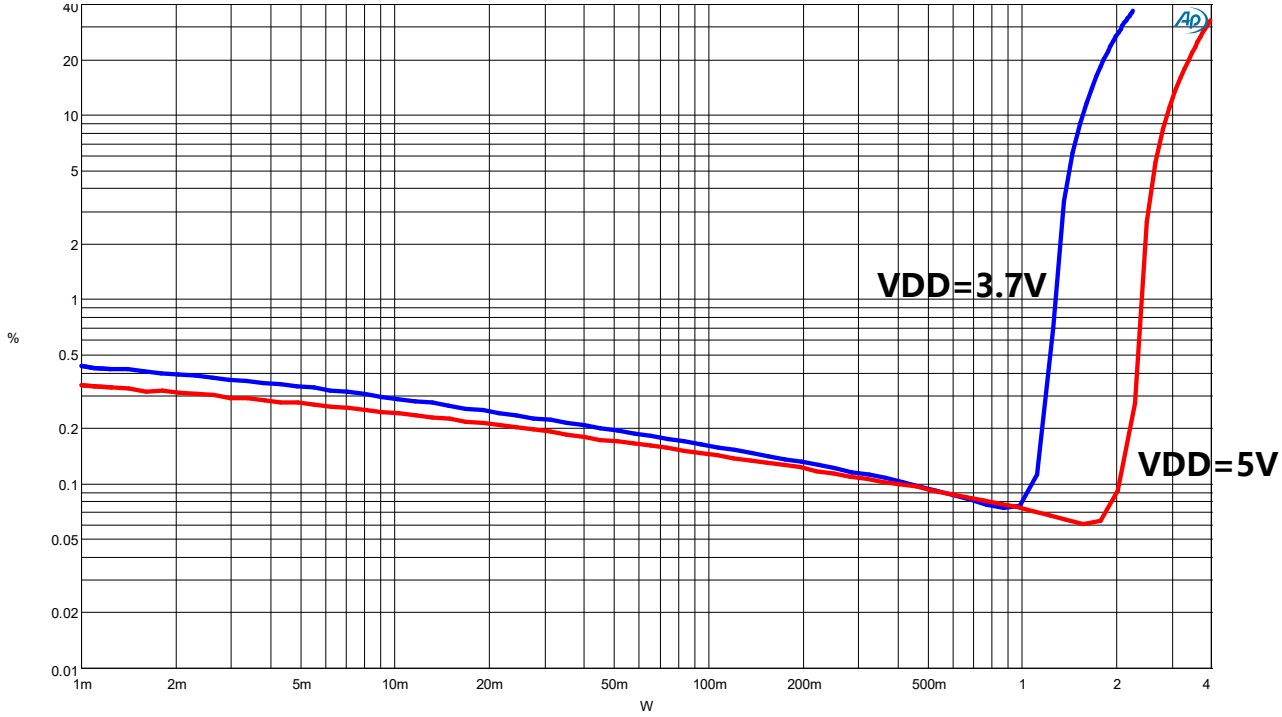
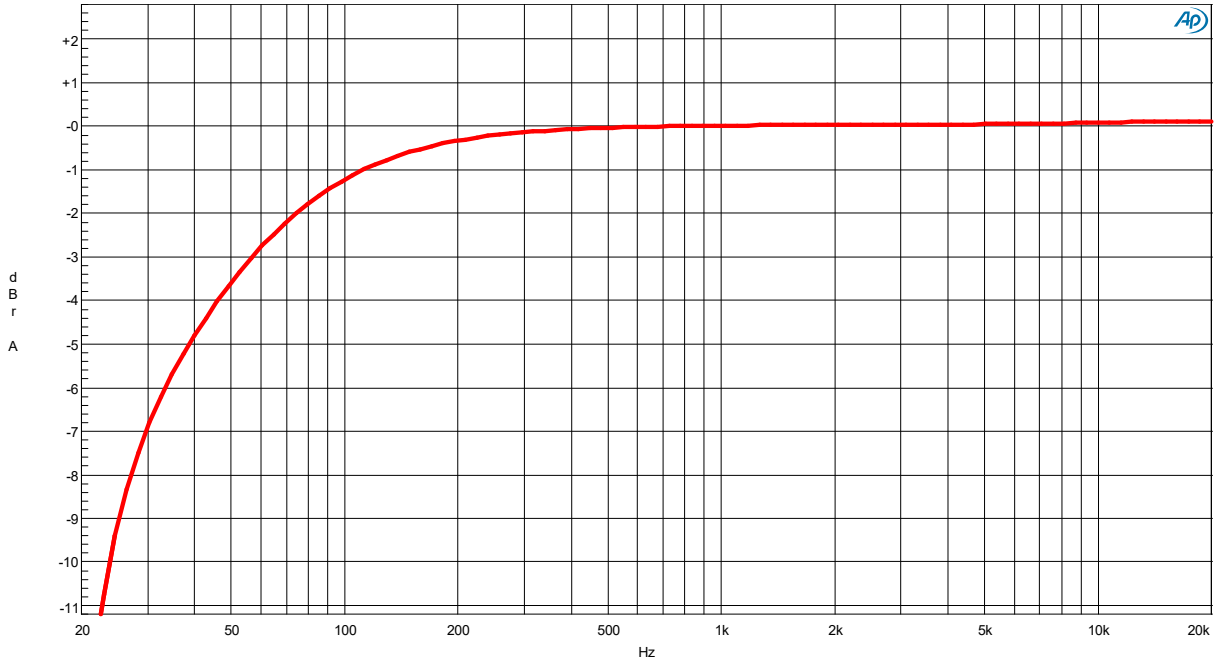
Class AB:

- **THD+N VS.Output Power**
  RL=33uH+4Ω，TA=25℃



- **Frequency Response**

  IN:C=104、R=22K,RL=33uH+4Ω，TA=25℃



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XA9106B Application Description

- **Selection of input resistance (Ri)**

The XA9106B has a built-in two-stage amplifier，The first stage gain can be configured with an external resistor, while the second stage gain is internally fixed. The gain of the amplifier can be configured by selecting the parameter value of the input resistance (Ri) :

$$\mathrm{GAIN} = 576\mathrm{K}/(\mathrm{Ri} + 6\mathrm{K})$$

- **Selection of decoupling capacitors (Cs)**

In the application of amplifier, the bypass design of the power supply is very important, especially for the noise performance of the application scheme and the power supply voltage ripple suppression performance. The XA9106B is a high-performance audio power amplifier that requires proper power decoupling to ensure its high efficiency and low harmonic distortion. The decoupling capacitor uses a low-impedance ceramic capacitor, as close as possible to the chip power supply pin, because any resistance, capacitance and inductance in the circuit can affect the efficiency of the power conversion. A 470uF or larger electrolytic capacitor placed near the power supply will get a better filtering effect. Typical capacitors are 470uF electrolytic capacitors and 10uF+0.1uF ceramic capacitors.

- **Selection of input capacitance (Ci)**

In the XA9106B input system, the input end is a high-pass filter, and the input capacitance is necessary. When the input is used as a high-pass filter, the formula for calculating the cut-off frequency of the filter is as follows:

$$f_c = \frac{1}{2\pi\ \ (Ri + 6K)C_i}$$

The parameters of input resistance and input capacitance directly affect the lower frequency of the filter and thus the performance of the amplifier. The input capacitance is calculated as follows:

$$C_i = \frac{1}{2\pi\ \ (Ri + 6K)f_c}$$

If the input frequency of the signal is in the audio range, the accuracy of the input capacitance can be ± 10% or higher, because capacitor mismatches can affect the performance of the filter.

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In addition to the cost and size of the system, noise performance is affected by the size of the input coupling capacitor, a large input coupling capacitor requires more charge to reach the static DC voltage (usually the midpoint voltage of the power supply, i.e. 1/2VDD), and this charge comes from the output of the feedback, which often produces noise when the device is enabled. Thus, the opening noise can be minimized based on the minimization of the input capacitance based on the required low frequency response.

- **CTRL pin mode Settings**

You can set the working mode of class D and Class AB by CTRL. The specific control mode is as follows:

CTRL	mode
<0.2V	Off
1V<CTRL<2V (1.5V recommended)	Class AB
>2.5V (3.3V recommended)	Class D

Description: To switch mode, turn off the power amplifier for more than 150ms before setting the CTRL pin voltage.

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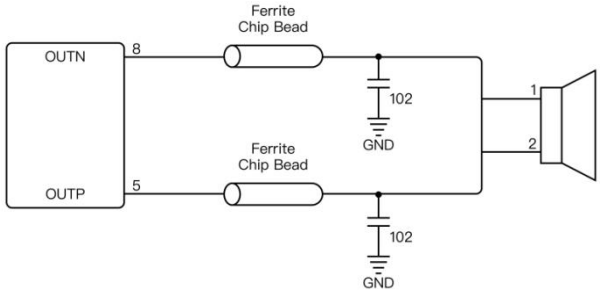
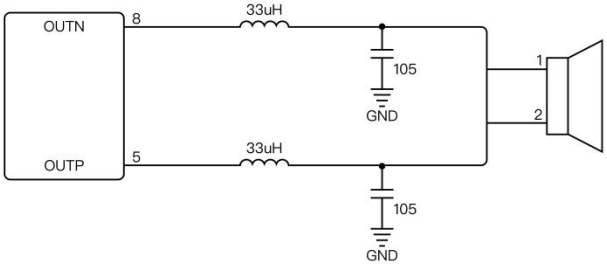
- **Class D output filter**

  The length of the cable to the speaker using the XA9106B without an output filter is generally less than 100mm. In mobile phones and other portable communication equipment applications, you can not use the output filter. In some environmental and other conditions do not allow and some special cases, to add the output low-pass filter, such as LC filter.



Typical application circuit of the output patch ferrite magnetic bead filter



Output plus LC filter typical application circuit (cut-off frequency 27KHz)

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- **chip power consumption and heat dissipation design**

Power consumption is one of the key indicators for the amplifier, the maximum self-

power consumption of the differential output amplifier is:

$$P_{DMAX} = 4\times (V_{DD})\ 2/\ (2\times\pi^2\times R_L)$$

Note: It must be noted that the self-power consumption is a function of the output power.

In the circuit design, the junction temperature inside the chip can not be higher than TJMAX (150 ° C), and the heat dissipation performance can be increased by increasing the heat dissipation copper foil.

In the PCB design, the XA9106B heat dissipation problem should be fully considered. It is required to attach copper foil to the patch layer and expose copper foil at the XA9106B heat sink, so that the IC heat sink can be in good contact with the PCB copper foil to achieve good heat dissipation effect. Multi-panel, requiring the top and bottom layers to attach copper foil and exposed copper foil at the XA9106B heat sink, in addition to the IC substrate and surrounding holes to achieve good heat dissipation effect.

If the chip still does not meet the requirements, it needs to increase the load impedance, reduce the power supply voltage, or reduce the ambient temperature to solve the problem.

- **XA9106B PCB routing precautions**

The analog ground corresponding to the input of the sound source and the analog ground of the chip must be routed separately and away from the interference source. The audio input resistance Ri should be as close as possible to the input pin. The input line of the sound source should avoid the large disturbance line (such as PGND) on the board and walk the line to avoid the bottom noise.

When the load is above 2 euro speakers, it is necessary to do a good job in heat dissipation to ensure that the maximum temperature does not exceed 80 degrees.

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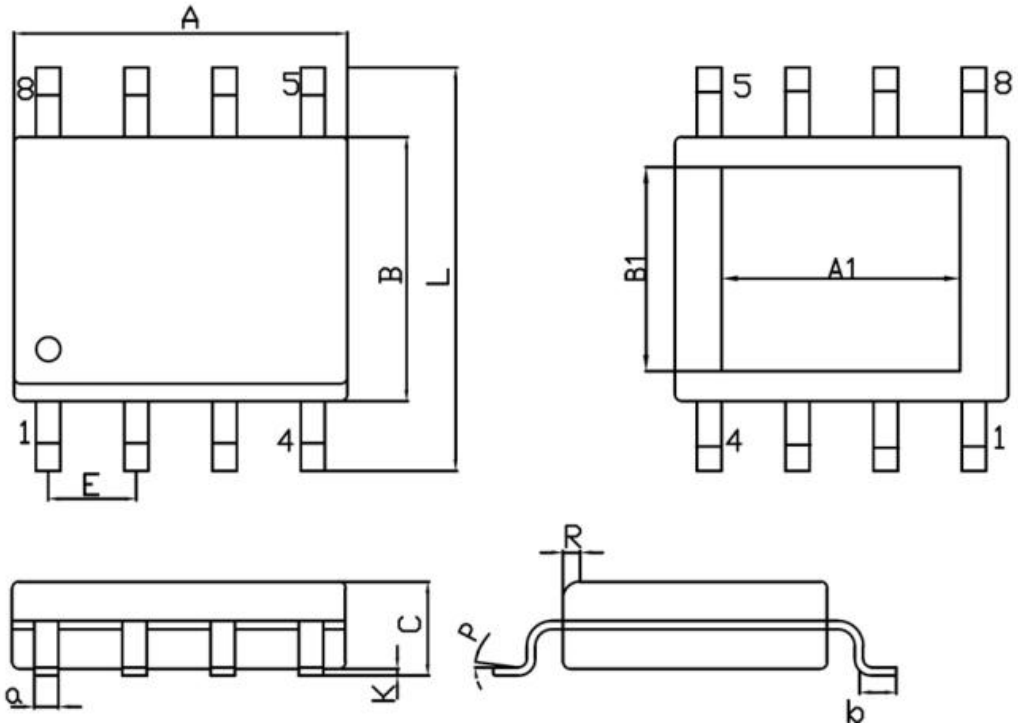
Chip packaging

ESOP8 package size



SYMBOL	DLMENSLONS IN MILLIMETERS		SYMBOL	DLMENSLONS IN MILLIMETERS	
	MIN	MAX		MIN	MAX
A	4.70	5.10	C	1.35	1.75
B	3.70	4.10	a	0.35	0.49
L	6.00	6.40	R	0.30	0.60
E	1.27BSC		P	0°	7°
K	0.02	0.10	b	0.40	1.25
A1	3.1	3.5	B1	2.2	2.6