



AiP3211/3212/3213/3214/3219 Ultra-High-Speed Differential Comparator

Product Specification

Specification Revision History:

Version	Date	Description
2024-08-A0	2024-08	New
2024-11-A1	2024-11	Modify parameters



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1、General Description

The AiP321X series consists of low-power, ultra-high-speed comparators with internal hysteresis. Among them, the AiP3211, AiP3212 and AiP3214 are single-channel, dual-channel and quad-channel comparators without shutdown pins respectively. The AiP3213 is a single-channel comparator with a shutdown pin, while the AiP3219 is a dual-channel comparator with a shutdown pin. These comparators feature rail-to-rail input and push-pull output stages. This series is widely used in high-speed sampling circuits, peak and zero-crossing detectors, window comparators, clock and data signal recovery, and other applications.

Features:

- Supply voltage: 2.5V to 5.5V
- Propagation delay: 6.7ns
- Quiescent current per comparator: 1.4mA
- Offset voltage: $\leq 10\text{mV}$
- Hysteresis voltage: 7.2mV
- Rail-to-rail output input
- Push-pull output
- Operating temperature: -40°C to 125°C
- Package form:
 - AiP3211: SOT23-5/SOT353/SOP8
 - AiP3212: SOP8/MSOP8/TSSOP8/DFN8
 - AiP3213: SOT23-6/ SOT363/SOP8
 - AiP3214: SOP14/TSSOP14
 - AiP3219: MSOP10



Ordering Information:

Reel packing specifications:

Part number	Packaging form	Marking code	Reel quantity	Boxed reel quantity	Notes
AiP3211GB235.TR	SOT23-5	3211XX	3000 PCS/reel	30000 PCS/box	Dimensions of plastic enclosure: 2.9mm×1.6mm Pin spacing: 0.95mm
AiP3211GC353.TR	SOT353	3211XX	3000 PCS/reel	30000 PCS/box	Dimensions of plastic enclosure: 2.1mm×1.3mm Pin spacing: 0.65mm
AiP3211SA8.TR	SOP8	AiP3211	4000 PCS/reel	8000 PCS/box	Dimensions of plastic enclosure: 4.9mm×3.9mm Pin spacing: 1.27mm
AiP3212SA8.TR	SOP8	AiP3212	4000 PCS/reel	8000 PCS/box	Dimensions of plastic enclosure: 4.9mm×3.9mm Pin spacing: 1.27mm
AiP3212TB8.TR	TSSOP8	3212	5000 PCS/reel	10000 PCS/box	Dimensions of plastic enclosure: 3.0mm×4.4mm Pin spacing: 0.65mm
AiP3212MA8.TR	MSOP8	AiP3212	5000 PCS/reel	10000 PCS/box	Dimensions of plastic enclosure: 3.0mm×3.0mm Pin spacing: 0.65mm
AiP3212XB8.TR	DFN8	3212	3000 PCS/reel	30000 PCS/box	Dimensions of plastic enclosure: 2.0mm×2.0mm Pin spacing: 0.5mm
AiP3213GB236.TR	SOT23-6	3213XX	3000 PCS/reel	30000 PCS/box	Dimensions of plastic enclosure: 2.9mm×1.6mm Pin spacing: 0.95mm
AiP3213GC363.TR	SOT363	3213XX	3000 PCS/reel	30000 PCS/box	Dimensions of plastic enclosure: 2.1mm×1.3mm Pin spacing: 0.65mm
AiP3213SA8.TR	SOP8	AiP3213	4000 PCS/reel	8000 PCS/box	Dimensions of plastic enclosure: 4.9mm×3.9mm Pin spacing:



					1.27mm
AiP3214SA14.TR	SOP14	AiP3214	4000 PCS/reel	8000 PCS/box	Dimensions of plastic enclosure: 8.7mm×3.9mm Pin spacing: 1.27mm
AiP3214TA14.TR	TSSOP14	AiP3214	5000 PCS/reel	10000 PCS/box	Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing: 0.65mm
AiP3219MA10.TR	MSOP10	AiP3219	5000 PCS/reel	10000 PCS/box	Dimensions of plastic enclosure: 3.0mm×3.0mm Pin spacing: 0.5mm

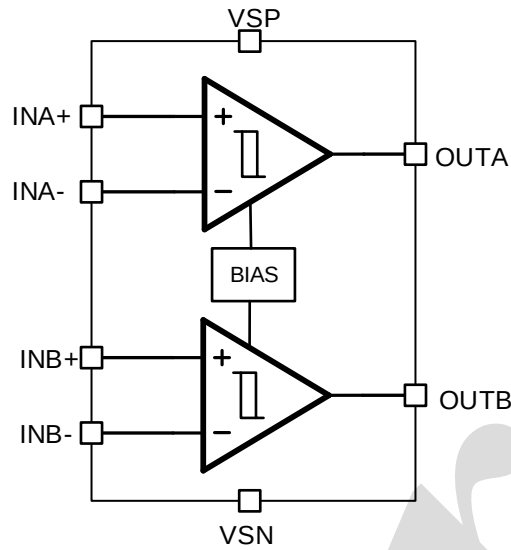
Note 1: “XX” refers to variable content, meaning package batch serial number.

Note 2: If the physical information is inconsistent with the ordering information, please refer to the actual product.



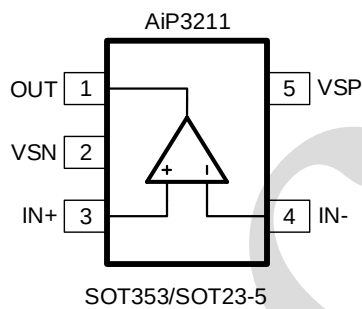
2、Block Diagram And Pin Description

2.1、Block Diagram

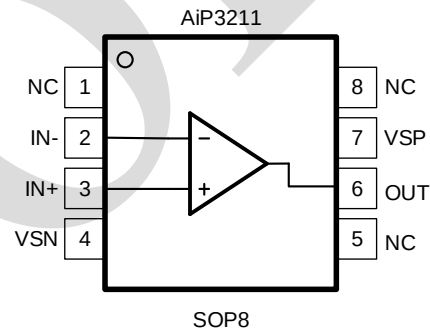


AiP3212 block diagram

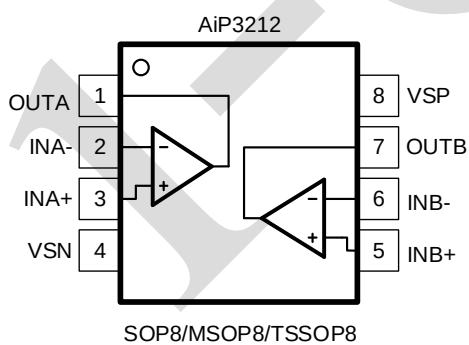
2.2、Pin Configurations



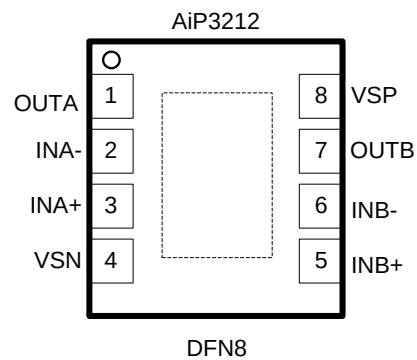
SOT353/SOT23-5



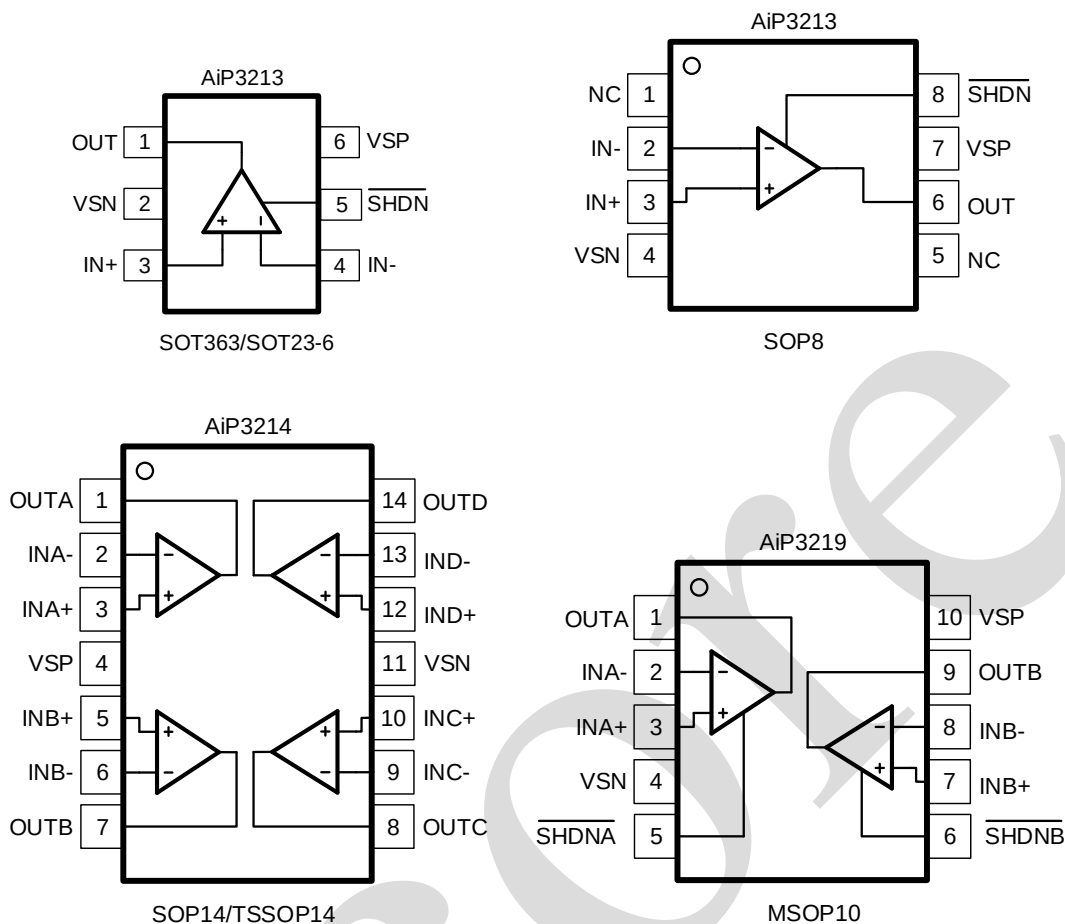
SOP8



SOP8/MSOP8/TSSOP8



DFN8



2.3、Pin Description

AiP3211 Pin Description

Pin No.		Pin Name	Description
SOT235/SOT353	SOP8		
1	6	OUT	comparator output
2	4	VSN	ground (negative power supply)
3	3	IN+	comparator positive input
4	2	IN-	comparator negative input
5	7	VSP	positive power supply
-	1, 5, 8	NC	not connected



AiP3212 Pin Description

Pin No.	Pin Name	Description	Pin No.	Pin Name	Description
1	OUTA	comparator A output	5	INB+	comparator B positive input
2	INA-	comparator A negative input	6	INB-	comparator B negative input
3	INA+	comparator A positive input	7	OUTB	comparator B output
4	VSN	ground (negative power supply)	8	VSP	positive power supply

AiP3213 Pin Description

Pin No.		Pin Name	Description
SOT236/SOT363	SOP8		
1	6	OUT	comparator output
2	4	VSN	ground (negative power supply)
3	3	IN+	comparator positive input
4	2	IN-	comparator negative input
5	8	$\overline{\text{SHDN}}$	comparator shutdown pin, Low level: disabled, output Low level High level: normal operation
6	7	VSP	positive power supply
-	1, 5	NC	not connected

AiP3214 Pin Description

Pin No.	Pin Name	Description	Pin No.	Pin Name	Description
1	OUTA	comparator A output	8	OUTC	comparator C output
2	INA-	comparator A negative input	9	INC-	comparator C negative input
3	INA+	comparator A positive input	10	INC+	comparator C positive input
4	VSP	positive power supply	11	VSN	ground (negative power supply)
5	INB+	comparator B positive input	12	IND+	comparator D positive input
6	INB-	comparator B negative input	13	IND-	comparator D negative input
7	OUTB	comparator B output	14	OUTD	comparator D output



AiP3219 Pin Description: MSOP10

Pin No.	Pin Name	Description	Pin No.	Pin Name	Description
1	OUTA	comparator A output	6	$\overline{\text{SHDNB}}$	Comparator B shutdown pin, Low level: disabled, output Low level High level: normal operation
2	INA-	comparator A negative input	7	INB+	comparator B positive input
3	INA+	comparator A positive input	8	INB-	comparator B negative input
4	VSN	ground (negative power supply)	9	OUTB	comparator B output
5	$\overline{\text{SHDNA}}$	Comparator A shutdown pin, Low level: disabled, output Low level High level: normal operation	10	VSP	positive power supply

3、Electrical Parameter

3.1、Absolute Maximum Ratings

($T_{\text{amb}}=25^{\circ}\text{C}$, unless otherwise specified)

Characteristic	Symbol	Conditions		Min.	Max.	Unit
supply voltage	VSP	-		-	6	V
supply current	I _{VSP}	-		-	60	mA
storage temperature	T _{stg}	-		-65	+150	°C
soldering temperature	T _L	10 秒	SOT23-5/SOT23-6	260		°C
			SOT353/SOT363	260		
			TSSOP8/MSOP8/SOP8/DFN8	260		
			MSOP10	260		
			TSSOP14	260		
			SOP14	260		
ESD	V(ESD)	HBM		4000	-	V

3.2、Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
supply voltage (single power supply)	VS	2.5	5	5.5	V
supply voltage (dual power supply)	VS	± 1.25	-	± 2.75	V
ambient temperature	T_{amb}	-40	-	+125	$^{\circ}\text{C}$



3.3、Electrical Characteristics

($T_{amb}=25^{\circ}\text{C}$, $V_{SP}=5\text{V}$, $V_{SN}=0\text{V}$, $C_L=15\text{pF}$, unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
offset voltage	V_{OS}	$V_{CM}=1.2\text{V}$	-10	3	+10	mV
input offset voltage temperature drift	$\Delta V_{OS}/\Delta T$	$V_{CM}=1.2\text{V}$	-	5.4	-	$\mu\text{V}/^{\circ}\text{C}$
input hysteresis voltage	V_{hyst}	$V_{CM}=1.2\text{V}$	-	7.2	-	mV
input bias current	I_B	$V_{CM}=V_{SP}/2$	-	5	-	pA
input offset current	I_{OS}	$V_{CM}=V_{SP}/2$	-	5	-	pA
input resistance	R_{IN}	-	-	42	-	$\text{G}\Omega$
input capacitance	C_{IN}	differential mode	-	2.5	-	pF
		common mode	-	1	-	pF
common-mode rejection ratio	CMRR	$V_{CM}=V_{SN}$ to V_{SP}	-	82	-	dB
common-mode voltage range	V_{CM}	-	$V_{SN}-0.1$	-	$V_{SP}+0.1$	V
power supply rejection ratio	PSRR	-	-	89	-	dB
High level output voltage	V_{OH}	$I_{OUT}=4\text{mA}$, $V_{ID}=500\text{mV}$	$V_{SP}-0.2$	$V_{SP}-0.08$	-	V
		$I_{OUT}=0.4\text{mA}$, $V_{ID}=500\text{mV}$	$V_{SP}-0.05$	$V_{SP}-0.01$	-	V
Low level output voltage	V_{OL}	$I_{OUT}=4\text{mA}$, $V_{ID}=500\text{mV}$	-	50	150	mV
		$I_{OUT}=0.4\text{mA}$, $V_{ID}=500\text{mV}$	-	6	20	mV
output short-circuit current	I_{SINK}	-	-	80	-	mA
	I_{SOURCE}	-	-	82	-	mA
per comparator short-circuit Quiescent current per comparator	I_Q	-	-	1.4	2.5	mA
rise time	t_R	-	-	2	5	ns
fall time	t_F	-	-	2	5	ns
propagation delay (Low to high)	T_{PD+}	Overdrive=100mV, $V_{IN}=1.2\text{V}$	-	5.4	10	ns
propagation delay (High to Low)	T_{PD-}	Overdrive=100mV, $V_{IN}=1.2\text{V}$	-	6.7	12	ns
propagation delay skew	T_{PDSKEW}	Overdrive=100mV, $V_{IN}=1.2\text{V}$	-	1.3	-	ns

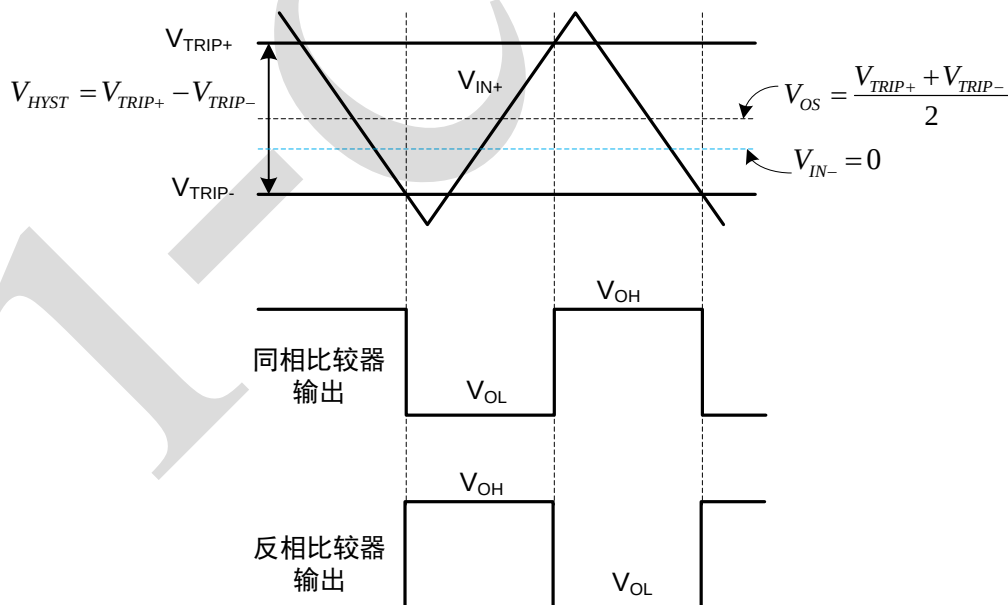


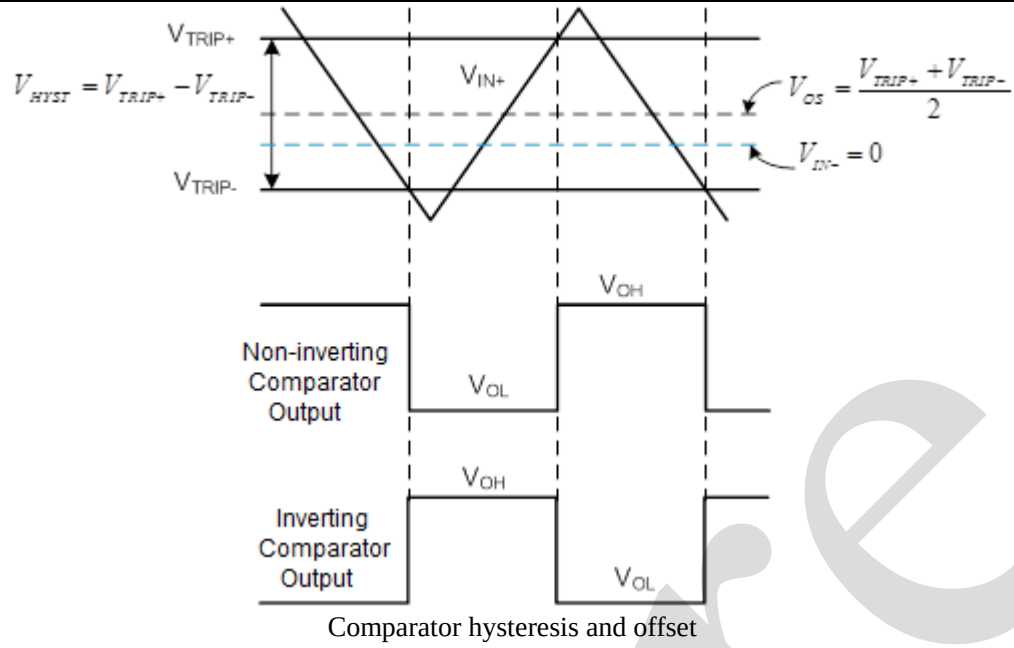
4、Function Description

The AiP321X series are low-power, ultra-high-speed comparators with internal hysteresis, available in single-channel, dual-channel and quad-channel configurations, supporting rail-to-rail input and push-pull output. The AiP3213 and AiP3219 integrate a shutdown function. The comparator operates normally when the $\overline{\text{SHDNx}}$ pin is driven high; when $\overline{\text{SHDNx}}$ is pulled low, the comparator enters shutdown mode and outputs a low level. The AiP321X series operates over a supply voltage range of +2.5V to +5.5V.

The devices have an internal hysteresis of 7.2mV to prevent oscillations caused by noise or undesired parasitic feedback. The hysteresis in a comparator creates two trip points: one for the rising input voltage and one for the falling input voltage. The difference between the trip points is the hysteresis. The average of the trip points is the offset voltage. When the comparator's input voltages are equal, the hysteresis effectively causes one comparator input voltage to move quickly past the other, thus taking the input out of the region where oscillation occurs. To increase hysteresis and noise margin even more, external resistors can be used.

The waveform below illustrates the case where IN- is fixed and IN+ is varied. If the inputs were reversed, the waveform would look the same, except the output would be inverted. The comparators are designed with 7.2mV internal hysteresis to avoid oscillation caused by noise or unwanted parasitic feedback. The built-in hysteresis generates two threshold trip voltages: one for rising input voltage and the other for falling input voltage. The voltage difference between the two trip points is defined as hysteresis voltage, while the average value of the two trip voltages equals the input offset voltage. When the two input pins of the comparator are at equal potentials, hysteresis accelerates one input to exceed the other rapidly, pulling the input operating point out of the oscillation region. Further increase of hysteresis and noise margin can be realized via external resistors. The waveform below illustrates the condition with IN- fixed and IN+ varying. If the two input ports are swapped, the waveform shape remains identical but the output phase is inverted.

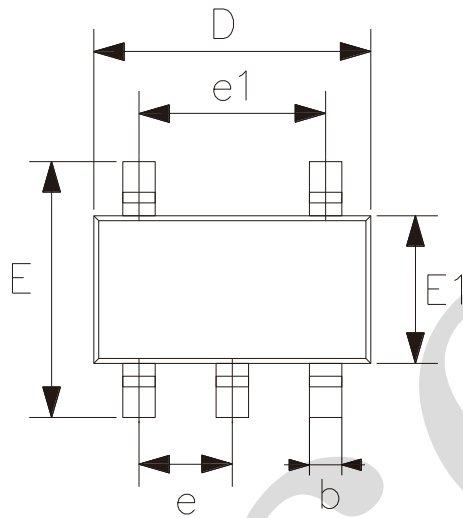
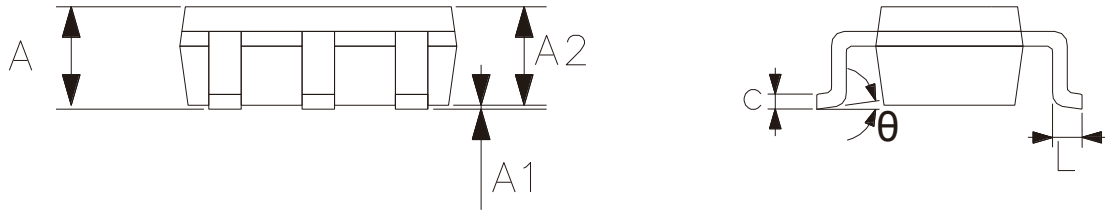






5、Package Information

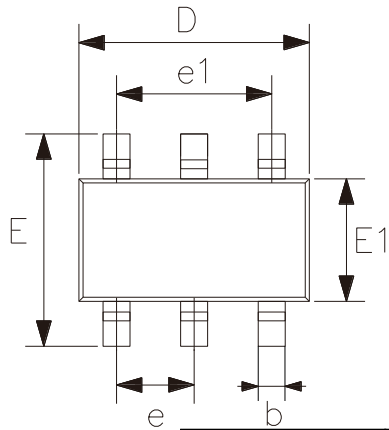
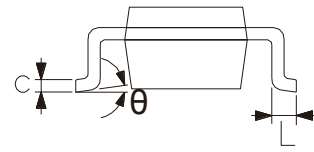
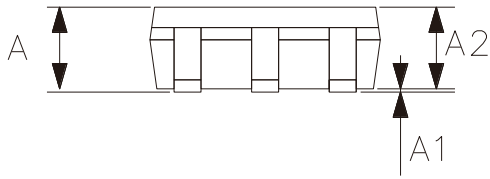
5.1、SOT23-5



2023/12/A	Dimensions In Millimeters	
Symbol	Min.	Max.
A	—	1.26
A1	0.00	0.12
A2	1.00	1.20
b	0.30	0.50
c	0.10	0.20
D	2.82	3.02
E	2.60	3.00
E1	1.50	1.70
e	0.95	
e1	1.80	2.00
L	0.30	0.60
θ	0°	8°



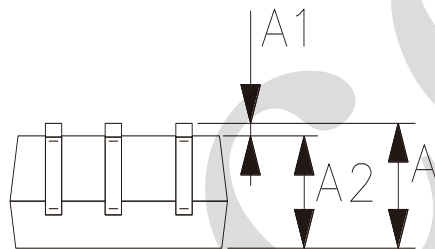
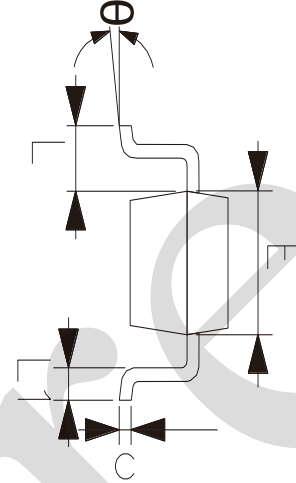
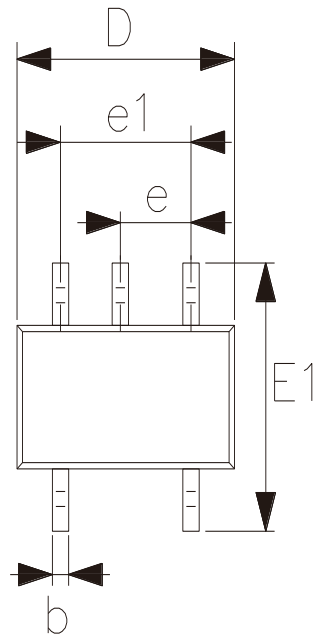
5.2、SOT23-6



2023/12/A	Dimensions In Millimeters	
Symbol	Min.	Max.
A	—	1.25
A1	0.00	0.12
A2	1.00	1.20
b	0.30	0.50
c	0.10	0.20
D	2.82	3.02
E	2.60	3.00
E1	1.50	1.70
e	0.95	
e1	1.80	2.00
L	0.30	0.60
θ	0°	8°



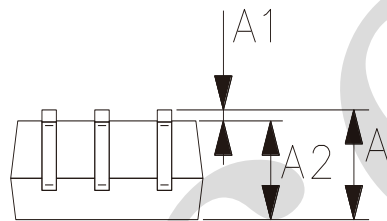
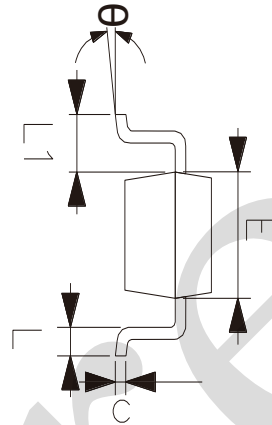
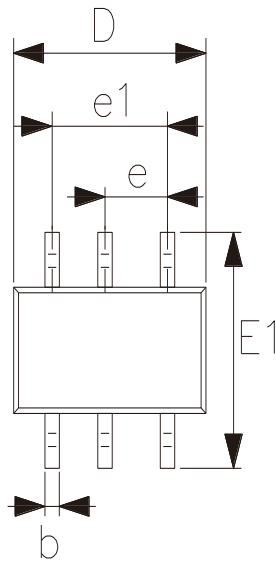
5.3、SOT353



2023/12/A	Dimensions In Millimeters	
Symbol	Min.	Max.
A	0.90	1.10
A1	0.00	0.10
A2	0.90	1.00
b	0.15	0.35
c	0.11	0.175
D	2.00	2.20
E	1.15	1.35
E1	2.15	2.45
e	0.65	
e1	1.20	1.40
L	0.525	
L1	0.26	0.46
θ	0°	8°



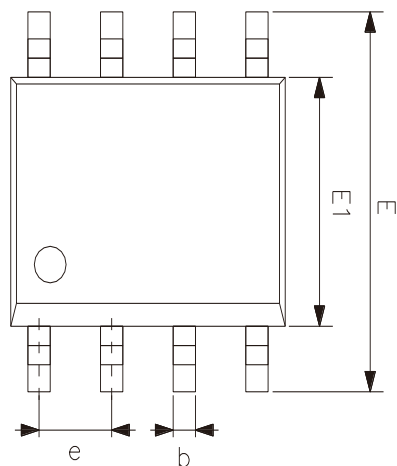
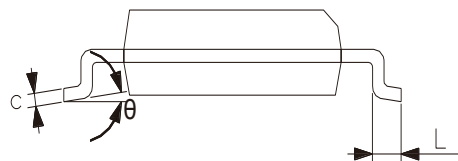
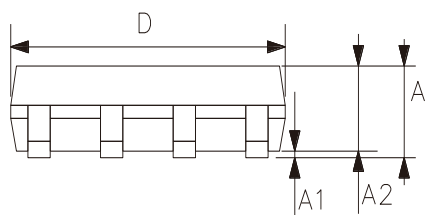
5.4、SOT363



2023/12/A	Dimensions In Millimeters	
Symbol	Min.	Max.
A	0.90	1.10
A1	0.00	0.10
A2	0.90	1.00
b	0.15	0.35
c	0.11	0.175
D	2.00	2.20
E1	2.15	2.45
E	1.15	1.35
e	0.65	
e1	1.20	1.40
L	0.26	0.46
L1	0.525	
θ	0°	8°



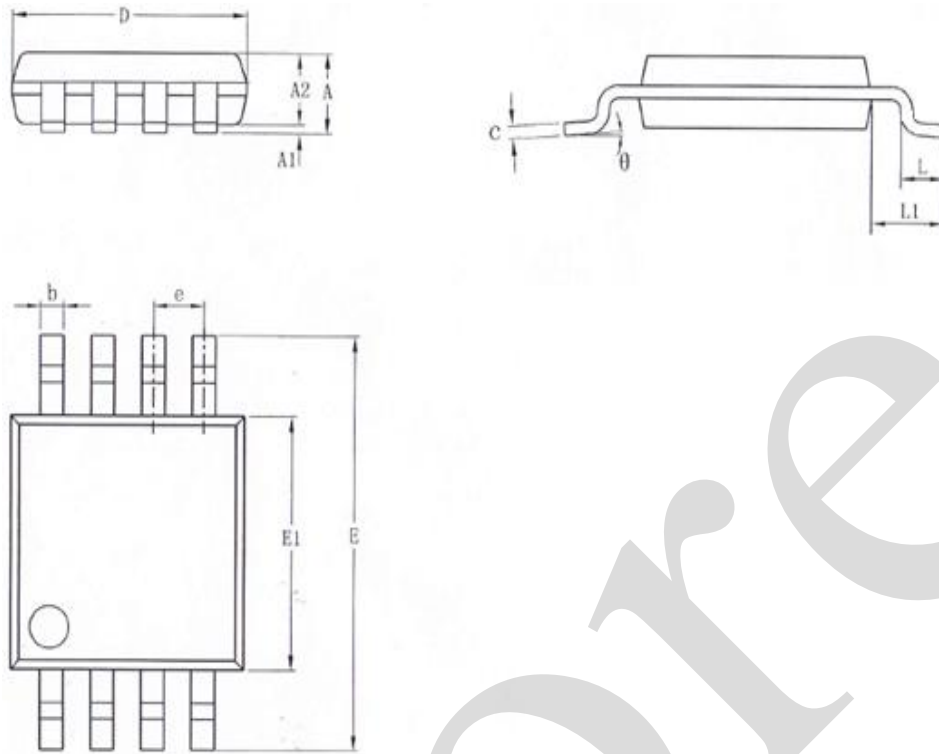
5.5、SOP8



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°



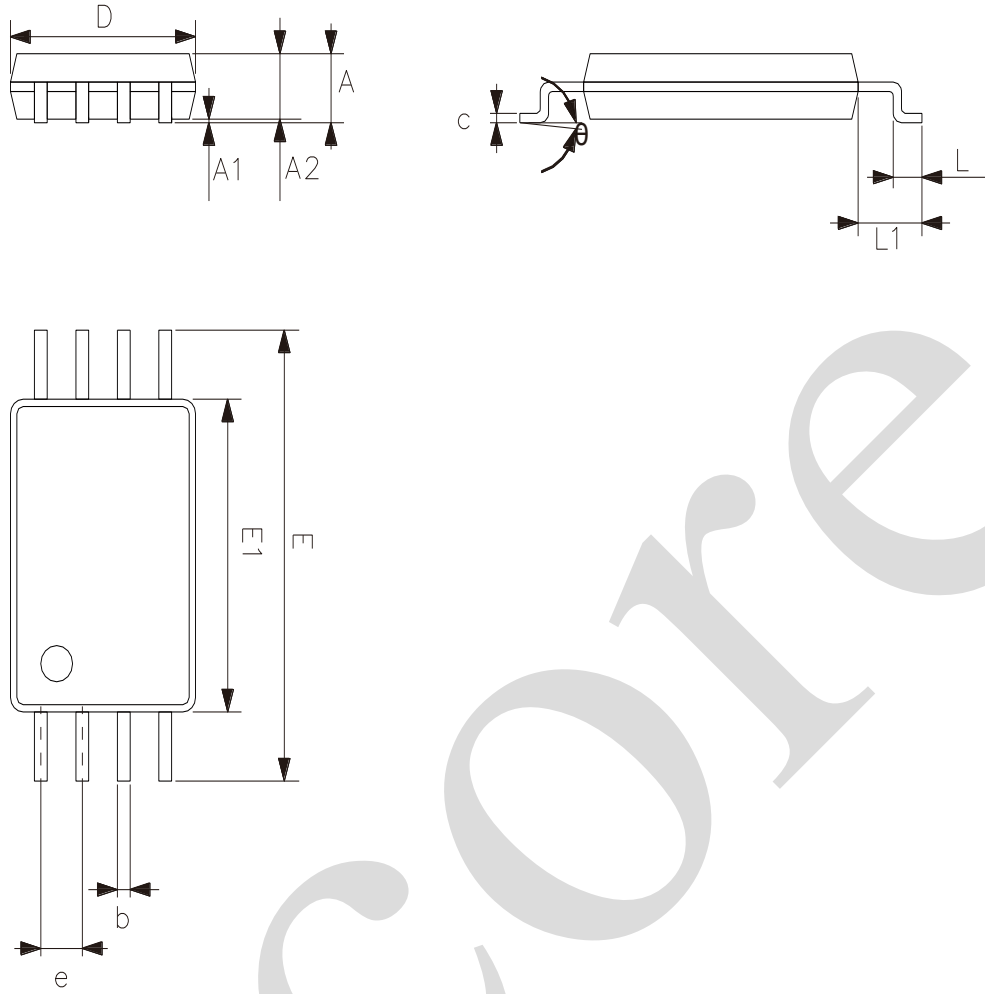
5.6、MSOP8



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°



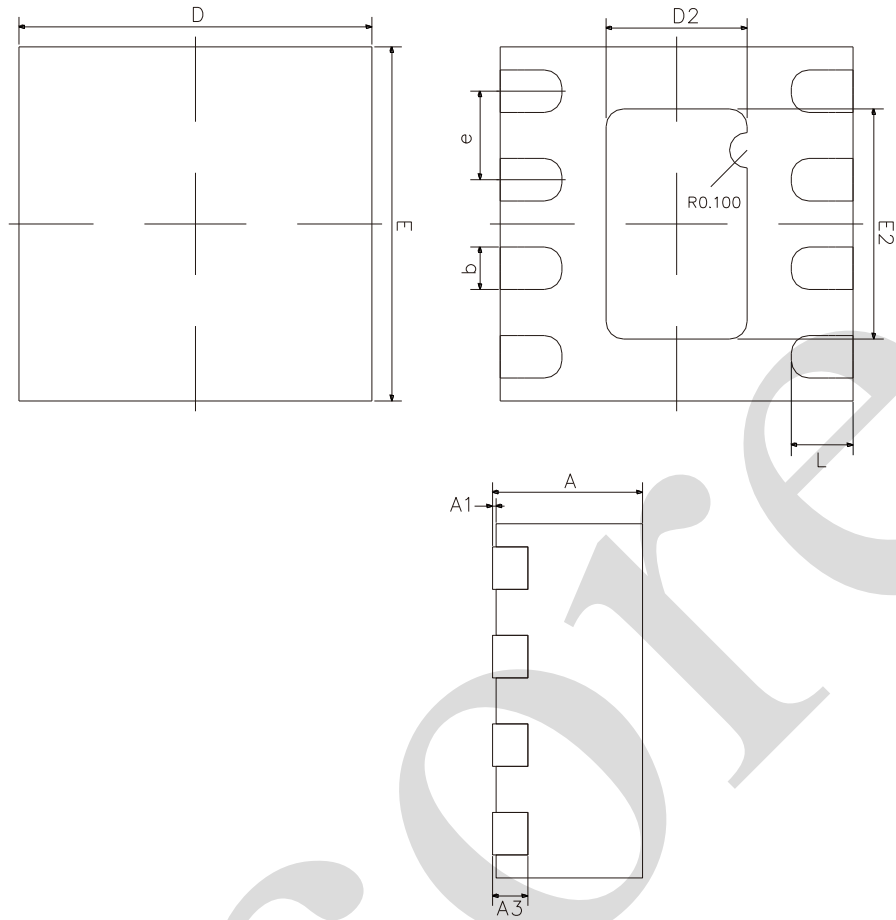
5.7、TSSOP8



2023/12/A Symbol	Dimensions In Millimeters	
	Min	Max
A	—	1.20
A1	0.05	0.15
A2	0.80	1.05
b	0.19	0.30
c	0.09	0.20
D	2.90	3.10
E1	4.30	4.50
E	6.20	6.60
e	0.65	
L	0.45	0.75
L1	1.00	
θ	0°	8°



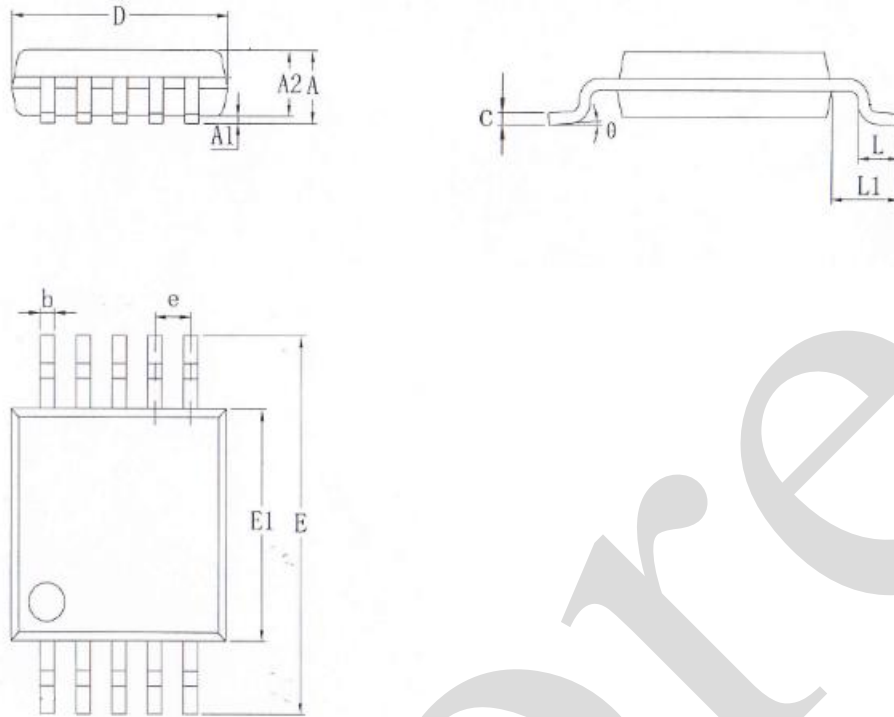
5.8、DFN8



2023/12/A	Dimensions In Millimeters	
Symbol	Min	Max
A	0.70	0.80
A1	0.00	0.05
A3	0.20	
b	0.19	0.30
D	1.90	2.10
E	1.90	2.10
D2	0.60	0.85
E2	1.10	1.35
e	0.50	
L	0.30	0.40



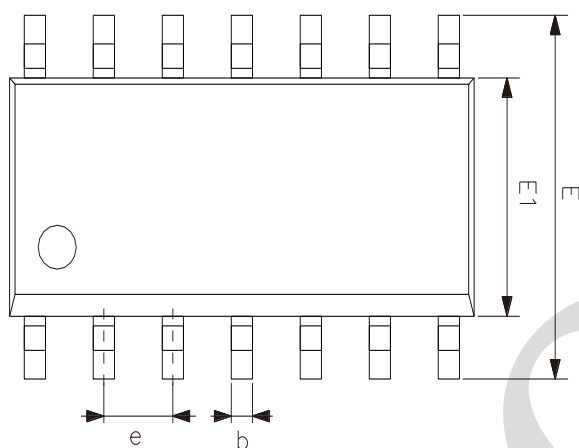
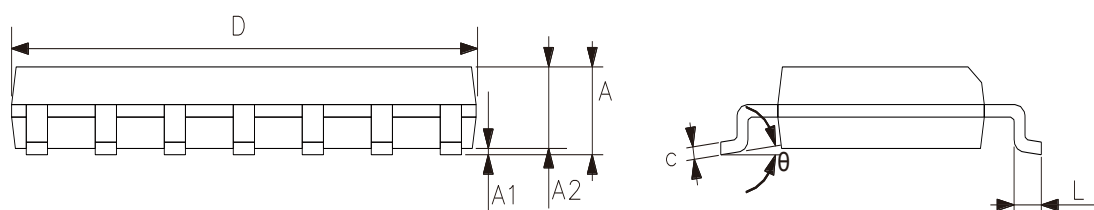
5.9、MSOP10



2023/12/A	Dimensions In Millimeters	
Symbol	Min	Max
A	—	1.10
A1	0.05	0.15
A2	0.75	0.95
b	0.17	0.27
c	0.08	0.23
D	2.90	3.10
E	4.70	5.10
E1	2.90	3.10
e	0.50	
L	0.40	0.80
L1	0.95	
θ	0°	8°



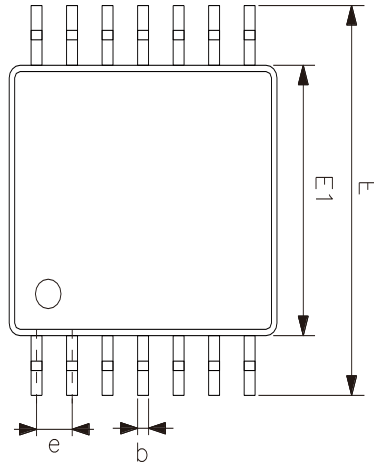
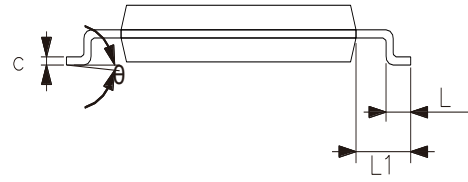
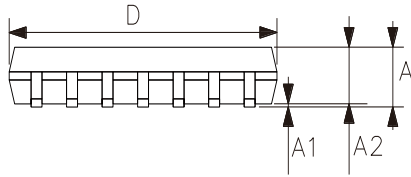
5.10、SOP14



2023/12/A Symbol	Dimensions In Millimeters	
	Min.	Max.
A	1.50	1.75
A1	0.05	0.25
A2	1.30	—
b	0.33	0.50
c	0.19	0.25
D	8.43	8.76
E	5.80	6.25
E1	3.75	4.00
e	1.27	
L	0.40	0.89
θ	0°	8°



5.11、TSSOP14



2023/12/A	Dimensions In Millimeters	
Symbol	Min	Max
A	—	1.20
A1	0.05	0.15
A2	0.80	1.05
b	0.19	0.30
c	0.09	0.20
D	4.90	5.10
E1	4.30	4.50
E	6.20	6.60
e	0.65	
L	0.45	0.75
L1	1.00	
θ	0°	8°



6、Statements And Notes

6.1、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.									

6.2、Notes

We recommend you to read this chapter carefully before using this product.

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