



AiP494 PWM Controller

Product Specification

Specification Revision History:

Version	Date	Description
2020-08-A1	2020-08	New
2022-12-B1	2022-12	Update the template
2024-08-B2	2024-08	Modify the content



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1、General Description

The AiP494 integrates all the modules required to form a pulse-width modulation (PWM) control circuit on a single chip. It is primarily used for power control and can be flexibly adjusted according to specific applications.

The AiP494 device contains two error amplifiers, an adjustable oscillator, a dead-time control (DTC) comparator, a pulse-steering control flip-flop, a 5V, 5%-precision regulator, and output-control circuits.

The error amplifiers exhibit a common-mode voltage range from -0.3V to $V_{CC}-2V$. The dead-time control comparator has a fixed offset that provides approximately 5% dead time. The sawtooth wave at the oscillator's CT pin can serve as a common signal for other synchronized multi-rail power supply systems. Additionally, the RT pin can be shorted to the REF pin to stop the oscillator, allowing the sawtooth wave to be input directly from the CT pin.

The uncommitted output transistors provide either common-emitter or emitter-follower output capability. The AiP494 device provides for push-pull or single-ended output operation, which can be selected through the output-control function.

Features:

- Complete PWM power-control circuitry
- Uncommitted outputs for sink or source current
- Output control selects single-ended or push-pull operation
- Dead time adjusted
- Internal regulator provides a stable 5V reference supply with 5% tolerance
- Circuit architecture allows easy synchronization
- ESD-HBM: 4000V
- Operating temperature range: -40°C to +85°C
- Package form: DIP16/SOP16/TSSOP16



Ordering Information:

Tube packing specifications:

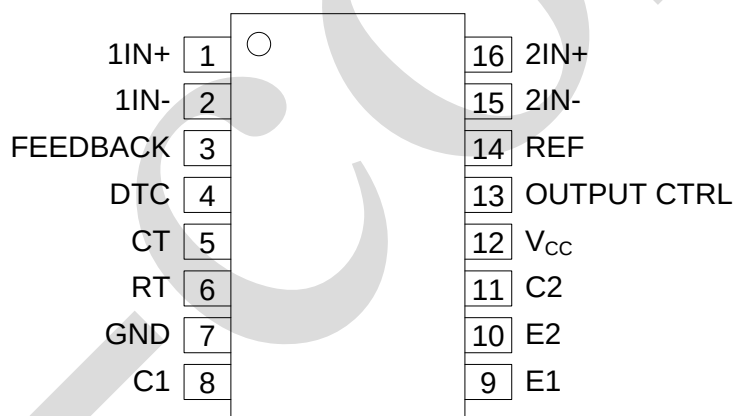
Part number	Packaging form	Marking code	Tube quantity	Boxed tube quantity	Boxed quantity	Notes
AiP494DA16.TB	DIP16	AiP494	25 PCS/tube	40 tube/box	1000 PCS/box	Dimensions of plastic enclosure: 19.0mm×6.4mm Pin spacing:2.54mm
AiP494SA16.TB	SOP16	AiP494	50 PCS/tube	200 tube/box	10000 PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing:1.27mm
AiP494TA16.TB	TSSOP16	AiP494	96 PCS/tube	200 tube/box	19200 PCS/box	Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing:0.65mm

Reel packing specifications:

Part number	Packaging form	Marking code	Reel quantity	Boxed reel quantity	Notes
AiP494SA16.TR	SOP16	AiP494	4000PCS/reel	8000PCS/box	Dimensions of plastic enclosure: 10.0mm×3.9mm Pin spacing:1.27mm
AiP494TA16.TR	TSSOP16	AiP494	5000PCS/reel	10000PCS/box	Dimensions of plastic enclosure: 5.0mm×4.4mm Pin spacing:0.65mm

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

2.1、 Block Diagram





2.3、Pin Description

Pin No.	Pin Name	IO	Description
1	1IN+	I	Non-inverting input to error amplifier 1
2	1IN-	I	Inverting input to error amplifier 1
3	FEEDBACK	I	Input pin for feedback
4	DTC	I	Dead-time control comparator input
5	CT	-	Capacitor terminal used to set oscillator frequency
6	RT	-	Resistor terminal used to set oscillator frequency
7	GND	-	Ground
8	C1	O	Collector terminal of BJT output 1
9	E1	O	Emitter terminal of BJT output 1
10	E2	O	Emitter terminal of BJT output 2
11	C2	O	Collector terminal of BJT output 2
12	V _{CC}	-	Positive Supply
13	OUTPUT CTRL	I	Selects single-ended/parallel output or push-pull operation
14	REF	O	5V reference regulator output
15	2IN-	I	Inverting input to error amplifier 2
16	2IN+	I	Non-inverting input to error amplifier 2

3、Electrical Parameter

3.1、Absolute Maximum Ratings

(T_{amb}=25℃, All voltage referenced to V_{ss}, unless otherwise specified)

Characteristic		Symbol	Conditions		Value	Unit
Supply voltage		V _{CC}	-		41	V
Amplifier input voltage		V _I	-		V _{CC} +0.3	V
Collector output voltage		V _O	-		41	V
Collector output current		I _O	-		250	mA
Storage temperature		T _{stg}	-		-65 to 150	℃
Thermal resistance (Note 1, 2)	DIP16	θ_{JA}	-		88	℃/W
	SOP16		-		115	
	TSSOP16		-		155	
Soldering temperature		T _L	10s	DIP	245	℃
				SOP/TSSOP	260	

Note 1: The package thermal impedance is calculated in accordance with JEDEC 2S2P.

Note 2: Maximum power dissipation is a function of T_J, θ_{JA} and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D=(T_J-T_A)/\theta_{JA}$.



3.2、Recommended Operating Conditions

Characteristic	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	7	-	40	V
Amplifier input voltage	V_I	-0.3	-	$V_{CC}-2$	V
Collector output voltage	V_O	-	-	40	V
Collector output current (each transistor)	I_O	-	-	200	mA
Current into feedback terminal	I_{fb}	-	-	0.3	mA
Oscillator frequency	f_{OSC}	1	-	300	kHz
Timing capacitor	C_T	0.47	-	10000	nF
Timing resistor	R_T	1.8	-	500	k Ω
Ambient temperature	T_A	-40	-	85	$^{\circ}\text{C}$

3.3、Electrical Characteristics

($T_A=25^{\circ}\text{C}$, $V_{CC}=15\text{V}$, $f=10\text{kHz}$, $C_T=0.01\mu\text{F}$, $R_T=12\text{k}\Omega$, unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Reference Section						
REF output voltage	V_{ref}	$I_O=1\text{mA}$	4.75	5	5.25	V
Line regulation	Reg_{line}	$V_{CC}=7\text{V to }40\text{V}$	-	2	25	mV
Load regulation	Reg_{load}	$I_O=1\text{mA to }10\text{mA}$	-	1	15	mV
Output voltage change with temperature	$\Delta V_O(\Delta T)$	$\Delta T_A=\text{MIN to MAX}$	-	0.6	-	mV/V
Short-circuit output current	I_{SC}	REF=0V	-	25	-	mA
Oscillator Section						
Frequency	f_{osc}	-	-	10	-	kHz
Frequency change with voltage	$\Delta f_{osc}(\Delta V)$	$V_{CC}=7\text{V to }40\text{V}$	-	1	-	%
Frequency change with temperature	$\Delta f_{osc}(\Delta T)$	$\Delta T_A=\text{MIN to MAX}$	-	-	10	%
Error-Amplifier Section						
Input offset voltage	V_{IO}	$V_O(\text{FEEDBACK})=2.5\text{V}$	-	2	10	mV
Input offset current	I_{IO}	$V_O(\text{FEEDBACK})=2.5\text{V}$	-	25	250	nA
Input bias current	I_{IB}	$V_O(\text{FEEDBACK})=2.5\text{V}$	-	200	1000	nA
Common-mode input voltage	V_{ICR}	$V_{CC}=7\text{V to }40\text{V}$	-0.3	-	$V_{CC}-2$	V
Open-loop voltage amplification	G_{VO}	$V_O(\text{FEEDBACK})=0.5\text{V}$ to 3.5V, $R_L=2\text{k}\Omega$	70	95	-	dB
Unity-gain bandwidth	GBW	$R_L=2\text{k}\Omega$	-	800	-	kHz
Common-mode rejection ratio	CMRR	$V_O(\text{FEEDBACK})=0.5\text{V}$ to 3.5V, $R_L=2\text{k}\Omega$	65	80	-	dB
Output sink current (FEEDBACK)	I_{O-}	$V_{ID}=-15\text{mV to }-5\text{V}$, $V(\text{FEEDBACK})=0.7\text{V}$	0.3	0.7	-	mA
Output source current (FEEDBACK)	I_{O+}	$V_{ID}=15\text{ mV to }5\text{V}$, $V(\text{FEEDBACK})=3.5\text{V}$	-2	-	-	mA
Output Section						
Collector off-state current	$I_{C(off)}$	$V_{CE}=40\text{V}$, $V_{CC}=40\text{V}$	-	2	100	μA



Emitter off-state current		$I_{E(off)}$	$V_{CC}=V_C=40V, V_E=0$	-100	-	-	μA
Collector-emitter saturation voltage	Common emitter	$V_{sat(C)}$	$V_E=0, I_C=200mA$	-	1.1	1.3	V
	Emitter follower	$V_{sat(E)}$	$V_{O(C1 \text{ or } C2)}=15V, I_E=-200mA$	-	1.5	2.5	V
Output control input current		I_{OC}	$V_I=V_{ref}$	-	-	3.5	mA
Dead-Time Control Section							
Input bias current (DEAD-TIME CTRL)		$I_{IB(DT)}$	$V_I=0$ to 5.25V	-	-2	-10	μA
Maximum duty cycle (each output)		DC_{max}	V_I (DEAD-TIME CTRL)=0, $C_T=0.01\mu F$, $R_T=12k\Omega$	-	45	-	%
Input threshold voltage (DEAD-TIME CTRL))	V_{th}	Zero duty cycle		-	2.7	3.3	V
		Maximum duty cycle		0	-	-	V
PWM Comparator Section							
Input threshold voltage (FEEDBACK)		V_{TH}	Zero duty cycle	-	3.7	4.5	V
Input sink current (FEEDBACK)		I_{I-}	$V(FEEDBACK)=0.7V$	0.3	0.7	-	mA
Total Device							
Standby supply current	I_{CC}	$R_T=V_{ref}$, all other inputs and outputs open	$V_{CC}=15V$	-	6	10	mA
			$V_{CC}=40V$	-	9	15	mA
Average supply current		-	V_I (DEAD-TIME CTRL)=2V, see Figure 1	-	7.5	-	mA

3.4、Switching Characteristics

($T_A=25^{\circ}C$, unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Rise time	t_r	Common-emitter configuration, See Figure 3	-	100	200	ns
Fall time	t_f		-	25	100	ns
Rise time	t_r	Emitter-follower configuration, See Figure 4	-	100	200	ns
Fall time	t_f		-	40	100	ns

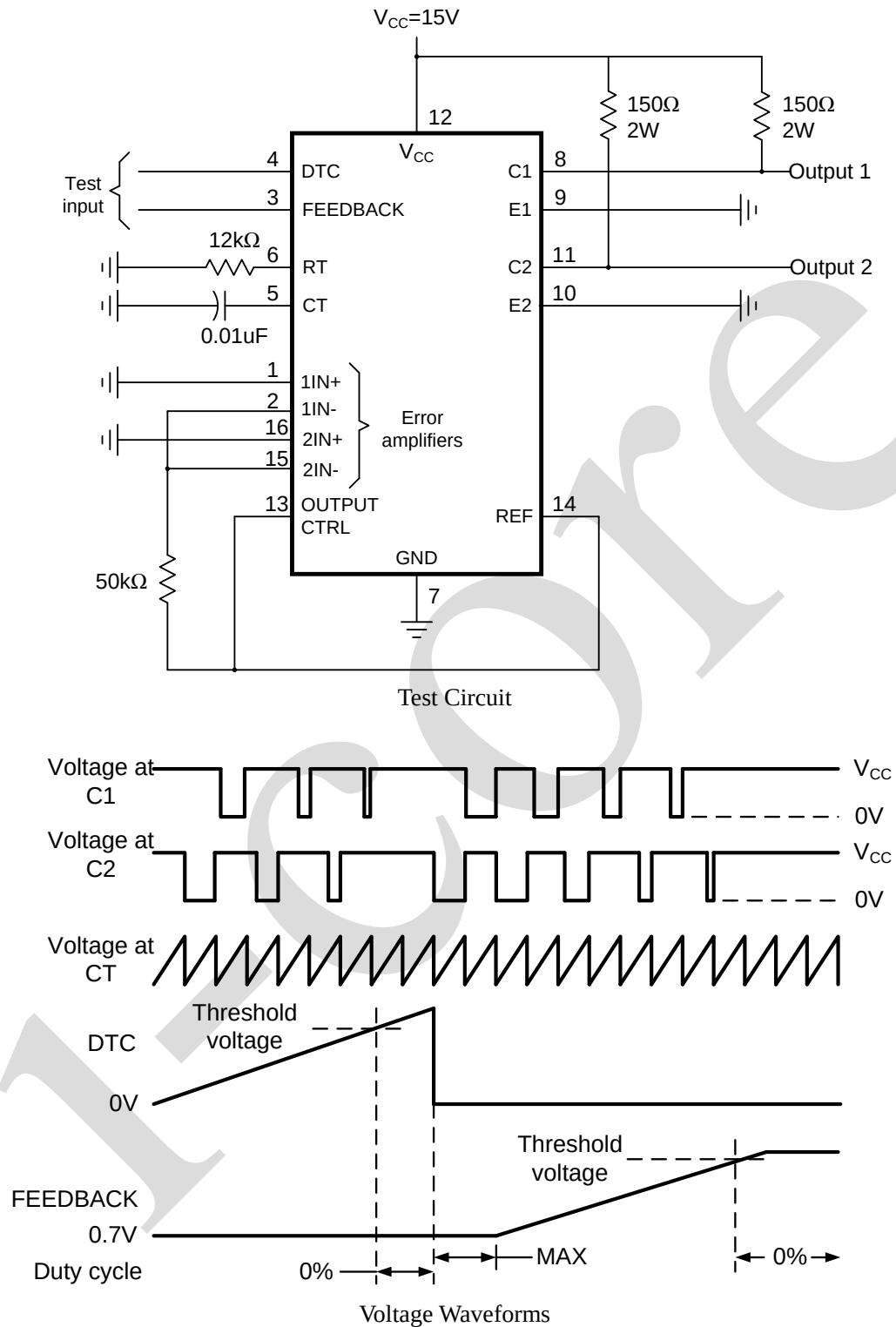
**4、Testing Circuit**

Figure 1. Operational Test Circuit and Waveforms

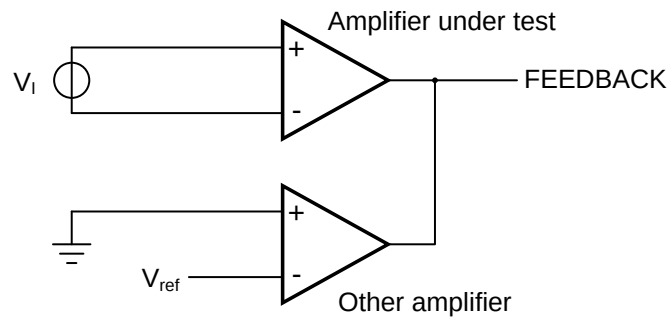
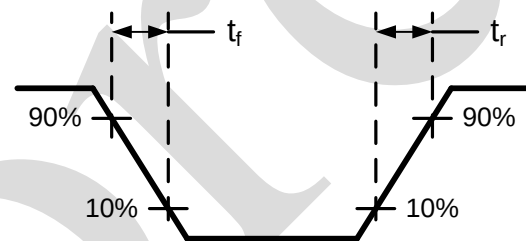
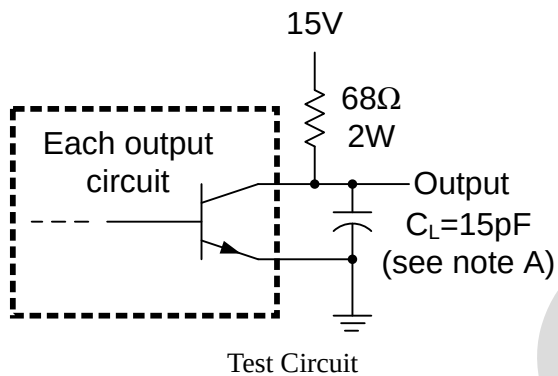


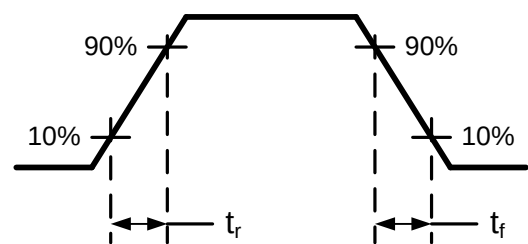
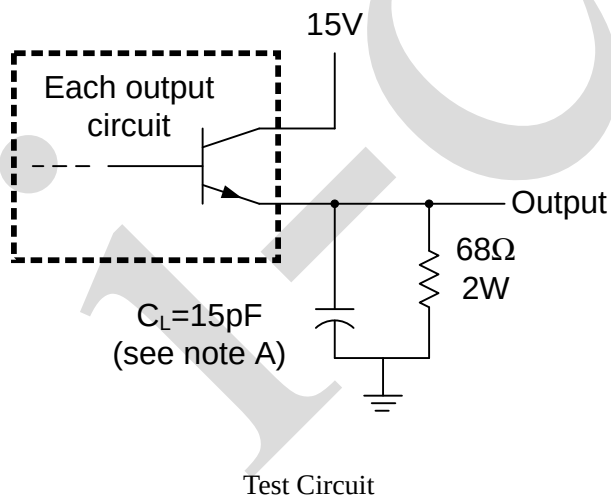
Figure 2. Amplifier Characteristics



Output Voltage Waveform

Note A: C_L includes probe and jig capacitance.

Figure 3. Common-Emitter Configuration



Output Voltage Waveform

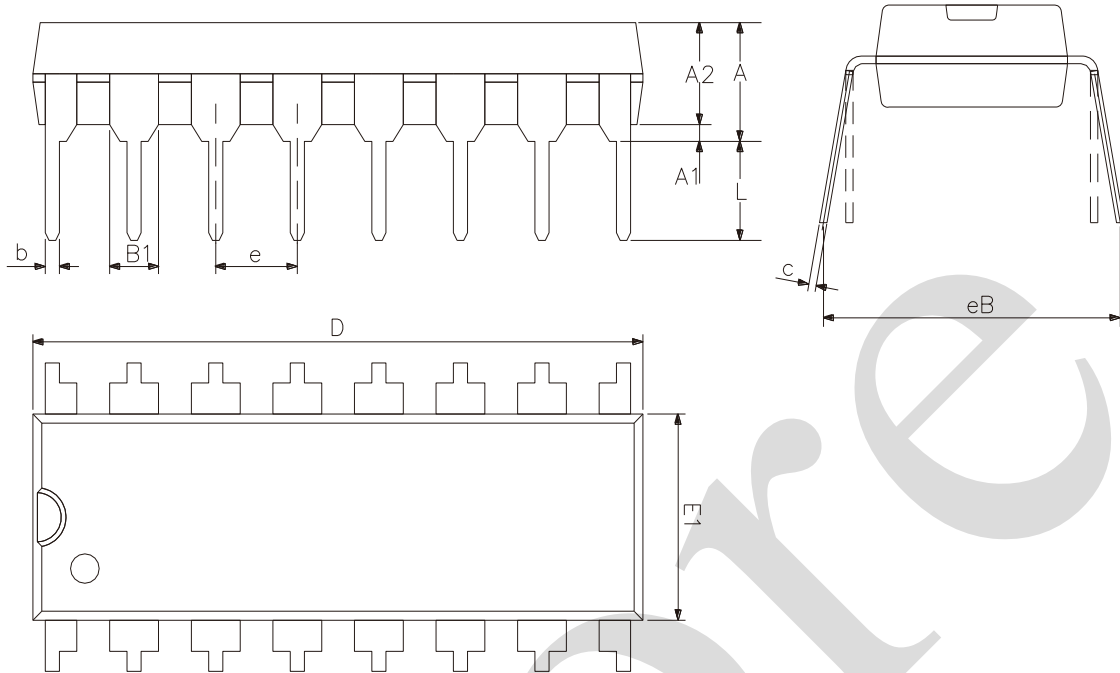
Note A: C_L includes probe and jig capacitance.

Figure 4. Emitter-Follower Configuration



5、Package Information

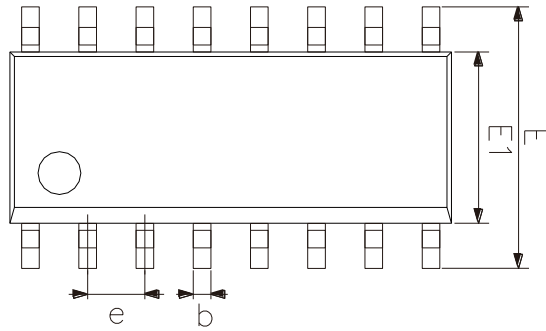
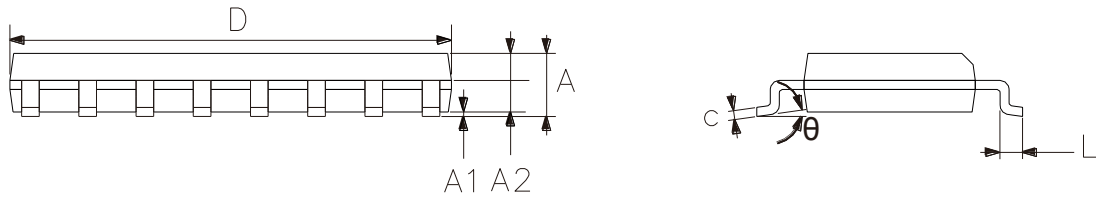
5.1、DIP16



2023/12/A	Dimensions In Millimeters	
Symbol	Min	Max
A2	3.00	3.60
A1	0.51	—
A	3.60	5.33
L	3.00	3.60
b	0.36	0.56
B1	1.52	
D	18.80	19.94
E1	6.20	6.60
e	2.54	
c	0.20	0.36
eB	7.62	9.30



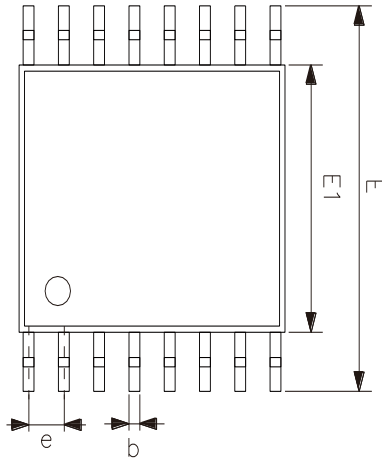
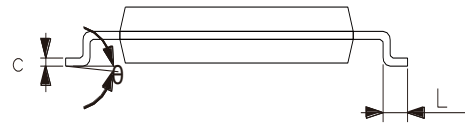
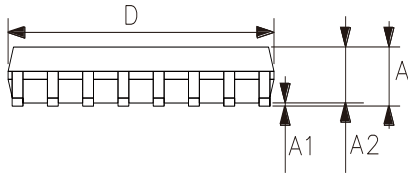
5.2、SOP16



2023/12/A	Dimensions In Millimeters	
Symbol	Min.	Max.
A	1.35	1.80
A1	0.10	0.25
A2	1.25	1.55
b	0.33	0.51
c	0.19	0.25
D	9.50	10.10
E	5.80	6.30
E1	3.70	4.10
e	1.27	
L	0.35	0.89
θ	0°	8°



5.3、TSSOP16



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
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

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