1. DESCRIPTION

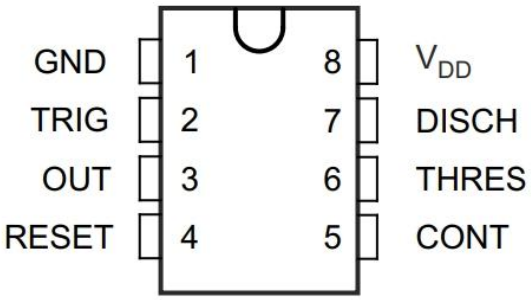
The XD551 and XL551 are monolithic timing circuit chips. The timers are fully compatible with CMOS, TTL, and MOS logic and operates at frequencies up to 2MHz. this device uses smaller timing capacitors because of its high input impedance. As a result, more accurate time delays and oscillations are possible. Power consumption is low across the full range of power supply voltage.

The XD551 and XL551 have a trigger level equal to approximately one-third of the supply voltage and a threshold level equal to approximately two-thirds of the supply voltage. These levels can be altered by use of the control voltage terminal (CONT). When the trigger input (TRIG) falls below the trigger level, the flip-flop is set and the output goes high. If TRIG is above the trigger level and the threshold input (THRES) is above the threshold level, the flip-flop is reset and the output is low. The reset input (RESET) can override all other inputs and can be used to initiate a new timing cycle. If RESET is low, the flip-flop is reset and the output is low. Whenever the output is low, a low-impedance path is provided between DISCH and GND. All unused inputs should be tied to an appropriate logic level to prevent false triggering.

2. FEATURES

- Very Low Power Consumption: 170uA at VDD = 5 V
- Capable of Operation in Astable Mode
- High Output-Current Capability: Sink 100 mA (Max) and Source 10 mA (Tpy)
- Output Fully Compatible With CMOS, TTL,and MOS
- Low Supply Current Reduces Spikes During Output Transitions
- Single-Supply Operation From 2 V to 15 V
- ESD Protection Exceeds 1500 V PerMIL-STD-883C, Method 3015.2
- Operation from 0°C to 70°C
- Footprint options : DIP8 (XD551) and SOP8 (XL551)

3. FUNCTIONAL BLOCK DIAGRAM



(TOP VIEW)

Pin Function Definition:

XD551 / XL555		I/O Type	DESCRIPTION
NAME	PIIN		
GND	1	—	Ground.
TRIG	2	Input	Start of timing input. TRIG < 1/2 CONT sets output high and discharge open.
OUT	3	Output	High current timer output signal.
RESET	4	Input	Active low reset input forces output and discharge low.
CONT	5	Input	Controls comparator thresholds. Outputs 2/3 V_{DD} and allows bypass capacitor connection.
THRES	6	Input	End of timing input. THRES > CONT sets output low and discharge low.
DISCH	7	Output	Open collector output to discharge timing capacitor.
V_{DD}	8	—	Power-supply voltage.

4. FUNCTIONAL BLOCK DIAGRAM

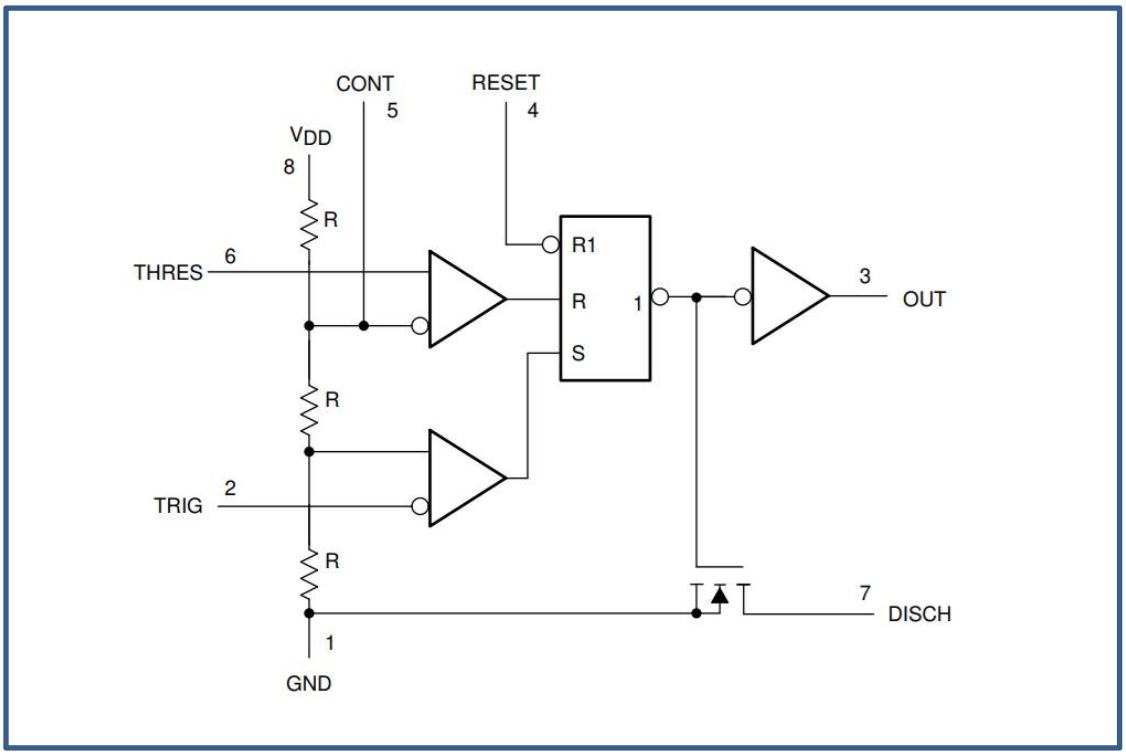


Table 1: Logic Functional

FUNCTION TABLE

RESET VOLTAGE†	TRIGGER VOLTAGE†	THRESHOLD VOLTAGE†	OUTPUT	DISCHARGE SWITCH
<MIN	Irrelevant	Irrelevant	Low	On
>MAX	<MIN	Irrelevant	High	Off
>MAX	>MAX	>MAX	Low	On
>MAX	>MAX	<MIN	As previously established	

Note: For conditions shown as MIN or MAX, use the appropriate value specified under electrical characteristics.

5. ABSOLUTE MAXIMUM RATINGS

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

- Supply voltage, VDD (see Note 1) ..... 17.5 V
- Input voltage range, VI (any input)..... –0.3 to V_{DD}
- Sink current, discharge or output..... 100 mA .
- Source current, output, I_O ..... 10 mA
- Continuous total power dissipation..... See Dissipation Rating Table
- Operating free-air temperature range..... 0 °C to 70°C
- Storage temperature range ..... –50 °C to 150°C
- Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds..... 260°C

NOTE 1: All voltage values are with respect to network GND.

NOTE 2:Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

6. DISSIPATION RATING TABLE

PACKAGE	TA ≤ 25°C POWER RATING	DERATING FACTOR ABOVE TA = 25°C	TA = 70°C POWER RATING
SOP8	725mW	6.5mW/°C	500mW
DIP8	1000mW	10.0mW/°C	680mW

7. RECOMMENDED OPERATING CONDITIONS

	MIN	MAX	UNIT
Supply voltage, V_{DD}	2	15	V
Operating free-air temperature range, T_A	0	70	°C

8. ELECTRICAI CHARACTERISTICS

ELECTRICAI CHARACTERISTICS(continued)

electrical characteristics at specified free-air temperature, V_{DD} = 2 V

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
V_{IT}	Threshold voltage		25°C	0.95	1.33	1.65	V
			Full range	0.85		1.75	
I_{IT}	Threshold current		25°C		10		pA
			70°C		75		
$V_{I(TRIG)}$	Trigger voltage		25°C	0.4	0.67	0.95	V
			Full range	0.3		1.05	
$I_{I(TRIG)}$	Trigger current		25°C		10		pA
			70°C		75		
$V_{I(RESET)}$	Reset voltage		25°C	0.4	1.1	1.5	V
			Full range	0.3		1.8	
$I_{I(RESET)}$	Reset current		25°C		10		pA
			70°C		75		
	Control voltage (open circuit) as a percentage of supply voltage		70°C		66.7%		
	Discharge switch on stage voltage	I_{OL} = 1 mA	25°C		0.03	0.2	V
			Full range			0.25	
	Discharge switch off stage voltage		25°C		0.1		nA
			70°C		0.5		
V_{OH}	High level output voltage	I_{OH} = = 300 µA	25°C	1.5	1.9		V
			Full range	1.5			
V_{OL}	Low level output voltage	I_{OL} = 1 mA	25°C		0.07	0.3	V
			Full range			0.35	
I_{DD}	Supply curren	See Note 1	25°C		65	250	µA
			Full range			400	

NOTE 1: These values apply for the expected operating configurations in which THRES is connected directly to DISCH or to TRIG.
Full range is 0°C to 70°C.

ELECTRICAI CHARACTERISTICS(continued)

electrical characteristics at specified free-air temperature, V_{DD} = 5 V

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
V_{IT}	Threshold voltage		25°C	2.8	3.3	3.8	V
			Full range	2.7		3.9	
I_{IT}	Threshold current		25°C		10		pA
			70°C		75		
$V_{I(TRIG)}$	Trigger voltage		25°C	1.36	1.66	1.96	V
			Full range	1.26		2.06	
$I_{I(TRIG)}$	Trigger current		25°C		10		pA
			70°C		75		
$V_{I(RESET)}$	Reset voltage		25°C	0.4	1.1	1.5	V
			Full range	0.3		1.8	
$I_{I(RESET)}$	Reset current		25°C		10		pA
			70°C		75		
	Control voltage (open circuit) as a percentage of supply voltage		70°C		66.7%		
	Discharge switch on stage voltage	I_{OL} = 10mA	25°C		0.14	0.5	V
			Full range			0.6	
	Discharge switch off stage voltage		25°C		0.1		nA
			70°C		0.5		
V_{OH}	High level output voltage	I_{OH} = 1 mA	25°C	4.1	4.8		V
			Full range	4.1			
V_{OL}	Low level output voltage	I_{OL} = 8 mA	25°C		0.21	0.4	V
			Full range			0.5	
		I_{OL} = 5 mA	25°C		0.13	0.3	
			Full range			0.4	
		I_{OL} = 3.2 mA	25°C		0.08	0.3	
			Full range			0.35	
I_{DD}	Supply curren	See Note 1	25°C		170	350	µA
			Full range			500	

NOTE 1: These values apply for the expected operating configurations in which THRES is connected directly to DISCH or to TRIG.
Full range is 0°C to 70°C.

ELECTRICAI CHARACTERISTICS(continued)

electrical characteristics at specified free-air temperature, V_{DD} = 15 V

PARAMETER		TEST CONDITIONS	TA	MIN	TYP	MAX	UNIT
V_{IT}	Threshold voltage		25°C	9.45		10.55	V
			Full range	9.35		10.65	
I_{IT}	Threshold current		25°C		10		pA
			70°C		75		
$V_{I(TRIG)}$	Trigger voltage		25°C	4.65	5	5.35	V
			Full range	4.55		5.45	
$I_{I(TRIG)}$	Trigger current		25°C		10		pA
			70°C		75		
$V_{I(RESET)}$	Reset voltage		25°C	0.4	1.1	1.5	V
			Full range	0.3		1.8	
$I_{I(RESET)}$	Reset current		25°C		10		pA
			70°C		75		
	Control voltage (open circuit) as a percentage of supply voltage		70°C		66.7%		
	Discharge switch on stage voltage	I_{OL} = 100mA	25°C		0.77	1.7	V
			Full range			1.8	
	Discharge switch off stage voltage		25°C		0.1		nA
			70°C		0.5		
V_{OH}	High level output voltage	I_{OH} = -10 mA	25°C	12.5	14.2		V
			Full range	12.5			
		I_{OH} = -5 mA	25°C	13.5	14.6		
			Full range	13.5			
		I_{OH} = -1 mA	25°C	14.2	14.9		
			Full range	14.2			
V_{OL}	Low level output voltage	I_{OL} = 100 mA	25°C		1.28	3.2	V
			Full range			3.6	
		I_{OL} = 50 mA	25°C		0.63	1	
			Full range			1.3	
		I_{OL} = 10 mA	25°C		0.12	0.3	
			Full range			0.4	
I_{DD}	Supply curren	See Note 1	25°C		360	600	µA
			Full range			800	

NOTE 1: These values apply for the expected operating configurations in which THRES is connected directly to DISCH or to TRIG
Full range is 0°C to 70°C.

operating characteristics, V_{DD} = 5 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
	Initial error of timinginterval NOTE 1	V_{DD} = 5V to 15V, C_T = 0.1 µF,	R_A=R_B =1kΩ to 100kΩ See Note 2		5%		
	Supply voltage sensitivity of timing interval				0.6	1	%/V
t_r	Rise time, output pulse	RL = 10 MΩ	CL = 10 pF		20	75	ns
t_f	Fall time, output pulse				15	60	
f_{max}	Maximum frequency in astable mode	RA = 470 Ω, CT = 200 pF	RB = 200 Ω, See Note 2	1.2	1.8		MHZ

NOTE 1: Timing interval error is defined as the difference between the measured value and the average value of a random sample from each process run.
NOTE 2: RA, RB, and CT are as defined in Figure 3.

ELECTRICAI CHARACTERISTICS(continued)

electrical characteristics at V_{DD} = 5 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IT}	Threshold voltage		2.8	3.3	3.8	V
I_{IT}	Threshold current			10		pA
$V_{I(TRIG)}$	Trigger voltage		1.36	1.66	1.96	V
$I_{I(TRIG)}$	Trigger current			10		pA
$V_{I(RESET)}$	Reset voltage		0.4	1.1	1.5	V
$I_{I(RESET)}$	Reset current			10		pA
	Control voltage (open circuit) as a percentage of supply voltage			66.7%		
	Discharge switch on stage voltage	I_{OL} = 10 mA		0.14	0.5	V
	Discharge switch off stage voltage			0.1		nA
V_{OH}	High level output voltage	I_{OH} = = 300 µA	4.1	4.8		V
V_{OL}	Low level output voltage	I_{OL} = 8 mA		0.21	0.4	V
		I_{OL} = 5 mA		0.13	0.3	
		I_{OL} = 3.2 mA		0.08	0.3	
I_{DD}	Supply curren	See Note 1		170	350	µA

NOTE 1: These values apply for the expected operating configurations in which THRES is connected directly to DISCH or to TRIG.

9. TYPICAL CHARACTERISTICS

DISCHARGE SWITCH ON-STATERESISTANCE vs FREE-AIR TEMPERATURE

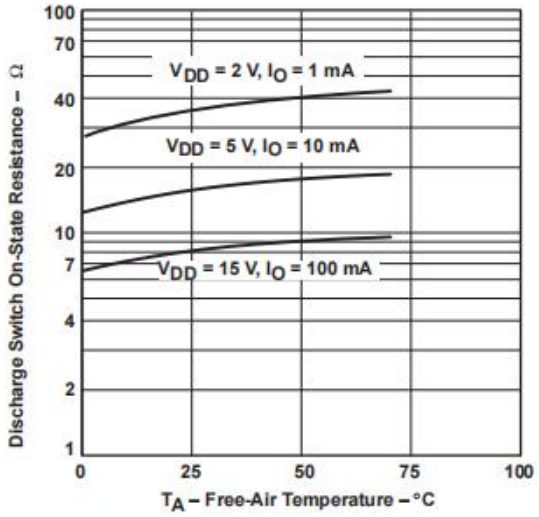


Figure 1

PROPAGATION DELAY TIMES (TO DISCHARGE OUTPUT FROM TRIGGER AND THRESHOLD SHORTED TOGETHER) vs SUPPLY VOLTAGE

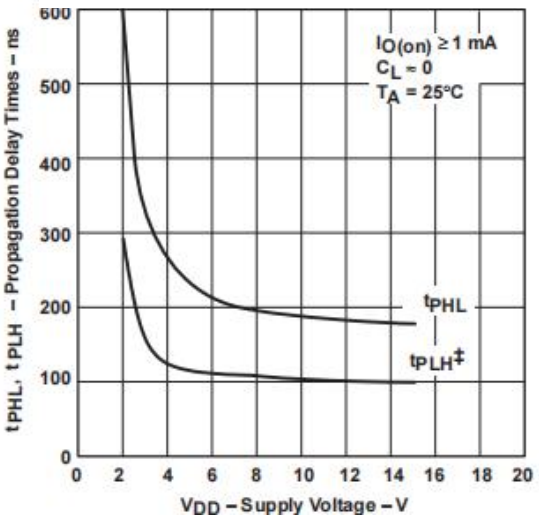


Figure 2

10. APPLICATION INFORMATION

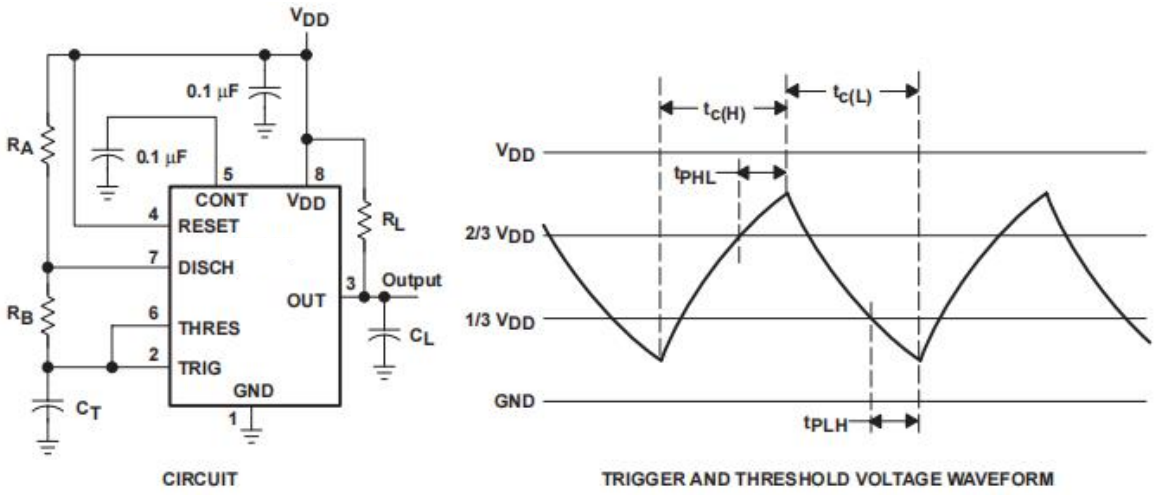


Figure 3. Astable Operation

Connecting TRIG to THRES, as shown in Figure 3, causes the timer to run as a multivibrator. The capacitor C_T charges through R_A and R_B to the threshold voltage level (approximately 0.67 V_{DD}) and then discharges through RB only to the value of the trigger voltage level (approximately 0.33 V_{DD}). The output is high during the charging cycle ($t_{c(H)}$) and low during the discharge cycle ($t_{c(L)}$). The duty cycle is controlled by the values of R_A, and R_B, and C_T, as shown in the equations below.

$$t_{c(H)} \approx C_T (R_A + R_B) \ln 2 \quad (\ln 2 = 0.693)$$

$$t_{c(L)} \approx C_T R_B \ln 2$$

$$\text{Period} = t_{c(H)} + t_{c(L)} \approx C_T (R_A + 2R_B) \ln 2$$

$$\text{Output driver duty cycle} = \frac{t_{c(L)}}{t_{c(H)} + t_{c(L)}} \approx 1 - \frac{R_B}{R_A + 2R_B}$$

$$\text{Output waveform duty cycle} = \frac{t_{c(H)}}{t_{c(H)} + t_{c(L)}} \approx \frac{R_B}{R_A + 2R_B}$$

The 0.1-µF capacitor at CONT in Figure 3 decreases the period by about 10%.

The formulas shown above do not allow for any propagation delay times from TRIG and THRES to DISCH. These delay times add directly to the period and create differences between calculated and actual values that increase with frequency. In addition, the internal on-state resistance ron during discharge adds to RB to provide another source of timing error in the calculation when R_B is very low or ron is very high.

APPLICATION INFORMATION(continued)

The equations below provide better agreement with measured values.

$$t_{c(H)} = C_T (R_A + R_B) \ln\left[3 - \exp\left(\frac{-t_{PLH}}{C_T (R_B + r_{on})}\right)\right] + t_{PHL}$$

$$t_{c(L)} = C_T (R_B + r_{on}) \ln\left[3 - \exp\left(\frac{-t_{PHL}}{C_T (R_A + R_B)}\right)\right] + t_{PLH}$$

These equations and those given earlier are similar in that a time constant is multiplied by the logarithm of a number or function. The limit values of the logarithmic terms must be between In 2 at low frequencies and In 3 at extremely high frequencies. For a duty cycle close to 50%, an appropriate constant for the logarithmic terms can be substituted with good results. Duty cycles less than 50% $\frac{t_{c(H)}}{t_{c(H)} + t_{c(L)}}$ require that $\frac{t_{c(H)}}{t_{c(L)}}$ <1 and possibly $R_A \le r_{on}$. These conditions can be difficult to obtain.

In monostable applications, the trip point of the trigger input can be set by a voltage applied to CONT. An input voltage between 10% and 80% of the supply voltage from a resistor divider with at least 500-µA bias provides good results.

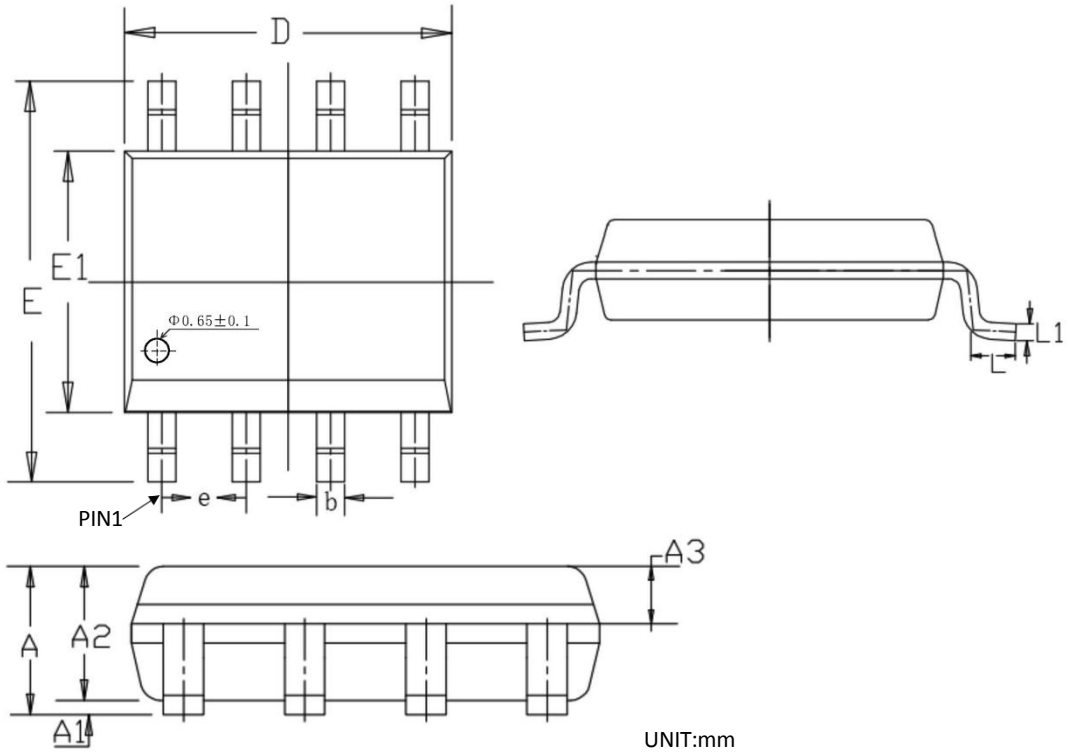
11. ORDERING INFORMATION

Ordering Information

Part Number	Device Marking	Package Type	Body size (mm)	Temperature (°C)	MSL	Transport Media	Package Quantity
XL551	XL551	SOP8	4.90 * 3.90	- 0 to 70	MSL3	T&R	2500
XD551	XD551	DIP8	9.25 * 6.38	- 0 to 70	MSL3	Tube 50	2000

12. DIMENSIONAL DRAWINGS

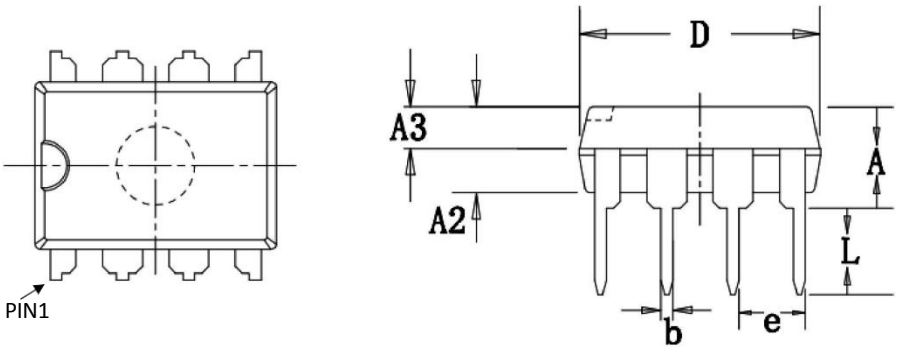
SOP8

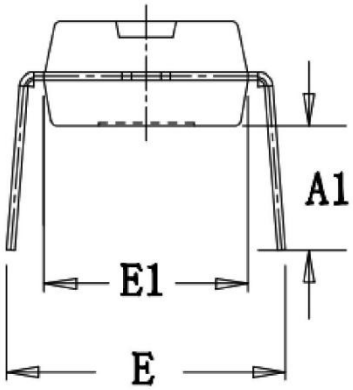


UNIT:mm

	MIN	NOM	MAX
A	1.450	1.550	1.650
A1	0.100	0.150	0.200
A2	1.300	1.400	1.500
A3	0.600	0.650	0.700
b	0.380	–	0.510
e	1.240	1.270	1.300
D	4.800	4.900	5.000
E	5.800	6.000	6.200
E1	3.800	3.900	4.000
L	0.450	0.600	0.750
L1	—	0.25BSC	—

DIP8





UNIT:mm

	MIN	NOM	MAX
A	3.600	3.800	4.000
A1	3.786	3.886	3.986
A2	3.200	3.300	3.400
A3	1.550	1.600	1.650
b	0.440	–	0.490
e	2.510	2.540	2.570
D	9.150	9.250	9.350
E	7.800	8.500	9.200
E1	6.280	6.380	6.480
L	3.000	–	–