

## 1. DESCRIPTION

The XL7555 and XD7555 are CMOS RC timers providing significantly improved performance over the standard SE/NE 555 timers, while at the same time being direct replacements for those devices in most applications.

Improved parameters include low supply current, wide operating supply voltage range, low Threshold, Trigger and Reset currents, no crowbarbing of the supply current during output transitions, higher frequency performance and no requirement to decouple Control Voltage for stable operation.

Specifically, the XL7555 and XD7555 are stable controllers capable of producing accurate time delays or frequencies. In the one shot mode, the pulse width of each circuit is precisely controlled by one external resistor and capacitor. For astable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled by two external resistors and one capacitor. Unlike the regular bipolar SE/NE 555 devices, the Control Voltage terminal need not be decoupled with a capacitor. The circuits are triggered and reset on falling (negative) waveforms, and the output inverter can source or sink currents large enough to drive TTL loads, or provide minimal offsets to drive CMOS loads.

## 2. FEATURES

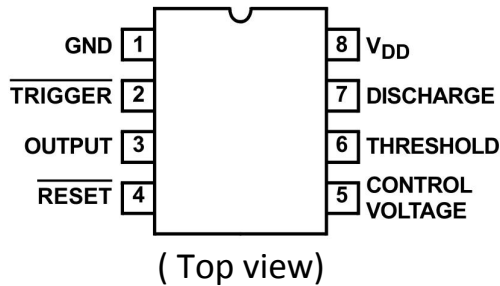
- Low supply current  
-XL/XD7555 . . . . . 60 $\mu$ A
- Extremely low input currents . . . . . 20pA
- High speed operation . . . . . 1MHz
- Guaranteed supply voltage range . . . . . 2V to 18V
- Temperature stability . . . . . 0.005%/ $^{\circ}$ C at +25 $^{\circ}$ C
- Normal reset function - no crowbarbing of supply during output transition
- Timing from microseconds through hours
- Adjustable duty cycle
- High output source/sink driver can drive TTL/CMOS
- Outputs have very low offsets, HIGH and LOW
- Pb-free (RoHS Compliant)

### **3. APPLICATIONS**

- Precision timing
- Pulse generation
- Sequential timing
- Time delay generation
- Pulse width modulation
- Pulse position modulation
- Missing pulse detector

## 4. PIN CONFIGURATIONS

Pin Configuration



## 5. ABSOLUTE MAXIMUM RATINGS

Supply Voltage ..... +18V  
Input Voltage

Trigger, Control Voltage, Threshold,

Reset (Note 4). ..... V+ +0.3V to GND -0.3V

Output Current ..... 100mA

## 6. OPERATING CONDITIONS

Temperature Range

XL/XD7555 ..... -25°C to +85°C

## 7. THERMAL INFORMATION

Thermal Resistance (Typical, Notes 5, 6)

	$\theta_{JA}$ (°C/W)	$\theta_{JC}$ (°C/W)
14 Ld CERDIP Package	80	24
14 Ld PDIP Package*	115	46
8 Ld PDIP Package*	130	69
8 Ld SOIC Package.	170	67

Maximum Junction Temperature (Hermetic Package) .....+175°C

Maximum Junction Temperature (Plastic Package) .....+150°C

Maximum Storage Temperature Range ..... -65°C to +150°C

\* Pb-free PDIPs can be used for through-hole wave solder processing only. They are not intended for use in Reflow solder processing applications.

*CAUTION: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.*

### NOTES:

4. Due to the SCR structure inherent in the CMOS process used to fabricate these devices, connecting any terminal to a voltage greater than V+ +0.3V or less than V- -0.3V may cause destructive latch-up. For this reason it is recommended that no inputs from external sources not operating from the same power supply be applied to the device before its power supply is established. In multiple supply systems, the supply of the XL7555 and XD7555 must be turned on first.

5.  $\theta_{JA}$  is measured with the component mounted on a low effective thermal conductivity test board in free air. See Tech Brief TB379 for details.

6. For  $\theta_{JC}$ , the “case temp” location is taken at the package top center.

**8. ELECTRICAL SPECIFICATIONS** Applies to XL/XD7555, unless otherwise specified.

PARAMETER	SYMBOL	TEST CONDITIONS	T <sub>A</sub> = +25°C			(Note 8) -55°C TO +125°C			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Static Supply Current	I <sub>DD</sub>	XL/XD7555 V <sub>DD</sub> = 5V	—	40	200	—	—	300	μA
			—	60	300	—	—	300	μA
Monostable Timing Accuracy	—	R <sub>A</sub> = 10k, C = 0.1μF, V <sub>DD</sub> = 5V	—	2	—	—	—	—	%
			—	—	—	858	—	1161	μs
Drift with Temperature (Note 7)	—	V <sub>DD</sub> = 5V	—	—	—	—	150	—	ppm/°C
		V <sub>DD</sub> = 10V	—	—	—	—	200	—	ppm/°C
		V <sub>DD</sub> = 15V	—	—	—	—	250	—	ppm/°C
Drift with Supply (Note 7)	—	V <sub>DD</sub> = 5V to 15V	—	0.5	—	—	0.5	—	%/V
Astable Timing Accuracy	—	R <sub>A</sub> = R <sub>B</sub> = 10k, C = 0.1μF, V <sub>DD</sub> = 5V	—	2	—	—	—	—	%
			—	—	—	1717	—	2323	μs
Drift with Temperature (Note 7)	—	V <sub>DD</sub> = 5V	—	—	—	—	150	—	ppm/°C
		V <sub>DD</sub> = 10V	—	—	—	—	200	—	ppm/°C
		V <sub>DD</sub> = 15V	—	—	—	—	250	—	ppm/°C
Drift with Supply (Note 7)	—	V <sub>DD</sub> = 5V to 15V	—	0.5	—	—	0.5	—	%/V
Threshold Voltage	V <sub>TH</sub>	V <sub>DD</sub> = 15V	62	67	71	61	—	72	% V <sub>DD</sub>
Trigger Voltage	V <sub>TRIG</sub>	V <sub>DD</sub> = 15V	28	32	36	27	—	37	% V <sub>DD</sub>
Trigger Current	I <sub>TRIG</sub>	V <sub>DD</sub> = 15V	—	—	10	—	—	50	nA
Threshold Current	I <sub>TH</sub>	V <sub>DD</sub> = 15V	—	—	10	—	—	50	nA
Control Voltage	V <sub>CV</sub>	V <sub>DD</sub> = 15V	62	67	71	61	—	72	% V <sub>DD</sub>

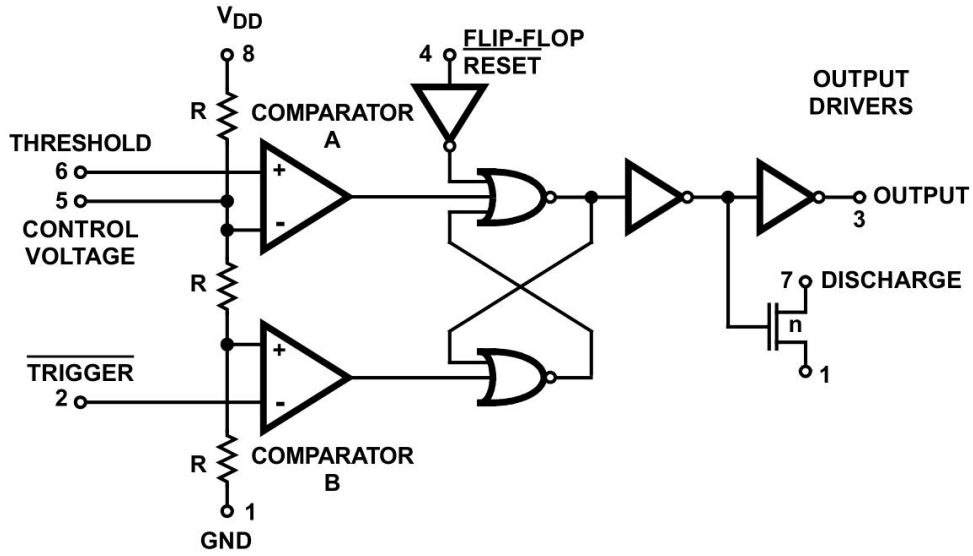
**Electrical Specifications** Applies to XL/XD7555, unless otherwise specified. (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	T <sub>A</sub> = +25°C			(Note 8) -55°C TO +125°C			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
Reset Voltage	V <sub>RST</sub>	V <sub>DD</sub> = 2V to 15V	0.4	—	1.0	0.2	—	1.2	V
Reset Current	I <sub>RST</sub>	V <sub>DD</sub> = 15V	—	—	10	—	—	50	nA
Discharge Leakage	I <sub>DIS</sub>	V <sub>DD</sub> = 15V	—	—	10	—	—	50	nA
Output Voltage	V <sub>OL</sub>	V <sub>DD</sub> = 15V, I <sub>SINK</sub> = 20mA	—	0.4	1.0	—	—	1.25	V
		V <sub>DD</sub> = 5V, I <sub>SINK</sub> = 3.2mA	—	0.2	0.4	—	—	0.5	V
—	V <sub>OH</sub>	V <sub>DD</sub> = 15V, I <sub>SOURCE</sub> = 0.8mA	14.3	14.6	—	14.2	—	—	V
		V <sub>DD</sub> = 5V, I <sub>SOURCE</sub> = 0.8mA	4.0	4.3	—	3.8	—	—	V
Discharge Output Voltage	V <sub>DIS</sub>	V <sub>DD</sub> = 5V, I <sub>SINK</sub> = 15mA	—	0.2	0.4	—	—	0.6	V
		V <sub>DD</sub> = 15V, I <sub>SINK</sub> = 15mA	—	—	—	—	—	0.4	V
Supply Voltage (Note 7)	V <sub>DD</sub>	Functional Operation	2.0	—	18.0	3.0	—	16.0	V
Output Rise Time (Note 7)	t <sub>R</sub>	R <sub>L</sub> = 10M, C <sub>L</sub> = 10pF, V <sub>DD</sub> = 5V	—	75	—	—	—	—	ns
Output Fall Time (Note 7)	t <sub>F</sub>	R <sub>L</sub> = 10M, C <sub>L</sub> = 10pF, V <sub>DD</sub> = 5V	—	75	—	—	—	—	ns
Oscillator Frequency (Note 7)	f <sub>MAX</sub>	V <sub>DD</sub> = 5V, R <sub>A</sub> = 470Ω, R <sub>B</sub> = 270Ω, C = 200pF	—	1	—	—	—	—	M Hz

NOTES:

1. These parameters are based upon characterization data and are not tested.
2. Applies only to military temperature range product (M suffix).

## 9. FUNCTIONAL DIAGRAM



NOTE: This functional diagram reduces the circuitry down to its simplest equivalent components. Tie down unused inputs.

FIGURE 1. FUNCTIONAL DIAGRAM

### TRUTH TABLE

THRESHOLD VOLTAGE	TRIGGER VOLTAGE	RESET	OUTPUT	DISCHARGE SWITCH
Don't Care	Don't Care	Low	Low	On
$>^{2/3}(V_+)$	$>^{1/3}(V_+)$	High	Low	On
$<^{2/3}(V_+)$	$>^{1/3}(V_+)$	High	Stable	Stable
Don't Care	$<^{1/3}(V_+)$	High	High	Off

NOTE: RESET will dominate all other inputs: TRIGGER will dominate over THRESHOLD.

## 10. SCHEMATIC DIAGRAM

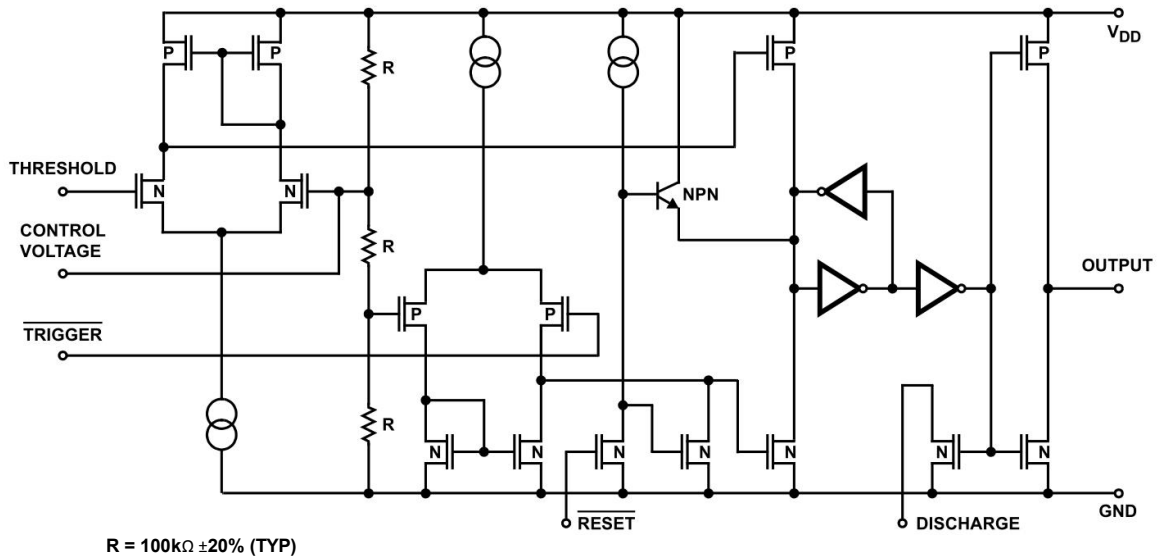


FIGURE 2. SCHEMATIC DIAGRAM

## 11. APPLICATION INFORMATION

### General

The XL7555 and XD7555 devices are, in most instances, direct replacements for the SE/NE 555/556 devices. However, it is possible to effect economies in the external component count using the XL7555 and XD7555. Because the bipolar SE/NE 555/556 devices produce large crowbar currents in the output driver, it is necessary to decouple the power supply lines with a good capacitor close to the device. The XL7555 and XD7555 devices produce no such transients (see Figure 3).

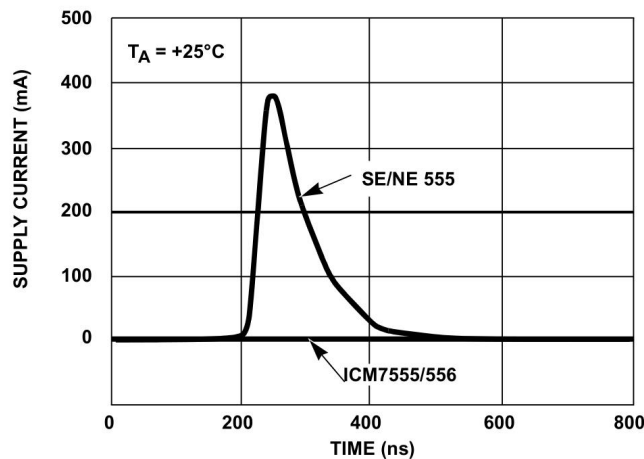
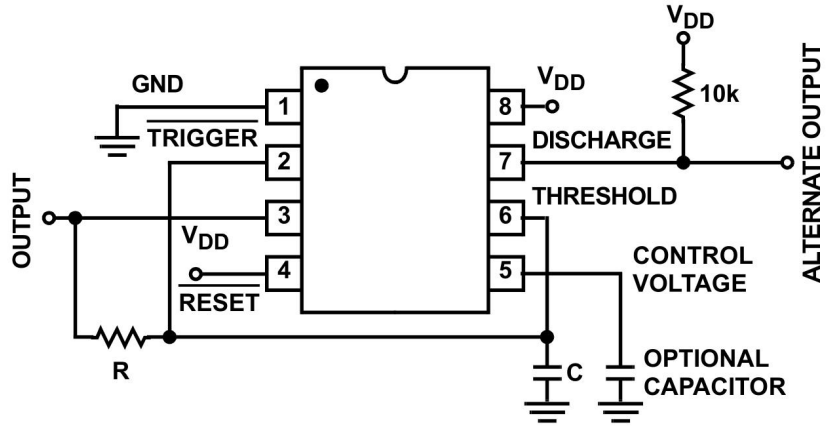


FIGURE 3. SUPPLY CURRENT TRANSIENT COMPARED WITH A STANDARD BIPOLAR 555 DURING AN OUTPUT TRANSITION

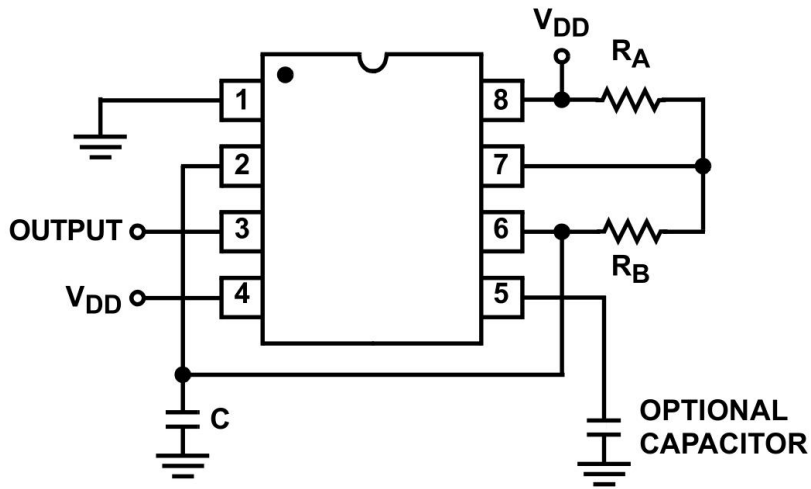
The XL7555 and XD7555 produce supply current spikes of only 2mA to 3mA instead of 300mA to 400mA and supply decoupling is normally not necessary. Also, in most instances, the Control Voltage decoupling capacitors are not required since the input impedance of the CMOS comparators on chip are very high.

**POWER SUPPLY CONSIDERATIONS**

Although the supply current consumed by the XL7555 and XD7555 devices is very low, the total system supply current can be high unless the timing components are high impedance. Therefore, use high values for R and low values for C in Figures 4, 5, and 6.



**FIGURE 4. ASTABLE OPERATION**



**FIGURE 5. ALTERNATE ASTABLE CONFIGURATION**



## 12. OUTPUT DRIVE CAPABILITY

The output driver consists of a CMOS inverter capable of driving most logic families including CMOS and TTL. As such, if driving CMOS, the output swing at all supply voltages will equal the supply voltage. At a supply voltage of 4.5V or more, the XL7555 and XD7555 will drive at least two standard TTL loads.

## 13. ASTABLE OPERATION

The circuit can be connected to trigger itself and free run as a multivibrator, see Figure 4. The output swings from rail-to-rail, and is a true 50% duty cycle square wave. Trip points and output swings are symmetrical. Less than a 1% frequency variation is observed over a voltage range of +5V to +15V.

$$f = \frac{1}{1.4 RC}$$

The timer can also be connected as shown in [Figure 5](#). In this circuit, the frequency is as shown by [Equation 2](#):

$$f = 1.44 / (R_A + 2R_B)C$$

The duty cycle is controlled by the values of  $R_A$  and  $R_B$ , by [Equation 3](#):

$$D = (R_A + R_B) / (R_A + 2R_B)$$

## 14. MONOSTABLE OPERATION

In this mode of operation, the timer functions as a one-shot (see Figure 6). Initially the external capacitor (C) is held discharged by a transistor inside the timer. Upon application of a negative Trigger pulse to pin 2, the internal flip-flop is set, which releases the short-circuit across the external capacitor and drives the Output high. The voltage across the capacitor now increases exponentially with a time constant  $t = RAC$ . When the voltage across the capacitor equals  $2/3 V+$ , the comparator resets the flip-flop, which in turn discharges the capacitor rapidly and also drives the OUTPUT to its low state. Trigger must return to a high state before the OUTPUT can return to a low state.

$$t_{\text{OUTPUT}} = -\ln(1/3) R_A C = 1.1 R_A C$$

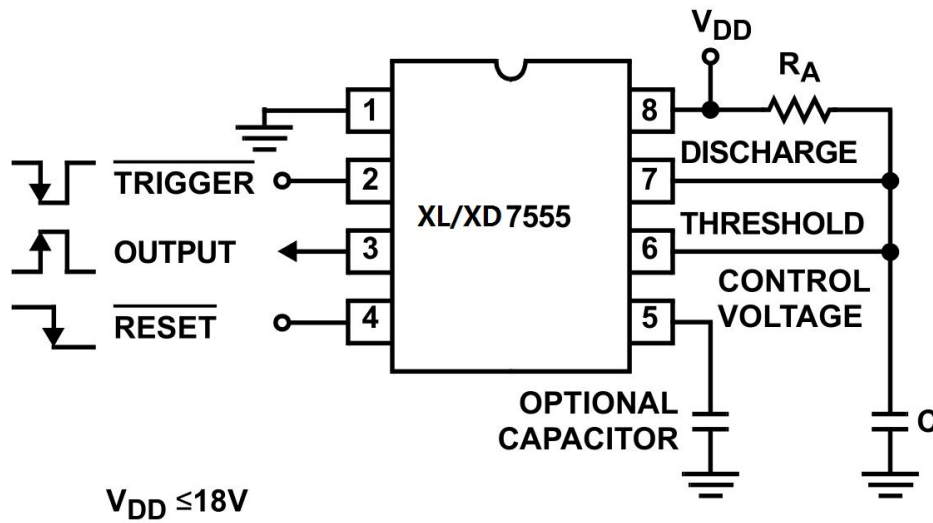


FIGURE 6. MONOSTABLE OPERATION

## 15. CONTROL VOLTAGE

The Control Voltage terminal permits the two trip voltages for the Threshold and Trigger internal comparators to be controlled. This provides the possibility of oscillation frequency modulation in the astable mode or even inhibition of oscillation, depending on the applied voltage. In the monostable mode, delay times can be changed by varying the applied voltage to the Control Voltage pin.

## 16. RESET

The Reset terminal is designed to have essentially the same trip voltage as the standard bipolar 555/556, i.e., 0.6V to 0.7V. At all supply voltages it represents an extremely high input impedance. The mode of operation of the Reset function is, however, much improved over the standard bipolar SE/NE 555/556 in that it controls only the internal flip-flop, which in turn controls simultaneously the state of the Output and Discharge pins. This avoids the multiple threshold problems sometimes encountered with slow falling edges in the bipolar devices.

### 17. TYPICAL PERFORMANCE CURVES

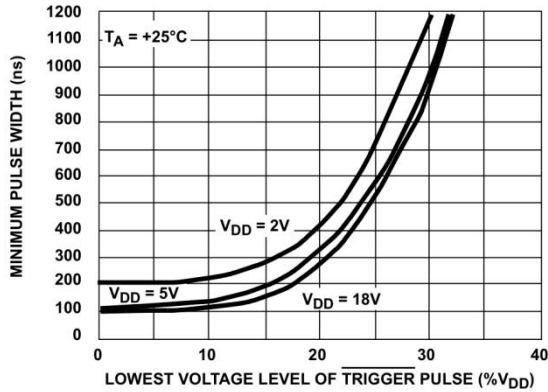


FIGURE 7. MINIMUM PULSE WIDTH REQUIRED FOR TRIGGERING

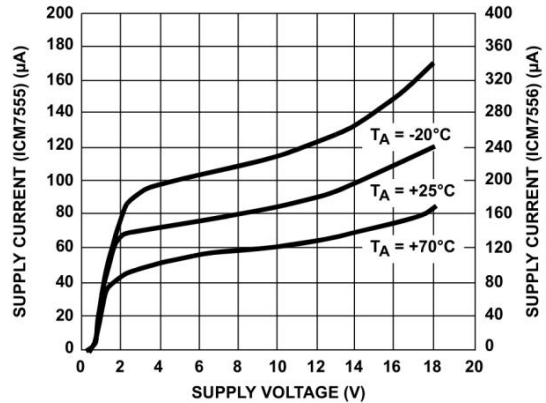


FIGURE 8. SUPPLY CURRENT vs SUPPLY VOLTAGE

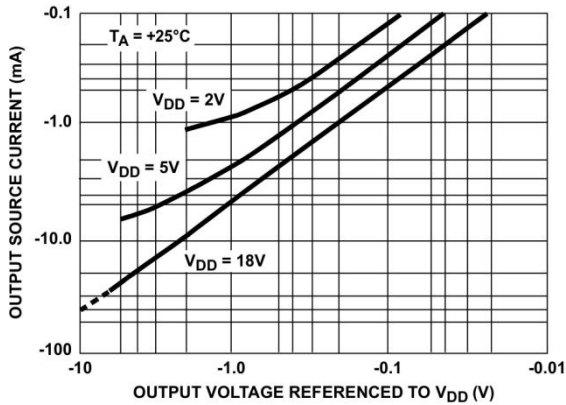


FIGURE 9. OUTPUT SOURCE CURRENT vs OUTPUT VOLTAGE

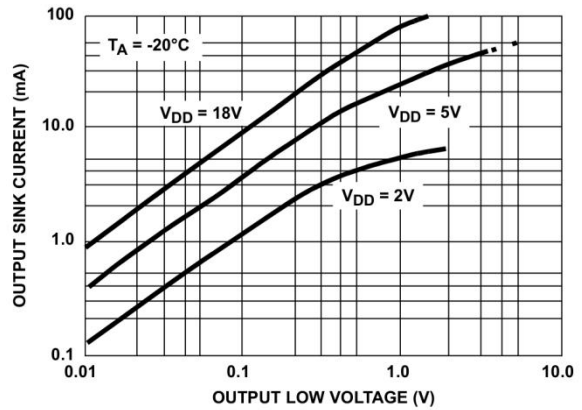


FIGURE 10. OUTPUT SINK CURRENT vs OUTPUT VOLTAGE

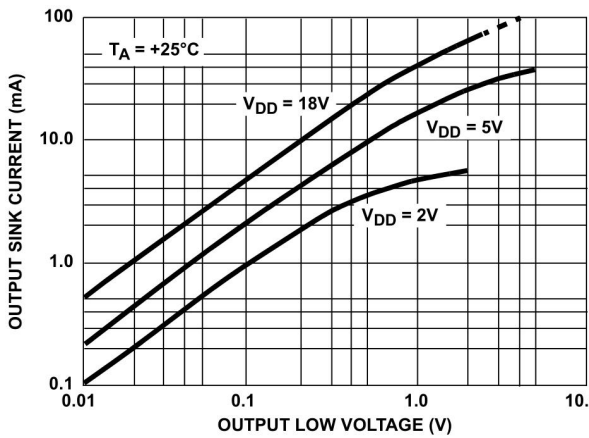


FIGURE 11. OUTPUT SINK CURRENT vs OUTPUT VOLTAGE

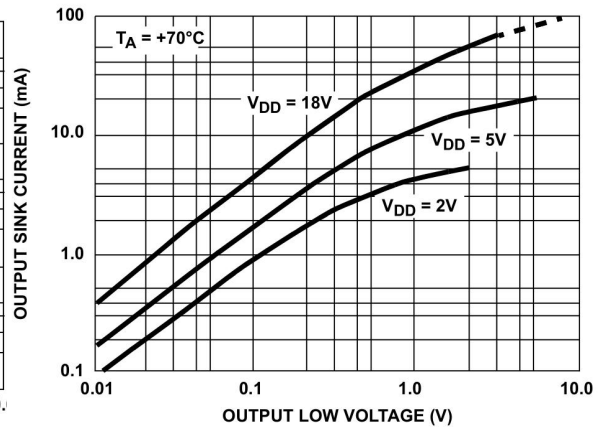


FIGURE 12. OUTPUT SINK CURRENT vs OUTPUT VOLTAGE

TYPICAL PERFORMANCE CURVES(Continued)

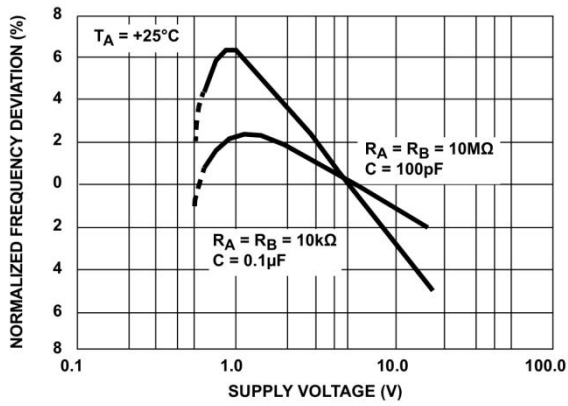


FIGURE 13. NORMALIZED FREQUENCY STABILITY IN THE ASTABLE MODE vs SUPPLY VOLTAGE

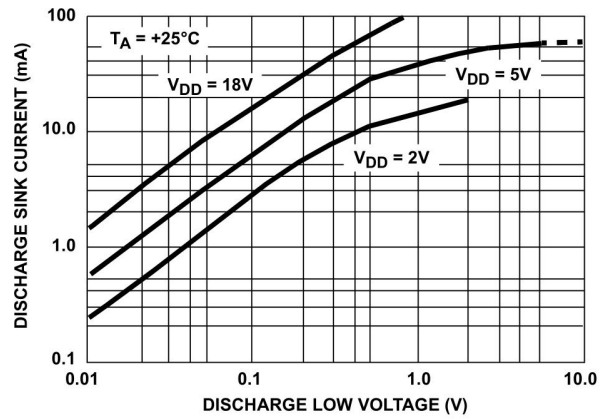


FIGURE 14. DISCHARGE OUTPUT CURRENT vs DISCHARGE OUTPUT VOLTAGE

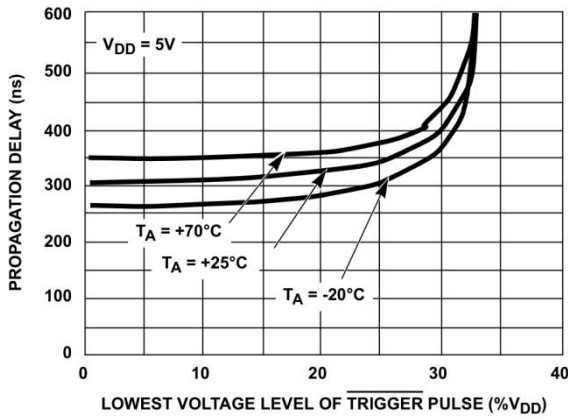


FIGURE 15. PROPAGATION DELAY vs VOLTAGE LEVEL OF TRIGGER PULSE

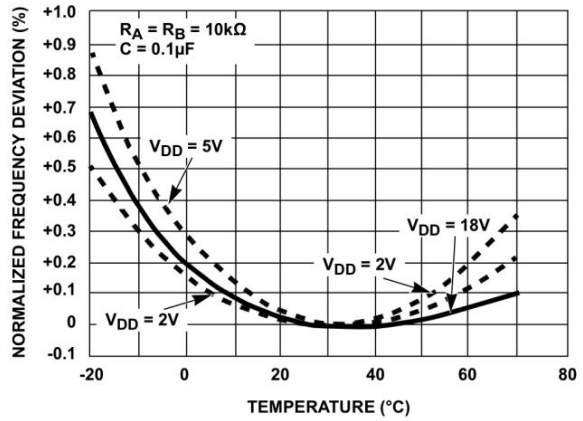


FIGURE 16. PROPAGATION DELAY vs VOLTAGE LEVEL OF TRIGGER PULSE

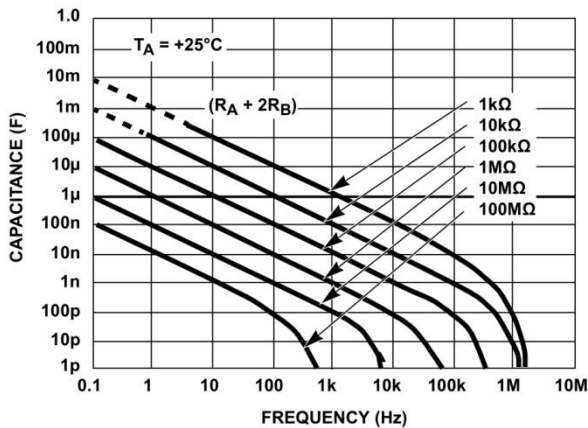


FIGURE 17. FREE RUNNING FREQUENCY vs RA, RB AND C

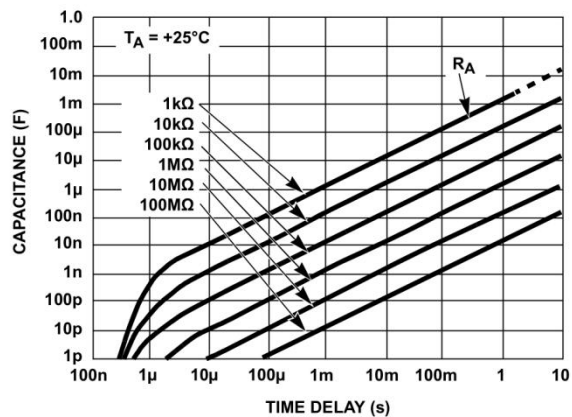


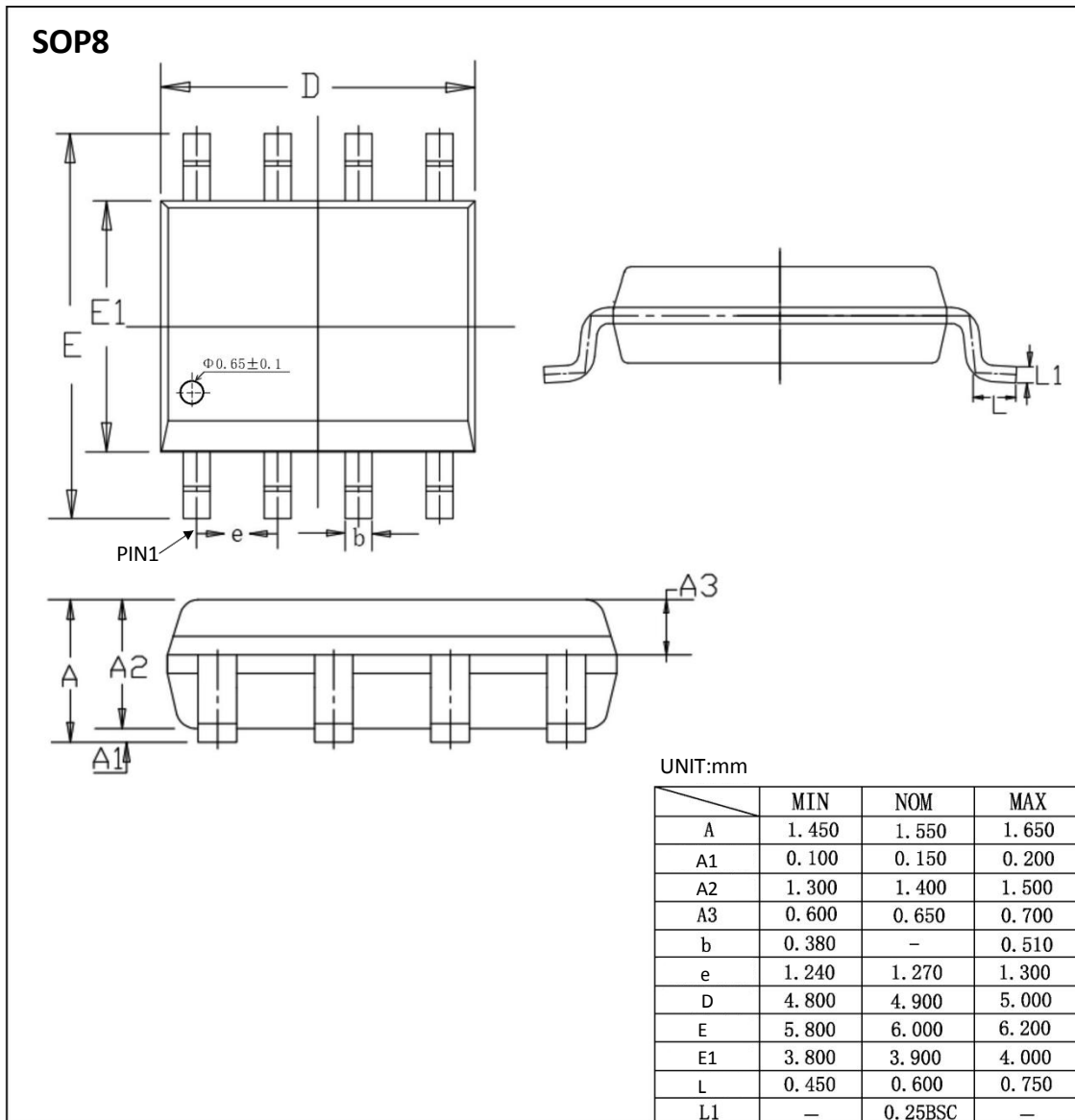
FIGURE 18. TIME DELAY IN THE MONOSTABLE MODE vs RA AND C

## 18. ORDERING INFORMATION

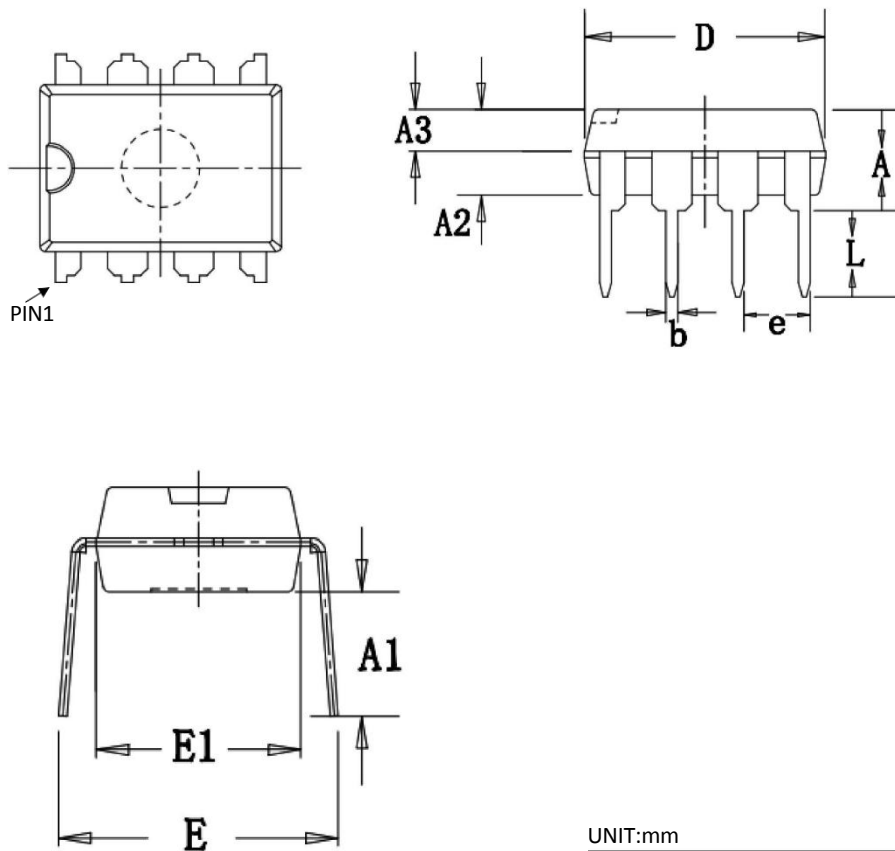
Ordering Information

Part Number	Device Marking	Package Type	Body size (mm)	Temperature (°C)	MSL	Transport Media	Package Quantity
XL7555	XL7555	SOP8	4.90 * 3.90	- 25 to 85	MSL3	T&R	2500
XD7555	XD7555	DIP8	9.25 * 6.38	- 25 to 85	MSL3	Tube 50	2000

## 19. DIMENSIONAL DRAWINGS



**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	—	—

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