FAIRCHILD

A Schlumberger Company

μA555 Single Timing Circuit

Linear Division Special Functions

Description

The μA555 Timing Circuit is a very stable controller for producing accurate time delays or oscillations. In the time delay mode, the delay time is precisely controlled by one external resistor and one capacitor; in the oscillator mode, the frequency and duty cycle are both accurately controlled with two external resistors and one capacitor. By applying a trigger signal, the timing cycle is started and an internal flip-flop is set, immunizing the circuit from any further trigger signals. To interrupt the timing cycle a reset signal is applied ending the time-out.

The output, which is capable of sinking or sourcing 200 mA, is compatible with TTL circuits and can drive relays or indicator lamps.

- **Timing Control, μs To Hours**
- **Astable Or Monostable Operating Modes**
- **Adjustable Duty Cycle**
- **200 mA Sink or Source Output Current**
- **TTL Output Drive Capability**
- **Temperature Stability Of 0.005% Per °C Typ**
- **Normally On Or Normally Off Output**
- **Direct Replacement For SE555/NE555**

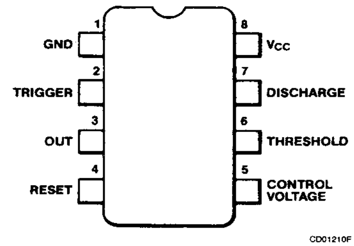
Absolute Maximum Ratings

Storage Temperature Range	−65°C to +150°C
Operating Temperature Range	0°C to +70°C
Lead Temperature (soldering, 10 s)	265°C
Internal Power Dissipation[1, 2]	
8L-Molded DIP	0.93 W
SO-8	0.81 W
Supply Voltage	+18 V

Notes

1. $T_{J\,Max}$ = 150°C.
2. Ratings apply to ambient temperature at 25°C. Above this temperature, derate the 8L-Molded DIP at 7.5 mW/°C, and SO-8 at 6.5 mW/°C.

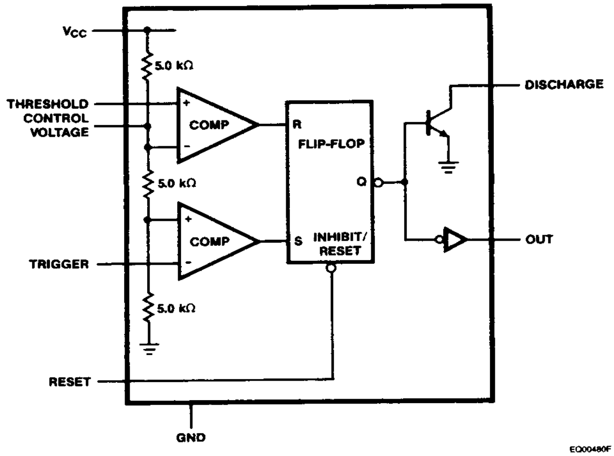
Connection Diagram 8-Lead DIP and SO-8 Package (Top View)



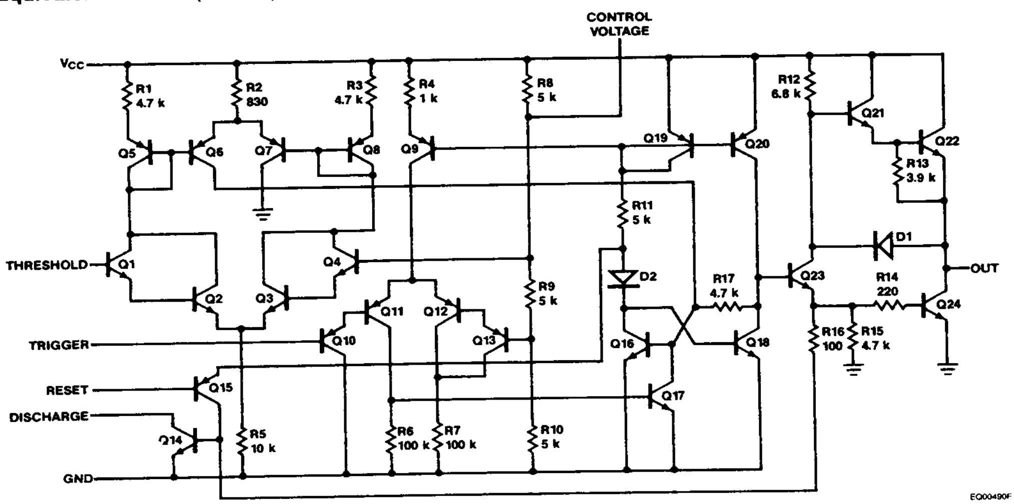
Order Information

Device Code	Package Code	Package Description
μA555TC	9T	Molded DIP
μA555SC	KC	Molded Surface Mount

Block Diagram



Equivalent Circuit (Note 1)



Note

1. All resistor values in ohms.

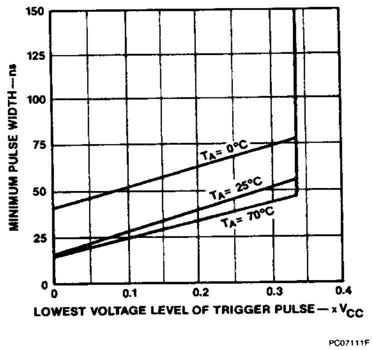
μA555
Electrical Characteristics $T_A = 25°C$, V+ = +5.0 V to +15 V, unless otherwise specified.

Symbol	Characteristic		Condition	Min	Typ	Max	Unit
V_{CC}	Supply Voltage			4.5		16	V
I_{CC}	Supply Current[1]		$V_{CC} = 5.0$ V, $R_L = \infty$		3.0	6.0	mA
			$V_{CC} = 15$ V, $R_L = \infty$ LOW State		10	15	
t_D	Timing Error	Initial Accuracy	$R_I = 2.0$ kΩ to 100 kΩ C = 0.1 μF		1.0		%
		Drift with Temperature			50		ppm/°C
		Drift with Supply Voltage			0.1		% V
V_{TH}	Threshold Voltage		$V_{CC} = 5.0$ V	2.6	3.33	4.0	V
			$V_{CC} = 15$ V	9.0	10	11	
V_{TR}	Trigger Voltage		$V_{CC} = 15$ V	4.0	5.0	6.0	V
			$V_{CC} = 5.0$ V	1.1	1.67	2.2	
I_{TR}	Trigger Current				0.5	5.0	μA
V_R	Reset Voltage			0.4	0.7	1.0	V
I_R	Reset Current				0.1	1.5	mA
I_{TH}	Threshold Current[2]				0.1	0.25	μA
V_{CV}	Control Voltage Level		$V_{CC} = 15$ V	9.0	10	11	V
			$V_{CC} = 5.0$ V	2.6	3.33	4.0	
V_{OL}	Output Voltage LOW		$V_{CC} = 15$ V, $I_{O-} = 10$ mA		0.1	0.25	V
			$I_{O-} = 50$ mA, $V_{CC} = 15$ V		0.4	0.75	
			$I_{O-} = 100$ mA, $V_{CC} = 15$ V		2.0	2.5	
			$I_{O-} = 200$ mA, $V_{CC} = 15$ V		2.5	3.5	
			$V_{CC} = 5.0$ V, $I_{O-} = 8.0$ mA		0.3		
			$I_{O-} = 5.0$ mA, $V_{CC} = 5.0$ V		0.25	0.35	
V_{OH}	Output Voltage HIGH		$I_{O+} = 200$ mA, $V_{CC} = 15$ V	11.0	12.5		V
			$I_{O+} = 100$ mA, $V_{CC} = 15$ V	12.75	13.3		
			$V_{CC} = 5.0$ V, $I_{O+} = 100$ mA	2.75	3.3		
t_r	Rise Time of Output				100		ns
t_f	Fall Time of Output				100		ns
I_{DIS}	Discharge Leakage Current				20	100	nA

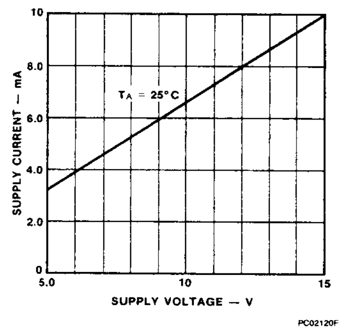
Notes
1. Supply Current is typically 1.0 mA less when output is HIGH.
2. This will determine the maximum value of $R_1 + R_2$. For 15 V operation, the maximum total R = 10 MΩ.

Typical Performance Curves

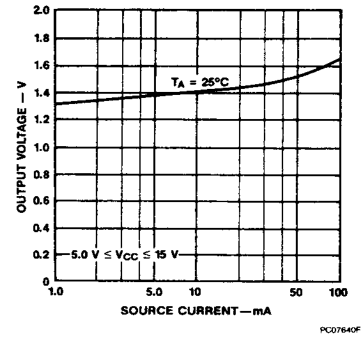
Minimum Pulse Width Required for Triggering



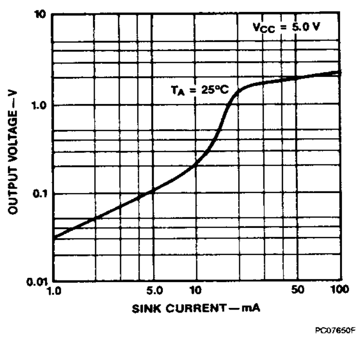
Total Supply Current vs Supply Voltage



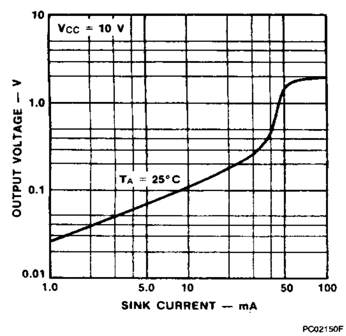
Output Voltage HIGH vs Output Source Current



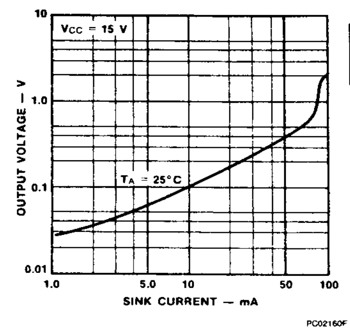
Output Voltage LOW vs Output Sink Current



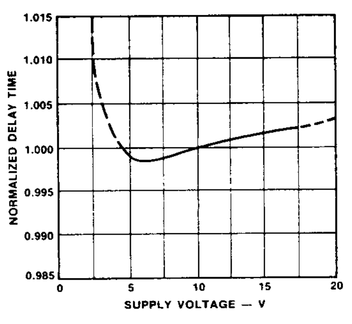
Output Voltage LOW vs Output Sink Current



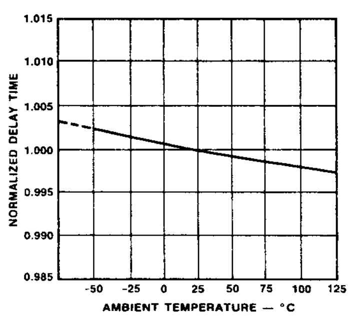
Output Voltage LOW vs Output Sink Current



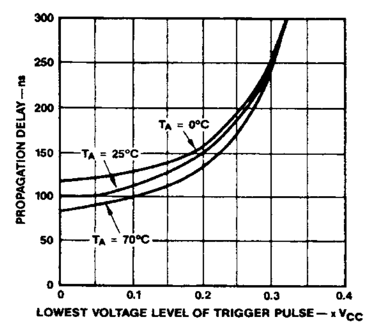
Delay Time vs Supply Voltage



Delay Time vs Ambient Temperature



Propagation Delay vs Voltage Level of Trigger Pulse



Typical Applications

Monostable Operation

In the monostable mode, the timer functions as a one shot. Referring to *Figure 1* the external capacitor is initially held discharged by a transistor inside the timer.

When a negative trigger pulse is applied to lead 2, the flip-flop is set, releasing the short circuit across the external capacitor and driving the output HIGH. The voltage across the capacitor increases exponentially with the time constant $\tau = R1C1$. When the voltage across the capacitor equals ⅔ V_{CC}, the comparator resets the flip-flop which then discharges the capacitor rapidly and drives the output to its LOW state. *Figure 2* shows the actual waveforms generated in this mode of operation.

The circuit triggers on a negative going input signal when the level reaches ⅓ V_{CC}. Once triggered, the circuit remains in this state until the set time elapsed, even if it is triggered again during this interval. The duration of the output HIGH state is given by $t = 1.1\ R1C1$ and is easily determined by *Figure 3*. Notice that since the charge rate and the threshold level of the comparator are both directly proportional to supply voltage, the timing interval is independent of supply. Applying a negative pulse simultaneously to the Reset terminal (lead 4) and the trigger terminal (lead 2) during the timing cycle discharges the external capacitor and causes the cycle to start over. The timing cycle now starts on the positive edge of the reset pulse. During the time the reset pulse is applied, the output is driven to its LOW state.

When Reset is not used, it should be tied HIGH to avoid any possibility of false triggering.

Figure 1 Monostable Mode

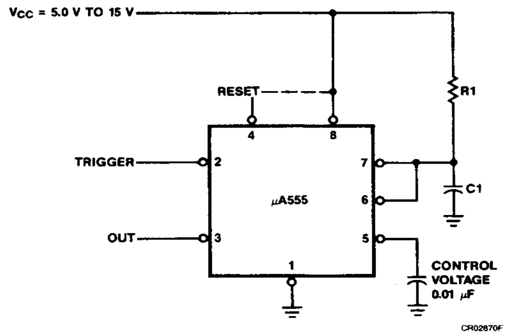
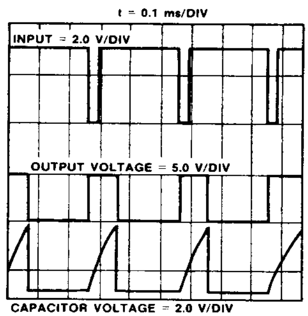


Figure 2 Monostable Waveform



R1 = 9.1 kΩ, C1 = 0.01 μF, R_L = 1.0 kΩ

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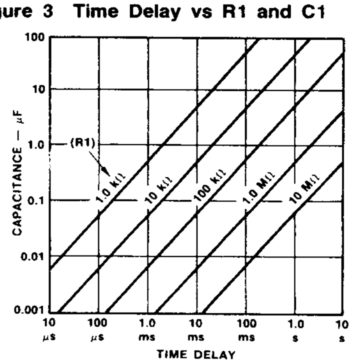
Figure 3 Time Delay vs R1 and C1



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Astable Operation

When the circuit is connected as shown in *Figure 4* (leads 2 and 6 connected) it triggers itself and free runs as a multivibrator. The external capacitor charges through R1 and R2 and discharges through R2 only. Thus the duty cycle may be precisely set by the ratio of these two resistors.

In the astable mode of operation, C1 charges and discharges between ⅓ V_{CC} and ⅔ V_{CC}. As in the triggered mode, the charge and discharge times and therefore frequency are independent of the supply voltage.

Figure 5 shows actual waveforms generated in this mode of operation.

The charge time (output HIGH) is given by:

$$t_1 = 0.693\ (R1 + R2)\ C1$$

and the discharge time (output LOW) by:

$$t_2 = 0.693\ (R2)\ C1$$

Thus the total period T is given by:

$$T = t_1 + t_2 = 0.693\ (R1 + 2R2)\ C1$$

The frequency of oscillation is then:

$$f = \frac{1}{T} = \frac{1.44}{(R1 + 2R2)\ C1}$$

and may be easily found by *Figure 6*.

The duty cycle is given by:

$$DC = \frac{R2}{R1 + 2R2}$$

Figure 4 Astable Mode

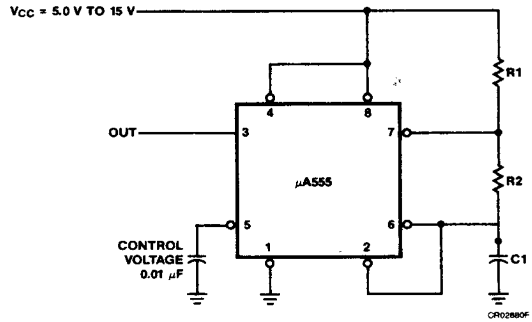


Figure 5 Astable Waveform

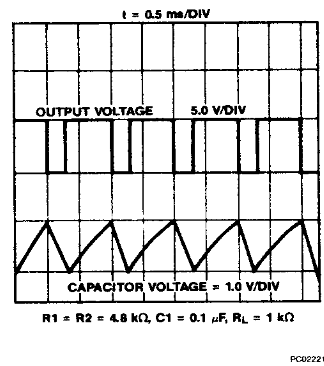
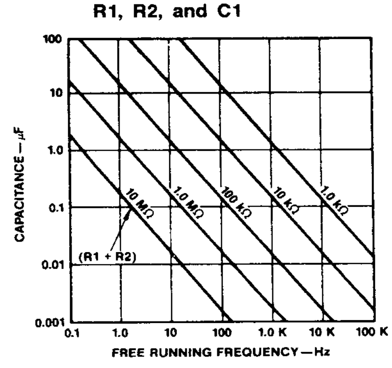


Figure 6 Free Running Frequency vs R1, R2, and C1



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