

Circuitos integrados de aplicaciones específicas

NOTAS DE CLASE

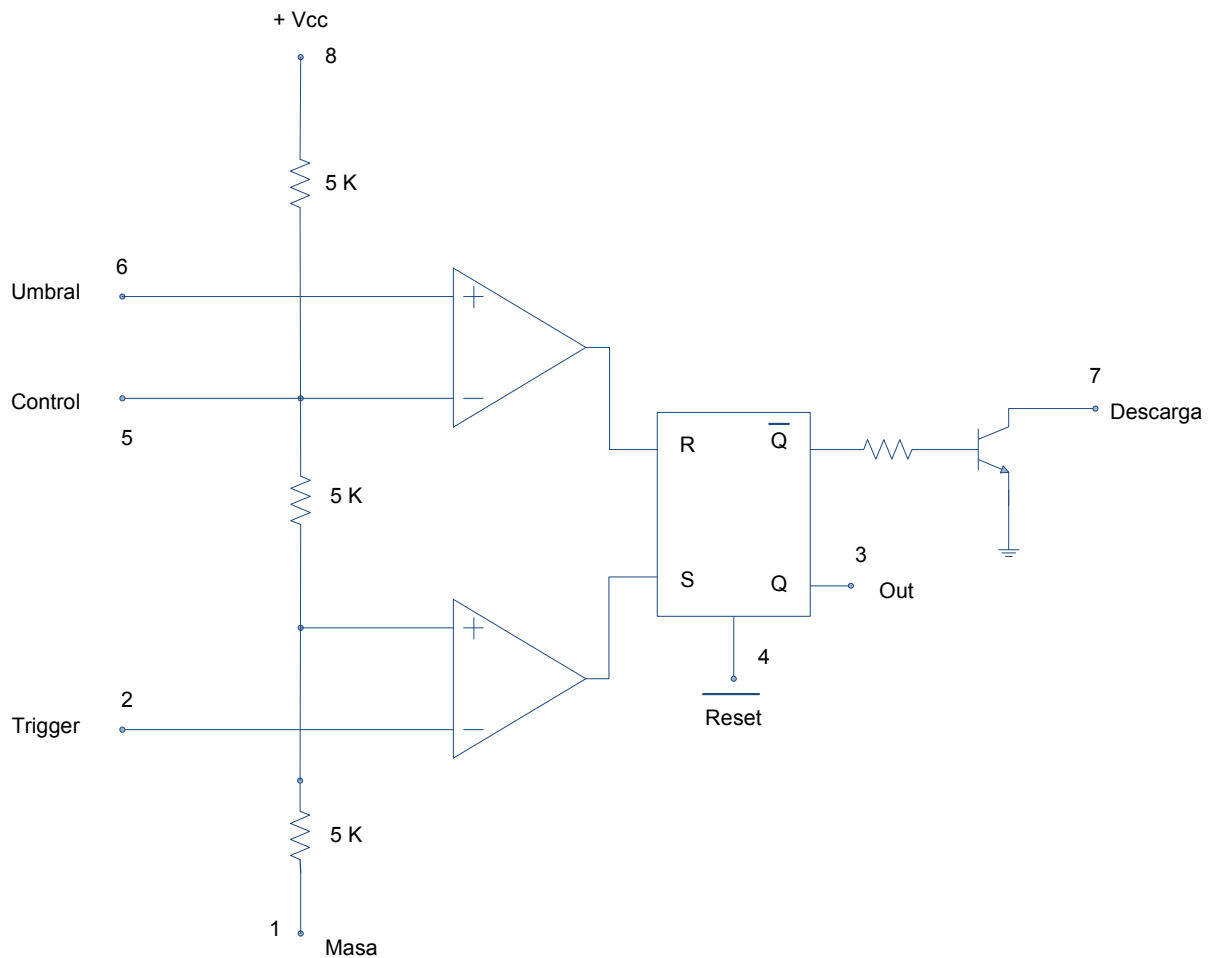
555

Contenido:

- Diagrama interno
- Monoestable
- Astable
- Problema ejemplo: generador de rampa
- Comentarios sobre la hoja de datos

Primera Edición – Año 2009

1. Diagrama interno

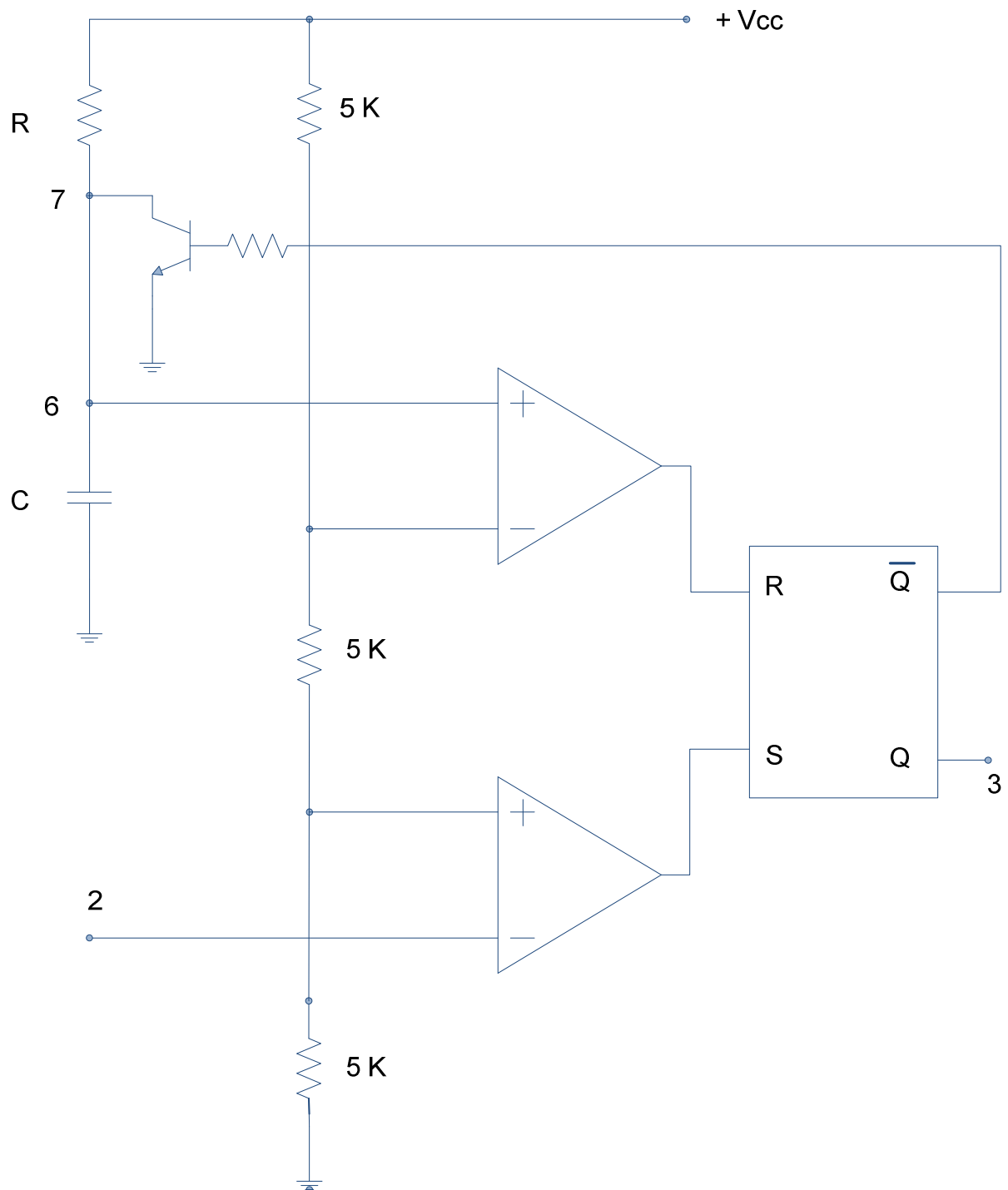


El 555 posee 8 pines, un flip-flop set-reset, dos comparadores y un transistor.

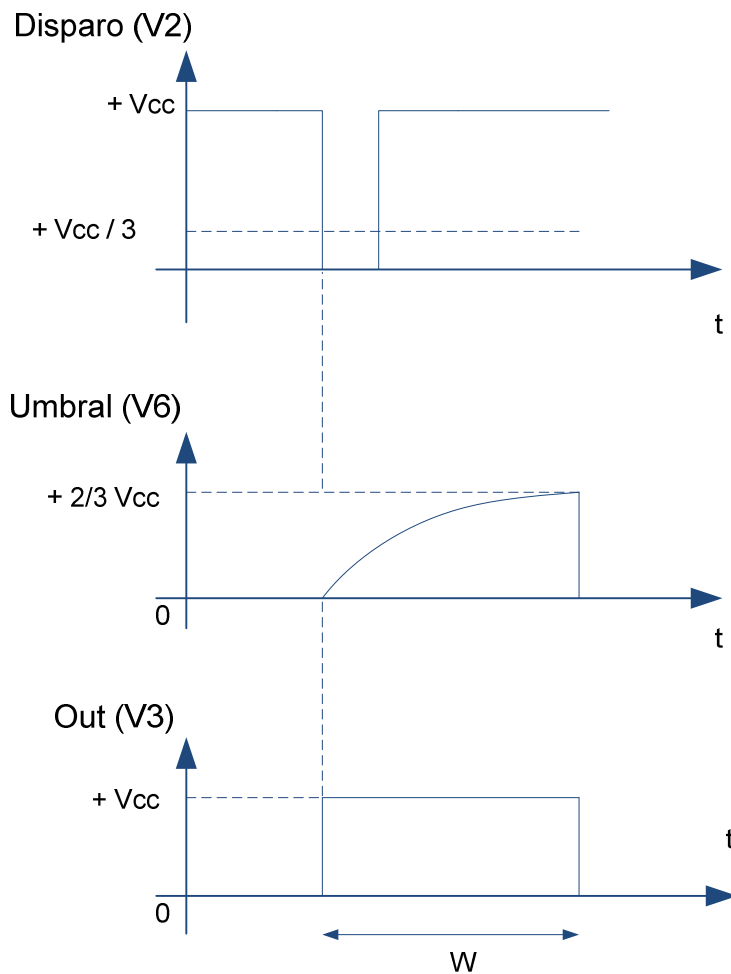
Las tensiones de conmutación de los comparadores son de $1/3 V_{cc}$ y de $2/3 V_{cc}$.

El F-F posee un terminal de Reset, para que en cualquier momento se pueda colocar un valor '0' en Q, independientemente de los valores que haya en las entradas S y R.

2. Monoestable



Este es el diagrama con las conexiones para que el 555 funcione como monoestable.



El disparo se realiza a través del pin 2 (disparo), en el cual se debe colocar una tensión menor a $1/3 V_{cc}$. Normalmente se le aplica un pulso, como indica la figura, el cual en algún momento pasa por debajo de $1/3 V_{cc}$. Esto genera un pulso en la salida (Out) de duración W .

La fórmula para calcular la duración es:

$$W = 1,1 R.C$$

$$V = V_f - (V_f - V_i) \cdot e^{-t/\tau}$$

$$V = V_i + (V_f - V_i) - (V_f - V_i) \cdot e^{-t/\tau}$$

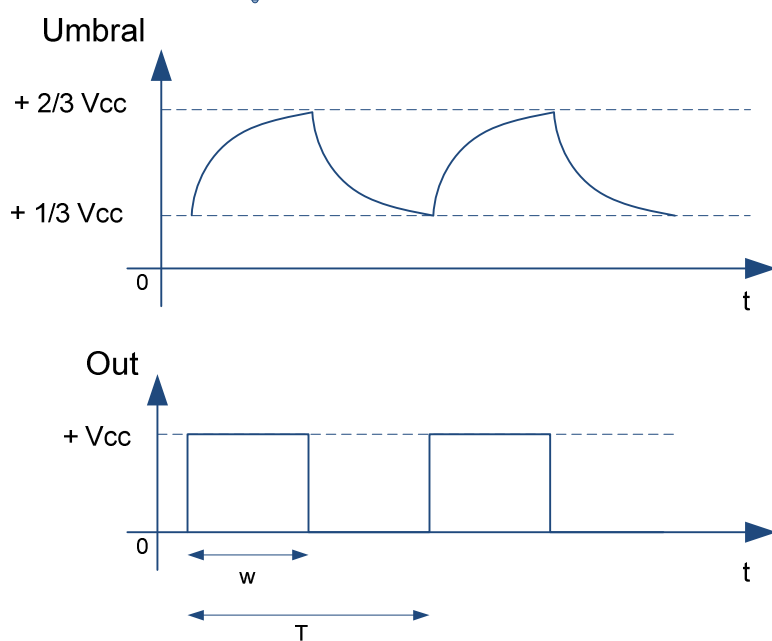
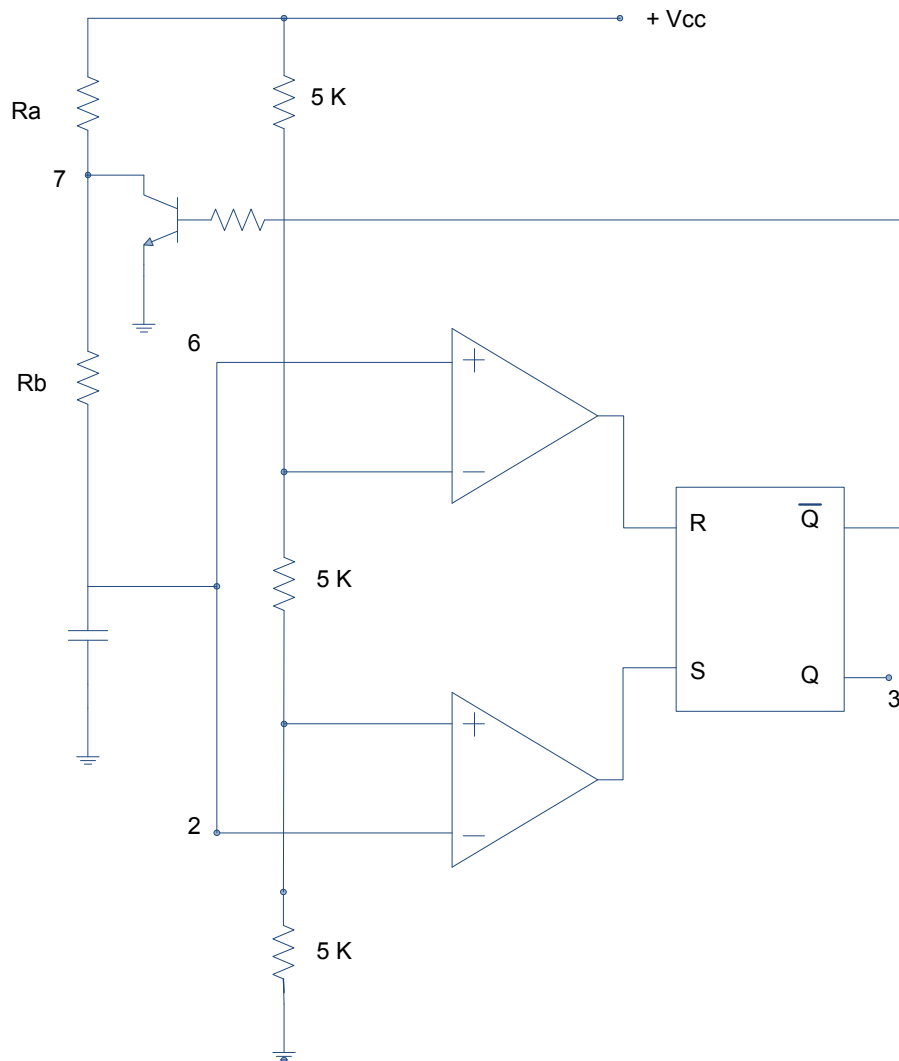
$$V = V_i + (V_f - V_i) \cdot (1 - e^{-\frac{t}{\tau}})$$

$$\frac{2}{3} V_{cc} = V_{cc} \cdot (1 - e^{-\frac{W}{R.C}})$$

$$e^{-\frac{W}{R.C}} = \frac{1}{3}$$

$$W = 1,0986 R.C \cong 1,1 R.C$$

3. Astable



$$D = \frac{T}{W} \cdot 100 \% ; \text{este es el ciclo de trabajo}$$

Según sea el valor de R_a y R_b , el ciclo de trabajo está entre el 50 % y el 100 %.

$$\text{La frecuencia está dada por: } f = \frac{1,44}{(R_a + 2 \cdot R_b) \cdot C}$$

Con carga ascendente:

$$\frac{2}{3} \cdot V_{CC} = \frac{V_{CC}}{3} + \left(V_{CC} - \frac{V_{CC}}{3} \right) \cdot \left(1 - e^{-\frac{W}{R \cdot C}} \right)$$

$$e^{-\frac{W}{R \cdot C}} = 0,5$$

$$W = 0,693 \cdot R \cdot C = 0,693 \cdot (R_a + R_b) \cdot C$$

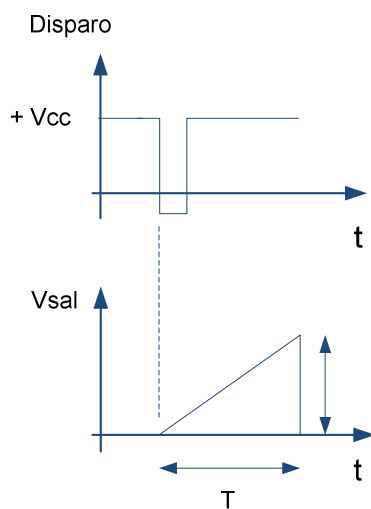
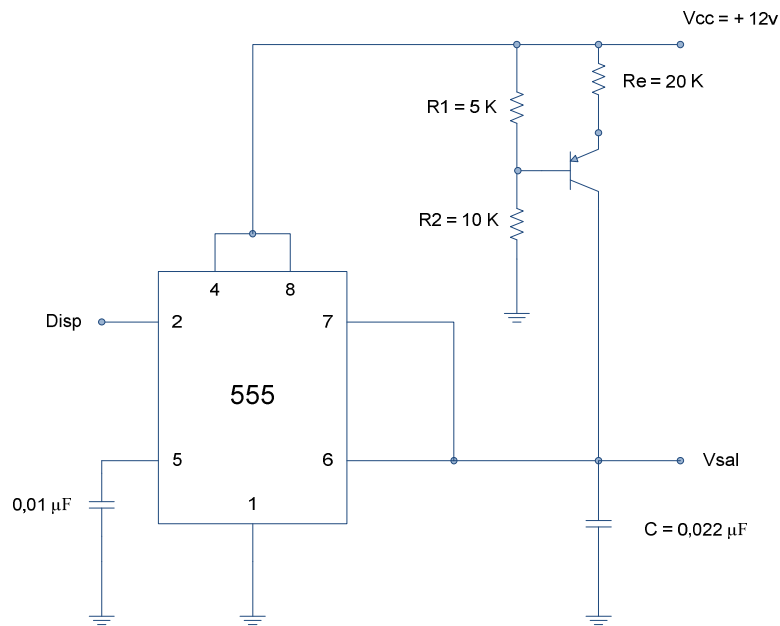
Con la descarga es igual excepto que usamos R_b en vez de $R_a + R_b$, y (T-W):

$$T - W = 0,693 \cdot R_b \cdot C$$

$$T = 0,693 \cdot (R_a + R_b) + 0,693 \cdot R_b \cdot C = 0,693 \cdot C \cdot (R_a + 2 \cdot R_b)$$

$$F = \frac{1}{T} = \frac{1,44}{C \cdot (R_a + 2 \cdot R_b)}$$

4. Generador de Rampa



Cálculo:

$$I_c = \frac{V_{cc} - V_e}{R_e}$$

$$V_e = \frac{V_{cc}}{(R_1 + R_2)} \cdot R_2 + V_{be}$$

$$V_e = \frac{15 \text{ V}}{15 \text{ K}} \cdot 10 \text{ K} + 0,7 \text{ V} = 10,7 \text{ V}$$

$$I_c = \frac{15\text{ V} - 10,7\text{ V}}{20\text{ K}} = 215\text{ mA}$$

$$Q = C \cdot V ; \quad \frac{dq}{dt} = c \cdot \frac{dV}{dt} \Rightarrow I = C \cdot \frac{\Delta V}{\Delta t}$$

$$\frac{2}{3} V_{cc} = \frac{2}{3} \cdot 15\text{ V} = 10\text{ V}$$

$$\Delta t = \frac{C \cdot \Delta V}{I} = \frac{0,022\text{ }\mu\text{F} \cdot 10\text{ V}}{0,215\text{ mA}} = 1,02\text{ ms}$$

5. Hoja de datos (comentarios)

LMC555 CMOS Timer

March 2002



LMC555

CMOS Timer

Tensión mínima de alimentación

General Description

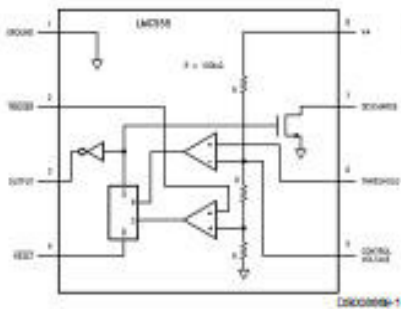
The LMC555 is a CMOS version of the industry standard 555 series general purpose timers. In addition to the standard package (SOIC, MSOP, and MDIP) the LMC555 is also available in a chip sized package (8 Bump micro SMD) using National's micro SMD package technology. The LMC555 offers the same capability of generating accurate time delays and frequencies as the LM555 but with much lower power dissipation and supply current spikes. When operated as a one-shot, the time delay is precisely controlled by a single external resistor and capacitor. In the stable mode the oscillation frequency and duty cycle are accurately set by two external resistors and one capacitor. The use of National Semiconductor's LMC MOS™ process extends both the frequency range and low supply capability.

Features

- Less than 1 mW typical power dissipation at 5V supply
- 3 MHz astable frequency capability
- 1.5V supply operating voltage guaranteed
- Output fully compatible with TTL and CMOS logic at 5V supply
- Tested to -10 mA, +50 mA output current levels
- Reduced supply current spikes during output transitions
- Extremely low reset, trigger, and threshold currents
- Excellent temperature stability
- Pin-for-pin compatible with 555 series of timers
- Available in 8 pin MSOP Package and 8-Bump micro SMD package

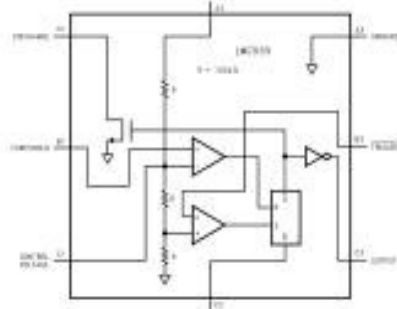
Block and Connection Diagrams

8-Pin SOIC, MSOP, and MDIP Packages



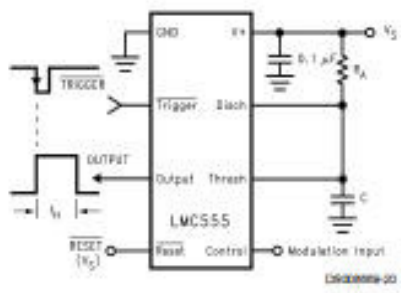
Top View
Circuit Diagram-1

8-Bump micro SMD

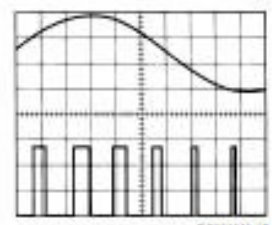


Top View
(Bump side down)
Circuit Diagram-2

Pulse Width Modulator



Circuit Diagram-3



Circuit Diagram-4

LCMOS™ is a trademark of National Semiconductor Corp.

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Absolute Maximum Ratings (Notes 2, 3)
If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage, V^+ 15V
Input Voltages, V_{TRIG} , V_{RES} , V_{CTRL} , V_{THRESH} $-0.3V$ to $V_D + 0.3V$
Output Voltages, V_O , V_{DIS} 15V
Output Current I_O , I_{DIS} 100 mA
Storage Temperature Range $-65^\circ C$ to $+150^\circ C$
Soldering Information
MDIP Soldering (10 seconds) $260^\circ C$
SOIC, MSOP Vapor Phase (60 sec) $215^\circ C$
SOIC, MSOP Infrared (15 sec) $220^\circ C$
Note: See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.

Operating Conditions
Temperature Range $-55^\circ C$ to $+125^\circ C$
Thermal Resistance
SOIC, MSOP $171^\circ C/W$
MDIP, 8-Lead Molded Dip $171^\circ C/W$
8-Bump micro SMD $220^\circ C/W$
Maximum Allowable Power Dissipation @ $25^\circ C$
MDIP-8 1126mW
SO-8 740mW
MSOP-8 555mW
568mW

Electrical Characteristics (Notes 1, 2)
Test Circuit, $T = 25^\circ C$, all switches open, RESET to V_D unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Units (Limits)
I_D	Supply Current	$V_D = 1.5V$ $V_D = 5V$ $V_D = 12V$		50 100 150	150 250 400	μA
V_{CTRL}	Control Voltage	$V_D = 1.5V$ $V_D = 5V$ $V_D = 12V$	0.8 2.9 7.4	1.0 3.3 8.0	1.2 3.8 8.6	V
V_{DIS}	Discharge Saturation Voltage	$V_D = 1.5V$, $I_{DIS} = 1$ mA $V_D = 5V$, $I_{DIS} = 10$ mA		75 150	150 300	mV
V_{OL}	Output Voltage (Low)	$V_D = 1.5V$, $I_O = 1$ mA $V_D = 5V$, $I_O = 8$ mA $V_D = 12V$, $I_O = 50$ mA		0.2 0.3 1.0	0.4 0.6 2.0	V
V_{OH}	Output Voltage (High)	$V_D = 1.5V$, $I_O = -0.25$ mA $V_D = 5V$, $I_O = -2$ mA $V_D = 12V$, $I_O = -10$ mA	1.0 4.4 10.5	1.25 4.7 11.3		V
V_{TRIG}	Trigger Voltage	$V_D = 1.5V$ $V_D = 12V$	0.4 3.7	0.5 4.0	0.6 4.3	V
I_{TRIG}	Trigger Current	$V_D = 5V$		10		pA
V_{RES}	Reset Voltage	$V_D = 1.5V$ (Note 4) $V_D = 12V$	0.4 0.4	0.7 0.75	1.0 1.1	V
I_{RES}	Reset Current	$V_D = 5V$		10		pA
I_{THRESH}	Threshold Current	$V_D = 5V$		10		pA
I_{DIS}	Discharge Leakage	$V_D = 12V$		1.0	100	nA
t	Timing Accuracy	SW 2, 4 Closed $V_D = 1.5V$ $V_D = 5V$ $V_D = 12V$	0.9 1.0 1.0	1.1 1.1 1.1	1.25 1.20 1.25	ms
$\Delta t / \Delta V_D$	Timing Shift with Supply	$V_D = 5V \pm 1V$		0.3		%/V
$\Delta t / \Delta T$	Timing Shift with Temperature	$V_D = 5V$ $-40^\circ C \leq T \leq +85^\circ C$		75		ppm/ $^\circ C$
f_A	Astable Frequency	SW 1, 3 Closed, $V_D = 12V$	4.0	4.8	5.6	kHz
f_{MAX}	Maximum Frequency	Max. Freq. Test Circuit, $V_D = 5V$		3.0		MHz
t_R , t_F	Output Rise and Fall Times	Max. Freq. Test Circuit $V_D = 5V$, $C_L = 10$ pF		15		ns

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LMC555

Electrical Characteristics (Notes 1, 2)

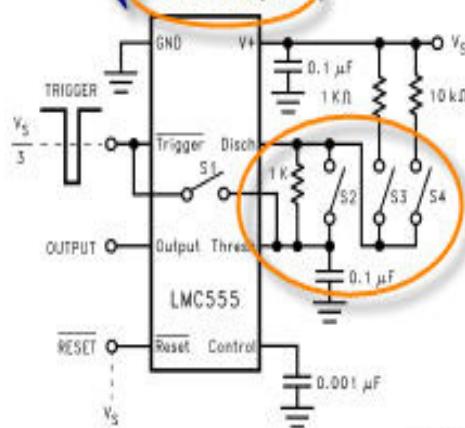
Test Circuit, T = 25°C, all switches open, RESET to V_{SS} unless otherwise noted (Continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Units (Limits)
t_{PD}	Trigger Propagation Delay	$V_{in} = 5V$, Measure Delay from Trigger to Output		100		ns

Circuito de test
usado para los
parámetros, de las
características
electricas

circuito para los parámetros de máxima frecuencia

Test Circuit (Note :)



Maximum Frequency Test Circuit (Note 5)

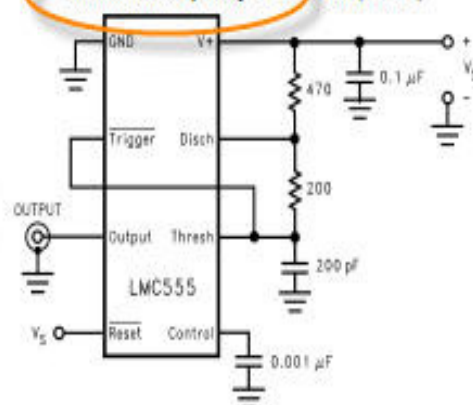


TABLE 1. Package Pinout Names vs. Pin Function

Pin Function	Package Pin numbers	
	8-Pin SO,MSOP, and MDIP	8-Bump micro SMD
GND	1	A3
Trigger	2	B3
Output	3	C3
Reset	4	C2
Control Voltage	5	C1
Threshold	6	B1
Discharge	7	A1
V*	8	A2