NOTAS DE CLASE

555

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- Monoestable
- Astable
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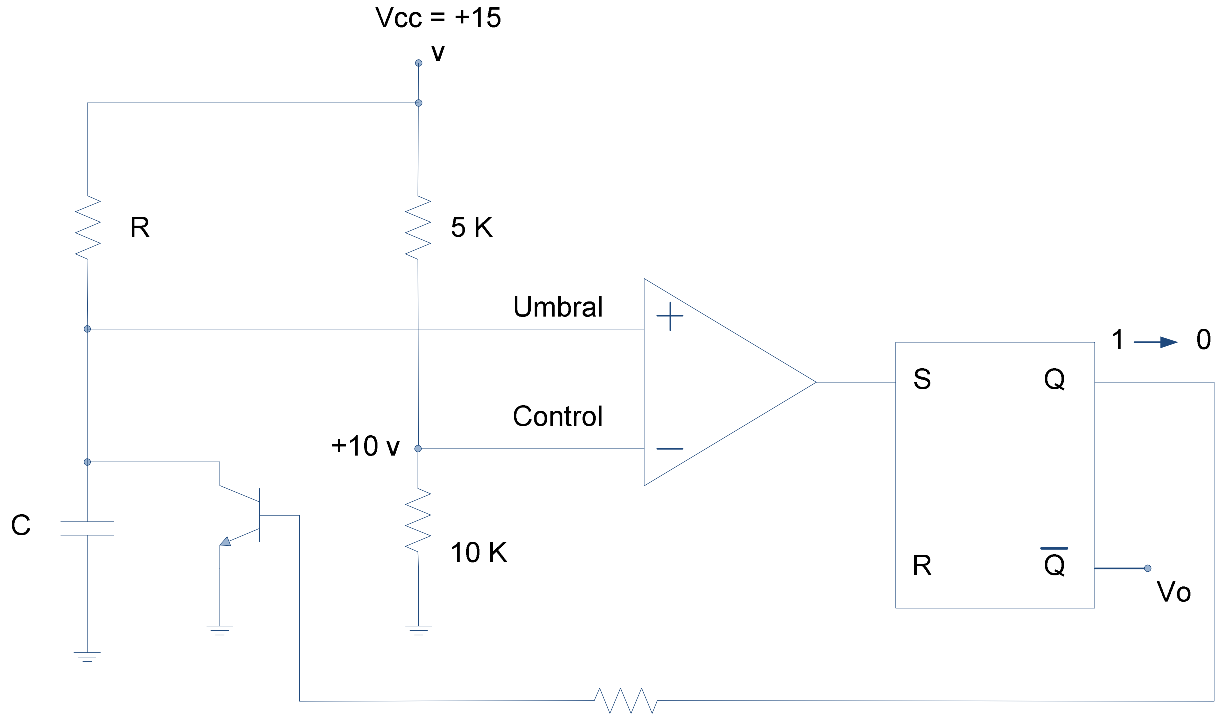
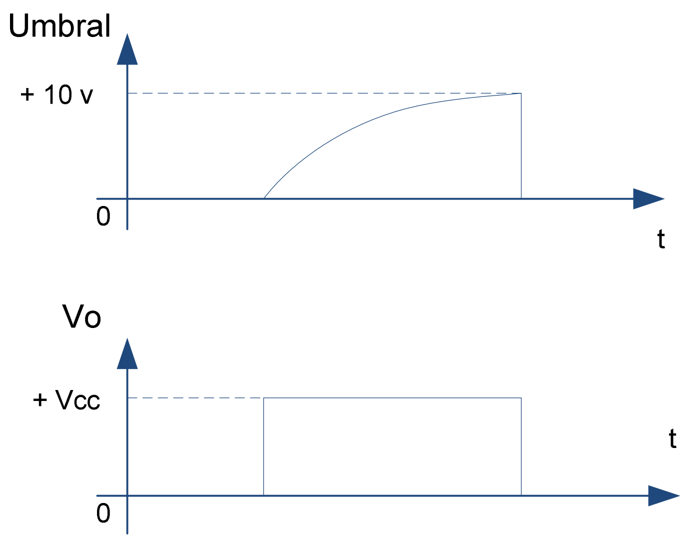
- Comentarios sobre la hoja de datos

Primera Edición – Año 2009

1. Circuito básico de timming





Este circuito básico introductorio de timming, está compuesto por un flip-flop set-reset asincrónico, un comparador (que tiene el mismo símbolo que un amplificador operacional), y un transistor que trabaja normalmente en corte o en saturación. La tensión en el pin control es de 10 V, o sea 2/3 de la tensión de alimentación.

En este circuito estando el terminal de salida Q en un 1 lógico,
y por lo tanto estando el transistor saturado, si en el pin del flip-flop R (reset) se le aplica un 1 (pulso de corta duración) , la salida Q va a 0 (cero), quedando cortado el transistor.

Luego el capacitor de carga a través de la resistencia R, y cuando alcanza un valor de 2/3 Vcc, esta tensión aparece en la entrada umbral, cambia de estado la salida del comprador colocando un valor 1 en la entrada S (set) y volviendo la salida Q al valor 1, y descargando el capacitor a través del transistor.

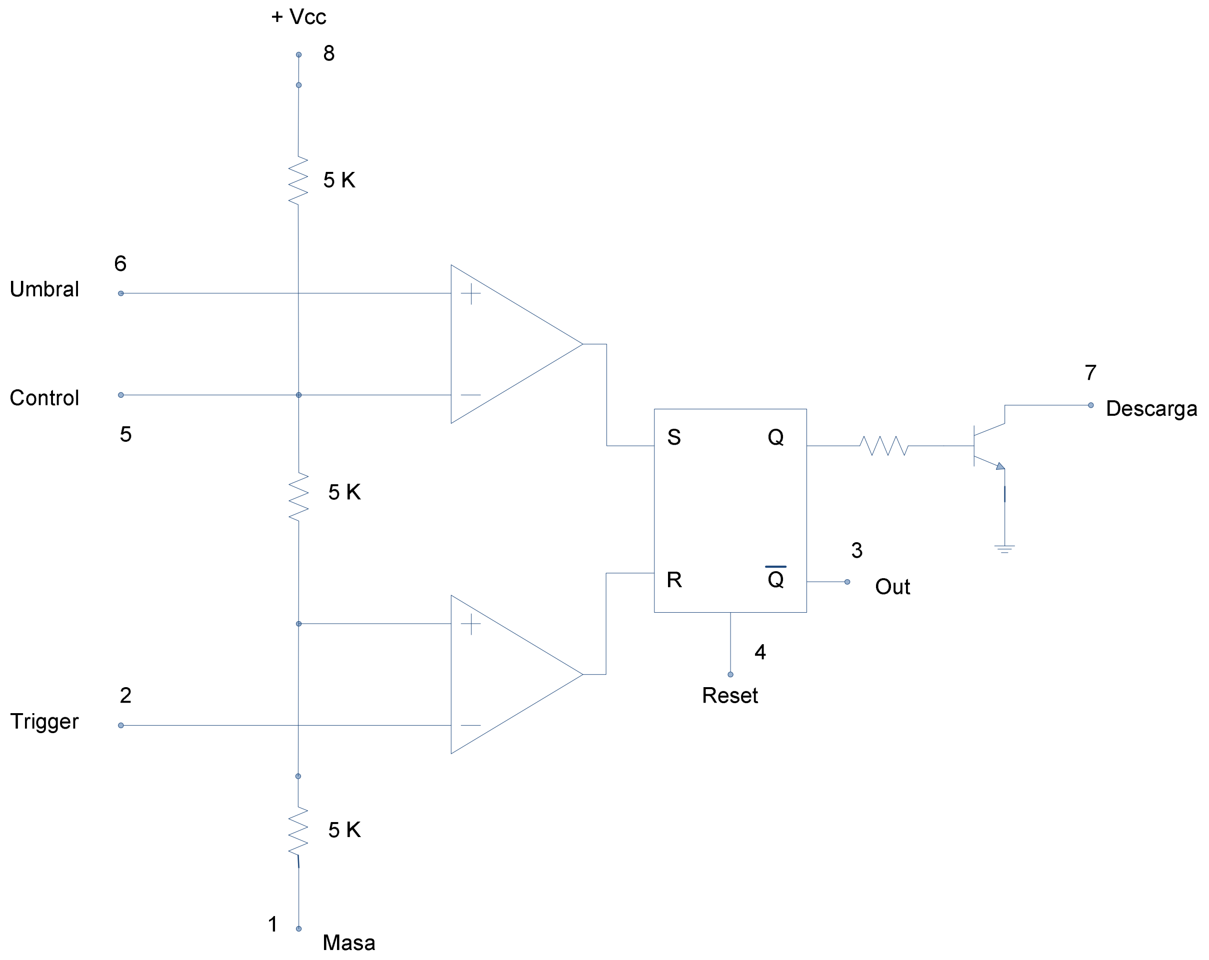
Recordemos que el valor '1' lógico tiene una tensión ideal de +Vcc, y el valor lógico '0', un valor de 0 (cero) voltios.

El circuito permanece en reposo hasta que aparece un pulso en el terminal R.

Un valor importante a tener en cuenta es el valor de conmutación del comparador que es 2/3 Vcc.

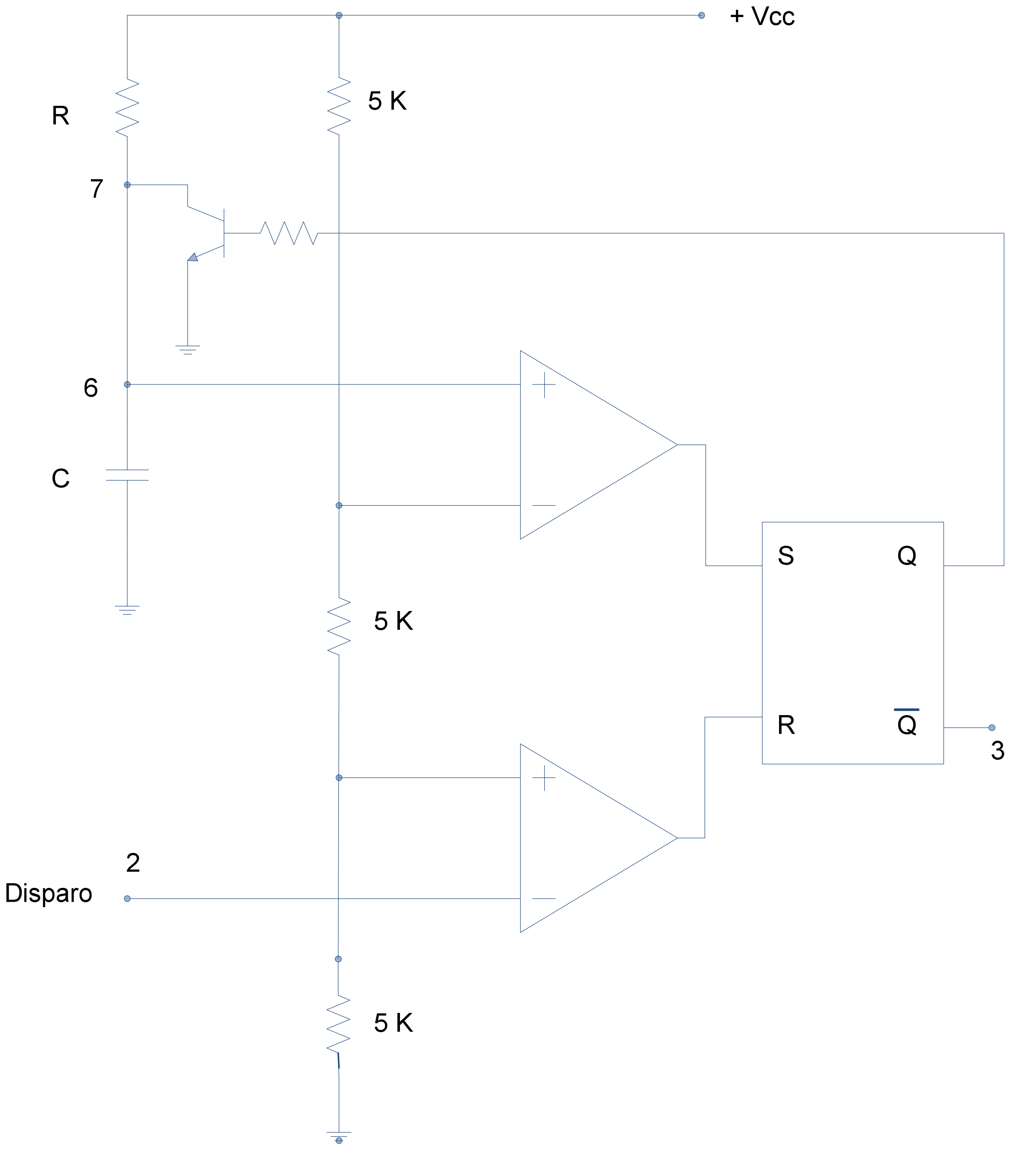
El comparador es básicamente un amplificador operacional que no tiene el capacitor de compensación de estabilidad en frecuencia, y sin el ismo hace que sea más rápido en la conmutación de un estado a otro. En este caso el comparador puede estar saturado positivamente o negativamente.

2. Diagrama interno

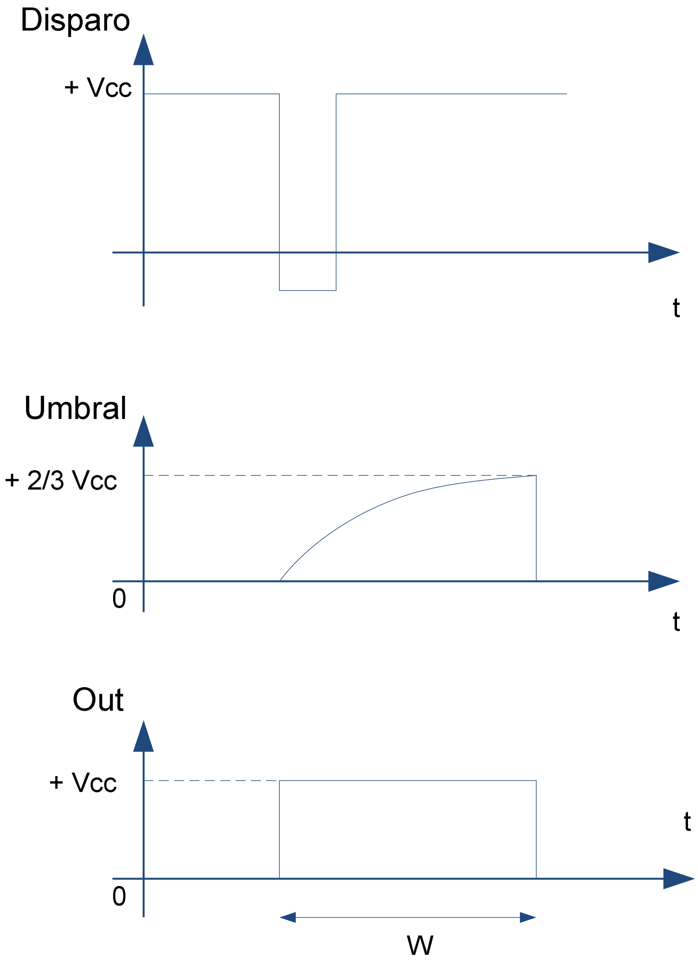


El 555 posee 8 pines, un flip-flop set-reset, dos comparadores y un transistor.
Las tensiones de conmutación de los comparadores es de 1/3 Vcc y de 2/3 Vcc.
El F-F posee un terminal de Reset, para que en cualquier momento se pueda colocar un valor '0' en Q, independientemente de los valores que haya en las entrada S y R.

3. Monoestable



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



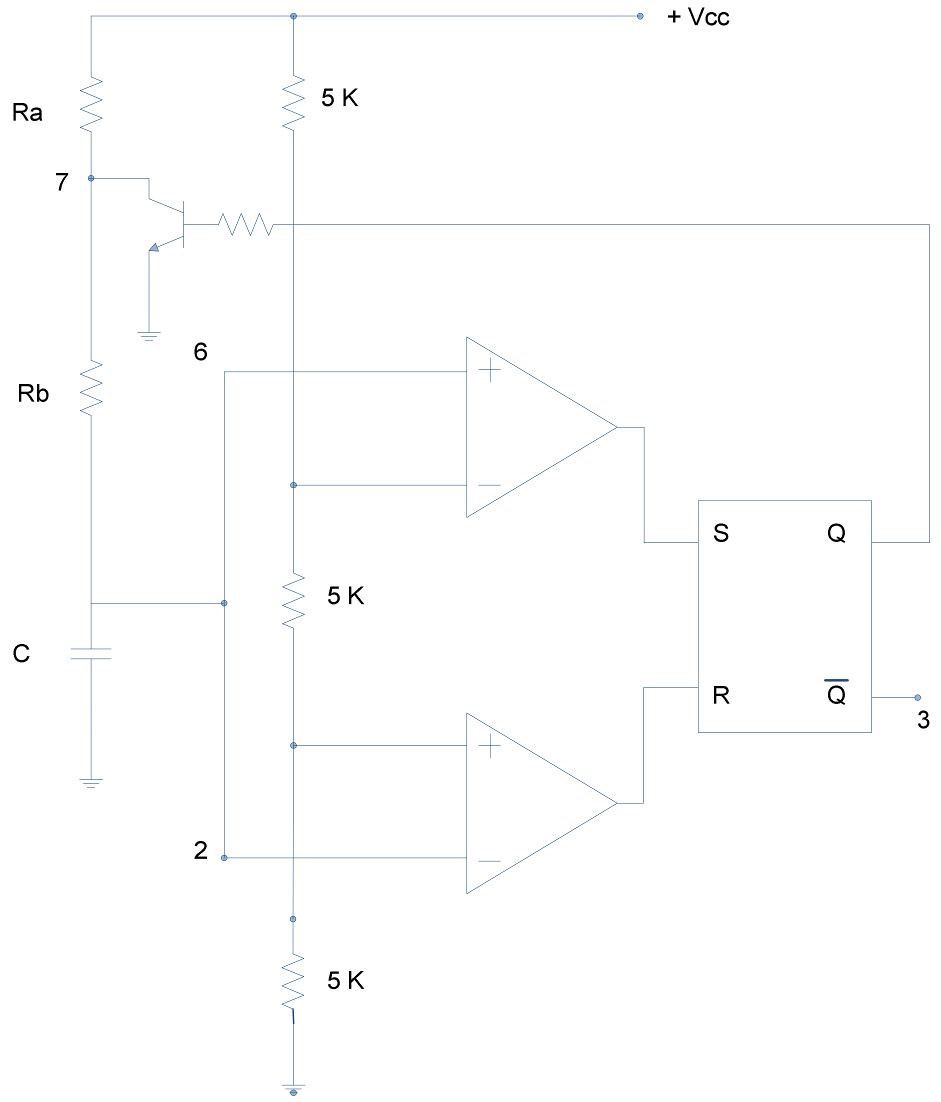
El disparo se realiza a través del pin 2 (disparo), en el cual se debe colocar una tensión menor a 1/3 Vcc. Normalmente se le aplica un pulso, como indica la figura, el cual en algún momento pasa por debajo de 1/3 Vcc. Esto genera un pulso en la salida (Out) de duración W.
La fórmula para calcular la duración es:

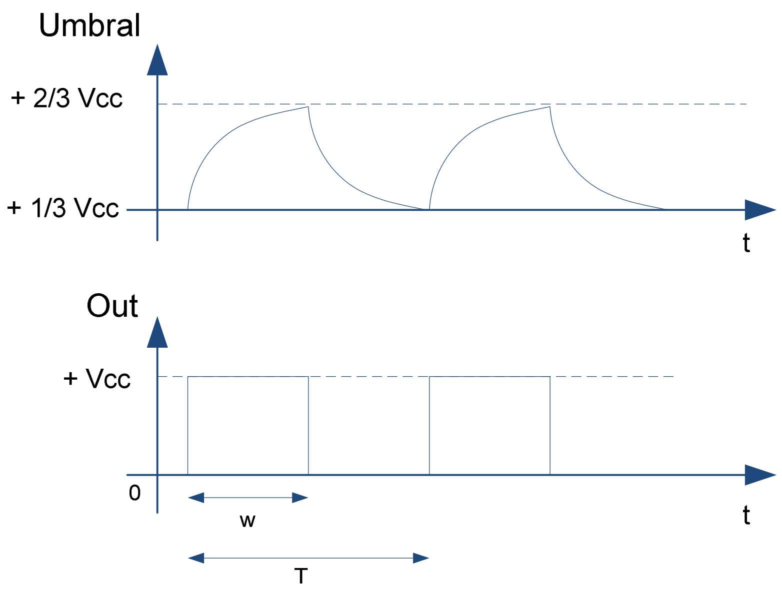
W= 1,1 R.C

$$V = Vf - (Vf - Vi).e^{-t/\tau}$$
$$V = Vi + (Vf - Vi) - (Vf - Vi).e^{-t/\tau}$$
$$V = Vi + (Vf - Vi).(1 - e^{-\frac{t}{\tau}})$$
$$\frac{2}{3}Vcc = Vcc.(1 - e^{-\frac{W}{R.C}})$$
$$e^{-\frac{W}{R.C}} = \frac{1}{3}$$

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

4. Astable





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

Según sea el valor de Ra y Rb, el ciclo de trabajo está entre el 50 % y el 100 %.

La frecuencia está dada por: $f = \frac{1.44}{(Ra+2.Rb).C}$

Con carga ascendente:

$\frac{2}{3}\ .\ Vcc = \frac{Vcc}{3} + (\ Vcc - \frac{Vcc}{3}\ )\ .\ (\ 1 - e^{-\frac{W}{R.C}}\ )$

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

W = 0,693 .R.C = 0,693. (Ra + Rb) .C

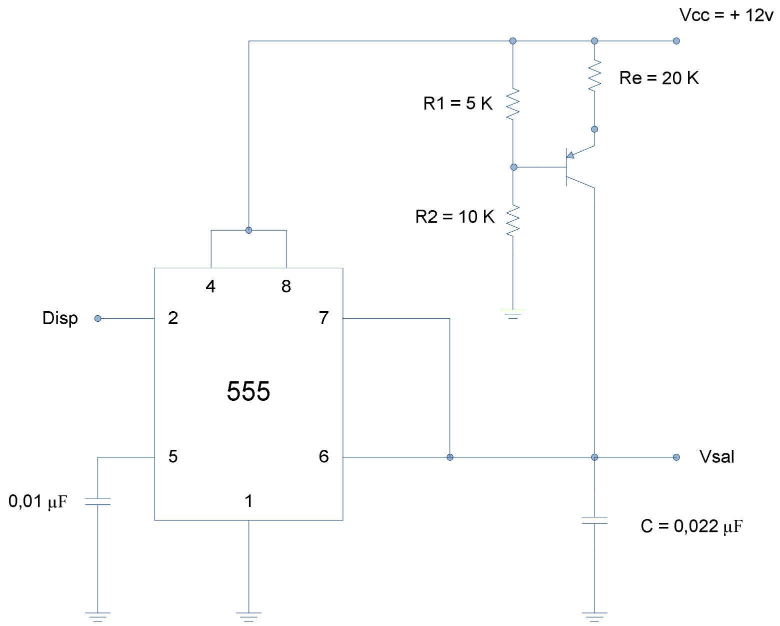
Con la descarga es igual excepto que usamos Rb en vez de Ra + Rb, y (T-W):

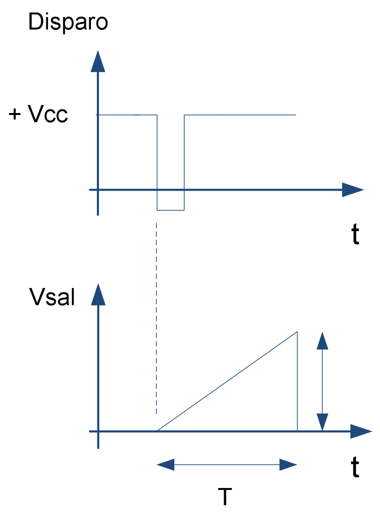
T- W = 0,693 . Rb.C

T = 0,693. (Ra + Rb) + 0,693 .Rb.C = 0,693 . C. (Ra + 2.Rb)

$F = \frac{1}{T} = \frac{1{,}44}{C.(\ Ra+2.Rb\ )}$

5. Generador de Rampa





Cálculo:

$$Ic = \frac{Vcc - Ve}{Re}$$

$$Ve = \frac{Vcc}{(R1 + R2)} \,.\, R2 + Vbe$$

$$Ve = \frac{15\ V}{15\ K} \,.\, 10\ K + 0{,}7\ V = \ 10{,}\ 7\ V$$

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

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

$$\frac{2}{3}\,Vcc = \frac{2}{3}\,.\,15\text{ V} = 10\text{ V}$$

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

6. Hoja de datos (comentarios)

National Semiconductor

March 2002

LMC555 CMOS Timer

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 LMCMOS™ process extends both the frequency range and low supply capability.

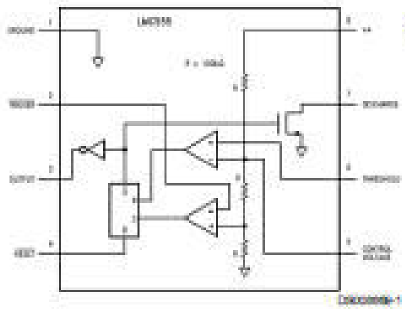
Features

- 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

Diagrama interno

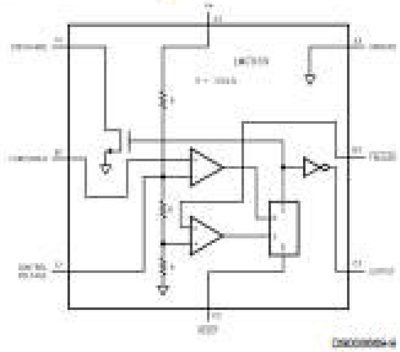
Block and Connection Diagrams

8-Pin SOIC, MSOP, and MDIP Packages



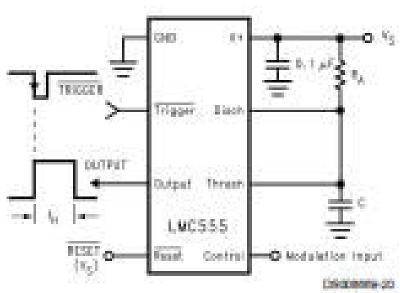
Top View

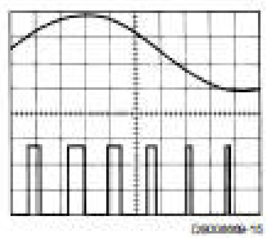
8-Bump micro SMD



Top View (Bump side down)

Pulse Width Modulator





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LMC555

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_S + 0.3V
Output Voltages, V_O, V_{DIS}	15V
Output Current I_O, I_{DIS}	100 mA
Storage Temperature Range	−65°C to +150°C
Soldering Information	
MDIP Soldering (10 seconds)	260°C
SOIC, MSOP Vapor Phase (60 sec)	215°C
SOIC, MSOP Infrared (15 sec)	220°C

Note: See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.

Oper...

Tempe... C

Therma...

S... W

MSO...

Outlin... W

MDIP, 8-lead ... 111°C/W

8-Bump micro SMD 220°C/W

Maximum Allowable Power Dissipation @25°C

MDIP-8	1126mW
SO-8	740mW
MSOP-8	555mW
	568mW

Tensión maxima de alimentación, corriente maxima de salida, tensiones maximas de entrada, etc

parámetros en base al circuito "test circuit"

Electrical Characteristics (Notes 1, 2)

Test Circuit, T = 25°C, all switches open, $\overline{RESET}$ to V_S unless otherwise noted

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

Voltaje para el reset

tiempos de subida y de bajada (max. frecuencia)

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LMC555

Electrical Characteristics (Notes 1, 2)

Test Circuit, T = 25°C, all switches open, $\overline{RESET}$ to V_S unless otherwise noted (Continued)

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

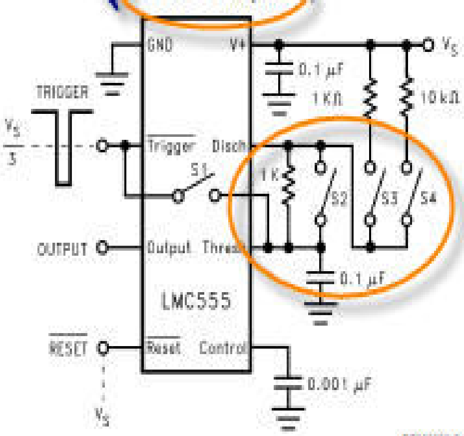
...asured with respect to the ground pin, unless otherwise specified.

...Ratings indicate limits beyond which damage to the device may occur. Operating ... device is ...ee specific performance limits. Electrical Characteristics state DC and AC electrical ... ns which ...ce limits. This assumes that the device is within the Operating Ratings. Specificatio... ...e no limit ...l value is a good indication of device performance.

...r methods of soldering surface mount devices, and also AN-1112 for micro SMD ...

...to be used at temperatures of −20°C and below V_S is required to be 2.0V or great...

...lease refer to table 1



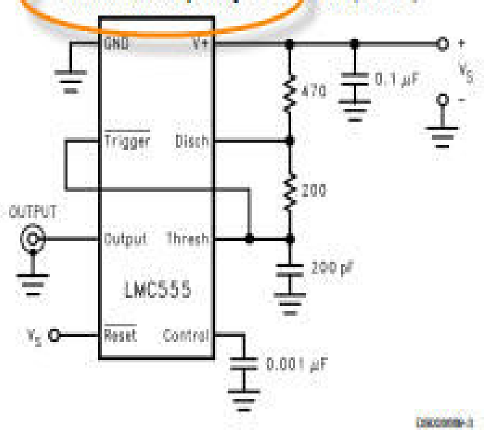


TABLE 1. Package Pinout Names vs. Pin Function

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