


SGS-THOMSON
MICROELECTRONICS
TS555C,I,M

T-51-19

LOW POWER SINGLE CMOS TIMERS

- VERY LOW POWER CONSUMPTION :
100 μ A typ at $V_{CC} = 5V$
- HIGH MAXIMUM ASTABLE FREQUENCY
2.7MHz
- PIN-TO-PIN AND FUNCTIONALLY COMPATIBLE WITH BIPOLAR NE555
- VOLTAGE RANGE : +2V to +18V
- HIGH OUTPUT CURRENT CAPABILITY
- SUPPLY CURRENT SPIKES REDUCED DURING OUTPUT TRANSITIONS
- HIGH INPUT IMPEDANCE : $10^{12} \Omega$
- OUTPUT COMPATIBLE WITH TTL, CMOS AND LOGIC MOS

DESCRIPTION

The TS555 is a single CMOS timer which offers very low consumption ($I_{CC(TYP)}$ TS555 = 100 μ A $I_{CC(TYP)}$ NE555 = 3mA) and high frequency ($f_{(MAX)}$ TS555 = 2.7 MHz - $f_{(MAX)}$ NE555 = 0.1 MHz) Thus, either in Monostable or Astable mode, timing remains very accurate.

The TS555 provides reduced supply current spikes during output transitions, which enables the use of lower decoupling capacitors compared to those required by bipolar NE555.

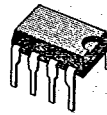
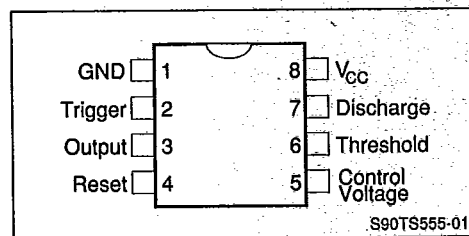
Timing capacitors can also be minimized due to high input impedance ($10^{12} \Omega$).

ORDER CODES

Part Number	Temperature Range	Package		
		N	D	J
TS555C	0 to +70°C	●	●	●
TS555I	-40 to +105°C	●	●	●
TS555M	-55 to +125°C	●	●	●

Examples : TS555CD, TS555IN

PIN CONNECTION (top view)



N

Minidip Plastic

J

CERDIP8

(Cerdip Package)



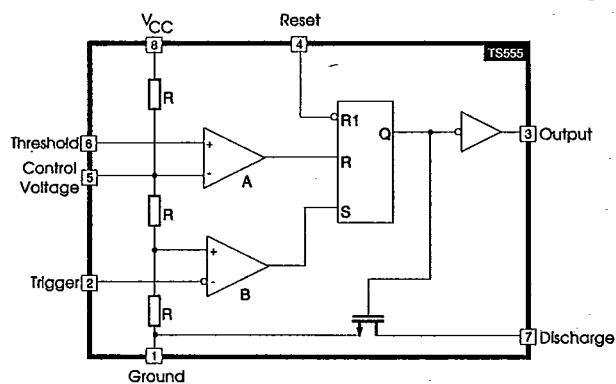
D

SO8

(Plastic Micropackage)

BLOCK DIAGRAM

T-51-19



S90TS555-02

FUNCTION TABLE

RESET	TRIGGER	THRESHOLD	OUTPUT
Low	x	x	Low
High	Low	x	High
High	High	High	Low
High	High	Low	Previous State

LOW ↔ Level Voltage $\leq$ Min voltage specified

HIGH ↔ Level Voltage $\geq$ Max voltage specified

X ↔ Irrelevant

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V _{CC}	Supply Voltage	+18	V
T _J	Junction Temperature	+150	°C

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	Unit
T _{OPER}	Operating Temperature Range		°C
	TS555C	0 to +70	
	TS555I	-40 to +105	
	TS555M	-55 to +125	
T _{STG}	Storage Temperature Range	-65 to +150	°C

OPERATING CONDITIONS S G S-THOMSON

T-51-19

Symbol	Parameter	Value	Unit
V _{CC}	Supply Voltage	+2 to +16	V

STATIC ELECTRICAL CHARACTERISTICS

V_{CC} = +2V, T_{AMB} = +25°C, Reset to V_{CC}
(Unless otherwise specified)

Symbol	Parameter	TS555C - TS555I - TS555M			Unit
		Min	Typ	Max	
I _{CC}	Supply Current (no load, High and Low States) T _{AMB} = + 25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	- -	65 -	200 200	μA
V _{CL}	Control Voltage T _{AMB} = + 25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	1.2 1.1	1.3 -	1.4 1.5	V
V _{DIS}	Discharge Saturation Voltage (I _{DIS} = 1mA) T _{AMB} = + 25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	- -	0.05 -	0.2 0.25	V
V _{OL}	Low Level Output Voltage (I _{SINK} = 1mA) T _{AMB} = + 25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	- -	0.1 -	0.3 0.35	V
V _{OH}	High Level Output Voltage (I _{SOURCE} = -0.3mA) T _{AMB} = + 25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	1.5 1.5	1.9 -	- -	V
V _{TRIG}	Trigger Voltage T _{AMB} = + 25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	0.4 0.3	0.67 -	0.95 1.05	V
I _{TRIG}	Trigger Current	-	10	-	pA
I _{TH}	Threshold Current	-	10	-	pA
V _{RESET}	Reset Voltage T _{AMB} = + 25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	0.4 0.3	1.1 -	1.5 2.0	V
I _{RESET}	Reset Current	-	10	-	pA
I _{DIS}	Discharge Pin Leakage Current	-	1	100	nA

STATIC ELECTRICAL CHARACTERISTICS (continued)

S G S-THOMSON

V_{CC} = +5V, T_{AMB} = +25°C, Reset to V_{CC}
(Unless otherwise specified)

T-51-19

Symbol	Parameter	TS555C - TS555I - TS555M			Unit
		Min	Typ	Max	
I _{CC}	Supply Current (no load, High and Low States) T _{AMB} = +25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	-	110	250	μA
V _{CL}	Control Voltage T _{AMB} = +25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	2.9 2.8	3.3 -	3.8 3.9	V
V _{DIS}	Discharge Saturation Voltage (I _{DIS} = 10mA) T _{AMB} = +25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	- -	0.2 -	0.3 0.35	V
V _{OL}	Low Level Output Voltage (I _{SINK} = 8mA) T _{AMB} = +25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	- -	0.3 -	0.6 0.8	V
V _{OH}	High Level Output Voltage (I _{SOURCE} = -2mA) T _{AMB} = +25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	4.4 4.4	4.6 -	- -	V
V _{TRIG}	Trigger Voltage T _{AMB} = +25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	1.36 1.26	1.67 -	1.96 2.06	V
I _{TRIG}	Trigger Current	-	10	-	pA
I _{TH}	Threshold Current	-	10	-	pA
V _{RESET}	Reset Voltage T _{AMB} = +25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	0.4 0.3	1.1 -	1.5 2.0	V
I _{RESET}	Reset Current	-	10	-	pA
I _{DIS}	Discharge Pin Leakage Current	-	1	100	nA

S G S-THOMSON

STATIC ELECTRICAL CHARACTERISTICS (continued)

$V_{CC} = +12V$, $T_{AMB} = +25^{\circ}C$, Reset to V_{CC}
(Unless otherwise specified)

T-51-19

Symbol	Parameter	TS555C - TS555I - TS555M			Unit
		Min	Typ	Max	
I_{CC}	Supply Current (no load, High and Low States) $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	- -	170 -	400 400	μA
V_{CL}	Control Voltage $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	7.4 7.3	8 -	8.6 8.7	V
V_{DIS}	Discharge Saturation Voltage ($I_{DIS} = 80mA$) $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	- -	0.9 -	1.6 2.0	V
V_{OL}	Low Level Output Voltage ($I_{SINK} = 50mA$) $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	- -	1.2 -	2 2.8	V
V_{OH}	High Level Output Voltage ($I_{SOURCE} = -10mA$) $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	10.5 10.5	11 -	- -	V
V_{TRIG}	Trigger Voltage $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	3.2 3.1	4 -	4.8 4.9	V
I_{TRIG}	Trigger Current	-	10	-	pA
I_{TH}	Threshold Current	-	10	-	pA
V_{RESET}	Reset Voltage $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	0.4 0.3	1.1 -	1.5 2.0	V
I_{RESET}	Reset Current	-	10	-	pA
I_{DIS}	Discharge Pin Leakage Current	-	1	100	nA

DYNAMIC ELECTRICAL CHARACTERISTICS

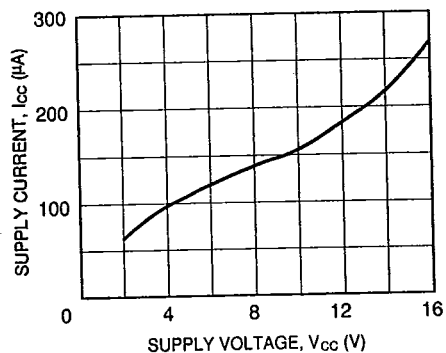
$T_{AMB} = +25^{\circ}\text{C}$, Reset to V_{CC}
(Unless otherwise specified)

T-51-19

Symbol	Parameter	TS555C - TS555I - TS555M			Unit
		Min	Typ	Max	
	Timing Accuracy (Monostable) - $R = 10\text{ k}\Omega$, $C = 0.1\text{ }\mu\text{F}$ - (Note 1) $V_{CC} = +2\text{V}$ $V_{CC} = +5\text{V}$ $V_{CC} = +12\text{V}$	-	1 2 4	-	%
	Timing Shift with supply voltage variations (Monostable) $R = 10\text{ k}\Omega$, $C = 0.1\text{ }\mu\text{F}$, $V_{CC} = +5\text{V} \pm 1\text{V}$	-	0.38	-	%/V
	Timing Shift with temperature $T_{MIN} \leq T_{AMB} \leq T_{MAX}$, $V_{CC} = +5\text{V}$	-	75	-	ppm/°C
f_{MAX}	Maximum astable frequency $R_A = 470\Omega$, $R_B = 200\Omega$, $C = 200\text{ pF}$, $V_{CC} = +5\text{V}$	-	2.7	-	MHz
	Astable frequency accuracy - (Note 2) $R_A = R_B = 1\text{ k}\Omega$ to $100\text{ k}\Omega$, $C = 0.1\text{ }\mu\text{F}$ $V_{CC} = +5\text{V}$ $V_{CC} = +12\text{V}$	-	3 3	-	%
	Timing Shift with supply voltage variations (Astable mode) $R_A = R_B = 1\text{ k}\Omega$ to $100\text{ k}\Omega$, $C = 0.1\text{ }\mu\text{F}$, $V_{CC} = +5$ to $+12\text{V}$	-	0.1	-	%/V
t_r	Output Rise Time ($V_{CC} = +5\text{V}$, $C_{LOAD} = 10\text{ pF}$)	-	25	-	ns
t_f	Output Fall Time ($V_{CC} = +5\text{V}$, $C_{LOAD} = 10\text{ pF}$)	-	20	-	ns
t_{PD}	Trigger Propagation Delay ($V_{CC} = +5\text{V}$)	-	100	-	ns
t_{RPW}	Minimum Reset Pulse Width ($V_{TRIG} = +5\text{V}$)	-	350	-	ns

Notes : 1. See Figure 1
2. See Figure 2

TYPICAL CHARACTERISTICS

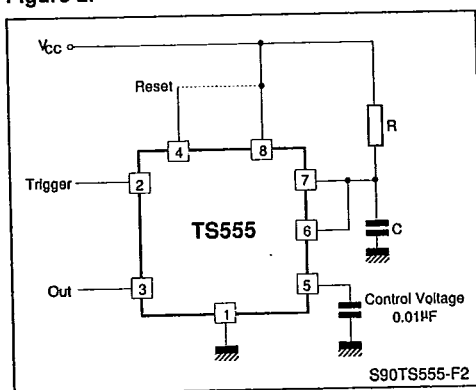
Figure 1 : Supply Current (each timer) versus Supply Voltage.

S90TS555-F1

APPLICATION INFORMATION

MONOSTABLE OPERATION

In the monostable mode, the timer functions as a one-shot. Referring to figure 2 the external capacitor is initially held discharged by a transistor inside the timer.

Figure 2.

S90TS555-F2

The circuit triggers on a negative-going input signal when the level reaches $1/3 V_{cc}$. Once triggered, the

circuit remains in this state until the set time has elapsed, even if it is triggered again during this interval. The duration of the output HIGH state is given by $t = 1.1 R \times C$.

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 (pin 4) and the Trigger terminal (pin 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 a negative trigger pulse is applied to pin 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 $\tau = R \times C$.

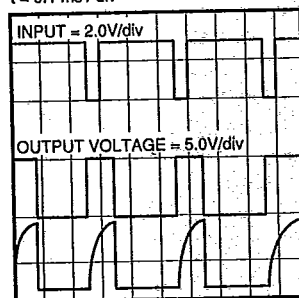
When the voltage across the capacitor equals $2/3 V_{cc}$, the comparator resets the flip-flop which then discharges the capacitor rapidly and drives the output to its LOW state.

Figure 3 shows the actual waveforms generated in this mode of operation.

When Reset is not used, it should be tied high to avoid any possible or false triggering.

Figure 3.

S G S-THOMSON

 $t = 0.1 \text{ ms / div}$ 

CAPACITOR VOLTAGE = 2.0V/div
 $R = 9.1 \text{ k}\Omega$, $C = 0.01 \mu\text{F}$, $R_L = 1.0 \text{ k}\Omega$

S90TS555-F3

ASTABLE OPERATION

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

In the astable mode of operation, C charges and discharges between $1/3 V_{CC}$ and $2/3 V_{CC}$. 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 :

$$t_1 = 0.693 (R_A + R_B) C$$

and the discharge time (output LOW) by :

$$t_2 = 0.693 (R_B) C$$

Thus the total period T is given by :

$$T = t_1 + t_2 = 0.693 (R_A + 2R_B) C$$

The frequency of oscillation is then :

$$f = \frac{1}{T} = \frac{1.44}{(R_A + 2R_B)C}$$

The duty cycle is given by : $D = \frac{R_B}{R_A + 2R_B}$

Figure 4.

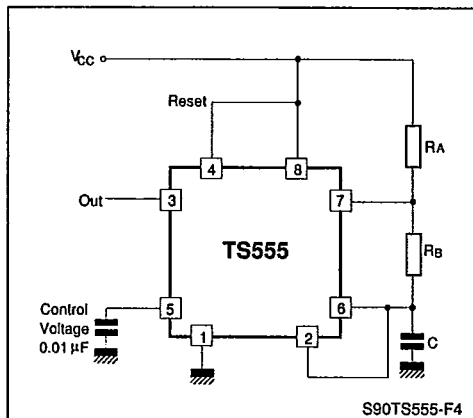
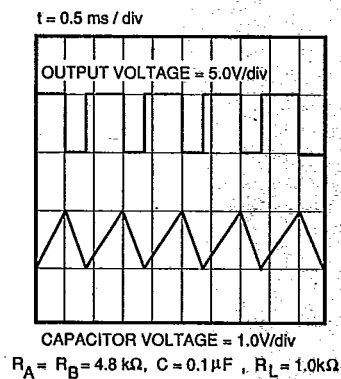


Figure 5.

S G S-THOMSON



S90TS555-F5