

LOW POWER DUAL CMOS TIMERS

- VERY LOW POWER CONSUMPTION :
100 μ A typ / TIMER AT $V_{CC} = 5V$
- HIGH MAXIMUM ASTABLE FREQUENCY
2.7MHz
- PIN-TO-PIN AND FUNCTIONALLY COMPATIBLE WITH BIPOLAR NE556
- 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 TS556 is a dual CMOS timer which offers very low consumption ($I_{CC(TYP)}$ TS556 = 200 μ A, $I_{CC(TYP)}$ NE556 = 6mA) and high frequency ($f_{(MAX)}$ TS556 = 2.7MHz - $f_{(MAX)}$ NE556 = 0.1MHz). Thus, either in Monostable or Astable mode, timing remains very accurate.

The TS556 provides reduced supply current spikes during output transitions, which enables the use of lower decoupling capacitors compared to those required by bipolar NE556.

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

ORDER CODES

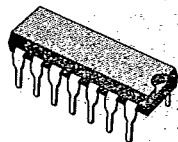
Part Number	Temperature Range	Package		
		N	D	J
TS556C	0 to +70°C	●	●	●
TS556I	-40 to +105°C	●	●	●
TS556M	-55 to +125°C	●	●	●

Examples : TS556CD, TS556IN

April 1990

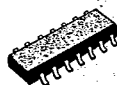
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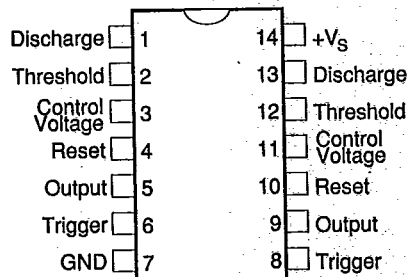


N
DIP14
(Plastic Package)

J
CERDIP14
(Cerdip Package)



D
SO14
(Plastic Micropackage)

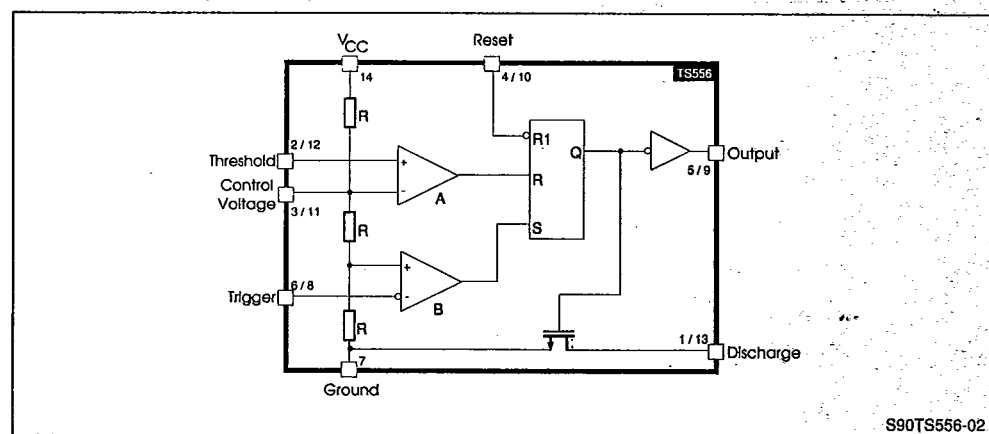
PIN CONNECTION (top view)

S90TS556-01

BLOCK DIAGRAM (1/2 TS556)

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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 ≤ Min voltage specified

HIGH ↔ Level Voltage ≥ 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 _{OPR}	Operating Temperature Range		°C
	TS556C	0 to +70	
	TS556I	-40 to +105	
	TS556M	-55 to +125	
T _{STG}	Storage Temperature Range	-65 to +150	°C

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OPERATING CONDITIONS

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	TS556C - TS556I - TS556M			Unit
		Min	Typ	Max	
I _{CC}	Supply Current (no load, High and Low States) T _{AMB} = +25 °C T _{MIN} ≤ T _{AMB} ≤ T _{MAX}	-	130	400	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)

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

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Symbol	Parameter	TS556C - TS556I - TS556M			Unit
		Min	Typ	Max	
I_{CC}	Supply Current (no load, High and Low States) $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	- -	220 -	500 500	μA
V_{CL}	Control Voltage $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	2.9 2.8	3.3 -	3.8 3.9	V
V_{DIS}	Discharge Saturation Voltage ($I_{DIS} = 10mA$) $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	- -	0.2 -	0.3 0.35	V
V_{OL}	Low Level Output Voltage ($I_{SINK} = 8mA$) $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	- -	0.3 -	0.6 0.8	V
V_{OH}	High Level Output Voltage ($I_{SOURCE} = -2mA$) $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	4.4 4.4	4.6 -	- -	V
V_{TRIG}	Trigger Voltage $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	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 $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	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

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STATIC ELECTRICAL CHARACTERISTICS (continued)

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

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Symbol	Parameter	TS556C - TS556I - TS556M			Unit
		Min	Typ	Max	
I_{CC}	Supply Current (no load, High and Low States) $T_{AMB} = +25^{\circ}C$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	-	340	800	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

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 $T_{AMB} = +25^{\circ}\text{C}$, Reset to V_{CC}

(Unless otherwise specified)

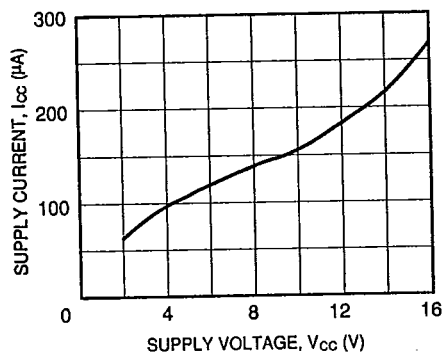
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Symbol	Parameter	TS556C - TS556I - TS556M			Unit
		Min	Typ	Max	
	Timing Accuracy (Monostable) - $R = 10\text{ k}\Omega$, $C = 0.1\text{ }\mu\text{F}$ - (Note 1) $V_{CC} = +2\text{V}$ $V_{CC} = +5\text{V}$ $V_{CC} = +12\text{V}$	- - -	1 2 4	- - -	%
	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/ $^{\circ}\text{C}$
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.



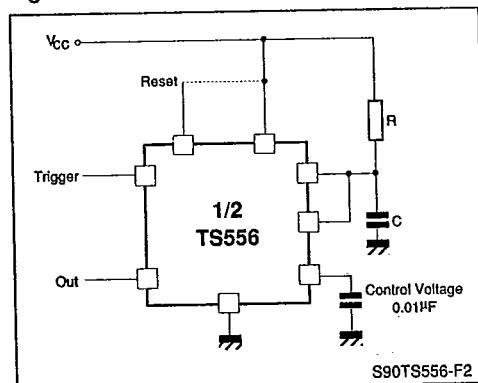
S90TS556-F1

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.



S90TS556-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 or 10) and the Trigger terminal (pin 6 or 8) 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.

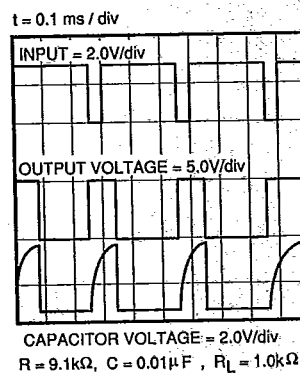
When a negative trigger pulse is applied to the trigger terminal, the flip-flop is set, releasing the short circuit across the external capacitor and driving the output HIGH. The voltage across the capacitor increases exponentially with the time constant $\tau = R \times C$.

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.



$R = 9.1k\Omega$, $C = 0.01\mu F$, $R_L = 1.0k\Omega$

S90TS556-F3

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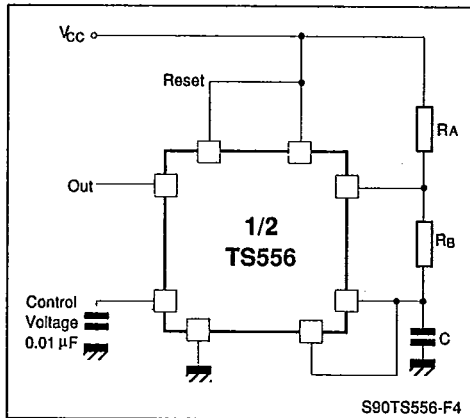
ASTABLE OPERATION

When the circuit is connected as shown in figure 4, 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.

Figure 4.



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 :

$$f = \frac{1}{T} = \frac{1.44}{(R_A + 2R_B)C} \quad \text{T-51-19}$$

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

Figure 5.

