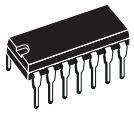
TS556

LOW POWER DUAL CMOS TIMER

- VERY LOW POWER CONSUMPTION :
  220 µA typ at V_{CC} = 5V
  180 µA typ at V_{CC} = 3V
- HIGH MAXIMUM ASTABLE FREQUENCY 2.7MHz
- PIN-TO-PIN AND FUNCTIONALLY COMPATIBLE WITH BIPOLAR NE556
- WIDE VOLTAGE RANGE : +2V to +16V
- 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



N
DIP14
(Plastic Package)



D
SO14
(Plastic Micropackage)

DESCRIPTION

The TS556 is a dual CMOS timer which offers very low consumption ($I_{cc(TYP)}$ TS556 = 220µA at V_{CC}=+5V versus $I_{cc(TYP)}$ NE556 = 6mA) and high frequency $f_{f(max.)}$ TS556 = 2.7MHz versus $f_{(max.)}$ NE556 = 0.1 MHz)

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.

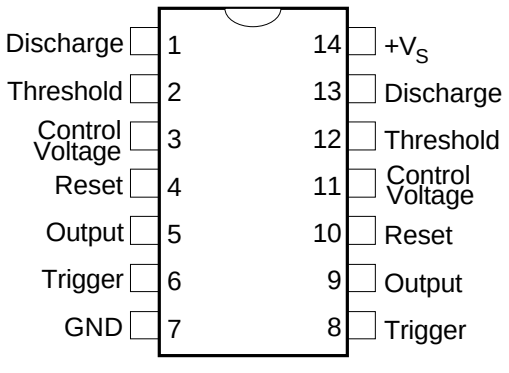
Timing capacitors can also be minimized due to high input impedance ($10^{12}\Omega$).

ORDER CODES

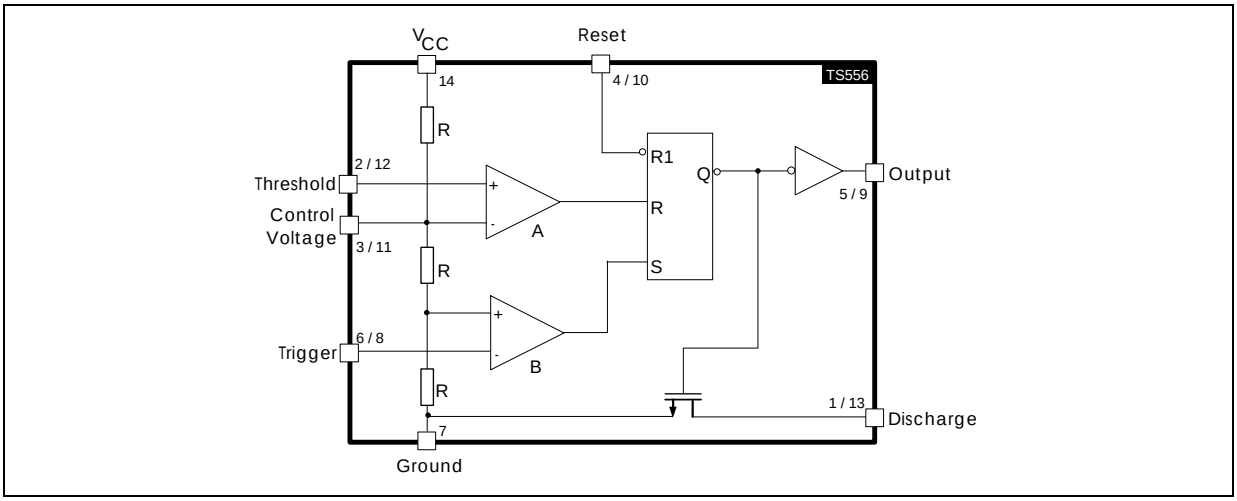
Part Number	Temperature Range	Package	
		N	D
TS556C	0°C, +70°C	•	•
TS556I	-40°C, +125°C	•	•
TS556M	-55°C, +125°C	•	•

N = Dual in Line Package (DIP)
D = Small Outline Package (SO) - also available in Tape & Reel (DT)

PIN CONNECTIONS (top view)



BLOCK DIAGRAM



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 specificed
HIGH <-----> Level Voltage ≥ Max voltage specificed
x <-----> Irrelevant

ABSOLUTE MAXIMUM RATINGS

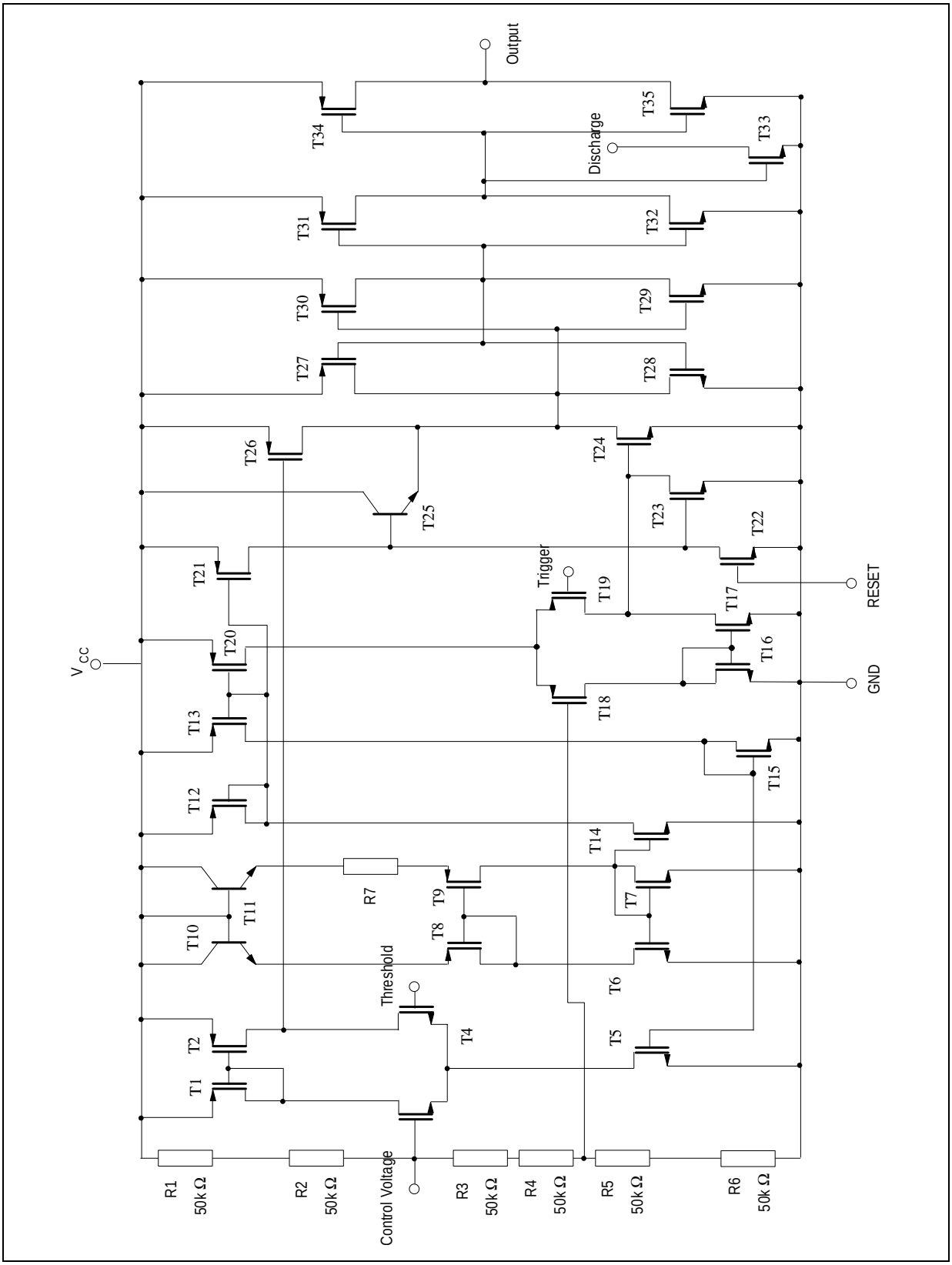
Symbol	Parameter		Value	Unit
V_{CC}	Supply Voltage		+18	V
T_j	Junction Temperature		+150	°C
T_{stg}	Storage Temperature Range		-65 to +150	°C
P_D	Power dissipation[1)]	DIP14 SO14	1560 830	mW

1. T_j = 150°C, T_{amb} = 25°C with Rthja = 80°C/W for DIP14 package
Rthja = 150°C/W for SO14 package

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	+2 to +16	V
T_{oper}	Operating Free Air Temperature Range TS556C TS556I TS556M	 0 to +70 -40 to +125 -55 to +125	°C

SCHEMATIC DIAGRAM (1/2 TS556)



STATIC ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
I_{CC}	Supply Current (no load, High and Low States) $T_{min.} \le T_{amb} \le T_{max.}$		130	400 400	µA
V_{CL}	Control Voltage Level $T_{min.} \le T_{amb} \le T_{max.}$	1.2 1.1	1.3	1.4 1.5	V
V_{DIS}	Discharge Saturation Voltage (I_{dis} = 1mA) $T_{min.} \le T_{amb} \le T_{max.}$		0.05	0.2 0.25	V
I_{DIS}	Discharge Pin Leakage Current		1	100	nA
V_{OL}	Low Level Output Voltage (I_{sink} = 1mA) $T_{min.} \le T_{amb} \le T_{max.}$		0.1	0.3 0.35	V
V_{OH}	High Level Output Voltage (I_{source} = -0.3mA) $T_{min.} \le T_{amb} \le T_{max.}$	1.5 1.5	1.9		V
V_{TRIG}	Trigger Voltage $T_{min.} \le T_{amb} \le T_{max.}$	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 $T_{min.} \le T_{amb} \le T_{max.}$	0.4 0.3	1.1	1.5 2.0	V
I_{RESET}	Reset Current		10		pA

ELECTRICAL CHARACTERISTICS

V_{CC} = +3V, T_{amb} = +25°C, Reset to V_{CC} (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
I_{CC}	Supply Current (no load, High and Low States) $T_{min.} \le T_{amb} \le T_{max.}$		180	460 460	µA
V_{CL}	Control Voltage Level $T_{min.} \le T_{amb} \le T_{max.}$	1.8 1.7	2	2.2 2.3	V
V_{DIS}	Discharge Saturation Voltage (I_{dis} = 1mA) $T_{min.} \le T_{amb} \le T_{max.}$		0.05	0.2 0.25	V
I_{DIS}	Discharge Pin Leakage Current		1	100	nA
V_{OL}	Low Level Output Voltage (I_{sink} = 1mA) $T_{min.} \le T_{amb} \le T_{max.}$		0.1	0.3 0.35	V
V_{OH}	High Level Output Voltage (I_{source} = -0.3mA) $T_{min.} \le T_{amb} \le T_{max.}$	2.5 2.5	2.9		V
V_{TRIG}	Trigger Voltage $T_{min.} \le T_{amb} \le T_{max.}$	0.9 0.8	1	1.1 1.2	V
I_{TRIG}	Trigger Current		10		pA
I_{TH}	Threshold Current		10		pA
V_{RESET}	Reset Voltage $T_{min.} \le T_{amb} \le T_{max.}$	0.4 0.3	1.1	1.5 2.0	V
I_{RESET}	Reset Current		10		pA

DYNAMIC ELECTRICAL CHARACTERISTICS

V_{CC} = +3V, T_{amb} = +25°C, Reset to V_{CC} (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
	Timing Accuracy (Monostable) [1] R = 10kΩ, C = 0.1µF V_{CC}=+2V V_{CC}=+3V		1 1		%
	Timing Shift with Supply Voltage Variations (Monostable) [1] R = 10kΩ, C = 0.1µF,V_{CC} = +3V ±0.3V		0.5		%/V
	Timing Shift with Temperature [1] $T_{min.} \le T_{amb} \le T_{max}$		75		ppm/°C
f_{max}	Maximum Astable Frequency [2] R_A = 470Ω, R_B = 200Ω, C = 200pF		2		MHz
	Astable Frequency Accuracy [2] R_A =R_B = 1kΩ to 100kΩ, C = 0.1µF		5		%
	Timing Shift with Supply Voltage Variations (Astable mode) [2] R_A =R_B = 10kΩ, C = 0.1µF, V_{CC} = +3 to +5V		0.5		%/V
t_R	Output Rise Time (C_{load} = 10pF)		25		ns
t_F	Output Fall Time (C_{load} = 10pF)		20	-	ns
t_{PD}	Trigger Propagation Delay		100		ns
t_{RPW}	Minimum Reset Pulse Width (V_{trig} = +3V)		350		ns

1. see figure 2
2. see figure 4

STATIC ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
I_{CC}	Supply Current (no load, High and Low States) $T_{min.} \le T_{amb} \le T_{max.}$		220	500 500	µA
V_{CL}	Control Voltage Level $T_{min.} \le T_{amb} \le T_{max.}$	2.9 2.8	3.3	3.8 3.9	V
V_{DIS}	Discharge Saturation Voltage (I_{dis} = 10mA) $T_{min.} \le T_{amb} \le T_{max.}$		0.2	0.3 0.35	V
I_{DIS}	Discharge Pin Leakage Current		1	100	nA
V_{OL}	Low Level Output Voltage (I_{sink} = 8mA) $T_{min.} \le T_{amb} \le T_{max.}$		0.3	0.6 0.8	V
V_{OH}	High Level Output Voltage (I_{source} = -2mA) $T_{min.} \le T_{amb} \le T_{max.}$	4.4 4.4	4.6		V
V_{TRIG}	Trigger Voltage $T_{min.} \le T_{amb} \le T_{max.}$	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 $T_{min.} \le T_{amb} \le T_{max.}$	0.4 0.3	1.1	1.5 2.0	V
I_{RESET}	Reset Current		10		pA

DYNAMIC ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
	Timing Accuracy (Monostable) [1] R = 10kΩ, C = 0.1µF		2		%
	Timing Shift with Supply Voltage Variations (Monostable) [1] R = 10kΩ, C = 0.1µF,V_{CC} = +5V ±1V		0.38		%/V
	Timing Shift with Temperature [1] $T_{min.} \le T_{amb} \le T_{max.}$		75		ppm/°C
f_{max}	Maximum Astable Frequency [2] R_A = 470Ω, R_B = 200Ω, C = 200pF		2.7		MHz
	Astable Frequency Accuracy [2] R_A =R_B = 1kΩ to 100kΩ, C = 0.1µF		3		%
	Timing Shift with Supply Voltage Variations (Astable mode) [2] R_A =R_B = 1kΩ to 100kΩ, C = 0.1µF, V_{CC} = +5 to +12V		0.1		%/V
t_R	Output Rise Time (C_{load} = 10pF)		25		ns
t_F	Output Fall Time (C_{load} = 10pF)		20	-	ns
t_{PD}	Trigger Propagation Delay		100		ns
t_{RPW}	Minimum Reset Pulse Width (V_{trig} = +5V)		350		ns

1. see figure 2
2. see figure 4

STATIC ELECTRICAL CHARACTERISTICS

V_{CC} = +12V, T_{amb} = +25°C, Reset to V_{CC} (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
I_{CC}	Supply Current (no load, High and Low States) $T_{min.} \le T_{amb} \le T_{max.}$		340	800 800	µA
V_{CL}	Control Voltage Level $T_{min.} \le T_{amb} \le T_{max.}$	7.4 7.3	8	8.6 8.7	V
V_{DIS}	Discharge Saturation Voltage (I_{dis} = 80mA) $T_{min.} \le T_{amb} \le T_{max.}$		0.09	1.6 2.0	V
I_{DIS}	Discharge Pin Leakage Current		1	100	nA
V_{OL}	Low Level Output Voltage (I_{sink} = 50mA) $T_{min.} \le T_{amb} \le T_{max.}$		1.2	2 2.8	V
V_{OH}	High Level Output Voltage (I_{source} = -10mA) $T_{min.} \le T_{amb} \le T_{max.}$	10.5 10.5	11		V
V_{TRIG}	Trigger Voltage $T_{min.} \le T_{amb} \le T_{max.}$	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 $T_{min.} \le T_{amb} \le T_{max.}$	0.4 0.3	1.1	1.5 2.0	V
I_{RESET}	Reset Current		10		pA

DYNAMIC ELECTRICAL CHARACTERISTICS

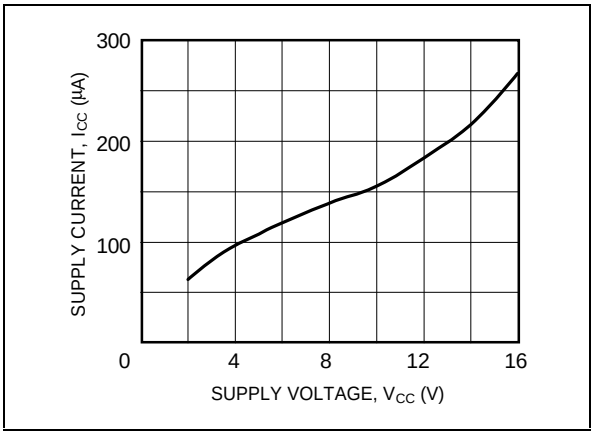
V_{CC} = +12V, T_{amb} = +25°C, Reset to V_{CC} (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
	Timing Accuracy (Monostable) [1] R = 10kΩ, C = 0.1µF		4		%
	Timing Shift with Supply Voltage Variations (Monostable) R = 10kΩ, C = 0.1µF,V_{CC} = +5V ±1V		0.38		%/V
	Timing Shift with Temperature $T_{min.} \le T_{amb} \le T_{max.}$, V_{CC} = +5V		75		ppm/°C
f_{max}	Maximum Astable Frequency R_A = 470Ω, R_B = 200Ω, C = 200pF, V_{CC} = +5V		2.7		MHz
	Astable Frequency Accuracy [2] R_A =R_B = 1kΩ to 100kΩ, C = 0.1µF		3		%
	Timing Shift with Supply Voltage Variations (Astable mode) R_A =R_B = 1kΩ to 100kΩ, C = 0.1µF, V_{CC} = 5 to +12V		0.1		%/V

1. see figure 2
2. see figure 4

TYPICAL CHARACTERISTICS

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

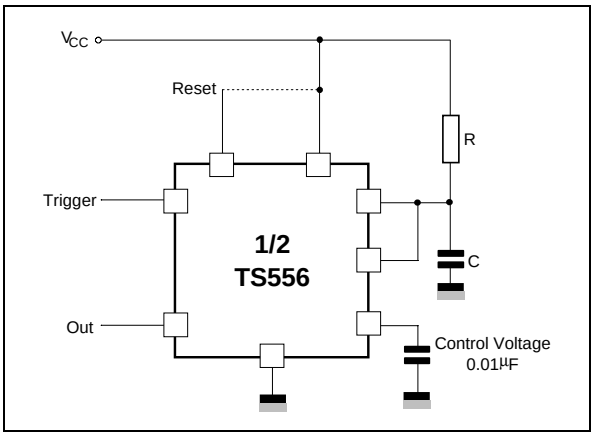


APPLICATION INFORMATION

MONOSTABLE OPERATION

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

Figure 2 :



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 x C.

It can be noticed that since the charge rate and the threshold level of the comparator are both directly proportional to the supply voltage, the timing interval is independent of the 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. While the reset pulse is applied, the output is driven to the LOW state.

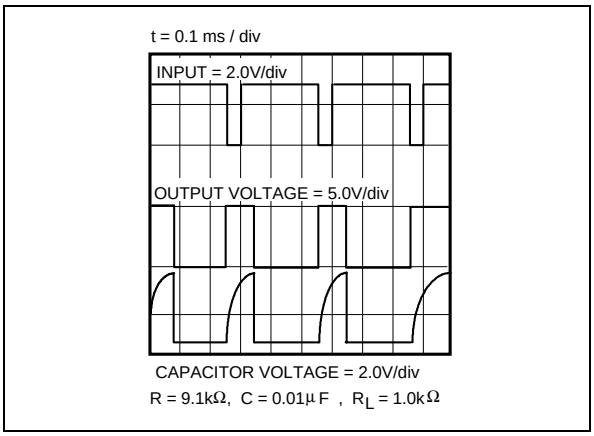
When a negative trigger pulse is applied to pin 2, the flip-flop is set, releasing the short circuit across the external capacitor and driving the output HIGH. The voltage across the capacitor increases exponentially with the time constant τ = R x C.

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 :



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 :
$t1 = 0.693 (R_A + R_B) C$
and the discharge time (output LOW) by :
$t2 = 0.693 \times R_B \times C$
Thus the total period T is given by :
$T = t1 + t2 = 0.693 (R_A + 2R_B) C$
The frequency of oscillation is then :

$$f = \frac{1}{T} = \frac{1.44}{(RA + 2RB)C}$$

The duty cycle is given by :

$$D = \frac{RB}{RA + 2RB}$$

Figure 4:

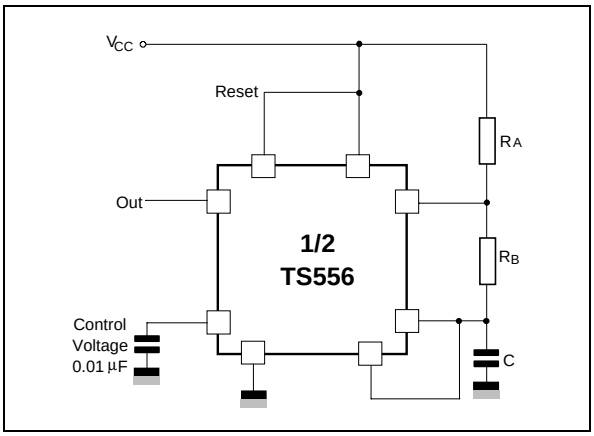
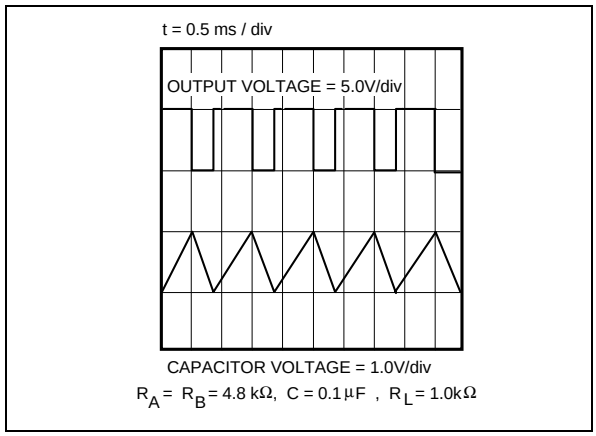
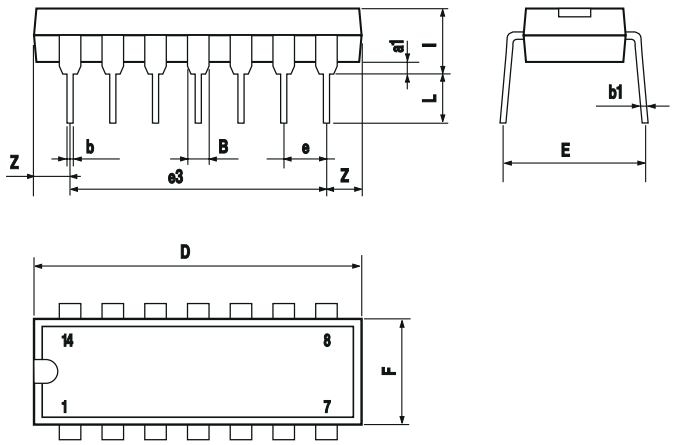


Figure 5:



PACKAGE MECHANICAL DATA

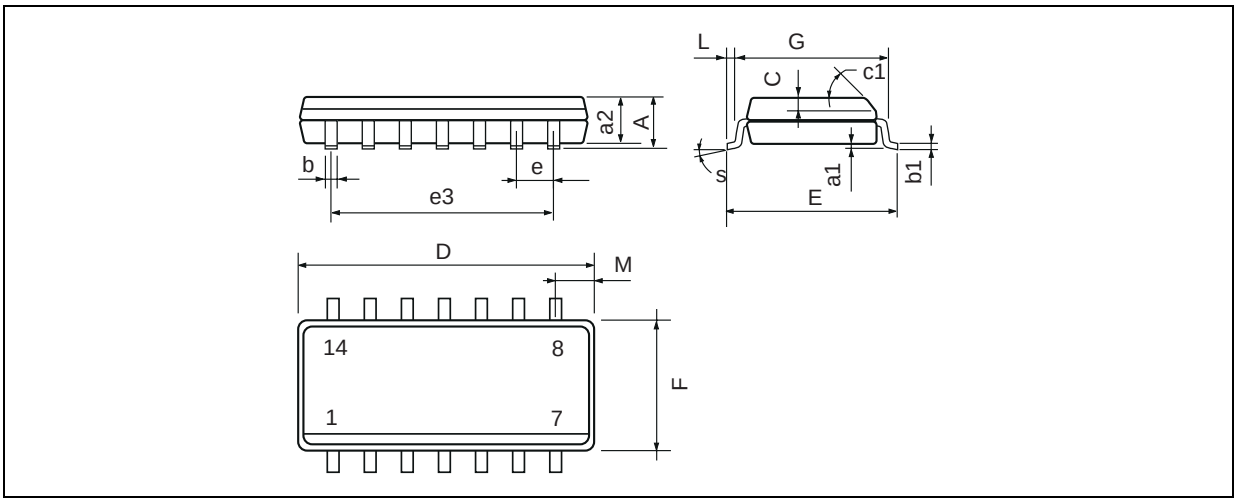
14 PINS - PLASTIC DIP



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	1.39		1.65	0.055		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		15.24			0.600	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z	1.27		2.54	0.050		0.100

PACKAGE MECHANICAL DATA

14 PINS - PLASTIC MICROPACKAGE (SO)



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.2	0.004		0.008
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1	45° (typ.)					
D (1)	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F (1)	3.8		4.0	0.150		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.020		0.050
M			0.68			0.027
S	8° (max.)					

Note : (1) D and F do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.066 inc) ONLY FOR DATA BOOK.

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