

| Order code | Manufacturer code | Description |
|------------|-------------------|-------------------------------------|
| 82-1052 | TS556CN | TS556CN DUAL CMOS TIMER DIL-14 (RC) |
| 82-1054 | TS556CD | TS556CD DUAL CMOS TIMER SO-14 (RC) |

| | |
|--|--------------------------|
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| The enclosed information is believed to be correct, Information may change 'without notice' due to product improvement. Users should ensure that the product is suitable for their use. E. & O. E. | Revision A 04/07/2003 |

LOW POWER DUAL CMOS TIMER

- VERY LOW POWER CONSUMPTION :
220 μ A typ at $V_{CC} = 5V$
180 μ A 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

DESCRIPTION

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

Thus, either in Monostable or Astable mode, timing remains very accurate.

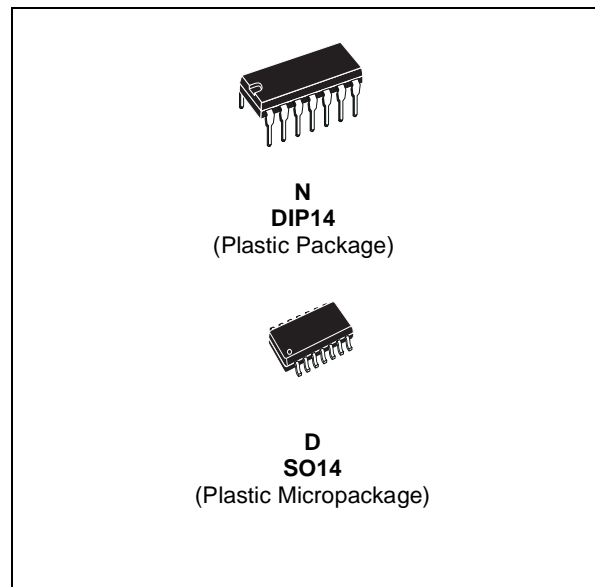
The TS556 provides reduced supply current spikes during output transitions, which enables the use of lower decoupling capacitors compared to those required by bipolar NE556.

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

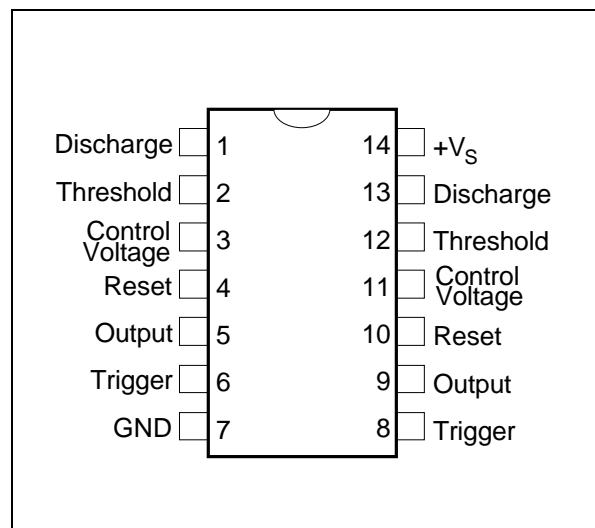
ORDER CODES

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

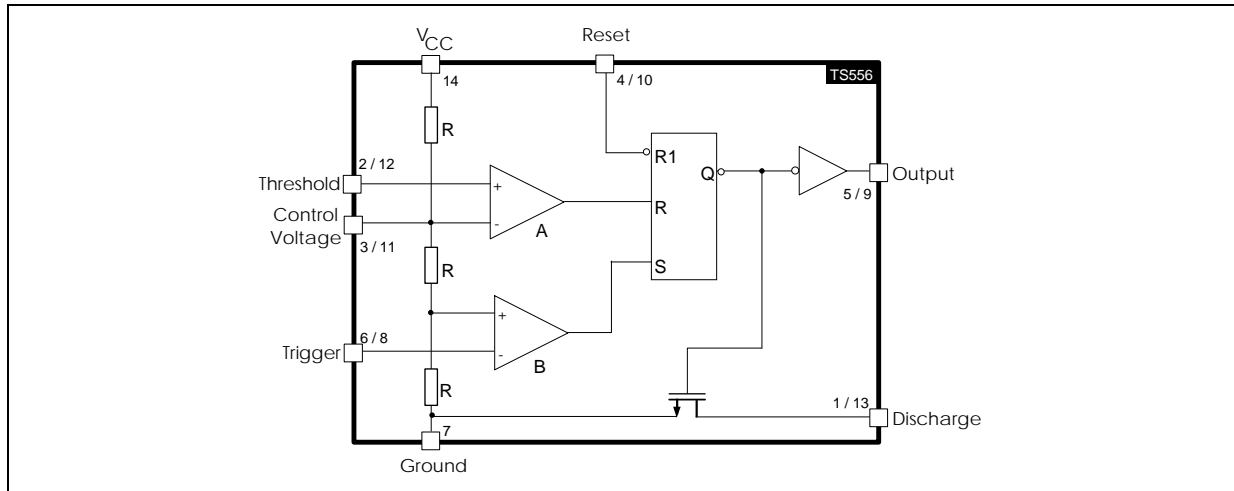
N = Dual in Line Package (DIP)
D = Small Outline Package (SO) - also available in Tape & Reel (DT)



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 \leq Min voltage specified
HIGH <-----> Level Voltage \geq Max voltage specified
x <-----> Irrelevant

ABSOLUTE MAXIMUM RATINGS

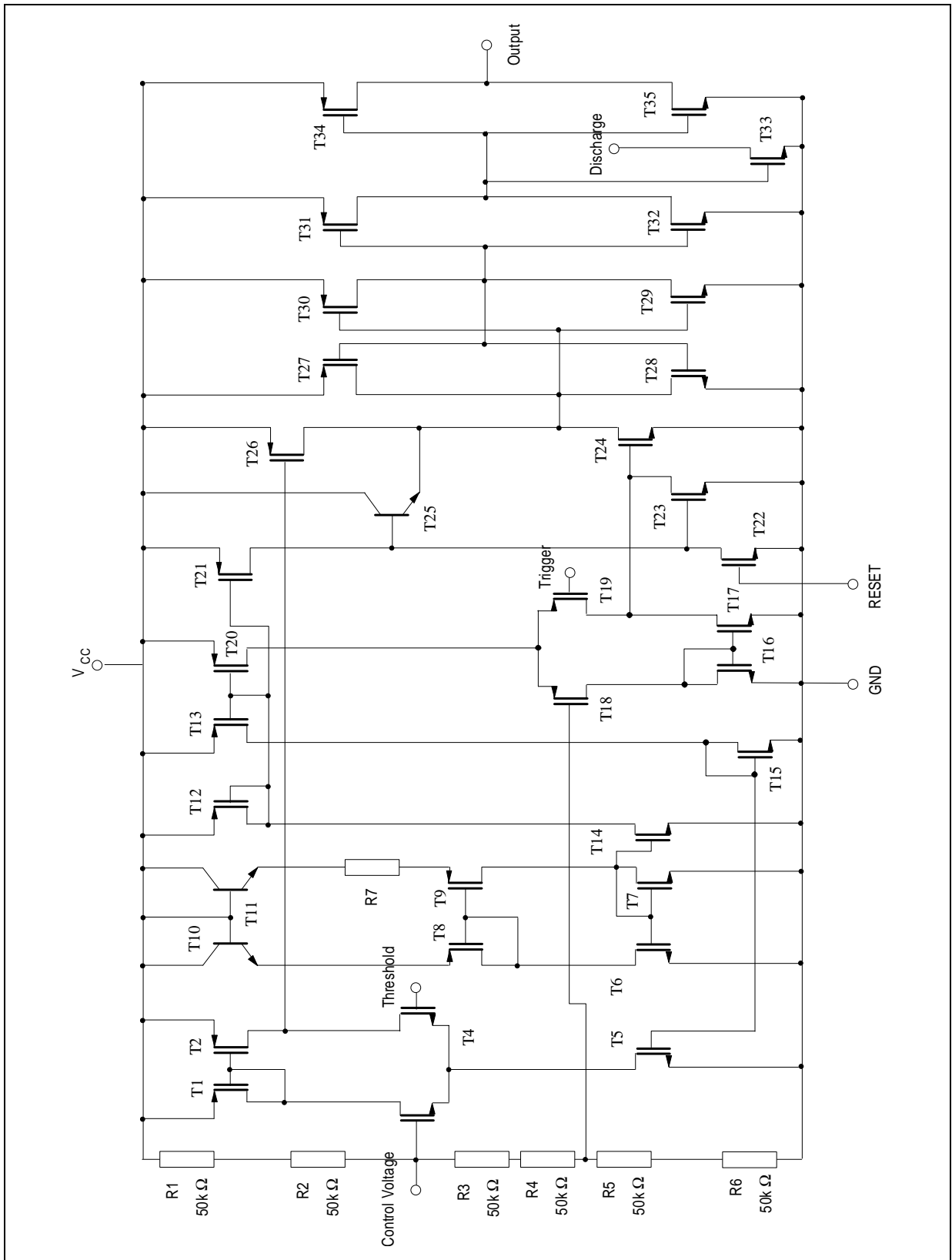
| Symbol | Parameter | Value | Unit |
|-----------|---------------------------------|------------------------------|-------------|
| V_{CC} | Supply Voltage | +18 | V |
| T_j | Junction Temperature | +150 | $^{\circ}C$ |
| T_{stg} | Storage Temperature Range | -65 to +150 | $^{\circ}C$ |
| P_D | Power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

1. $T_j = 150^{\circ}C$, $T_{amb} = 25^{\circ}C$ with $R_{thja} = 80^{\circ}C/W$ for DIP14 package
 $R_{thja} = 150^{\circ}C/W$ 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 0 to +70 TS556I -40 to +125 TS556M -55 to +125 | $^{\circ}C$ |

SCHEMATIC DIAGRAM (1/2 TS556)



STATIC ELECTRICAL CHARACTERISTICS

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

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

ELECTRICAL CHARACTERISTICS

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

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

DYNAMIC ELECTRICAL CHARACTERISTICS

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

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|-----------|---|------|--------|------|------------------|
| | Timing Accuracy (Monostable) ¹⁾ $R = 10k\Omega$, $C = 0.1\mu F$ $V_{CC}=+2V$ $V_{CC}=+3V$ | | 1 1 | | % |
| | Timing Shift with Supply Voltage Variations (Monostable) ¹⁾ $R = 10k\Omega$, $C = 0.1\mu F$, $V_{CC} = +3V \pm 0.3V$ | | 0.5 | | %/V |
| | Timing Shift with Temperature ¹⁾ $T_{min.} \leq T_{amb} \leq T_{max}$ | | 75 | | ppm/ $^{\circ}C$ |
| f_{max} | Maximum Astable Frequency ²⁾ $R_A = 470\Omega$, $R_B = 200\Omega$, $C = 200pF$ | | 2 | | MHz |
| | Astable Frequency Accuracy ²⁾ $R_A = R_B = 1k\Omega$ to $100k\Omega$, $C = 0.1\mu F$ | | 5 | | % |
| | Timing Shift with Supply Voltage Variations (Astable mode) ²⁾ $R_A = R_B = 10k\Omega$, $C = 0.1\mu F$, $V_{CC} = +3$ 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

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

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|-------------|--|--------------|------|--------------|---------|
| I_{CC} | Supply Current (no load, High and Low States) $T_{min.} \leq T_{amb} \leq T_{max.}$ | | 220 | 500 500 | μA |
| V_{CL} | Control Voltage Level $T_{min.} \leq T_{amb} \leq T_{max.}$ | 2.9 2.8 | 3.3 | 3.8 3.9 | V |
| V_{DIS} | Discharge Saturation Voltage ($I_{dis} = 10mA$) $T_{min.} \leq T_{amb} \leq T_{max.}$ | | 0.2 | 0.3 0.35 | V |
| I_{DIS} | Discharge Pin Leakage Current | | 1 | 100 | nA |
| V_{OL} | Low Level Output Voltage ($I_{sink} = 8mA$) $T_{min.} \leq T_{amb} \leq T_{max.}$ | | 0.3 | 0.6 0.8 | V |
| V_{OH} | High Level Output Voltage ($I_{source} = -2mA$) $T_{min.} \leq T_{amb} \leq T_{max.}$ | 4.4 4.4 | 4.6 | | V |
| V_{TRIG} | Trigger Voltage $T_{min.} \leq T_{amb} \leq T_{max.}$ | 1.36 1.26 | 1.67 | 1.96 2.06 | V |
| I_{TRIG} | Trigger Current | | 10 | | μA |
| I_{TH} | Threshold Current | | 10 | | μA |
| V_{RESET} | Reset Voltage $T_{min.} \leq T_{amb} \leq T_{max.}$ | 0.4 0.3 | 1.1 | 1.5 2.0 | V |
| I_{RESET} | Reset Current | | 10 | | μA |

DYNAMIC ELECTRICAL CHARACTERISTICS

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

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|-----------|---|------|------|------|------------------|
| | Timing Accuracy (Monostable) ¹⁾ $R = 10k\Omega$, $C = 0.1\mu F$ | | 2 | | % |
| | Timing Shift with Supply Voltage Variations (Monostable) ¹⁾ $R = 10k\Omega$, $C = 0.1\mu F$, $V_{CC} = +5V \pm 1V$ | | 0.38 | | %/V |
| | Timing Shift with Temperature ¹⁾ $T_{min.} \leq T_{amb} \leq T_{max.}$ | | 75 | | ppm/ $^{\circ}C$ |
| f_{max} | Maximum Astable Frequency ²⁾ $R_A = 470\Omega$, $R_B = 200\Omega$, $C = 200pF$ | | 2.7 | | MHz |
| | Astable Frequency Accuracy ²⁾ $R_A = R_B = 1k\Omega$ to $100k\Omega$, $C = 0.1\mu F$ | | 3 | | % |
| | Timing Shift with Supply Voltage Variations (Astable mode) ²⁾ $R_A = R_B = 1k\Omega$ to $100k\Omega$, $C = 0.1\mu F$, $V_{CC} = +5$ 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 $V_{CC} = +12V$, $T_{amb} = +25^{\circ}C$, Reset to V_{CC} (unless otherwise specified)

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|-------------|---|--------------|------|------------|---------|
| I_{CC} | Supply Current (no load, High and Low States) $T_{min.} \leq T_{amb} \leq T_{max.}$ | | 340 | 800 800 | μA |
| V_{CL} | Control Voltage Level $T_{min.} \leq T_{amb} \leq T_{max.}$ | 7.4 7.3 | 8 | 8.6 8.7 | V |
| V_{DIS} | Discharge Saturation Voltage ($I_{dis} = 80mA$) $T_{min.} \leq T_{amb} \leq T_{max.}$ | | 0.09 | 1.6 2.0 | V |
| I_{DIS} | Discharge Pin Leakage Current | | 1 | 100 | nA |
| V_{OL} | Low Level Output Voltage ($I_{sink} = 50mA$) $T_{min.} \leq T_{amb} \leq T_{max.}$ | | 1.2 | 2 2.8 | V |
| V_{OH} | High Level Output Voltage ($I_{source} = -10mA$) $T_{min.} \leq T_{amb} \leq T_{max.}$ | 10.5 10.5 | 11 | | V |
| V_{TRIG} | Trigger Voltage $T_{min.} \leq T_{amb} \leq T_{max.}$ | 3.2 3.1 | 4 | 4.8 4.9 | V |
| I_{TRIG} | Trigger Current | | 10 | | μA |
| I_{TH} | Threshold Current | | 10 | | μA |
| V_{RESET} | Reset Voltage $T_{min.} \leq T_{amb} \leq T_{max.}$ | 0.4 0.3 | 1.1 | 1.5 2.0 | V |
| I_{RESET} | Reset Current | | 10 | | μA |

DYNAMIC ELECTRICAL CHARACTERISTICS $V_{CC} = +12V$, $T_{amb} = +25^{\circ}C$, Reset to V_{CC} (unless otherwise specified)

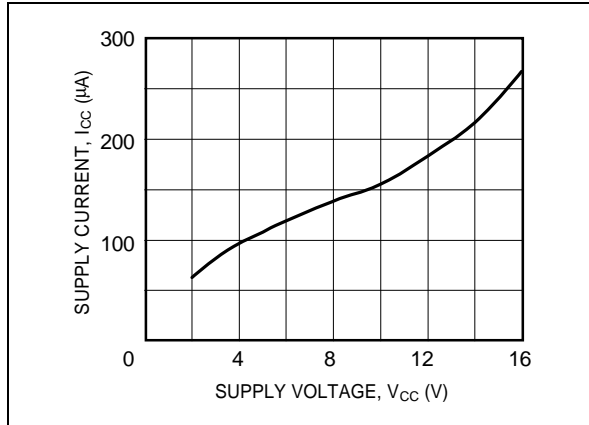
| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|-----------|--|------|------|------|------------------|
| | Timing Accuracy (Monostable) ¹⁾ $R = 10k\Omega$, $C = 0.1\mu F$ | | 4 | | % |
| | Timing Shift with Supply Voltage Variations (Monostable) $R = 10k\Omega$, $C = 0.1\mu F$, $V_{CC} = +5V \pm 1V$ | | 0.38 | | %/V |
| | Timing Shift with Temperature $T_{min.} \leq T_{amb} \leq T_{max.}$, $V_{CC} = +5V$ | | 75 | | ppm/ $^{\circ}C$ |
| f_{max} | Maximum Astable Frequency $R_A = 470\Omega$, $R_B = 200\Omega$, $C = 200pF$, $V_{CC} = +5V$ | | 2.7 | | MHz |
| | Astable Frequency Accuracy ²⁾ $R_A = R_B = 1k\Omega$ to $100k\Omega$, $C = 0.1\mu F$ | | 3 | | % |
| | Timing Shift with Supply Voltage Variations (Astable mode) $R_A = R_B = 1k\Omega$ to $100k\Omega$, $C = 0.1\mu F$, $V_{CC} = 5$ to $+12V$ | | 0.1 | | %/V |

1. see figure 2

2. see figure 4

TYPICAL CHARACTERISTICS

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

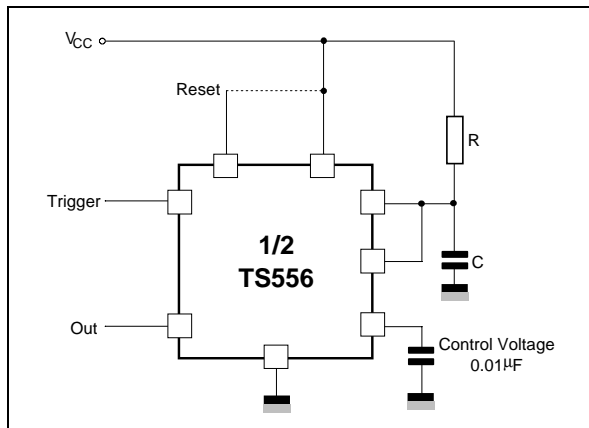


APPLICATION INFORMATION

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 $t = 1.1 R \times C$.

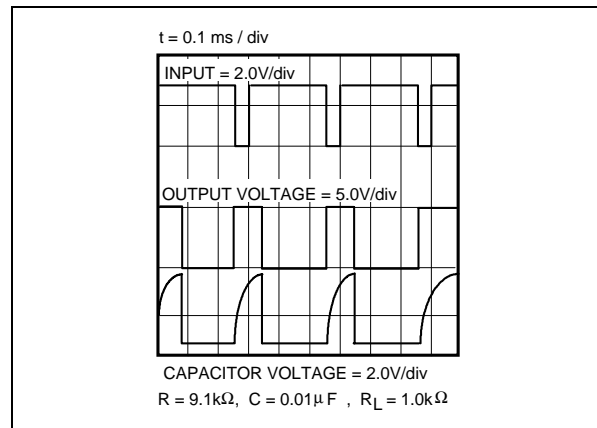
It can be noticed that since the charge rate and the threshold level of the comparator are both directly proportional to the supply voltage, the timing interval is independent of the supply. Applying a negative pulse simultaneously to the Reset terminal (pin 4) and the Trigger terminal (pin 2) during 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 $\tau = R \times C$. 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 :



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 4:

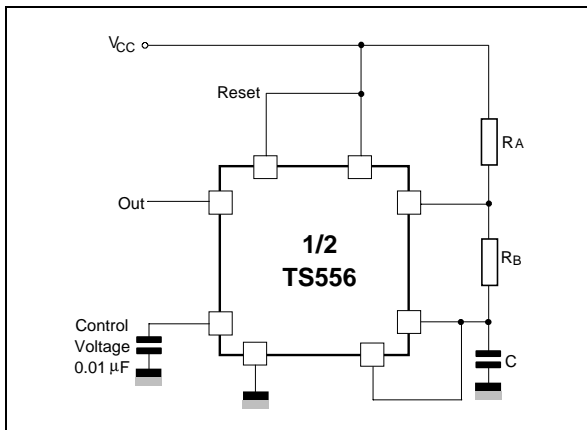


Figure 5 shows actual waveforms generated in this mode of operation.

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 :

$$T = t1 + t2 = 0.693 (R_A + 2R_B) C$$

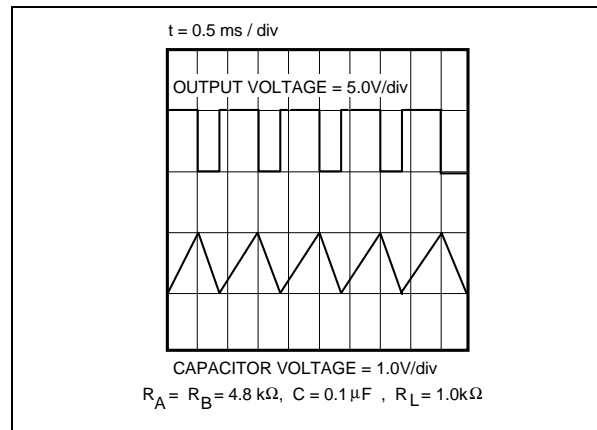
The frequency of oscillation is then :

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

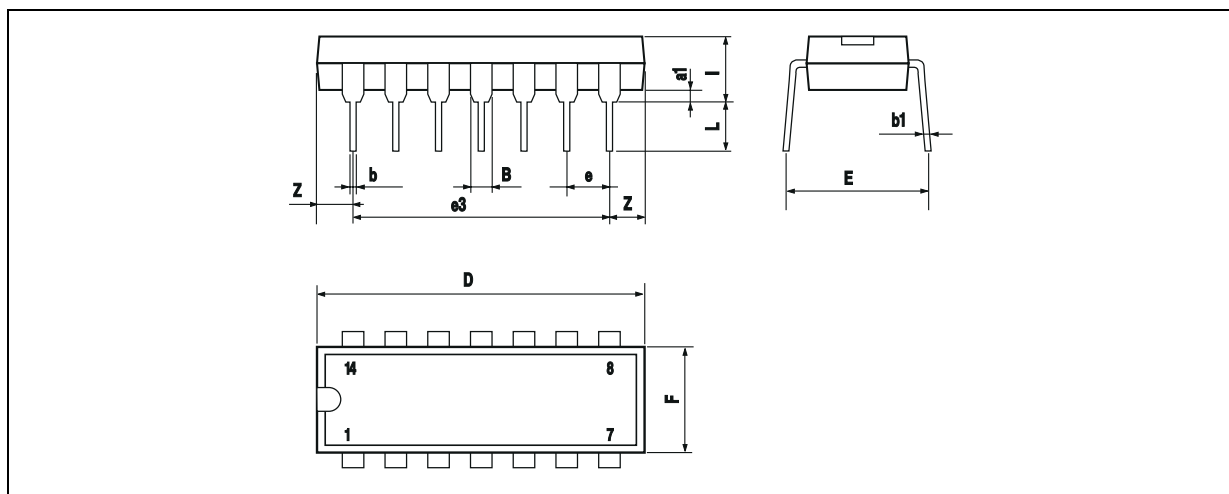
The duty cycle is given by :

$$D = \frac{R_B}{R_A + 2R_B}$$

Figure 5:

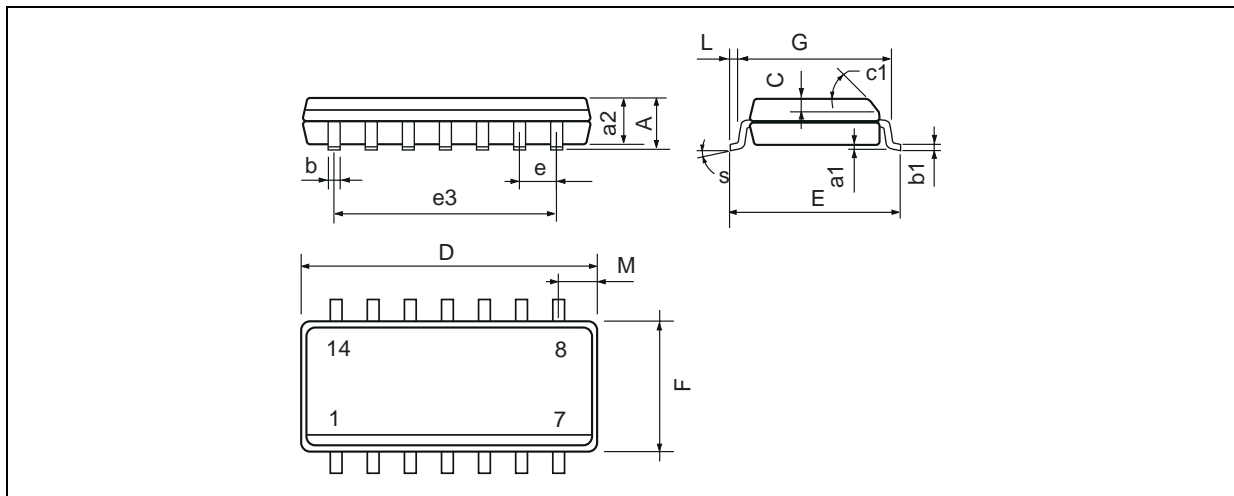


PACKAGE MECHANICAL DATA
14 PINS - PLASTIC DIP



| 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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