# DUAL PRECISION MONOSTABLE MULTIVIBRATOR

The HEF4538B is a dual retriggerable-resettable monostable multivibrator. Each multivibrator has an active LOW trigger/retrigger input ($\overline{I}_0$), an active HIGH trigger/retrigger input ($I_1$), an overriding active LOW direct reset input ($\overline{C}_D$), an output (O) and its complement ($\overline{O}$), and two pins ($C_{TC}$,* $RC_{TC}$) for connecting the external timing components $C_t$ and $R_t$. Typical pulse width variation over temperature range is ± 0,2%.

The HEF4538B may be triggered by either the positive or the negative edges of the input pulse and will produce an accurate output pulse with a pulse width range of 10 μs to infinity. The duration and accuracy of the output pulse are determined by the external timing components $C_t$ and $R_t$. The output pulse width (T) is equal to $R_t \times C_t$. The linear design techniques in LOCMOS guarantee precise control of the output pulse width.

A LOW level at $\overline{CE}$ terminates the output pulse immediately.

Schmitt-trigger action in the trigger inputs makes the circuit highly tolerant to slower rise and fall times.

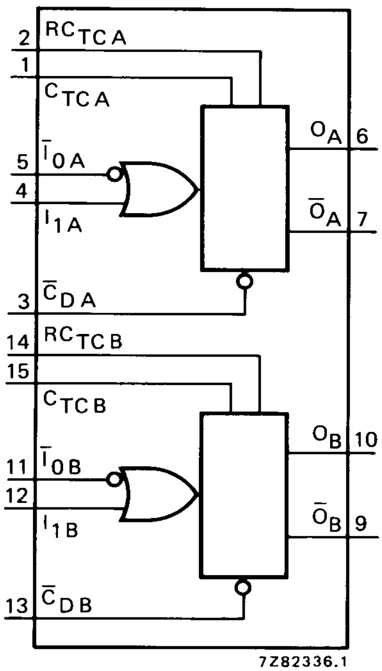



Fig. 1 Functional diagram.

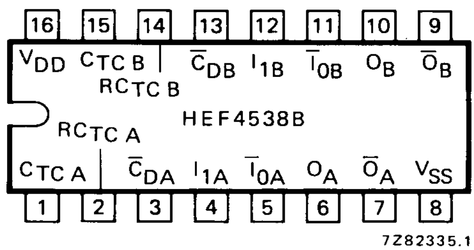



Fig. 2 Pinning diagram.

HEF4538BP : 16-lead DIL; plastic (SOT-38Z).
HEF4538BD: 16-lead DIL; ceramic (cerdip) (SOT-74).
HEF4538BT : 16-lead mini-pack; plastic (SO-16; SOT-109A).

**PINNING**

| | |
|---|---|
| $\overline{I}_{0A}$, $\overline{I}_{0B}$ | input (HIGH to LOW triggered) |
| $I_{1A}$, $I_{1B}$ | input (LOW to HIGH triggered) |
| $\overline{C}_{DA}$, $\overline{C}_{DB}$ | direct reset input (active LOW) |
| $O_A$, $O_B$ | output |
| $\overline{O}_A$, $\overline{O}_B$ | complementary output (active LOW) |
| $C_{TC\,A}$, $C_{TC\,B}$ | external capacitor connections* |
| $RC_{TC\,A}$, $RC_{TC\,B}$ | external capacitor/ resistor connections |

* Always connected to ground.

**FAMILY DATA; $I_{DD}$ LIMITS category MSI:** see Family specifications.

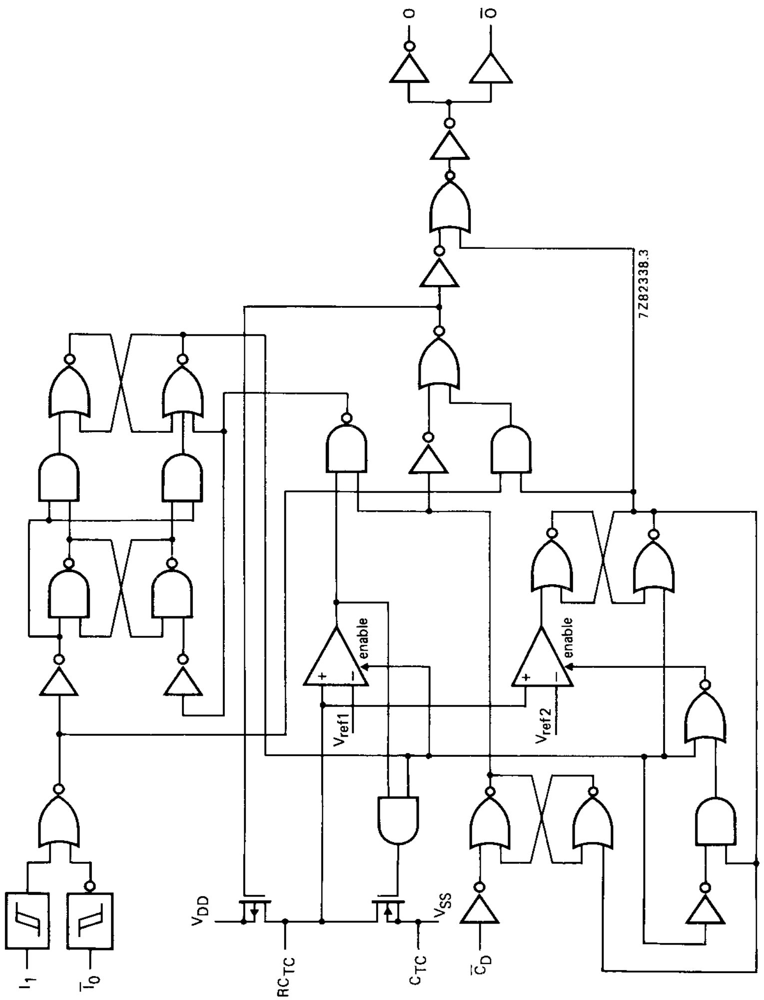



Fig. 3 Logic diagram.

## FUNCTION TABLE

| inputs | | | outputs | |
|---|---|---|---|---|
| $\overline{I}_0$ | $I_1$ | $\overline{C}_D$ | O | $\overline{O}$ |
| ╲ | L | H | ⊓ | ⊔ |
| H | ╱ | H | ⊓ | ⊔ |
| X | X | L | L | H |

H = HIGH state (the more positive voltage)
L = LOW state (the less positive voltage)
X = state is immaterial
╱ = positive-going transition
╲ = negative-going transition
⊓ = positive output pulse
⊔ = negative output pulse

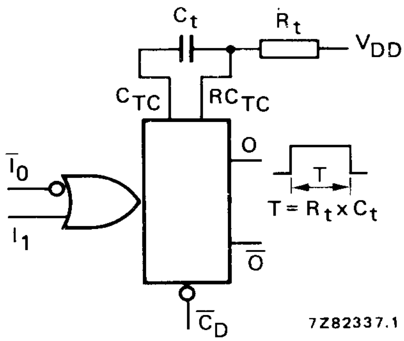



Fig. 4 Connection of the external timing components $R_t$ and $C_t$.

## D.C. CHARACTERISTICS

$V_{SS} = 0$ V

| | $V_{DD}$ V | symbol | $T_{amb}$ (°C) −40 typ. | −40 max. | +25 typ. | +25 max. | +85 typ. | +85 max. | |
|---|---|---|---|---|---|---|---|---|---|
| Supply current active state (see note) | 5 | $I_D$ | | | 55 | | | | μA |
| | 10 | | | | 150 | | | | μA |
| | 15 | | | | 220 | | | | μA |
| Input leakage current (pins 2 and 14) | 15 | $\pm I_{IN}$ | | | | 300 | | 1000 | nA |

Note
Only one monostable is switching: current present during output pulse (output O is HIGH).

## A.C. CHARACTERISTICS

$V_{SS}$ = 0 V; $T_{amb}$ = 25 °C; $C_L$ = 50 pF; input transition times ≤ 20 ns

| | $V_{DD}$ V | symbol | min. | typ. | max. | | typical extrapolation formula |
|---|---|---|---|---|---|---|---|
| Propagation delays | | | | | | | |
| $\overline{I}_0, I_1 \rightarrow O$ | 5 | | | 200 | 460 | ns | 173 ns + (0,55 ns/pF) $C_L$ |
| HIGH to LOW | 10 | $t_{PHL}$ | | 90 | 180 | ns | 79 ns + (0,23 ns/pF) $C_L$ |
| | 15 | | | 60 | 120 | ns | 52 ns + (0,16 ns/pF) $C_L$ |
| $\overline{I}_0, I_1 \rightarrow \overline{O}$ | 5 | | | 220 | 440 | ns | 193 ns + (0,55 ns/pF) $C_L$ |
| LOW to HIGH | 10 | $t_{PLH}$ | | 85 | 190 | ns | 74 ns + (0,23 ns/pF) $C_L$ |
| | 15 | | | 60 | 120 | ns | 52 ns + (0,16 ns/pF) $C_L$ |
| $\overline{C}_D \rightarrow O$ | 5 | | | 125 | 250 | ns | 98 ns + (0,55 ns/pF) $C_L$ |
| HIGH to LOW | 10 | $t_{PHL}$ | | 55 | 110 | ns | 44 ns + (0,23 ns/pF) $C_L$ |
| | 15 | | | 40 | 80 | ns | 32 ns + (0,16 ns/pF) $C_L$ |
| $\overline{C}_D \rightarrow \overline{O}$ | 5 | | | 125 | 250 | ns | 98 ns + (0,55 ns/pF) $C_L$ |
| LOW to HIGH | 10 | $t_{PLH}$ | | 55 | 110 | ns | 44 ns + (0,23 ns/pF) $C_L$ |
| | 15 | | | 40 | 80 | ns | 32 ns + (0,16 ns/pF) $C_L$ |
| Recovery times | 5 | | | 20 | 40 | ns | |
| $\overline{C}_D \rightarrow \overline{I}_0, I_1$ | 10 | $t_{RCD}$ | | 10 | 20 | ns | |
| | 15 | | | 5 | 10 | ns | |
| Retrigger times | 5 | | 0 | | | ns | |
| $O, \overline{O} \rightarrow \overline{I}_0, I_1$ | 10 | $t_{RO}$ | 0 | | | ns | |
| | 15 | | 0 | | | ns | |
| Minimum $\overline{I}_0$ | 5 | | 90 | 45 | | ns | |
| pulse width; LOW | 10 | $t_{WI0L}$ | 30 | 15 | | ns | |
| | 15 | | 24 | 12 | | ns | |
| Minimum $I_1$ | 5 | | 50 | 25 | | ns | |
| pulse width; HIGH | 10 | $t_{WI1H}$ | 24 | 12 | | ns | |
| | 15 | | 20 | 10 | | ns | |
| Minimum $\overline{C}_D$ | 5 | | 55 | 25 | | ns | |
| pulse width; LOW | 10 | $t_{WCDL}$ | 25 | 12 | | ns | |
| | 15 | | 20 | 10 | | ns | |
| Output O or $\overline{O}$ | 5 | | 218 | 230 | 242 | μs | |
| pulse width | 10 | $t_{WO}$ | 213 | 224 | 235 | μs | $R_t$ = 100 kΩ; $C_t$ = 0,002 μF |
| | 15 | | 211 | 223 | 234 | μs | |
| Output O or $\overline{O}$ | 5 | | 10,3 | 10,8 | 11,3 | ms | |
| pulse width | 10 | $t_{WO}$ | 10,2 | 10,7 | 11,2 | ms | $R_t$ = 100 kΩ; $C_t$ = 0,1 μF |
| | 15 | | 10,1 | 10,6 | 11,1 | ms | |
| Output O or $\overline{O}$ | 5 | | 1,01 | 1,09 | 1,11 | s | |
| pulse width | 10 | $t_{WO}$ | 0,99 | 1,04 | 1,09 | s | $R_t$ = 100 kΩ; $C_t$ = 10 μF |
| | 15 | | 0,99 | 1,04 | 1,09 | s | |

## A.C. CHARACTERISTICS

$V_{SS}$ = 0 V; $T_{amb}$ = 25 °C; $C_L$ = 50 pF; input transition times ≤ 20 ns

| | $V_{DD}$ V | symbol | min. | typ. | max. | | |
|---|---|---|---|---|---|---|---|
| Change in output O pulse width over temperature ($T_{amb}$) | 5<br>10<br>15 | $\Delta t_{WO}$ | | ± 0,2<br>± 0,2<br>± 0,2 | | %<br>%<br>% | |
| Change in output O pulse width over $V_{DD}$ range 5 to 15 V | | $\Delta t_{WO}$ | | ± 1,5 | | % | |
| Pulse width variation between circuits in same package | 5<br>10<br>15 | $\Delta t_{WO}$ | | ± 1<br>± 1<br>± 1 | | %<br>%<br>% | $R_t$ = 100 kΩ<br>$C_t$ = 2 nF to 10 μF |
| External timing resistor | | $R_t$ | 5 | – | * | kΩ | |
| External timing capacitor | | $C_t$ | 2000 | – | no limits | pF | |
| Input capacitance (pin 2 or 14) | | $C_{IN}$ | | 15 | | pF | |

* The maximum permissible resistance $R_t$, which holds the specified accuracy of $t_{WO}$, depends on the leakage current of the capacitor $C_t$ and the leakage of the HEF4538B.

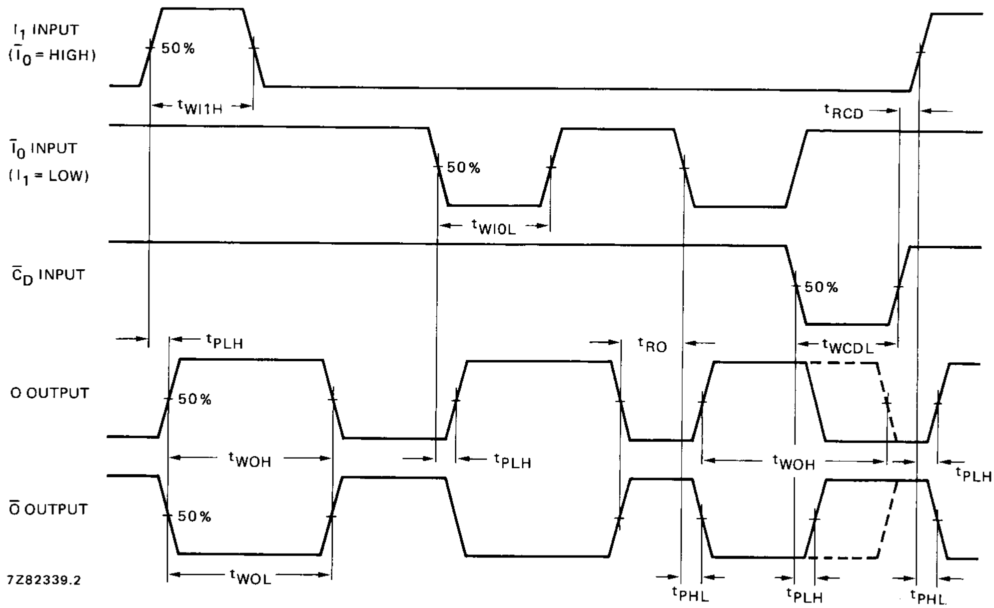
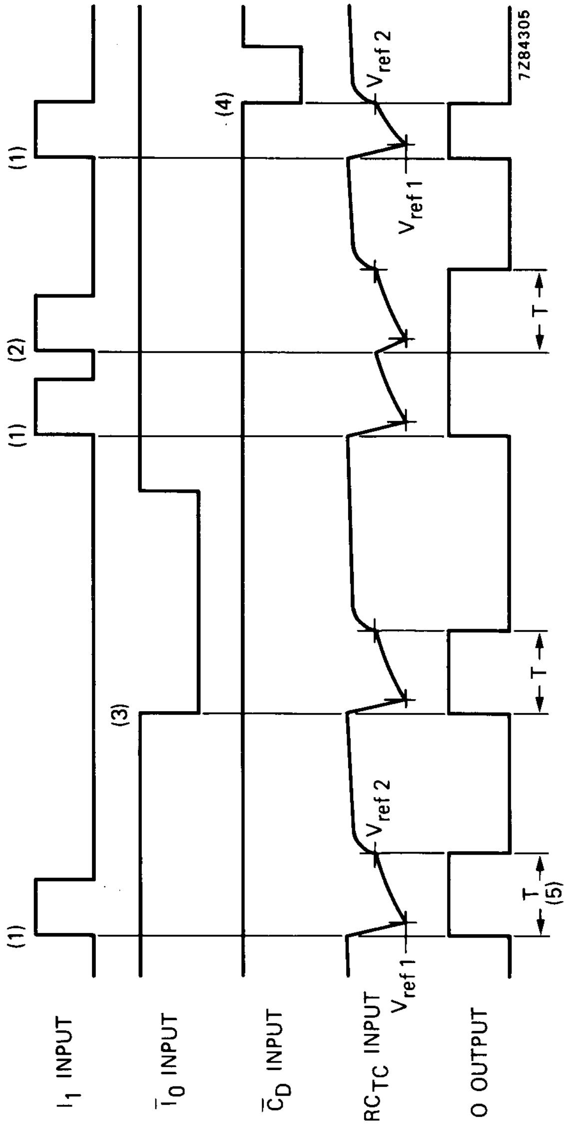
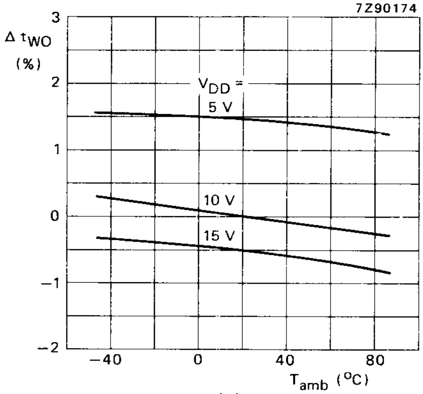



Fig. 5 Waveforms showing minimum $\bar{I}_0$, $I_1$, O and $\bar{C}_D$ pulse widths, recovery times and propagation delays.

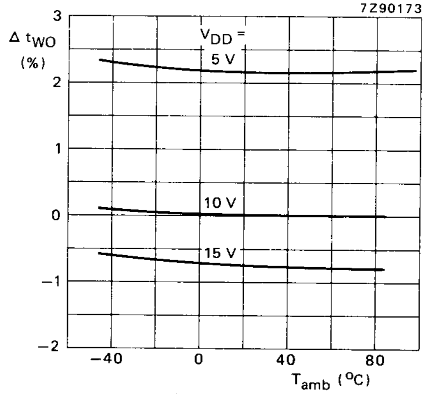



(1) Positive edge triggering.
(2) Positive edge re-triggering (pulse lengthening).
(3) Negative edge triggering.
(4) Reset (pulse shortening).
(5) $T = R_t \times C_t$.

Fig. 6 Timing diagram.




(a)




(b)

Fig. 7 Typical normalized change in output pulse width as a function of ambient temperature; 0% at $V_{DD}$ = 10 V and $T_{amb}$ = 25 °C.
(a) $R_t$ = 100 kΩ; $C_t$ = 100 nF. (b) $R_t$ = 100 kΩ; $C_t$ = 2 nF.

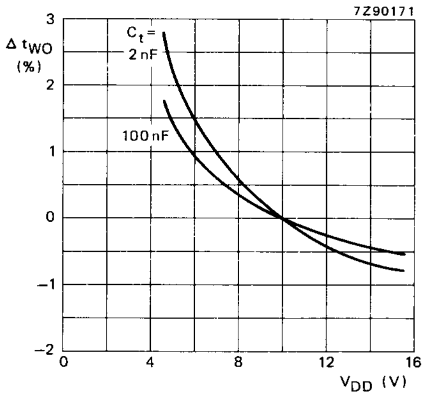



Fig. 8 Typical normalized change in output pulse width as a function of the supply voltage at $T_{amb}$ = 25 °C; 0% at $V_{DD}$ = 10 V; $R_t$ = 100 kΩ.

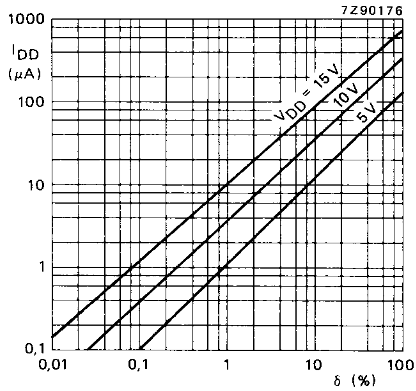



Fig. 9 Total supply current as a function of the output duty factor; $R_t$ = 100 kΩ; $C_t$ = 100 nF; $C_L$ = 50 pF. One monostable multivibrator switching only.