



## DUAL MONOSTABLE MULTIVIBRATOR

- RETRIGGERABLE/RESETTABLE CAPABILITY
- TRIGGER AND RESET PROPAGATION DELAYS INDEPENDENT OF  $R_X$ ,  $C_X$
- TRIGGERING FROM LEADING OR TRAILING EDGE
- Q AND  $\bar{Q}$  BUFFERED OUTPUT AVAILABLE
- SEPARATE RESETS
- WIDE RANGE OF OUTPUT PULSE WIDTHS
- QUIESCENT CURRENT SPECIFIED UP TO 20V
- 5V, 10V AND 15V PARAMETRIC RATINGS
- SCHMITT TRIGGER INPUT ALLOWS UNLIMITED RISE AND FALL TIMES ON +TR AND -TR INPUTS
- INPUT LEAKAGE CURRENT  
 $I_l = 100\text{nA (MAX) AT } V_{DD} = 18\text{V } T_A = 25^\circ\text{C}$
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC JESD13B "STANDARD SPECIFICATIONS FOR DESCRIPTION OF B SERIES CMOS DEVICES"



### ORDER CODES

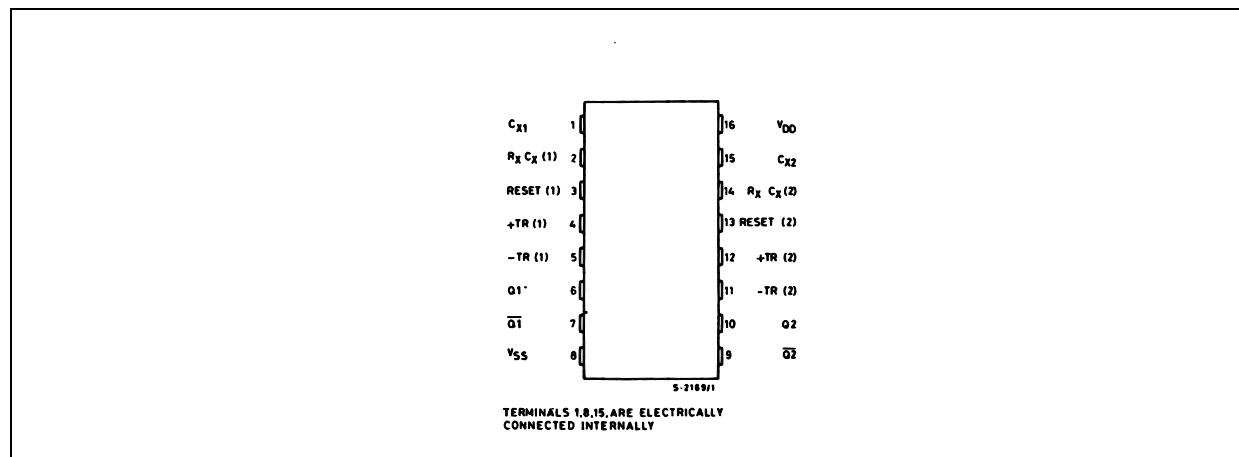
| PACKAGE | TUBE       | T & R         |
|---------|------------|---------------|
| DIP     | HCF4538BEY |               |
| SOP     | HCF4538BM1 | HCF4538M013TR |

### DESCRIPTION

The HCF4538B is a monolithic integrated circuit fabricated in Metal Oxide Semiconductor technology available in DIP and SOP packages. The HCF4538B dual precision monostable multivibrator provides stable retriggerable/resettable one-shot operation for any fixed voltage

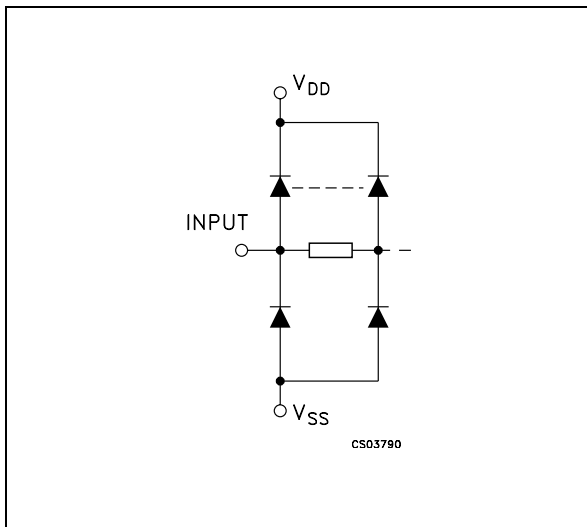
timing application. An external resistor ( $R_X$ ) and an external capacitor ( $C_X$ ) control the timing and accuracy for the circuit. Adjustment of  $R_X$  and  $C_X$  provides a wide range of output pulse widths from the Q and  $\bar{Q}$  terminals. The time delay from trigger input to output transition (trigger propagation delay) and the time delay from reset input to output transition (reset propagation delay) and the time delay from reset input to output transition (reset propagation delay) are independent of  $R_X$  and  $C_X$ . Precision control of output pulse width is achieved through linear CMOS techniques. Leading edge triggering (+TR) and trailing edge triggering (-TR) inputs are provided for triggering

### PIN CONNECTION



from either edge of an input pulse. An unused +TR input should be tied to  $V_{SS}$ . An unused -TR input should be tied to  $V_{DD}$ . A RESET (on low level) is provided for immediate termination of the output pulse or to prevent output pulses when power is turned on. An unused RESET input should be tied to  $V_{DD}$ . However, if an entire section of the HCF4538B is not used, its inputs must be tied to either  $V_{DD}$  or  $V_{SS}$  (see table 1). In normal operation the circuit triggers (extends the output

**IINPUT EQUIVALENT CIRCUIT**



pulse one period) on the application of each new trigger pulse. For operation in the non-retiggerable mode,  $\bar{Q}$  is connected to -TR when leading edge triggering (+TR) is used or Q is connected to +TR when trailing edge triggering (-TR) is used. The time period (T) for this multivibrator can be calculated by :  $T = R_X C_X$ . The min. value of external resistance,  $R_X$ , is 4K $\Omega$ . The max. and min. values of external capacitance,  $C_X$ , are 100  $\mu$ F and 5nF, respectively.

**PIN DESCRIPTION**

| PIN No | SYMBOL               | NAME AND FUNCTION                            |
|--------|----------------------|----------------------------------------------|
| 4, 12  | +TR                  | Trigger Inputs (Low to High, Edge-Triggered) |
| 5, 11  | -TR                  | Trigger Inputs (High to Low, Edge-Triggered) |
| 3, 13  | RESET                | Direct Reset Inputs (Active Low)             |
| 1, 15  | $C_X1, C_X2$         | External Capacitor Connections               |
| 2, 14  | $R_X C_X1, R_X C_X2$ | External Resistor/Capacitor Connections      |
| 6, 10  | Q1, Q2               | Pulse Outputs                                |
| 7, 9   | $\bar{Q}1, \bar{Q}2$ | Complementary Pulse Outputs                  |
| 8      | $V_{SS}$             | Negative Supply Voltage                      |
| 16     | $V_{DD}$             | Positive Supply Voltage                      |

Terminals 1, 8, 15 are electrically connected internally

**FUNCTIONAL DIAGRAM**

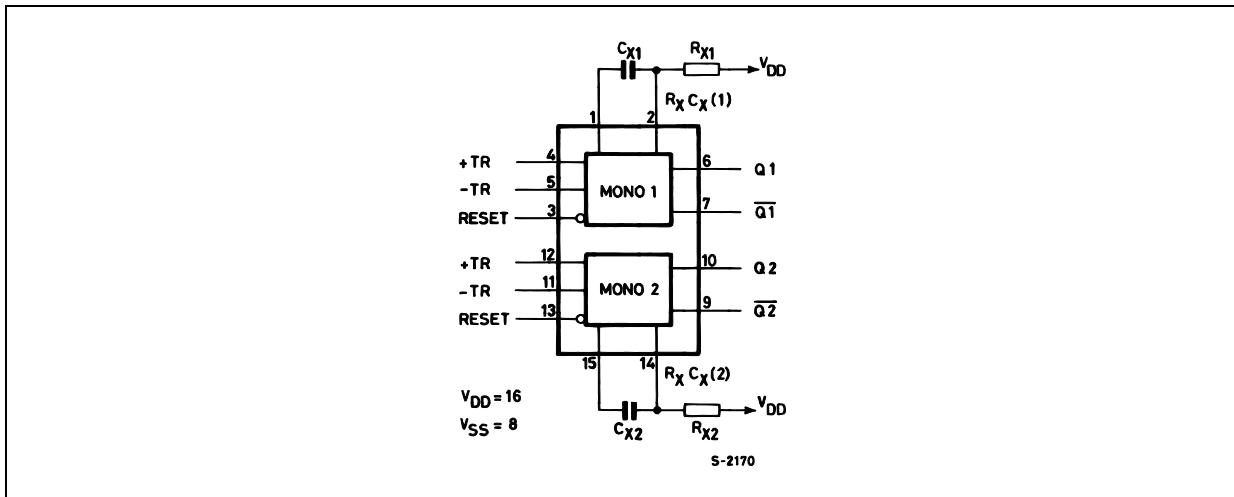


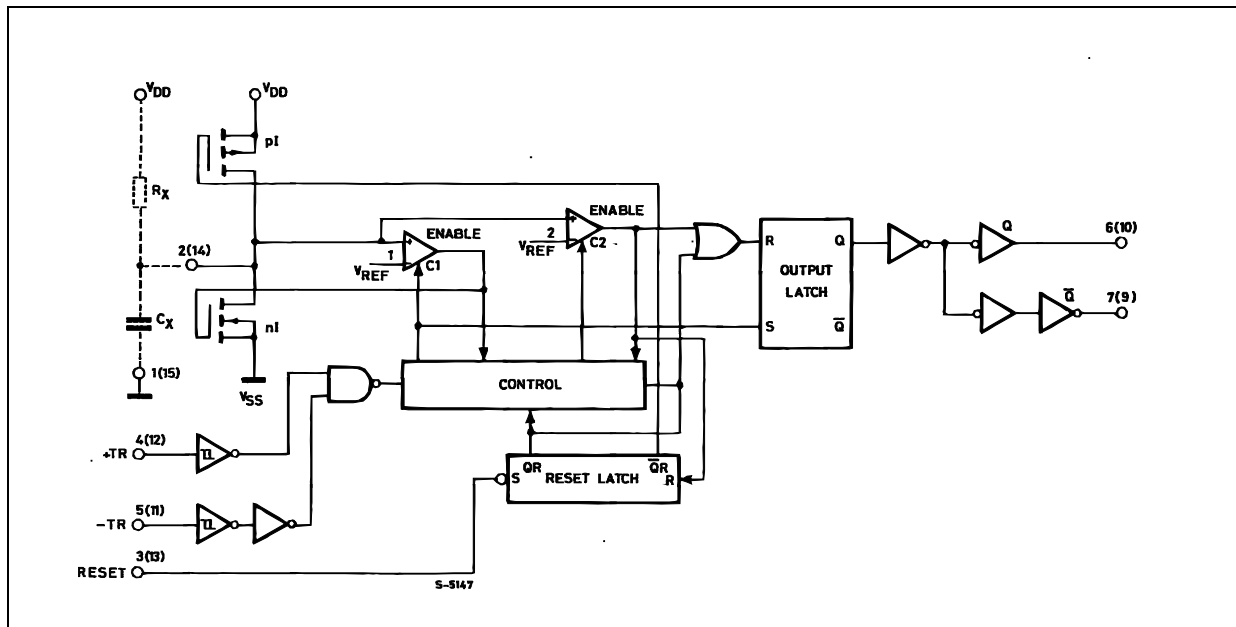
TABLE 1 : Functional Terminal Connections

| FUNCTION                                | V <sub>DD</sub> to Term. N° |          | V <sub>SS</sub> to Term. N° |          | Input Pulse to Term. N° |          | Other Connections |          |
|-----------------------------------------|-----------------------------|----------|-----------------------------|----------|-------------------------|----------|-------------------|----------|
|                                         | Mono (1)                    | Mono (2) | Mono (1)                    | Mono (2) | Mono (1)                | Mono (2) | Mono (1)          | Mono (2) |
| Leading Edge Trigger/Retriggerable      | 3, 5                        | 11, 13   |                             |          | 4                       | 12       |                   |          |
| Leading Edge Trigger/Non Retriggerable  | 3                           | 13       |                             |          | 4                       | 12       | 5, 7              | 11, 9    |
| Trailing Edge Trigger/Retriggerable     | 3                           | 13       | 4                           | 12       | 5                       | 11       |                   |          |
| Trailing Edge Trigger/Non Retriggerable | 3                           | 13       |                             |          | 5                       | 11       | 4, 6              | 12, 10   |

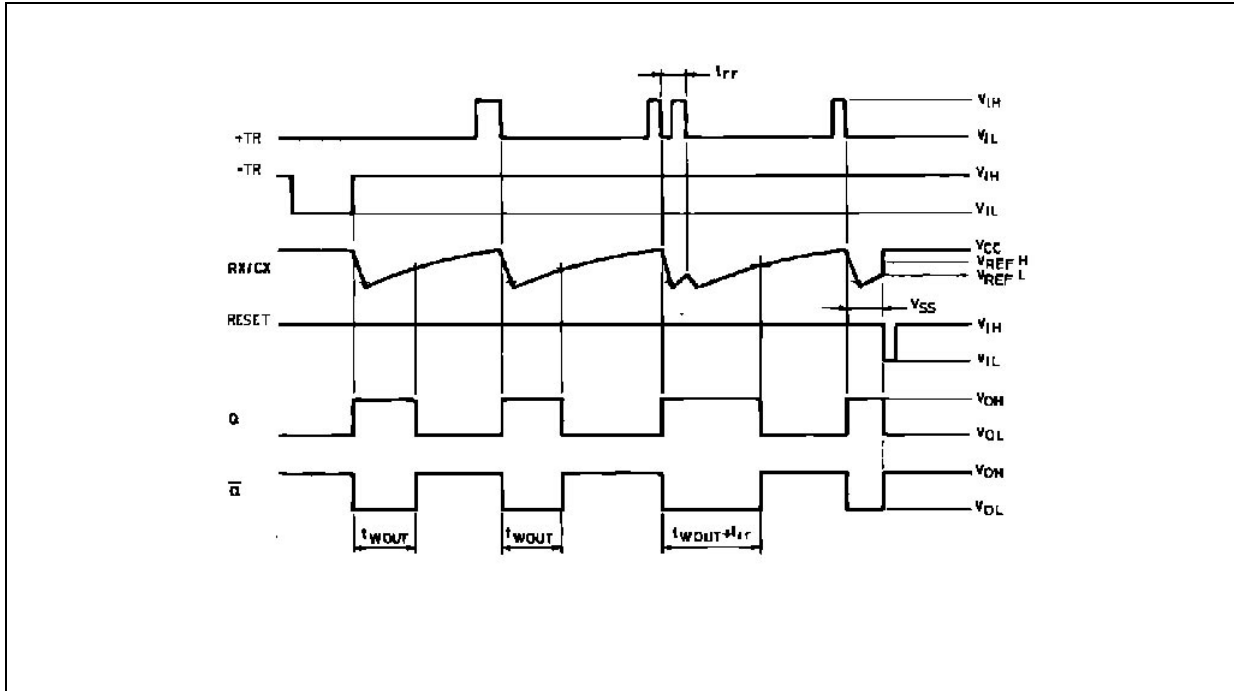
A Retriggerable one-shot multivibrator has an output pulse width which is extended on full time period (T) after application of the last trigger pulse.

A Non-Retriggerable one-shot multivibrator has a time period (T) referenced from the application of the first trigger pulse.

LOGIC DIAGRAM



LOGIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

| Symbol    | Parameter                               | Value                  | Unit        |
|-----------|-----------------------------------------|------------------------|-------------|
| $V_{DD}$  | Supply Voltage                          | -0.5 to +22            | V           |
| $V_I$     | DC Input Voltage                        | -0.5 to $V_{DD} + 0.5$ | V           |
| $I_I$     | DC Input Current                        | $\pm 10$               | mA          |
| $P_D$     | Power Dissipation per Package           | 200                    | mW          |
|           | Power Dissipation per Output Transistor | 100                    | mW          |
| $T_{op}$  | Operating Temperature                   | -55 to +125            | $^{\circ}C$ |
| $T_{stg}$ | Storage Temperature                     | -65 to +150            | $^{\circ}C$ |

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

All voltage values are referred to  $V_{SS}$  pin voltage.

RECOMMENDED OPERATING CONDITIONS

| Symbol   | Parameter             | Value         | Unit        |
|----------|-----------------------|---------------|-------------|
| $V_{DD}$ | Supply Voltage        | 3 to 20       | V           |
| $V_I$    | Input Voltage         | 0 to $V_{DD}$ | V           |
| $T_{op}$ | Operating Temperature | -55 to 125    | $^{\circ}C$ |

## DC SPECIFICATIONS

| Symbol          | Parameter                 | Test Condition        |                       |                                 |                        | Value                 |               |           |             |         |              | Unit    |         |
|-----------------|---------------------------|-----------------------|-----------------------|---------------------------------|------------------------|-----------------------|---------------|-----------|-------------|---------|--------------|---------|---------|
|                 |                           | V <sub>I</sub><br>(V) | V <sub>O</sub><br>(V) | I <sub>OL</sub>  <br>( $\mu$ A) | V <sub>DD</sub><br>(V) | T <sub>A</sub> = 25°C |               |           | -40 to 85°C |         | -55 to 125°C |         |         |
|                 |                           |                       |                       |                                 |                        | Min.                  | Typ.          | Max.      | Min.        | Max.    | Min.         |         | Max.    |
| I <sub>L</sub>  | Quiescent Current         | 0/5                   |                       |                                 | 5                      |                       | 0.04          | 5         |             | 150     |              | 150     | $\mu$ A |
|                 |                           | 0/10                  |                       |                                 | 10                     |                       | 0.04          | 10        |             | 300     |              | 300     |         |
|                 |                           | 0/15                  |                       |                                 | 15                     |                       | 0.04          | 20        |             | 600     |              | 600     |         |
|                 |                           | 0/20                  |                       |                                 | 20                     |                       | 0.08          | 100       |             | 3000    |              | 3000    |         |
| V <sub>OH</sub> | High Level Output Voltage | 0/5                   |                       | <1                              | 5                      | 4.95                  |               |           | 4.95        |         | 4.95         |         | V       |
|                 |                           | 0/10                  |                       | <1                              | 10                     | 9.95                  |               |           | 9.95        |         | 9.95         |         |         |
|                 |                           | 0/15                  |                       | <1                              | 15                     | 14.95                 |               |           | 14.95       |         | 14.95        |         |         |
| V <sub>OL</sub> | Low Level Output Voltage  | 5/0                   |                       | <1                              | 5                      |                       | 0.05          |           |             | 0.05    |              | 0.05    | V       |
|                 |                           | 10/0                  |                       | <1                              | 10                     |                       | 0.05          |           |             | 0.05    |              | 0.05    |         |
|                 |                           | 15/0                  |                       | <1                              | 15                     |                       | 0.05          |           |             | 0.05    |              | 0.05    |         |
| V <sub>IH</sub> | High Level Input Voltage  |                       | 0.5/4.5               | <1                              | 5                      | 3.5                   |               |           | 3.5         |         | 3.5          |         | V       |
|                 |                           |                       | 1/9                   | <1                              | 10                     | 7                     |               |           | 7           |         | 7            |         |         |
|                 |                           |                       | 1.5/13.5              | <1                              | 15                     | 11                    |               |           | 11          |         | 11           |         |         |
| V <sub>IL</sub> | Low Level Input Voltage   |                       | 4.5/0.5               | <1                              | 5                      |                       |               | 1.5       |             | 1.5     |              | 1.5     | V       |
|                 |                           |                       | 9/1                   | <1                              | 10                     |                       |               | 3         |             | 3       |              | 3       |         |
|                 |                           |                       | 13.5/1.5              | <1                              | 15                     |                       |               | 4         |             | 4       |              | 4       |         |
| I <sub>OH</sub> | Output Drive Current      | 0/5                   | 2.5                   | <1                              | 5                      | -1.6                  | -3.2          |           | -1.3        |         | -1.3         |         | mA      |
|                 |                           | 0/5                   | 4.6                   | <1                              | 5                      | -0.51                 | -1            |           | -0.42       |         | -0.42        |         |         |
|                 |                           | 0/10                  | 9.5                   | <1                              | 10                     | -1.3                  | -2.6          |           | -1.1        |         | -1.1         |         |         |
|                 |                           | 0/15                  | 13.5                  | <1                              | 15                     | -3.4                  | -6.8          |           | -2.8        |         | -2.8         |         |         |
| I <sub>OL</sub> | Output Sink Current       | 0/5                   | 0.4                   | <1                              | 5                      | -0.51                 | 1             |           | -0.42       |         | -0.42        |         | mA      |
|                 |                           | 0/10                  | 0.5                   | <1                              | 10                     | -1.3                  | 2.6           |           | -1.1        |         | -1.1         |         |         |
|                 |                           | 0/15                  | 1.5                   | <1                              | 15                     | -3.4                  | 6.8           |           | -2.8        |         | -2.8         |         |         |
| I <sub>I</sub>  | Input Leakage Current     | 0/18                  | Any Input             |                                 | 18                     |                       | $\pm 10^{-5}$ | $\pm 0.1$ |             | $\pm 1$ |              | $\pm 1$ | $\mu$ A |
| C <sub>I</sub>  | Input Capacitance         |                       | Any Input             |                                 |                        |                       | 5             | 7.5       |             |         |              |         | pF      |

The Noise Margin for both "1" and "0" level is: 1V min. with V<sub>DD</sub>=5V, 2V min. with V<sub>DD</sub>=10V, 2.5V min. with V<sub>DD</sub>=15V

## HCF4538B

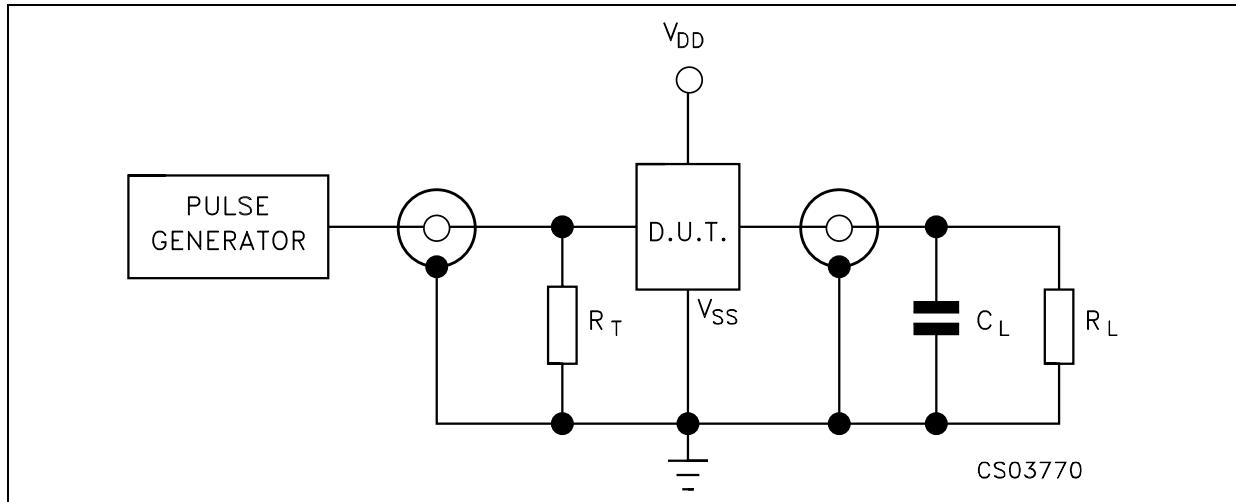
### DYNAMIC ELECTRICAL CHARACTERISTICS ( $T_{amb} = 25^{\circ}\text{C}$ , $C_L = 50\text{pF}$ , $R_L = 200\text{K}\Omega$ , $t_r = t_f = 20\text{ ns}$ )

| Symbol              | Parameter                                                                                                                                     | Test Condition |                         | Value (*) |         |      | Unit          |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------------|-----------|---------|------|---------------|
|                     |                                                                                                                                               | $V_{DD}$ (V)   |                         | Min.      | Typ.    | Max. |               |
| $t_{TLH}$ $t_{THL}$ | Transition Time                                                                                                                               | 5              |                         |           | 100     | 200  | ns            |
|                     |                                                                                                                                               | 10             |                         |           | 50      | 100  |               |
|                     |                                                                                                                                               | 15             |                         |           | 40      | 80   |               |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time<br>+TR or -TR to Q or $\bar{Q}$                                                                                        | 5              |                         |           | 300     | 600  | ns            |
|                     |                                                                                                                                               | 10             |                         |           | 150     | 300  |               |
|                     |                                                                                                                                               | 15             |                         |           | 100     | 200  |               |
| $t_{PLH}$ $t_{PHL}$ | Propagation Delay Time<br>Reset to Q or $\bar{Q}$                                                                                             | 5              | $R_L = 1\text{K}\Omega$ |           | 250     | 500  | ns            |
|                     |                                                                                                                                               | 10             |                         |           | 125     | 250  |               |
|                     |                                                                                                                                               | 15             |                         |           | 95      | 190  |               |
| $t_{WH}$ $t_{WL}$   | Minimum Input Pulse<br>Width +TR, -TR or Reset                                                                                                | 5              | $R_L = 1\text{K}\Omega$ |           | 80      | 140  | ns            |
|                     |                                                                                                                                               | 10             |                         |           | 40      | 80   |               |
|                     |                                                                                                                                               | 15             |                         |           | 30      | 60   |               |
| $t_{WT}$            | Output Pulse Width - Q or<br>$\bar{Q}$ ( $C_X = 0.005\ \mu\text{F}$ , $R_X =$<br>$10\text{K}\Omega$ <sup>(1)</sup> )                          | 5              |                         | 57        | 60.6    | 64.5 | $\mu\text{s}$ |
|                     |                                                                                                                                               | 10             |                         | 55        | 58.9    | 63.0 |               |
|                     |                                                                                                                                               | 15             |                         | 55        | 59.1    | 63.5 |               |
| $t_{WT}$            | Output Pulse Width - Q or<br>$\bar{Q}$ ( $C_X = 0.1\ \mu\text{F}$ , $R_X =$<br>$100\text{K}\Omega$ )                                          | 5              |                         | 9.4       | 9.97    | 10.5 | ms            |
|                     |                                                                                                                                               | 10             |                         | 9.4       | 9.95    | 10.6 |               |
|                     |                                                                                                                                               | 15             |                         | 9.5       | 10.0    | 10.6 |               |
| $t_{WT}$            | Output Pulse Width - Q or<br>$\bar{Q}$ ( $C_X = 10\ \mu\text{F}$ , $R_X =$<br>$100\text{K}\Omega$ )                                           | 5              |                         | 0.95      | 1.0     | 1.06 | s             |
|                     |                                                                                                                                               | 10             |                         | 0.95      | 1.0     | 1.06 |               |
|                     |                                                                                                                                               | 15             |                         | 0.96      | 1.0     | 1.07 |               |
| $t_W$               | Pulse Width Match<br>Between Circuits in Same<br>Package : $(100(T_1 - T_2)/T_1)$<br>( $C_X = 0.1\ \mu\text{F}$ , $R_X = 100\text{K}\Omega$ ) | 5              |                         |           | $\pm 1$ |      | %             |
|                     |                                                                                                                                               | 10             |                         |           | $\pm 1$ |      |               |
|                     |                                                                                                                                               | 15             |                         |           | $\pm 1$ |      |               |
| $t_{rr}$            | Minimum Retrigger Time                                                                                                                        | 5              |                         | 0         |         |      | ns            |
|                     |                                                                                                                                               | 10             |                         | 0         |         |      |               |
|                     |                                                                                                                                               | 15             |                         | 0         |         |      |               |
| $C_{IN}$            | Input Capacitance                                                                                                                             | Any Input      |                         |           | 5       | 7.5  | pF            |

(\*) Typical temperature coefficient for all  $V_{DD}$  value is 0.3 %/°C.

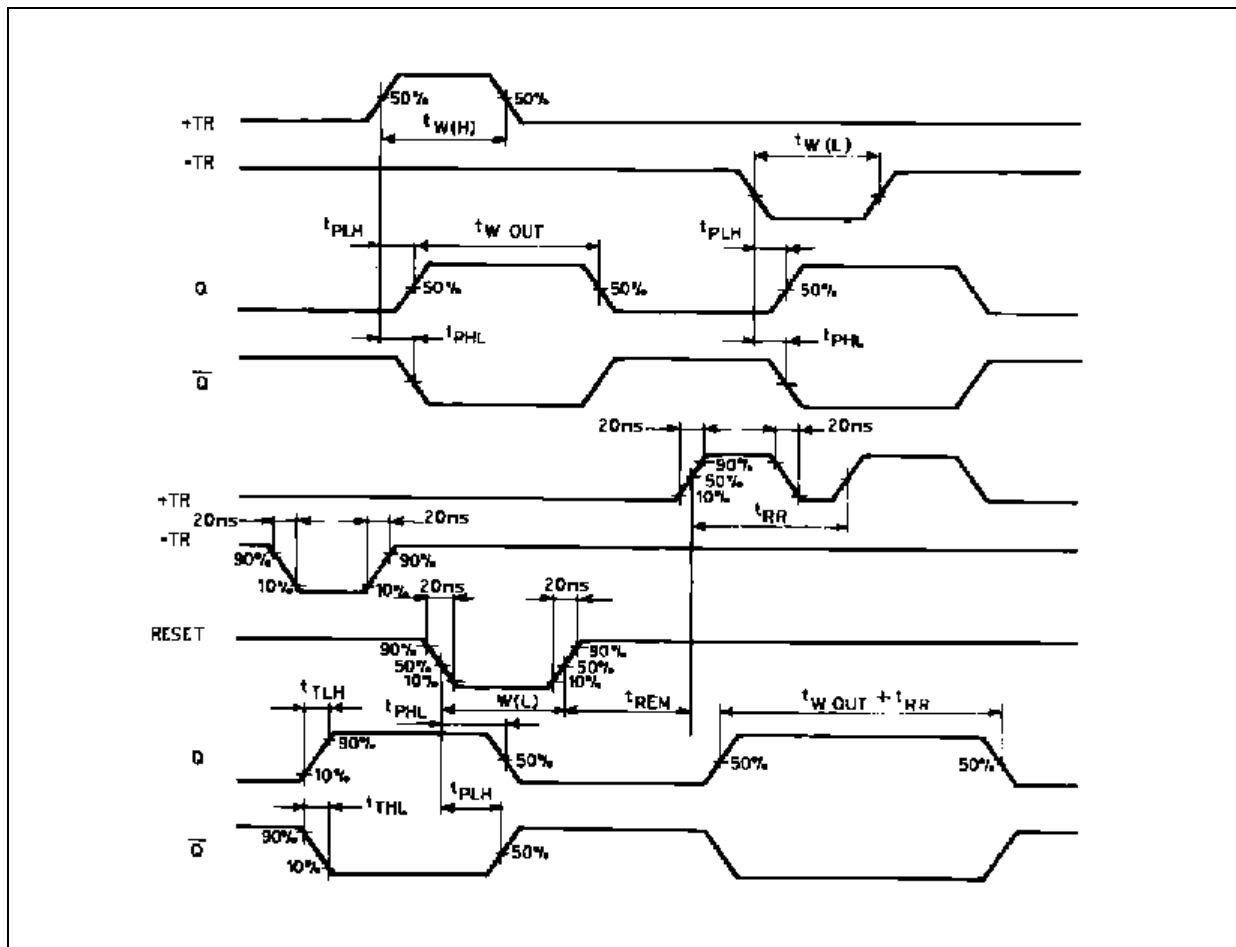
(1) Minimum  $R_X$  value = 4K $\Omega$  , minimum  $C_X$  value = 5000 pF

TEST CIRCUIT



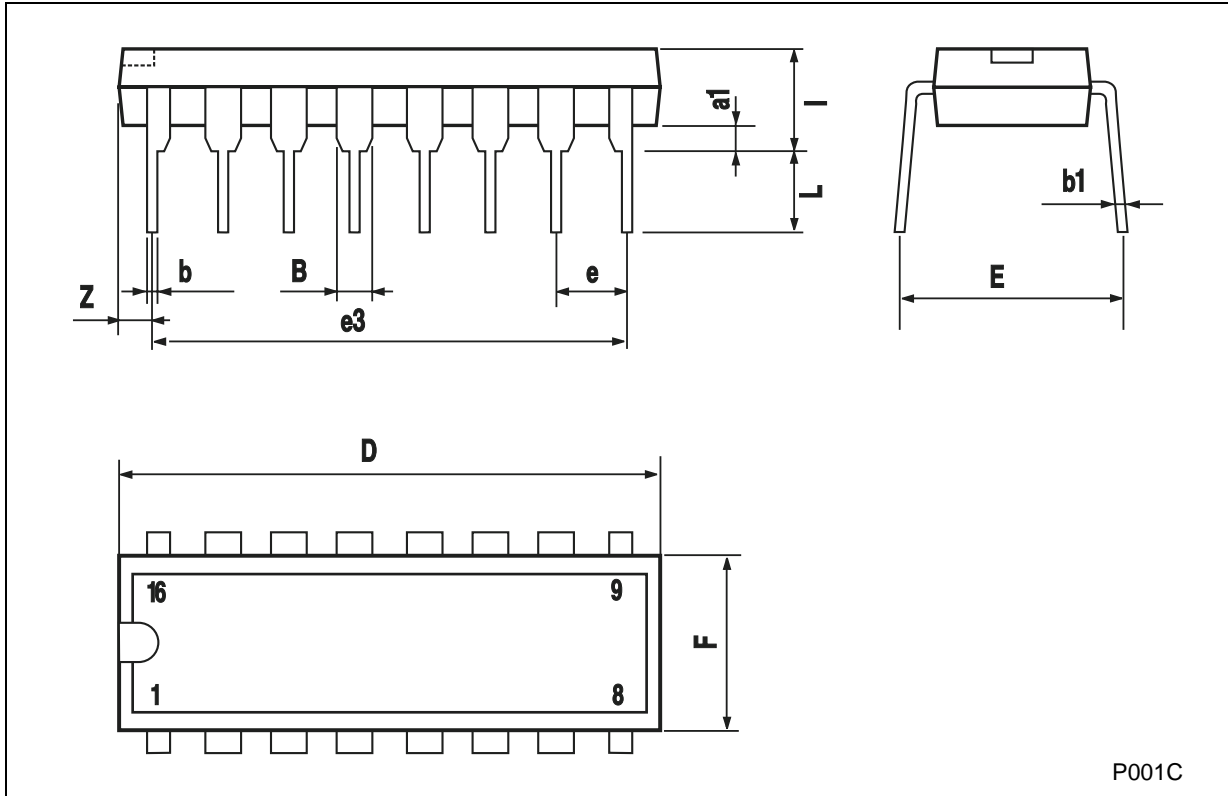
$C_L = 50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = 200\text{K}\Omega$   
 $R_T = Z_{\text{OUT}}$  of pulse generator (typically  $50\Omega$ )

WAVEFORM : PROPAGATION DELAY TIMES (f=1MHz; 50% duty cycle)



**Plastic DIP-16 (0.25) MECHANICAL DATA**

| DIM. | mm.  |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP   | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 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   |      | 17.78 |      |       | 0.700 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    |      |       | 1.27 |       |       | 0.050 |



P001C





## SO-16 MECHANICAL DATA

| DIM. | mm.        |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.003 |       | 0.007 |
| a2   |            |      | 1.65 |       |       | 0.064 |
| b    | 0.35       |      | 0.46 | 0.013 |       | 0.018 |
| b1   | 0.19       |      | 0.25 | 0.007 |       | 0.010 |
| C    |            | 0.5  |      |       | 0.019 |       |
| c1   | 45° (typ.) |      |      |       |       |       |
| D    | 9.8        |      | 10   | 0.385 |       | 0.393 |
| E    | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e    |            | 1.27 |      |       | 0.050 |       |
| e3   |            | 8.89 |      |       | 0.350 |       |
| F    | 3.8        |      | 4.0  | 0.149 |       | 0.157 |
| G    | 4.6        |      | 5.3  | 0.181 |       | 0.208 |
| L    | 0.5        |      | 1.27 | 0.019 |       | 0.050 |
| M    |            |      | 0.62 |       |       | 0.024 |
| S    | 8° (max.)  |      |      |       |       |       |



PO13H

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

© The ST logo is a registered trademark of STMicroelectronics

© 2001 STMicroelectronics - Printed in Italy - All Rights Reserved  
STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - China - Finland - France - Germany - Hong Kong - India - Italy - Japan - Malaysia - Malta - Morocco  
Singapore - Spain - Sweden - Switzerland - United Kingdom

© <http://www.st.com>