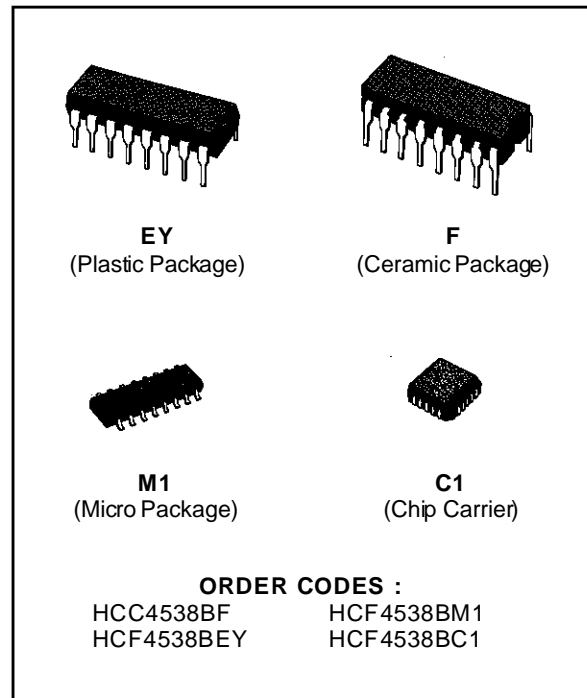


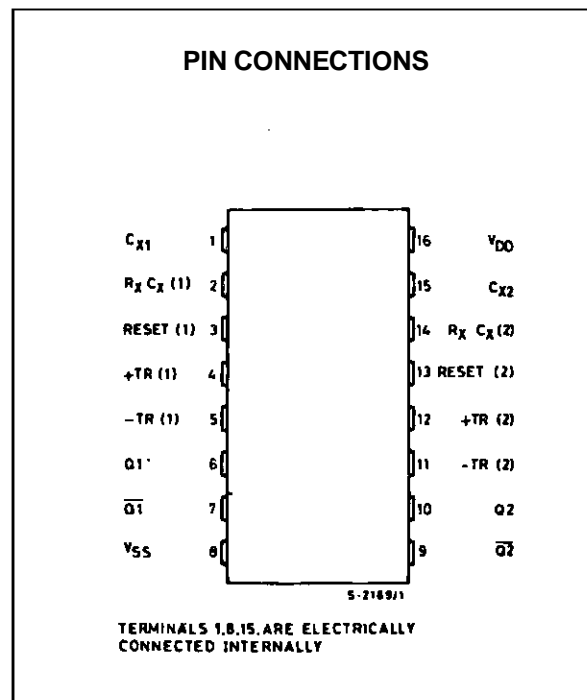
## DUAL MONOSTABLE MULTIVIBRATOR

- 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 OUTPUTS AVAILABLE
- SEPARATE RESETS
- WIDE RANGE OF OUTPUT-PULSE WIDTHS
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- SCHMITT TRIGGER INPUT ALLOWS UNLIMITER RISE AND FALL TIMES ON + TR AND - TR INPUTS
- INPUT CURRENT OF 100nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N° 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"



### DESCRIPTION

The **HCC4538B** (extended temperature range) and **HCF4538B** (intermediate temperature range) are monolithic integrated circuit, available in 16-lead dual in-line plastic or-ceramic package and plastic micropackage. The **HCC/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) are independent of  $R_X$  and  $C_X$ . Precision control of output pulse widths is achieved through linear CMOS techniques. Leading-edge-triggering (+ TR) and trailing-edge-triggering (- TR) inputs are provided for triggering 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

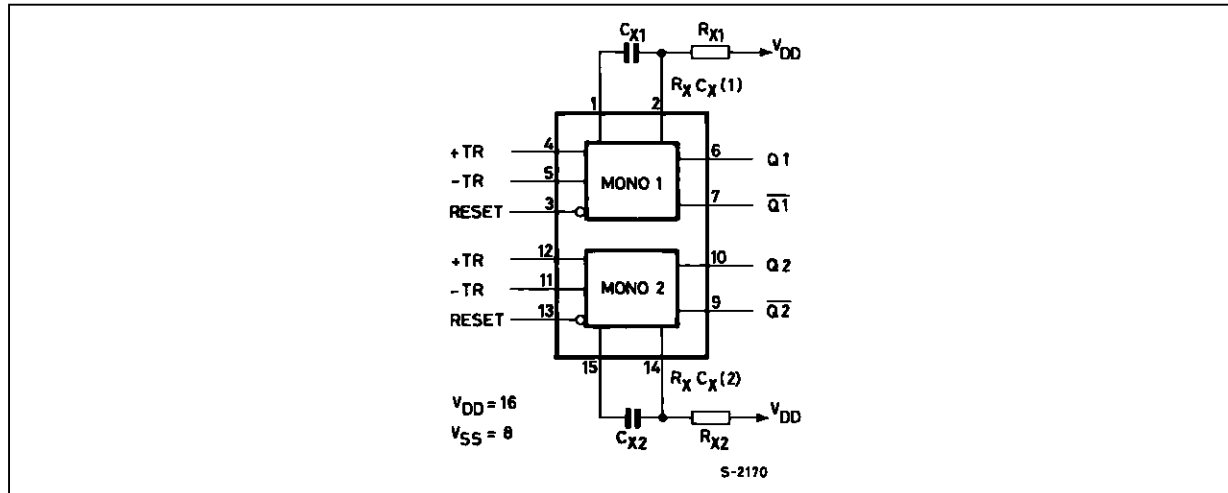


## HCC/HCF4538B

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 **HCC/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 pulse one period) on the application of each new trigger pulse. For operation in the non-retriggerable mode,  $Q$  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.

### FUNCTIONAL DIAGRAM



### ABSOLUTE MAXIMUM RATING

| Symbol     | Parameter   | Value                      | Unit        |
|------------|---|----------------------------|-------------|
| $V_{DD}^*$ | Supply Voltage: <b>HCC</b> Types<br><b>HCF</b> Types  | -0.5 to +20<br>-0.5 to +18 | V           |
| $V_i$      | Input Voltage   | -0.5 to $V_{DD} + 0.5$     | V           |
| $I_i$      | DC Input Current (any one input)  | $\pm 10$                   | mA          |
| $P_{tot}$  | Total Power Dissipation (per package)<br>Dissipation per Output Transistor<br>for $T_{op} =$ Full Package Temperature Range | 200<br>100                 | mW          |
| $T_{op}$   | Operating Temperature: <b>HCC</b> Types<br><b>HCF</b> Types   | -55 to +125<br>-40 to +85  | $^{\circ}C$ |
| $T_{stg}$  | Storage Temperature   | -65 to +150                | $^{\circ}C$ |

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for external periods may affect device reliability.

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

### RECOMMENDED OPERATING CONDITIONS

| Symbol   | Parameter   | Value                     | Unit        |
|----------|---|---------------------------|-------------|
| $V_{DD}$ | Supply Voltage: <b>HCC</b> Types<br><b>HCF</b> Types        | 3 to 18<br>3 to 15        | V           |
| $V_i$    | Input Voltage   | 0 to $V_{DD}$             | V           |
| $T_{op}$ | Operating Temperature: <b>HCC</b> Types<br><b>HCF</b> Types | -55 to +125<br>-40 to +85 | $^{\circ}C$ |

LOGIC DIAGRAM (1/2 of device shown)

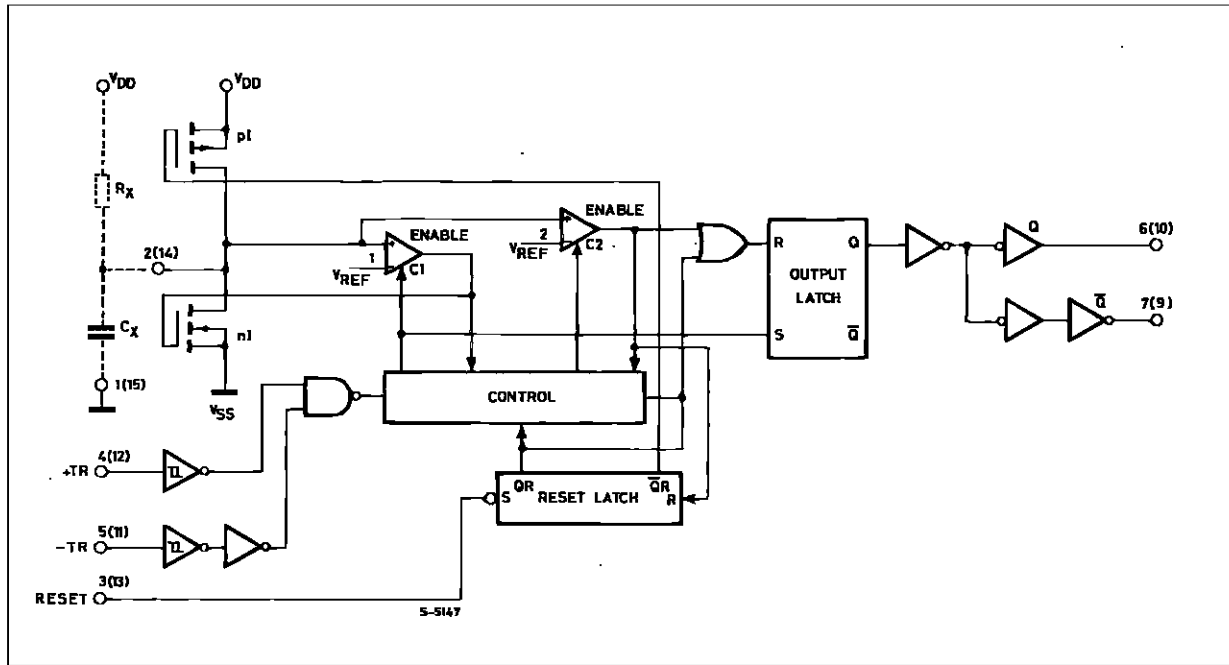
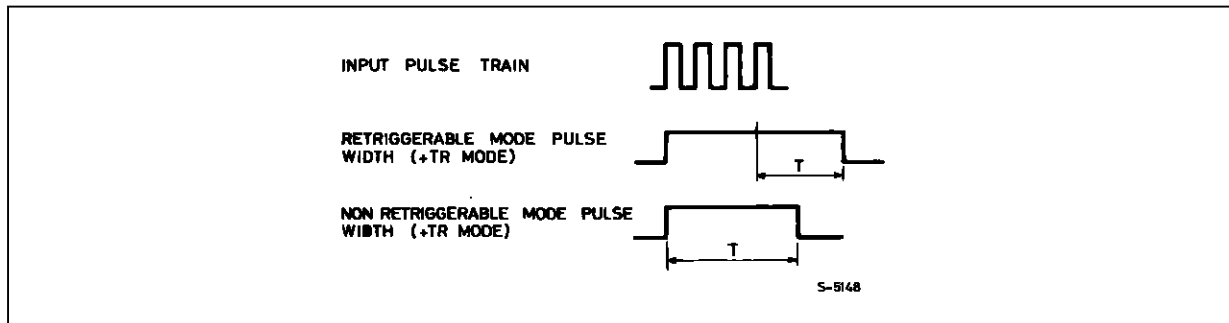


TABLE 1: Functional Terminal Connections

| Function                                | VDD to Term. NO |          | VSS to Term. NO |          | Input Pulse to Term. No |          | 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   |

- Notes :
1. 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.
  2. A Non-retriggerable one-shot multivibrator has a time period (T) referenced from the application of the first trigger pulse.

Pulse Width



STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

| Symbol                            | Parameter             |           | Test Conditions       |                       |                                |                        | Value              |       |                        |           |       |                     | Unit    |         |
|-----------------------------------|-----------------------|-----------|-----------------------|-----------------------|--------------------------------|------------------------|--------------------|-------|------------------------|-----------|-------|---------------------|---------|---------|
|                                   |                       |           | V <sub>I</sub><br>(V) | V <sub>O</sub><br>(V) | I <sub>O</sub>  <br>( $\mu$ A) | V <sub>DD</sub><br>(V) | T <sub>LOW</sub> * |       | 25 °C                  |           |       | T <sub>HIGH</sub> * |         |         |
|                                   |                       |           |                       |                       |                                |                        | Min.               | Max.  | Min.                   | Typ.      | Max.  | Min.                |         | Max.    |
| I <sub>L</sub>                    | Quiescent Current     | HCC Types | 0/5                   |                       |                                | 5                      |                    | 5     |                        | 0.04      | 5     |                     | 150     | $\mu$ A |
|                                   |                       |           | 0/10                  |                       |                                | 10                     |                    | 10    |                        | 0.04      | 10    |                     | 300     |         |
|                                   |                       |           | 0/15                  |                       |                                | 15                     |                    | 20    |                        | 0.04      | 20    |                     | 600     |         |
|                                   |                       | 0/20      |                       |                       | 20                             |                        | 100                |       | 0.08                   | 100       |       | 3000                |         |         |
|                                   |                       | HCF Types | 0/5                   |                       |                                | 5                      |                    | 5     |                        | 0.04      | 5     |                     | 150     |         |
|                                   |                       |           | 0/10                  |                       |                                | 10                     |                    | 10    |                        | 0.04      | 10    |                     | 300     |         |
| 0/15                              |                       |           |                       | 15                    |                                | 20                     |                    | 0.04  | 20                     |           | 600   |                     |         |         |
| V <sub>OH</sub>                   | Output High Voltage   | 0/5       |                       | < 1                   | 5                              | 4.95                   |                    | 4.95  | 5                      |           | 4.95  |                     | V       |         |
|                                   |                       | 0/10      |                       | < 1                   | 10                             | 9.95                   |                    | 9.95  | 10                     |           | 9.95  |                     |         |         |
|                                   |                       | 0/15      |                       | < 1                   | 15                             | 14.95                  |                    | 14.95 | 15                     |           | 14.95 |                     |         |         |
| V <sub>OL</sub>                   | Output Low 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>                   | Input High 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>                   | Input Low 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  | HCC Types | 0/5                   | 2.5                   |                                | 5                      | -2                 |       | -1.6                   | -3.2      |       | -1.15               | mA      |         |
|                                   |                       |           | 0/5                   | 4.6                   |                                | 5                      | -0.64              |       | -0.51                  | -1        |       | -0.36               |         |         |
|                                   |                       |           | 0/10                  | 9.5                   |                                | 10                     | -1.6               |       | -1.3                   | -2.6      |       | -0.9                |         |         |
|                                   |                       | 0/15      | 13.5                  |                       | 15                             | -4.2                   |                    | -3.4  | -6.8                   |           | -2.4  |                     |         |         |
|                                   |                       | HCF Types | 0/5                   | 2.5                   |                                | 5                      | -1.8               |       | -1.6                   | -3.2      |       | -1.3                |         |         |
|                                   |                       |           | 0/5                   | 4.6                   |                                | 5                      | -0.61              |       | -0.51                  | -1        |       | -0.42               |         |         |
| 0/10                              | 9.5                   |           |                       | 10                    | -1.5                           |                        | -1.3               | -2.6  |                        | -1.1      |       |                     |         |         |
| 0/15                              | 13.5                  |           | 15                    | -4                    |                                | -3.4                   | -6.8               |       | -2.8                   |           |       |                     |         |         |
| I <sub>OL</sub>                   | Output Sink Current   | HCC Types | 0/5                   | 0.4                   |                                | 5                      | 0.64               |       | 0.51                   | 1         |       | 0.36                | mA      |         |
|                                   |                       |           | 0/10                  | 0.5                   |                                | 10                     | 1.6                |       | 1.3                    | 2.6       |       | 0.9                 |         |         |
|                                   |                       |           | 0/15                  | 1.5                   |                                | 15                     | 4.2                |       | 3.4                    | 6.8       |       | 2.4                 |         |         |
|                                   |                       | HCF Types | 0/5                   | 0.4                   |                                | 5                      | 0.61               |       | 0.51                   | 1         |       | 0.42                |         |         |
|                                   |                       |           | 0/10                  | 0.5                   |                                | 10                     | 1.5                |       | 1.3                    | 2.6       |       | 1.1                 |         |         |
|                                   |                       |           | 0/15                  | 1.5                   |                                | 15                     | 3.6                |       | 3.4                    | 6.8       |       | 2.8                 |         |         |
| I <sub>IH</sub> , I <sub>IL</sub> | Input Leakage Current | 0/18      | Any Input             |                       | 18                             |                        | $\pm$ 0.1          |       | $\pm$ 10 <sup>-5</sup> | $\pm$ 0.1 |       | $\pm$ 1             | $\mu$ A |         |
| C <sub>I</sub>                    | Input Capacitance     |           | Any Input             |                       |                                |                        |                    |       | 5                      | 7.5       |       |                     | pF      |         |

\* T<sub>LOW</sub> = -55 °C for HCC device; -40 °C for HCF device.

\* T<sub>HIGH</sub> = +125 °C for HCC device; +85 °C for HCF device.

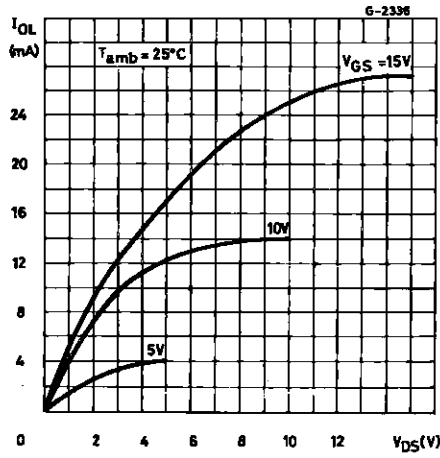
The Noise Margin for both "1" and "0" level is: 1V min. with V<sub>DD</sub> = 5V, 2V min. with V<sub>DD</sub> = 10V, 2.5V min. with V<sub>DD</sub> = 15V

**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ K}\Omega$ , typical temperature coefficient for all  $V_{DD}$  values is  $03\text{ } \%/^{\circ}\text{C}$ , all input rise and fall times =  $20\text{ ns}$ )

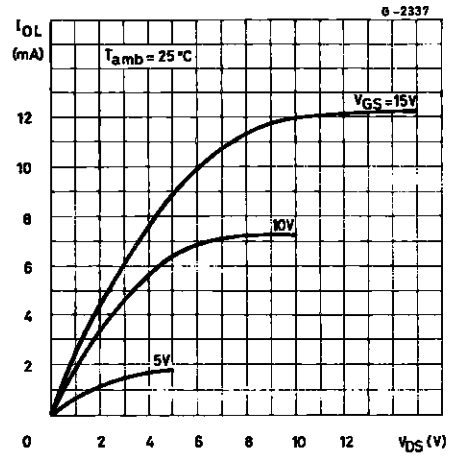
| Symbol                 | Parameter   | Test Conditions         | Value        |      |         | Unit |               |
|------------------------|---|-------------------------|--------------|------|---------|------|---------------|
|                        |   |                         | $V_{DD}$ (V) | Min. | Typ.    |      | Max.          |
| $t_{TLH}$<br>$t_{THL}$ | Transition Time   |                         | 5            |      | 100     | 200  | ns            |
|                        |   |                         | 10           |      | 50      | 100  |               |
|                        |   |                         | 15           |      | 40      | 80   |               |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay Time<br>+TR or -TR to Q or $\bar{Q}$  |                         | 5            |      | 300     | 600  | ns            |
|                        |   |                         | 10           |      | 150     | 300  |               |
|                        |   |                         | 15           |      | 100     | 220  |               |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay Time<br>Reset to Q or $\bar{Q}$   | $R_L = 1\text{K}\Omega$ | 5            |      | 250     | 500  | ns            |
|                        |   |                         | 10           |      | 125     | 250  |               |
|                        |   |                         | 15           |      | 95      | 190  |               |
| $t_{WH}$<br>$t_{WL}$   | Minimum Input Pulse Width<br>+TR, -TR or Reset  | $R_L = 1\text{K}\Omega$ | 5            |      | 80      | 140  | ns            |
|                        |   |                         | 10           |      | 40      | 80   |               |
|                        |   |                         | 15           |      | 30      | 60   |               |
| $t_{WT}$               | Output Pulse Width - Q or $\bar{Q}$<br>( $C_X = 0.005\text{ }\mu\text{F}$ , $R_X = 10\text{ K}\Omega$ *)  |                         | 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 $\bar{Q}$<br>( $C_X = 0.1\text{ }\mu\text{F}$ , $R_X = 100\text{ K}\Omega$ )  |                         | 5            | 9.4  | 9.97    | 10.5 | ms            |
|                        |   |                         | 10           | 9.4  | 9.95    | 10.6 |               |
|                        |   |                         | 15           | 9.5  | 10.00   | 10.6 |               |
| $t_{WT}$               | Output Pulse Width - Q or $\bar{Q}$<br>( $C_X = 10\text{ }\mu\text{F}$ , $R_X = 100\text{ K}\Omega$ )   |                         | 5            | 0.95 | 1.00    | 1.06 | s             |
|                        |   |                         | 10           | 0.95 | 1.00    | 1.06 |               |
|                        |   |                         | 15           | 0.96 | 1.00    | 1.07 |               |
| $t_W$                  | Pulse Width Match Between<br>Circuits in Same Package:<br>( $C_X = 0.1\text{ }\mu\text{F}$ , $R_X = 100\text{ K}\Omega$ )<br>$\frac{100(T_1 - T_2)}{T_1}$ |                         | 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            |

\* Minimum  $R_X$  value =  $4\text{ K}\Omega$ , minimum  $C_X$  value =  $500\text{ pF}$

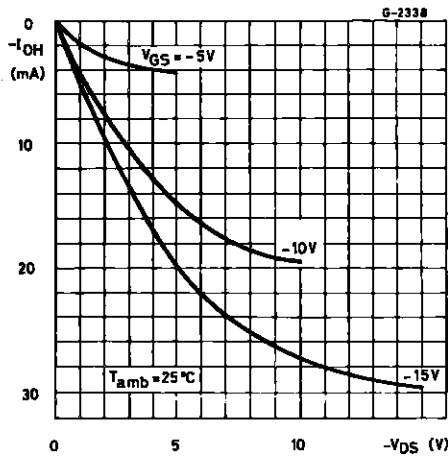
Typical Output Low (sink) Current Characteristics



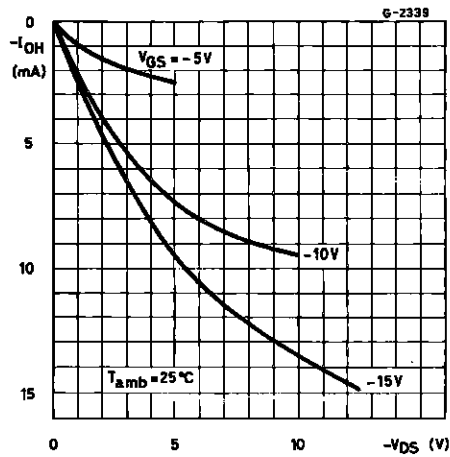
Minimum Output Low (sink) Current Characteristics



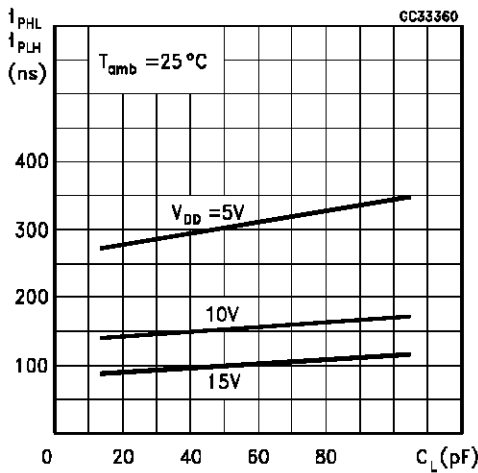
Typical Output High (source) Current Characteristics



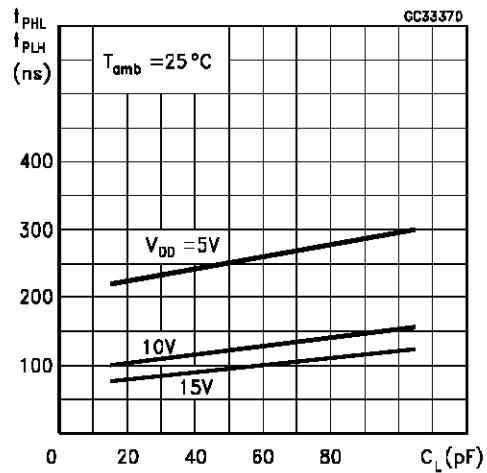
Minimum Output High (source) Current Characteristics



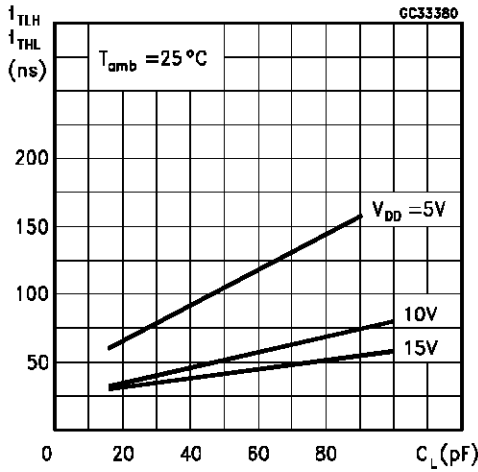
Typical Propagation Delay Time as a Function of Load Capacitance (+TR or -TR to Q or  $\bar{Q}$ )



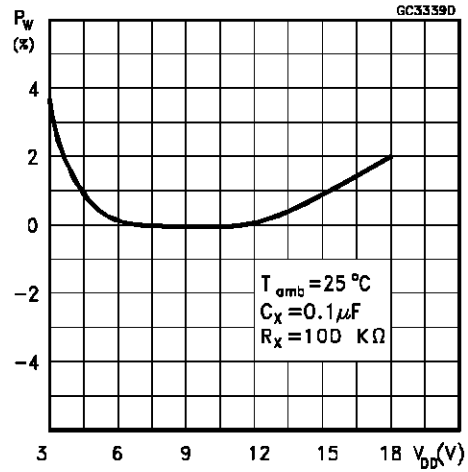
Typical Propagation Delay Time as a Function of Load Capacitance (RESET to Q or  $\bar{Q}$ )



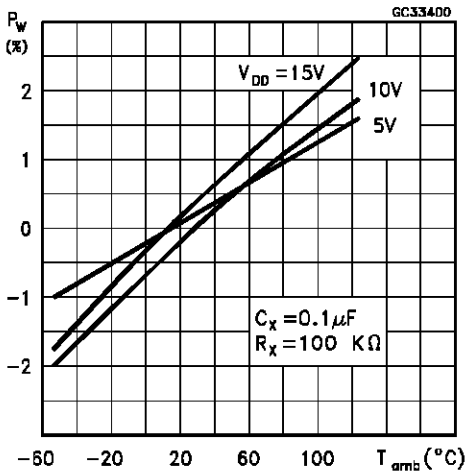
Typical Transition Time as a Function of Load Capacitance



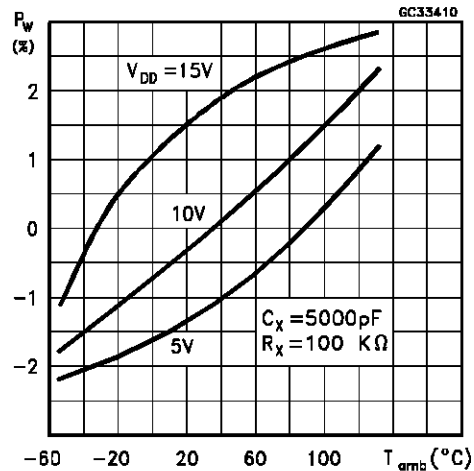
Typical Pulse Width Variation as a Function of Supply Voltage



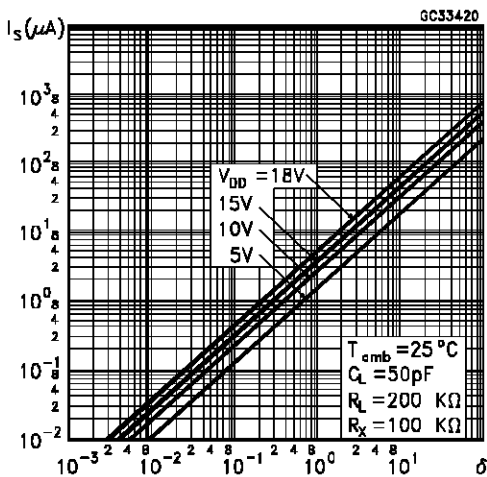
Typical Pulse Width Variation as a Function of Temperature



Typical Pulse Width Variation as a Function of Temperature



Typical Total Supply Current as a Function of Output Duty Cycle



## Power Down Mode

During a rapid power-down condition, as would occur with a power supply short circuit or with a poorly filtered power supply, the energy stored in  $C_X$  could discharge into Pin 2 or 14. To Avoid possible device damage in this mode, when  $C_X$  is  $\leq 0.5$  microfarad, a protection diode with a 1 Ampere or higher rating (1N5395 or equivalent) and a separate ground return for  $C_X$  should be provided as shown in Fig. 1

An alternate protection method is shown in Fig. 2, where a  $51 \Omega$  current limit resistor is inserted in series with  $C_X$ . Note that a small pulse width decrease will occur however, and  $R_X$  must be appropriately increased to obtain the originally desired pulse width.

Figure 1: rapid Power Down Protection Circuit

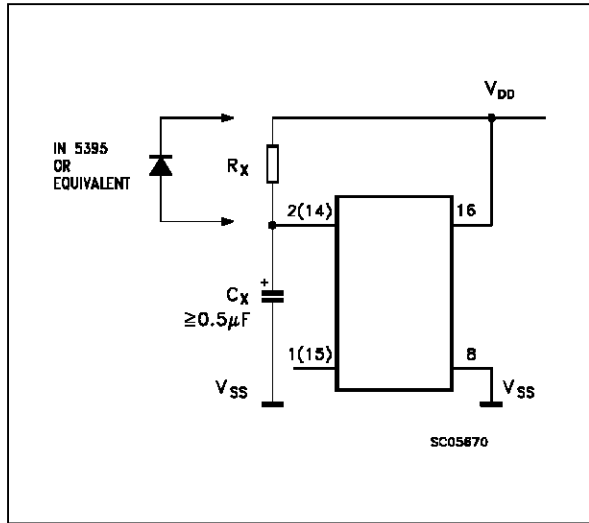
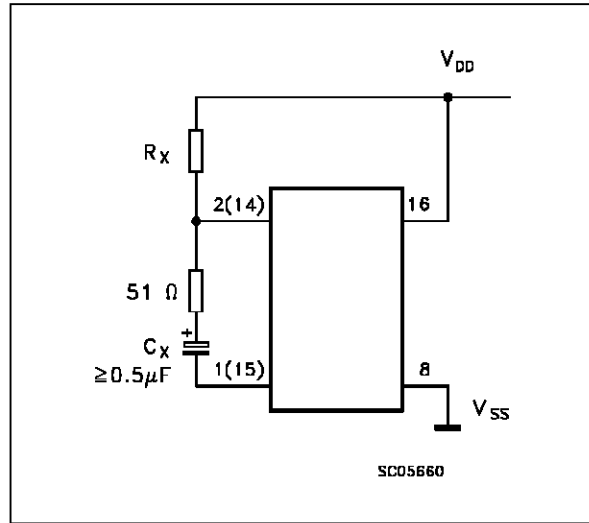


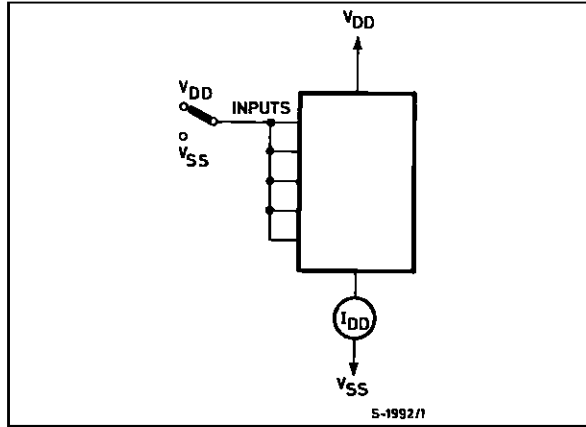
Figure 2: Alternate rapid Power Down Protection Circuit



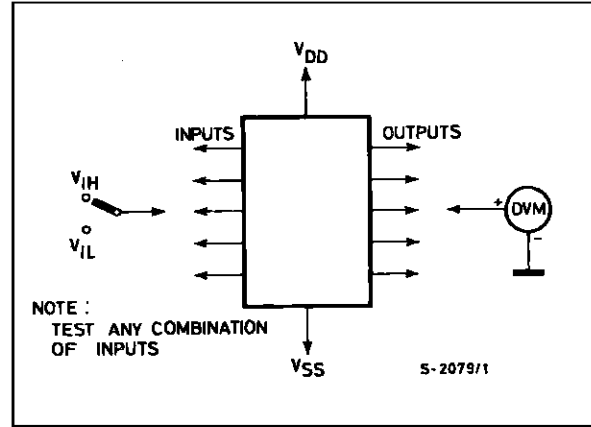


**TEST CIRCUITS**

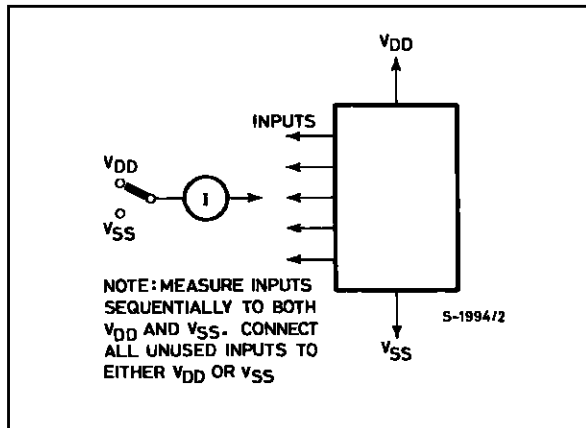
Quiescent Device Current



Noise Immunity.



Input Leakage Current.



Plastic DIP16 (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

## Ceramic DIP16/1 MECHANICAL DATA

| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |       | 20   |       |       | 0.787 |
| B    |      |       | 7    |       |       | 0.276 |
| D    |      | 3.3   |      |       | 0.130 |       |
| E    | 0.38 |       |      | 0.015 |       |       |
| e3   |      | 17.78 |      |       | 0.700 |       |
| F    | 2.29 |       | 2.79 | 0.090 |       | 0.110 |
| G    | 0.4  |       | 0.55 | 0.016 |       | 0.022 |
| H    | 1.17 |       | 1.52 | 0.046 |       | 0.060 |
| L    | 0.22 |       | 0.31 | 0.009 |       | 0.012 |
| M    | 0.51 |       | 1.27 | 0.020 |       | 0.050 |
| N    |      |       | 10.3 |       |       | 0.406 |
| P    | 7.8  |       | 8.05 | 0.307 |       | 0.317 |
| Q    |      |       | 5.08 |       |       | 0.200 |



SO16 (Narrow) MECHANICAL DATA

| DIM. | mm         |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.004 |       | 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.)  |      |      |       |       |       |



P013H

## PLCC20 MECHANICAL DATA

| DIM. | mm   |      |       | inch  |       |       |
|------|------|------|-------|-------|-------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 9.78 |      | 10.03 | 0.385 |       | 0.395 |
| B    | 8.89 |      | 9.04  | 0.350 |       | 0.356 |
| D    | 4.2  |      | 4.57  | 0.165 |       | 0.180 |
| d1   |      | 2.54 |       |       | 0.100 |       |
| d2   |      | 0.56 |       |       | 0.022 |       |
| E    | 7.37 |      | 8.38  | 0.290 |       | 0.330 |
| e    |      | 1.27 |       |       | 0.050 |       |
| e3   |      | 5.08 |       |       | 0.200 |       |
| F    |      | 0.38 |       |       | 0.015 |       |
| G    |      |      | 0.101 |       |       | 0.004 |
| M    |      | 1.27 |       |       | 0.050 |       |
| M1   |      | 1.14 |       |       | 0.045 |       |



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