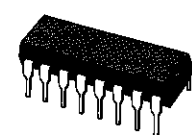
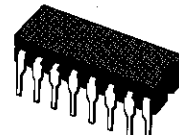


## HC4049 HEX BUFFER/CONVERTER (INVERTER) HC4050 HEX BUFFER/CONVERTER

- **HIGH SPEED**  
 $t_{PD} = 9 \text{ ns (TYP.) AT } V_{CC} = 5 \text{ V}$
- **LOW POWER DISSIPATION**  
 $I_{CC} = 1 \mu\text{A (MAX.) AT } T_A = 25^\circ\text{C}$
- **HIGH NOISE IMMUNITY**  
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- **OUTPUT DRIVE CAPABILITY**  
 15 LSTTL LOADS
- **SYMMETRICAL OUTPUT IMPEDANCE**  
 $|I_{OH}| = I_{OL} = 6 \text{ mA (MIN.)}$
- **BALANCED PROPAGATION DELAYS**  
 $t_{PLH} = t_{PHL}$
- **WIDE OPERATING VOLTAGE RANGE**  
 $V_{CC} \text{ (OPR)} = 2 \text{ V TO } 6 \text{ V}$
- **PIN AND FUNCTION COMPATIBLE**  
 WITH 4049B/4050B



**B1R**  
(Plastic Package)



**F1R**  
(Ceramic Package)



**M1R**  
(Micro Package)



**C1R**  
(Chip Carrier)

**ORDER CODES :**

|              |              |
|--------------|--------------|
| M54HCXXXXF1R | M74HCXXXXM1R |
| M74HCXXXXB1R | M74HCXXXXC1R |

### DESCRIPTION

The M54/74HC4049 and the M54/74HC4050 are high speed CMOS HEX BUFFER fabricated in silicon gate C<sup>2</sup>MOS technology.

They have the same high speed performance of LSTTL combined with true CMOS low power consumption.

The M54/75HC4049 is an inverting buffer, while the M54/74HC4050 is a non-inverting buffer.

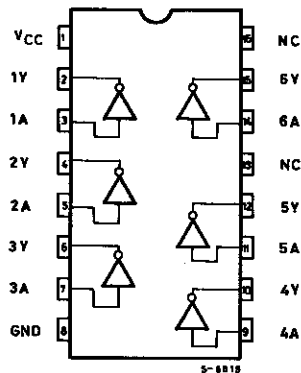
The internal circuit is composed of 3 stage or 2-stage inverters, which provides high noise immunity and a stable output.

Input protection circuits are different from those of the high speed CMOS IC's.

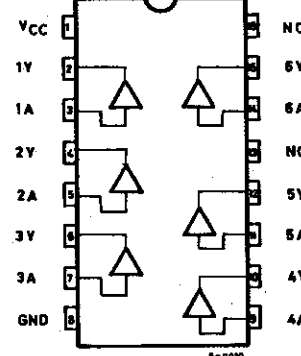
The VCC side diodes are designed to allow logic-level conversion from high-level voltages (up to 15 V) to low-level voltages.

### PIN CONNECTIONS (top view)

#### HC4049

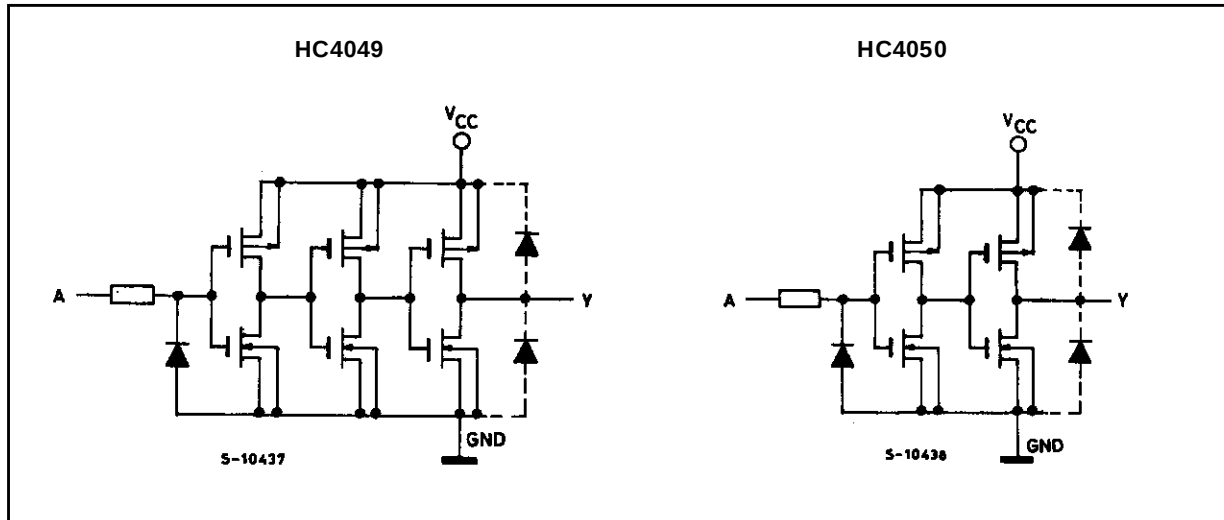


#### HC4050

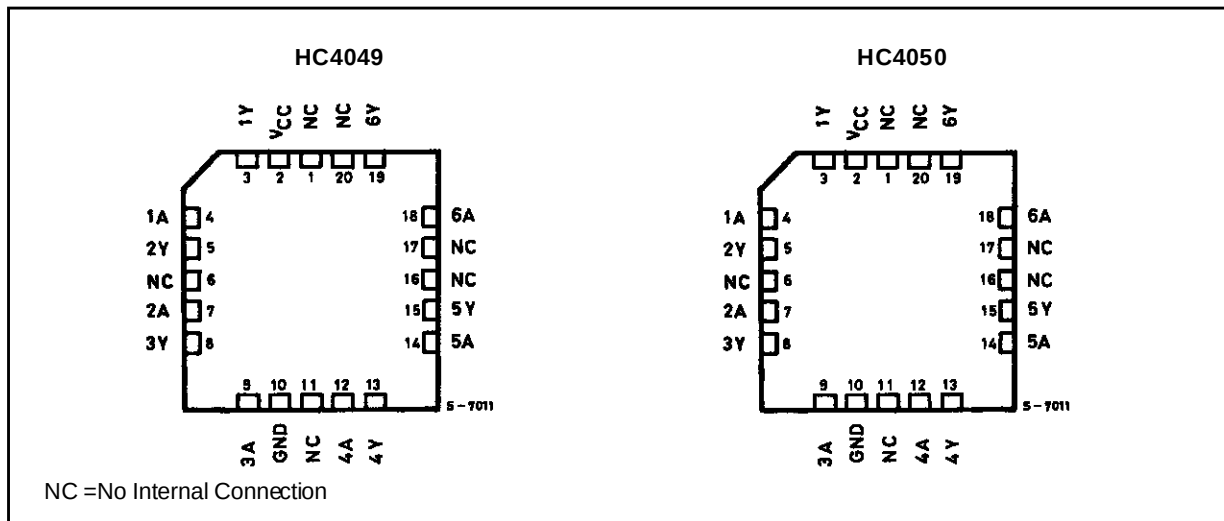


NC =  
No Internal  
Connection

CIRCUIT SCHEMATIC (Per Gate)



CHIP CARRIER



TRUTH TABLE (HC4049)

| INPUT | OUTPUT |
|-------|--------|
| nA    | nY     |
| L     | H      |
| H     | L      |

TRUTH TABLE (HC4050)

| INPUT | OUTPUT |
|-------|--------|
| nA    | nY     |
| L     | L      |
| H     | H      |

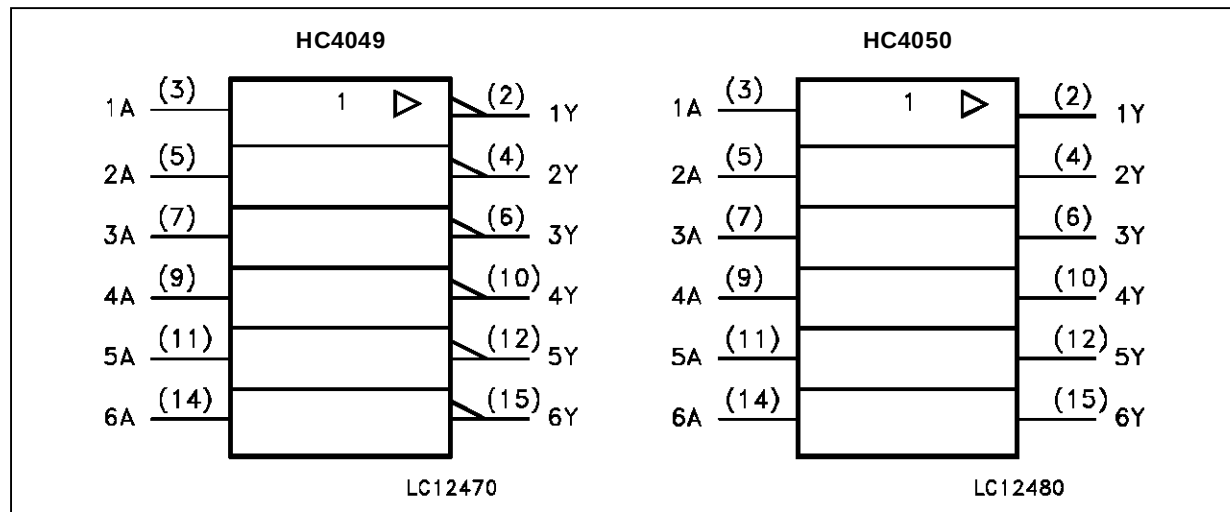
**PIN DESCRIPTION (HC4049)**

| PIN No              | SYMBOL                     | NAME AND FUNCTION       |
|---------------------|----------------------------|-------------------------|
| 2, 4, 6, 10, 12, 15 | 1 $\bar{Y}$ to 6 $\bar{Y}$ | Data Outputs            |
| 3, 5, 7, 9, 11, 14  | 1A to 6A                   | Data Inputs             |
| 13, 16              | NC                         | Not Connected           |
| 8                   | GND                        | Ground (0V)             |
| 1                   | V <sub>CC</sub>            | Positive Supply Voltage |

**PIN DESCRIPTION (HC4050)**

| PIN No              | SYMBOL          | NAME AND FUNCTION       |
|---------------------|-----------------|-------------------------|
| 2, 4, 6, 10, 12, 15 | 1Y to 6Y        | Data Outputs            |
| 3, 5, 7, 9, 11, 14  | 1A to 6A        | Data Inputs             |
| 13, 16              | NC              | Not Connected           |
| 8                   | GND             | Ground (0V)             |
| 1                   | V <sub>CC</sub> | Positive Supply Voltage |

**IEC LOGIC SYMBOLS**



**ABSOLUTE MAXIMUM RATINGS**

| Symbol                              | Parameter                                    | Value                         | Unit |
|-------------------------------------|----------------------------------------------|-------------------------------|------|
| V <sub>CC</sub>                     | Supply Voltage                               | -0.5 to +7                    | V    |
| V <sub>I</sub>                      | DC Input Voltage                             | -0.5 to V <sub>CC</sub> + 0.5 | V    |
| V <sub>O</sub>                      | DC Output Voltage                            | -0.5 to V <sub>CC</sub> + 0.5 | V    |
| I <sub>IK</sub>                     | DC Input Diode Current                       | ± 20                          | mA   |
| I <sub>OK</sub>                     | DC Output Diode Current                      | ± 20                          | mA   |
| I <sub>O</sub>                      | DC Output Source Sink Current Per Output Pin | ± 25                          | mA   |
| I <sub>CC</sub> or I <sub>GND</sub> | DC V <sub>CC</sub> or Ground Current         | ± 50                          | mA   |
| P <sub>D</sub>                      | Power Dissipation                            | 500 (*)                       | mW   |
| T <sub>stg</sub>                    | Storage Temperature                          | -65 to +150                   | °C   |
| T <sub>L</sub>                      | Lead Temperature (10 sec)                    | 300                           | °C   |

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

(\*) 500 mW: ≡ 65 °C derate to 300 mW by 10mW/°C: 65 °C to 85 °C

**RECOMMENDED OPERATING CONDITIONS**

| Symbol                          | Parameter                                                         |                         | Value                     | Unit                             |
|---------------------------------|-------------------------------------------------------------------|-------------------------|---------------------------|----------------------------------|
| V <sub>CC</sub>                 | Supply Voltage                                                    |                         | 2 to 6                    | V                                |
| V <sub>I</sub>                  | Input Voltage                                                     |                         | 0 to V <sub>CC</sub>      | V                                |
| V <sub>O</sub>                  | Output Voltage                                                    |                         | 0 to V <sub>CC</sub>      | V                                |
| T <sub>op</sub>                 | Operating Temperature: <b>M54HC Series</b><br><b>M74HC Series</b> |                         | -55 to +125<br>-40 to +85 | <sup>o</sup> C<br><sup>o</sup> C |
| t <sub>r</sub> , t <sub>f</sub> | Input Rise and Fall Time                                          | V <sub>CC</sub> = 2 V   | 0 to 1000                 | ns                               |
|                                 |                                                                   | V <sub>CC</sub> = 4.5 V | 0 to 500                  |                                  |
|                                 |                                                                   | V <sub>CC</sub> = 6 V   | 0 to 400                  |                                  |

**DC SPECIFICATIONS**

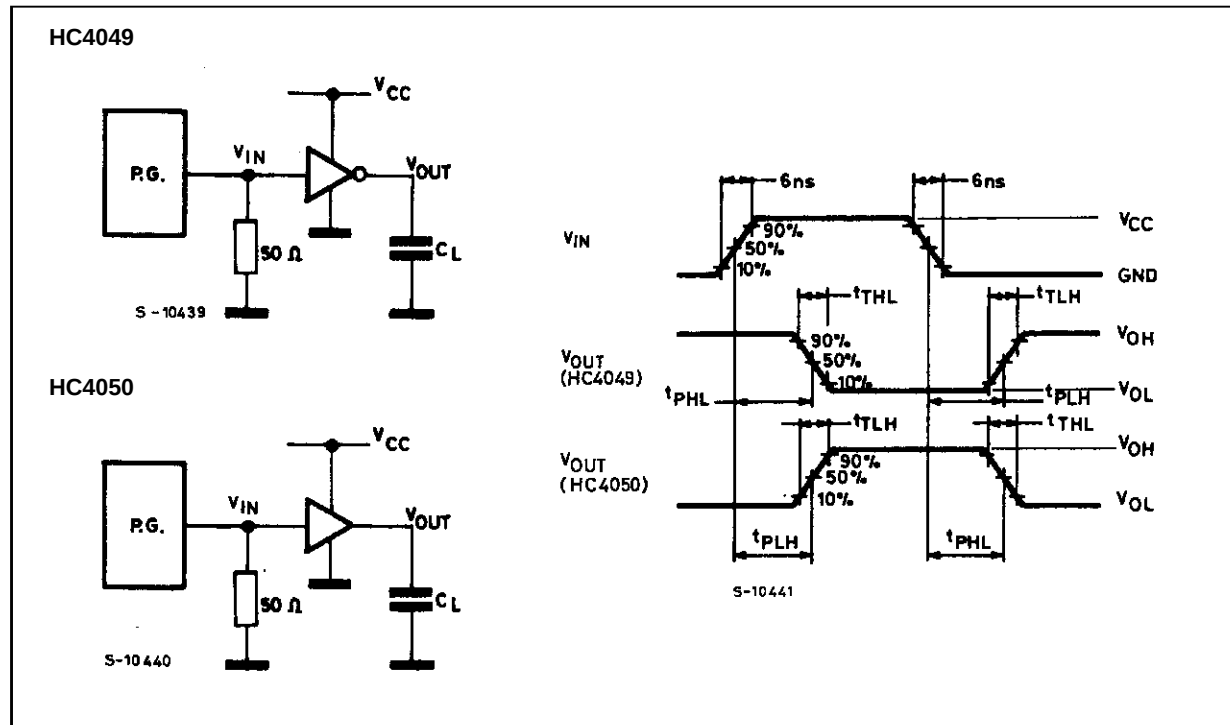
| Symbol          | Parameter                 | Test Conditions        |                                                                  |                         | Value                                   |              |      |                      |      |                       | Unit |      |  |
|-----------------|---------------------------|------------------------|------------------------------------------------------------------|-------------------------|-----------------------------------------|--------------|------|----------------------|------|-----------------------|------|------|--|
|                 |                           | V <sub>CC</sub><br>(V) |                                                                  |                         | T <sub>A</sub> = 25 °C<br>54HC and 74HC |              |      | -40 to 85 °C<br>74HC |      | -55 to 125 °C<br>54HC |      |      |  |
|                 |                           |                        |                                                                  |                         | Min.                                    | Typ.         | Max. | Min.                 | Max. | Min.                  |      | Max. |  |
| V <sub>IH</sub> | High Level Input Voltage  | 2.0                    |                                                                  |                         | 1.5                                     |              |      | 1.5                  |      | 1.5                   |      | V    |  |
|                 |                           | 4.5                    |                                                                  |                         | 3.15                                    |              |      | 3.15                 |      | 3.15                  |      |      |  |
|                 |                           | 6.0                    |                                                                  |                         | 4.2                                     |              |      | 4.2                  |      | 4.2                   |      |      |  |
| V <sub>IL</sub> | Low Level Input Voltage   | 2.0                    |                                                                  |                         |                                         |              | 0.5  |                      | 0.5  |                       | 0.5  | V    |  |
|                 |                           | 4.5                    |                                                                  |                         |                                         | 1.35         |      | 1.35                 |      | 1.35                  |      |      |  |
|                 |                           | 6.0                    |                                                                  |                         |                                         | 1.8          |      | 1.8                  |      | 1.8                   |      |      |  |
| V <sub>OH</sub> | High Level Output Voltage | 2.0                    | V <sub>I</sub> =<br>V <sub>IH</sub><br>or<br>V <sub>IL</sub>     | I <sub>O</sub> =-20 μA  | 1.9                                     | 2.0          |      | 1.9                  |      | 1.9                   |      | V    |  |
|                 |                           | 4.5                    |                                                                  |                         | 4.4                                     | 4.5          |      | 4.4                  |      | 4.4                   |      |      |  |
|                 |                           | 6.0                    |                                                                  |                         | 5.9                                     | 6.0          |      | 5.9                  |      | 5.9                   |      |      |  |
|                 |                           | 4.5                    |                                                                  | I <sub>O</sub> =-6.0 mA | 4.18                                    | 4.31         |      | 4.13                 |      | 4.10                  |      |      |  |
|                 |                           | 6.0                    |                                                                  | I <sub>O</sub> =-7.8 mA | 5.68                                    | 5.8          |      | 5.63                 |      | 5.60                  |      |      |  |
| V <sub>OL</sub> | Low Level Output Voltage  | 2.0                    | V <sub>I</sub> =<br>V <sub>IH</sub><br>or<br>V <sub>IL</sub>     | I <sub>O</sub> = 20 μA  |                                         | 0.0          | 0.1  |                      | 0.1  |                       | 0.1  | V    |  |
|                 |                           | 4.5                    |                                                                  |                         |                                         | 0.0          | 0.1  |                      | 0.1  |                       | 0.1  |      |  |
|                 |                           | 6.0                    |                                                                  |                         |                                         | 0.0          | 0.1  |                      | 0.1  |                       | 0.1  |      |  |
|                 |                           | 4.5                    |                                                                  | I <sub>O</sub> = 6.0 mA |                                         | 0.17         | 0.26 |                      | 0.33 |                       | 0.40 |      |  |
|                 |                           | 6.0                    |                                                                  | I <sub>O</sub> = 7.8 mA |                                         | 0.18         | 0.26 |                      | 0.33 |                       | 0.40 |      |  |
| I <sub>I</sub>  | Input Leakage Current     | 6.0                    | V <sub>I</sub> = V <sub>CC</sub> or GND<br>V <sub>I</sub> = 15 V |                         |                                         | ±0.1<br>±0.5 |      | ±1<br>±5             |      | ±1                    | μA   |      |  |
| I <sub>CC</sub> | Quiescent Supply Current  | 6.0                    | V <sub>I</sub> = V <sub>CC</sub> or GND                          |                         |                                         | 1            |      | 10                   |      | 20                    | μA   |      |  |

AC ELECTRICAL CHARACTERISTICS ( $C_L = 50 \text{ pF}$ , Input  $t_r = t_f = 6 \text{ ns}$ )

| Symbol                               | Parameter                     | Test Conditions        |                        |  | Value                                   |      |      |                      |      |                       | Unit |      |
|--------------------------------------|-------------------------------|------------------------|------------------------|--|-----------------------------------------|------|------|----------------------|------|-----------------------|------|------|
|                                      |                               | V <sub>CC</sub><br>(V) | C <sub>L</sub><br>(pF) |  | T <sub>A</sub> = 25 °C<br>54HC and 74HC |      |      | -40 to 85 °C<br>74HC |      | -55 to 125 °C<br>54HC |      |      |
|                                      |                               |                        |                        |  | Min.                                    | Typ. | Max. | Min.                 | Max. | Min.                  |      | Max. |
| t <sub>TLH</sub><br>t <sub>THL</sub> | Output Transition Time        | 2.0                    | 50                     |  |                                         | 25   | 60   |                      | 75   |                       | 90   | ns   |
|                                      |                               | 4.5                    |                        |  |                                         | 7    | 12   |                      | 15   |                       | 18   |      |
|                                      |                               | 6.0                    |                        |  |                                         | 6    | 10   |                      | 13   |                       | 15   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay Time        | 2.0                    | 50                     |  |                                         | 30   | 75   |                      | 95   |                       | 115  | ns   |
|                                      |                               | 4.5                    |                        |  |                                         | 9    | 15   |                      | 19   |                       | 23   |      |
|                                      |                               | 6.0                    |                        |  |                                         | 8    | 13   |                      | 16   |                       | 20   |      |
|                                      |                               | 2.0                    | 150                    |  |                                         | 45   | 100  |                      | 125  |                       | 150  | ns   |
|                                      |                               | 4.5                    |                        |  |                                         | 14   | 20   |                      | 25   |                       | 30   |      |
|                                      |                               | 6.0                    |                        |  |                                         | 12   | 17   |                      | 21   |                       | 26   |      |
| C <sub>IN</sub>                      | Input Capacitance             |                        |                        |  |                                         | 5    | 10   |                      | 10   |                       | 10   | pF   |
| C <sub>PD</sub> (*)                  | Power Dissipation Capacitance |                        |                        |  |                                         | 26   |      |                      |      |                       |      | pF   |

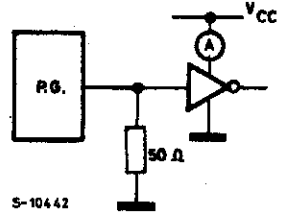
$C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$  (per Gate)

## SWITCHING CHARACTERISTICS TEST WAVEFORM

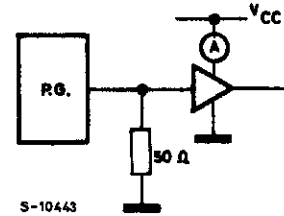


TEST CIRCUIT  $I_{CC}$  (Opr.)

HC4049



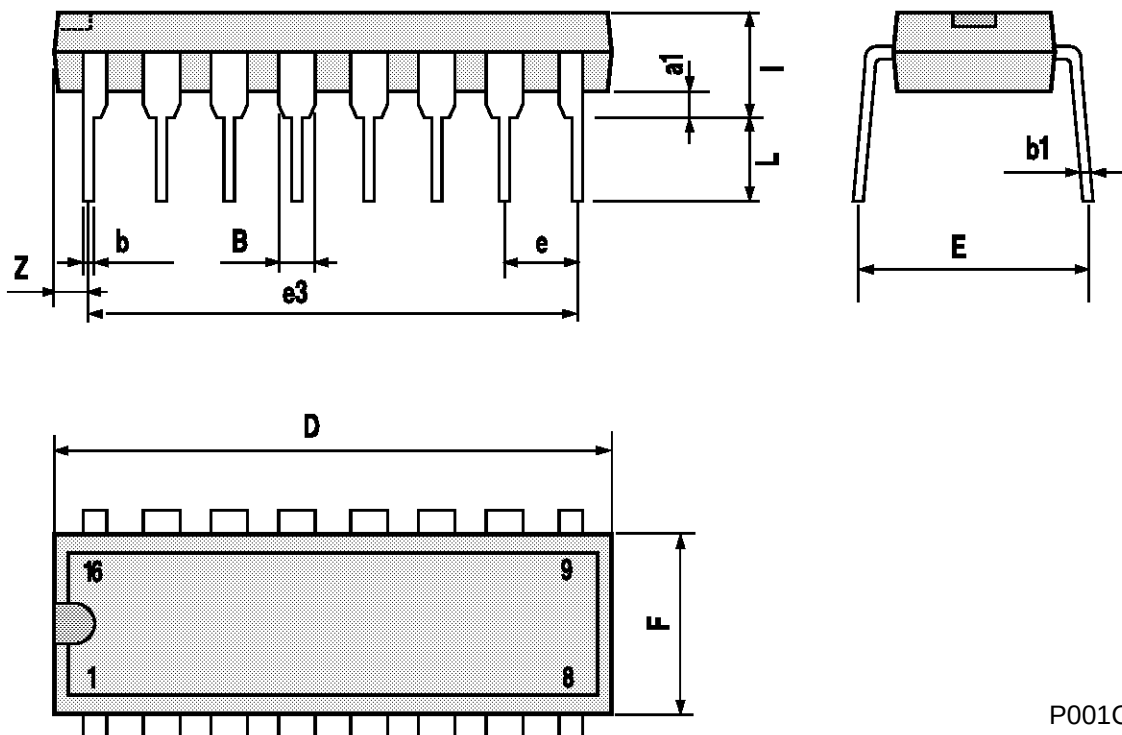
HC4050



INPUT WAVEFORM IS THE SAME AS THAT IN CASE OF SWITCHING CHARACTERISTICS TEST.

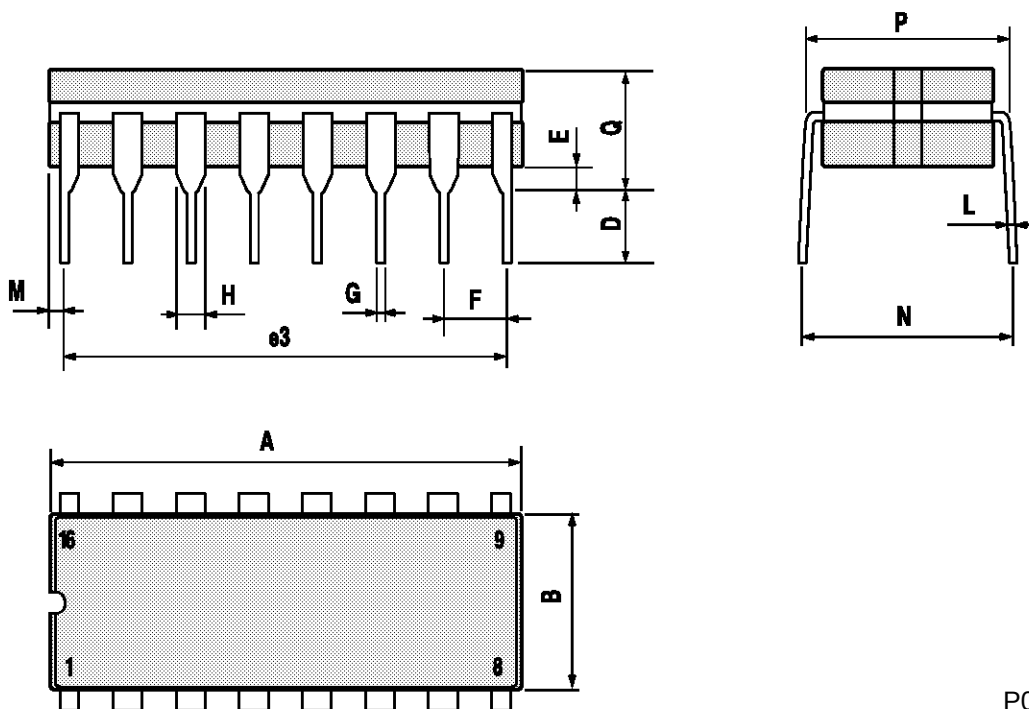
## Plastic DIP16 (0.25) MECHANICAL DATA

| 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 |



## 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 |

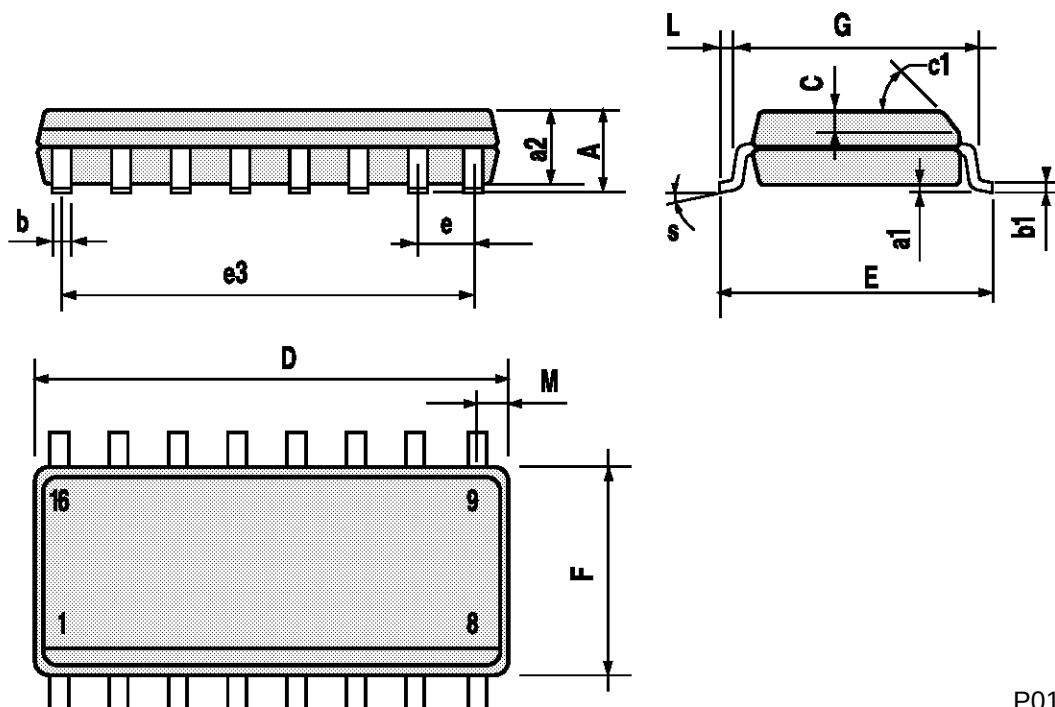


P053D



## SO16 (Narrow) MECHANICAL DATA

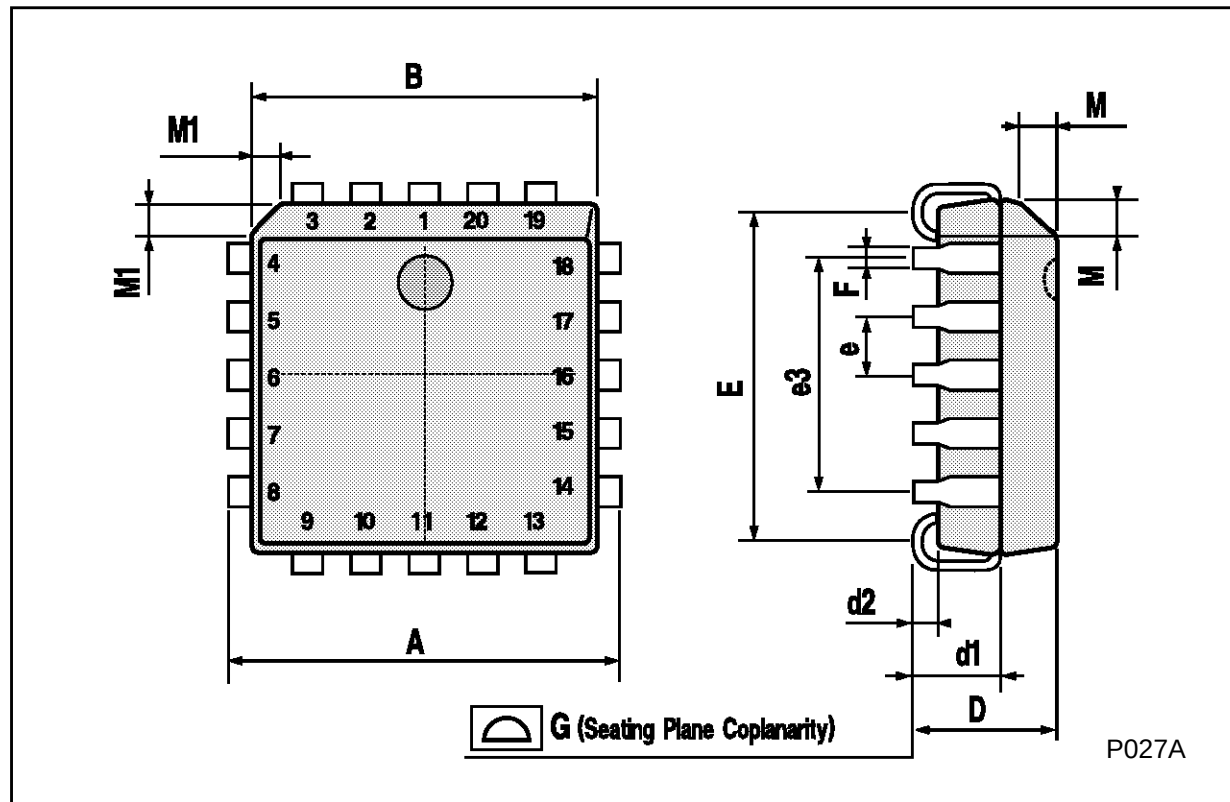
| DIM. | mm         |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.004 |       | 0.007 |
| 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 |       |



Information furnished is believed to be accurate and reliable. However, SGS-THOMSON Microelectronics 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 SGS-THOMSON Microelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. SGS-THOMSON Microelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of SGS-THOMSON Microelectronics.

© 1994 SGS-THOMSON Microelectronics - All Rights Reserved

SGS-THOMSON Microelectronics GROUP OF COMPANIES

Australia - Brazil - France - Germany - Hong Kong - Italy - Japan - Korea - Malaysia - Malta - Morocco - The Netherlands -  
Singapore - Spain - Sweden - Switzerland - Taiwan - Thailand - United Kingdom - U.S.A