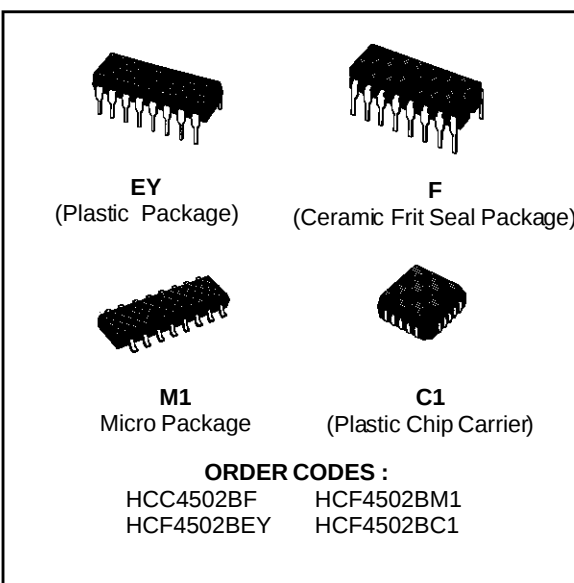


**STROBED HEX INVERTER/BUFFER**

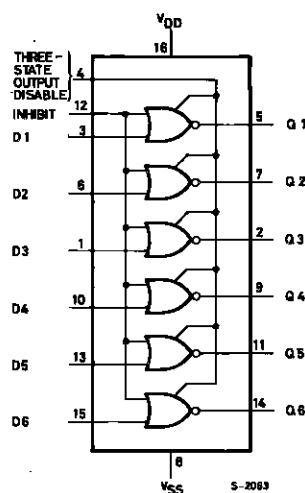
- 2 TTL-LOAD OUTPUT DRIVE CAPABILITY
- 3-STATE OUTPUTS
- COMMON OUTPUT-DISABLE CONTROL
- INHIBIT CONTROL
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N°. 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"



**DESCRIPTION**

The **HCC4502B** (extended temperature range) and **HCF4502B** (intermediate temperature range) are monolithic integrated circuit, available in 16-lead dual in-line plastic or ceramic package and plastic micro package. The **HCC/HCF 4502B** consists of six inverter-buffers with 3-state outputs. A logic "1" on the OUTPUT DISABLE input produces a high-impedance state in all six outputs. This feature permits common busing of the outputs, thus simplifying system design. A logic "1" on the INHIBIT input switches all six outputs to logic "0" if the OUTPUT DISABLE input is a logic "0". This device is capable of driving two standard TTL loads, which is equivalent to six times the JEDEC "B" series  $I_{OL}$  standard.

**PIN CONNECTIONS**



**ABSOLUTE MAXIMUM RATINGS**

| Symbol     | Parameter                                                                                                                   | Value                   | Unit |
|------------|-----------------------------------------------------------------------------------------------------------------------------|-------------------------|------|
| $V_{DD}^*$ | Supply Voltage : <b>HCC</b> Types<br><b>HCF</b> Types                                                                       | – 0.5 to + 20           | V    |
|            |                                                                                                                             | – 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                     | mW   |
|            |                                                                                                                             | 100                     | mW   |
| $T_{op}$   | Operating Temperature : <b>HCC</b> Types<br><b>HCF</b> Types                                                                | – 55 to + 125           | °C   |
|            |                                                                                                                             | – 40 to + 85            | °C   |
| $T_{stg}$  | Storage Temperature                                                                                                         | – 65 to + 150           | °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     | V    |
|          |                                                              | 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 | °C   |
|          |                                                              | – 40 to + 85  | °C   |

**TRUTH TABLE**

| Disable | Inhibit | Dn | Qn |
|---------|---------|----|----|
| 0       | 0       | 0  | 1  |
| 0       | 0       | 1  | 0  |
| 0       | 1       | X  | 0  |
| 1       | X       | X  | Z  |

X = don't care

Z = high impedance

Logic 1 = high

Logic 0 = low

## STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

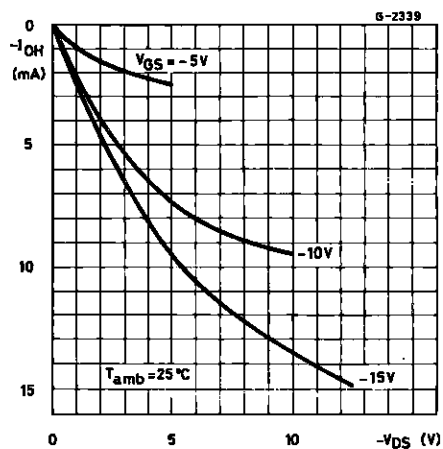
| Symbol                            | Parameter             |           | Test Conditions       |                       |                          |                        | Value              |       |       |                   |       |                     | Unit  |      |
|-----------------------------------|-----------------------|-----------|-----------------------|-----------------------|--------------------------|------------------------|--------------------|-------|-------|-------------------|-------|---------------------|-------|------|
|                                   |                       |           | V <sub>I</sub><br>(V) | V <sub>O</sub><br>(V) | I <sub>O</sub>  <br>(μA) | 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                      |                    | 1     |       | 0.02              | 1     |                     | 30    | μA   |
|                                   |                       |           | 0/10                  |                       |                          | 10                     |                    | 2     |       | 0.02              | 2     |                     | 60    |      |
|                                   |                       |           | 0/15                  |                       |                          | 15                     |                    | 4     |       | 0.02              | 4     |                     | 120   |      |
|                                   |                       |           | 0/20                  |                       |                          | 20                     |                    | 20    |       | 0.04              | 20    |                     | 600   |      |
|                                   |                       | HCF Types | 0/ 5                  |                       |                          | 5                      |                    | 4     |       | 0.02              | 4     |                     | 30    |      |
|                                   |                       |           | 0/10                  |                       |                          | 10                     |                    | 8     |       | 0.02              | 8     |                     | 60    |      |
|                                   |                       |           | 0/15                  |                       |                          | 15                     |                    | 16    |       | 0.02              | 16    |                     | 120   |      |
| V <sub>OH</sub>                   | Output High 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>                   | 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                      | −1.53              |       | −1.36 | − 3.2             |       | − 1.1               |       |      |
|                                   |                       |           | 0/ 5                  | 4.6                   |                          | 5                      | −0.52              |       | −0.44 | − 1               |       | −0.36               |       |      |
|                                   |                       |           | 0/10                  | 9.5                   |                          | 10                     | − 1.3              |       | − 1.1 | − 2.6             |       | − 0.9               |       |      |
| I <sub>OL</sub>                   | Output Sink Current   | HCC Types | 0/ 5                  | 0.4                   |                          | 5                      | 3.84               |       | 3.06  | 6                 |       | 2.10                |       | mA   |
|                                   |                       |           | 0/10                  | 0.5                   |                          | 10                     | 9.6                |       | 7.8   | 15.6              |       | 5.4                 |       |      |
|                                   |                       |           | 0/15                  | 1.5                   |                          | 15                     | 25.2               |       | 20.4  | 40.8              |       | 14.4                |       |      |
|                                   |                       | HCF Types | 0/ 5                  | 0.4                   |                          | 5                      | 3.11               |       | 2.6   | 6                 |       | 2.10                |       |      |
|                                   |                       |           | 0/10                  | 0.5                   |                          | 10                     | 7.05               |       | 6.63  | 15.6              |       | 5.61                |       |      |
|                                   |                       |           | 0/15                  | 1.5                   |                          | 15                     | 20.4               |       | 17.3  | 40.8              |       | 14.2                |       |      |
|                                   |                       |           |                       |                       |                          |                        |                    |       |       |                   |       |                     |       |      |
| I <sub>IH</sub> , I <sub>IL</sub> | Input Leakage Current | HCC Types | 0/18                  | Any Input             |                          | 18                     |                    | ± 0.1 |       | ±10 <sup>−5</sup> | ± 0.1 |                     | ± 1   | μA   |
|                                   |                       | HCF Types | 0/15                  |                       |                          | 15                     |                    | ± 0.3 |       | ±10 <sup>−5</sup> | ± 0.3 |                     | ± 1   |      |
| I <sub>OH</sub> , I <sub>OL</sub> | 3-state Output        | HCC Types | 0/18                  |                       |                          | 18                     |                    | ± 0.4 |       | ±10 <sup>−4</sup> | ± 0.4 |                     | ± 12  | μA   |
|                                   |                       | HCF Types | 0/15                  |                       |                          | 15                     |                    | ± 1.0 |       | ±10 <sup>−4</sup> | ± 1.0 |                     | ± 7.5 |      |
| C <sub>I</sub>                    | Input Capacitance     |           |                       | Any Input             |                          |                        |                    |       |       | 5                 | 7.5   |                     |       | pF   |

\*  $T_{Low}$  = - 55°C for **HCC** device : - 40°C for **HCF** device.\*  $T_{High}$  = + 125°C for **HCC** device : + 85°C for **HCF** device.The Noise Margin for both "1" and "0" level is : 1V min. with  $V_{DD}$  = 5V, 2V min. with  $V_{DD}$  = 10V, 2.5 V min. with  $V_{DD}$  = 15V.

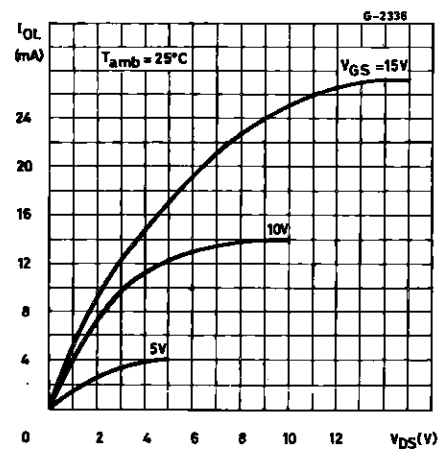
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$   
typical temperature coefficient for all  $V_{DD}$  values is  $0.3\text{ \%}/^{\circ}\text{C}$ , all input rise and fall times =  $20\text{ ns}$ )

| Symbol    | Parameter                                          | Test Conditions |              | Value |      |      | Unit |
|-----------|----------------------------------------------------|-----------------|--------------|-------|------|------|------|
|           |                                                    |                 | $V_{DD}$ (V) | Min.  | Typ. | Max. |      |
| $t_{PHL}$ | Data or Inhibit Delay Time                         |                 | 5            |       | 135  | 270  | ns   |
|           |                                                    |                 | 10           |       | 60   | 120  |      |
|           |                                                    |                 | 15           |       | 40   | 80   |      |
| $t_{PLH}$ | Data or Inhibit Delay Time                         |                 | 5            |       | 190  | 380  | ns   |
|           |                                                    |                 | 10           |       | 90   | 180  |      |
|           |                                                    |                 | 15           |       | 65   | 30   |      |
| $t_{PHZ}$ | Disable Delay Time (output high to high impedance) |                 | 5            |       | 60   | 120  | ns   |
|           |                                                    |                 | 10           |       | 40   | 80   |      |
|           |                                                    |                 | 15           |       | 30   | 60   |      |
| $t_{PZH}$ | Disable Delay Time (high impedance to output high) |                 | 5            |       | 110  | 220  | ns   |
|           |                                                    |                 | 10           |       | 50   | 100  |      |
|           |                                                    |                 | 15           |       | 40   | 80   |      |
| $t_{PLZ}$ | Disable Delay Time (output low to high impedance)  |                 | 5            |       | 125  | 250  | ns   |
|           |                                                    |                 | 10           |       | 65   | 130  |      |
|           |                                                    |                 | 15           |       | 55   | 110  |      |
| $t_{PZL}$ | Disable Delay Time (high impedance to output low)  |                 | 5            |       | 125  | 250  | ns   |
|           |                                                    |                 | 10           |       | 55   | 110  |      |
|           |                                                    |                 | 15           |       | 40   | 80   |      |
| $t_{TLH}$ | Transition Time                                    |                 | 5            |       | 100  | 200  | ns   |
|           |                                                    |                 | 10           |       | 50   | 100  |      |
|           |                                                    |                 | 15           |       | 40   | 80   |      |
| $t_{THL}$ | Transition Time                                    |                 | 5            |       | 60   | 120  | ns   |
|           |                                                    |                 | 10           |       | 30   | 60   |      |
|           |                                                    |                 | 15           |       | 20   | 40   |      |

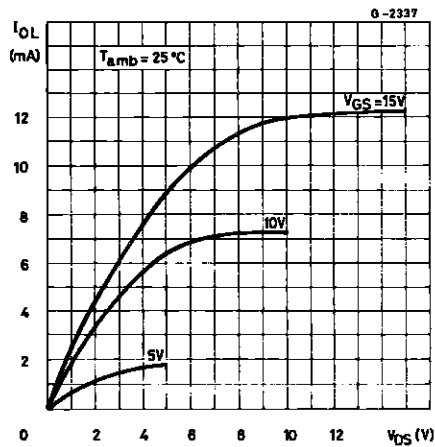
Minimum Output High (source) Current Characteristics.



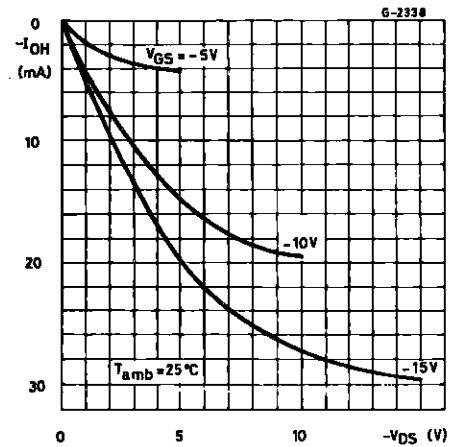
Typical Output Low (sink) Current.



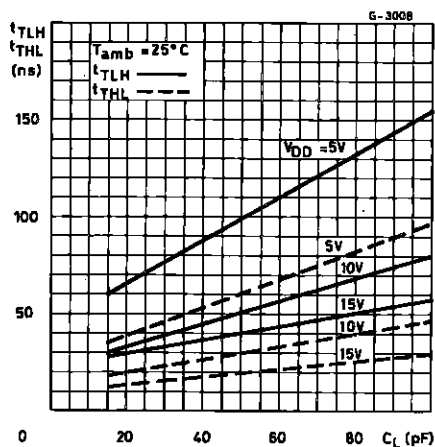
Minimum Output Low (sink) Current Characteristics.



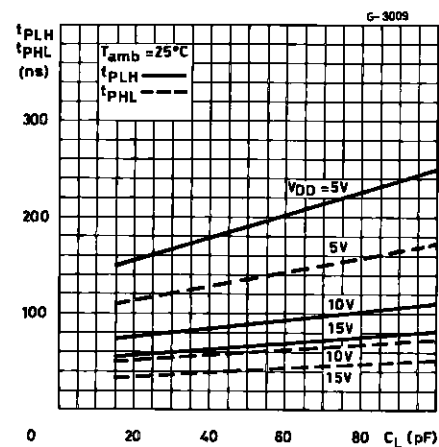
Typical Output High (source) Current Characteristics.



Typical Transition Time vs. Load Capacitance.

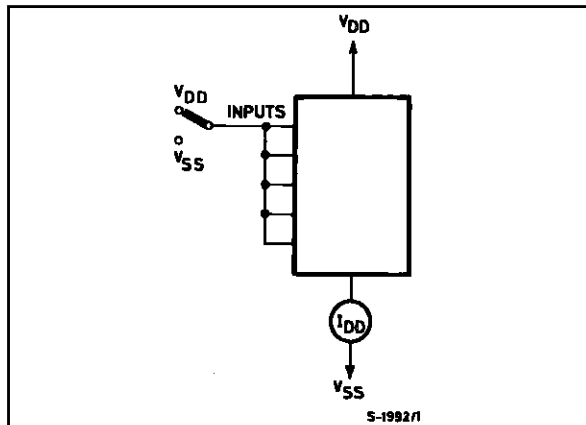


Typical Propagation Delay Time vs. Load Capacitance.

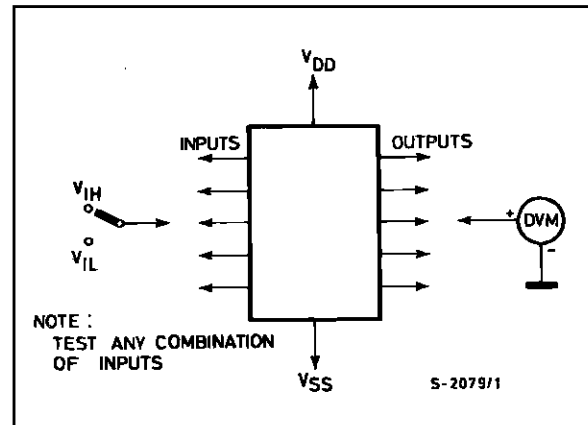


## TEST CIRCUIT

Quiescent Device Current.

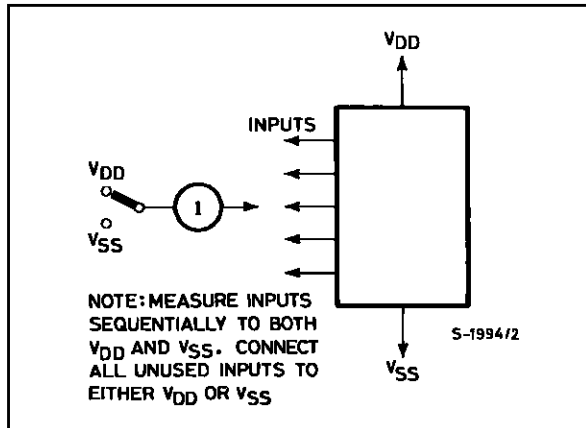


Input Voltage.



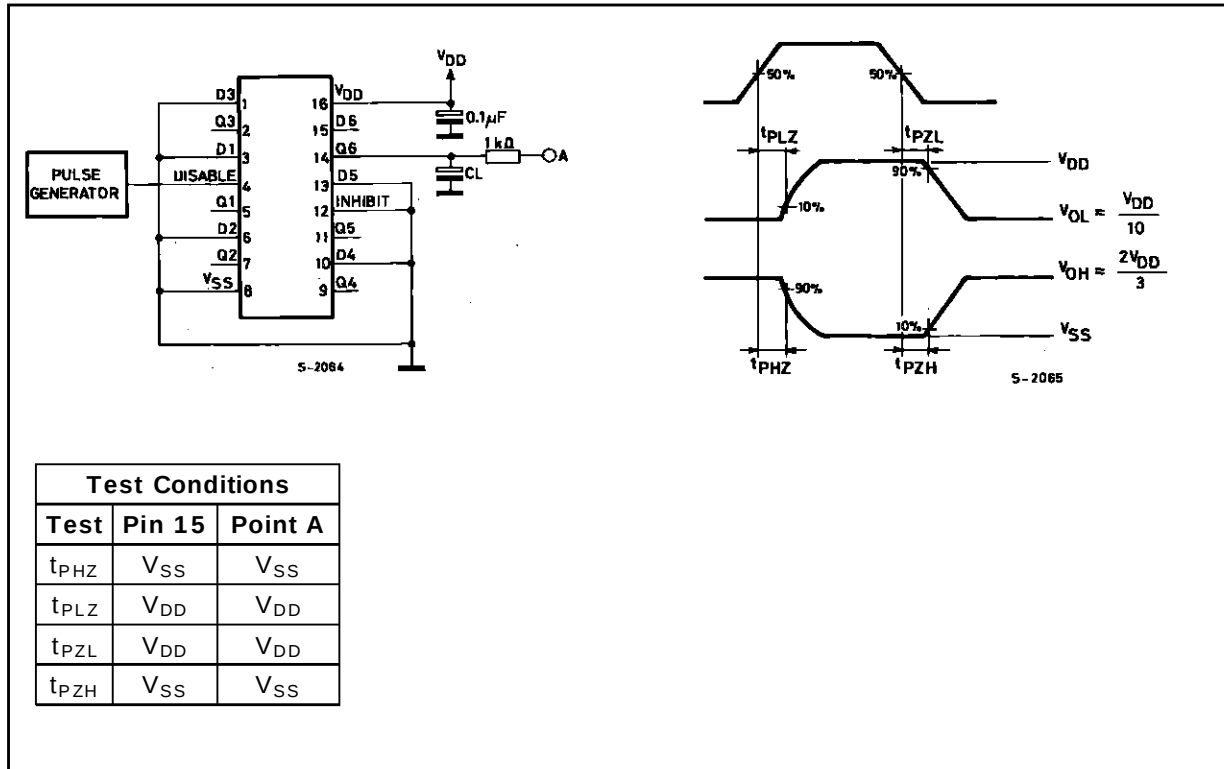
# TEST CIRCUIT (continued)

Input Leakage Current.



# TEST CIRCUIT AND WAVEFORMS

Disable Delay Time.



## Plastic DIP16 (0.25) MECHANICAL DATA

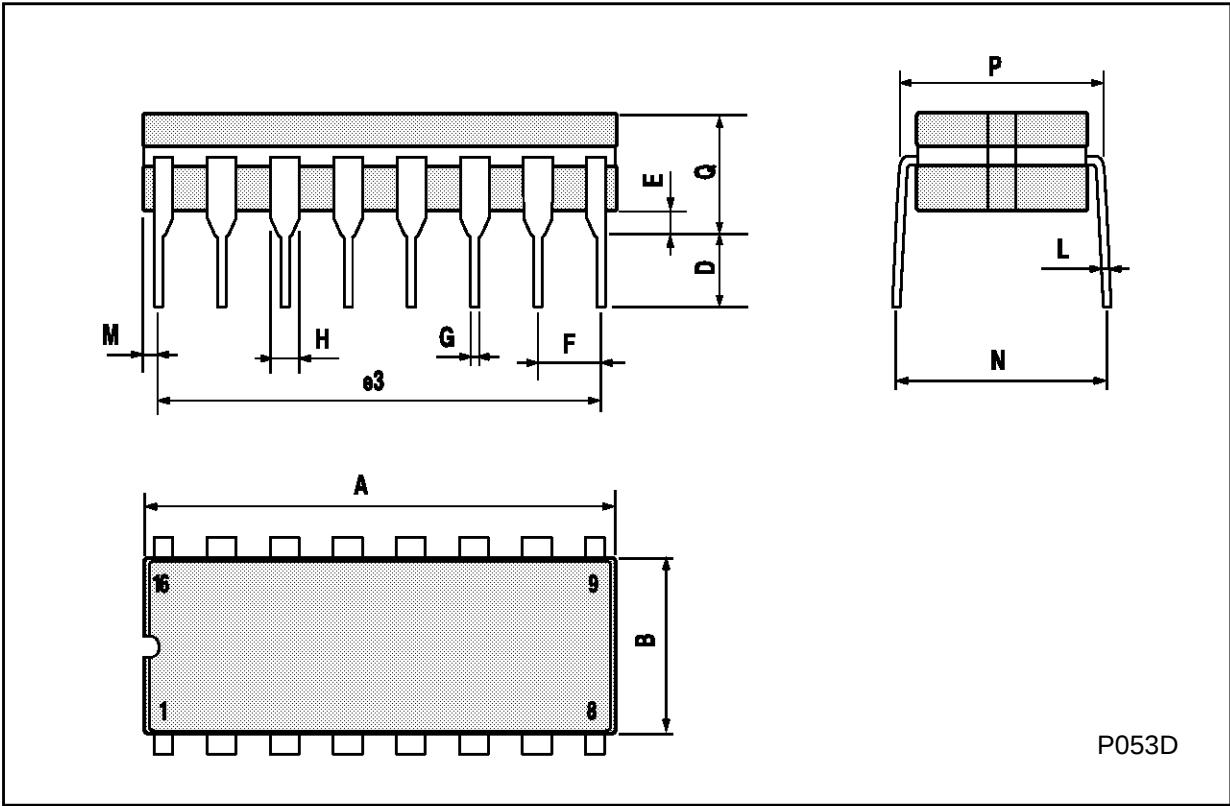
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |      |       | 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

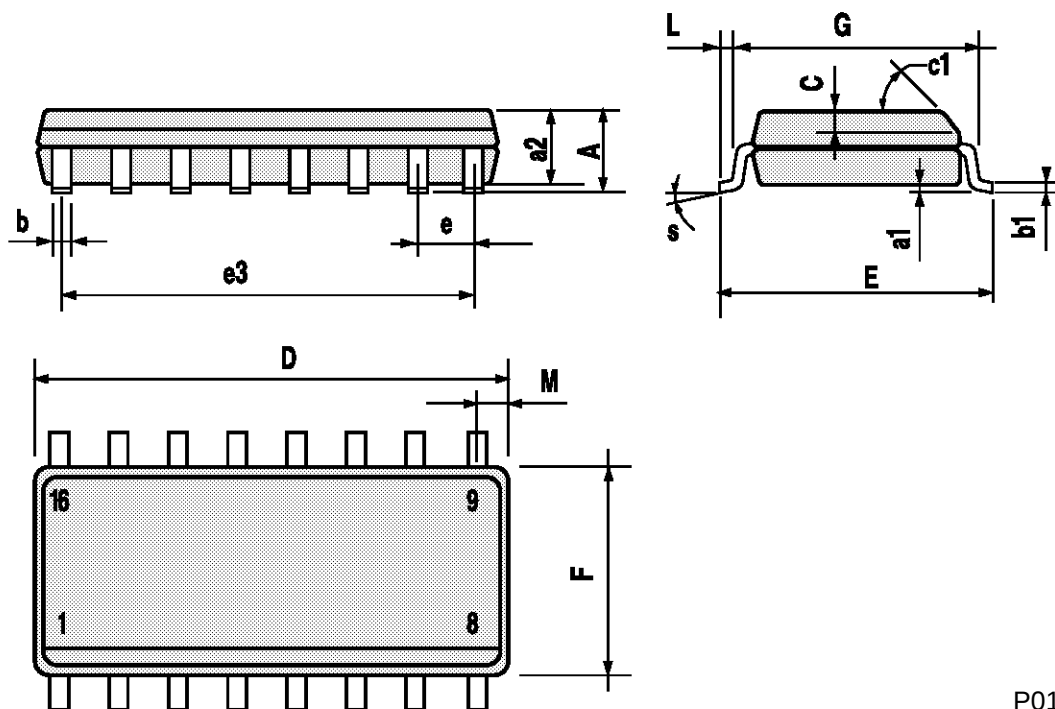
Ceramic DIP16/1 MECHANICAL DATA

| 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

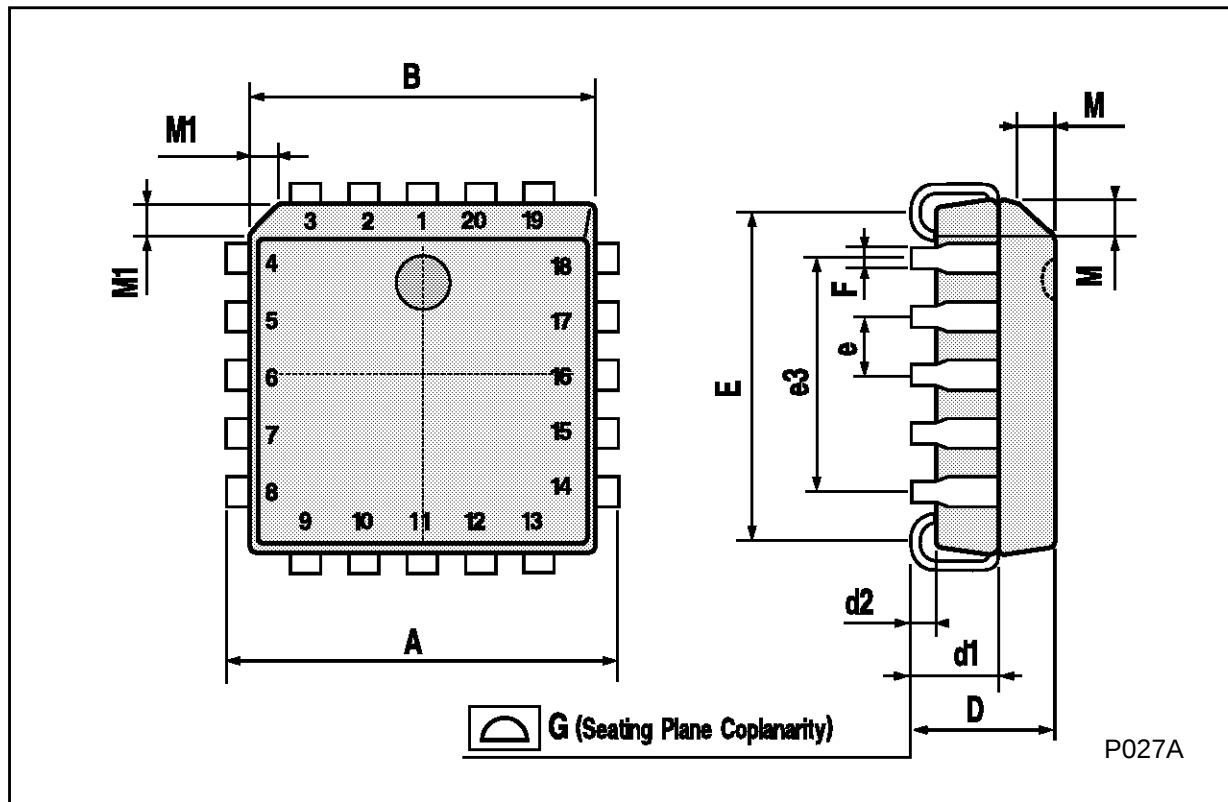
| DIM. | mm         |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.004 |       | 0.007 |
|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