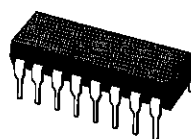
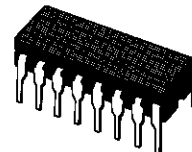


## 4-BIT MAGNITUDE COMPARATOR

- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- STANDARD B-SERIES OUTPUT DRIVE
- EXPANSION TO 8-16V...4 N BITS BY CASCADING UNITS
- MEDIUM SPEED OPERATION : COMPARES TWO 4-BIT WORDS IN 250ns (typ.) AT 10V
- 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"



**EY**  
(Plastic Package)



**F**  
(Ceramic Frit Seal Package)



**M1**  
(Micro Package)



**C1**  
(Plastic Chip Carrier)

### ORDER CODES :

|            |            |
|------------|------------|
| HCC4063BF  | HCF4063BM1 |
| HCF4063BEY | HCF4063BC1 |

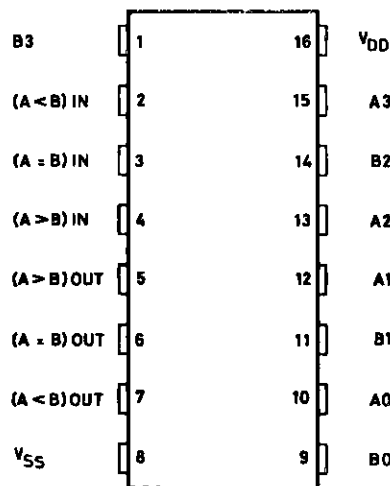
### DESCRIPTION

The **HCC4063B** (extended temperature range) and **HCF4063B** (intermediate temperature range) are available in 16-lead dual in-line plastic or ceramic package and plastic micro package. The **HCC/HCF4063B** is a low-power 4-bit magnitude comparator designed for use in computer and logic applications that require the comparison of two 4-bit words. This logic circuit determines whether one 4-bit word (Binary or BCD) is "less than", "equal to" or "greater than" a second 4-bit word. The **HCC/HCF4063B** has eight comparing inputs (A3, B3, through A0, B0), three outputs (A < B, A = B, A > B) and three cascading inputs (A < B, A = B, A > B) that permit systems designers to expand the comparator function to 8, 12, 16...4 N bits. When a single **HCC/HCF4063B** is used, the cascading inputs are connected as follows :

(A < B) = low, (A = B) = high, (A > B) = low.

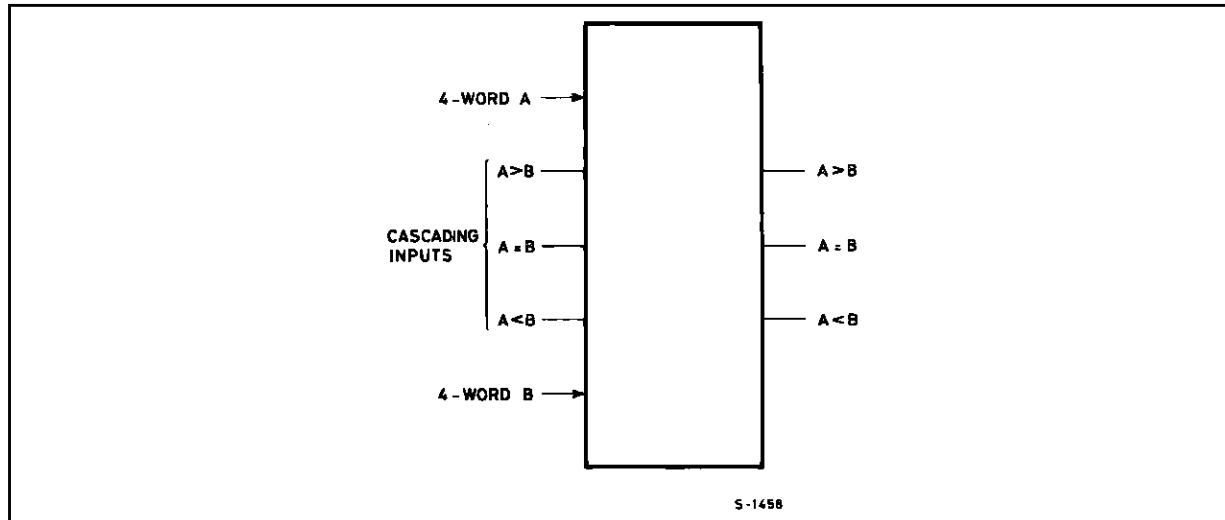
For words longer than 4 bits, **HCC/HCF4063B** devices may be cascaded by connecting the outputs of the less-significant comparator to the corresponding cascading inputs of the more-significant comparator. Cascading inputs (A < B, A = B, and A > B) on the least significant comparator are connected to a low, a high, and a low level, respectively.

### PIN CONNECTIONS



S-1488/1

## FUNCTIONAL DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

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

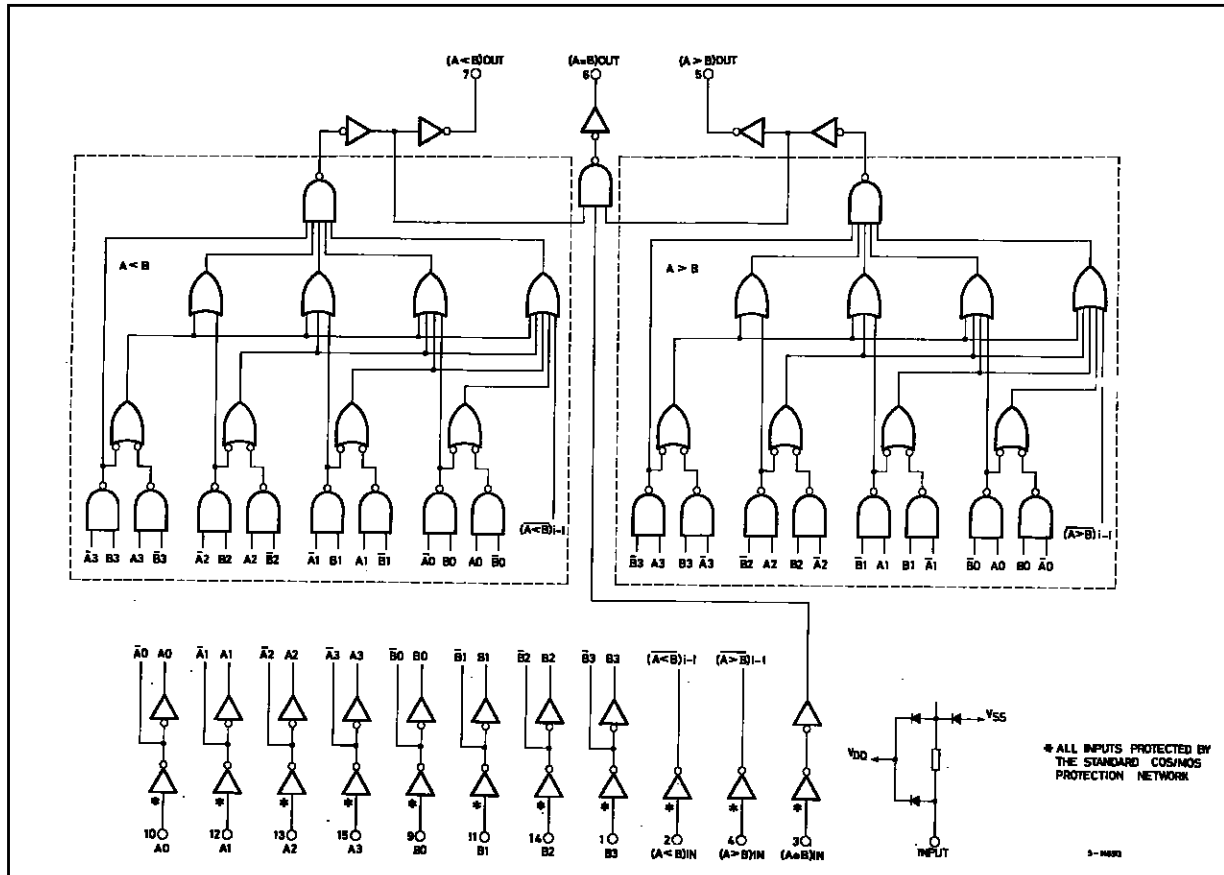
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure 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 : HCC Types<br>HCF Types        | 3 to 18       | V    |
|          |                                                | 3 to 15       | V    |
| $V_i$    | Input Voltage                                  | 0 to $V_{DD}$ | V    |
| $T_{op}$ | Operating Temperature : HCC Types<br>HCF Types | – 55 to + 125 | °C   |
|          |                                                | – 40 to + 85  | °C   |

## LOGIC DIAGRAM



## TRUTH TABLE

| Inputs    |         |         |         |           |       |       | Outputs |       |       |
|-----------|---------|---------|---------|-----------|-------|-------|---------|-------|-------|
| Comparing |         |         |         | Cascading |       |       |         |       |       |
| A3, B3    | A2, B2  | A1, B1  | A0, B0  | A < B     | A = B | A > B | A < B   | A = B | A > B |
| A3 > B3   | X       | X       | X       | X         | X     | X     | 0       | 0     | 1     |
| A3 = B3   | A2 > B2 | X       | X       | X         | X     | X     | 0       | 0     | 1     |
| A3 = B3   | A2 = B2 | A1 > B1 | X       | X         | X     | X     | 0       | 0     | 1     |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 > B0 | X         | X     | X     | 0       | 0     | 1     |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 = B0 | 0         | 0     | 1     | 0       | 0     | 1     |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 = B0 | 0         | 1     | 0     | 0       | 1     | 0     |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 = B0 | 1         | 0     | 0     | 1       | 0     | 0     |
| A3 = B3   | A2 = B2 | A1 = B1 | A0 < B0 | X         | X     | X     | 1       | 0     | 0     |
| A3 = B3   | A2 = B2 | A1 < B1 | X       | X         | X     | X     | 1       | 0     | 0     |
| A3 = B3   | A2 < B2 | X       | X       | X         | X     | X     | 1       | 0     | 0     |
| A3 < B3   | X       | X       | X       | X         | X     | X     | 1       | 0     | 0     |

X = Don't care

1 = High state

0 = Low state.

## STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

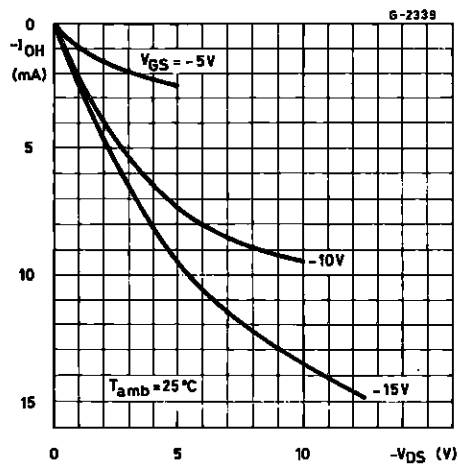
| Symbol                            | Parameter             |           | Test Conditions       |                       |                          |                        | Value              |       |                   |       |       |                     |      | Unit |
|-----------------------------------|-----------------------|-----------|-----------------------|-----------------------|--------------------------|------------------------|--------------------|-------|-------------------|-------|-------|---------------------|------|------|
|                                   |                       |           | 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                      |                    | 5     |                   | 0.04  | 5     |                     | 150  | μA   |
|                                   |                       |           | 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                      |                    | 20    |                   | 0.04  | 20    |                     | 150  |      |
|                                   |                       |           | 0/10                  |                       |                          | 10                     |                    | 40    |                   | 0.04  | 40    |                     | 300  |      |
|                                   |                       |           | 0/15                  |                       |                          | 15                     |                    | 80    |                   | 0.04  | 80    |                     | 600  |      |
| 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               |      |      |
|                                   |                       |           | 0/15                  | 13.5                  |                          | 15                     | − 3.6              |       | − 3.0             | − 6.8 |       | − 2.4               |      |      |
| 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                      | 0.52               |       | 0.44              | 1     |       | 0.36                |      |      |
|                                   |                       |           | 0/10                  | 0.5                   |                          | 10                     | 1.3                |       | 1.1               | 2.6   |       | 0.9                 |      |      |
|                                   |                       |           | 0/15                  | 1.5                   |                          | 15                     | 3.6                |       | 3.0               | 6.8   |       | 2.4                 |      |      |
| 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                 |      |      |
| 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.

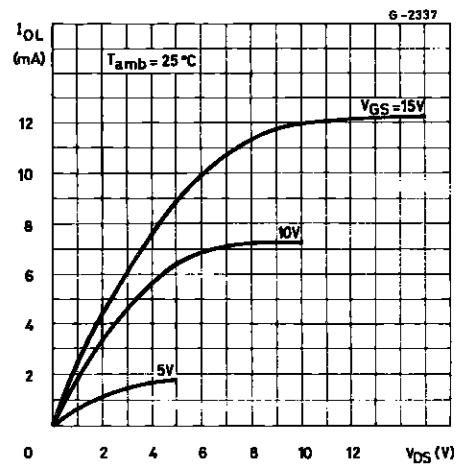
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{k}\Omega$ , typical temperature coefficient for all  $V_{DD}$  values is  $0.3\%/^{\circ}\text{C}$ , all input rise and fall times =  $20\text{ns}$ )

| Symbol                | Parameter              | Test Conditions             |              | Value |      |      | Unit |
|-----------------------|------------------------|-----------------------------|--------------|-------|------|------|------|
|                       |                        |                             | $V_{DD}$ (V) | Min.  | Typ. | Max. |      |
| $t_{PLH}$ , $t_{PHL}$ | Propagation Delay Time | Comparing Inputs to Outputs | 5            |       | 625  | 1250 | ns   |
|                       |                        |                             | 10           |       | 250  | 500  |      |
|                       |                        |                             | 15           |       | 175  | 350  |      |
|                       |                        | Cascading Inputs to Outputs | 5            |       | 500  | 1000 |      |
|                       |                        |                             | 10           |       | 200  | 400  |      |
|                       |                        |                             | 15           |       | 140  | 280  |      |
| $t_{TLH}$ , $t_{THL}$ | Transition Time        |                             | 5            |       | 100  | 200  | ns   |
|                       |                        |                             | 10           |       | 50   | 100  |      |
|                       |                        |                             | 15           |       | 40   | 80   |      |

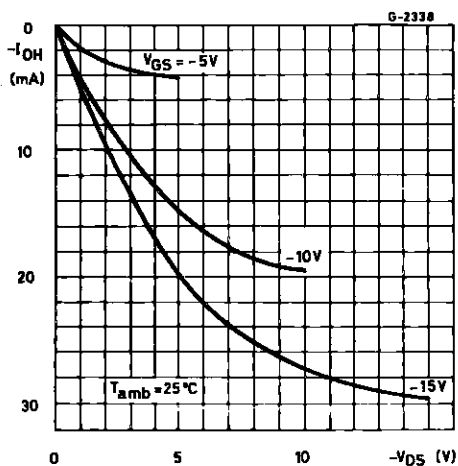
Minimum Output High (source) Current Characteristics.



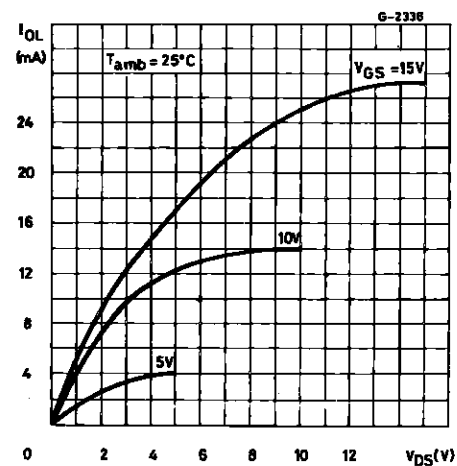
Minimum Output Low (sink) Current Characteristics.



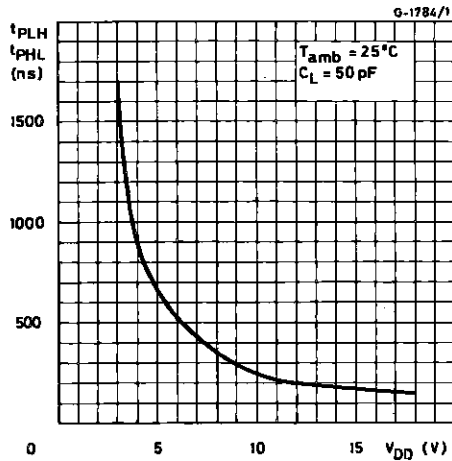
Typical Output High (source) Current Characteristics.



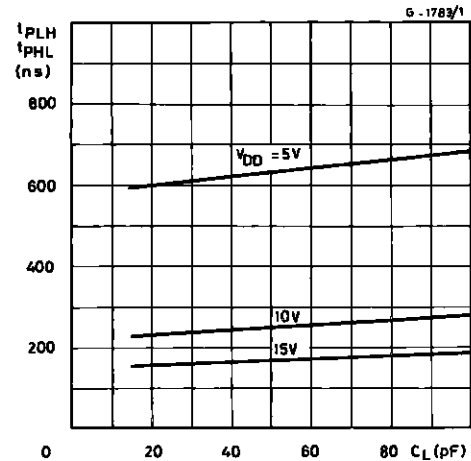
Typical Output Low (sink) Current Characteristics.



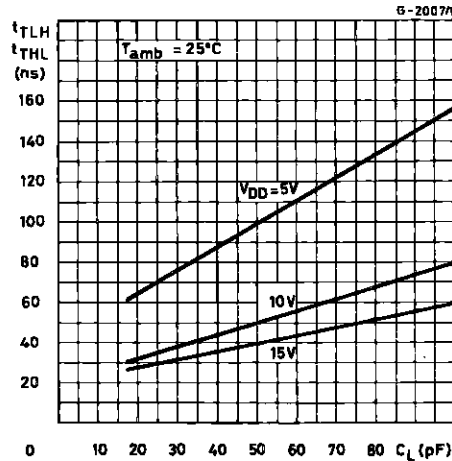
Typical Propagation Delay Time vs.  $V_{DD}$ .



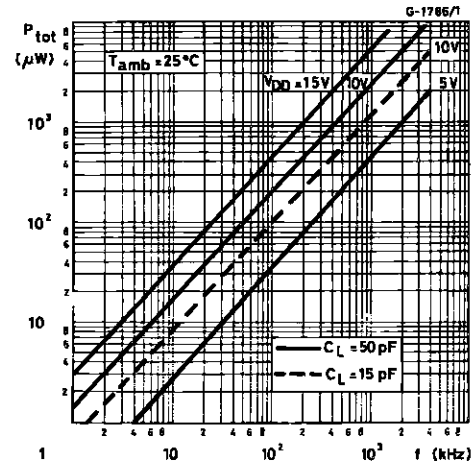
Typical Propagation Delay Time vs.  $C_L$ .



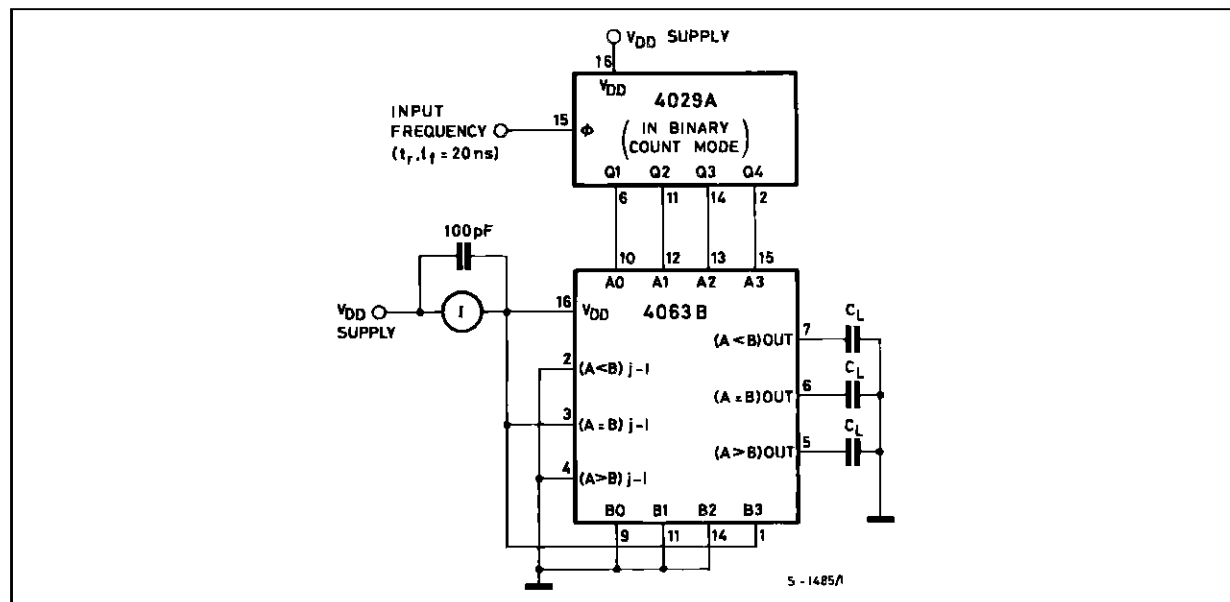
Typical Transition Time vs. Load Capacitance.



Typical Power Dissipation Characteristics.

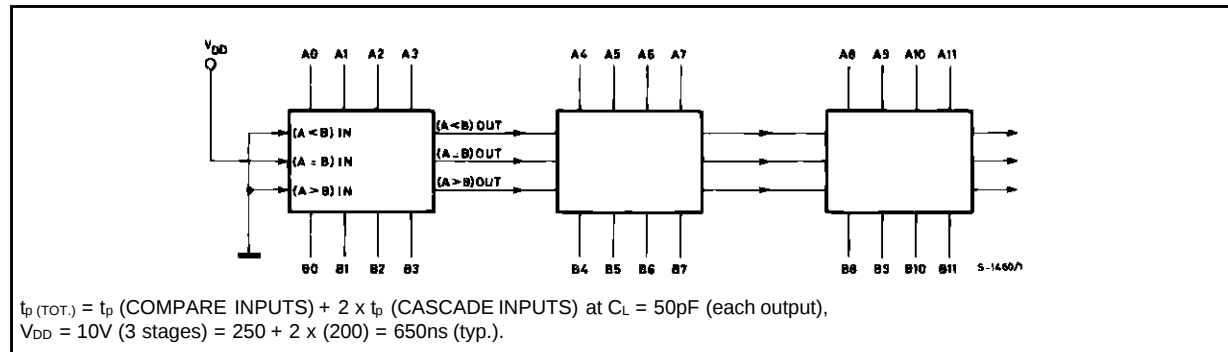


Dynamic Power Dissipation.



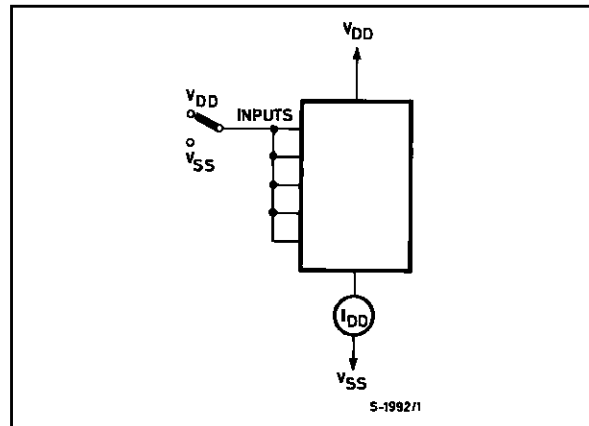
## TYPICAL APPLICATION

### TYPICAL SPEED CHARACTERISTICS OF A 12-BIT COMPARATOR

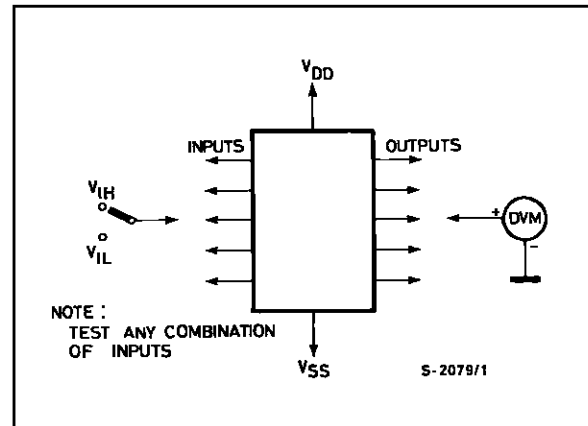


## TEST CIRCUITS

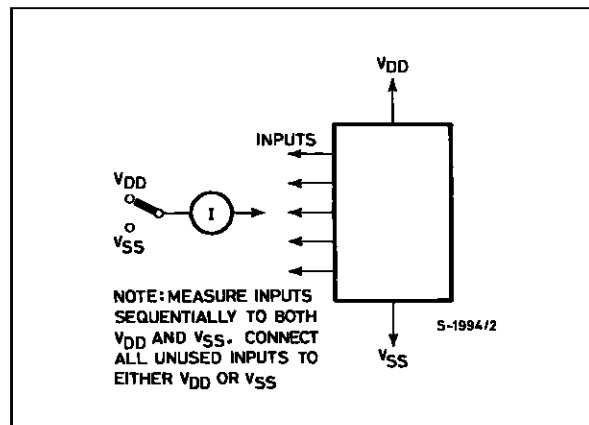
### Quiescent Device Current



### Noise Immunity.

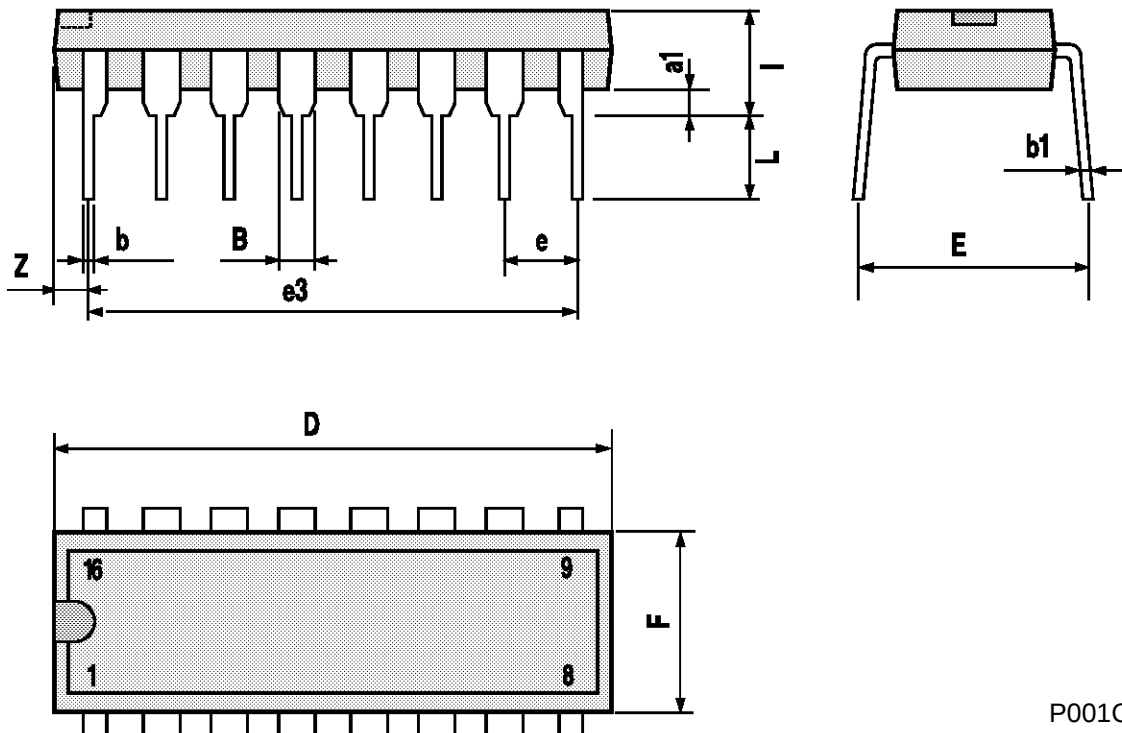


### Input Leakage Current.



## Plastic DIP16 (0.25) MECHANICAL DATA

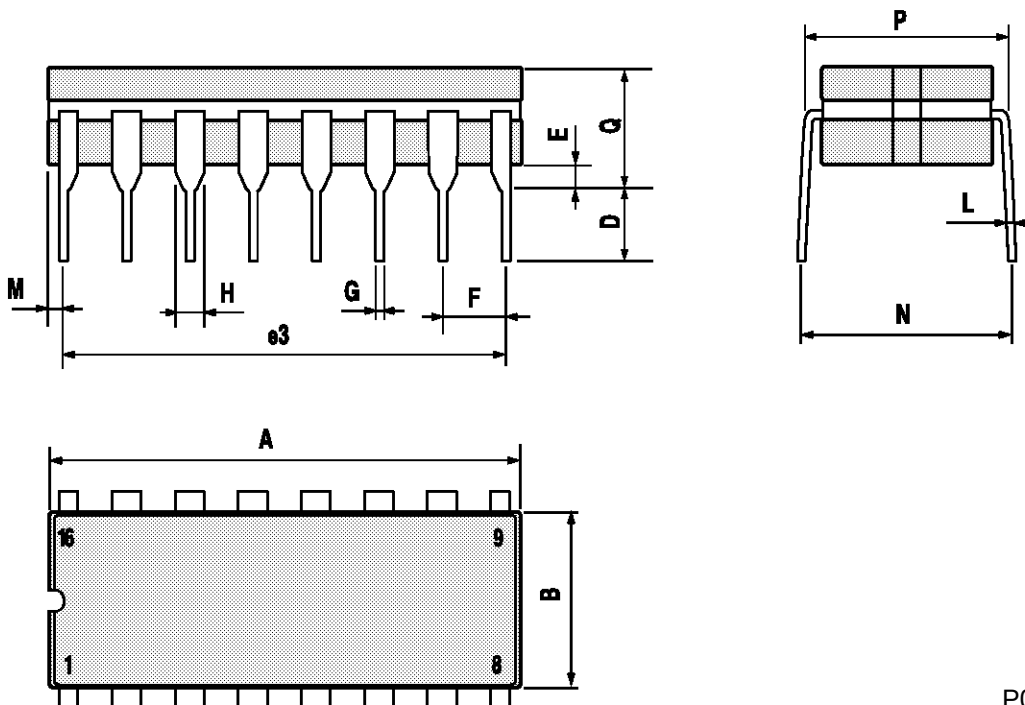
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |  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

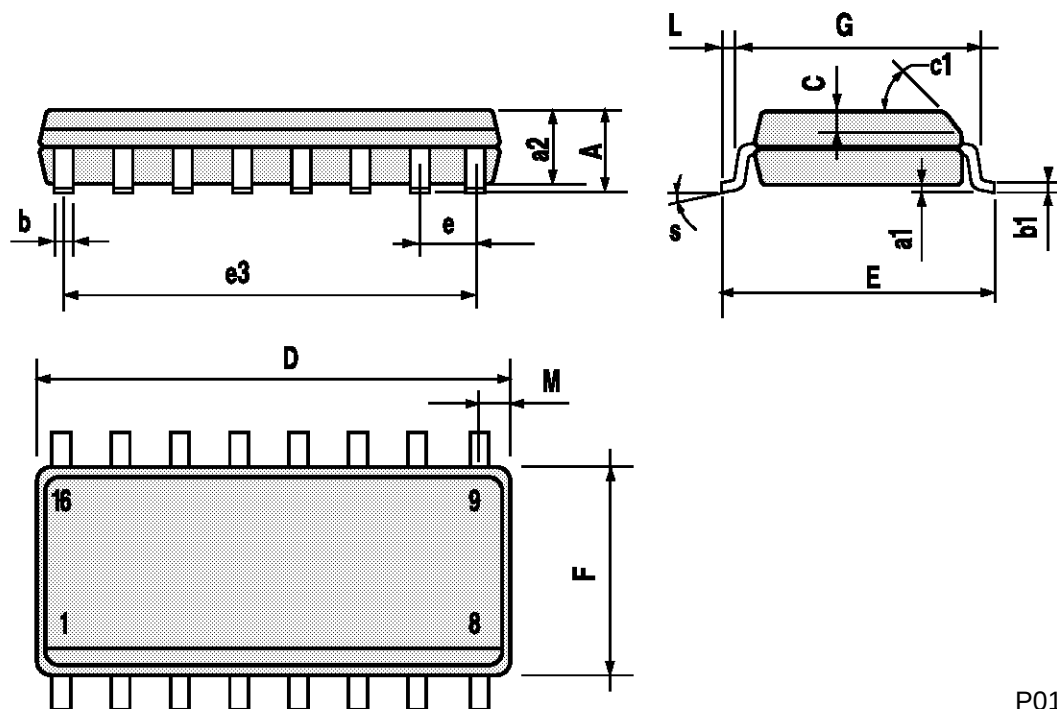
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |       | 20   |       |       | 0.787 |
| B    |      |       | 7    |       |       | 0.276 |
| D    |      | 3.3   |      |       | 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 |



P053D

## SO16 (Narrow) MECHANICAL DATA

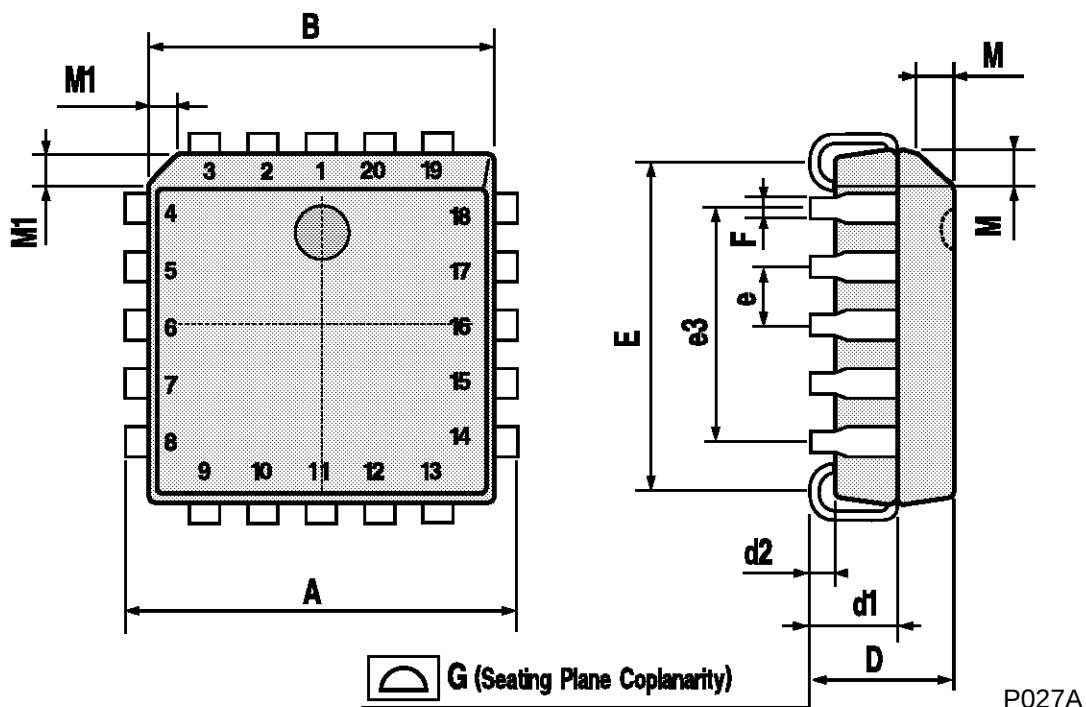
| DIM. | mm         |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.004 |       | 0.007 |
|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