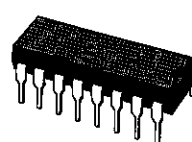
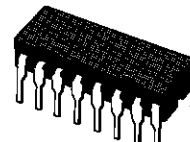


## DUAL-J-K MASTER-SLAVE FLIP-FLOP

- SET-RESET CAPABILITY
- STATIC FLIP-FLOP OPERATION - RETAINS STATE INDEFINITELY WITH CLOCK LEVEL EITHER "HIGH" OR "LOW"
- MEDIUM SPEED OPERATION - 16MHz (typ. clock toggle rate at 10V)
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- 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<sup>0</sup>. 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 :

|            |            |
|------------|------------|
| HCC4027BF  | HCF4027BM1 |
| HCF4027BEY | HCF4027BC1 |

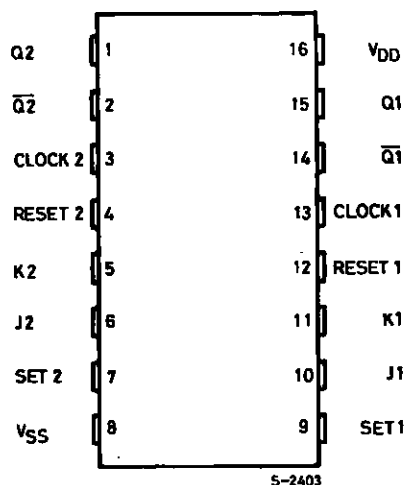
### DESCRIPTION

The **HCC4027B** (extended temperature range) and **HCF4027B** (intermediate temperature range) are monolithic integrated circuit, available in 16-lead dual in-line plastic or ceramic package and plastic micro package.

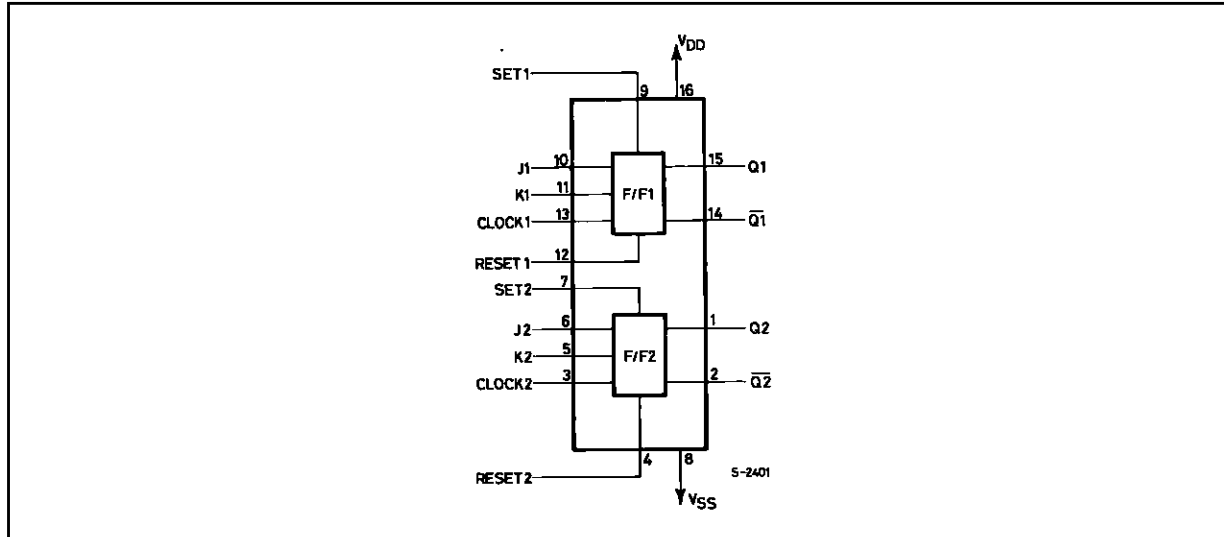
The **HCC/HCF4027B** is a single monolithic chip integrated circuit containing two identical complementary-symmetry J-K master-slave flip-flops. Each flip-flop has provisions for individual J, K, Set, Reset, and Clock input signals, Buffered Q and  $\bar{Q}$  signals are provided as outputs. This input-output arrangement provides for compatible operation with the **HCC/HCF4013B** dual D-type flip-flop.

The **HCC/HCF4027B** is useful in performing control, register, and toggle functions. Logic levels present at the J and K inputs along with internal self-steering control the state of each flip-flop ; changes in the flip-flop state are synchronous with the positive-going transition of the clock pulse. Set and reset functions are independent of the clock and are initiated when a high level signal is present at either the Set or Reset input.

### PIN CONNECTIONS



## FUNCTIONAL DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| 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<br>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)                                              | 200                            | mW       |
|            | Dissipation per Output Transistor<br>for $T_{op}$ = Full Package-temperature Range | 100                            | mW       |
| $T_{op}$   | Operating Temperature : <b>HCC</b> Types<br><b>HCF</b> Types                       | – 55 to + 125<br>– 40 to + 85  | °C<br>°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.

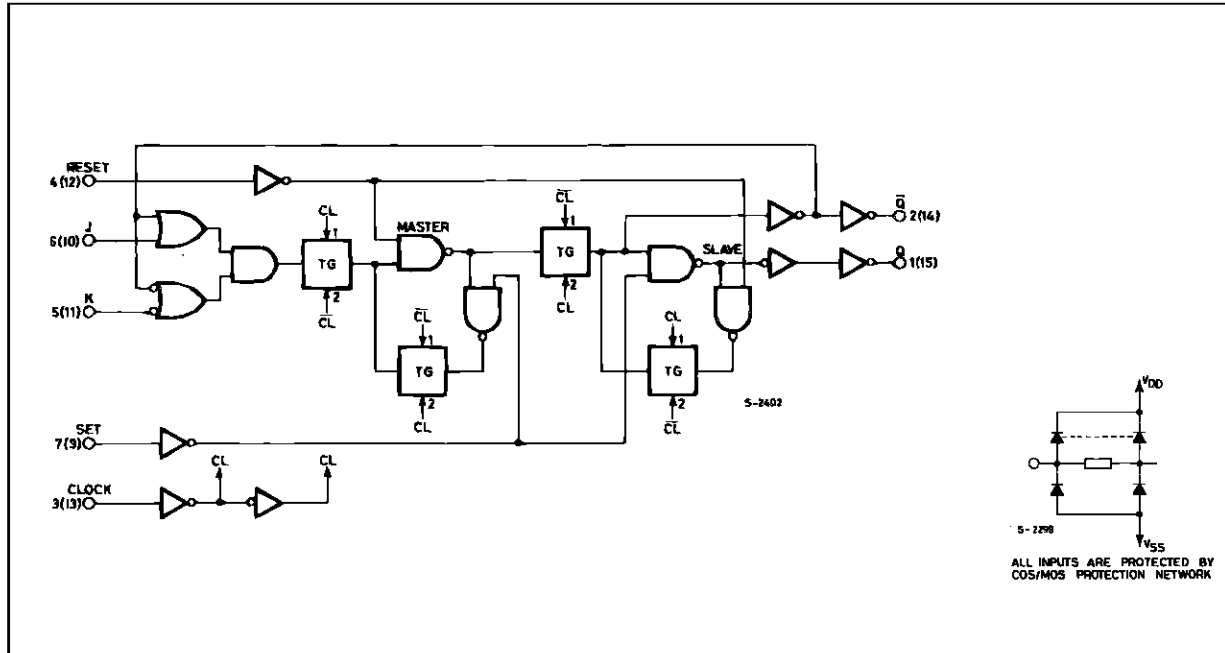
\* All voltage values are referred to  $V_{SS}$  pin voltage .

## RECOMMENDED OPERATING CONDITIONS

| Symbol   | Parameter                                                    | Value                         | Unit     |
|----------|--------------------------------------------------------------|-------------------------------|----------|
| $V_{DD}$ | Supply Voltage : <b>HCC</b> Types<br><b>HCF</b> Types        | 3 to 18<br>3 to 15            | V<br>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 | °C<br>°C |

### LOGIC DIAGRAM AND TRUTH TABLE

ONE OF TWO IDENTICAL J-K FLIP-FLOPS



## TRUTH TABLE

| Present State |   |   |   |        | CL $\Delta$   | Next State |                |             |
|---------------|---|---|---|--------|---------------|------------|----------------|-------------|
| Inputs        |   |   |   | Output |               | Outputs    |                |             |
| J             | K | S | R | Q      |               | Q          | $\overline{Q}$ |             |
| I             | X | O | O | O      | $\_ \nearrow$ | I          | O              |             |
| X             | O | O | O | I      | $\_ \nearrow$ | I          | O              |             |
| O             | X | O | O | O      | $\_ \nearrow$ | O          | I              |             |
| X             | I | O | O | I      | $\_ \nearrow$ | O          | I              |             |
| X             | X | O | O | X      | $\_ \searrow$ |            |                | ← No Change |
| X             | X | I | O | X      | X             | I          | O              |             |
| X             | X | O | I | X      | X             | O          | I              |             |
| X             | X | I | I | X      | X             | I          | I              |             |

LOGIC 1 = HIGH LEVEL  
LOGIC 0 = LOW LEVEL  
Δ - LEVEL CHANGE  
X - DON'T CARE

## 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               |      |      |
|                                   |                       |           | 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   |      |

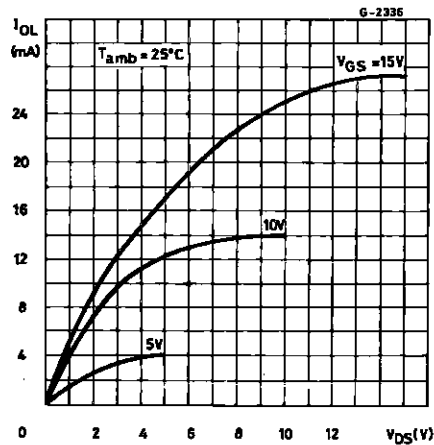
\* T<sub>Low</sub> = - 55°C for HCC device : - 40°C for HCF device.\* T<sub>High</sub> = + 125°C for HCC device : + 85°C for HCF device.The Noise Margin for both "1" and "0" level is : 1V min. with V<sub>DD</sub> = 5V, 2V min. with V<sub>DD</sub> = 10V, 2.5 V min. with V<sub>DD</sub> = 15V.

**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  $V_{DD} = 0.3\%/^{\circ}\text{C}$  values, all input rise and fall time = 20ns)

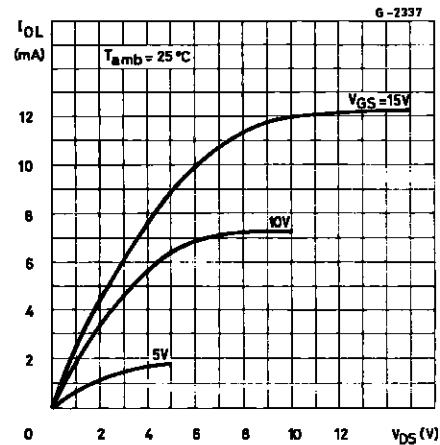
| Symbol                | Parameter                       |                                 | Test Conditions |              | Value |      |      | Unit          |
|-----------------------|---------------------------------|---------------------------------|-----------------|--------------|-------|------|------|---------------|
|                       |                                 |                                 |                 | $V_{DD}$ (V) | Min.  | Typ. | Max. |               |
| $t_{PLH}$ , $t_{PHL}$ | Propagation Delay Time          | Clock to Q or $\bar{Q}$ Outputs |                 | 5            |       | 150  | 300  | ns            |
|                       |                                 |                                 |                 | 10           |       | 65   | 130  |               |
|                       |                                 |                                 |                 | 15           |       | 45   | 90   |               |
| $t_{PLH}$             | Propagation Delay Time          | Set to Q or Reset to $\bar{Q}$  |                 | 5            |       | 150  | 300  | ns            |
|                       |                                 |                                 |                 | 10           |       | 65   | 130  |               |
|                       |                                 |                                 |                 | 15           |       | 45   | 90   |               |
| $t_{PHL}$             | Propagation Delay Time          | Set to $\bar{Q}$ or Reset to Q  |                 | 5            |       | 200  | 400  | ns            |
|                       |                                 |                                 |                 | 10           |       | 85   | 170  |               |
|                       |                                 |                                 |                 | 15           |       | 60   | 120  |               |
| $t_{THL}$ , $t_{TLH}$ | Transition Time                 |                                 |                 | 5            |       | 100  | 200  | ns            |
|                       |                                 |                                 |                 | 10           |       | 50   | 100  |               |
|                       |                                 |                                 |                 | 15           |       | 40   | 80   |               |
| $t_W$                 | Pulse Width                     | Clock                           |                 | 5            | 140   | 70   |      | ns            |
|                       |                                 |                                 |                 | 10           | 60    | 30   |      |               |
|                       |                                 |                                 |                 | 15           | 40    | 20   |      |               |
| $t_W$                 | Pulse Width                     | Set or Reset                    |                 | 5            | 180   | 90   |      | ns            |
|                       |                                 |                                 |                 | 10           | 80    | 40   |      |               |
|                       |                                 |                                 |                 | 15           | 50    | 25   |      |               |
| $t_r$ , $t_f$         | Clock Input Rise or Fall Time   |                                 |                 | 5            |       |      | 15   | $\mu\text{s}$ |
|                       |                                 |                                 |                 | 10           |       |      | 4    |               |
|                       |                                 |                                 |                 | 15           |       |      | 1    |               |
| $t_{setup}$           | Setup Time                      | Data                            |                 | 5            | 200   | 100  |      | ns            |
|                       |                                 |                                 |                 | 10           | 75    | 35   |      |               |
|                       |                                 |                                 |                 | 15           | 50    | 25   |      |               |
| $f_{max}$             | Maximum Clock Input Frequency * | Toggle Mode                     |                 | 5            | 3.5   | 7    |      | MHz           |
|                       |                                 |                                 |                 | 10           | 8     | 16   |      |               |
|                       |                                 |                                 |                 | 15           | 12    | 24   |      |               |

\* Input  $t_r$ ,  $t_f = 5\text{ns}$ .

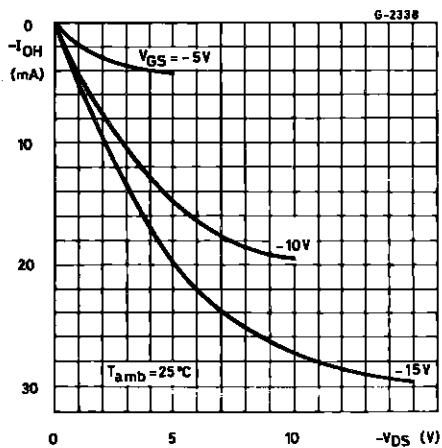
Typical Output Low (sink) Current Characteristics.



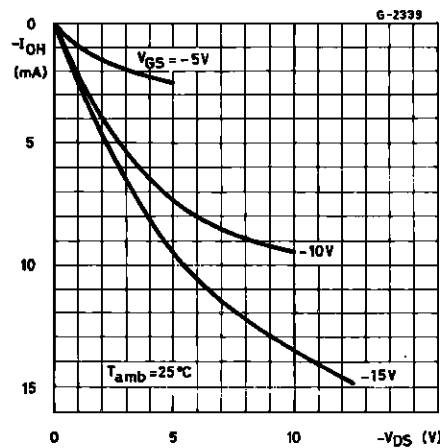
Minimum Output Low (sink) Current Characteristics.



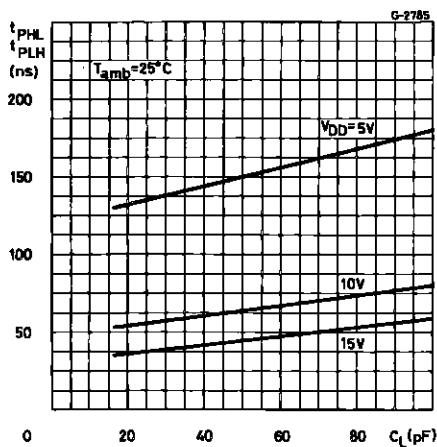
Typical Output High (source) Current Characteristics.



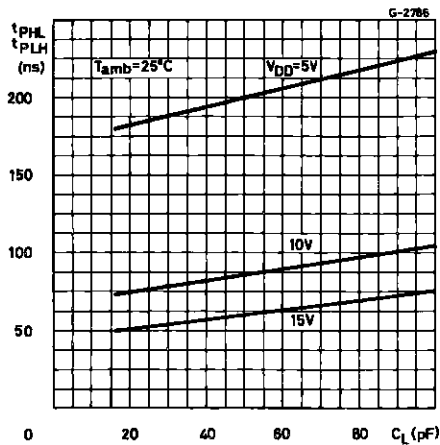
Minimum Output High (source) Current Characteristics.



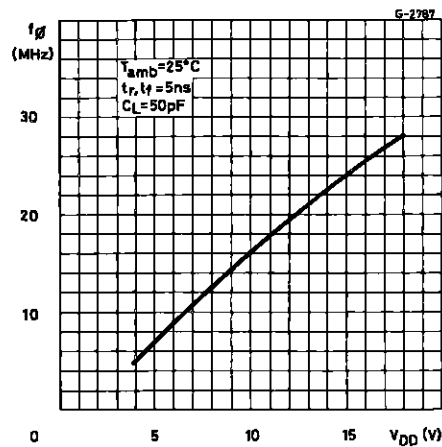
Typical Propagation Delay Time vs. Load Capacitance (CLOCK or SET to  $\bar{Q}$ , CLOCK or RESET to  $\bar{Q}$ ).



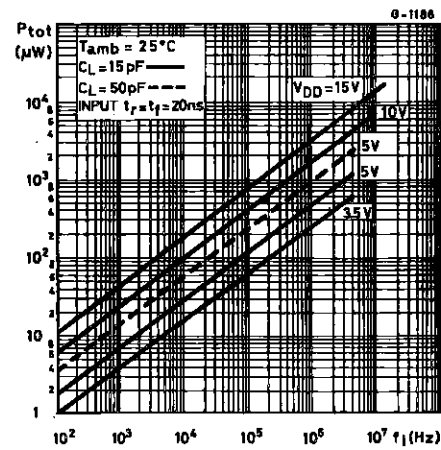
Typical Propagation Delay Time vs. Load Capacitance (SET to  $\bar{Q}$  or RESET to  $\bar{Q}$ ).



Typical Maximum Clock Frequency vs. Supply Voltage (Toggle Mode).

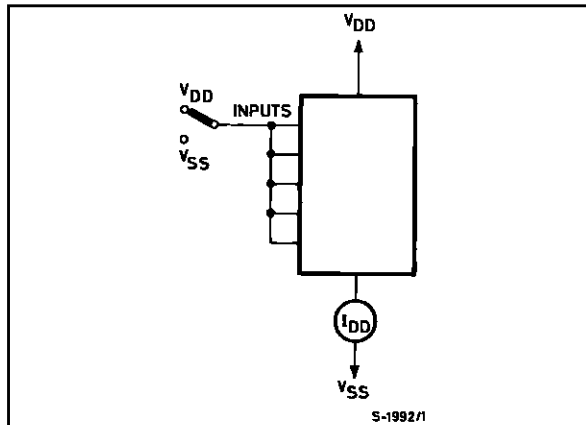


Typical Dynamic Power Dissipation/ Per Device vs. Frequency.

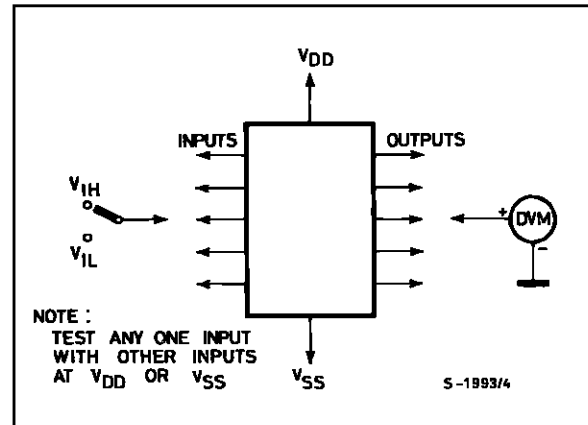


## TEST CIRCUITS

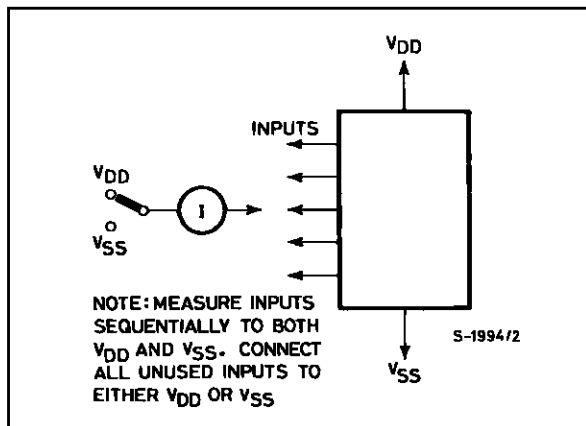
Quiescent Device Current.



Input Voltage.



Input Leakage Current.



## Plastic DIP16 (0.25) MECHANICAL DATA

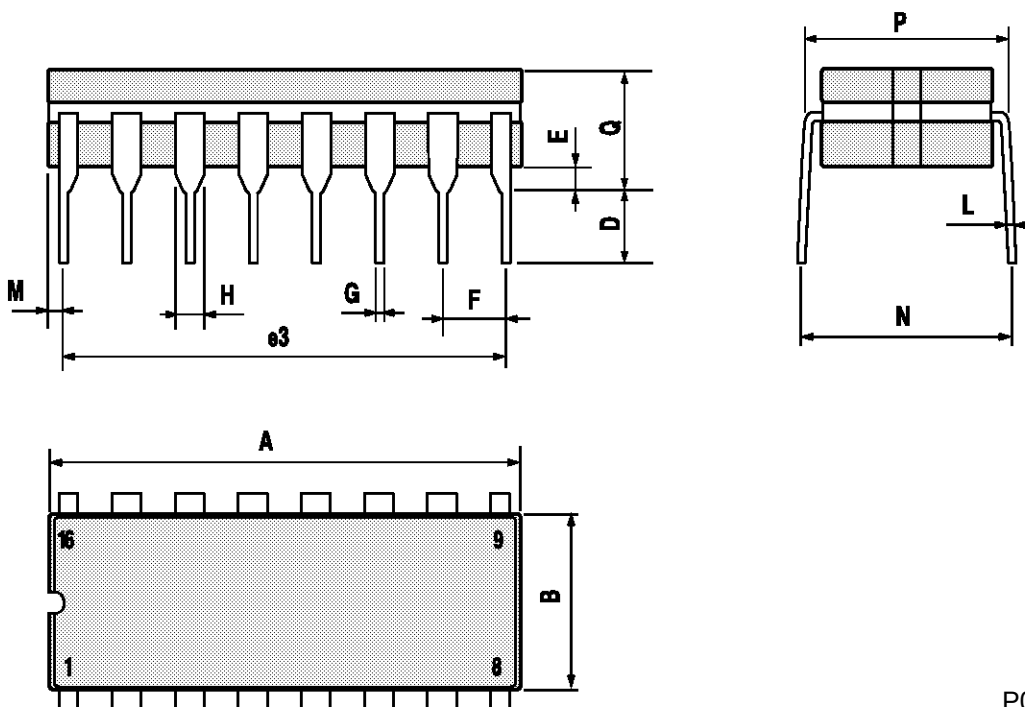
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |  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

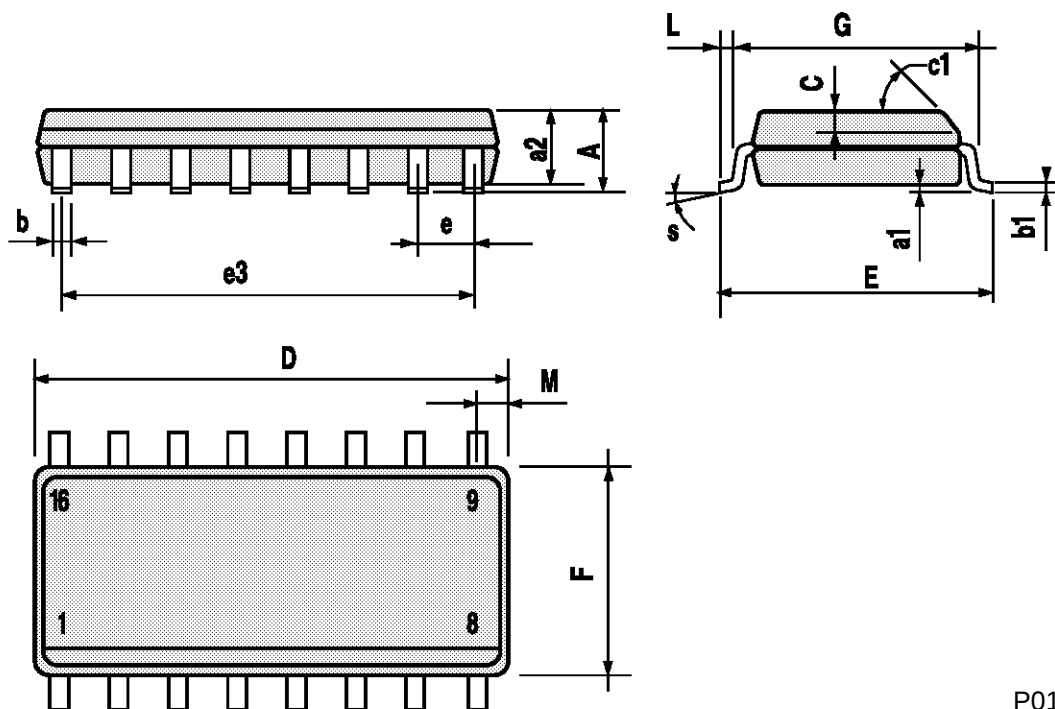
## Ceramic DIP16/1 MECHANICAL DATA

| 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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