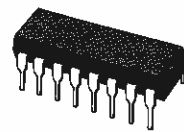




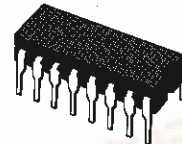
**M54HC4094**  
**M74HC4094**

## 8 BIT SIPO SHIFT LATCH REGISTER (3-STATE)

- HIGH SPEED  
 $f_{MAX} = 73 \text{ MHz (TYP.) AT } V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION  
 $I_{CC} = 4 \mu\text{A (MAX.) AT } T_A = 25^\circ\text{C}$
- HIGH NOISE IMMUNITY  
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- OUTPUT DRIVE CAPABILITY  
10 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE  
 $|I_{OH}| = I_{OL} = 4 \text{ mA (MIN.)}$
- 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 4094B



**B1R**  
(Plastic Package)



**F1R**  
(Ceramic Package)



**M1R**  
(Micro Package)



**C1R**  
(Chip Carrier)

### ORDER CODES :

M54HC4094F1R    M74HC4094M1R  
M74HC4094B1R    M74HC4094C1R

### DESCRIPTION

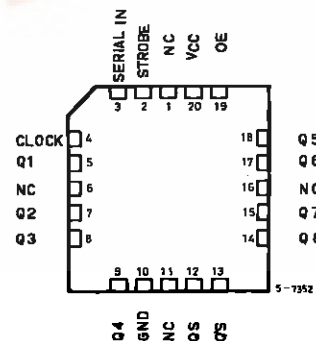
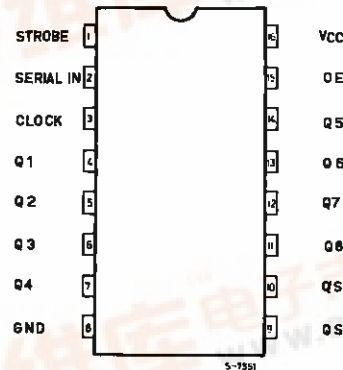
The M54/74HC4094 is a high speed CMOS 8 BIT SIPO SHIFT LATCH REGISTER fabricated with silicon gate C<sup>2</sup>MOS technology.

It has the same high speed performance of LSTTL combined with true CMOS low power consumption. This device consists of an 8-bit shift register and an 8-bit latch with 3-state output buffer. Data is shifted serially through the shift register on the positive going transition of the clock input signal. The output of the last stage (Qs) can be used to cascade several devices.

Data on the Qs output is transferred to a second output (Qs') on the following negative transition of the clock input signal. The data of each stage of the shift register is provided with a latch, which latches data on the negative going transition of the STROBE input signal. When the STROBE input is held high, data propagates through the latch to a 3-state output buffer.

This buffer is enabled when OUTPUT ENABLE input is taken high. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

### PIN CONNECTIONS (top view)



NC =  
No Internal  
Connection

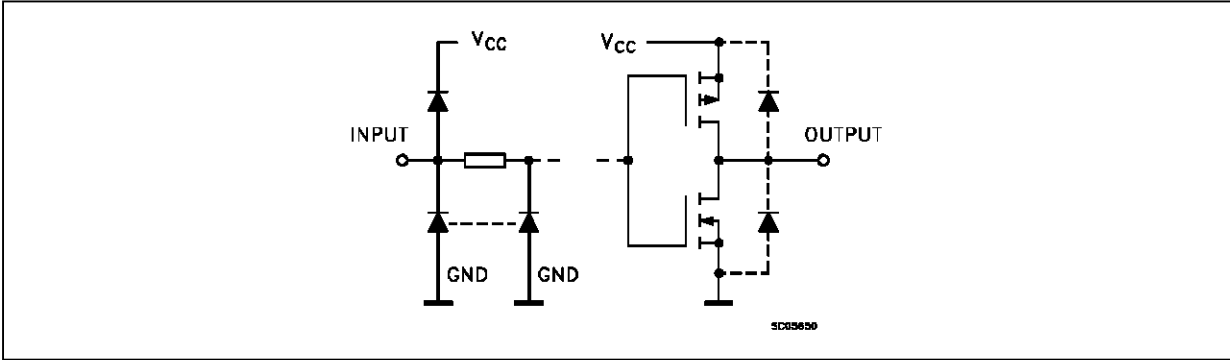


TRUTH TABLE

| CK | OE | ST | SI | PARALLEL OUTPUT |      | SERIAL OUTPUT |     |
|----|----|----|----|-----------------|------|---------------|-----|
|    |    |    |    | Q1              | Qn   | Qs            | Qs' |
|    | H  | H  | L  | L               | Qn-1 | Q7            | NC  |
|    | H  | H  | H  | H               | Qn-1 | Q7            | NC  |
|    | H  | L  | X  | NC              | NC   | Q7            | NC  |
|    | L  | X  | X  | Z               | Z    | Q7            | NC  |
|    | H  | X  | X  | NC              | NC   | NC            | Qs  |
|    | L  | X  | X  | Z               | Z    | NC            | Qs  |

X: Don't Care    Z: High Impedance    NC: No Change

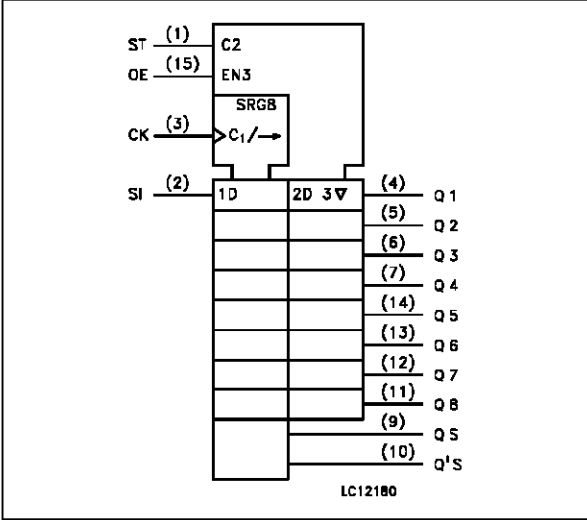
INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

| PIN No                     | SYMBOL    | NAME AND FUNCTION       |
|----------------------------|-----------|-------------------------|
| 1                          | STROBE    | Strobe Input            |
| 2                          | SERIAL IN | Serial Input            |
| 3                          | CLOCK     | Clock Input             |
| 4, 5, 6, 7, 14, 13, 12, 11 | Q1 to Q7  | Parallel Outputs        |
| 9, 10                      | QS Q'S    | Serial Outputs          |
| 15                         | OE        | Output Enable Input     |
| 8                          | GND       | Ground (0V)             |
| 16                         | Vcc       | Positive Supply Voltage |

IEC LOGIC SYMBOL



## M54/M74HC4094

### 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 | °C<br>°C |
| t <sub>r</sub> , t <sub>f</sub> | Input Rise and Fall Time                                          | V <sub>CC</sub> = 2 V     | ns       |
|                                 |                                                                   | V <sub>CC</sub> = 4.5 V   |          |
|                                 |                                                                   | V <sub>CC</sub> = 6 V     |          |

## 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> =-4.0 mA                 | 4.18  | 4.31 |                      | 4.13 |                       | 4.10 |      |   |  |
|                 |                                  | 6.0                    |                                                                                                | I <sub>O</sub> =-5.2 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> = 4.0 mA                 |       | 0.17 | 0.26                 |      | 0.37                  |      | 0.40 |   |  |
|                 |                                  | 6.0                    |                                                                                                | I <sub>O</sub> = 5.2 mA                 |       | 0.18 | 0.26                 |      | 0.37                  |      | 0.40 |   |  |
| I <sub>I</sub>  | Input Leakage Current            | 6.0                    | V <sub>I</sub> = V <sub>CC</sub> or GND                                                        |                                         |       | ±0.1 |                      | ±1   |                       | ±1   | μA   |   |  |
| I <sub>OZ</sub> | 3 State Output Off State Current | 6.0                    | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>O</sub> = V <sub>CC</sub> or GND |                                         |       | ±0.5 |                      | ±5.0 |                       | ±10  | μA   |   |  |
| I <sub>CC</sub> | Quiescent Supply Current         | 6.0                    | V <sub>I</sub> = V <sub>CC</sub> or GND                                                        |                                         |       | 4    |                      | 40   |                       | 80   | μA   |   |  |

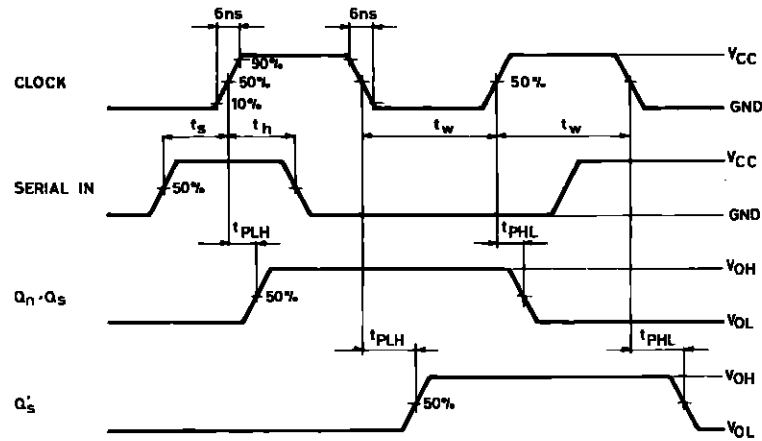
## M54/M74HC4094

### AC ELECTRICAL CHARACTERISTICS ( $C_L = 50$ pF, Input $t_r = t_f = 6$ ns)

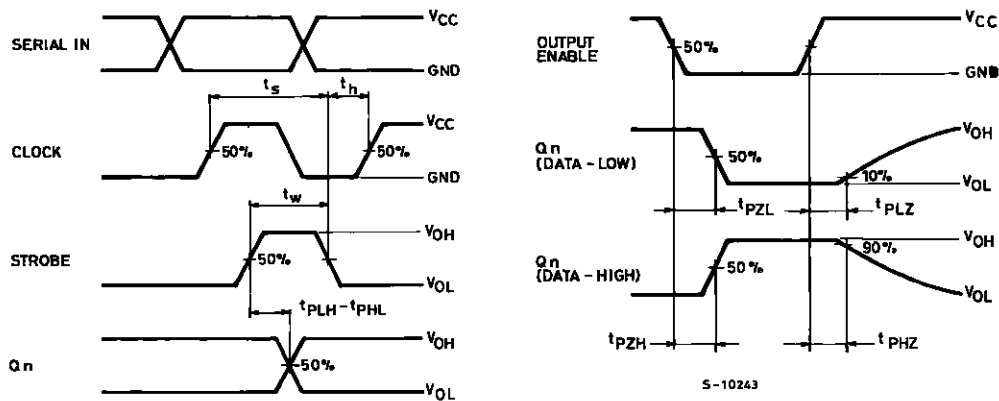
| Symbol                                 | Parameter                                  | Test Conditions        |  | Value                                   |      |      |                      |      |                       | Unit |      |
|----------------------------------------|--------------------------------------------|------------------------|--|-----------------------------------------|------|------|----------------------|------|-----------------------|------|------|
|                                        |                                            | 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. |
| t <sub>TLH</sub><br>t <sub>THL</sub>   | Output Transition Time                     | 2.0                    |  |                                         | 30   | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                            | 4.5                    |  |                                         | 8    | 15   |                      | 19   |                       | 22   |      |
|                                        |                                            | 6.0                    |  |                                         | 7    | 13   |                      | 16   |                       | 19   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay Time<br>(CLOCK - Qn)     | 2.0                    |  |                                         | 92   | 200  |                      | 250  |                       | 300  | ns   |
|                                        |                                            | 4.5                    |  |                                         | 26   | 40   |                      | 50   |                       | 60   |      |
|                                        |                                            | 6.0                    |  |                                         | 20   | 34   |                      | 43   |                       | 51   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay Time<br>(CLOCK - QS, QS) | 2.0                    |  |                                         | 65   | 150  |                      | 190  |                       | 225  | ns   |
|                                        |                                            | 4.5                    |  |                                         | 19   | 30   |                      | 38   |                       | 45   |      |
|                                        |                                            | 6.0                    |  |                                         | 15   | 26   |                      | 32   |                       | 38   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay Time<br>(STROBE - Qn)    | 2.0                    |  |                                         | 75   | 160  |                      | 200  |                       | 240  | ns   |
|                                        |                                            | 4.5                    |  |                                         | 20   | 32   |                      | 40   |                       | 48   |      |
|                                        |                                            | 6.0                    |  |                                         | 16   | 27   |                      | 34   |                       | 41   |      |
| t <sub>PZL</sub><br>t <sub>PZH</sub>   | 3 State Output Enable Time                 | 2.0                    |  |                                         | 58   | 150  |                      | 190  |                       | 225  | ns   |
|                                        |                                            | 4.5                    |  |                                         | 16   | 30   |                      | 38   |                       | 45   |      |
|                                        |                                            | 6.0                    |  |                                         | 13   | 26   |                      | 32   |                       | 38   |      |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub>   | 3 State Output Disable Time                | 2.0                    |  |                                         | 35   | 150  |                      | 190  |                       | 225  | ns   |
|                                        |                                            | 4.5                    |  |                                         | 16   | 30   |                      | 38   |                       | 45   |      |
|                                        |                                            | 6.0                    |  |                                         | 13   | 26   |                      | 32   |                       | 38   |      |
| f <sub>MAX</sub>                       | Maximum Clock Frequency                    | 2.0                    |  | 6                                       | 16   |      | 4.8                  |      | 4                     |      | MHz  |
|                                        |                                            | 4.5                    |  | 30                                      | 66   |      | 24                   |      | 20                    |      |      |
|                                        |                                            | 6.0                    |  | 35                                      | 80   |      | 28                   |      | 24                    |      |      |
| t <sub>W(H)</sub><br>t <sub>W(L)</sub> | Minimum Pulse Width                        | 2.0                    |  |                                         | 17   | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                            | 4.5                    |  |                                         | 7    | 15   |                      | 19   |                       | 22   |      |
|                                        |                                            | 6.0                    |  |                                         | 6    | 13   |                      | 16   |                       | 19   |      |
| t <sub>W(L)</sub>                      | Minimum Pulse Width                        | 2.0                    |  |                                         | 28   | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                            | 4.5                    |  |                                         | 6    | 15   |                      | 19   |                       | 22   |      |
|                                        |                                            | 6.0                    |  |                                         | 6    | 13   |                      | 16   |                       | 19   |      |
| t <sub>s</sub>                         | Minimum Set-up Time (SI)                   | 2.0                    |  |                                         | 30   | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                            | 4.5                    |  |                                         | 7    | 15   |                      | 19   |                       | 22   |      |
|                                        |                                            | 6.0                    |  |                                         | 5    | 13   |                      | 16   |                       | 19   |      |
| t <sub>s</sub>                         | Minimum Set-up Time (ST)                   | 2.0                    |  |                                         | 45   | 100  |                      | 125  |                       | 145  | ns   |
|                                        |                                            | 4.5                    |  |                                         | 10   | 20   |                      | 25   |                       | 29   |      |
|                                        |                                            | 6.0                    |  |                                         | 8    | 17   |                      | 21   |                       | 25   |      |
| t <sub>h</sub>                         | Minimum Hold Time (SI, ST)                 | 2.0                    |  |                                         |      | 0    |                      | 0    |                       | 0    | ns   |
|                                        |                                            | 4.5                    |  |                                         |      | 0    |                      | 0    |                       | 0    |      |
|                                        |                                            | 6.0                    |  |                                         |      | 0    |                      | 0    |                       | 0    |      |
| C <sub>IN</sub>                        | Input Capacitance                          |                        |  |                                         | 5    | 10   |                      | 10   |                       | 10   | pF   |
| C <sub>PD</sub> (*)                    | Power Dissipation Capacitance              |                        |  |                                         | 140  |      |                      |      |                       |      | 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.  $I_{CC(opr)} = C_{PD} \bullet V_{CC} \bullet f_{IN} + I_{CC}/2$  (per FLIP/FLOP)

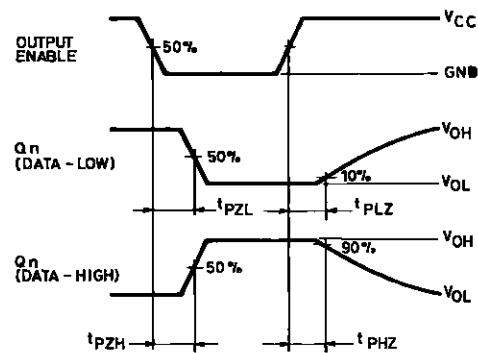
## SWITCHING CHARACTERISTICS TEST WAVEFORM



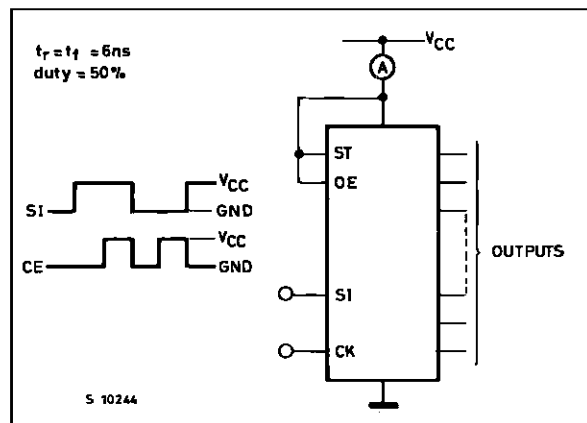
S-10241



S-10242



S-10243

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

S-10244

 $C_{PD}$  CALCULATION

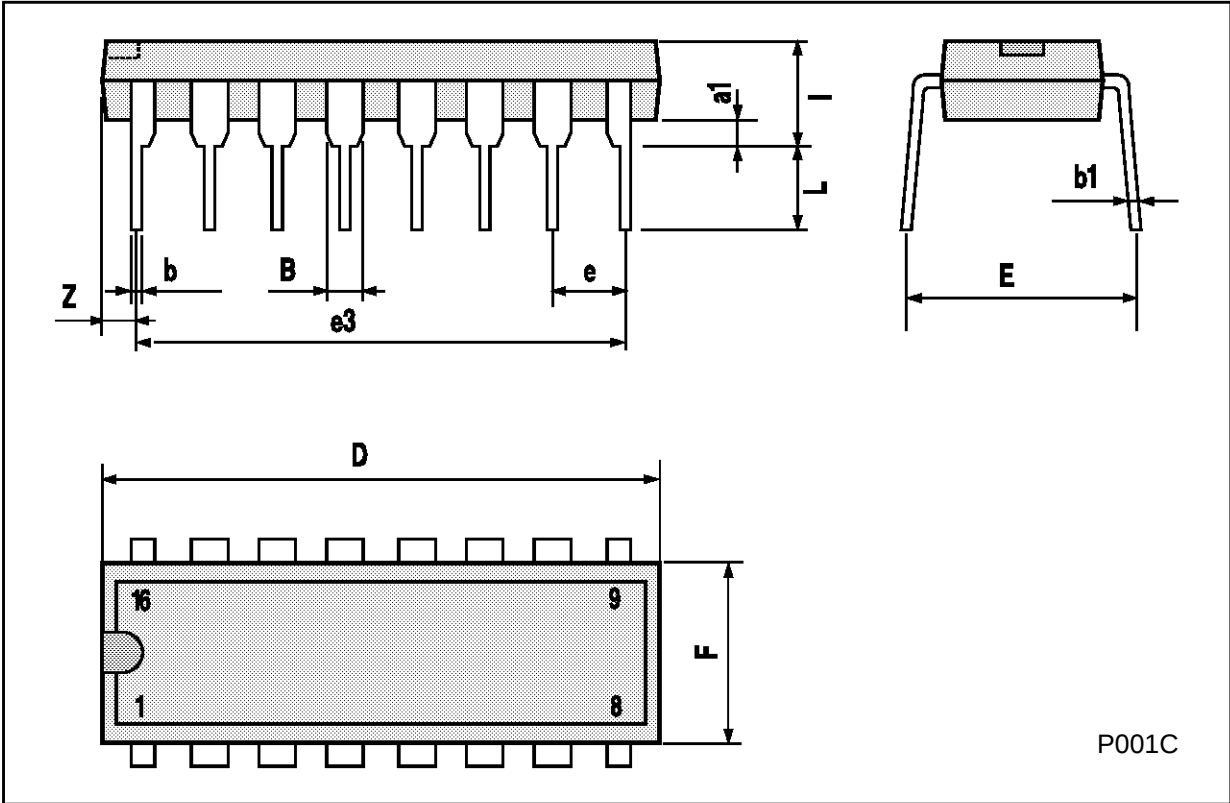
$C_{PD}$  is to be calculated with the following formula by using the measured value of  $I_{CC}$  (Opr.) in the test circuit opposite.

$$C_{PD} = \frac{I_{CC}(\text{Opr})}{f_{IN} \times V_{CC}}$$

In determining the typical value of  $C_{PD}$ , a relatively high frequency of 1 MHz was applied to  $f_{IN}$ , in order to eliminate any error caused by the quiescent supply current.

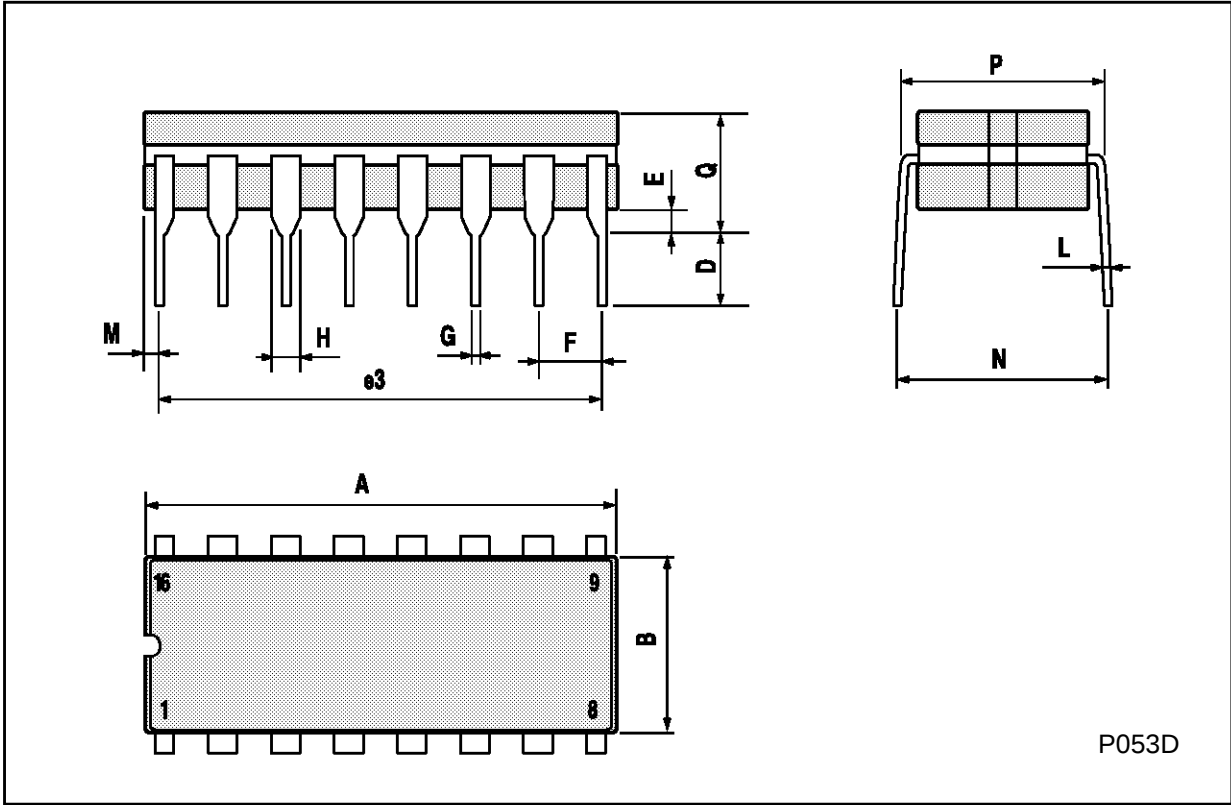
Plastic DIP16 (0.25) MECHANICAL DATA

| 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 |



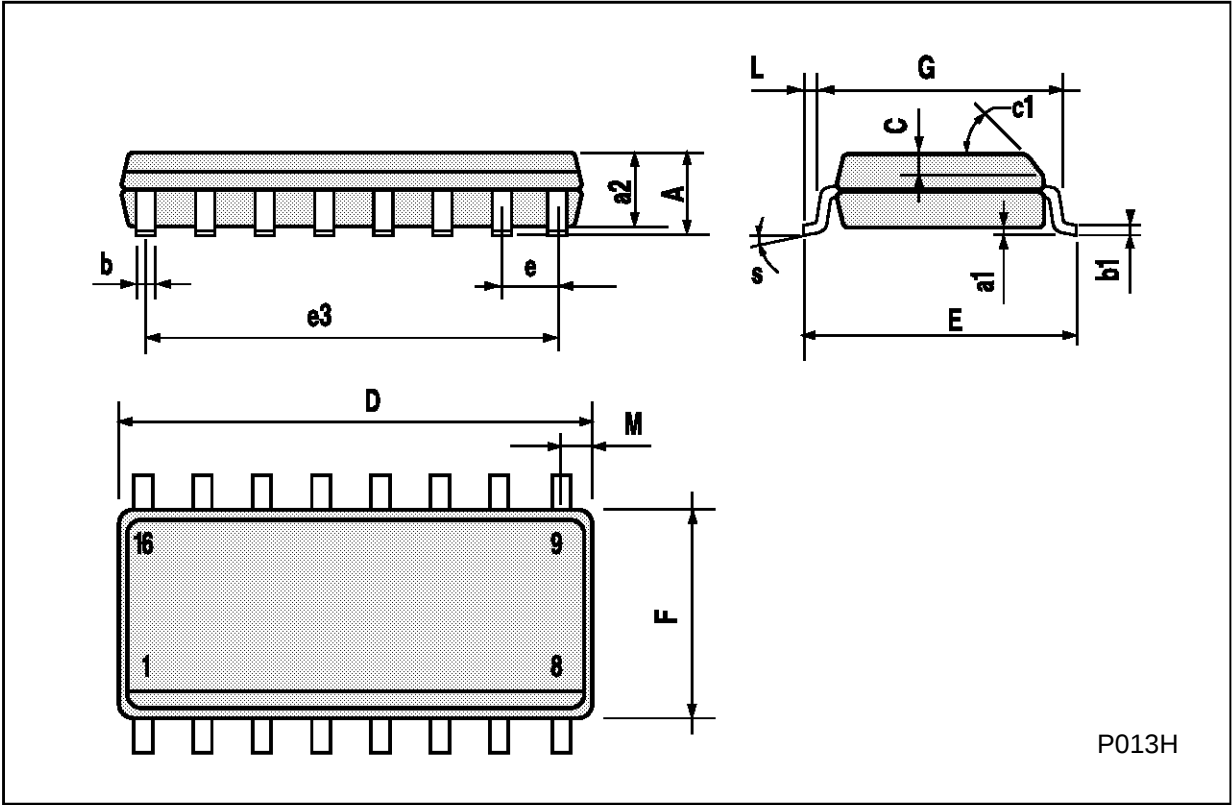
Ceramic DIP16/1 MECHANICAL DATA

| 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 |



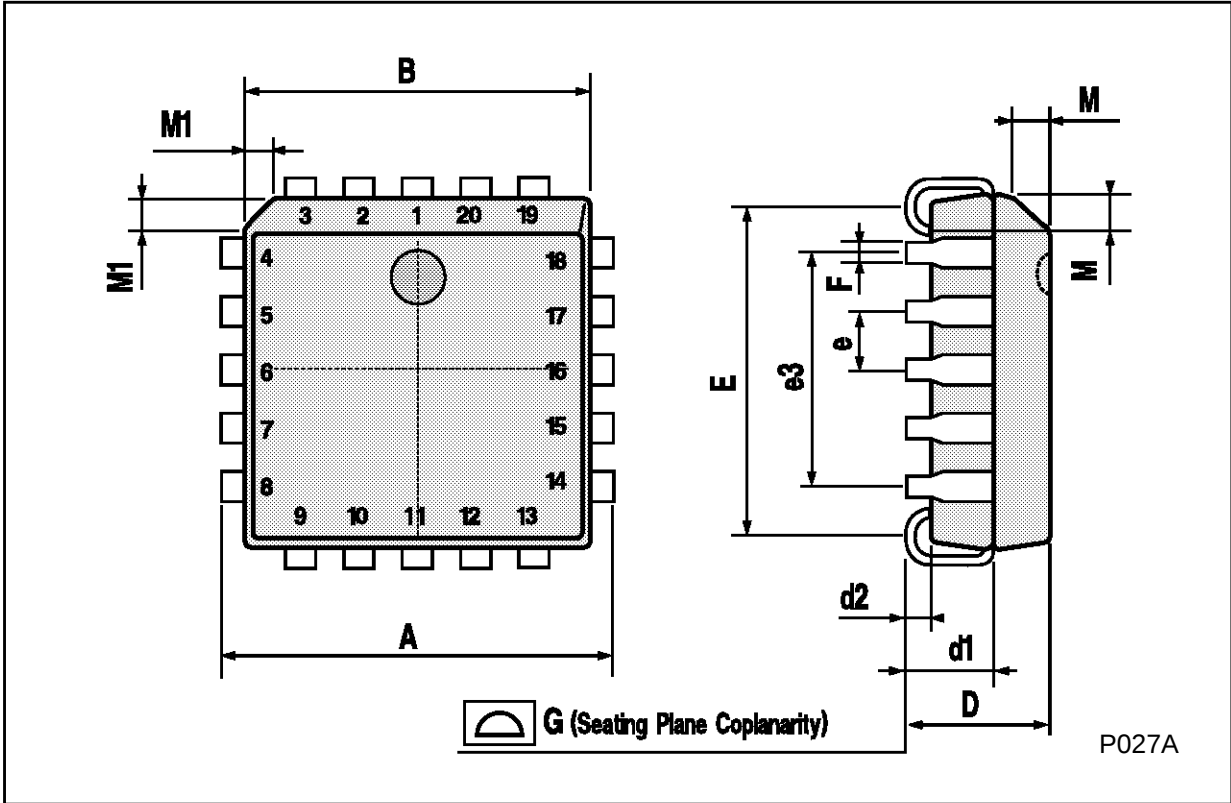
SO16 (Narrow) MECHANICAL DATA

| 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.)  |      |      |       |       |       |



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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