

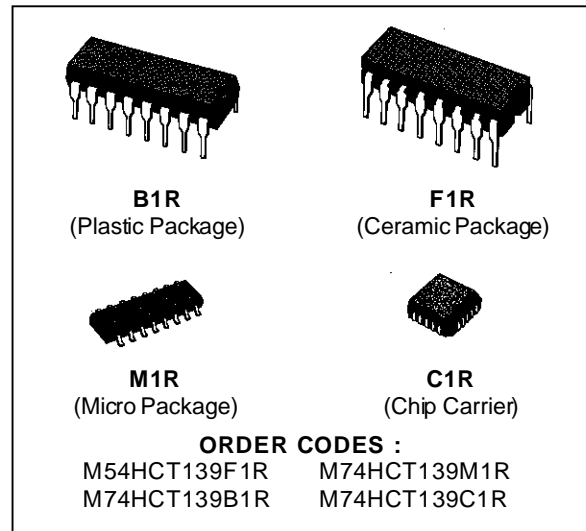
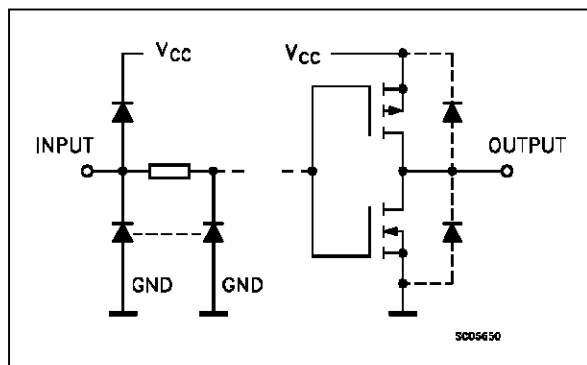
## DUAL 2 TO 4 DECODER/DEMULTIPLEXER

- HIGH SPEED  
 $t_{PD} = 17 \text{ ns (TYP.) AT } V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION  
 $I_{CC} = 4 \mu\text{A (MAX.) AT } T_A = 25 \text{ }^\circ\text{C}$
- COMPATIBLE WITH TTL OUTPUTS  
 $V_{IH} = 2\text{V (MIN.) } V_{IL} = 0.8\text{V (MAX)}$
- OUTPUT DRIVE CAPABILITY  
 10 LSTTL LOADS
- SYMMETRICAL OUTPUT IMPEDANCE  
 $|I_{OH}| = I_{OL} = 4 \text{ mA (MIN.)}$
- BALANCED PROPAGATION DELAYS  
 $t_{PLH} = t_{PHL}$
- PIN AND FUNCTION COMPATIBLE  
 WITH 54/74LS139

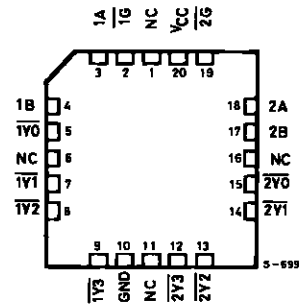
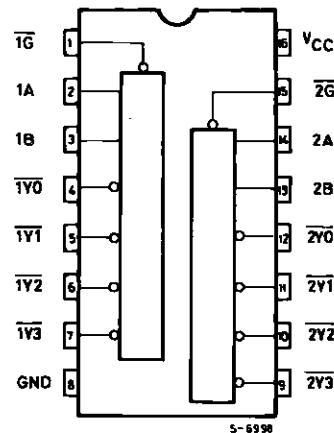
### DESCRIPTION

The M54/74HCT139 is a high speed CMOS DUAL TWO LINE TO FOUR LINE DECODER/DEMULTIPLEXER fabricated in silicon gate C2MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption. The active low enable input can be used for gating or as a data input for demultiplexing applications. While the enable input is held high, all four outputs are high independently of the other inputs. All inputs are equipped with protection circuits against static discharge and transient excess volt-ages. This integrated circuit has input and output characteristics that are fully compatible with 54/74 LSTTL logic families. M54/74HCT devices are designed to directly interface HSC<sup>2</sup>MOS systems with TTL and NMOS components. They are also plug in replacements for

### INPUT AND OUTPUT EQUIVALENT CIRCUIT



### PIN CONNECTIONS (top view)



NC =  
No Internal  
Connection

# M54/M74HCT139

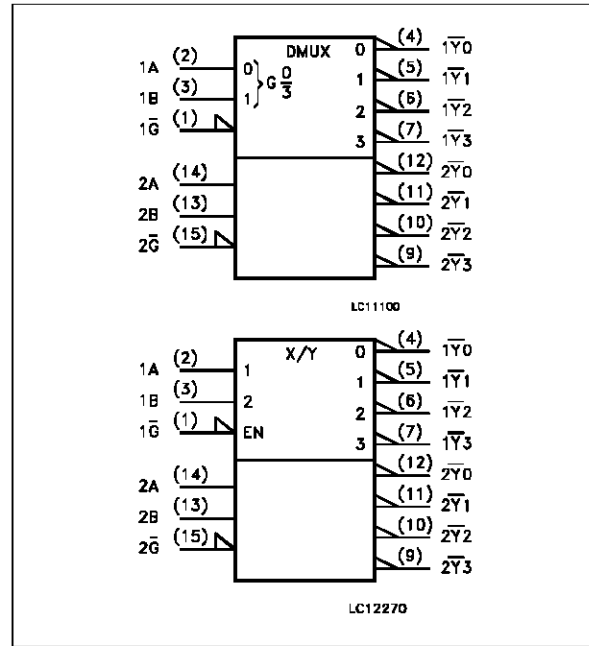
## TRUTH TABLE

| INPUTS    |        |   | OUTPUTS     |             |             |             | SELECTED OUTPUT |
|-----------|--------|---|-------------|-------------|-------------|-------------|-----------------|
| ENABLE    | SELECT |   | $\bar{Y}_0$ | $\bar{Y}_1$ | $\bar{Y}_2$ | $\bar{Y}_3$ |                 |
| $\bar{G}$ | B      | A |             |             |             |             |                 |
| H         | X      | X | H           | H           | H           | H           | NONE            |
| L         | L      | L | L           | H           | H           | H           | $\bar{Y}_0$     |
| L         | L      | H | H           | L           | H           | H           | $\bar{Y}_1$     |
| L         | H      | L | H           | H           | L           | H           | $\bar{Y}_2$     |
| L         | H      | H | H           | H           | H           | L           | $\bar{Y}_3$     |

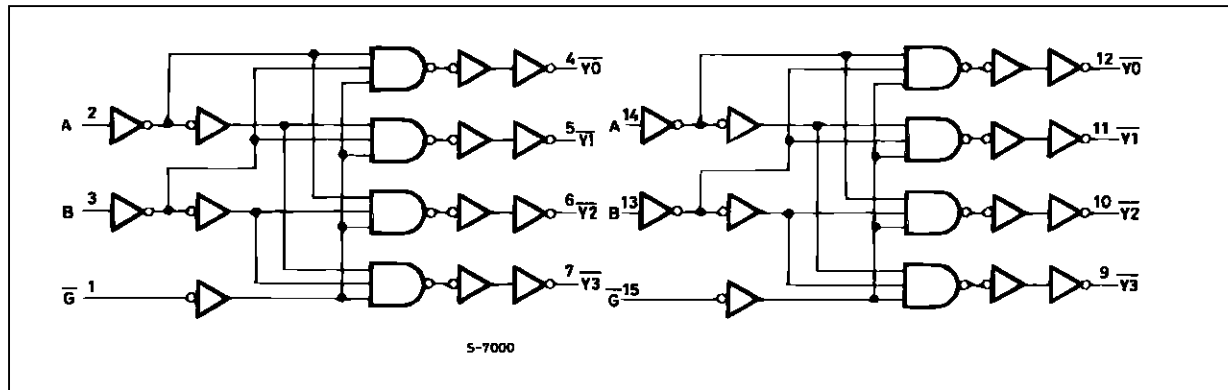
## PIN DESCRIPTION

| PIN No        | SYMBOL                         | NAME AND FUNCTION       |
|---------------|--------------------------------|-------------------------|
| 1, 15         | 1G, 2G                         | Enable Inputs           |
| 2, 3          | 1A, 1B                         | Address Inputs          |
| 4, 5, 6, 7    | 1 $\bar{Y}_0$ to 1 $\bar{Y}_3$ | Outputs                 |
| 12, 11, 10, 9 | 2 $\bar{Y}_0$ to 2 $\bar{Y}_3$ | Outputs                 |
| 14, 13        | 2A, 2B                         | Address Inputs          |
| 8             | GND                            | Ground (0V)             |
| 16            | V <sub>CC</sub>                | Positive Supply Voltage |

## IEC LOGIC SYMBOLS



## SCHEMATIC CIRCUIT



## 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     |
|------------|---|---------------------------|----------|
| $V_{CC}$   | Supply Voltage  | 4.5 to 5.5                | V        |
| $V_I$      | Input Voltage   | 0 to $V_{CC}$             | V        |
| $V_O$      | Output Voltage  | 0 to $V_{CC}$             | V        |
| $T_{op}$   | Operating Temperature: <b>M54HC Series</b><br><b>M74HC Series</b> | -55 to +125<br>-40 to +85 | °C<br>°C |
| $t_r, t_f$ | Input Rise and Fall Time ( $V_{CC} = 4.5$ to $5.5V$ )             | 0 to 500                  | ns       |

## DC SPECIFICATIONS

| Symbol          | Parameter                            | Test Conditions |   | Value   |      |      |   |      |  | Unit |         |               |
|-----------------|--------------------------------------|-----------------|---|---|------|------|---|------|--|------|---------|---------------|
|                 |                                      | $V_{CC}$<br>(V) |   | $T_A = 25\text{ }^\circ\text{C}$<br>54HC and 74HC |      |      | $-40$ to $85\text{ }^\circ\text{C}$<br>74HC |      | $-55$ to $125\text{ }^\circ\text{C}$<br>54HC |      |         |               |
|                 |                                      |                 |   | Min.  | Typ. | Max. | Min.  | Max. | Min.   |      | Max.    |               |
| $V_{IH}$        | High Level Input Voltage             | 4.5 to 5.5      |   | 2.0   |      |      | 2.0   |      | 2.0  |      | V       |               |
| $V_{IL}$        | Low Level Input Voltage              | 4.5 to 5.5      |   |   |      | 0.8  |   | 0.8  |  | 0.8  | V       |               |
| $V_{OH}$        | High Level Output Voltage            | 4.5             | $V_I = V_{IH}$<br>or<br>$V_{IL}$  | $I_O = -20\text{ }\mu\text{A}$                    | 4.4  | 4.5  |   | 4.4  |  | 4.4  | V       |               |
|                 |                                      |                 |   | $I_O = -4.0\text{ mA}$                            | 4.18 | 4.31 |   | 4.13 |  | 4.10 |         |               |
| $V_{OL}$        | Low Level Output Voltage             | 4.5             | $V_I = V_{IH}$<br>or<br>$V_{IL}$  | $I_O = 20\text{ }\mu\text{A}$                     |      | 0.0  | 0.1   |      | 0.1  |      | 0.1     | V             |
|                 |                                      |                 |   | $I_O = 4.0\text{ mA}$                             |      | 0.17 | 0.26  |      | 0.33   |      | 0.4     |               |
| $I_I$           | Input Leakage Current                | 5.5             | $V_I = V_{CC}$ or GND   |   |      |      | $\pm 0.1$                                   |      | $\pm 1$                                      |      | $\pm 1$ | $\mu\text{A}$ |
| $I_{CC}$        | Quiescent Supply Current             | 5.5             | $V_I = V_{CC}$ or GND   |   |      |      | 4   |      | 40   |      | 80      | $\mu\text{A}$ |
| $\Delta I_{CC}$ | Additional worst case supply current | 5.5             | Per Input pin<br>$V_I = 0.5V$ or<br>$V_I = 2.4V$<br>Other Inputs at<br>$V_{CC}$ or GND<br>$I_O = 0$ |   |      |      | 2.0   |      | 2.9  |      | 3.0     | mA            |

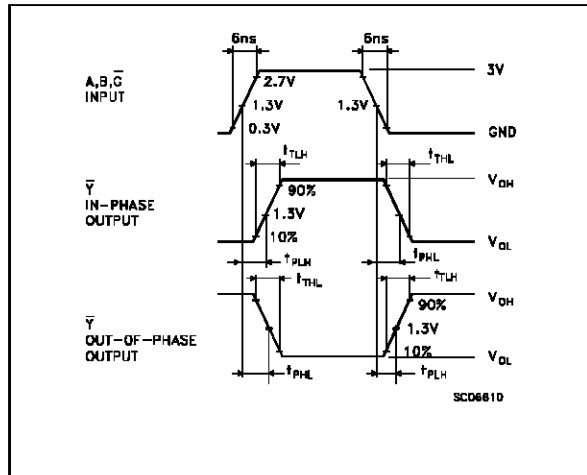
# M54/M74HCT139

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

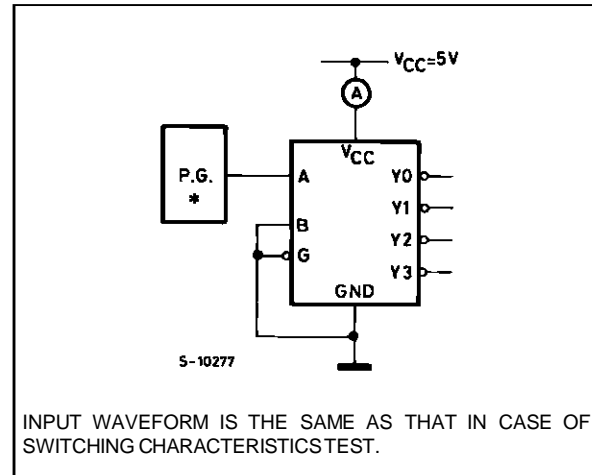
| Symbol                 | Parameter                               | Test Conditions |  | Value  |      |      |   |      |  | Unit |      |
|------------------------|---|-----------------|--|--|------|------|---|------|--|------|------|
|                        |   | $V_{CC}$<br>(V) |  | $T_A = 25 \text{ }^\circ\text{C}$<br>54HC and 74HC |      |      | $-40 \text{ to } 85 \text{ }^\circ\text{C}$<br>74HC |      | $-55 \text{ to } 125 \text{ }^\circ\text{C}$<br>54HC |      |      |
|                        |   |                 |  | Min.   | Typ. | Max. | Min.  | Max. | Min.   |      | Max. |
| $t_{TLH}$<br>$t_{THL}$ | Output Transition Time                  | 4.5             |  |  | 8    | 15   |   | 19   |  | 22   | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay Time (A, B - Y)       | 4.5             |  |  | 19   | 30   |   | 38   |  | 45   | ns   |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay Time ( $\bar{G}$ - Y) | 4.5             |  |  | 17   | 27   |   | 34   |  | 41   | ns   |
| $C_{IN}$               | Input Capacitance                       |                 |  |  | 5    | 10   |   | 10   |  | 10   | pF   |
| $C_{PD}$ (*)           | Power Dissipation Capacitance           |                 |  |  | 40   |      |   |      |  |      | pF   |

(\*)  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2$  (per decoder)

### SWITCHING CHARACTERISTICS TEST CIRCUIT

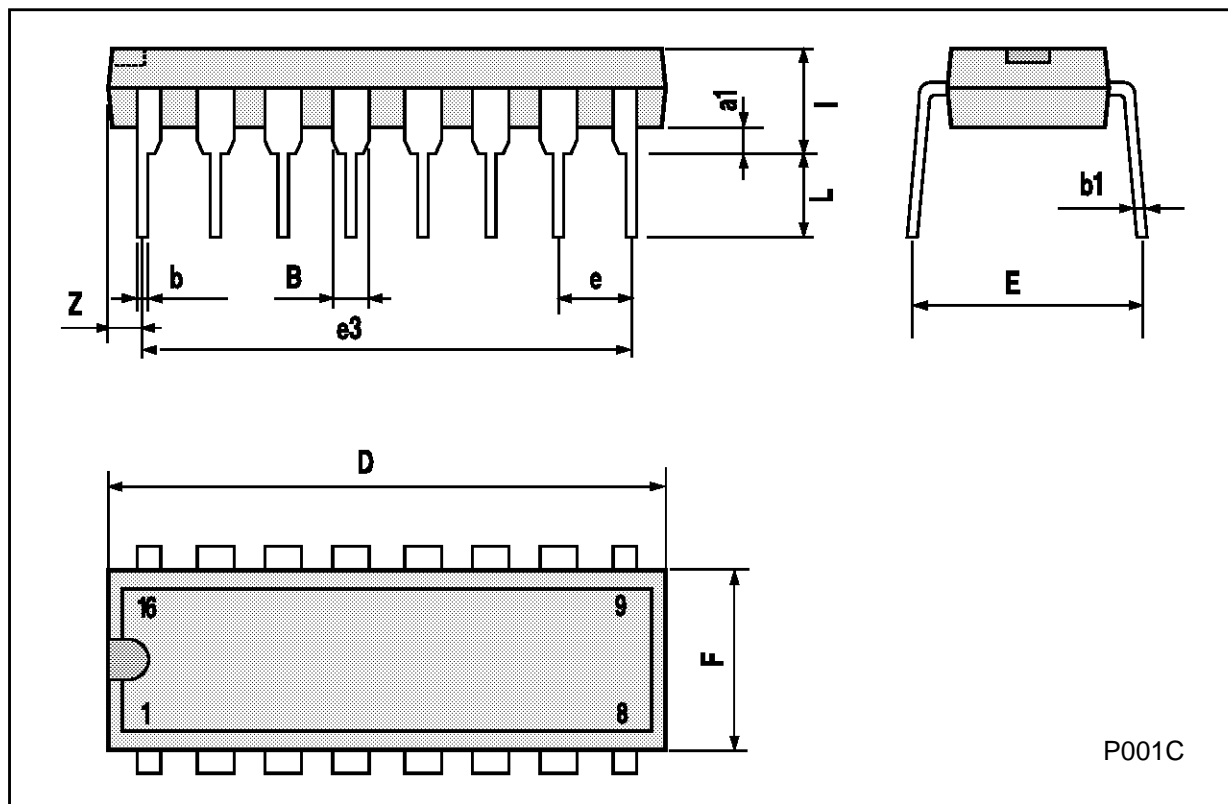


### TEST CIRCUIT $I_{CC}$ (Opr.)



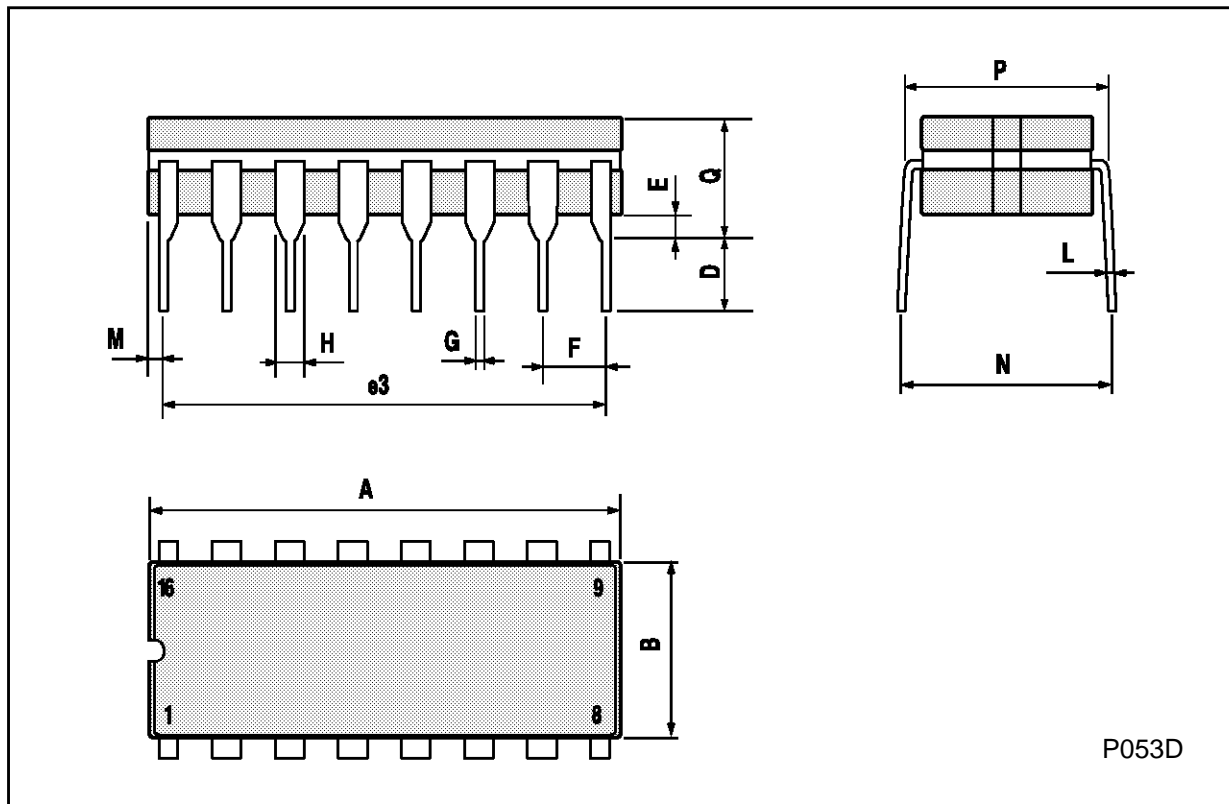
## Plastic DIP16 (0.25) MECHANICAL DATA

| 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 |



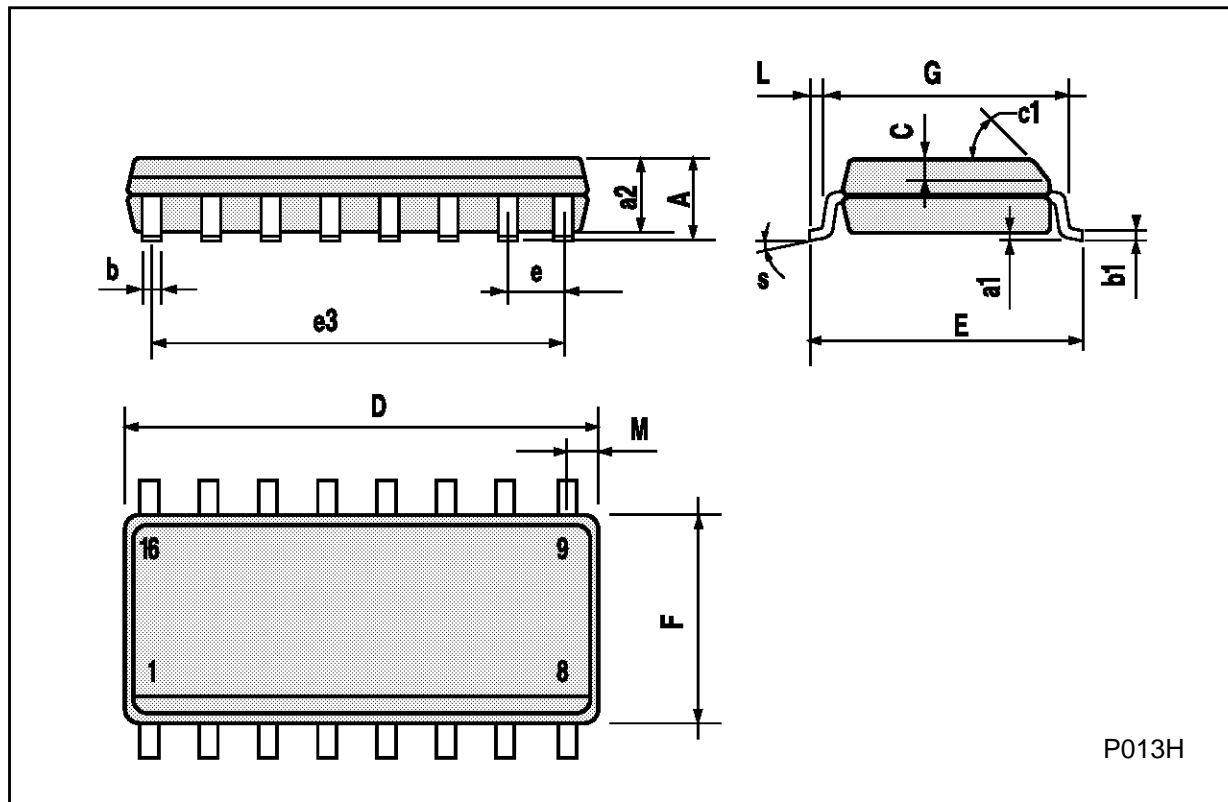
**Ceramic DIP16/1 MECHANICAL DATA**

| 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.)  |      |      |       |       |       |



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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