

## HEX D-TYPE FLIP FLOP WITH CLEAR

- HIGH SPEED  
 $f_{MAX} = 56 \text{ MHz (TYP.) AT } V_{CC} = 5 \text{ V}$
- 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  
 54/74LS174

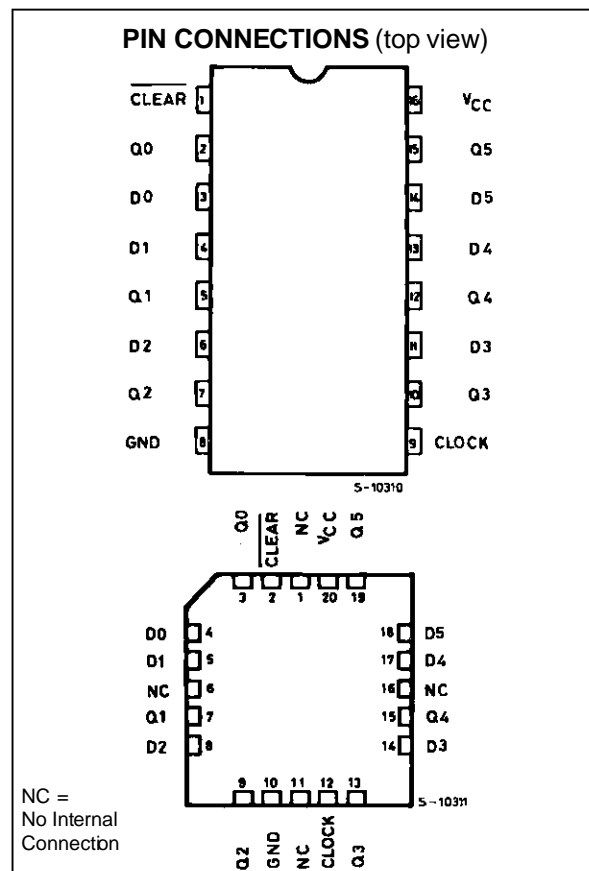
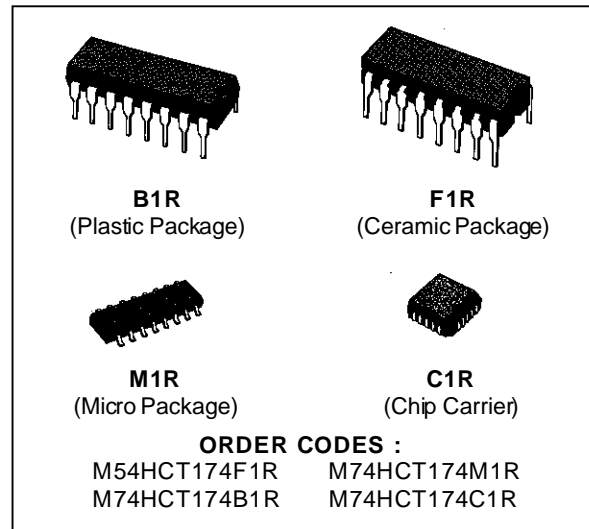
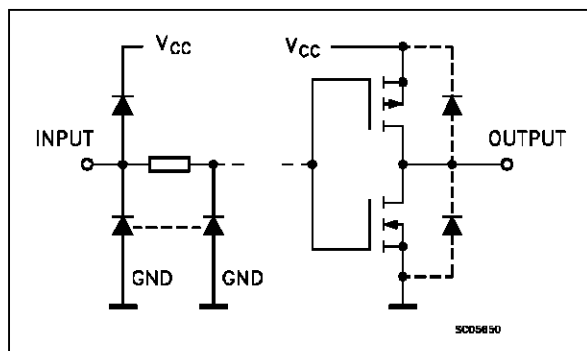
### DESCRIPTION

The M54/74HCT174 is a high speed CMOS HEX D-TYPE FLIP-FLOP WITH CLEAR fabricated in silicon gate C<sup>2</sup>MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption.

Information signals applied to D inputs are transferred to the Q output on the positive going edge of the clock pulse. When the CLEAR input is held low, the Q outputs are held low independently of the other inputs.

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 LSTTL devices giving a reduction of power consumption. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

### INPUT AND OUTPUT EQUIVALENT CIRCUIT



# M54/M74HCT174

## TRUTH TABLE

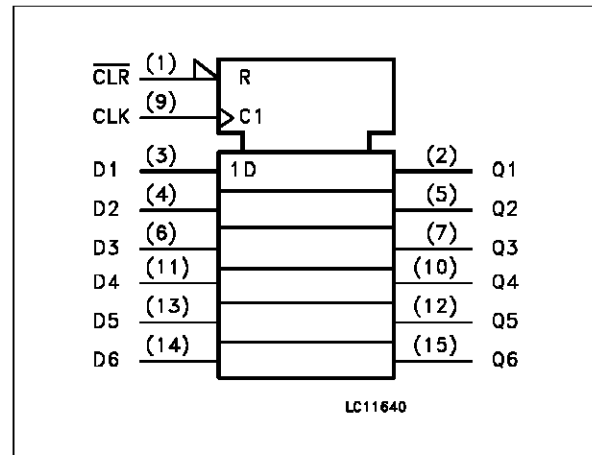
| INPUTS |   |    | OUTPUTS        | FUNCTION  |
|--------|---|----|----------------|-----------|
| CLEAR  | D | CK | Q              |           |
| L      | X | X  | L              | CLEAR     |
| H      | L |    | L              |           |
| H      | H |    | H              |           |
| H      | X |    | Q <sub>n</sub> | NO CHANGE |

X: Don't Care

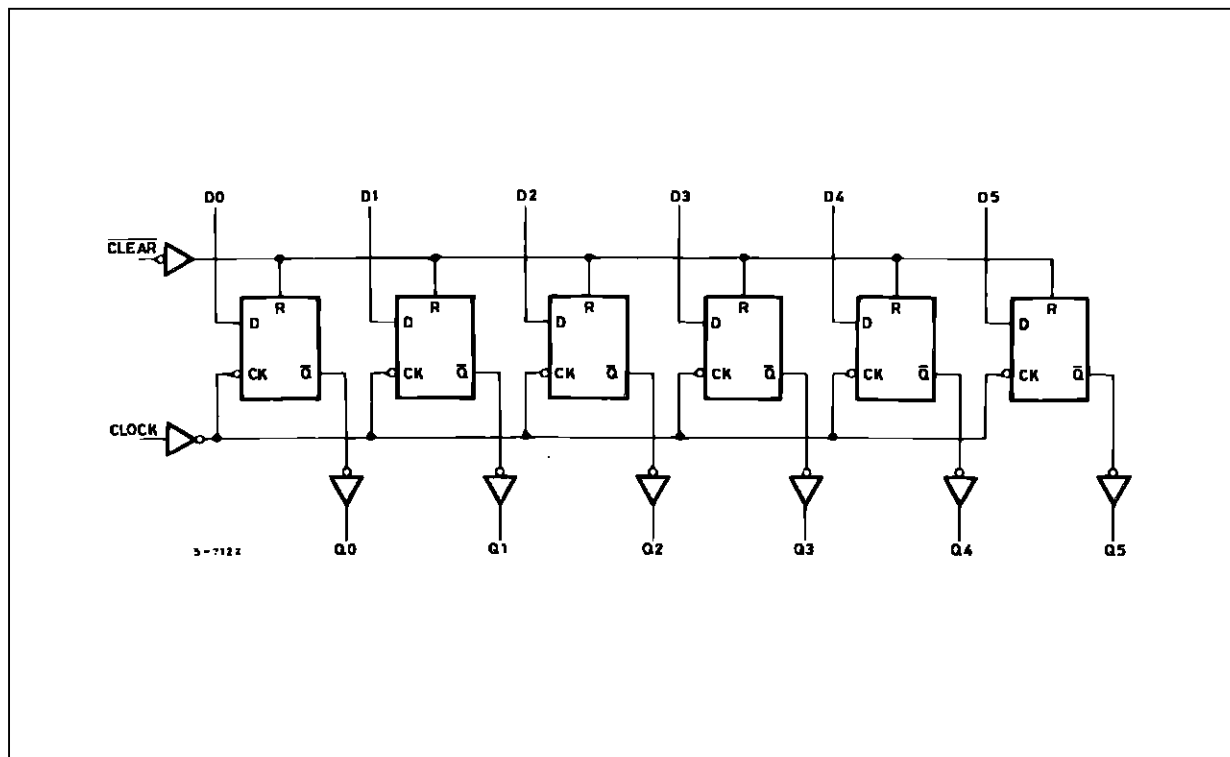
## PIN DESCRIPTION

| PIN No              | SYMBOL          | NAME AND FUNCTION                         |
|---------------------|-----------------|---|
| 1                   | CLEAR           | Asynchronous Master Reset (Active LOW)    |
| 2, 5, 7, 10, 12, 15 | Q0 to Q5        | Flip-flop Outputs                         |
| 3, 4, 6, 11, 13, 14 | D0 to D5        | Data Inputs                               |
| 9                   | CLOCK           | Clock Input (LOW to HIGH, edge triggered) |
| 8                   | GND             | Ground (0V)                               |
| 16                  | V <sub>cc</sub> | Positive Supply Voltage                   |

## IEC LOGIC SYMBOL



## LOGIC DIAGRAM



**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  | 4.5 to 5.5                | 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> = 4.5 to 5.5V)          | 0 to 500                  | ns       |

**DC SPECIFICATIONS**

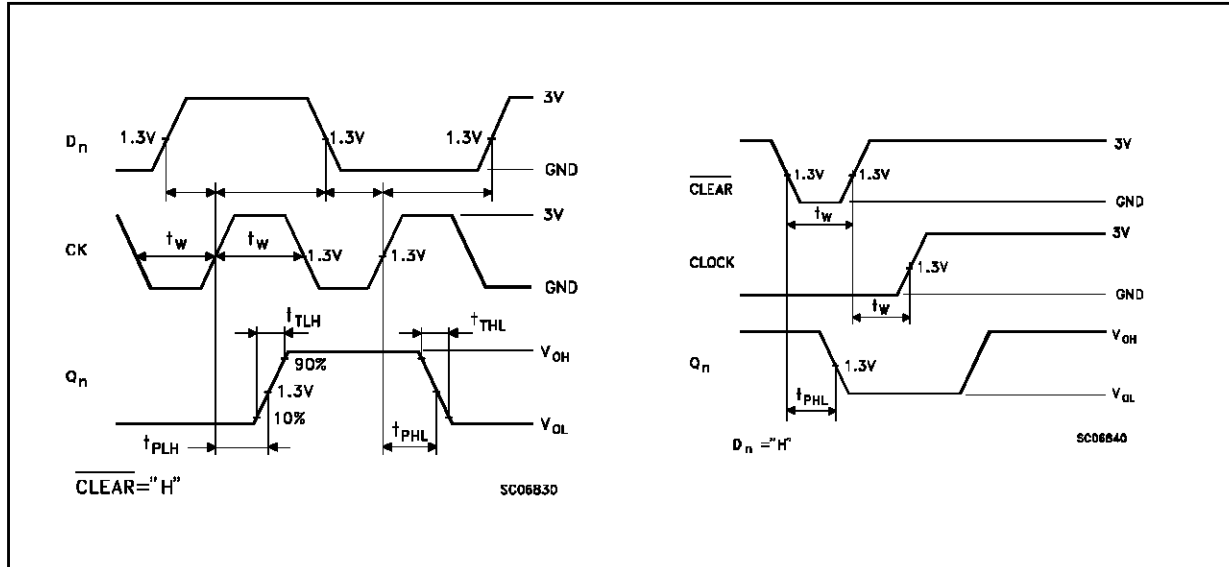
| Symbol           | Parameter                            | Test Conditions        |   | Value                                   |      |      |                      |      |                       | Unit |      |    |
|------------------|--------------------------------------|------------------------|---|---|------|------|----------------------|------|-----------------------|------|------|----|
|                  |                                      | 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             | 4.5 to 5.5             |   | 2.0                                     |      |      | 2.0                  |      | 2.0                   |      | V    |    |
| V <sub>IL</sub>  | Low Level Input Voltage              | 4.5 to 5.5             |   |   |      | 0.8  |                      | 0.8  |                       | 0.8  | V    |    |
| V <sub>OH</sub>  | High Level Output Voltage            | 4.5                    | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>   | I <sub>O</sub> = -20 μA                 | 4.4  | 4.5  |                      | 4.4  |                       | 4.4  | V    |    |
|                  |                                      |                        |   | I <sub>O</sub> = -4.0 mA                | 4.18 | 4.31 |                      | 4.13 |                       | 4.10 |      |    |
| V <sub>OL</sub>  | Low Level Output Voltage             | 4.5                    | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>   | I <sub>O</sub> = 20 μA                  |      | 0.0  | 0.1                  |      | 0.1                   |      | 0.1  | V  |
|                  |                                      |                        |   | I <sub>O</sub> = 4.0 mA                 |      | 0.17 | 0.26                 |      | 0.33                  |      | 0.4  |    |
| I <sub>I</sub>   | Input Leakage Current                | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> or GND   |   |      |      | ±0.1                 |      | ±1                    |      | ±1   | μA |
| I <sub>CC</sub>  | Quiescent Supply Current             | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> or GND   |   |      |      | 4                    |      | 40                    |      | 80   | μA |
| ΔI <sub>CC</sub> | Additional worst case supply current | 5.5                    | Per Input pin<br>V <sub>I</sub> = 0.5V or<br>V <sub>I</sub> = 2.4V<br>Other Inputs at<br>V <sub>CC</sub> or GND |   |      |      | 2.0                  |      | 2.9                   |      | 3.0  | mA |

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

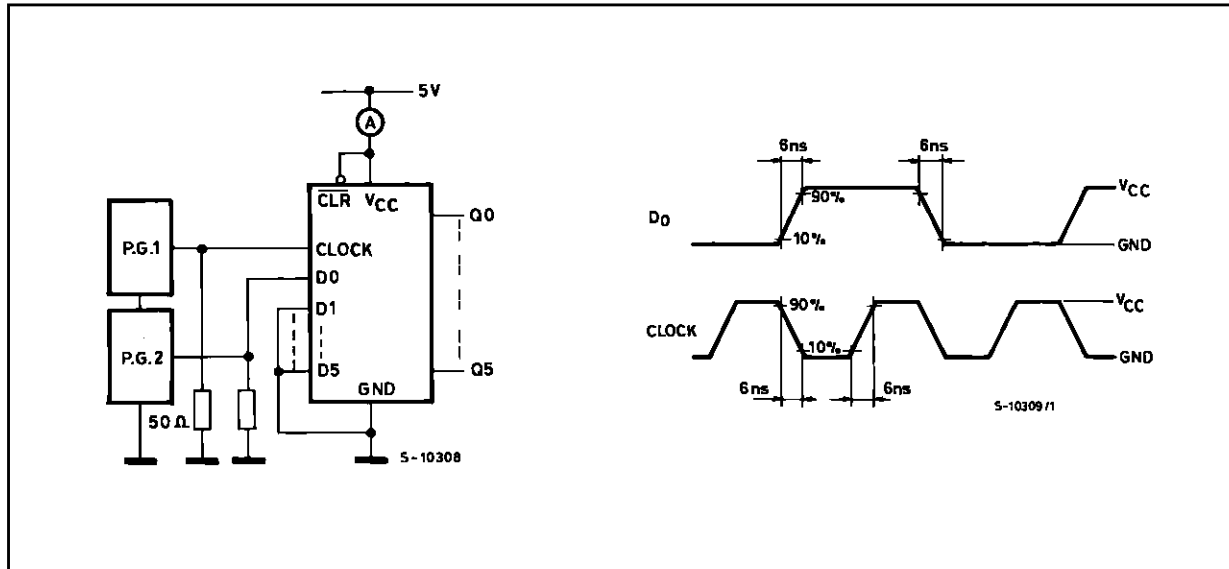
| Symbol                                 | Parameter                        | Test Conditions        |  | Value                                   |      |      |                      |      |                       | Unit |      |
|--|----------------------------------|------------------------|--|---|------|------|----------------------|------|-----------------------|------|------|
|  |                                  | 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           | 4.5                    |  |   | 8    | 15   |                      | 19   |                       | 22   | ns   |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay Time (CK - Q)  | 4.5                    |  |   | 18   | 28   |                      | 35   |                       |      | ns   |
| t <sub>PHL</sub>                       | Propagation Delay Time (CLR - Q) | 4.5                    |  |   | 18   | 28   |                      | 35   |                       | 42   | ns   |
| f <sub>MAX</sub>                       | Maximum Clock Frequency          | 4.5                    |  | 30                                      | 54   |      | 24                   |      |                       |      | MHz  |
| t <sub>W(H)</sub><br>t <sub>W(L)</sub> | Minimum Pulse Width (CLOCK)      | 4.5                    |  |   | 8    | 15   |                      | 19   |                       | 22   | ns   |
| t <sub>W(L)</sub>                      | Minimum Pulse Width (CLR)        | 4.5                    |  |   | 8    | 15   |                      | 19   |                       | 22   | ns   |
| t <sub>s</sub>                         | Minimum Set-up Time              | 4.5                    |  |   | 2    | 10   |                      | 13   |                       | 15   | ns   |
| t <sub>h</sub>                         | Minimum Hold Time                | 4.5                    |  |   |      | 5    |                      | 6    |                       | 8    | ns   |
| t <sub>REM</sub>                       | Minimum Removal Time             | 4.5                    |  |   | 5    | 5    |                      | 5    |                       | 5    | ns   |
| C <sub>IN</sub>                        | Input Capacitance                |                        |  |   | 5    | 10   |                      | 10   |                       | 10   | pF   |
| C <sub>PD</sub> (*)                    | Power Dissipation Capacitance    |                        |  |   | 68   |      |                      |      |                       |      | pF   |

(\*) C<sub>PD</sub> 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.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/6$  (per FLIP/FLOP)  
And the total CPD when N pcs of FLIP FLOP operate can be gained by the following equation:  $CPD (total) = 38 + 15 \times n$

SWITCHING CHARACTERISTICS TEST WAVEFORM

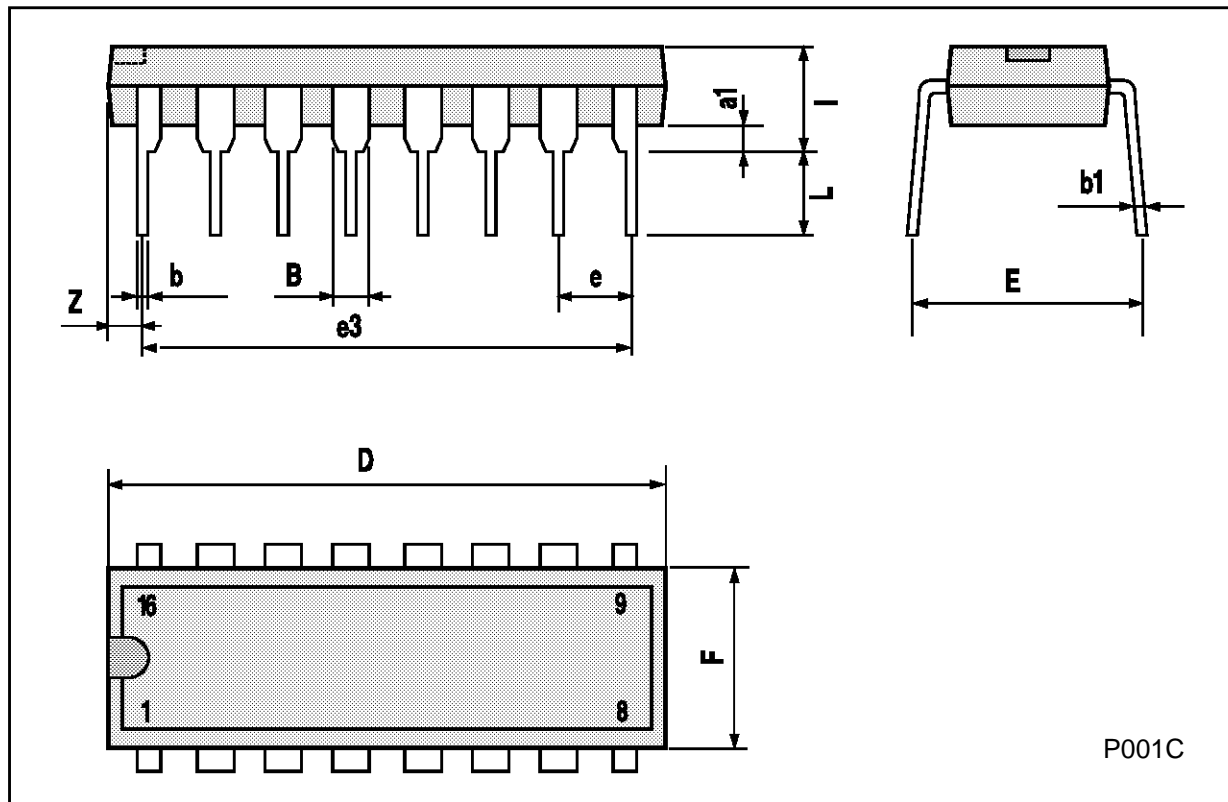


TEST CIRCUIT  $I_{CC}$  (Opr.)



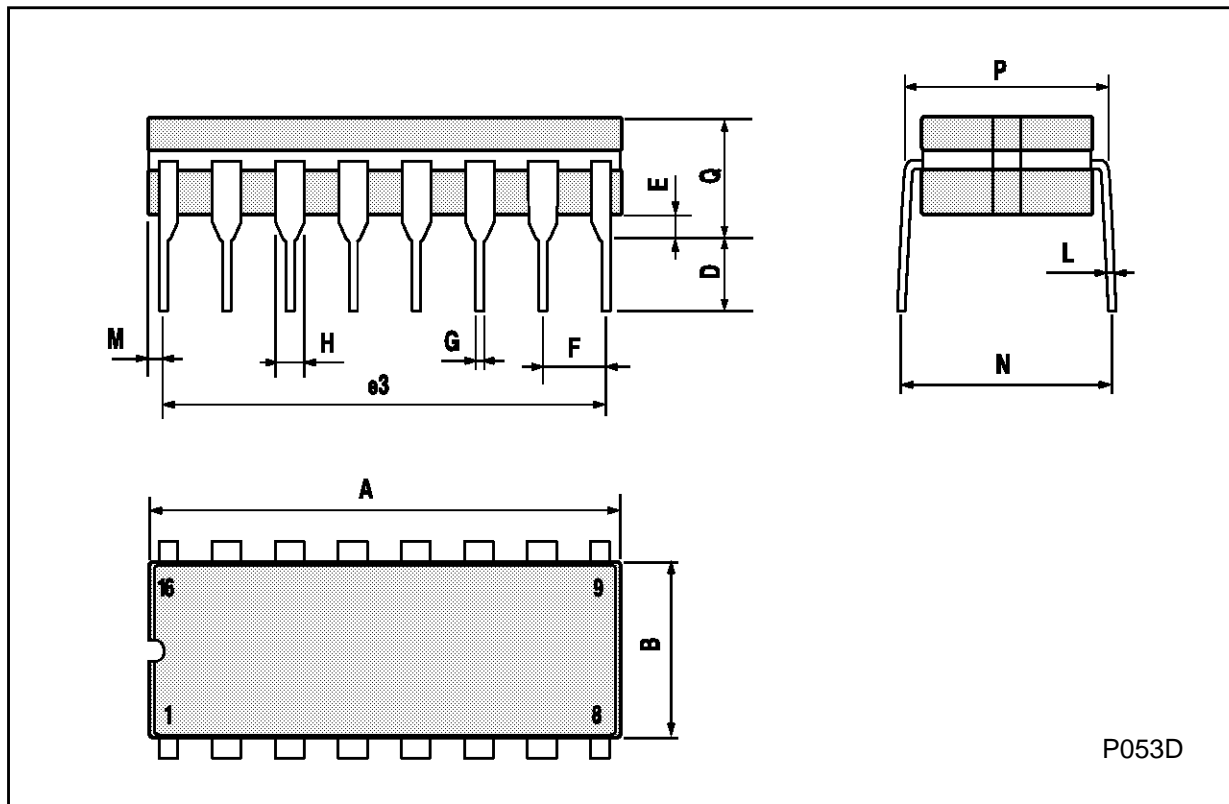
## Plastic DIP16 (0.25) MECHANICAL DATA

| 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**

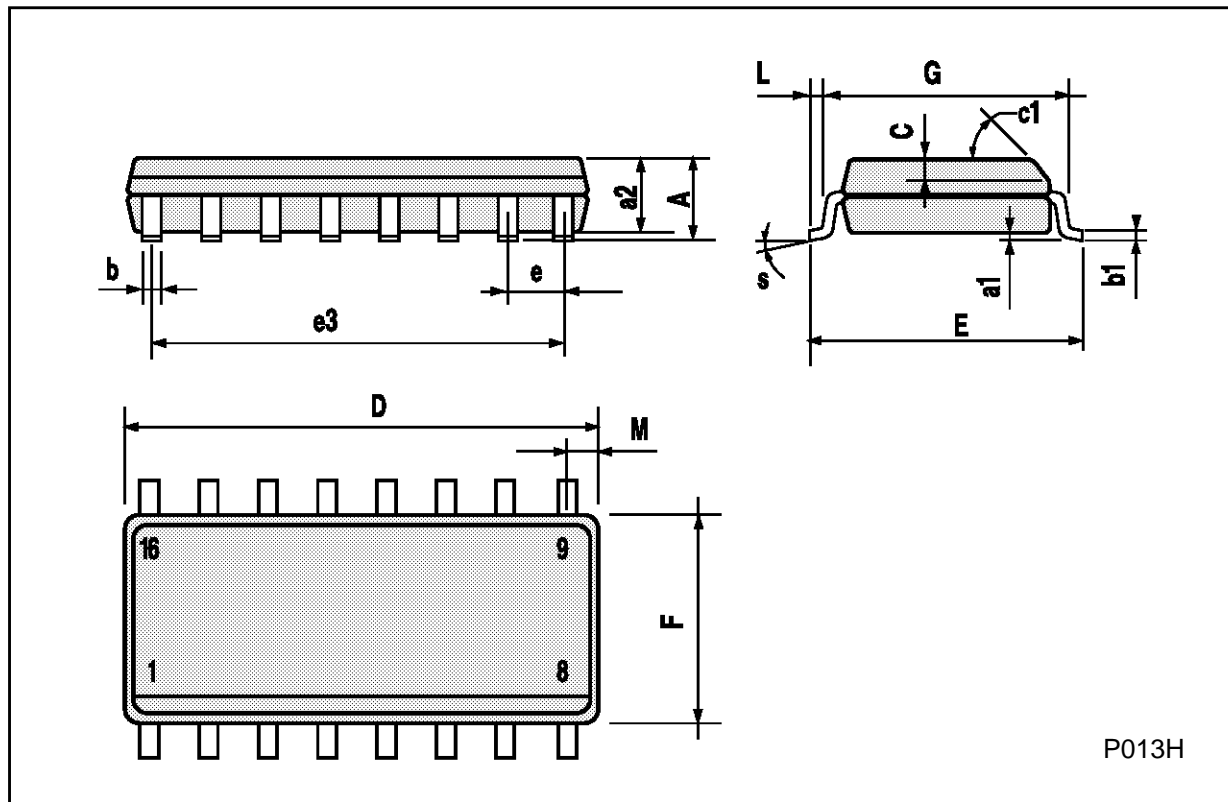
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |       | 20   |       |       | 0.787 |
| B    |      |       | 7    |       |       | 0.276 |
| D    |      | 3.3   |  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

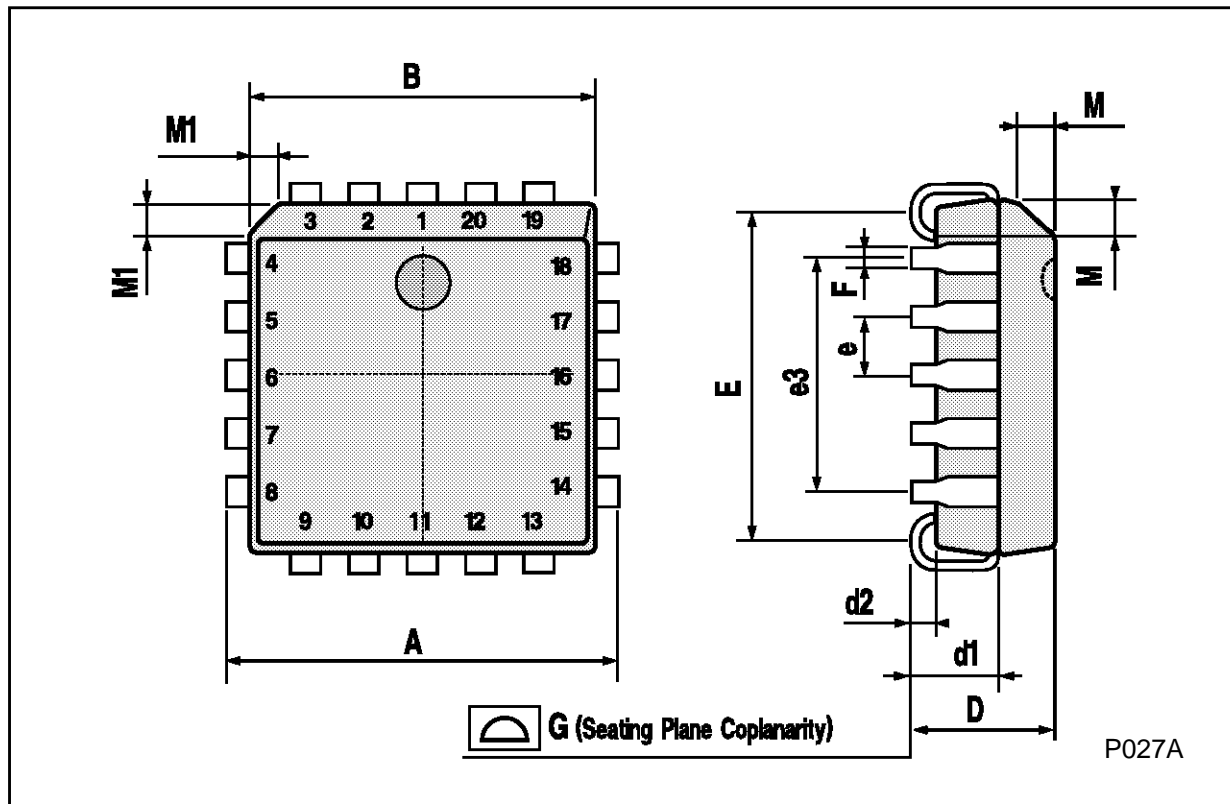
| DIM. | mm         |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.004 |       | 0.007 |
|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