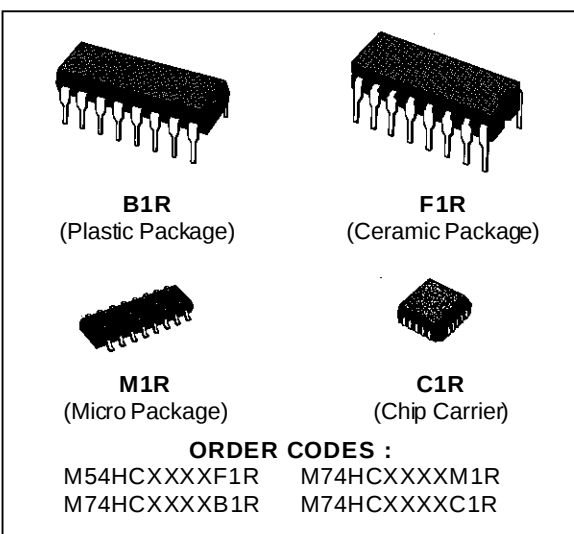


## HC4518 DUAL DECADE COUNTER HC4520 DUAL 4 BIT BINARY COUNTER

- **HIGH SPEED**  
 $f_{MAX} = 55 \text{ MHz (TYP.) at } V_{CC} = 5 \text{ V}$
- **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**  
 4520B/4518B



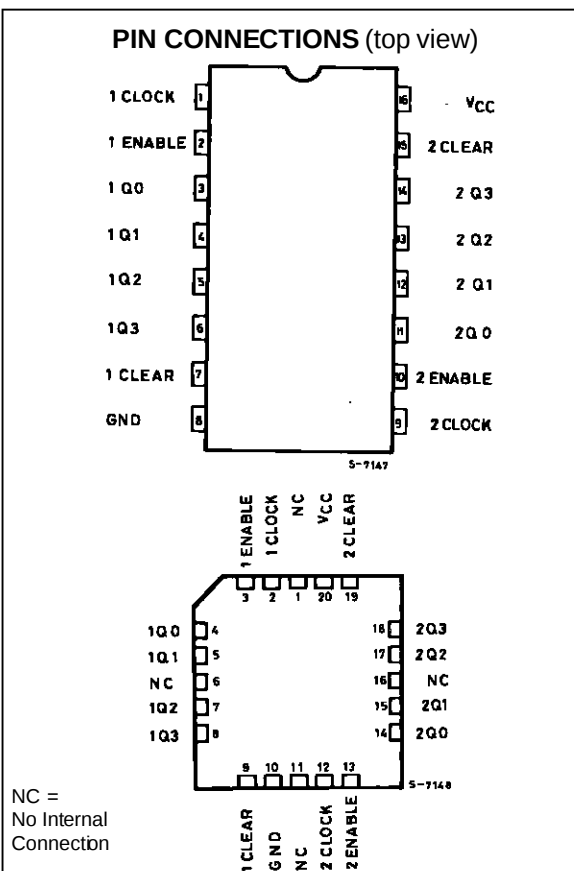
### DESCRIPTION

The M54/74HC4518/4520 are high speed CMOS DUAL 4 BIT BINARY COUNTERS fabricated in silicon gate C<sup>2</sup>MOS technology. They have the same high speed performance of LSTTL combined with true CMOS low power consumption.

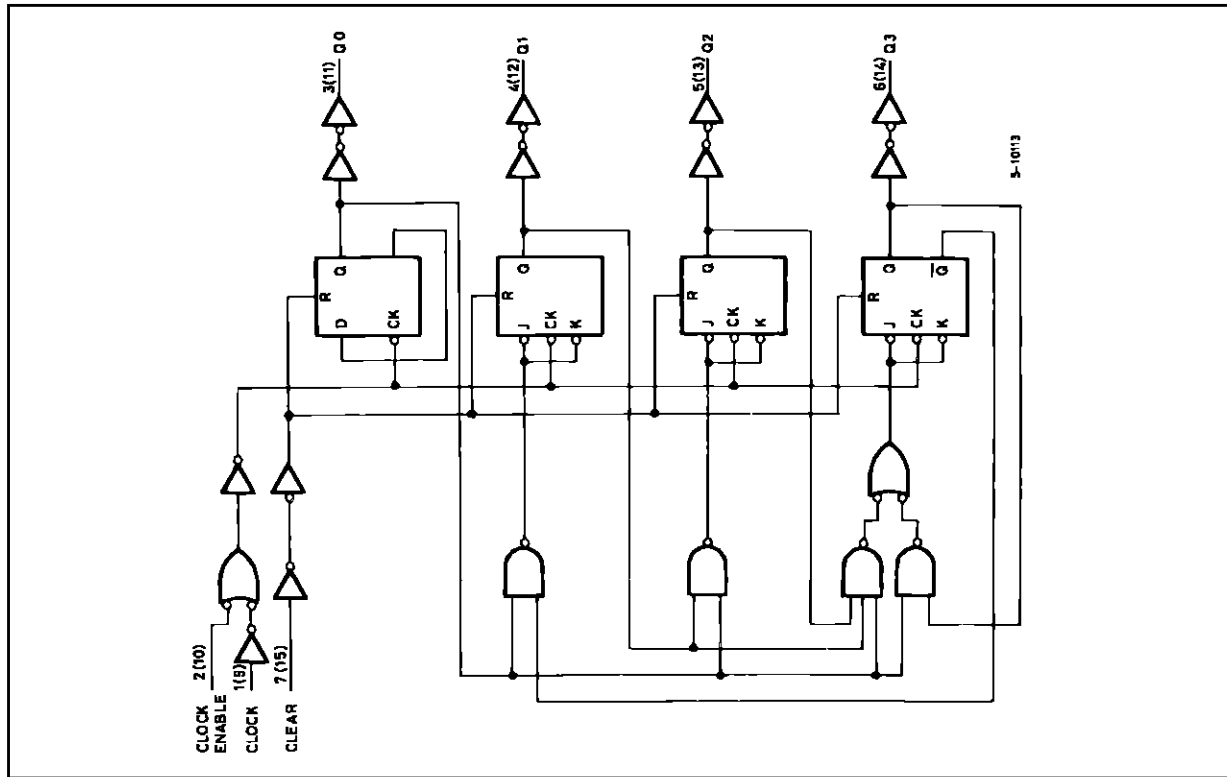
They consists of two identical internally synchronous 4-stage counters. The counter stages are D-type flip-flops having interchangeable Clock and ENABLE inputs for incrementing on either the positive-going or negative-going transition.

For single-unit operation the ENABLE input is maintained "high" and the counter advances on each positive-going transition of the CLOCK. The counters are cleared by high levels on their clear lines. The counter can be cascaded in the ripple mode by connecting Q4 to the enable input of the subsequent counter while the clock input of the latter is held permanently low.

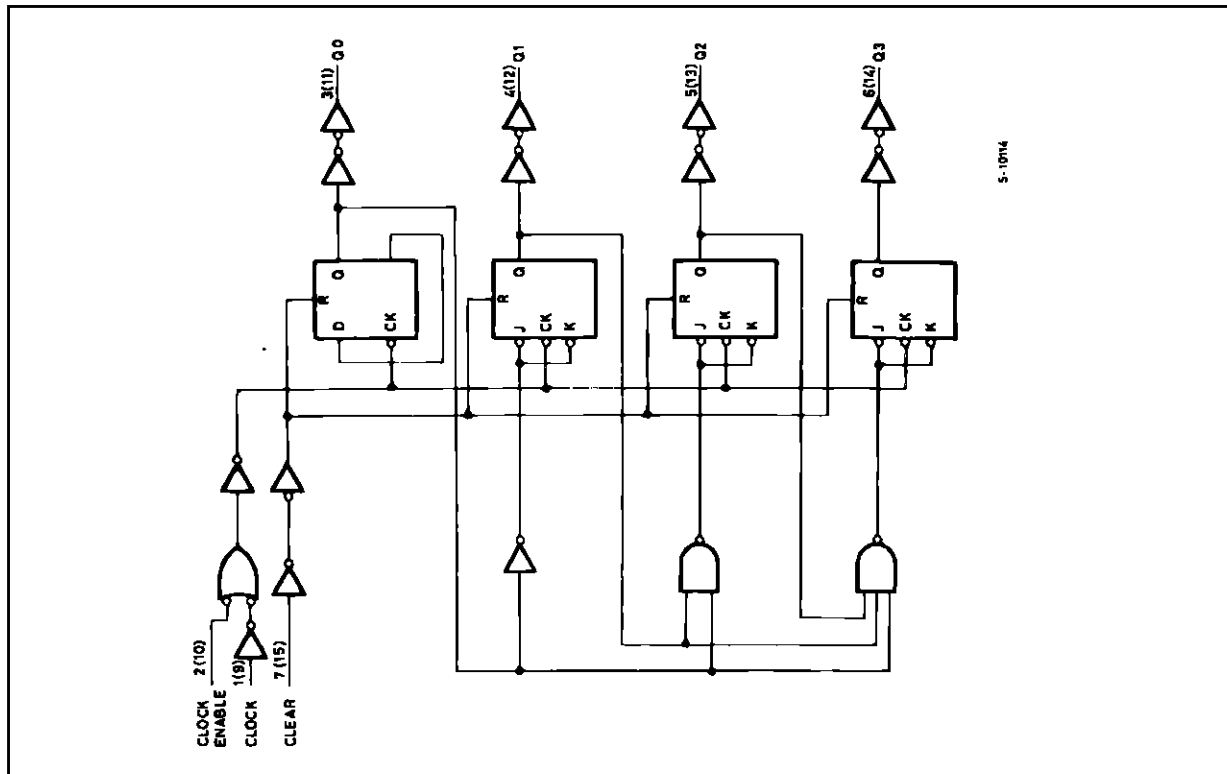
All inputs are equipped with protection circuits against static discharge and transient excess voltage.



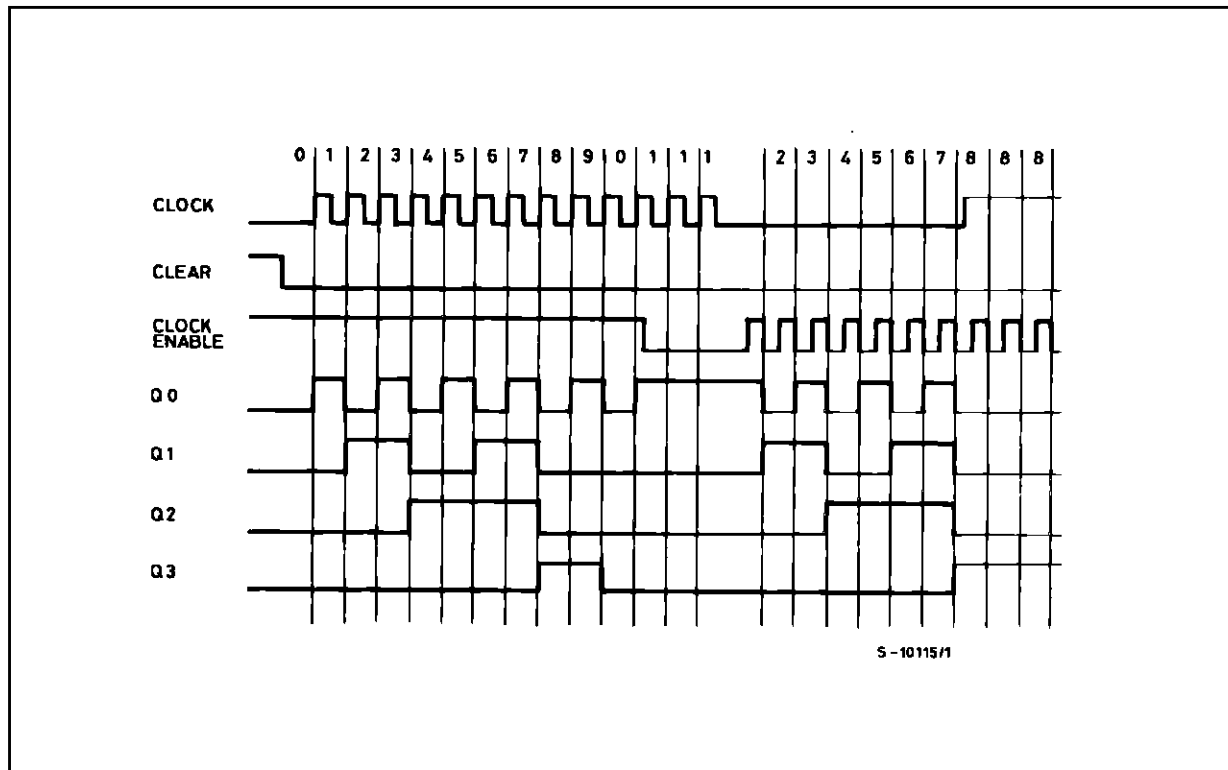
LOGIC DIAGRAM (1/2 HC4518)



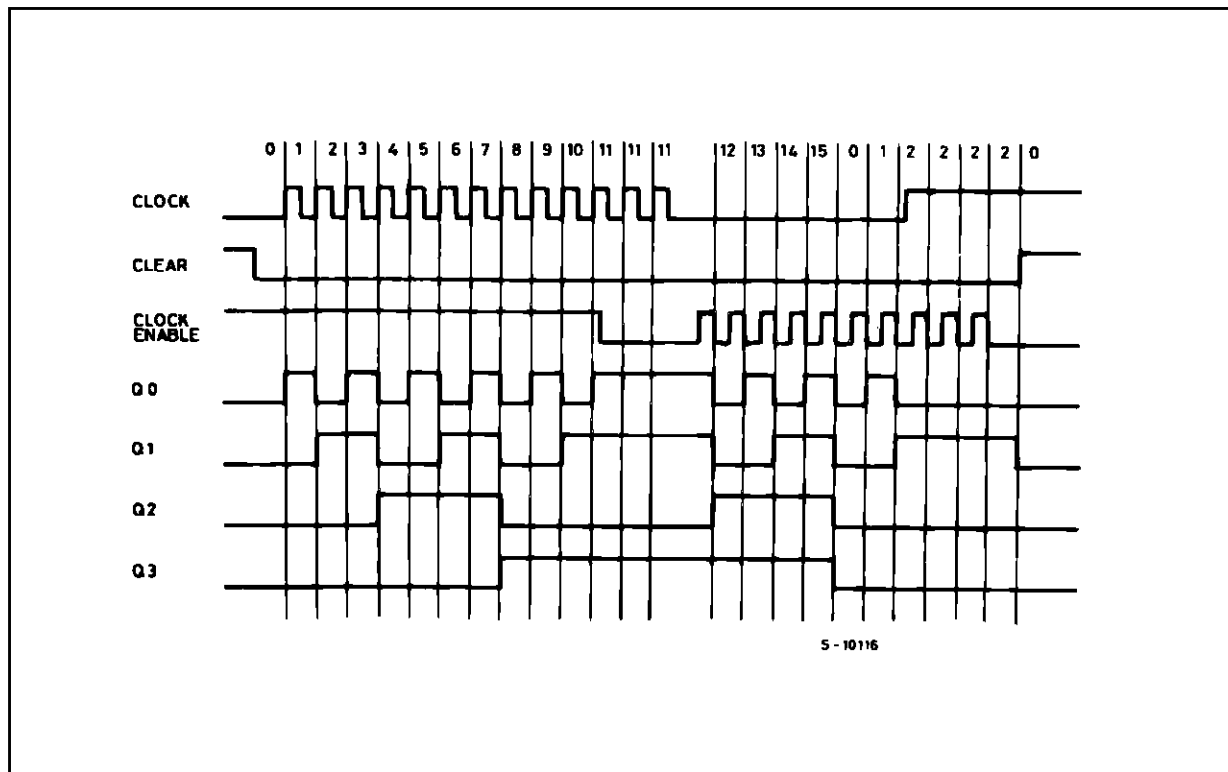
LOGIC DIAGRAM (1/2 HC4520)



TIMING CHART (HC4518)



TIMING CHART (HC4520)



# TRUTH TABLE

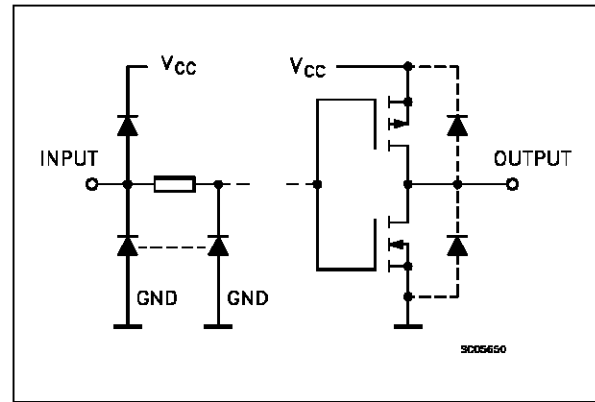
| INPUTS |        |       | FUNCTION          |
|--------|--------|-------|-------------------|
| CLOCK  | ENABLE | CLEAR |                   |
|        | H      | L     | INCREMENT COUNTER |
| L      |        | L     | INCREMENT COUNTER |
|        | X      | L     | NO CHANGE         |
| X      |        | L     | NO CHANGE         |
|        | L      | L     | NO CHANGE         |
| H      |        | L     | NO CHANGE         |
| X      | X      | H     | Q0 THRU Q3 = L    |

X: Don't Care Z: High Impedance

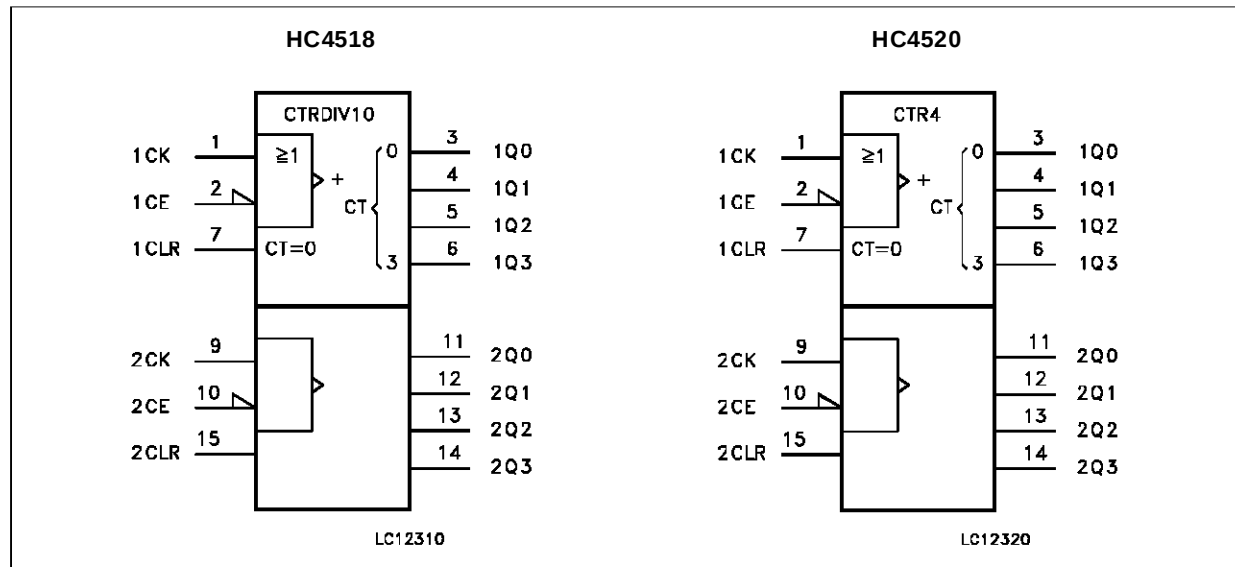
## PIN DESCRIPTION

| PIN No         | SYMBOL           | NAME AND FUNCTION                          |
|----------------|------------------|--------------------------------------------|
| 1, 9           | 1CLOCK, 2CLOCK   | Clock Inputs (LOW to HIGH, Edge-triggered) |
| 2, 10          | 1ENABLE, 2ENABLE | Clock Enable Inputs                        |
| 3, 4, 5, 6     | 1Q0 to 1Q3       | Data Outputs                               |
| 7, 15          | 1CLEAR, 2CLEAR   | Asynchronous Reset Inputs (Active LOW)     |
| 11, 12, 13, 14 | 2Q0 to 2Q3       | Data Outputs                               |
| 8              | GND              | Ground (0V)                                |
| 16             | Vcc              | Positive Supply Voltage                    |

## INPUT AND OUTPUT EQUIVALENT CIRCUIT



## IEC LOGIC SYMBOLS



**ABSOLUTE MAXIMUM RATINGS**

| Symbol                | Parameter                                    | Value                  | Unit |
|-----------------------|----------------------------------------------|------------------------|------|
| $V_{CC}$              | Supply Voltage                               | -0.5 to +7             | V    |
| $V_I$                 | DC Input Voltage                             | -0.5 to $V_{CC} + 0.5$ | V    |
| $V_O$                 | DC Output Voltage                            | -0.5 to $V_{CC} + 0.5$ | V    |
| $I_{IK}$              | DC Input Diode Current                       | $\pm 20$               | mA   |
| $I_{OK}$              | DC Output Diode Current                      | $\pm 20$               | mA   |
| $I_O$                 | DC Output Source Sink Current Per Output Pin | $\pm 25$               | mA   |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current                | $\pm 50$               | mA   |
| $P_D$                 | Power Dissipation                            | 500 (*)                | mW   |
| $T_{stg}$             | Storage Temperature                          | -65 to +150            | °C   |
| $T_L$                 | 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:  $\equiv 65^\circ\text{C}$  derate to 300 mW by 10mW/°C:  $65^\circ\text{C}$  to  $85^\circ\text{C}$

**RECOMMENDED OPERATING CONDITIONS**

| Symbol     | Parameter                                                         | Value                                                                     | Unit                              |
|------------|-------------------------------------------------------------------|---------------------------------------------------------------------------|-----------------------------------|
| $V_{CC}$   | Supply Voltage                                                    | 2 to 6                                                                    | 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                                          | $V_{CC} = 2\text{ V}$<br>$V_{CC} = 4.5\text{ V}$<br>$V_{CC} = 6\text{ V}$ | 0 to 1000<br>0 to 500<br>0 to 400 |
|            |                                                                   |                                                                           | ns                                |

**DC SPECIFICATIONS**

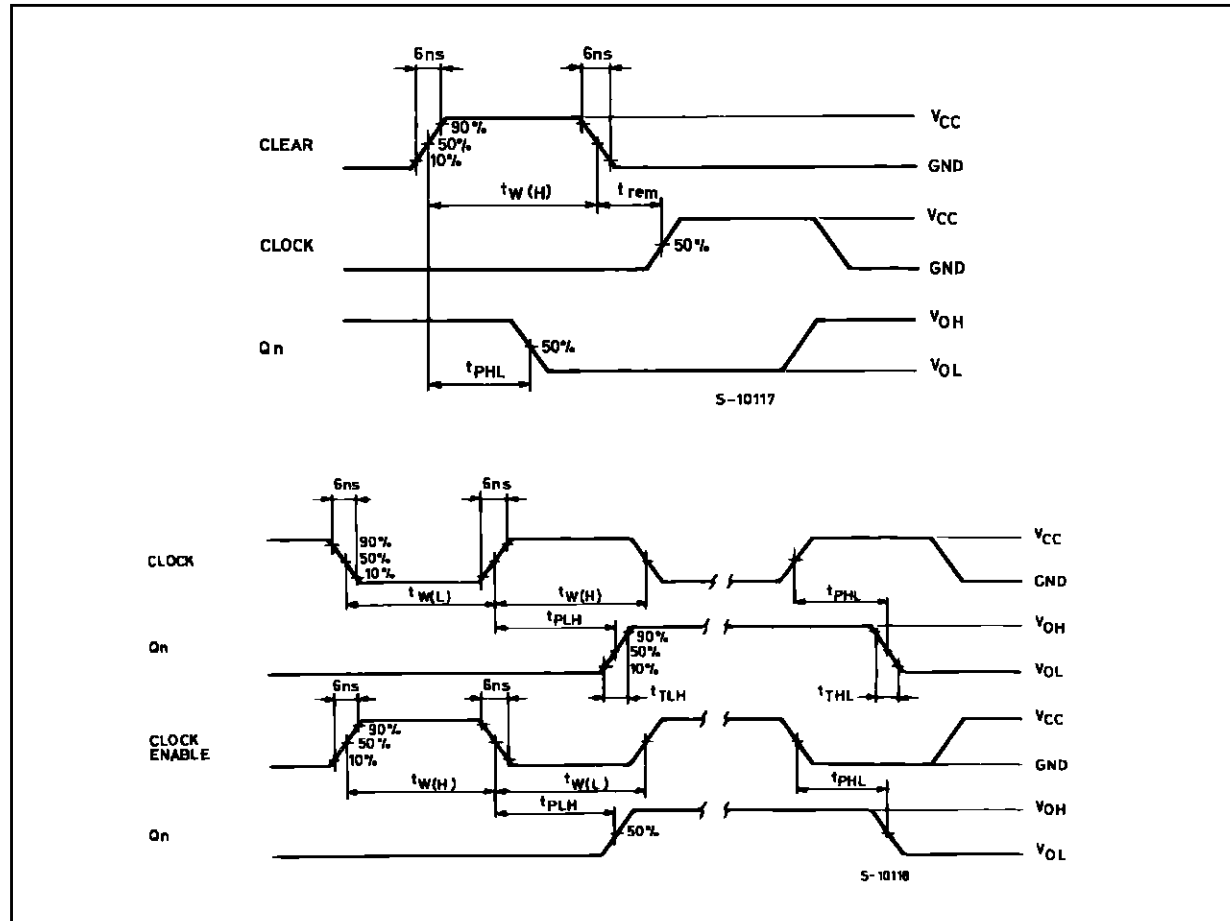
| Symbol          | Parameter                 | Test Conditions        |                                                              | Value                                   |                         |      |                      |      |                       | Unit |      |      |
|-----------------|---------------------------|------------------------|--------------------------------------------------------------|-----------------------------------------|-------------------------|------|----------------------|------|-----------------------|------|------|------|
|                 |                           | 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  | 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                   |      | V    |      |
|                 |                           | 4.5                    |                                                              |                                         |                         | 0.0  | 0.1                  |      | 0.1                   |      |      |      |
|                 |                           | 6.0                    |                                                              |                                         |                         | 0.0  | 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 |      |      |
| 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>CC</sub> | Quiescent Supply Current  | 6.0                    | V <sub>I</sub> = V <sub>CC</sub> or GND                      |                                         |                         | 4    |                      | 40   |                       | 80   | µA   |      |

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

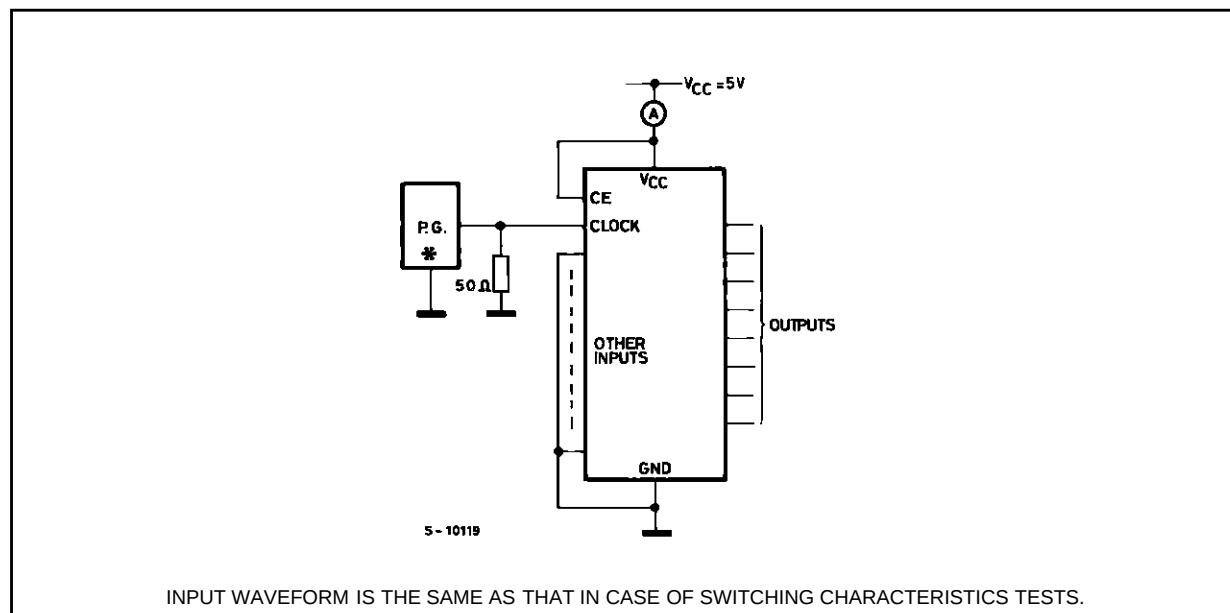
| Symbol                                 | Parameter                                            | Test Conditions        |                          | Value                                   |          |      |                      |      |                       | Unit |      |
|----------------------------------------|------------------------------------------------------|------------------------|--------------------------|-----------------------------------------|----------|------|----------------------|------|-----------------------|------|------|
|                                        |                                                      | 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>(CK, CE - Q <sub>n</sub> ) | 2.0                    |                          |                                         | 72       | 160  |                      | 200  |                       | 240  | ns   |
|                                        |                                                      | 4.5                    |                          |                                         | 22       | 32   |                      | 40   |                       | 48   |      |
|                                        |                                                      | 6.0                    |                          |                                         | 18       | 27   |                      | 34   |                       | 41   |      |
| t <sub>PHL</sub>                       | Propagation Delay Time<br>(CLR - Q <sub>n</sub> )    | 2.0                    |                          |                                         | 65       | 150  |                      | 190  |                       | 225  | ns   |
|                                        |                                                      | 4.5                    |                          |                                         | 20       | 30   |                      | 38   |                       | 45   |      |
|                                        |                                                      | 6.0                    |                          |                                         | 16       | 26   |                      | 33   |                       | 38   |      |
| f <sub>MAX</sub>                       | Maximum Clock Frequency                              | 2.0                    |                          |                                         | 6        | 23   |                      | 4.8  |                       | 4    | MHz  |
|                                        |                                                      | 4.5                    |                          |                                         | 30       | 51   |                      | 24   |                       | 20   |      |
|                                        |                                                      | 6.0                    |                          |                                         | 35       | 60   |                      | 28   |                       | 24   |      |
| t <sub>W(H)</sub><br>t <sub>W(L)</sub> | Minimum Pulse Width<br>(CK, CE)                      | 2.0                    |                          |                                         | 25       | 75   |                      | 95   |                       |      | ns   |
|                                        |                                                      | 4.5                    |                          |                                         | 6        | 15   |                      | 19   |                       |      |      |
|                                        |                                                      | 6.0                    |                          |                                         | 5        | 13   |                      | 16   |                       |      |      |
| t <sub>W(L)</sub>                      | Minimum Pulse Width<br>(CLR)                         | 2.0                    |                          |                                         | 20       | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                                      | 4.5                    |                          |                                         | 5        | 15   |                      | 19   |                       | 22   |      |
|                                        |                                                      | 6.0                    |                          |                                         | 4        | 13   |                      | 16   |                       | 19   |      |
| t <sub>REM</sub>                       | Minimum Removal Time<br>(CLR)                        | 2.0                    |                          |                                         | 21       | 50   |                      | 60   |                       | 75   | ns   |
|                                        |                                                      | 4.5                    |                          |                                         | 3        | 10   |                      | 12   |                       | 15   |      |
|                                        |                                                      | 6.0                    |                          |                                         | 3        | 9    |                      | 11   |                       | 13   |      |
| C <sub>IN</sub>                        | Input Capacitance                                    |                        |                          |                                         | 5        | 10   |                      | 10   |                       | 10   | pF   |
| C <sub>PD</sub> (*)                    | Power Dissipation Capacitance                        |                        | for HC4518<br>for HC4520 |                                         | 38<br>32 |      |                      |      |                       |      | 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 COUNTER)

## SWITCHING CHARACTERISTICS TEST WAVEFORMS

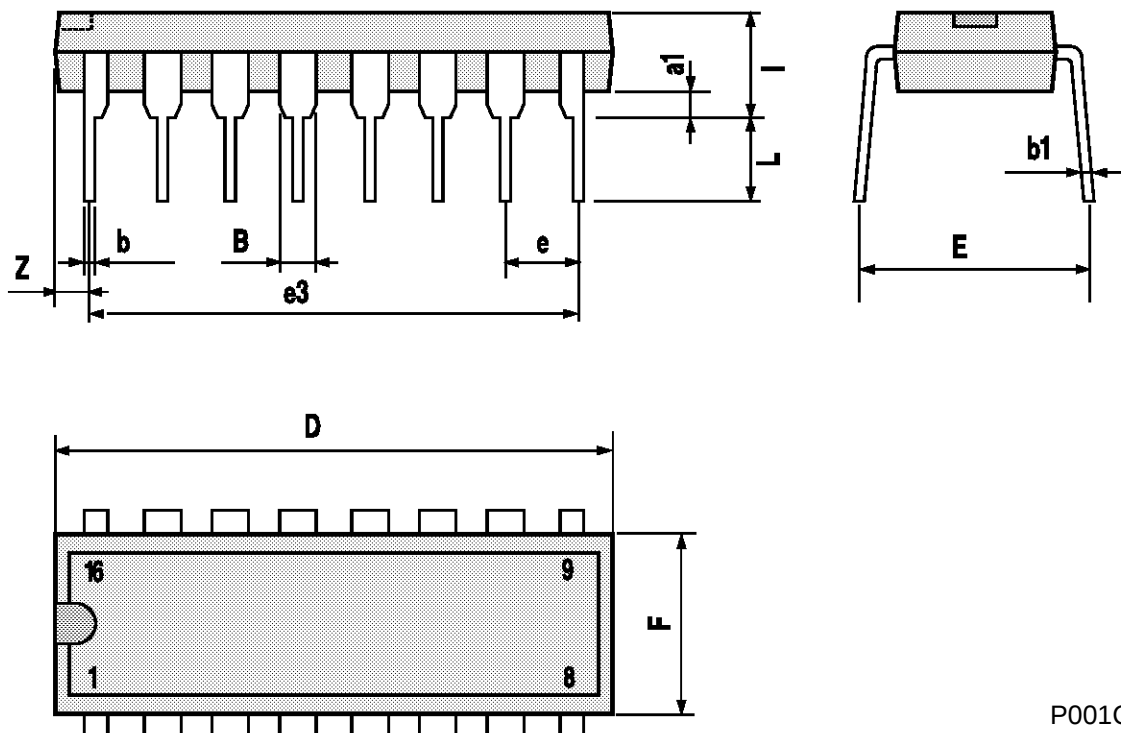


## TEST CIRCUIT $I_{CC}$ (Opr.)



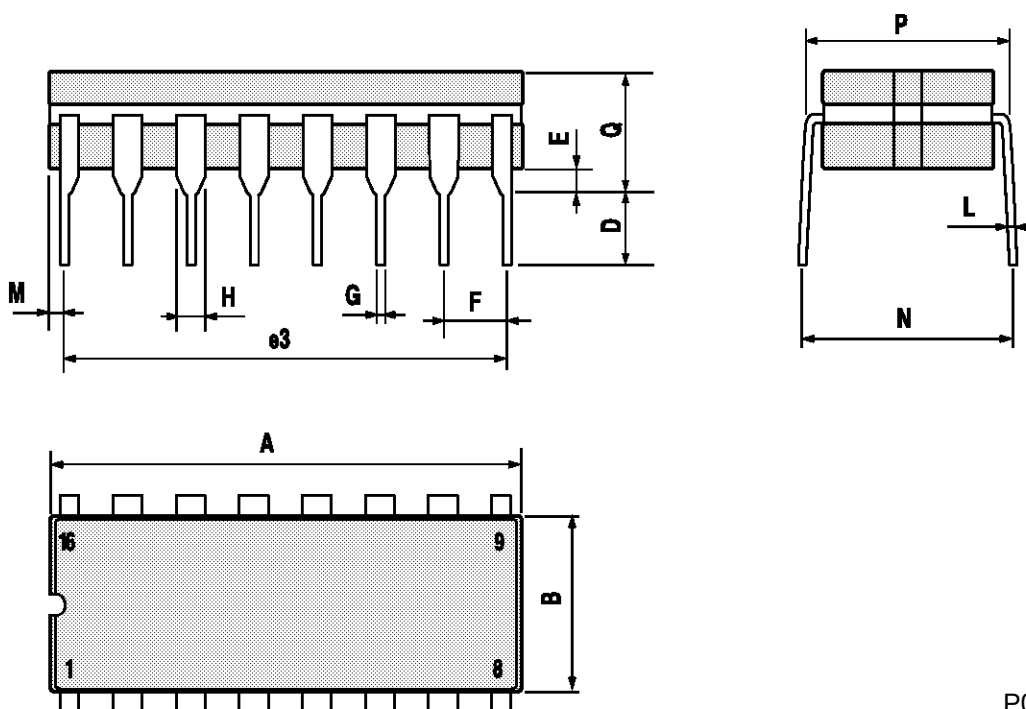
## Plastic DIP16 (0.25) MECHANICAL DATA

| 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 |



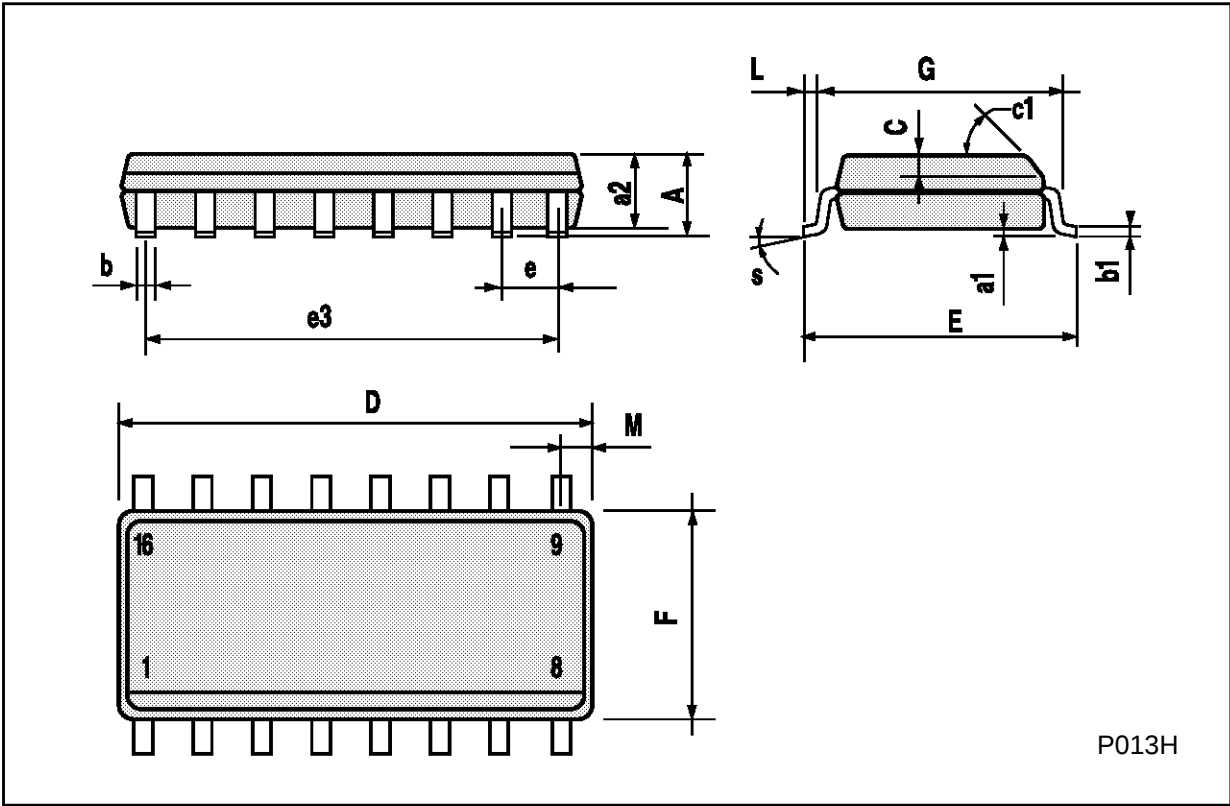
## Ceramic DIP16/1 MECHANICAL DATA

| 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 |



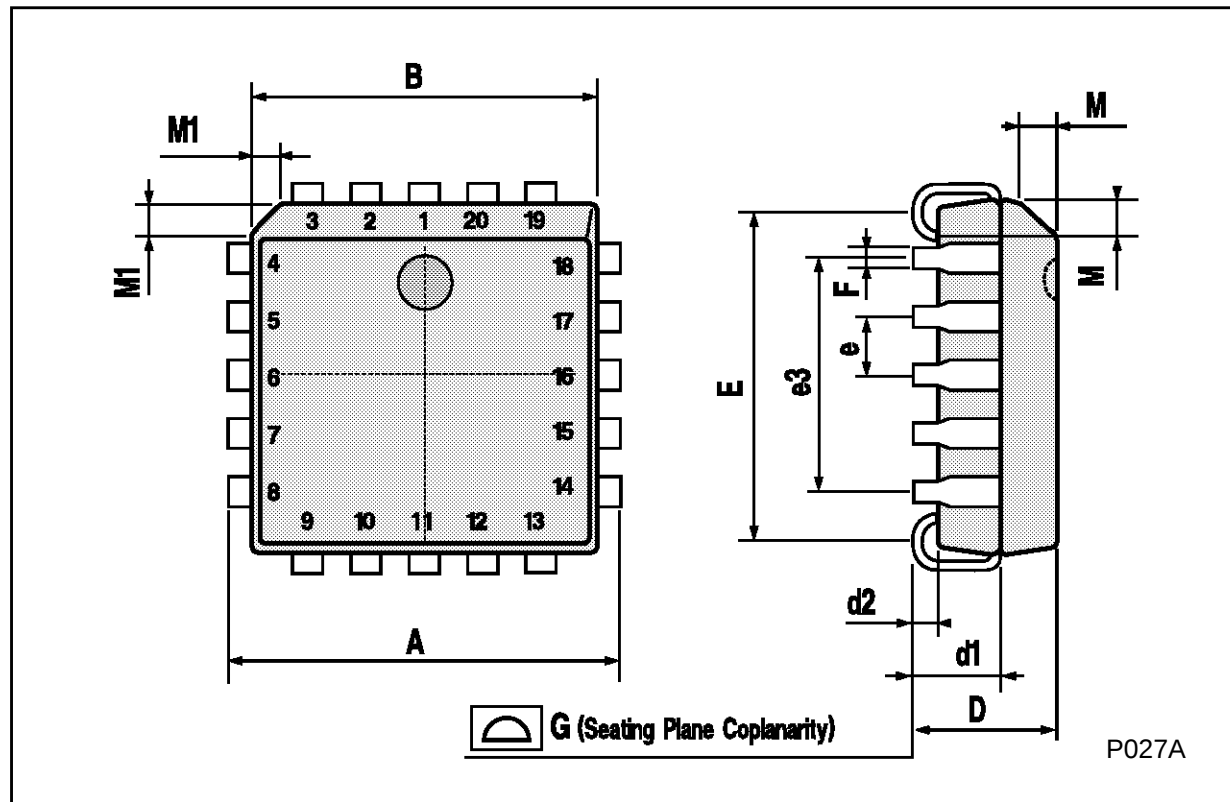
SO16 (Narrow) MECHANICAL DATA

| 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.)  |      |      |       |       |       |



## 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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