

## 4 BIT SYNCHRONOUS UP/DOWN COUNTERS

- HIGH SPEED  
 $f_{MAX} = 48 \text{ MHz (TYP.) AT } V_{CC} = 5 \text{ V}$
- 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 54/74LS190/191

### DESCRIPTION

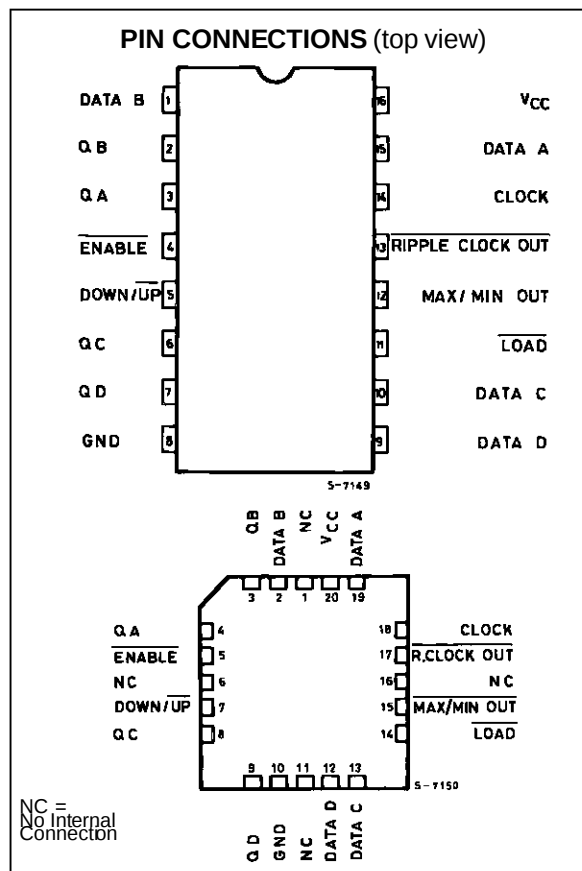
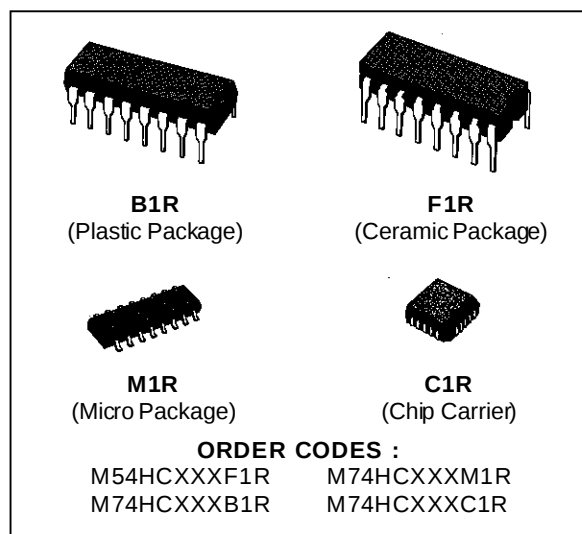
The M54/74HC190/191 are high speed CMOS 4-BIT SYNCHRONOUS UP/DOWN COUNTERS fabricated in silicon gate C<sup>2</sup>MOS technology.

They have the same high speed performance of LSTTL combined with true CMOS low power consumption.

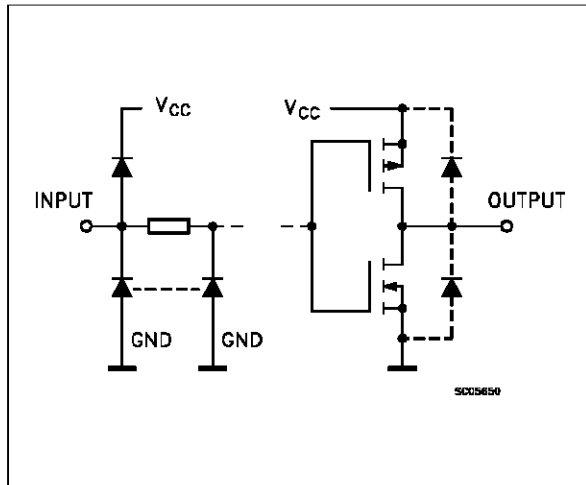
State changes of the counter are synchronous with the LOW-to-HIGH transition of the Clock Pulse input.

An asynchronous parallel load input overrides counting and loads the data present on the DATA inputs into the flip-flops, which makes it possible to use the circuits as programmable counters. A countenable input serves as the carry/borrow input in multi-stage counters. Control input, Down/Up, determines whether a circuit counts up or down. A MAX/MIN output and a Ripple Clock output provide overflow/underflow indication and make possible a variety of methods for generating carry/borrow signals in multi-stage counter applications.

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



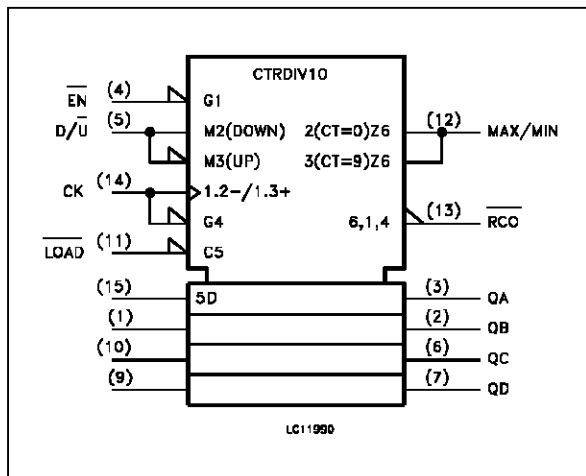
## INPUT AND OUTPUT EQUIVALENT CIRCUIT



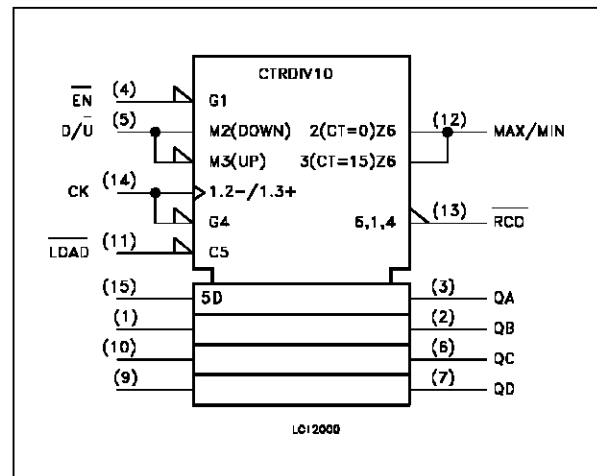
## PIN DESCRIPTION

| PIN No       | SYMBOL                     | NAME AND FUNCTION                         |
|--------------|----------------------------|-------------------------------------------|
| 3, 2, 6, 7   | QA to QD                   | Flip-Flop Outputs                         |
| 4            | $\overline{\text{ENABLE}}$ | Count Enable Input (Active LOW)           |
| 5            | $\overline{\text{U/D}}$    | Parallel Data Input                       |
| 11           | LOAD                       | Load Input (Active LOW)                   |
| 12           | MA/MI OUT                  | Terminal Count Output                     |
| 13           | $\overline{\text{RC}}$     | Ripple Clock Output (Active LOW)          |
| 14           | CLOCK                      | Clock Input (LOW to HIGH, Edge-triggered) |
| 15, 1, 10, 9 | DA to DD                   | Data Inputs                               |
| 8            | GND                        | Ground (0V)                               |
| 16           | Vcc                        | Positive Supply Voltage                   |

## IEC LOGIC SYMBOL (HC190)



## IEC LOGIC SYMBOL (HC191)

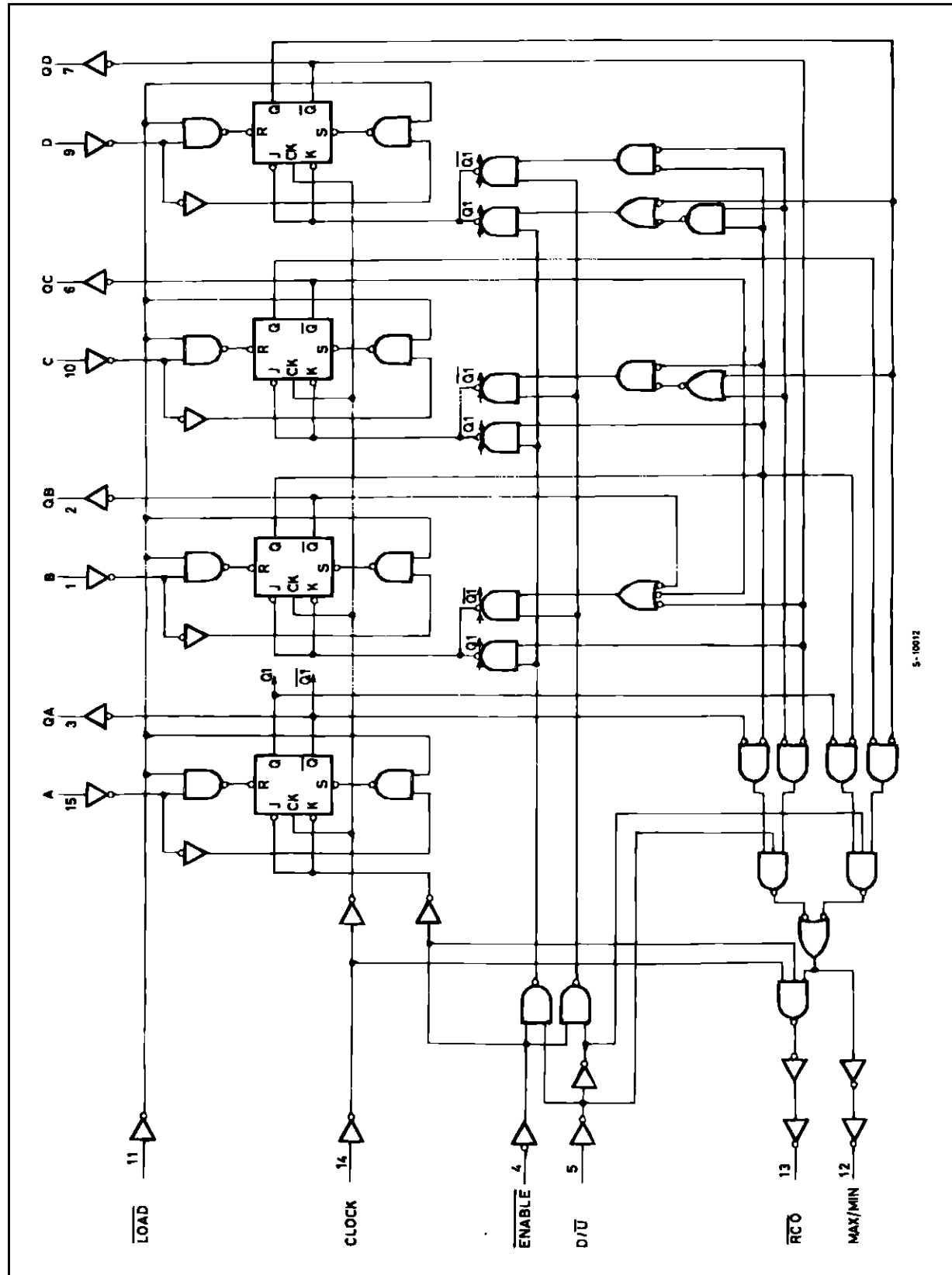


## TRUTH TABLE

| INPUTS |        |     |              | OUTPUTS    |    |    |    | FUNCTION    |
|--------|--------|-----|--------------|------------|----|----|----|-------------|
| LOAD   | ENABLE | D/U | CLOCK        | QA         | QB | QC | QD |             |
| L      | X      | X   | X            | a          | b  | c  | d  | PRESET DATA |
| H      | L      | L   | $\downarrow$ | UP COUNT   |    |    |    | UP COUNT    |
| H      | L      | H   | $\downarrow$ | DOWN COUNT |    |    |    | DOWN COUNT  |
| H      | H      | X   | $\downarrow$ | NO CHANGE  |    |    |    | NO COUNT    |
| H      | X      | X   | $\downarrow$ | NO CHANGE  |    |    |    | NO COUNT    |

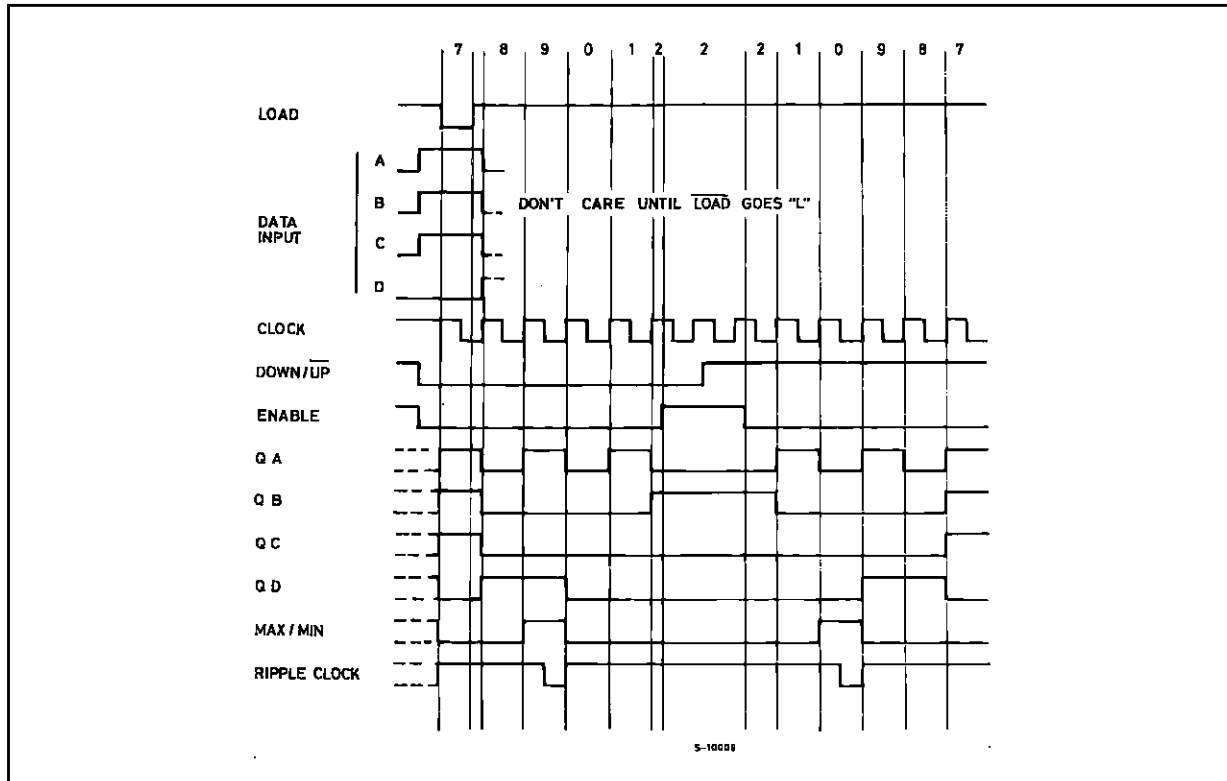
X: Don't Care

a - d: The level of steady state inputs at inputs a through d respectively

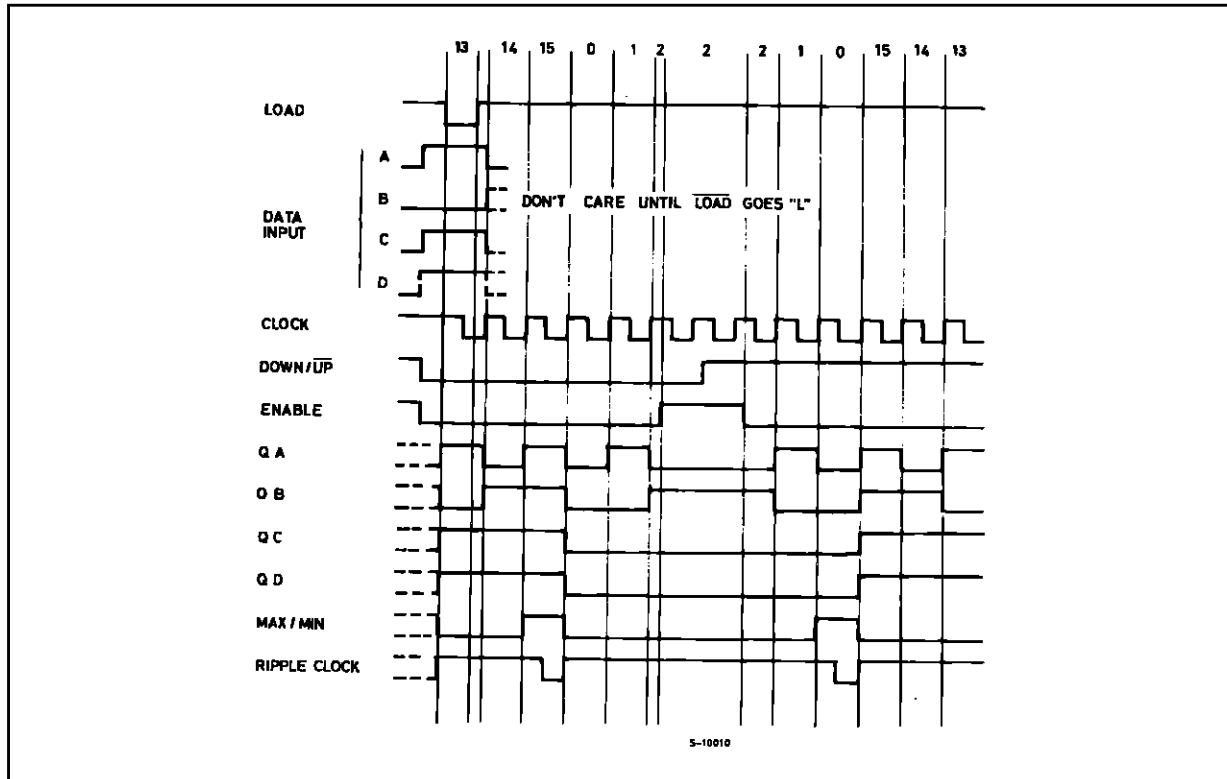




TIMING CHART (HC190)



TIMING CHART (HC191)



**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   | 0 to 1000                 | ns       |
|                                 |                                                                   | V <sub>CC</sub> = 4.5 V | 0 to 500                  |          |
|                                 |                                                                   | V <sub>CC</sub> = 6 V   | 0 to 400                  |          |

## 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                 |      | 0.33                  |      | 0.40 |      |
|                 |                           | 6.0                    |                                                              | I <sub>O</sub> = 5.2 mA                 |      | 0.18 | 0.26                 |      | 0.33                  |      | 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>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<sub>L</sub> = 50 pF, Input t<sub>r</sub> = t<sub>f</sub> = 6 ns)

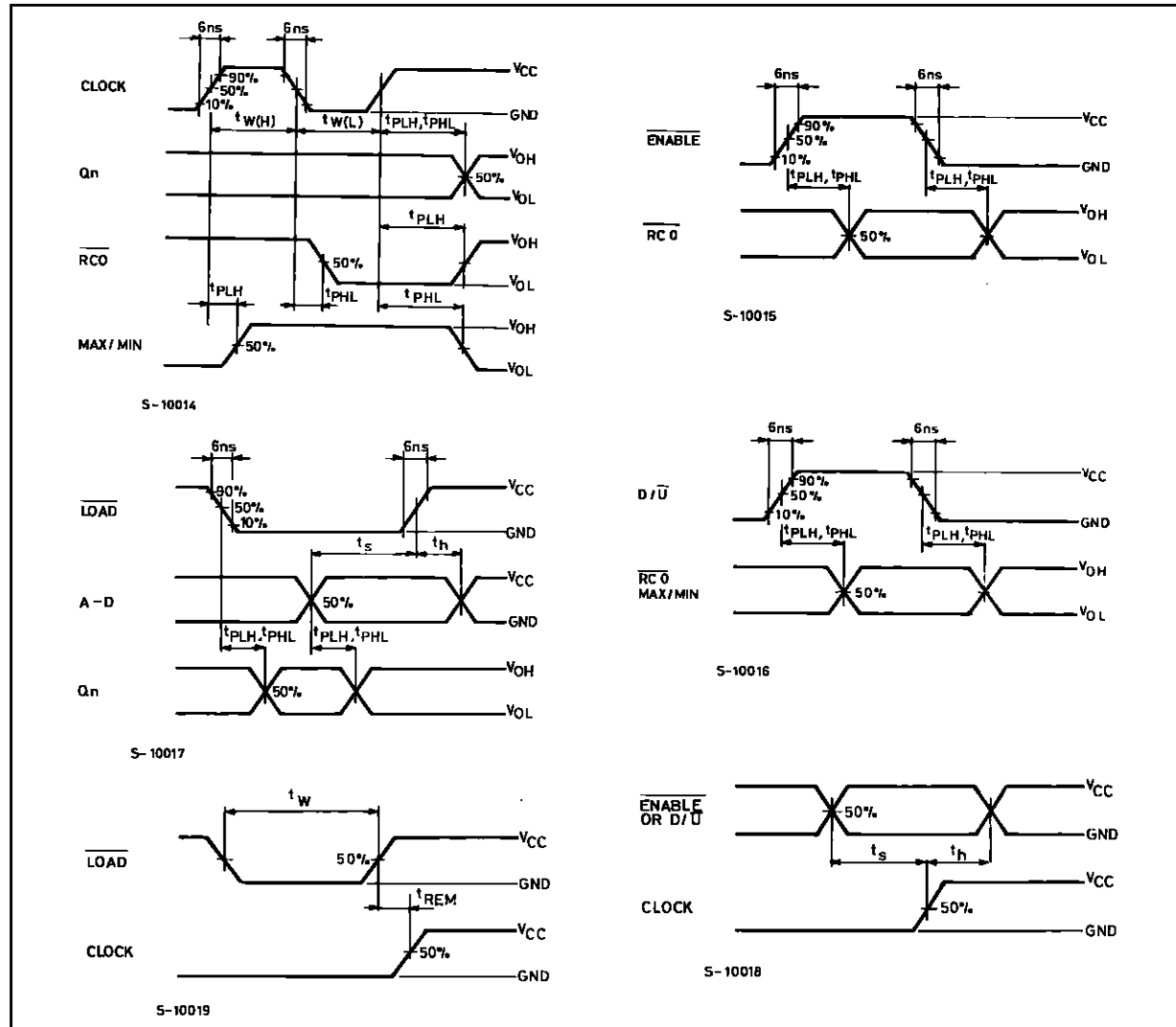
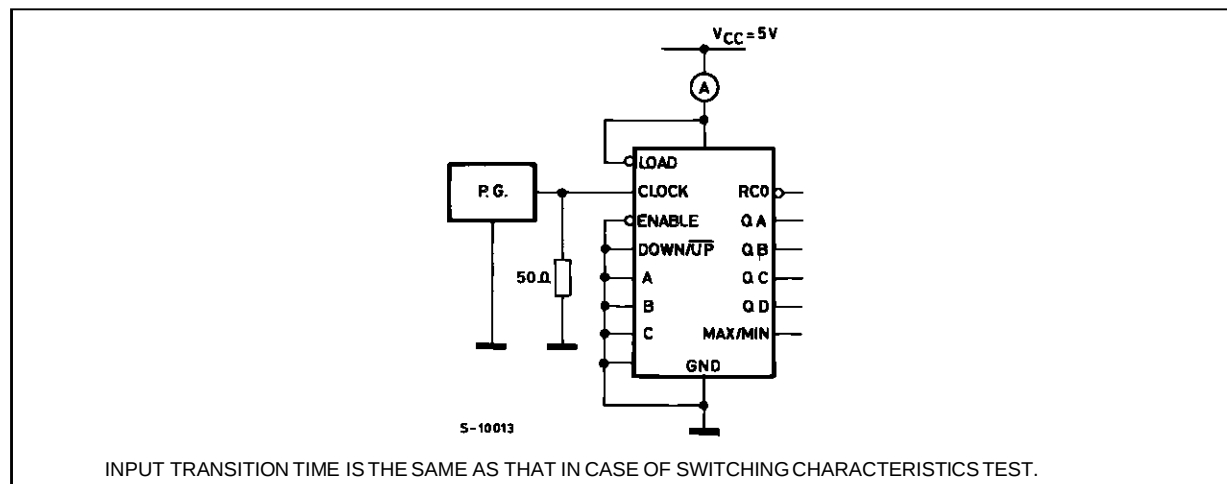
| Symbol                               | Parameter                                | Test Conditions        |  | Value                                   |      |      |                      |      |                       | Unit |      |
|--------------------------------------|------------------------------------------|------------------------|--|-----------------------------------------|------|------|----------------------|------|-----------------------|------|------|
|                                      |                                          | 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 (CLOCK - Q)       | 2.0                    |  |                                         | 92   | 180  |                      | 225  |                       | 270  | ns   |
|                                      |                                          | 4.5                    |  |                                         | 23   | 36   |                      | 45   |                       | 54   |      |
|                                      |                                          | 6.0                    |  |                                         | 20   | 31   |                      | 38   |                       | 46   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay Time (CLOCK - RCO)     | 2.0                    |  |                                         | 39   | 120  |                      | 150  |                       | 180  | ns   |
|                                      |                                          | 4.5                    |  |                                         | 13   | 24   |                      | 30   |                       | 36   |      |
|                                      |                                          | 6.0                    |  |                                         | 11   | 20   |                      | 26   |                       | 31   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay Time (CLOCK - MAX/MIN) | 2.0                    |  |                                         | 120  | 240  |                      | 300  |                       | 360  | ns   |
|                                      |                                          | 4.5                    |  |                                         | 30   | 48   |                      | 60   |                       | 72   |      |
|                                      |                                          | 6.0                    |  |                                         | 26   | 41   |                      | 51   |                       | 61   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay Time (LOAD - Q)        | 2.0                    |  |                                         | 108  | 205  |                      | 255  |                       | 310  | ns   |
|                                      |                                          | 4.5                    |  |                                         | 27   | 41   |                      | 51   |                       | 62   |      |
|                                      |                                          | 6.0                    |  |                                         | 23   | 35   |                      | 43   |                       | 53   |      |

**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>PLH</sub><br>t <sub>PHL</sub>   | Propagation<br>Delay Time<br>(DATA - Q)      | 2.0                    |                        |                                         | 84         | 175  |                      | 220  |                       | 265  | ns   |
|                                        |                                              | 4.5                    |                        |                                         | 21         | 35   |                      | 44   |                       | 53   |      |
|                                        |                                              | 6.0                    |                        |                                         | 18         | 30   |                      | 37   |                       | 45   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation<br>Delay Time<br>(ENABLE - RCO)  | 2.0                    |                        |                                         | 39         | 105  |                      | 130  |                       | 160  | ns   |
|                                        |                                              | 4.5                    |                        |                                         | 13         | 21   |                      | 26   |                       | 32   |      |
|                                        |                                              | 6.0                    |                        |                                         | 11         | 18   |                      | 22   |                       | 27   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation<br>Delay Time<br>(D/U - RCO)     | 2.0                    |                        |                                         | 63         | 180  |                      | 225  |                       | 270  | ns   |
|                                        |                                              | 4.5                    |                        |                                         | 21         | 36   |                      | 45   |                       | 54   |      |
|                                        |                                              | 6.0                    |                        |                                         | 18         | 31   |                      | 38   |                       | 46   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation<br>Delay Time<br>(D/U - MAX/MIN) | 2.0                    |                        |                                         | 64         | 160  |                      | 200  |                       | 240  | ns   |
|                                        |                                              | 4.5                    |                        |                                         | 18         | 32   |                      | 40   |                       | 48   |      |
|                                        |                                              | 6.0                    |                        |                                         | 15         | 27   |                      | 34   |                       | 41   |      |
| f <sub>MAX</sub>                       | Maximum Clock<br>Frequency                   | 2.0                    |                        | 5                                       | 9          |      | 4                    |      | 3.4                   |      | MHz  |
|                                        |                                              | 4.5                    |                        | 25                                      | 37         |      | 20                   |      | 17                    |      |      |
|                                        |                                              | 6.0                    |                        | 30                                      | 44         |      | 24                   |      | 20                    |      |      |
| t <sub>w(H)</sub><br>t <sub>w(L)</sub> | Minimum Pulse<br>Width<br>(CLOCK)            | 2.0                    |                        |                                         | 40         | 100  |                      | 125  |                       | 150  | ns   |
|                                        |                                              | 4.5                    |                        |                                         | 10         | 20   |                      | 25   |                       | 30   |      |
|                                        |                                              | 6.0                    |                        |                                         | 9          | 17   |                      | 21   |                       | 26   |      |
| t <sub>w(L)</sub>                      | Minimum Pulse<br>Width<br>(LOAD)             | 2.0                    |                        |                                         | 36         | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                              | 4.5                    |                        |                                         | 9          | 15   |                      | 19   |                       | 22   |      |
|                                        |                                              | 6.0                    |                        |                                         | 8          | 13   |                      | 16   |                       | 19   |      |
| t <sub>s</sub>                         | Minimum Set-up<br>Time<br>(SI, PI - CK)      | 2.0                    |                        |                                         | 80         | 175  |                      | 220  |                       | 265  | ns   |
|                                        |                                              | 4.5                    |                        |                                         | 20         | 35   |                      | 44   |                       | 53   |      |
|                                        |                                              | 6.0                    |                        |                                         | 17         | 30   |                      | 37   |                       | 45   |      |
| t <sub>s</sub>                         | Minimum Set-up<br>Time<br>(S0, S1 - CK)      | 2.0                    |                        |                                         | 16         | 50   |                      | 60   |                       | 75   | ns   |
|                                        |                                              | 4.5                    |                        |                                         | 4          | 10   |                      | 12   |                       | 15   |      |
|                                        |                                              | 6.0                    |                        |                                         | 3          | 9    |                      | 11   |                       | 13   |      |
| t <sub>h</sub>                         | Minimum Hold<br>Time                         | 2.0                    |                        |                                         |            | 0    |                      | 0    |                       | 0    | ns   |
|                                        |                                              | 4.5                    |                        |                                         |            | 0    |                      | 0    |                       | 0    |      |
|                                        |                                              | 6.0                    |                        |                                         |            | 0    |                      | 0    |                       | 0    |      |
| t <sub>REM</sub>                       | Minimum<br>Removal Time                      | 2.0                    |                        |                                         | 12         | 50   |                      | 60   |                       | 5    | 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<br>Capacitance             |                        | for HC190<br>for HC191 |                                         | 111<br>112 |      |                      |      |                       |      | pF   |

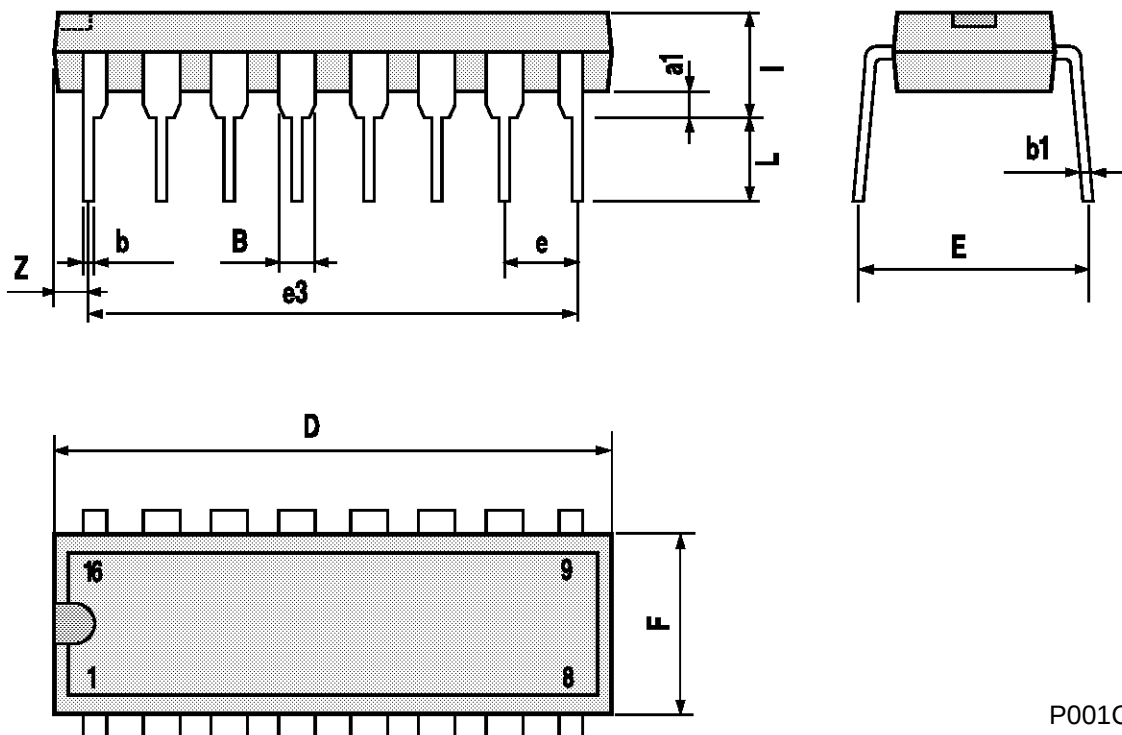
(\*) C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN}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

## SWITCHING CHARACTERISTICS TEST WAVEFORM

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

## Plastic DIP16 (0.25) MECHANICAL DATA

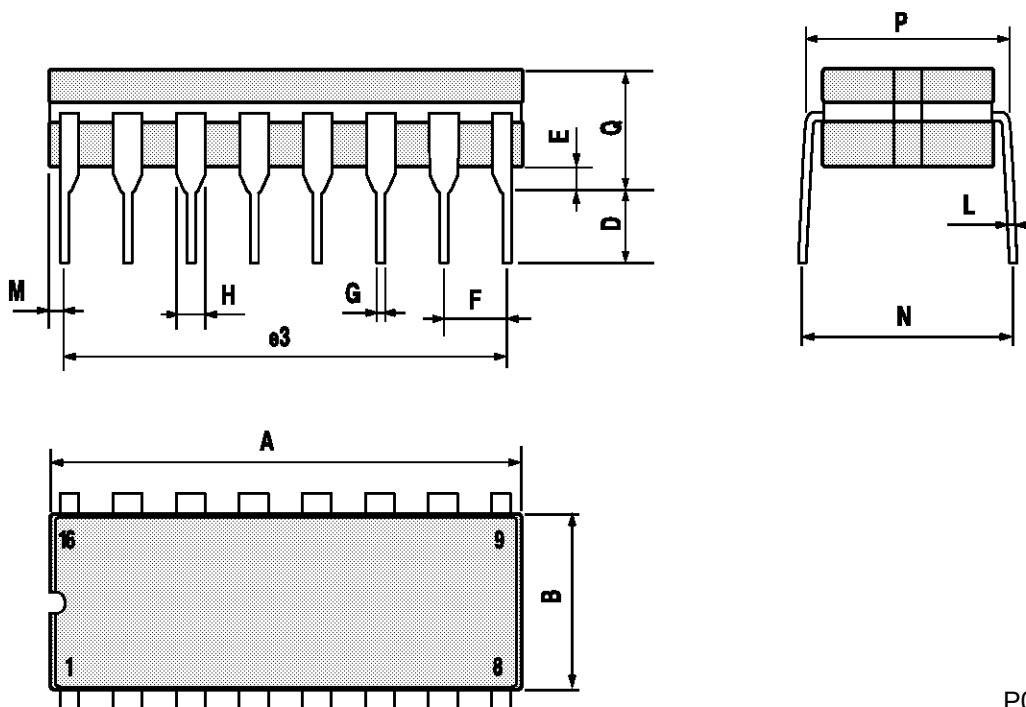
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |  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



P001C

## Ceramic DIP16/1 MECHANICAL DATA

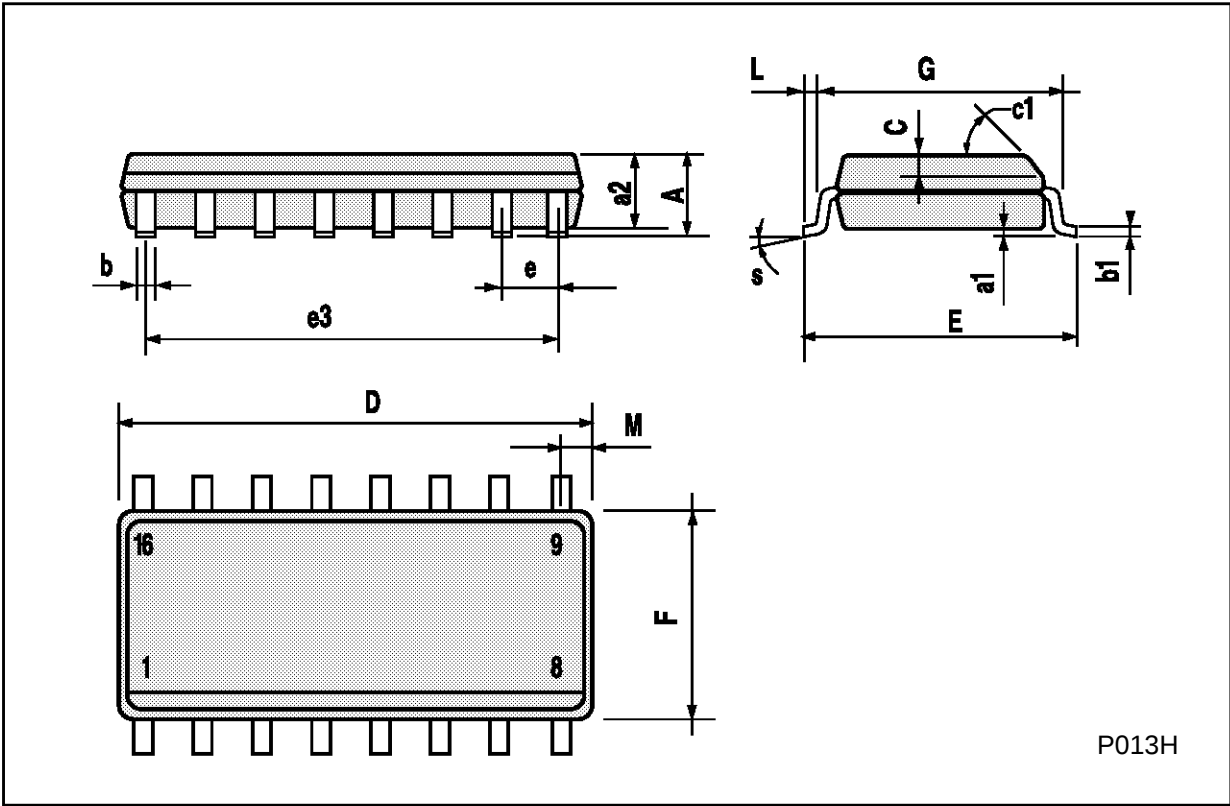
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |       | 20   |       |       | 0.787 |
| B    |      |       | 7    |       |       | 0.276 |
| D    |      | 3.3   |      |       | 0.130 |       |
| E    | 0.38 |       |      | 0.015 |       |       |
| e3   |      | 17.78 |      |       | 0.700 |       |
| F    | 2.29 |       | 2.79 | 0.090 |       | 0.110 |
| G    | 0.4  |       | 0.55 | 0.016 |       | 0.022 |
| H    | 1.17 |       | 1.52 | 0.046 |       | 0.060 |
| L    | 0.22 |       | 0.31 | 0.009 |       | 0.012 |
| M    | 0.51 |       | 1.27 | 0.020 |       | 0.050 |
| N    |      |       | 10.3 |       |       | 0.406 |
| P    | 7.8  |       | 8.05 | 0.307 |       | 0.317 |
| Q    |      |       | 5.08 |       |       | 0.200 |



P053D

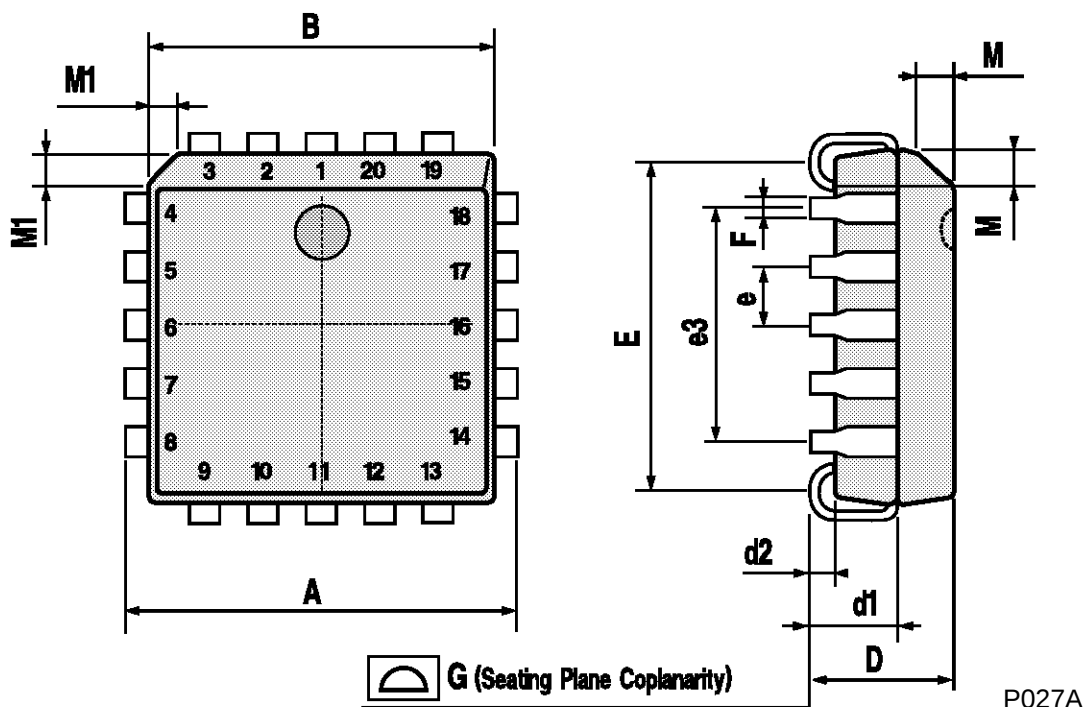
SO16 (Narrow) MECHANICAL DATA

| 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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