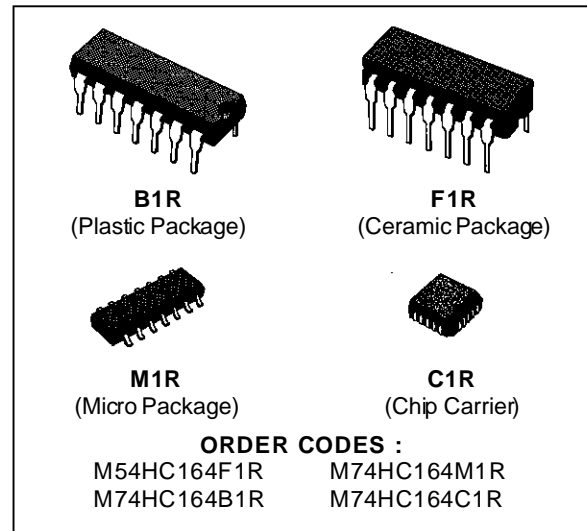


## 8 BIT SIPO SHIFT REGISTER

- HIGH SPEED  
 $t_{PD} = 15 \text{ ns (TYP.) AT } V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION  
 $I_{CC} = 4 \mu\text{A (MAX.) AT } T_A = 25 \text{ }^\circ\text{C}$
- OUTPUT DRIVE CAPABILITY  
 10 LSTTL LOADS
- BALANCED PROPAGATION DELAYS  
 $t_{PLH} = t_{PHL}$
- SYMMETRICAL OUTPUT IMPEDANCE  
 $I_{OL} = |I_{OH}| = 4 \text{ mA (MIN.)}$
- HIGH NOISE IMMUNITY  
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- WIDE OPERATING VOLTAGE RANGE  
 $V_{CC} \text{ (OPR)} = 2 \text{ V TO } 6 \text{ V}$
- PIN AND FUNCTION COMPATIBLE  
 WITH 54/74LS164



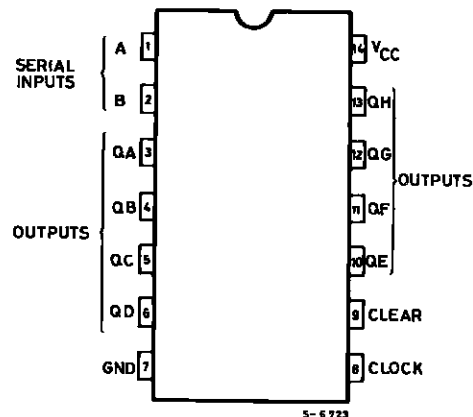
### DESCRIPTION

The M54/74HC164 is a high speed CMOS 8 BIT SIPO SHIFT REGISTER 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.

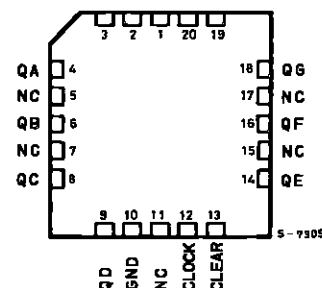
The HC164 is an 8 bit shift register with serial data entry and an output from each of the eight stages. Data is entered serially through one of two inputs (A or B), either of these inputs can be used as an active high enable for data entry through the other input. An unused input must be high, or both inputs connected together. Each low-to-high transition on the clock input shifts data one place to the right and enters into QA, the logic NAND of the two data inputs (A · B), the data that existed before the rising clock edge. A low level on the clear input overrides all other inputs and clears the register asynchronously, forcing all Q outputs low.

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

### PIN CONNECTIONS (top view)



B A NC VCC QH



NC =  
No Internal  
Connection

# M54/M74HC164

## INPUT AND OUTPUT EQUIVALENT CIRCUIT



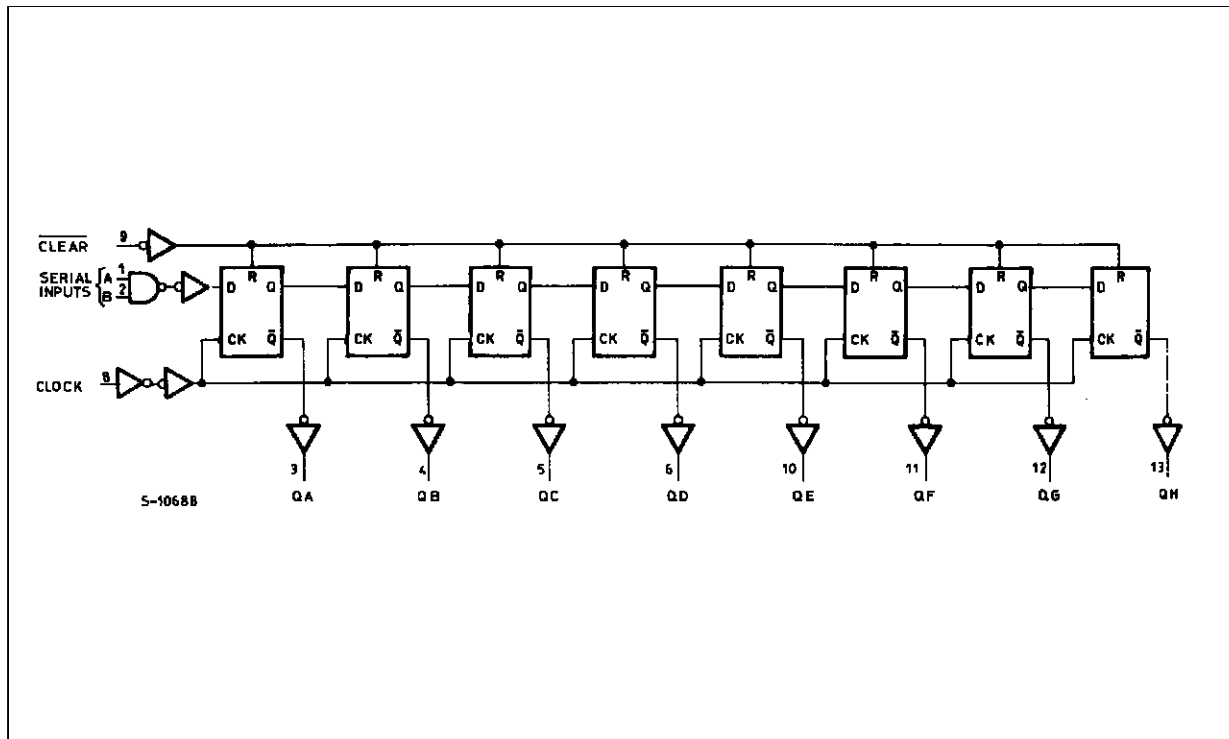
## TRUTH TABLE

| INPUTS |       |           |   | OUTPUTS   |     |       |     |
|--------|-------|-----------|---|-----------|-----|-------|-----|
| CLEAR  | CLOCK | SERIAL IN |   | QA        | QB  | ..... | QH  |
|        |       | A         | B |           |     |       |     |
| L      | X     | X         | X | L         | L   | ..... | L   |
| H      |       | X         | X | NO CHANGE |     |       |     |
| H      |       | L         | X | L         | QAn | ..... | QGn |
| H      |       | X         | L | L         | QAn | ..... | QGn |
| H      |       | H         | H | H         | QAn | ..... | QGn |

X: Don't Care

QAn - QGn : The level of QA -QG, respectively, before the most-recent transition of th clock.

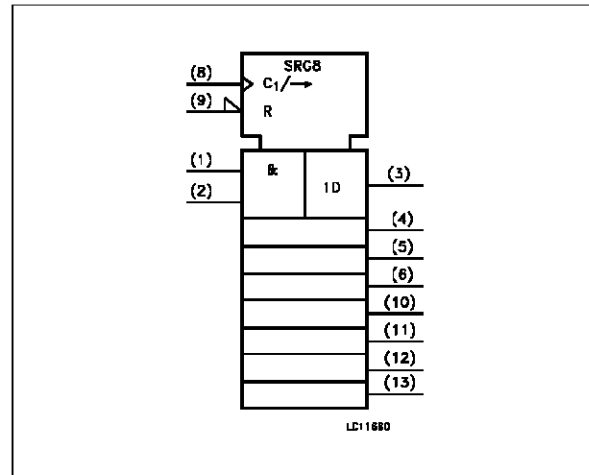
## LOGIC DIAGRAM



**PIN DESCRIPTION**

| PIN No                           | SYMBOL                    | NAME AND FUNCTION                         |
|----------------------------------|---------------------------|---|
| 1, 2                             | A, B                      | Data Inputs                               |
| 3, 4, 5, 6,<br>10, 11, 12,<br>13 | QA to QH                  | Outputs                                   |
| 8                                | CLOCK                     | Clock Input (LOW to HIGH, Edge-triggered) |
| 9                                | $\overline{\text{CLEAR}}$ | Master Reset Input                        |
| 7                                | GND                       | Ground (0V)                               |
| 14                               | V <sub>CC</sub>           | Positive Supply Voltage                   |

**IEC LOGIC SYMBOL**



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

**DC SPECIFICATIONS**

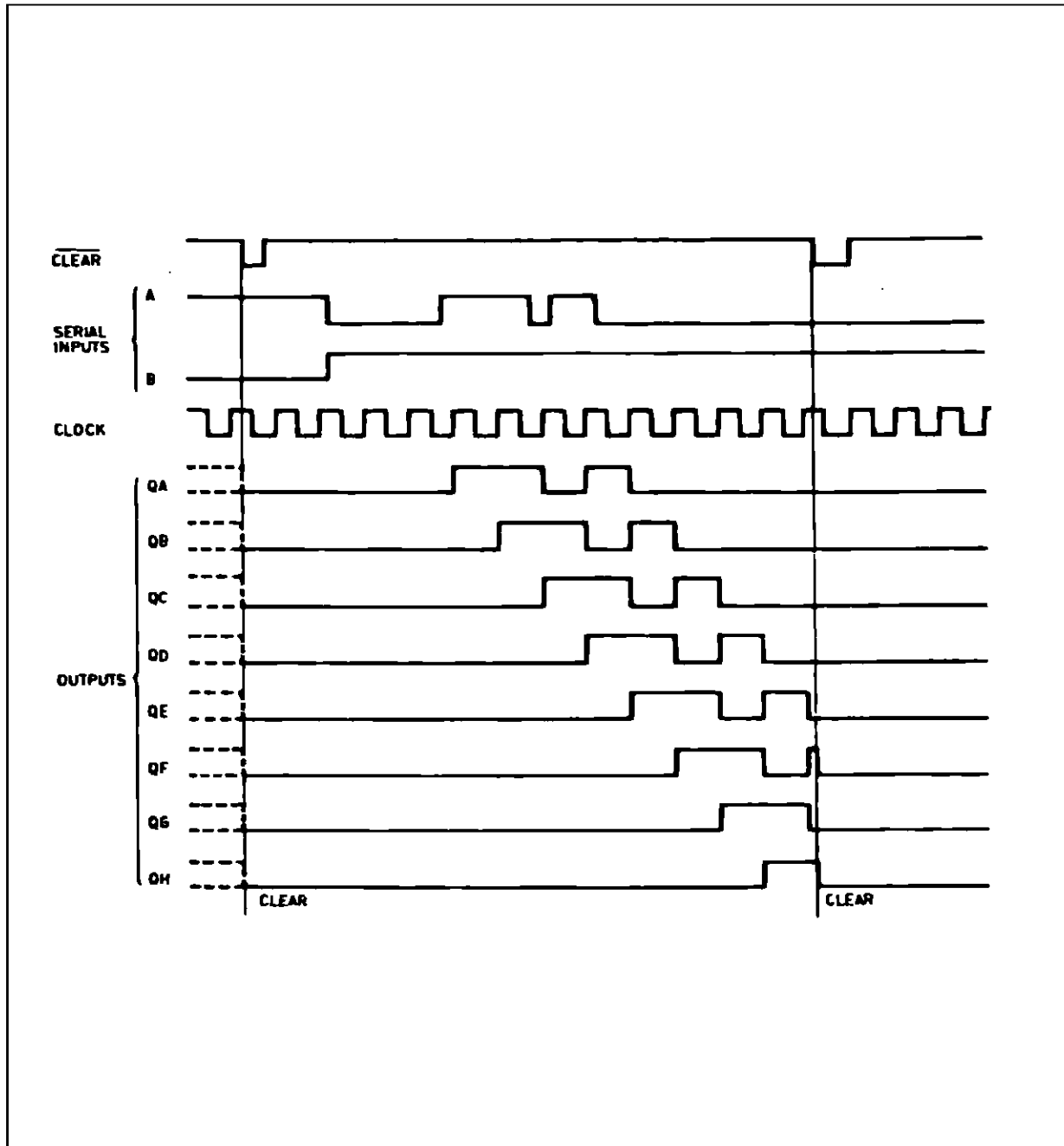
| Symbol          | Parameter                 | Test Conditions        |  | Value                                   |                         |      |                      |      |                       | Unit |      |   |
|-----------------|---------------------------|------------------------|--|---|-------------------------|------|----------------------|------|-----------------------|------|------|---|
|                 |                           | 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                   |      | 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 |      |   |
| 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 ( $C_L = 50$  pF, Input  $t_r = t_f = 6$  ns)

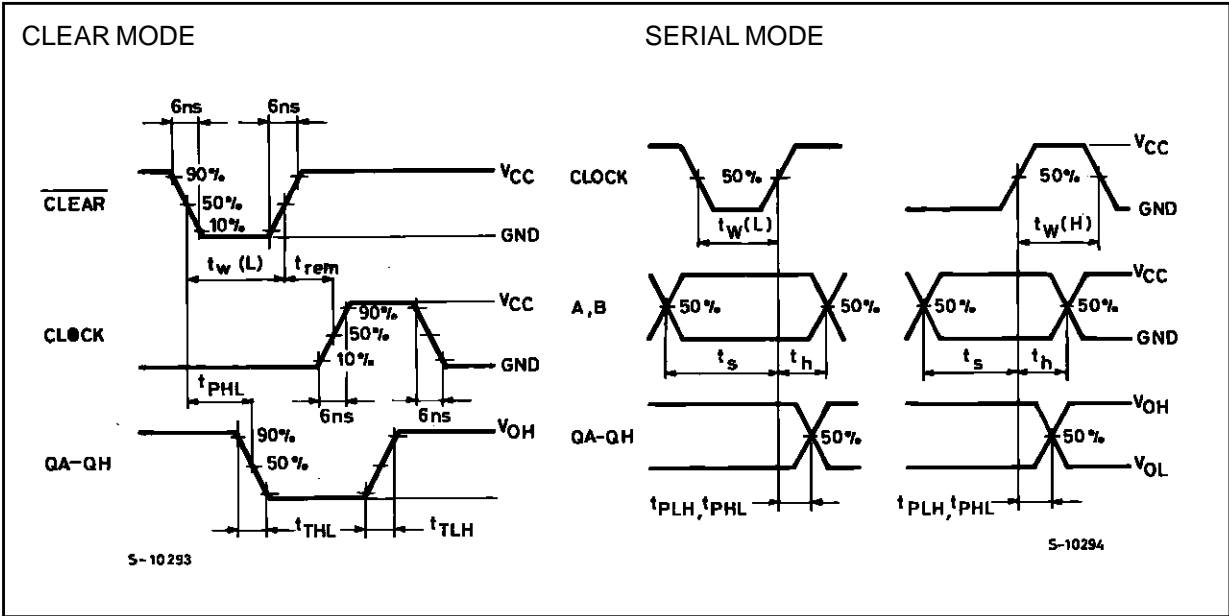
| Symbol                                 | Parameter                          | Test Conditions        |  | Value                                   |      |      |                      |      |                       | Unit |      |
|--|------------------------------------|------------------------|--|---|------|------|----------------------|------|-----------------------|------|------|
|  |                                    | V <sub>CC</sub><br>(V) |  | T <sub>A</sub> = 25 °C<br>54HC and 74HC |      |      | -40 to 85 °C<br>74HC |      | -55 to 125 °C<br>54HC |      |      |
|  |                                    |                        |  | Min.                                    | Typ. | Max. | Min.                 | Max. | Min.                  |      | Max. |
| t <sub>TLH</sub><br>t <sub>THL</sub>   | Output Transition Time             | 2.0                    |  |   | 30   | 75   |                      | 95   |                       | 110  | ns   |
|  |                                    | 4.5                    |  |   | 8    | 15   |                      | 19   |                       | 22   |      |
|  |                                    | 6.0                    |  |   | 7    | 13   |                      | 16   |                       | 19   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay Time (CLOCK - Q) | 2.0                    |  |   | 57   | 160  |                      | 200  |                       | 240  | ns   |
|  |                                    | 4.5                    |  |   | 19   | 32   |                      | 40   |                       | 48   |      |
|  |                                    | 6.0                    |  |   | 16   | 27   |                      | 34   |                       | 41   |      |
| t <sub>PHL</sub>                       | Propagation Delay Time (CLEAR - Q) | 2.0                    |  |   | 60   | 175  |                      | 220  |                       | 265  | ns   |
|  |                                    | 4.5                    |  |   | 20   | 35   |                      | 44   |                       | 53   |      |
|  |                                    | 6.0                    |  |   | 17   | 30   |                      | 37   |                       | 45   |      |
| f <sub>MAX</sub>                       | Maximum Clock Frequency            | 2.0                    |  | 6.2                                     | 18   |      | 5.0                  |      | 4.2                   |      | MHz  |
|  |                                    | 4.5                    |  | 31                                      | 53   |      | 25                   |      | 21                    |      |      |
|  |                                    | 6.0                    |  | 37                                      | 62   |      | 30                   |      | 25                    |      |      |
| t <sub>W(H)</sub><br>t <sub>W(L)</sub> | Minimum Pulse Width (CLOCK)        | 2.0                    |  |   | 24   | 75   |                      | 95   |                       | 110  | ns   |
|  |                                    | 4.5                    |  |   | 6    | 15   |                      | 19   |                       | 22   |      |
|  |                                    | 6.0                    |  |   | 5    | 13   |                      | 16   |                       | 19   |      |
| t <sub>W(L)</sub>                      | Minimum Pulse Width (CLEAR)        | 2.0                    |  |   | 40   | 75   |                      | 95   |                       | 110  | ns   |
|  |                                    | 4.5                    |  |   | 10   | 15   |                      | 19   |                       | 22   |      |
|  |                                    | 6.0                    |  |   | 9    | 13   |                      | 16   |                       | 19   |      |
| t <sub>s</sub>                         | Minimum Set-up Time (A, B - CK)    | 2.0                    |  |   | 16   | 50   |                      | 65   |                       | 75   | ns   |
|  |                                    | 4.5                    |  |   | 4    | 10   |                      | 13   |                       | 15   |      |
|  |                                    | 6.0                    |  |   | 3    | 9    |                      | 11   |                       | 13   |      |
| t <sub>h</sub>                         | Minimum Hold Time (A, B - CK)      | 2.0                    |  |   |      | 5    |                      | 5    |                       | 5    | ns   |
|  |                                    | 4.5                    |  |   |      | 5    |                      | 5    |                       | 5    |      |
|  |                                    | 6.0                    |  |   |      | 5    |                      | 5    |                       | 5    |      |
| t <sub>REM</sub>                       | Minimum Removal Time               | 2.0                    |  |   |      | 5    |                      | 5    |                       | 5    | ns   |
|  |                                    | 4.5                    |  |   |      | 5    |                      | 5    |                       | 5    |      |
|  |                                    | 6.0                    |  |   |      | 5    |                      | 5    |                       | 5    |      |
| C <sub>IN</sub>                        | Input Capacitance                  |                        |  |   | 5    | 10   |                      | 10   |                       | 10   | pF   |
| C <sub>PD</sub> (*)                    | Power Dissipation Capacitance      |                        |  |   | 99   |      |                      |      |                       |      | 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.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

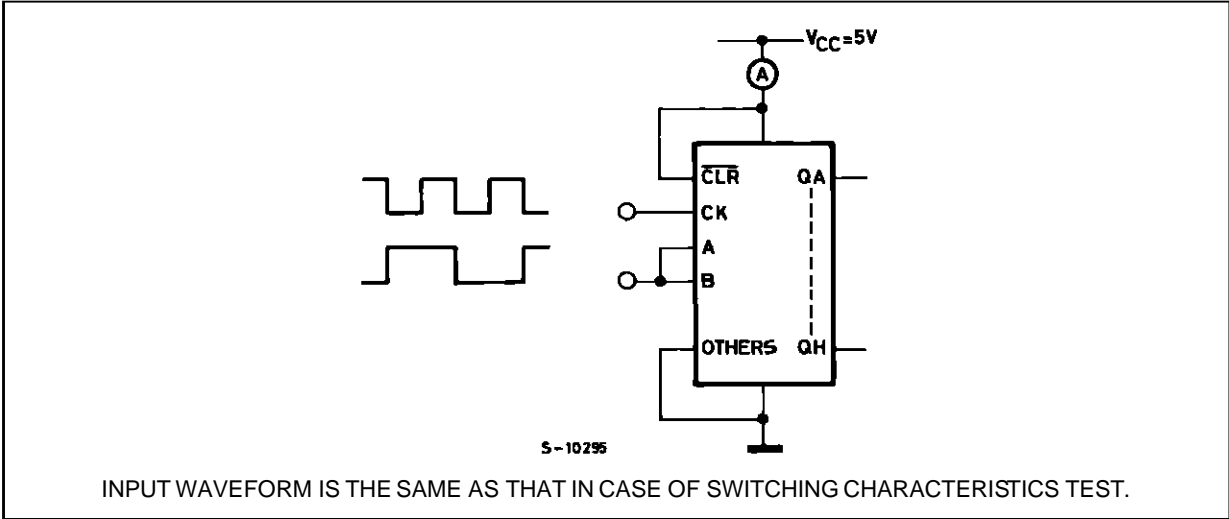
TIMING CHART



SWITCHING CHARACTERISTICS TEST WAVEFORM

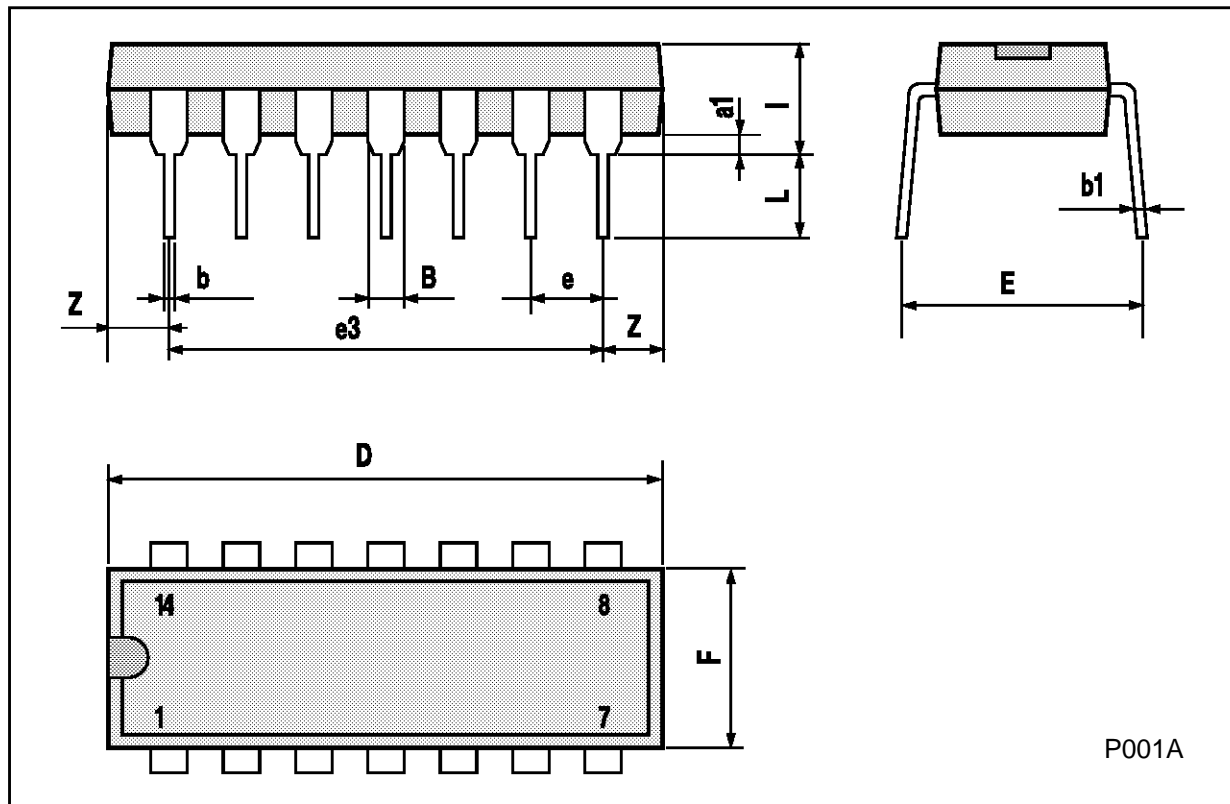


TEST CIRCUIT I<sub>cc</sub> (Opr.)



**Plastic DIP14 MECHANICAL DATA**

| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 1.39 |       | 1.65 | 0.055 |       | 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   |      | 15.24 |      |       | 0.600 |       |
| F    |      |       | 7.1  |       |       | 0.280 |
| I    |      |       | 5.1  |       |       | 0.201 |
| L    |      | 3.3   |      |       | 0.130 |       |
| Z    | 1.27 |       | 2.54 | 0.050 |       | 0.100 |

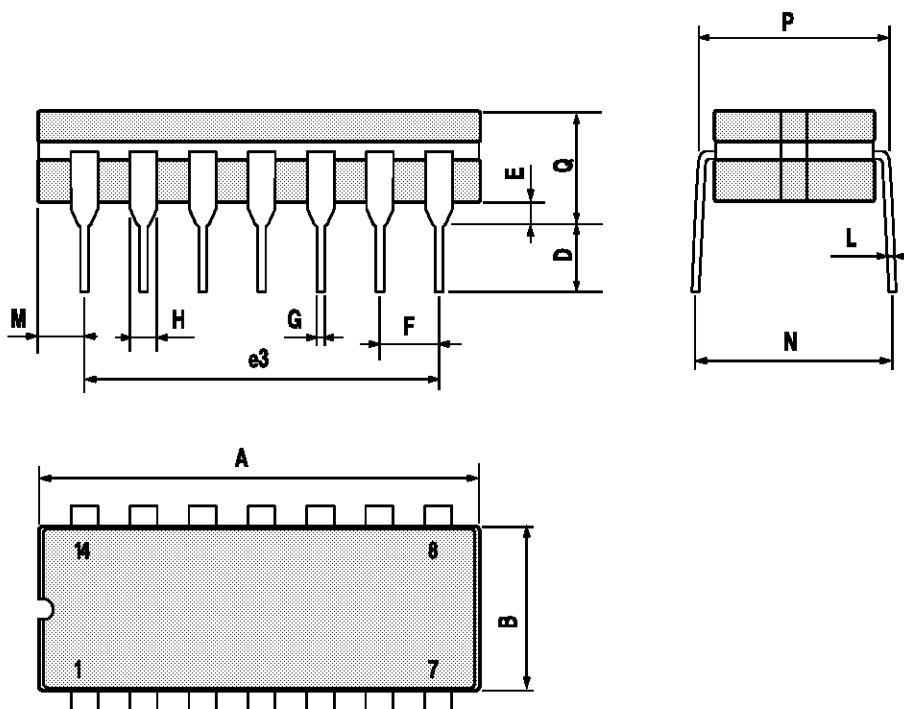


P001A



## Ceramic DIP14/1 MECHANICAL DATA

| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |       | 20   |       |       | 0.787 |
| B    |      |       | 7.0  |       |       | 0.276 |
| D    |      | 3.3   |      |       | 0.130 |       |
| E    | 0.38 |       |      | 0.015 |       |       |
| e3   |      | 15.24 |      |       | 0.600 |       |
| 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    | 1.52 |       | 2.54 | 0.060 |       | 0.100 |
| N    |      |       | 10.3 |       |       | 0.406 |
| P    | 7.8  |       | 8.05 | 0.307 |       | 0.317 |
| Q    |      |       | 5.08 |       |       | 0.200 |



P053C

SO14 MECHANICAL DATA

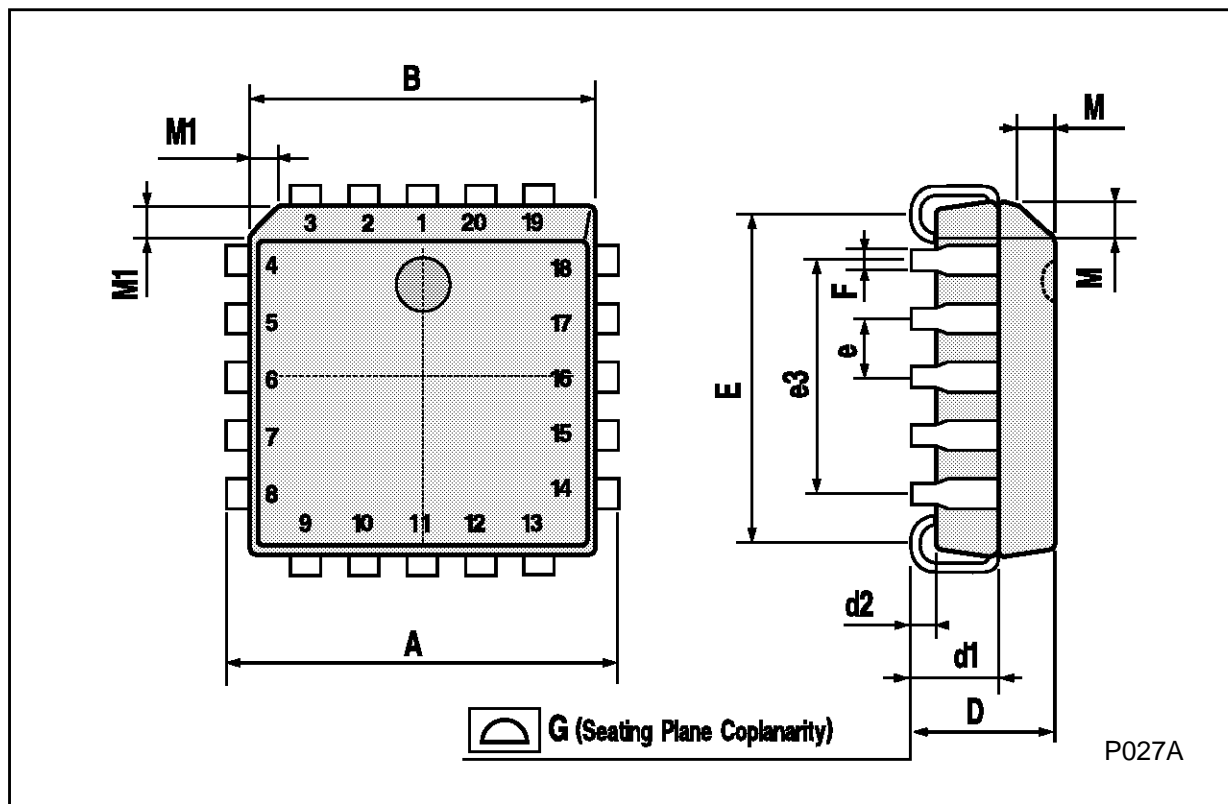
| DIM. | mm         |      |      | inch  |       |       |
|------|------------|------|------|-------|-------|-------|
|      | MIN.       | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |            |      | 1.75 |       |       | 0.068 |
| a1   | 0.1        |      | 0.2  | 0.003 |       | 0.007 |
| 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    | 8.55       |      | 8.75 | 0.336 |       | 0.344 |
| E    | 5.8        |      | 6.2  | 0.228 |       | 0.244 |
| e    |            | 1.27 |      |       | 0.050 |       |
| e3   |            | 7.62 |      |       | 0.300 |       |
| 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    |            |      | 0.68 |       |       | 0.026 |
| S    | 8° (max.)  |      |      |       |       |       |



P013G

## 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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