

## HC4020 14 STAGE BINARY COUNTER

## HC4040 12 STAGE BINARY COUNTER

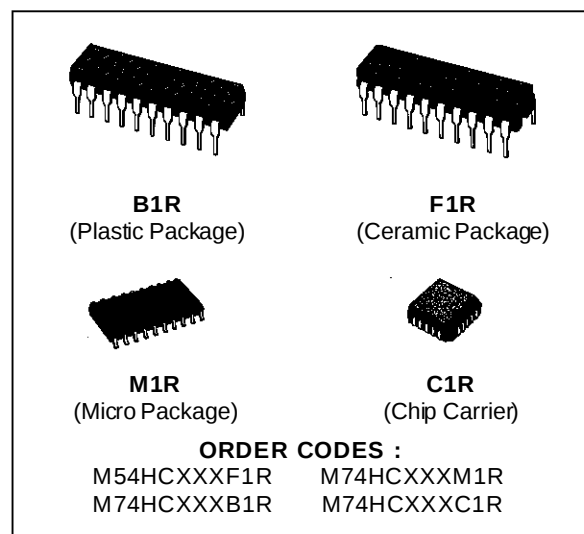
- **HIGH SPEED**  
 $f_{MAX} = 73 \text{ MHz (TYP.) at } V_{CC} = 5 \text{ V}$
- **LOW POWER DISSIPATION**  
 $I_{CC} = 4 \mu\text{A (MAX.) at } T_A = 25^\circ\text{C}$
- **HIGH NOISE IMMUNITY**  
 $V_{NIH} = V_{NIL} = 28 \% V_{CC} \text{ (MIN.)}$
- **OUTPUT DRIVE CAPABILITY**  
 10 LSTTL LOADS
- **SYMMETRICAL 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**  
 4020B/4040B

### DESCRIPTION

The M54/74HC4020/HC4040 are high speed CMOS 14/12-STAGE BINARY COUNTER fabricated in silicon gate C<sup>2</sup>MOS technology. They have the same high speed performance of LSTTL combined with true CMOS low consumption.

A clear input is used to reset the counter to the all low level state. A high level on CLEAR accomplishes the reset function. A negative transition on the CLOCK input increments the counter by one.

For HC4020 twelve kind of divided output are provided; 1st and 4th stage to 14th stage.

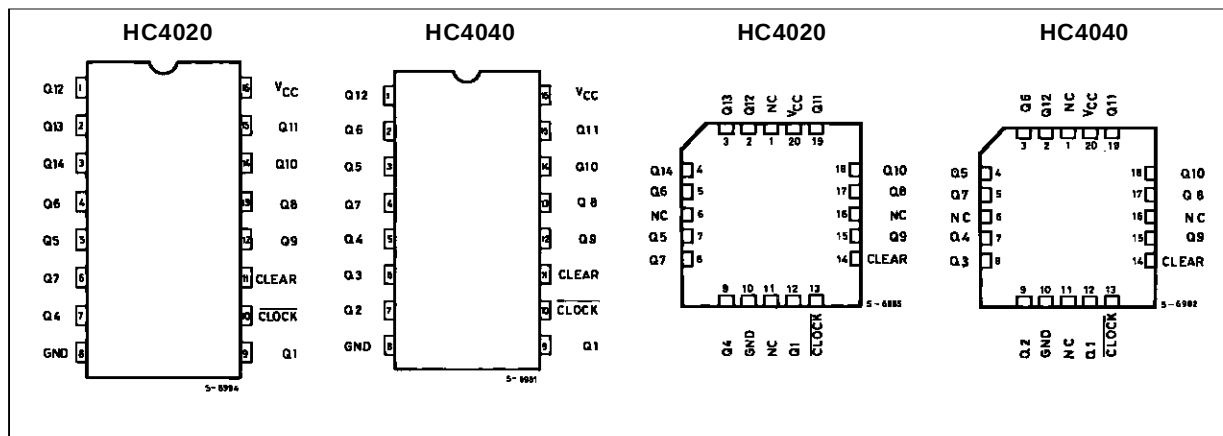


The maximum division available at last stage is  $1/16384 \times f_{IN}$  at clock.

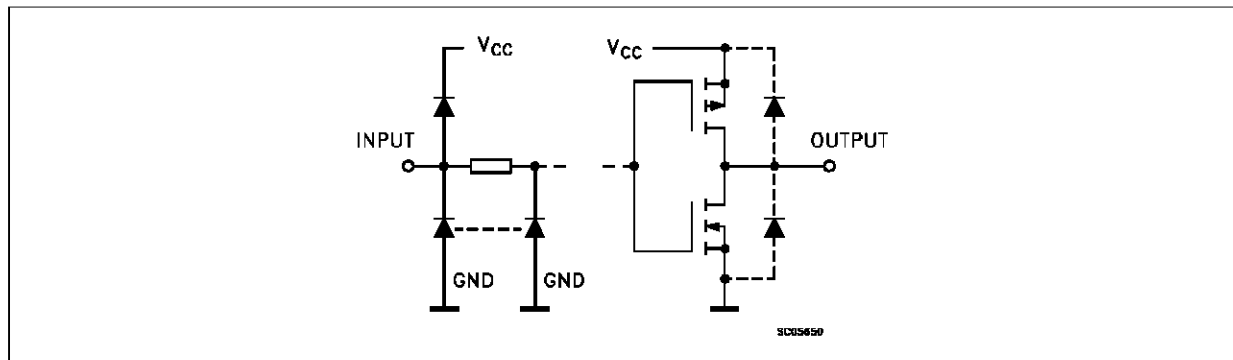
For HC4040 each division stage has an output; the final frequency is  $1/4096 \times f_{IN}$ .

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

### PIN CONNECTION (top view)



## INPUT AND OUTPUT EQUIVALENT CIRCUIT



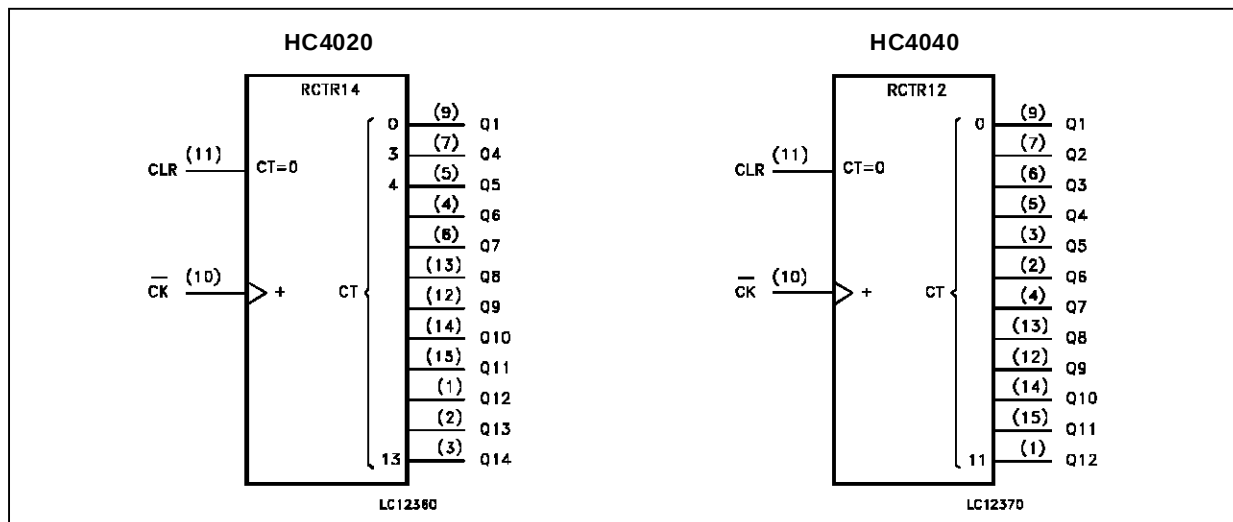
### PIN DESCRIPTION (HC4020)

| PIN No                                          | SYMBOL                    | NAME AND FUNCTION                         |
|-------------------------------------------------|---------------------------|-------------------------------------------|
| 9, 7, 6, 5,<br>3, 2, 4, 13,<br>12, 14, 15,<br>1 | Q1, Q4 to<br>Q14          | Parallel Outputs                          |
| 10                                              | $\overline{\text{CLOCK}}$ | Clock Input (LOW to HIGH, edge triggered) |
| 11                                              | CLEAR                     | Reset Inputs                              |
| 8                                               | GND                       | Ground (0V)                               |
| 16                                              | V <sub>CC</sub>           | Positive Supply Voltage                   |

### PIN DESCRIPTION (HC4040)

| PIN No                                          | SYMBOL                    | NAME AND FUNCTION                         |
|-------------------------------------------------|---------------------------|-------------------------------------------|
| 9, 7, 6, 5,<br>3, 2, 4, 13,<br>12, 14, 15,<br>1 | Q1 to Q12                 | Parallel Outputs                          |
| 10                                              | $\overline{\text{CLOCK}}$ | Clock Input (LOW to HIGH, edge triggered) |
| 11                                              | CLEAR                     | Reset Inputs                              |
| 8                                               | GND                       | Ground (0V)                               |
| 16                                              | V <sub>CC</sub>           | Positive Supply Voltage                   |

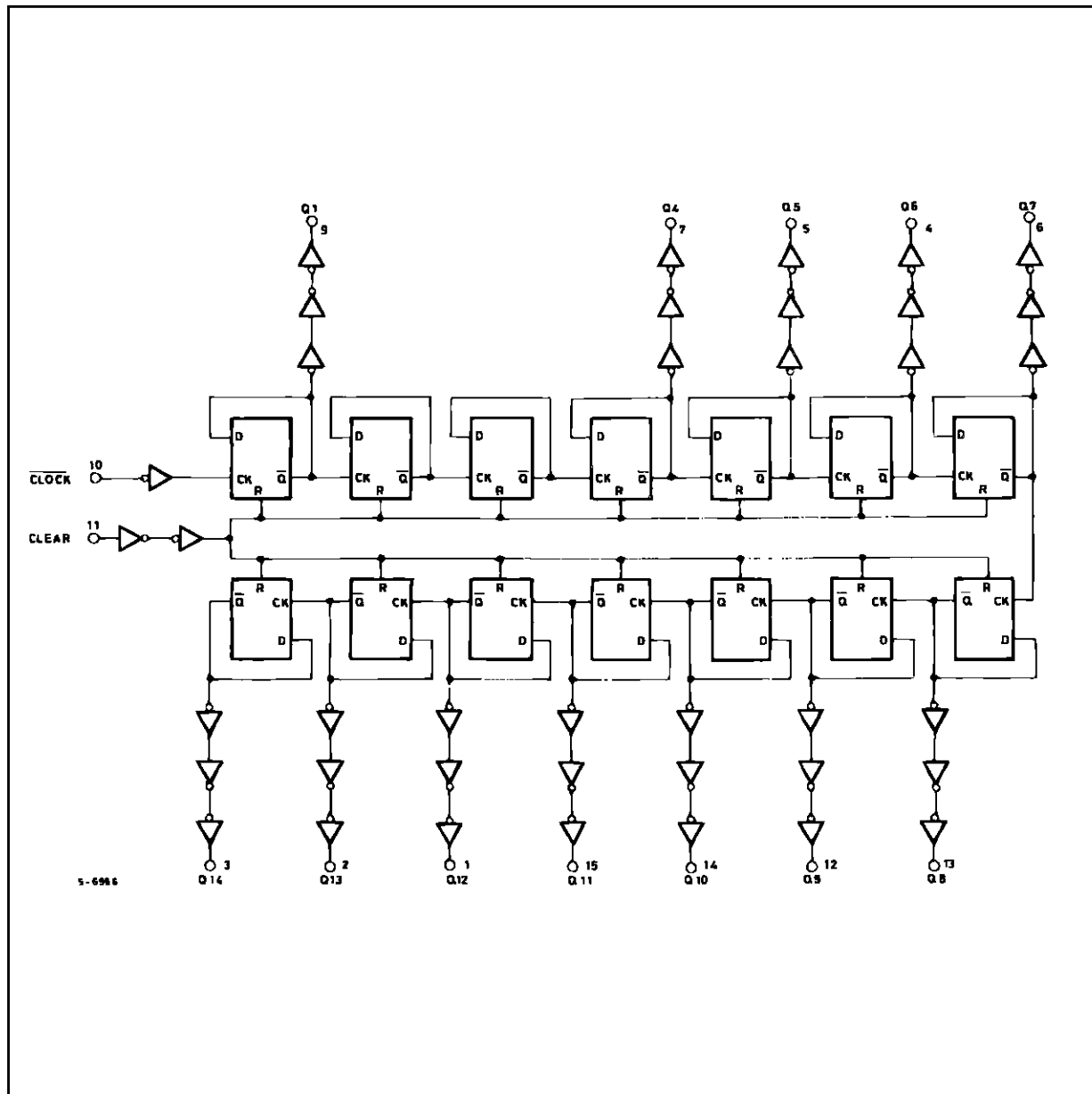
## IEC LOGIC SYMBOLS



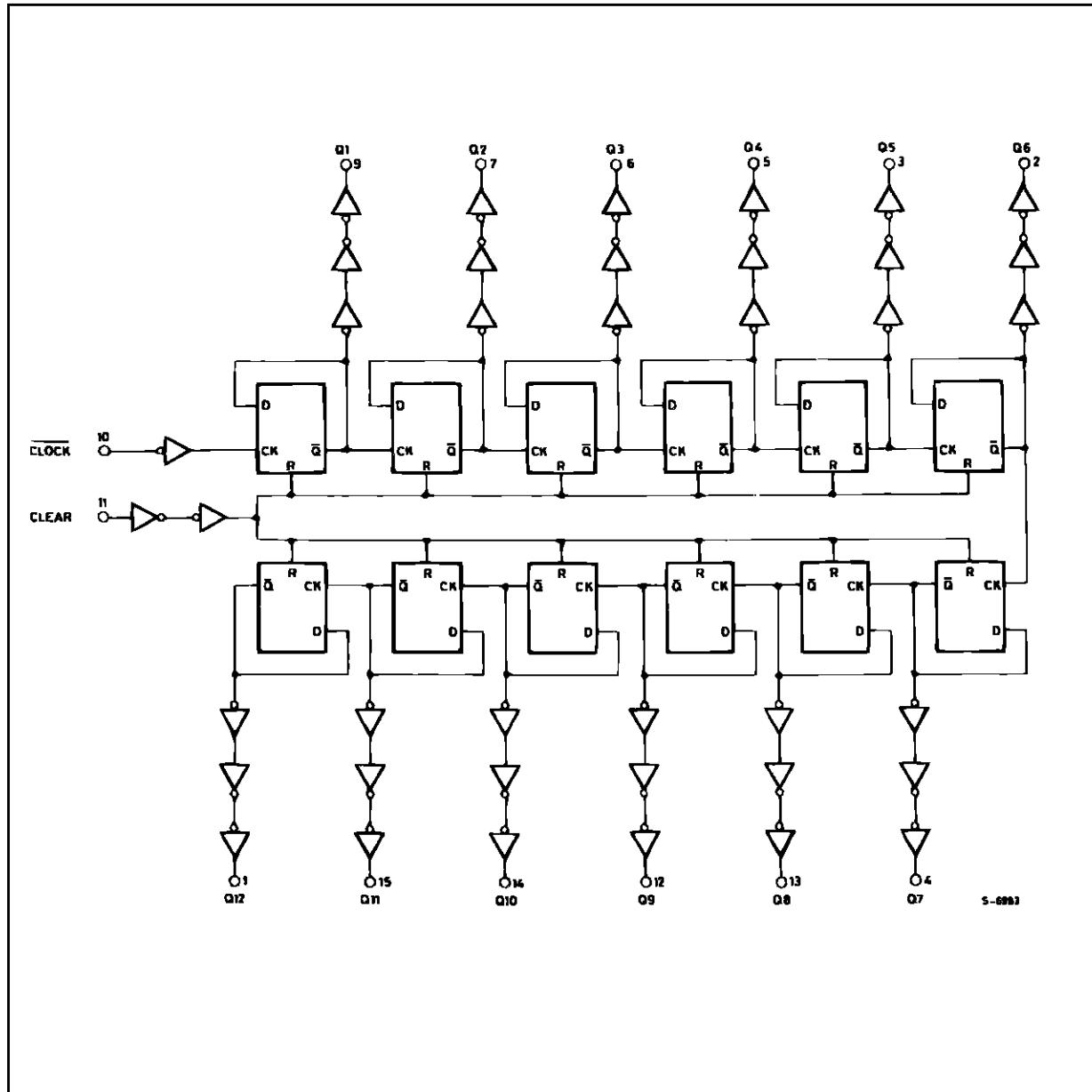
## TRUTH TABLE

| CLOCK | CLEAR | OUTPUT STATE          |
|-------|-------|-----------------------|
| X     | H     | ALL OUTPUTS = "L"     |
|       | L     | NO CHANGE             |
|       | L     | ADVANCE TO NEXT STATE |

## LOGIC DIAGRAM (HC4020)



LOGIC DIAGRAM (HC4040)



**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                                          | <div><math>V_{CC} = 2\text{ V}</math> 0 to 1000</div> <div><math>V_{CC} = 4.5\text{ V}</math> 0 to 500</div> <div><math>V_{CC} = 6\text{ V}</math> 0 to 400</div> | 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                 |      | 0.33                  |      |    | 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 ( $C_L = 50$  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<br>(Q <sub>n</sub> - Q <sub>n+1</sub> ) | 2.0                    |            |                                         | 20   | 50   |                      | 65   |                       | 75   | ns   |
|                                        |                                                                | 4.5                    |            |                                         | 5    | 10   |                      | 13   |                       | 15   |      |
|                                        |                                                                | 6.0                    |            |                                         | 4    | 9    |                      | 11   |                       | 13   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay Time<br>(CLOCK Q1)                           | 2.0                    | for HC4020 |                                         | 76   | 145  |                      | 180  |                       | 220  | ns   |
|                                        |                                                                | 4.5                    |            |                                         | 21   | 29   |                      | 36   |                       | 44   |      |
|                                        |                                                                | 6.0                    |            |                                         | 18   | 25   |                      | 31   |                       | 38   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay Time<br>(CLOCK Q1)                           | 2.0                    | for HC4040 |                                         | 48   | 145  |                      | 180  |                       | 220  | ns   |
|                                        |                                                                | 4.5                    |            |                                         | 17   | 29   |                      | 36   |                       | 44   |      |
|                                        |                                                                | 6.0                    |            |                                         | 13   | 25   |                      | 31   |                       | 38   |      |
| t <sub>PHL</sub>                       | Propagation Delay Time<br>(CLEAR - Q <sub>n</sub> )            | 2.0                    | for HC4020 |                                         | 60   | 140  |                      | 175  |                       | 210  | ns   |
|                                        |                                                                | 4.5                    |            |                                         | 18   | 28   |                      | 35   |                       | 42   |      |
|                                        |                                                                | 6.0                    |            |                                         | 15   | 24   |                      | 30   |                       | 36   |      |
| t <sub>PHL</sub>                       | Propagation Delay Time<br>(CLEAR - Q <sub>n</sub> )            | 2.0                    | for HC4040 |                                         | 56   | 140  |                      | 175  |                       | 210  | ns   |
|                                        |                                                                | 4.5                    |            |                                         | 18   | 28   |                      | 35   |                       | 42   |      |
|                                        |                                                                | 6.0                    |            |                                         | 15   | 24   |                      | 30   |                       | 36   |      |
| f <sub>MAX</sub>                       | Maximum Clock Frequency                                        | 2.0                    |            | 6.0                                     | 15   |      | 4.8                  |      | 4                     |      | MHz  |
|                                        |                                                                | 4.5                    |            | 30                                      | 65   |      | 24                   |      | 20                    |      |      |
|                                        |                                                                | 6.0                    |            | 35                                      | 70   |      | 28                   |      | 24                    |      |      |
| t <sub>W(H)</sub><br>t <sub>W(L)</sub> | Minimum Pulse Width<br>(CLOCK)                                 | 2.0                    |            |                                         | 40   | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                                                | 4.5                    |            |                                         | 8    | 15   |                      | 19   |                       | 22   |      |
|                                        |                                                                | 6.0                    |            |                                         | 7    | 13   |                      | 16   |                       | 19   |      |
| t <sub>W(H)</sub>                      | Minimum Pulse Width<br>(CLEAR)                                 | 2.0                    | for HC4020 |                                         | 32   | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                                                | 4.5                    |            |                                         | 8    | 15   |                      | 19   |                       | 22   |      |
|                                        |                                                                | 6.0                    |            |                                         | 7    | 13   |                      | 16   |                       | 19   |      |
| t <sub>W(H)</sub>                      | Minimum Pulse Width<br>(CLEAR)                                 | 2.0                    | for HC4040 |                                         | 70   | 175  |                      | 220  |                       | 265  | ns   |
|                                        |                                                                | 4.5                    |            |                                         | 19   | 35   |                      | 44   |                       | 53   |      |
|                                        |                                                                | 6.0                    |            |                                         | 16   | 30   |                      | 37   |                       | 45   |      |
| t <sub>REM</sub>                       | Minimum Removal Time                                           | 2.0                    | for HC4020 |                                         |      | 0    |                      | 0    |                       | 0    | ns   |
|                                        |                                                                | 4.5                    |            |                                         |      | 0    |                      | 0    |                       | 0    |      |
|                                        |                                                                | 6.0                    |            |                                         |      | 0    |                      | 0    |                       | 0    |      |
| t <sub>REM</sub>                       | Minimum Removal Time                                           | 2.0                    | for HC4040 |                                         |      | 25   |                      | 30   |                       | 40   | ns   |
|                                        |                                                                | 4.5                    |            |                                         |      | 5    |                      | 6    |                       | 8    |      |
|                                        |                                                                | 6.0                    |            |                                         |      | 5    |                      | 5    |                       | 7    |      |
| C <sub>IN</sub>                        | Input Capacitance                                              |                        |            |                                         | 5    | 10   |                      | 10   |                       |      | pF   |
| C <sub>PD</sub> (*)                    | Power Dissipation Capacitance                                  |                        |            |                                         | 34   |      |                      |      |                       |      | 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.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC2}$  (per FLIP/FLOP)



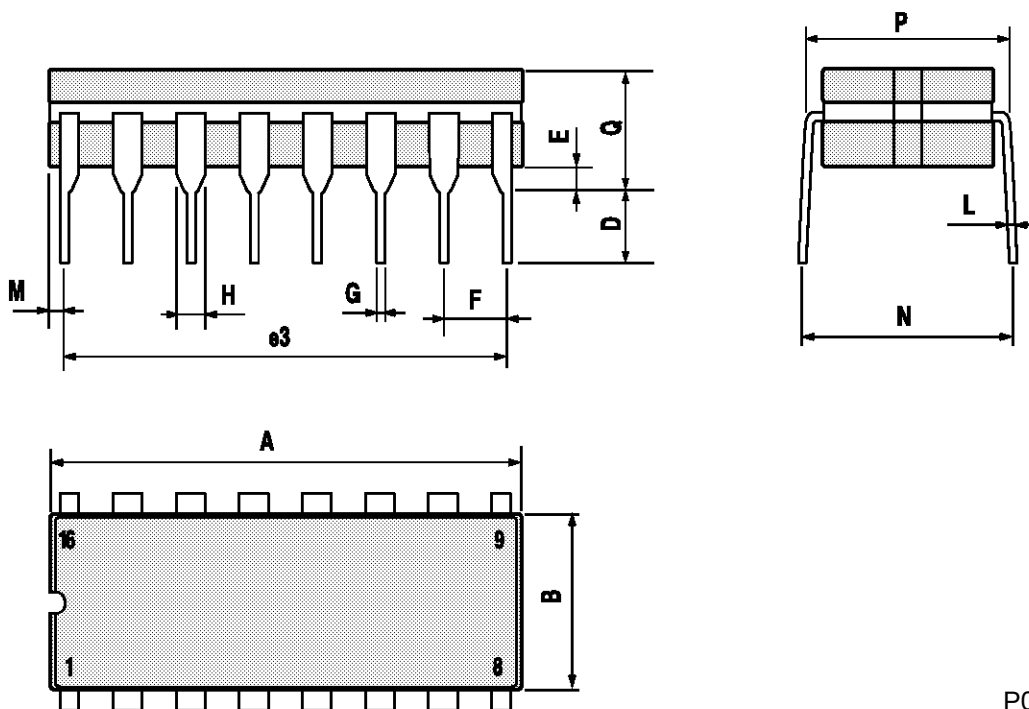
## Plastic DIP16 (0.25) MECHANICAL DATA

| 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

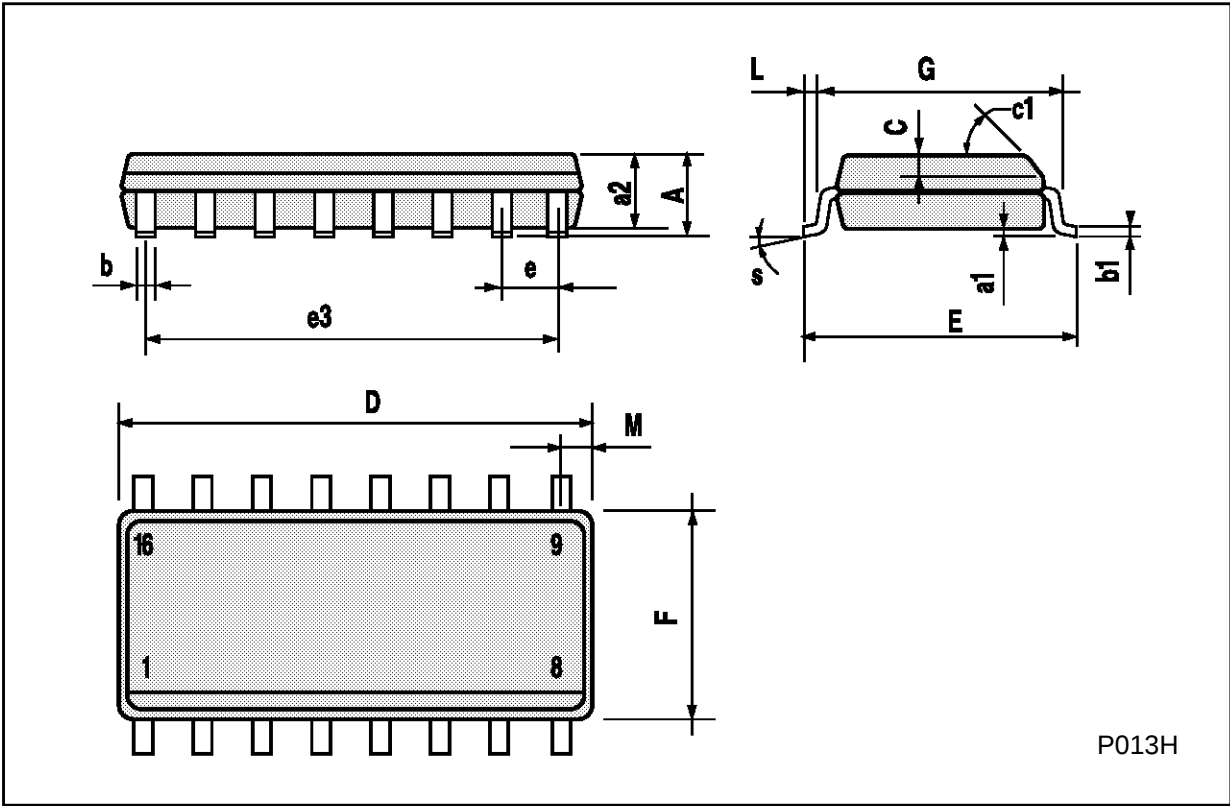
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |       | 20   |       |       | 0.787 |
| B    |      |       | 7    |       |       | 0.276 |
| D    |      | 3.3   |  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



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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