

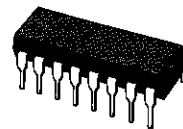
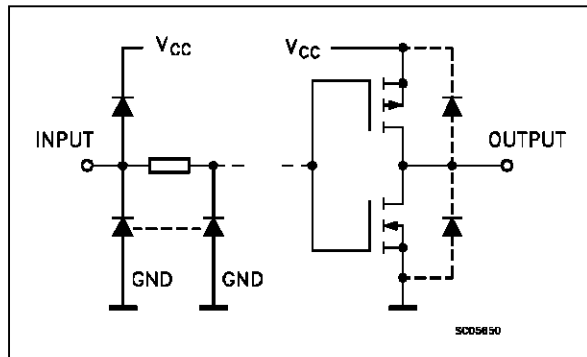
## DUAL J-K FLIP FLOP WITH PRESET AND CLEAR

- HIGH SPEED  
 $f_{MAX} = 67 \text{ MHz (TYP.) AT } V_{CC} = 5 \text{ V}$
- LOW POWER DISSIPATION  
 $I_{CC} = 2 \mu\text{A AT } T_A = 25^\circ\text{C}$
- 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 54/74LS112

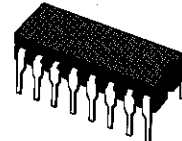
### DESCRIPTION

The M54/74HC112 is a high speed CMOS DUAL J-K FLIP-FLOP WITH PRESET AND CLEAR fabricated in silicon gate C<sup>2</sup>MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption. The M54HC112/M74HC112 dual JK flip-flop features individual J, K, clock, and asynchronous set and clear inputs for each flip-flop. When the clock goes high, the inputs are enabled and data will be accepted. The logic level of the J and K inputs may be allowed to change when the clock pulse is high and the bistable will function as shown in the truth table. Input data is transferred to the input on the negative going edge of the clock pulse. All inputs are equipped with protection circuits against static discharge and transient excess voltage.

### INPUT AND OUTPUT EQUIVALENT CIRCUIT



**B1R**  
(Plastic Package)



**F1R**  
(Ceramic Package)



**M1R**  
(Micro Package)

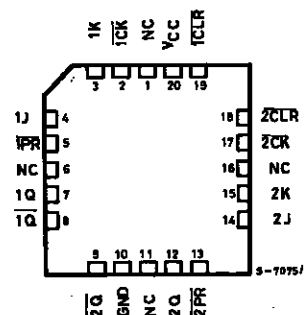
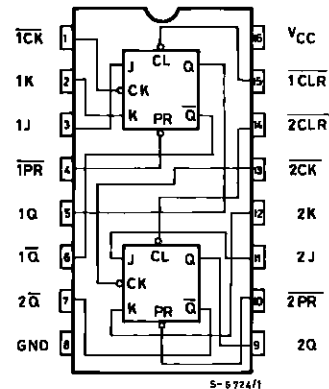


**C1R**  
(Chip Carrier)

#### ORDER CODES :

|             |             |
|-------------|-------------|
| M54HC112F1R | M74HC112M1R |
| M74HC112B1R | M74HC112C1R |

### PIN CONNECTIONS (top view)



NC =  
No Internal  
Connection

TRUTH TABLE

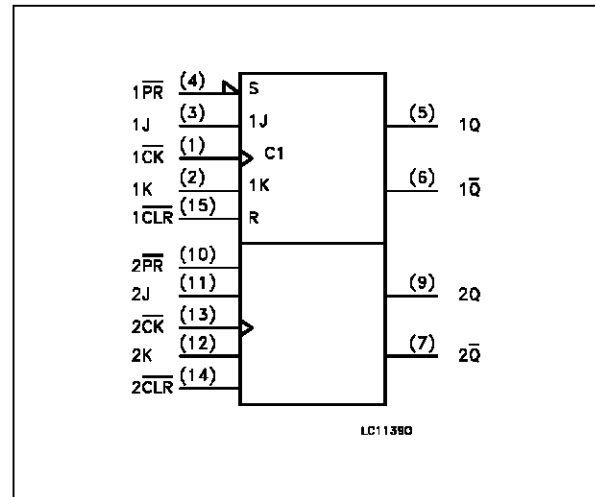
| INPUTS |    |   |   |              | OUTPUTS     |             | FUNCTION  |
|--------|----|---|---|--------------|-------------|-------------|-----------|
| CLR    | PR | J | K | CK           | Q           | $\bar{Q}$   |           |
| L      | H  | X | X | X            | L           | H           | CLEAR     |
| H      | L  | X | X | X            | H           | L           | PRESET    |
| L      | L  | X | X | X            | H           | H           |           |
| H      | H  | L | L | $\downarrow$ | $Q_n$       | $\bar{Q}_n$ | NO CHANGE |
| H      | H  | H | L | $\downarrow$ | H           | L           |           |
| H      | H  | L | H | $\downarrow$ | L           | H           |           |
| H      | H  | H | H | $\downarrow$ | $\bar{Q}_n$ | $Q_n$       | TOGGLE    |
| H      | H  | X | X | $\downarrow$ | $Q_n$       | $\bar{Q}_n$ | NO CHANGE |

X: Don't Care

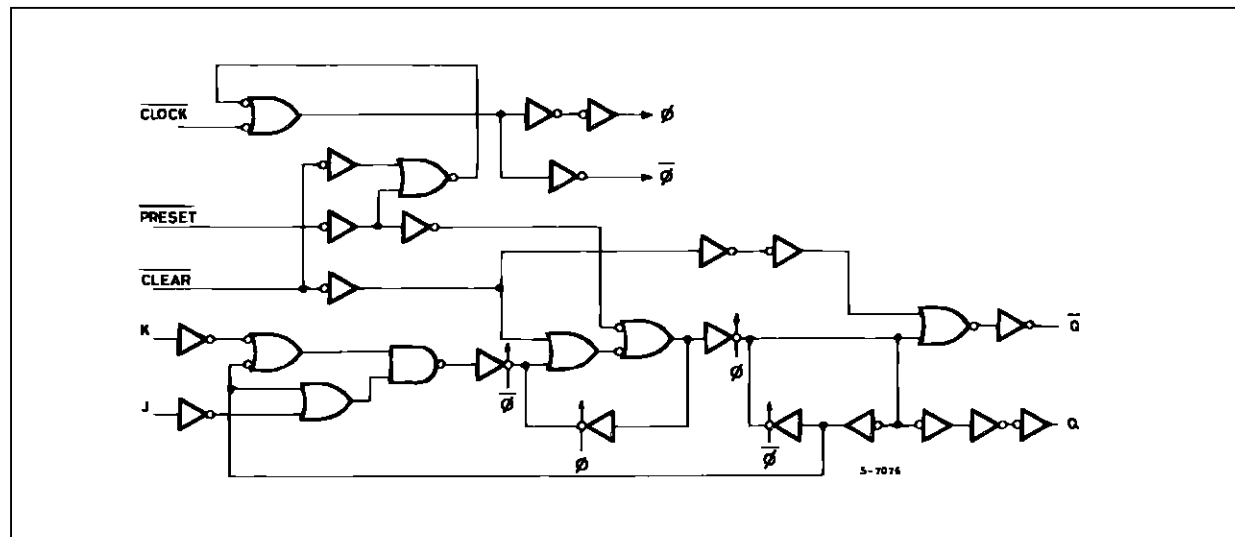
PIN DESCRIPTION

| PIN No | SYMBOL                             | NAME AND FUNCTION                        |
|--------|------------------------------------|------------------------------------------|
| 1, 13  | $\overline{1CK}, \overline{2CK}$   | Clock Input (HIGH to LOW edge triggered) |
| 2, 12  | 1K, 2K                             | Data Inputs: Flip-Flop 1 and 2           |
| 3, 11  | 1J, 2J                             | Data Inputs: Flip-Flop 1 and 2           |
| 4, 10  | $\overline{1PR}, \overline{2PR}$   | Set Inputs                               |
| 5, 9   | 1Q, 2Q                             | True Flip-Flop Outputs                   |
| 6, 7   | $\overline{1Q}, \overline{2Q}$     | Complement Flip-Flop Outputs             |
| 15, 14 | $\overline{1CLR}, \overline{2CLR}$ | Reset inputs                             |
| 8      | GND                                | Ground (0V)                              |
| 16     | V <sub>CC</sub>                    | Positive Supply Voltage                  |

IEC LOGIC SYMBOL



LOGIC DIAGRAM (1/2 Package)



**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**

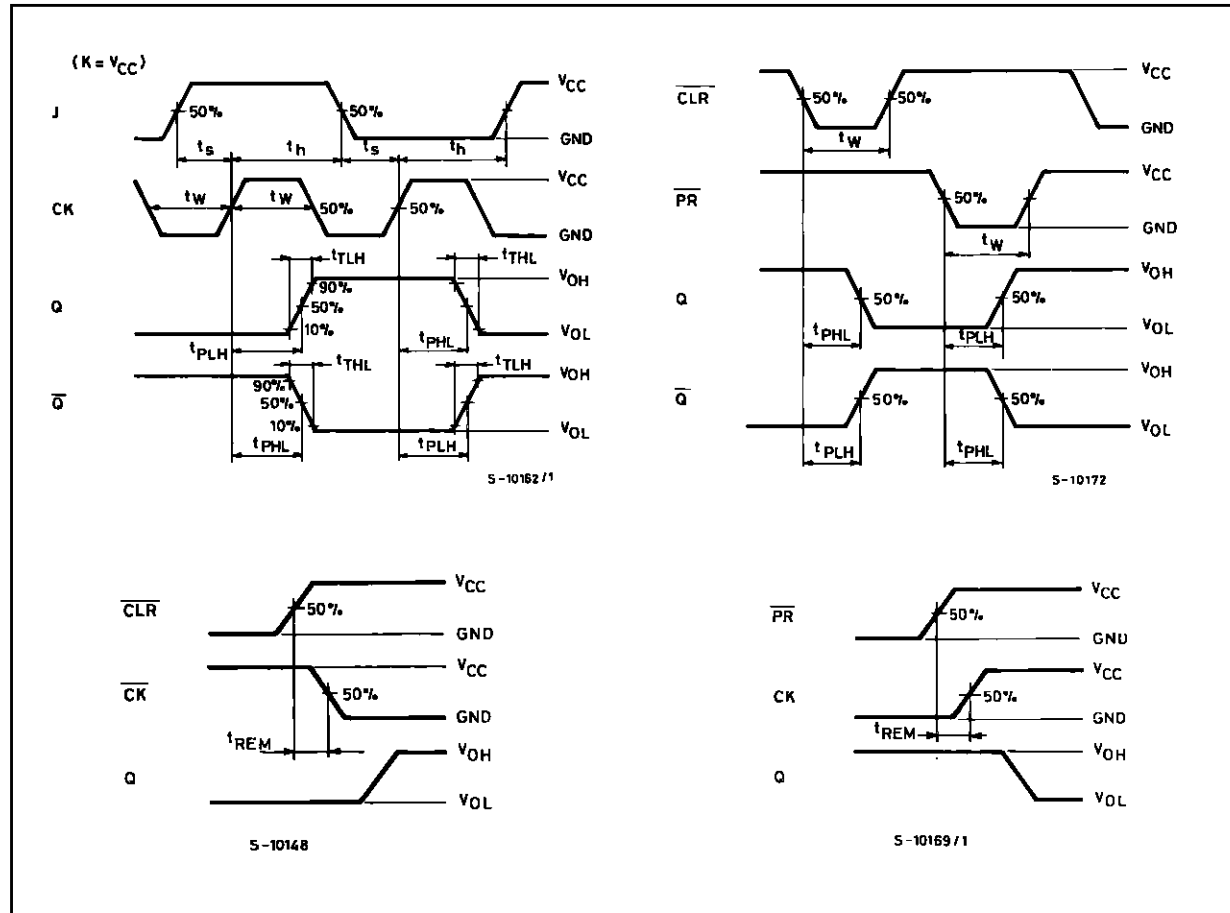
| Symbol          | Parameter                 | Test Conditions        |                                                              | Value                                   |      |      |                      |      |                       |      | Unit |   |
|-----------------|---------------------------|------------------------|--------------------------------------------------------------|-----------------------------------------|------|------|----------------------|------|-----------------------|------|------|---|
|                 |                           | 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                   |      | 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                      |                                         |      | 2    |                      | 20   |                       | 40   | μA   |   |

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

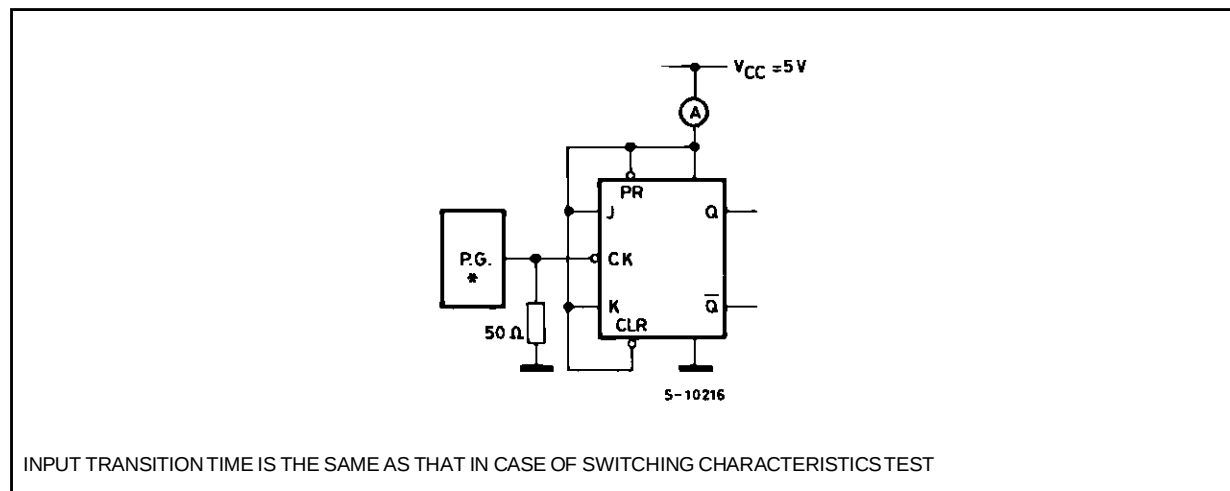
| Symbol                                 | Parameter                                   | Test Conditions        |  | Value                                   |      |      |                      |      |                       | Unit |      |
|----------------------------------------|---------------------------------------------|------------------------|--|-----------------------------------------|------|------|----------------------|------|-----------------------|------|------|
|                                        |                                             | 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>(CK - Q, Q̅)      | 2.0                    |  |                                         | 52   | 125  |                      | 155  |                       | 190  | ns   |
|                                        |                                             | 4.5                    |  |                                         | 16   | 25   |                      | 31   |                       | 38   |      |
|                                        |                                             | 6.0                    |  |                                         | 14   | 21   |                      | 26   |                       | 32   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay Time<br>(CLR, PR - Q, Q̅) | 2.0                    |  |                                         | 68   | 135  |                      | 170  |                       | 205  | ns   |
|                                        |                                             | 4.5                    |  |                                         | 17   | 27   |                      | 34   |                       | 41   |      |
|                                        |                                             | 6.0                    |  |                                         | 14   | 23   |                      | 29   |                       | 35   |      |
| f <sub>MAX</sub>                       | Maximum Clock Frequency                     | 2.0                    |  | 8                                       | 16   |      | 6.4                  |      | 5.4                   |      | MHz  |
|                                        |                                             | 4.5                    |  | 40                                      | 68   |      | 32                   |      | 27                    |      |      |
|                                        |                                             | 6.0                    |  | 47                                      | 79   |      | 38                   |      | 32                    |      |      |
| t <sub>W(H)</sub><br>t <sub>W(L)</sub> | Minimum Pulse Width<br>(CLOCK)              | 2.0                    |  |                                         | 20   | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                             | 4.5                    |  |                                         | 5    | 15   |                      | 19   |                       | 22   |      |
|                                        |                                             | 6.0                    |  |                                         | 4    | 13   |                      | 16   |                       | 19   |      |
| t <sub>W(L)</sub>                      | Minimum Pulse Width<br>(CLR, PR)            | 2.0                    |  |                                         | 20   | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                             | 4.5                    |  |                                         | 5    | 15   |                      | 19   |                       | 22   |      |
|                                        |                                             | 6.0                    |  |                                         | 4    | 13   |                      | 16   |                       | 19   |      |
| t <sub>S</sub>                         | Minimum Set-up Time                         | 2.0                    |  |                                         | 28   | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                             | 4.5                    |  |                                         | 7    | 15   |                      | 19   |                       | 22   |      |
|                                        |                                             | 6.0                    |  |                                         | 6    | 13   |                      | 16   |                       | 19   |      |
| t <sub>H</sub>                         | Minimum Hold Time                           | 2.0                    |  |                                         |      | 0    |                      | 0    |                       | 0    | ns   |
|                                        |                                             | 4.5                    |  |                                         |      | 0    |                      | 0    |                       | 0    |      |
|                                        |                                             | 6.0                    |  |                                         |      | 0    |                      | 0    |                       | 0    |      |
| t <sub>REM</sub>                       | Minimum Removal Time<br>(CLR, PR)           | 2.0                    |  |                                         | 24   | 50   |                      | 60   |                       | 70   | ns   |
|                                        |                                             | 4.5                    |  |                                         | 4    | 10   |                      | 12   |                       | 14   |      |
|                                        |                                             | 6.0                    |  |                                         | 3    | 9    |                      | 10   |                       | 12   |      |
| C <sub>IN</sub>                        | Input Capacitance                           |                        |  |                                         | 5    | 10   |                      | 10   |                       | 10   | pF   |
| C <sub>PD</sub> (*)                    | Power Dissipation Capacitance               |                        |  |                                         | 33   |      |                      |      |                       |      | 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.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2$  (per FLIP/FLOP)

# SWITCHING CHARACTERISTICS TEST WAVEFORM



## TEST CIRCUIT (Opr.)



INPUT TRANSITION TIME IS THE SAME AS THAT IN CASE OF SWITCHING CHARACTERISTICS TEST

## Plastic DIP16 (0.25) MECHANICAL DATA

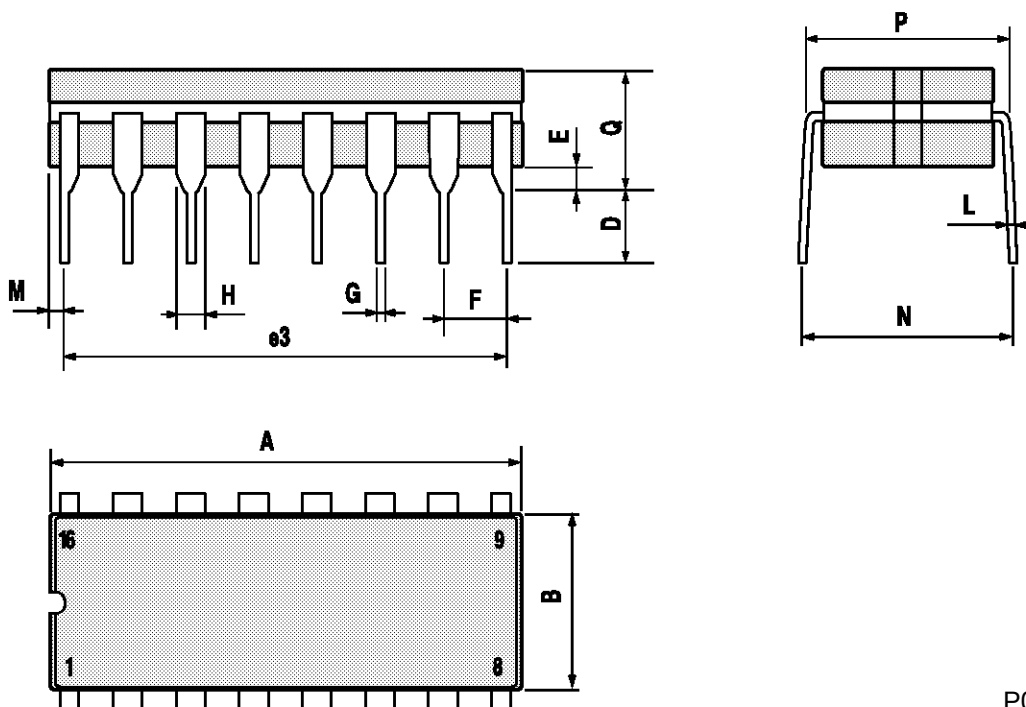
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |  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

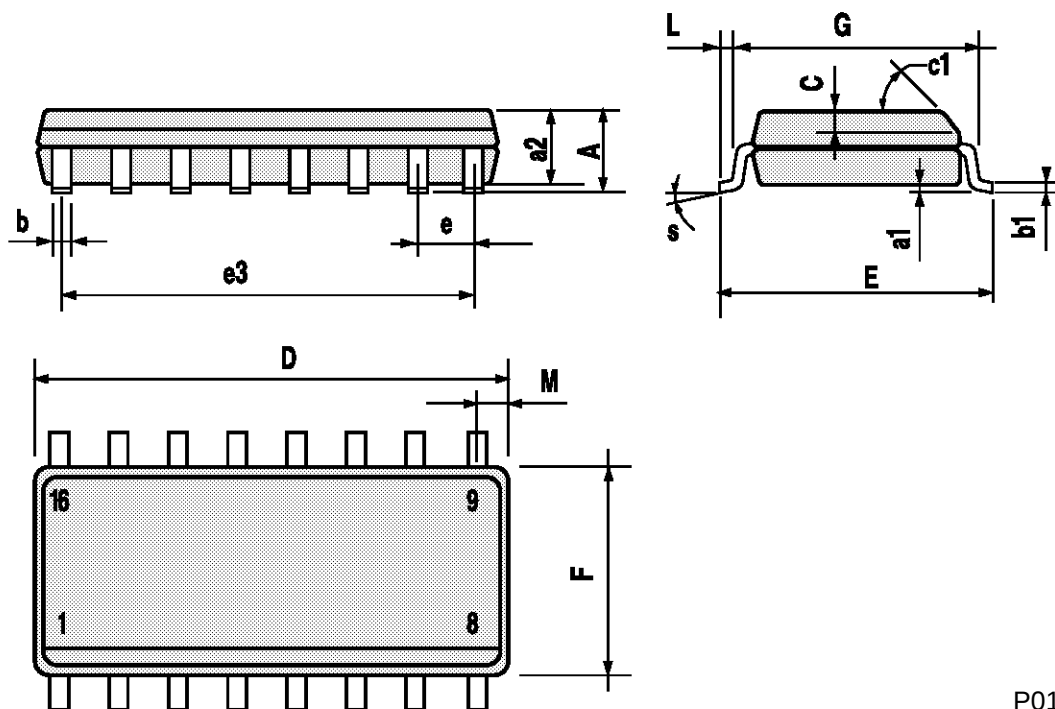
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |       | 20   |       |       | 0.787 |
| B    |      |       | 7    |       |       | 0.276 |
| D    |      | 3.3   |  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



P013H

## PLCC20 MECHANICAL DATA

| DIM. | mm   |      |       | inch  |       |       |
|------|------|------|-------|-------|-------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 9.78 |      | 10.03 | 0.385 |       | 0.395 |
| B    | 8.89 |      | 9.04  | 0.350 |       | 0.356 |
| D    | 4.2  |      | 4.57  | 0.165 |       | 0.180 |
| d1   |      | 2.54 |       |       | 0.100 |       |
| d2   |      | 0.56 |       |       | 0.022 |       |
| E    | 7.37 |      | 8.38  | 0.290 |       | 0.330 |
| e    |      | 1.27 |       |       | 0.050 |       |
| e3   |      | 5.08 |       |       | 0.200 |       |
| F    |      | 0.38 |       |       | 0.015 |       |
| G    |      |      | 0.101 |       |       | 0.004 |
| M    |      | 1.27 |       |       | 0.050 |       |
| M1   |      | 1.14 |       |       | 0.045 |       |



Information furnished is believed to be accurate and reliable. However, SGS-THOMSON Microelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of SGS-THOMSON Microelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. SGS-THOMSON Microelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of SGS-THOMSON Microelectronics.

© 1994 SGS-THOMSON Microelectronics - All Rights Reserved

SGS-THOMSON Microelectronics GROUP OF COMPANIES

Australia - Brazil - France - Germany - Hong Kong - Italy - Japan - Korea - Malaysia - Malta - Morocco - The Netherlands -  
Singapore - Spain - Sweden - Switzerland - Taiwan - Thailand - United Kingdom - U.S.A