

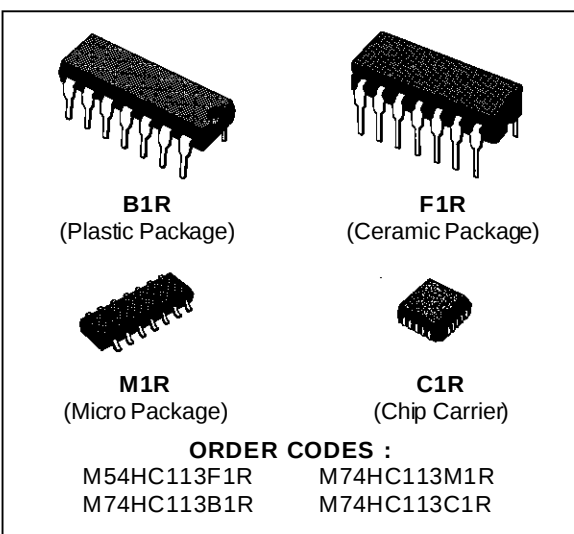
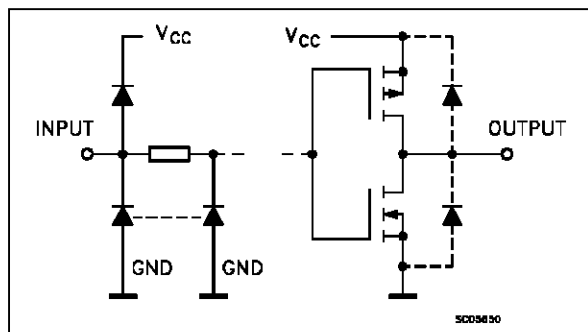
## DUAL J-K FLIP FLOP WITH PRESET

- HIGH SPEED  
 $f_{MAX} = 71 \text{ MHz (TYP.)}$  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  
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (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 54/74LS113

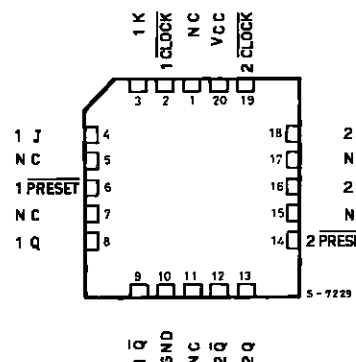
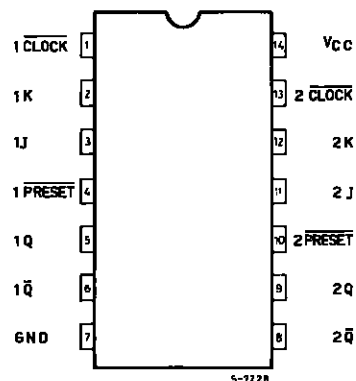
### DESCRIPTION

The M54/74HC113 is a high speed CMOS DUAL J-K FLIP FLOP WITH PRESET fabricated in silicon gate C2MOS technology. It has the same high speed performance of LSTTL combined with true CMOS low power consumption. This circuit offers individual J, K, set, and clock inputs. These monolithic dual flip-flops are designed so that 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 as long as minimum set-up times are observed. Input data is transferred to the outputs 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



### PIN CONNECTIONS (top view)

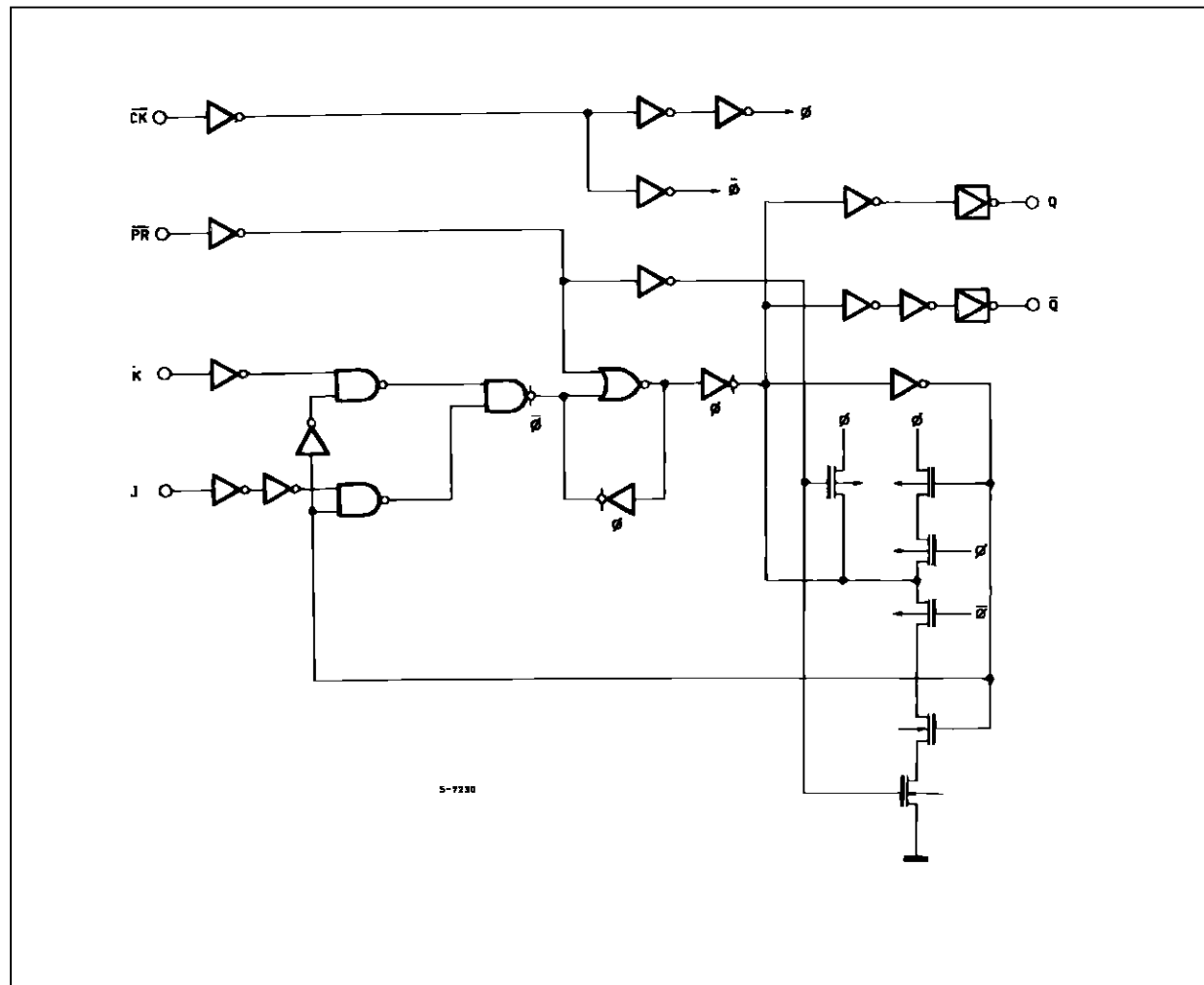


TRUTH TABLE

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

X: Don't Care

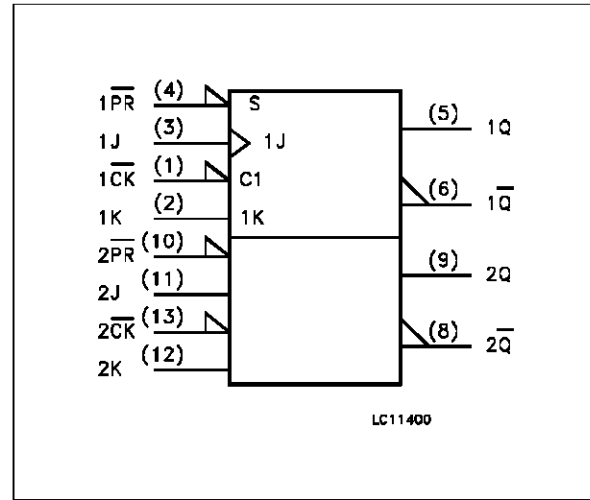
LOGIC DIAGRAM



## PIN DESCRIPTION

| PIN No | SYMBOL          | NAME AND FUNCTION                        |
|--------|-----------------|------------------------------------------|
| 1, 13  | 1CK, 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  | 1PR, 2PR        | Set Inputs                               |
| 5, 9   | 1Q, 2Q          | True Flip-Flop Outputs                   |
| 6, 8   | 1Q, 2Q          | Complement Flip-Flop Outputs             |
| 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     | ns       |
|                                 |                                                                   | V <sub>CC</sub> = 4.5 V   |          |
|                                 |                                                                   | V <sub>CC</sub> = 6 V     |          |

**DC SPECIFICATIONS**

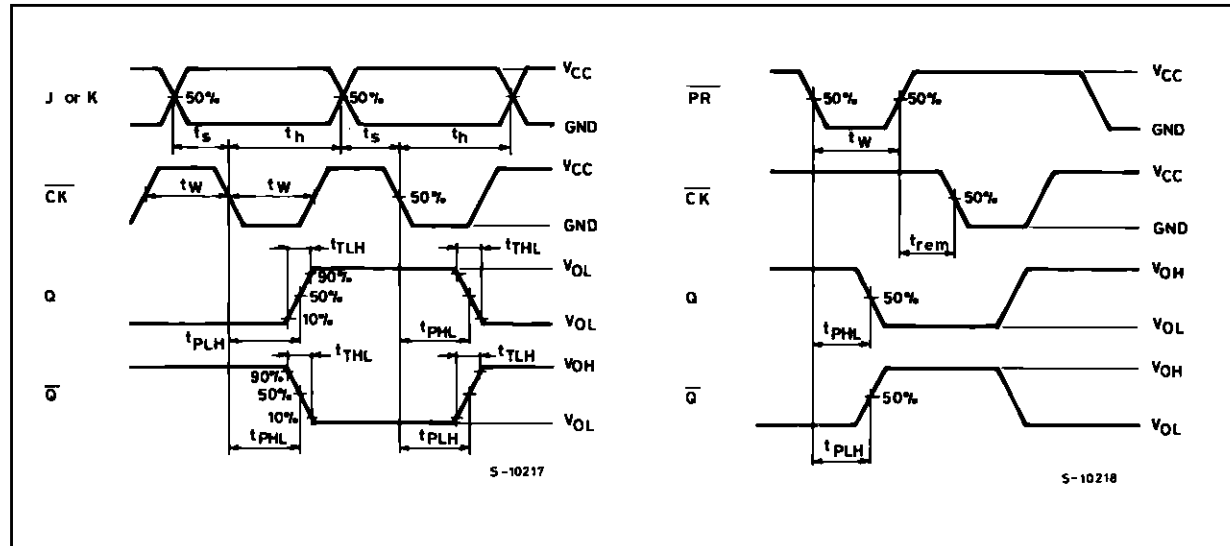
| Symbol          | Parameter                 | Test Conditions        |                                                              | Value                                   |      |      |                      |      |                       |      | Unit |   |
|-----------------|---------------------------|------------------------|--------------------------------------------------------------|-----------------------------------------|------|------|----------------------|------|-----------------------|------|------|---|
|                 |                           | 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)

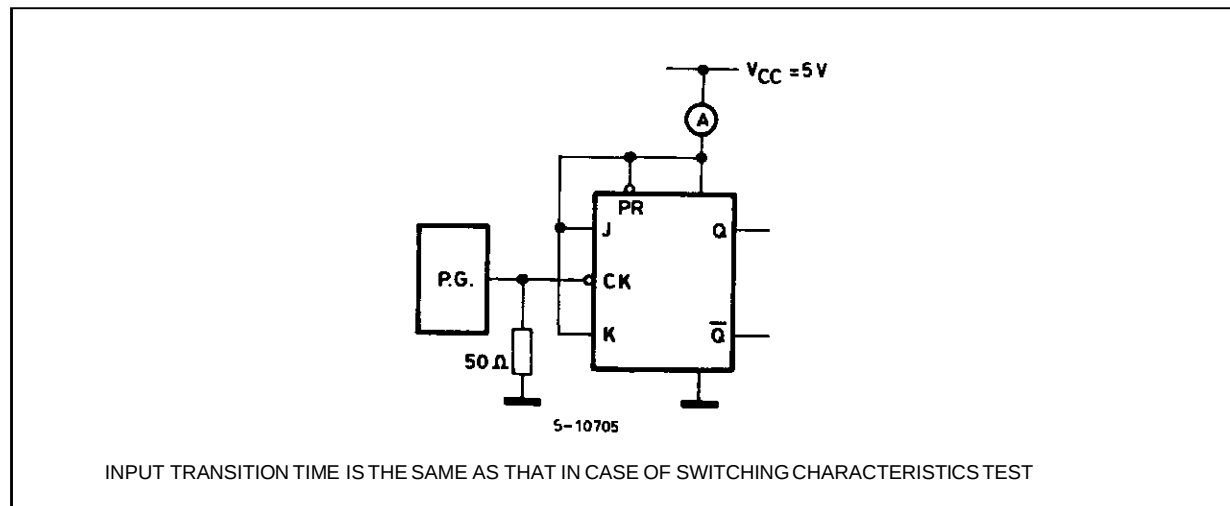
| Symbol                                 | Parameter                                               | Test Conditions        |  | Value                                   |      |      |                      |      |                       | Unit |      |
|----------------------------------------|---------------------------------------------------------|------------------------|--|-----------------------------------------|------|------|----------------------|------|-----------------------|------|------|
|                                        |                                                         | 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, $\overline{Q}$ )     | 2.0                    |  |                                         | 46   | 125  |                      | 155  |                       | 190  | ns   |
|                                        |                                                         | 4.5                    |  |                                         | 16   | 25   |                      | 31   |                       | 38   |      |
|                                        |                                                         | 6.0                    |  |                                         | 12   | 21   |                      | 26   |                       | 32   |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay Time<br>(PRESET - Q, $\overline{Q}$ ) | 2.0                    |  |                                         | 48   | 125  |                      | 155  |                       | 190  | ns   |
|                                        |                                                         | 4.5                    |  |                                         | 16   | 25   |                      | 31   |                       | 38   |      |
|                                        |                                                         | 6.0                    |  |                                         | 13   | 21   |                      | 26   |                       | 32   |      |
| f <sub>MAX</sub>                       | Maximum Clock Frequency                                 | 2.0                    |  | 8                                       | 16   |      | 6.4                  |      | 5.4                   |      | MHz  |
|                                        |                                                         | 4.5                    |  | 40                                      | 63   |      | 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                    |  |                                         | 16   | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                                         | 4.5                    |  |                                         | 4    | 15   |                      | 19   |                       | 22   |      |
|                                        |                                                         | 6.0                    |  |                                         | 3    | 13   |                      | 16   |                       | 19   |      |
| t <sub>W(L)</sub>                      | Minimum Pulse Width<br>(PRESET)                         | 2.0                    |  |                                         | 16   | 75   |                      | 95   |                       | 110  | ns   |
|                                        |                                                         | 4.5                    |  |                                         | 4    | 15   |                      | 19   |                       | 22   |      |
|                                        |                                                         | 6.0                    |  |                                         | 3    | 13   |                      | 16   |                       | 19   |      |
| t <sub>s</sub>                         | Minimum Set-up Time                                     | 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                                       | 2.0                    |  |                                         |      | 0    |                      | 0    |                       | 0    | ns   |
|                                        |                                                         | 4.5                    |  |                                         |      | 0    |                      | 0    |                       | 0    |      |
|                                        |                                                         | 6.0                    |  |                                         |      | 0    |                      | 0    |                       | 0    |      |
| t <sub>REM</sub>                       | Minimum Removal Time<br>(PRESET)                        | 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   |                       | 1 0  | pF   |
| C <sub>PD</sub> (*)                    | Power Dissipation Capacitance                           |                        |  |                                         | 37   |      |                      |      |                       |      | 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

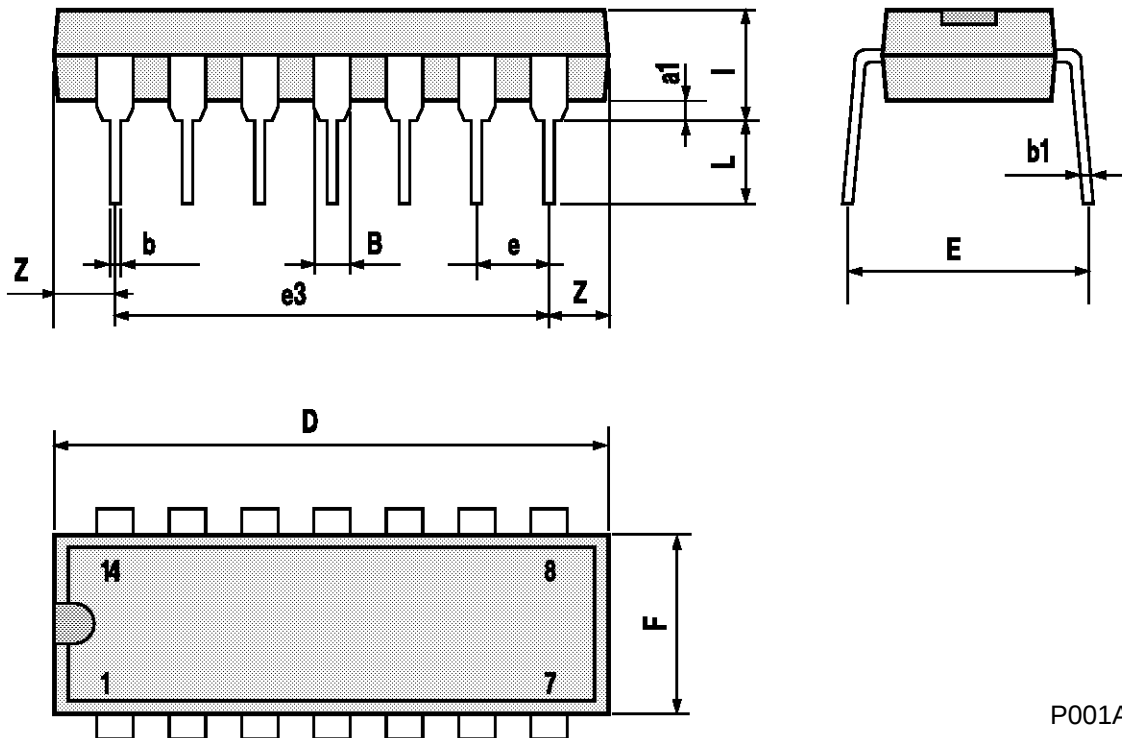


TEST CIRCUIT I<sub>cc</sub> (Opr.)



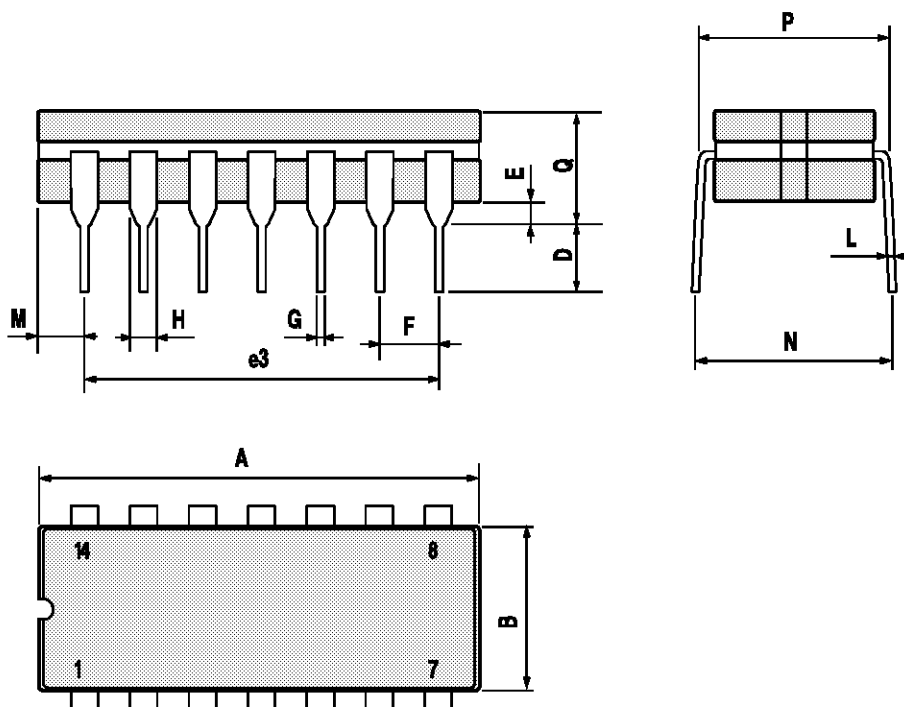
## Plastic DIP14 MECHANICAL DATA

| 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 |



## Ceramic DIP14/1 MECHANICAL DATA

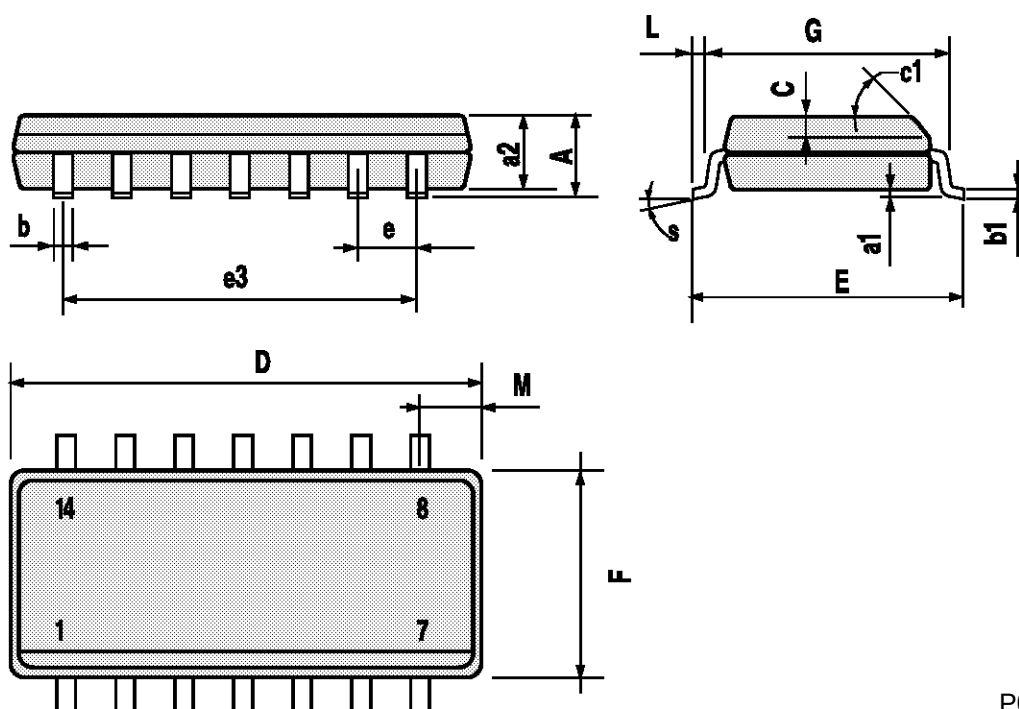
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| A    |      |       | 20   |       |       | 0.787 |
| B    |      |       | 7.0  |       |       | 0.276 |
| D    |      | 3.3   |      |       | 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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