



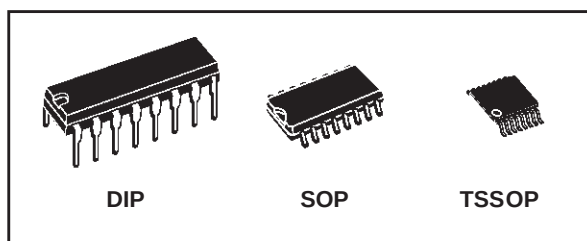
# 74ACT174

## HEX D-TYPE FLIP FLOP WITH CLEAR

- HIGH SPEED:  
 $f_{MAX} = 200\text{MHz}$  (TYP.) at  $V_{CC} = 5\text{V}$
- LOW POWER DISSIPATION:  
 $I_{CC} = 4\mu\text{A}$  (MAX.) at  $T_A = 25^\circ\text{C}$
- COMPATIBLE WITH TTL OUTPUTS  
 $V_{IH} = 2\text{V}$  (MIN.),  $V_{IL} = 0.8\text{V}$  (MAX.)
- $50\Omega$  TRANSMISSION LINE DRIVING CAPABILITY
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 24\text{mA}$  (MIN)
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \approx t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC}$  (OPR) = 4.5V to 5.5V
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 174
- IMPROVED LATCH-UP IMMUNITY

### DESCRIPTION

The 74ACT174 is an advanced high-speed CMOS HEX D-TYPE FLIP FLOP WITH CLEAR fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology. Information signals applied to D inputs are transferred to the Q output on the positive going edge of the clock pulse.

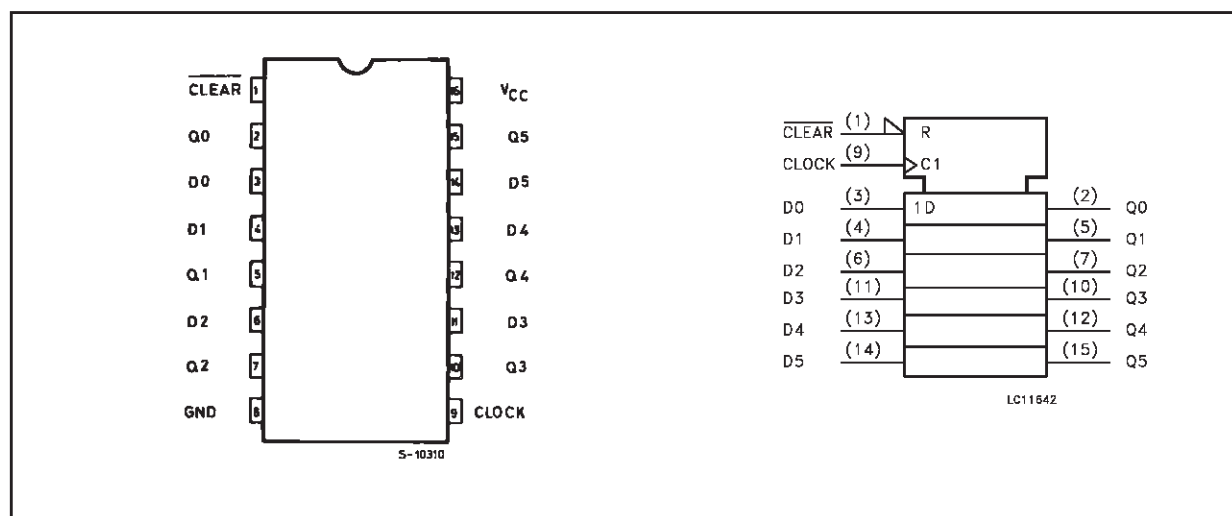


### ORDER CODES

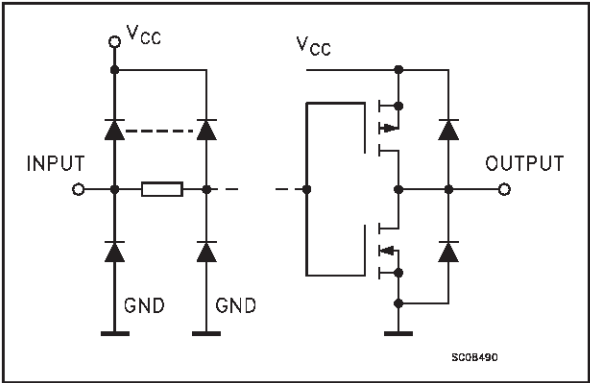
| PACKAGE | TUBE      | T & R       |
|---------|-----------|-------------|
| DIP     | 74ACT174B |             |
| SOP     | 74ACT174M | 74ACT174MTR |
| TSSOP   |           | 74ACT174TTR |

When the CLEAR input is held low, the Q outputs are held low independently of the other inputs. The device is designed to interface directly High Speed CMOS systems with TTL, NMOS and CMOS output voltage levels. All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

### PIN CONNECTION AND IEC LOGIC SYMBOLS



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

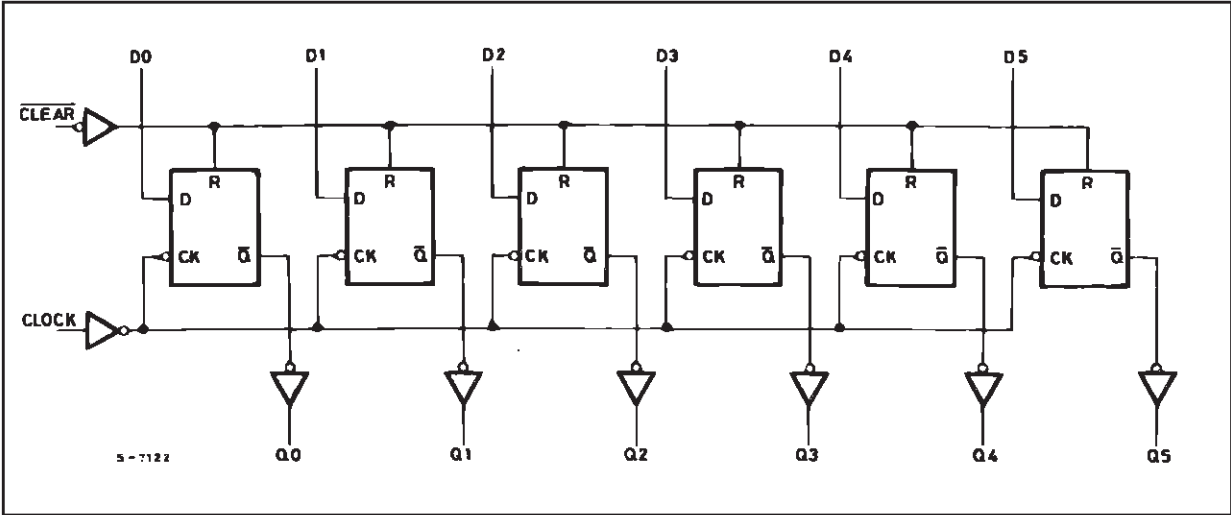
| PIN No              | SYMBOL                    | NAME AND FUNCTION                       |
|---------------------|---------------------------|-----------------------------------------|
| 1                   | $\overline{\text{CLEAR}}$ | Asynchronous Master Reset (Active LOW)  |
| 2, 5, 7, 10, 12, 15 | Q0 to Q5                  | Flip-Flop Outputs                       |
| 3, 4, 6, 11, 13, 14 | D0 to D5                  | Data Inputs                             |
| 9                   | CLOCK                     | Clock Input (LOW-to-HIGH, Edge Trigger) |
| 8                   | GND                       | Ground (0V)                             |
| 16                  | V <sub>CC</sub>           | Positive Supply Voltage                 |

TRUTH TABLE

| INPUTS                    |   |       | OUTPUT         | FUNCTION  |
|---------------------------|---|-------|----------------|-----------|
| $\overline{\text{CLEAR}}$ | D | CLOCK | Q              |           |
| L                         | X | X     | L              | CLEAR     |
| H                         | L |       | L              |           |
| H                         | H |       | H              |           |
| H                         | X |       | Q <sub>n</sub> | NO CHANGE |

X : Don't Care

LOGIC DIAGRAM



This logic diagram has not to be used to estimate propagation delays

**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 Current             | $\pm 50$               | mA   |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | $\pm 300$              | mA   |
| $T_{stg}$             | 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 conditions is not implied.

**RECOMMENDED OPERATING CONDITIONS**

| Symbol   | Parameter                                                  | Value         | Unit |
|----------|------------------------------------------------------------|---------------|------|
| $V_{CC}$ | Supply Voltage                                             | 4.5 to 5.5    | V    |
| $V_I$    | Input Voltage                                              | 0 to $V_{CC}$ | V    |
| $V_O$    | Output Voltage                                             | 0 to $V_{CC}$ | V    |
| $T_{op}$ | Operating Temperature                                      | -55 to 125    | °C   |
| dt/dv    | Input Rise and Fall Time $V_{CC} = 4.5$ to $5.5V$ (note 1) | 8             | ns/V |

1)  $V_{IN}$  from 0.8V to 2.0V

## DC SPECIFICATIONS

| Symbol           | Parameter                             | Test Condition         |                                                    | Value                 |       |       |             |      |              |      | Unit |
|------------------|---------------------------------------|------------------------|----------------------------------------------------|-----------------------|-------|-------|-------------|------|--------------|------|------|
|                  |                                       | V <sub>CC</sub><br>(V) |                                                    | T <sub>A</sub> = 25°C |       |       | -40 to 85°C |      | -55 to 125°C |      |      |
|                  |                                       |                        |                                                    | Min.                  | Typ.  | Max.  | Min.        | Max. | Min.         | Max. |      |
| V <sub>IH</sub>  | High Level Input Voltage              | 4.5                    | V <sub>O</sub> = 0.1 V or<br>V <sub>CC</sub> -0.1V | 2.0                   | 1.5   |       | 2.0         |      | 2.0          |      | V    |
|                  |                                       | 5.5                    |                                                    | 2.0                   | 1.5   |       | 2.0         |      | 2.0          |      |      |
| V <sub>IL</sub>  | Low Level Input Voltage               | 4.5                    | V <sub>O</sub> = 0.1 V or<br>V <sub>CC</sub> -0.1V |                       | 1.5   | 0.8   |             | 0.8  |              | 0.8  | V    |
|                  |                                       | 5.5                    |                                                    |                       | 1.5   | 0.8   |             | 0.8  |              | 0.8  |      |
| V <sub>OH</sub>  | High Level Output Voltage             | 4.5                    | I <sub>O</sub> =-50 μA                             | 4.4                   | 4.49  |       | 4.4         |      | 4.4          |      | V    |
|                  |                                       | 5.5                    | I <sub>O</sub> =-50 μA                             | 5.4                   | 5.49  |       | 5.4         |      | 5.4          |      |      |
|                  |                                       | 4.5                    | I <sub>O</sub> =-24 mA                             | 3.86                  |       |       | 3.76        |      | 3.7          |      | V    |
|                  |                                       | 5.5                    | I <sub>O</sub> =-24 mA                             | 4.86                  |       |       | 4.76        |      | 4.7          |      |      |
| V <sub>OL</sub>  | Low Level Output Voltage              | 4.5                    | I <sub>O</sub> =50 μA                              |                       | 0.001 | 0.1   |             | 0.1  |              | 0.1  | V    |
|                  |                                       | 5.5                    | I <sub>O</sub> =50 μA                              |                       | 0.001 | 0.1   |             | 0.1  |              | 0.1  |      |
|                  |                                       | 4.5                    | I <sub>O</sub> =24 mA                              |                       |       | 0.36  |             | 0.44 |              | 0.5  |      |
|                  |                                       | 5.5                    | I <sub>O</sub> =24 mA                              |                       |       | 0.36  |             | 0.44 |              | 0.5  |      |
| I <sub>I</sub>   | Input Leakage Cur-<br>rent            | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> or GND            |                       |       | ± 0.1 |             | ± 1  |              | ± 1  | μA   |
| I <sub>CCT</sub> | Max I <sub>CC</sub> /Input            | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> - 2.1V            |                       | 0.6   |       |             | 1.5  |              | 1.6  | mA   |
| I <sub>CC</sub>  | Quiescent Supply<br>Current           | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> or GND            |                       |       | 4     |             | 40   |              | 80   | μA   |
| I <sub>OLD</sub> | Dynamic Output<br>Current (note 1, 2) | 5.5                    | V <sub>OLD</sub> = 1.65 V max                      |                       |       |       |             | 75   |              | 50   | mA   |
| I <sub>OHD</sub> |                                       |                        | V <sub>OHD</sub> = 3.85 V min                      |                       |       |       |             | -75  |              | -50  | mA   |

1) Maximum test duration 2ms, one output loaded at time

2) Incident wave switching is guaranteed on transmission lines with impedances as low as 50Ω

AC ELECTRICAL CHARACTERISTICS (C<sub>L</sub> = 50 pF, R<sub>L</sub> = 500 Ω, Input t<sub>r</sub> = t<sub>f</sub> = 3ns)

| Symbol                            | Parameter                          | Test Condition         |  | Value                 |      |      |             |      |              |      | Unit |
|-----------------------------------|------------------------------------|------------------------|--|-----------------------|------|------|-------------|------|--------------|------|------|
|                                   |                                    | V <sub>CC</sub><br>(V) |  | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |      |      |
|                                   |                                    |                        |  | Min.                  | Typ. | Max. | Min.        | Max. | Min.         | Max. |      |
| t <sub>PLH</sub> t <sub>PHL</sub> | Propagation Delay Time CLOCK to Y  | 5.0(*)                 |  | 1.5                   | 6.0  | 10.5 |             | 11.5 |              | 11.5 | ns   |
| t <sub>PLH</sub> t <sub>PHL</sub> | Propagation Delay Time CLEAR to Y  | 5.0(*)                 |  | 1.5                   | 7.0  | 9.5  |             | 11.0 |              | 11.0 | ns   |
| t <sub>WL</sub>                   | CLEAR Pulse Width, LOW             | 5.0(*)                 |  |                       | 3.0  | 4.5  |             | 5.0  |              | 5.0  | ns   |
| t <sub>W</sub>                    | CLOCK Pulse Width                  | 5.0(*)                 |  |                       | 3.0  | 4.5  |             | 5.0  |              | 5.0  | ns   |
| t <sub>s</sub>                    | Setup Time D to CLOCK, HIGH or LOW | 5.0(*)                 |  |                       | 0.5  | 1.5  |             | 1.5  |              | 1.5  | ns   |
| t <sub>h</sub>                    | Hold Time D to CLOCK, HIGH or LOW  | 5.0(*)                 |  |                       | 1.0  | 2.0  |             | 2.0  |              | 2.0  | ns   |
| t <sub>REM</sub>                  | Recovery Time CLEAR to CLOCK       | 5.0(*)                 |  |                       | 0.0  | 0.5  |             | 0.5  |              | 0.5  | ns   |
| f <sub>MAX</sub>                  | Maximum CLOCK Frequency            | 5.0(*)                 |  | 165                   | 200  |      | 140         |      | 140          |      | MHz  |

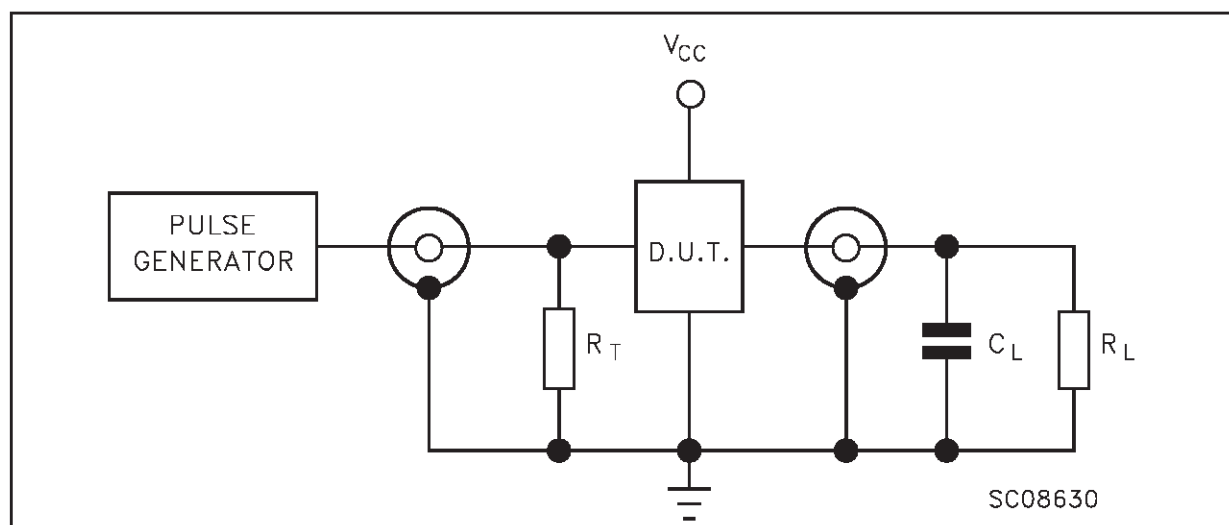
(\*) Voltage range is 5.0V ± 0.5V

## CAPACITIVE CHARACTERISTICS

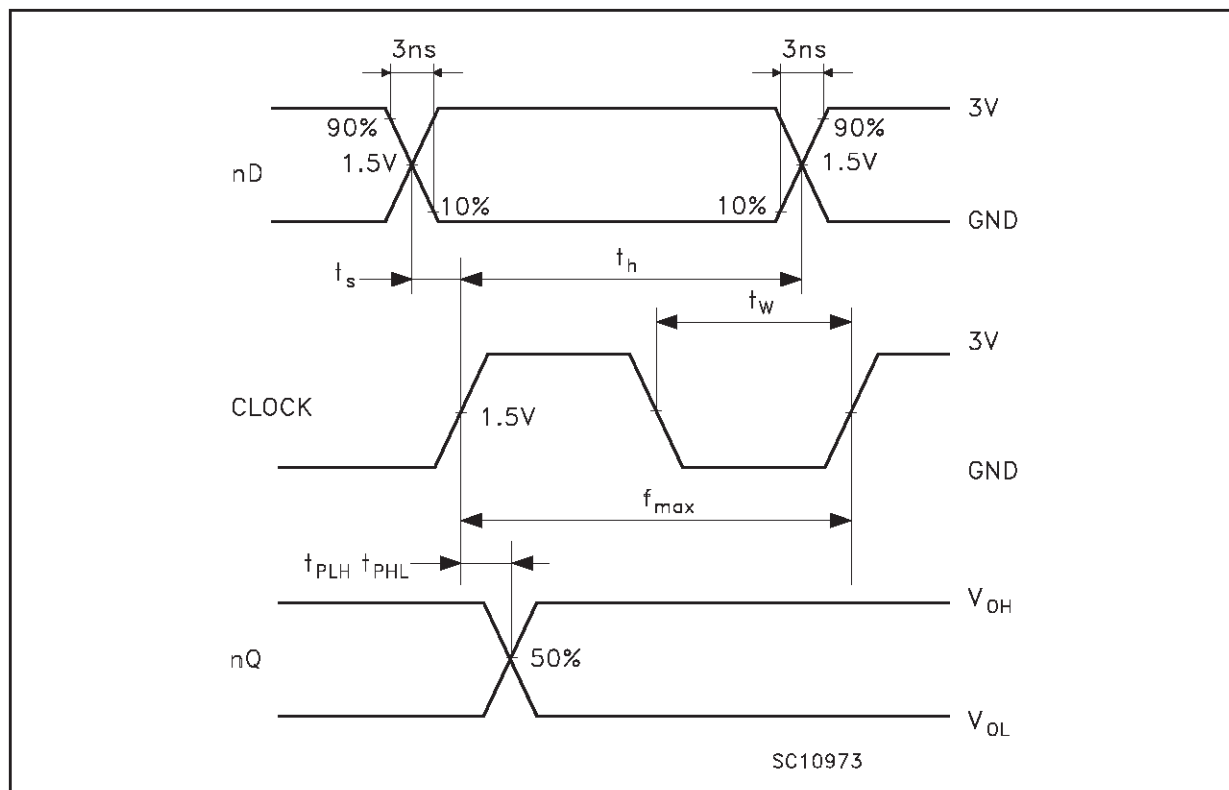
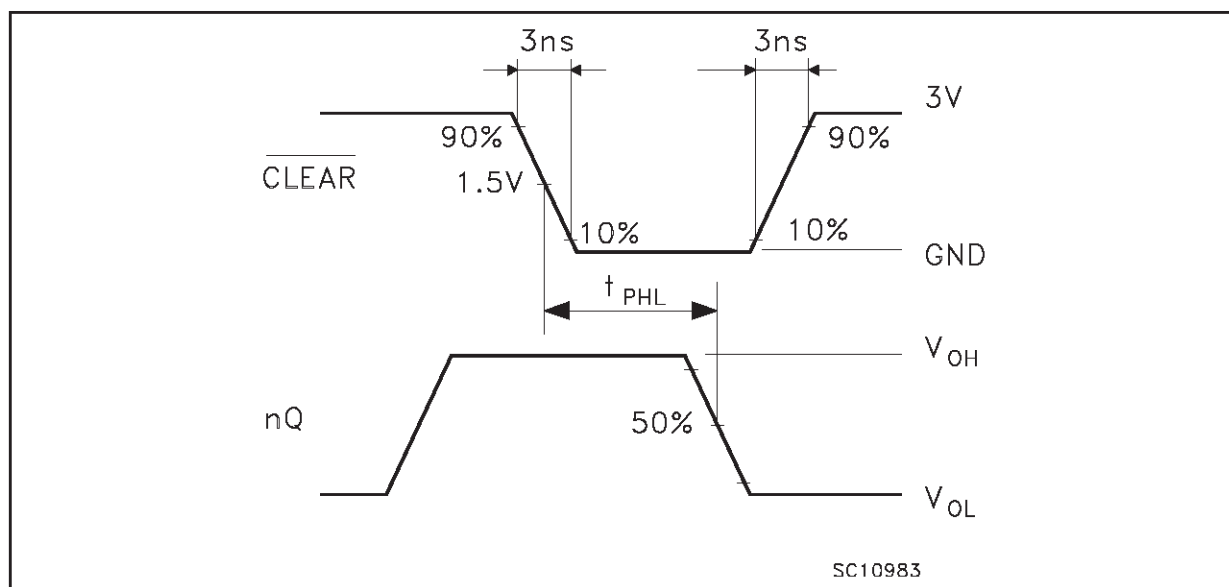
| Symbol          | Parameter                              | Test Condition         |                         | Value                 |      |      |             |      |              | Unit |      |
|-----------------|----------------------------------------|------------------------|-------------------------|-----------------------|------|------|-------------|------|--------------|------|------|
|                 |                                        | V <sub>CC</sub><br>(V) |                         | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |      |      |
|                 |                                        |                        |                         | Min.                  | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| C <sub>IN</sub> | Input Capacitance                      | 5.0                    |                         |                       | 4    |      |             |      |              |      | pF   |
| C <sub>PD</sub> | Power Dissipation Capacitance (note 1) | 5.0                    | f <sub>IN</sub> = 10MHz |                       | 35   |      |             |      |              |      | pF   |

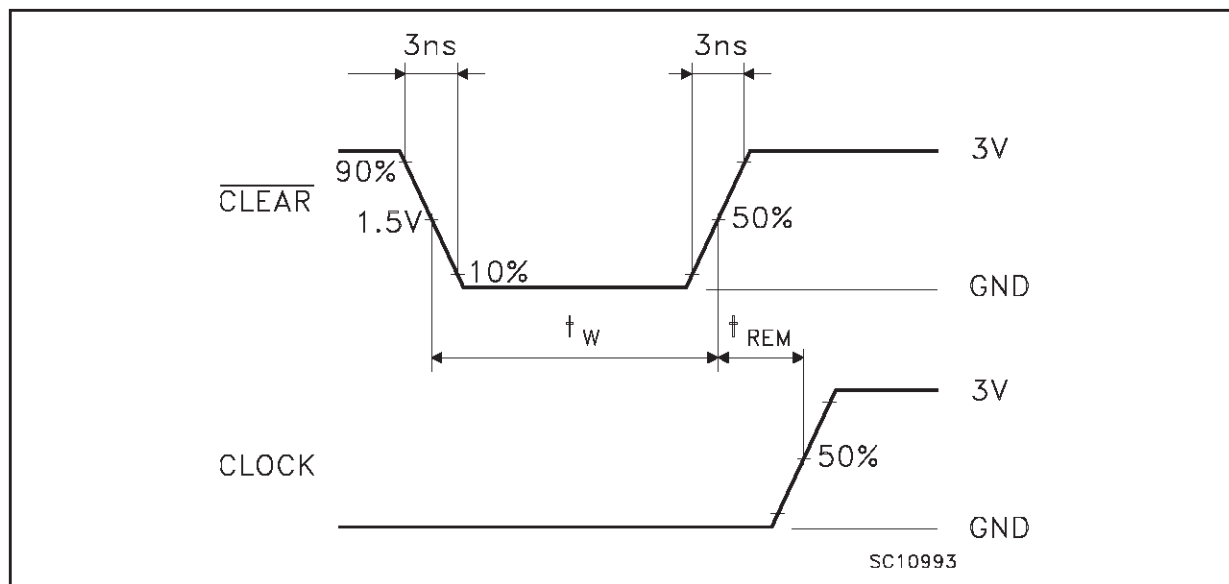
1) C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN}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

## TEST CIRCUIT



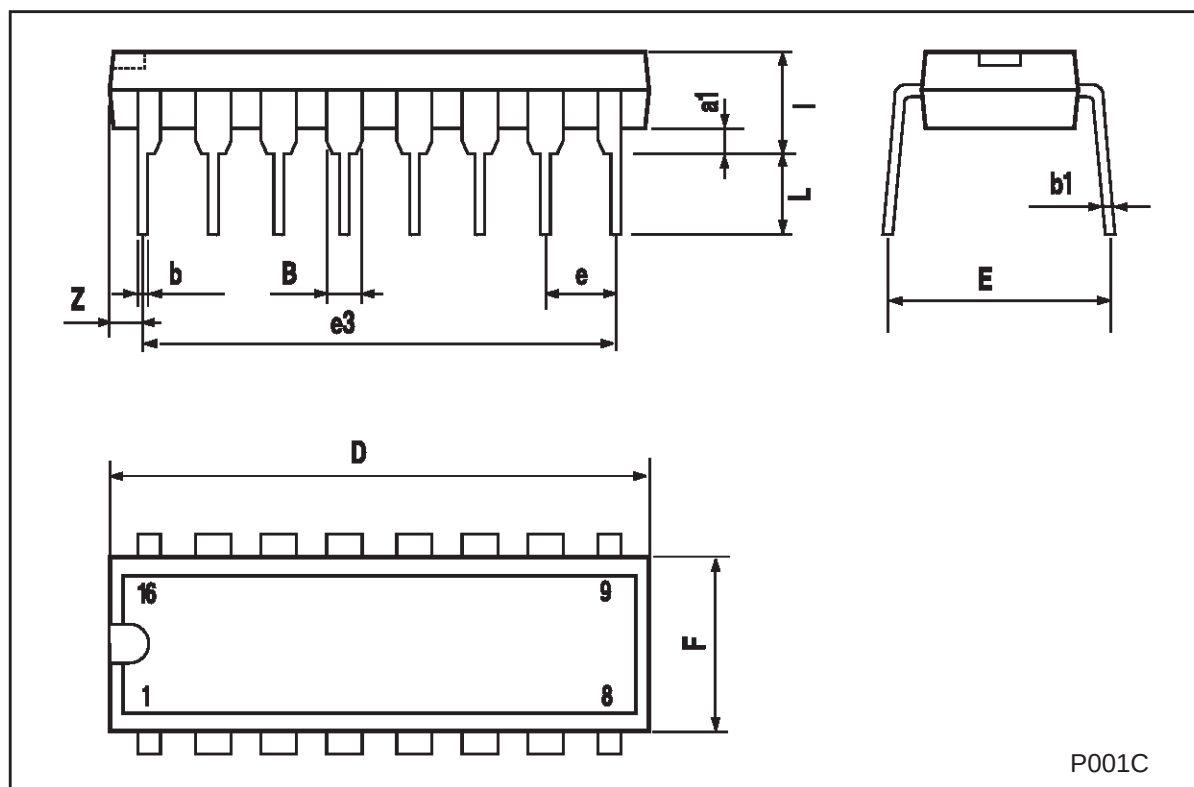
C<sub>L</sub> = 50pF or equivalent (includes jig and probe capacitance)  
R<sub>L</sub> = R<sub>1</sub> = 500Ω or equivalent  
R<sub>T</sub> = Z<sub>OUT</sub> of pulse generator (typically 50Ω)

**WAVEFORM 1: PROPAGATION DELAYS, SETUP AND HOLD TIMES ( $f=1\text{MHz}$ ; 50% duty cycle)****WAVEFORM 2: PROPAGATION DELAYS ( $f=1\text{MHz}$ ; 50% duty cycle)**

**WAVEFORM 3: RECOVERY TIME** ( $f=1\text{MHz}$ ; 50% duty cycle)

## Plastic DIP-16 (0.25) MECHANICAL DATA

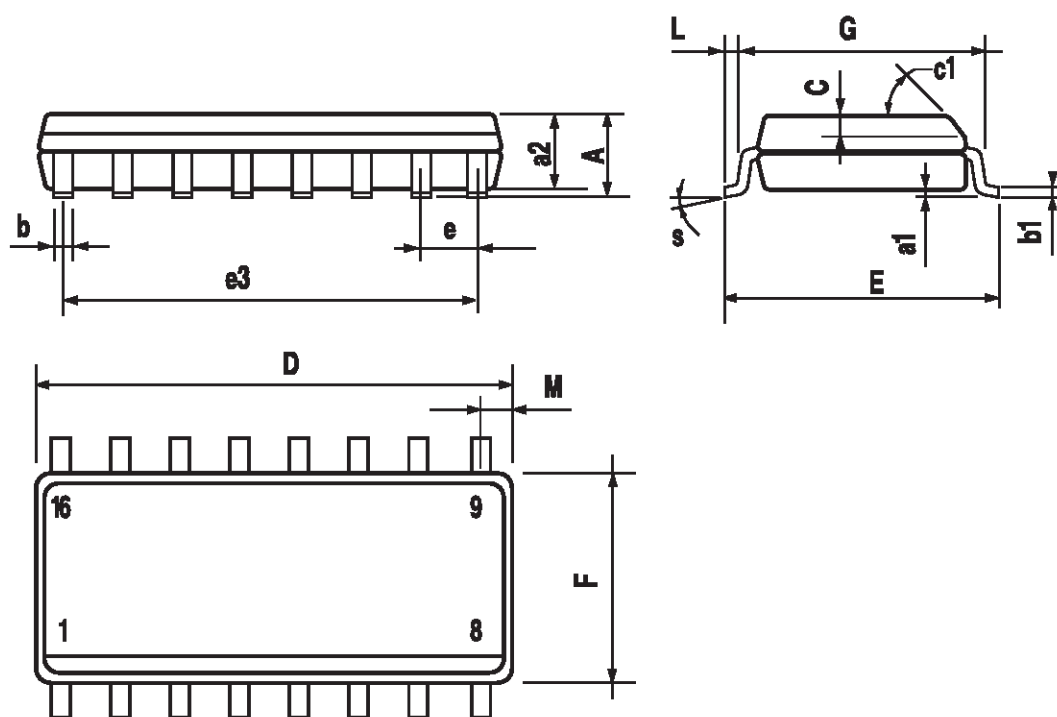
| DIM. | mm   |       |      | inch  |       |       |
|------|------|-------|------|-------|-------|-------|
|      | MIN. | TYP.  | MAX. | MIN.  | TYP.  | MAX.  |
| a1   | 0.51 |       |      | 0.020 |       |       |
| B    | 0.77 |       | 1.65 | 0.030 |       | 0.065 |
| b    |      | 0.5   |  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





## SO-16 MECHANICAL DATA

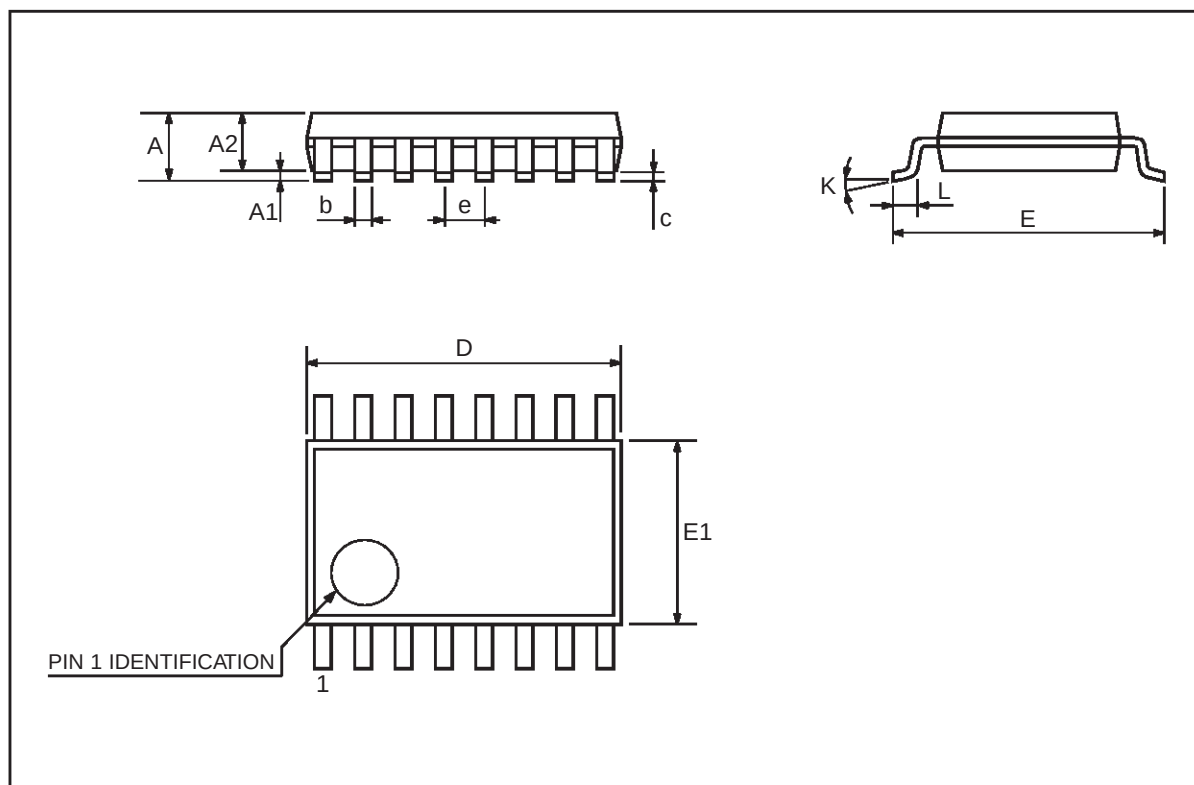
| DIM. | mm        |      |      | inch  |       |       |
|------|-----------|------|------|-------|-------|-------|
|      | MIN.      | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    |           |      | 1.75 |       |       | 0.068 |
| a1   | 0.1       |      | 0.2  | 0.004 |       | 0.007 |
| a2   |           |      | 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

## TSSOP16 MECHANICAL DATA

| DIM. | mm   |          |      | inch   |            |        |
|------|------|----------|------|--------|------------|--------|
|      | MIN. | TYP.     | MAX. | MIN.   | TYP.       | MAX.   |
| A    |      |          | 1.1  |        |            | 0.433  |
| A1   | 0.05 | 0.10     | 0.15 | 0.002  | 0.004      | 0.006  |
| A2   | 0.85 | 0.9      | 0.95 | 0.335  | 0.354      | 0.374  |
| b    | 0.19 |          | 0.30 | 0.0075 |            | 0.0118 |
| c    | 0.09 |          | 0.20 | 0.0035 |            | 0.0079 |
| D    | 4.9  | 5        | 5.1  | 0.193  | 0.197      | 0.201  |
| E    | 6.25 | 6.4      | 6.5  | 0.246  | 0.252      | 0.256  |
| E1   | 4.3  | 4.4      | 4.48 | 0.169  | 0.173      | 0.176  |
| e    |      | 0.65 BSC |      |        | 0.0256 BSC |        |
| K    | 0°   | 4°       | 8°   | 0°     | 4°         | 8°     |
| L    | 0.50 | 0.60     | 0.70 | 0.020  | 0.024      | 0.028  |



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