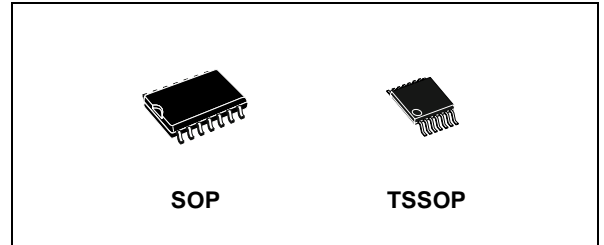


## DUAL D-TYPE FLIP FLOP WITH PRESET AND CLEAR

- HIGH SPEED:  
 $f_{MAX} = 170 \text{ MHz (TYP.) at } V_{CC} = 5\text{V}$
- LOW POWER DISSIPATION:  
 $I_{CC} = 2 \mu\text{A (MAX.) at } T_A = 25^\circ\text{C}$
- HIGH NOISE IMMUNITY:  
 $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (MIN.)}$
- POWER DOWN PROTECTION ON INPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 8 \text{ mA (MIN)}$
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC(OPR)} = 2\text{V to } 5.5\text{V}$
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 74
- IMPROVED LATCH-UP IMMUNITY

### DESCRIPTION

The 74VHC74 is an advanced high-speed CMOS DUAL D-TYPE FLIP FLOP WITH PRESET AND CLEAR fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology. A signal on the D INPUT is transferred to the Q OUTPUTS during the positive going transition of the clock pulse.



**Table 1: Order Codes**

| PACKAGE | T & R      |
|---------|------------|
| SOP     | 74VHC74MTR |
| TSSOP   | 74VHC74TTR |

$\overline{\text{CLR}}$  and  $\overline{\text{PR}}$  are independent of the clock and accomplished by a low setting on the appropriate input.

Power down protection is provided on all inputs and 0 to 7V can be accepted on inputs with no regard to the supply voltage. This device can be used to interface 5V to 3V.

All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

**Figure 1: Pin Connection And IEC Logic Symbols**

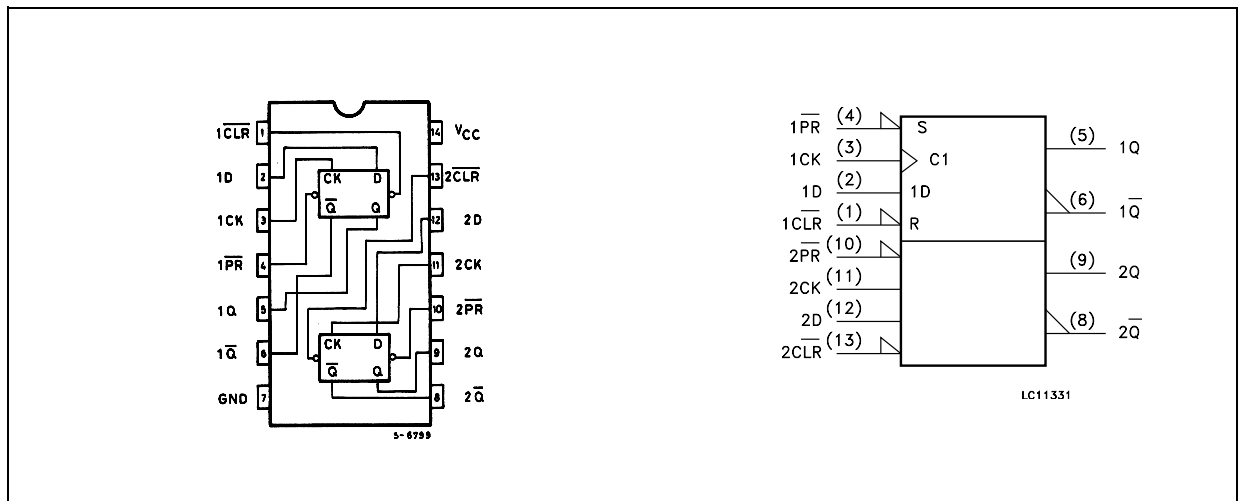


Figure 2: Input Equivalent Circuit

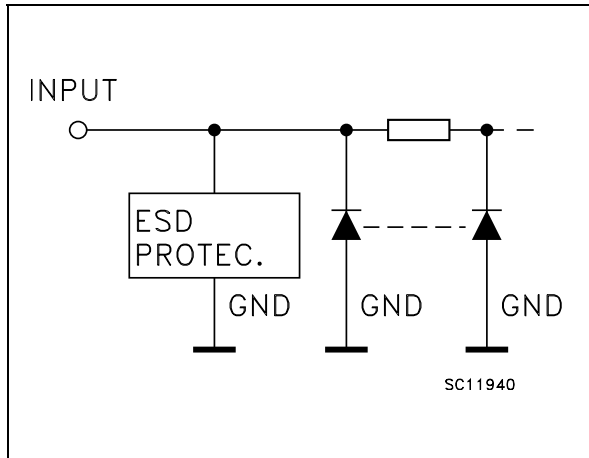


Table 2: Pin Description

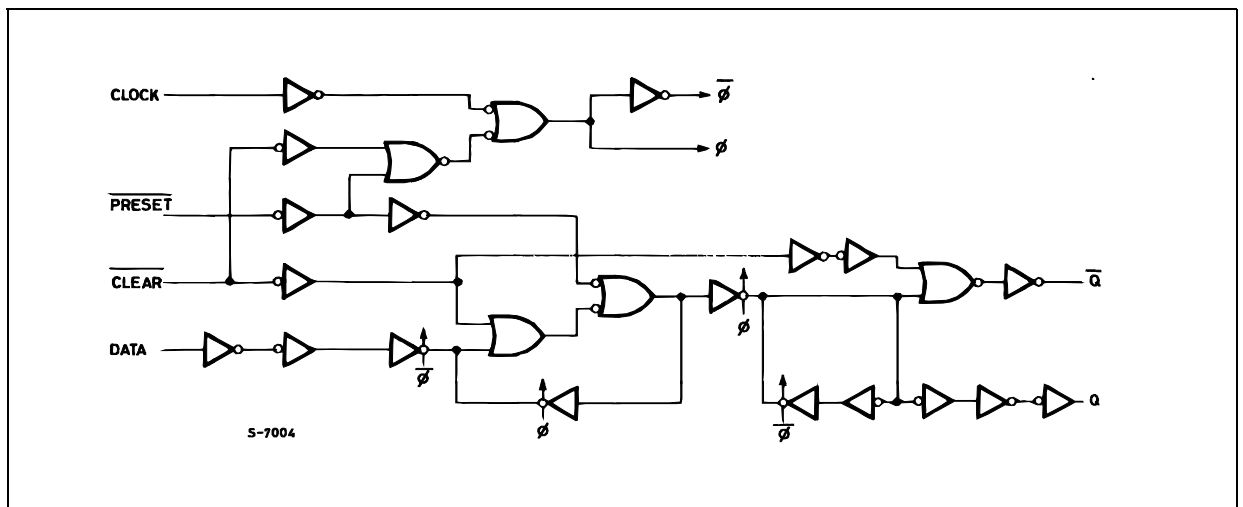
| PIN N° | SYMBOL                              | NAME AND FUNCTION                         |
|--------|-------------------------------------|---|
| 1, 13  | $\overline{1CLR}, \overline{2CLR}$  | Asynchronous Reset - Direct Input         |
| 2, 12  | 1D, 2D                              | Data Inputs                               |
| 3, 11  | 1CK, 2CK                            | Clock Input (LOW to HIGH, Edge Triggered) |
| 4, 10  | 1PR, 2PR                            | Asynchronous Set - Direct Input           |
| 5, 9   | 1Q, 2Q                              | True Flip-Flop Outputs                    |
| 6, 8   | 1 $\overline{Q}$ , 2 $\overline{Q}$ | Complement Flip-Flop Outputs              |
| 7      | GND                                 | Ground (0V)                               |
| 14     | V <sub>CC</sub>                     | Positive Supply Voltage                   |

Table 3: Truth Table

| INPUTS           |                 |   |    | OUTPUTS        |                  | FUNCTION  |
|------------------|-----------------|---|----|----------------|------------------|-----------|
| $\overline{CLR}$ | $\overline{PR}$ | D | CK | Q              | $\overline{Q}$   |           |
| L                | H               | X | X  | L              | H                | CLEAR     |
| H                | L               | X | X  | H              | L                | PRESET    |
| L                | L               | X | X  | H              | H                |           |
| H                | H               | L |    | L              | H                |           |
| H                | H               | H |    | H              | L                |           |
| H                | H               | X |    | Q <sub>n</sub> | $\overline{Q}_n$ | NO CHANGE |

X : Don't Care

Figure 3: Logic Diagram



This logic diagram has not be used to estimate propagation delays

**Table 4: Absolute Maximum Ratings**

| Symbol                | Parameter                     | Value                  | Unit |
|-----------------------|-------------------------------|------------------------|------|
| $V_{CC}$              | Supply Voltage                | -0.5 to +7.0           | V    |
| $V_I$                 | DC Input Voltage              | -0.5 to +7.0           | V    |
| $V_O$                 | DC Output Voltage             | -0.5 to $V_{CC} + 0.5$ | V    |
| $I_{IK}$              | DC Input Diode Current        | - 20                   | mA   |
| $I_{OK}$              | DC Output Diode Current       | $\pm 20$               | mA   |
| $I_O$                 | DC Output Current             | $\pm 25$               | mA   |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | $\pm 50$               | 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

**Table 5: Recommended Operating Conditions**

| Symbol   | Parameter  | Value               | Unit |
|----------|--|---------------------|------|
| $V_{CC}$ | Supply Voltage   | 2 to 5.5            | V    |
| $V_I$    | Input Voltage  | 0 to 5.5            | 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 (note 1) ( $V_{CC} = 3.3 \pm 0.3V$ )<br>( $V_{CC} = 5.0 \pm 0.5V$ ) | 0 to 100<br>0 to 20 | ns/V |

1)  $V_{IN}$  from 30% to 70% of  $V_{CC}$

Table 6: 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  | 2.0                    |   | 1.5                   |      |                    | 1.5                |                    | 1.5                |                    | V    |
|                 |                           | 3.0 to 5.5             |   | 0.7V <sub>CC</sub>    |      |                    | 0.7V <sub>CC</sub> |                    | 0.7V <sub>CC</sub> |                    |      |
| V <sub>IL</sub> | Low Level Input Voltage   | 2.0                    |   |                       |      | 0.5                |                    | 0.5                |                    | 0.5                | V    |
|                 |                           | 3.0 to 5.5             |   |                       |      | 0.3V <sub>CC</sub> |                    | 0.3V <sub>CC</sub> |                    | 0.3V <sub>CC</sub> |      |
| V <sub>OH</sub> | High Level Output Voltage | 2.0                    | I <sub>O</sub> =-50 μA                  | 1.9                   | 2.0  |                    | 1.9                |                    | 1.9                |                    | V    |
|                 |                           | 3.0                    | I <sub>O</sub> =-50 μA                  | 2.9                   | 3.0  |                    | 2.9                |                    | 2.9                |                    |      |
|                 |                           | 4.5                    | I <sub>O</sub> =-50 μA                  | 4.4                   | 4.5  |                    | 4.4                |                    | 4.4                |                    |      |
|                 |                           | 3.0                    | I <sub>O</sub> =-4 mA                   | 2.58                  |      |                    | 2.48               |                    | 2.4                |                    |      |
|                 |                           | 4.5                    | I <sub>O</sub> =-8 mA                   | 3.94                  |      |                    | 3.8                |                    | 3.7                |                    |      |
| V <sub>OL</sub> | Low Level Output Voltage  | 2.0                    | I <sub>O</sub> =50 μA                   |                       | 0.0  | 0.1                |                    | 0.1                |                    | 0.1                | V    |
|                 |                           | 3.0                    | I <sub>O</sub> =50 μA                   |                       | 0.0  | 0.1                |                    | 0.1                |                    | 0.1                |      |
|                 |                           | 4.5                    | I <sub>O</sub> =50 μA                   |                       | 0.0  | 0.1                |                    | 0.1                |                    | 0.1                |      |
|                 |                           | 3.0                    | I <sub>O</sub> =4 mA                    |                       |      | 0.36               |                    | 0.44               |                    | 0.55               |      |
|                 |                           | 4.5                    | I <sub>O</sub> =8 mA                    |                       |      | 0.36               |                    | 0.44               |                    | 0.55               |      |
| I <sub>I</sub>  | Input Leakage Current     | 0 to 5.5               | V <sub>I</sub> = 5.5V or GND            |                       |      | ± 0.1              |                    | ± 1                |                    | ± 1                | μA   |
| I <sub>CC</sub> | Quiescent Supply Current  | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> or GND |                       |      | 2                  |                    | 20                 |                    | 20                 | μA   |

Table 7: AC Electrical Characteristics (Input  $t_r = t_f = 3\text{ns}$ )

| Symbol                 | Parameter  | Test Condition      |               |                          | Value |      |                             |      |                              |      | Unit |    |
|------------------------|--|---------------------|---------------|--------------------------|-------|------|-----------------------------|------|------------------------------|------|------|----|
|                        |  | $V_{CC}$<br>(V)     | $C_L$<br>(pF) | $T_A = 25^\circ\text{C}$ |       |      | $-40$ to $85^\circ\text{C}$ |      | $-55$ to $125^\circ\text{C}$ |      |      |    |
|                        |  |                     |               | Min.                     | Typ.  | Max. | Min.                        | Max. | Min.                         | Max. |      |    |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>Time CK to Q or $\bar{Q}$                   | 3.3 <sup>(*)</sup>  | 15            |                          |       | 6.7  | 11.9                        | 1.0  | 14.0                         | 1.0  | 14.0 | ns |
|                        |  | 3.3 <sup>(*)</sup>  | 50            |                          |       | 9.2  | 15.4                        | 1.0  | 17.5                         | 1.0  | 17.5 |    |
|                        |  | 5.0 <sup>(**)</sup> | 15            |                          |       | 4.6  | 7.3                         | 1.0  | 8.5                          | 1.0  | 8.5  |    |
|                        |  | 5.0 <sup>(**)</sup> | 50            |                          |       | 6.1  | 9.3                         | 1.0  | 10.5                         | 1.0  | 10.5 |    |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>Time $\bar{PR}$ or CLR to<br>Q or $\bar{Q}$ | 3.3 <sup>(*)</sup>  | 15            |                          |       | 7.6  | 12.3                        | 1.0  | 14.5                         | 1.0  | 14.5 | ns |
|                        |  | 3.3 <sup>(*)</sup>  | 50            |                          |       | 10.1 | 15.8                        | 1.0  | 18.0                         | 1.0  | 18.0 |    |
|                        |  | 5.0 <sup>(**)</sup> | 15            |                          |       | 4.8  | 7.7                         | 1.0  | 9.0                          | 1.0  | 9.0  |    |
|                        |  | 5.0 <sup>(**)</sup> | 50            |                          |       | 6.3  | 9.7                         | 1.0  | 11.0                         | 1.0  | 11.0 |    |
| $t_W$                  | CK Pulse Width<br>HIGH or LOW                                    | 3.3 <sup>(*)</sup>  |               |                          |       | 6.0  |                             | 7.0  |                              | 7.0  | ns   |    |
|                        |  | 5.0 <sup>(**)</sup> |               |                          |       | 5.0  |                             | 5.0  |                              | 5.0  |      |    |
| $t_W$                  | PR or CLR Pulse<br>Width LOW                                     | 3.3 <sup>(*)</sup>  |               |                          |       | 6.0  |                             | 7.0  |                              | 7.0  | ns   |    |
|                        |  | 5.0 <sup>(**)</sup> |               |                          |       | 5.0  |                             | 5.0  |                              | 5.0  |      |    |
| $t_s$                  | Setup Time D to CK<br>HIGH or LOW                                | 3.3 <sup>(*)</sup>  |               |                          |       | 6.0  |                             | 7.0  |                              | 7.0  | ns   |    |
|                        |  | 5.0 <sup>(**)</sup> |               |                          |       | 5.0  |                             | 5.0  |                              | 5.0  |      |    |
| $t_h$                  | Hold Time D to CK<br>HIGH or LOW                                 | 3.3 <sup>(*)</sup>  |               |                          |       | 0.5  |                             | 0.5  |                              | 0.5  | ns   |    |
|                        |  | 5.0 <sup>(**)</sup> |               |                          |       | 0.5  |                             | 0.5  |                              | 0.5  |      |    |
| $t_{REM}$              | Removal Time<br>$\bar{PR}$ or CLR to CK                          | 3.3 <sup>(*)</sup>  |               |                          |       | 5.0  |                             | 5.0  |                              | 5.0  | ns   |    |
|                        |  | 5.0 <sup>(**)</sup> |               |                          |       | 3.0  |                             | 3.0  |                              | 3.0  |      |    |
| $f_{MAX}$              | Maximum Clock<br>Frequency                                       | 3.3 <sup>(*)</sup>  | 15            |                          | 80    | 125  |                             | 70   |                              | 70   | MHz  |    |
|                        |  | 3.3 <sup>(*)</sup>  | 50            |                          | 50    | 75   |                             | 45   |                              | 45   |      |    |
|                        |  | 5.0 <sup>(**)</sup> | 15            |                          | 130   | 170  |                             | 110  |                              | 110  |      |    |
|                        |  | 5.0 <sup>(**)</sup> | 50            |                          | 90    | 115  |                             | 75   |                              | 75   |      |    |

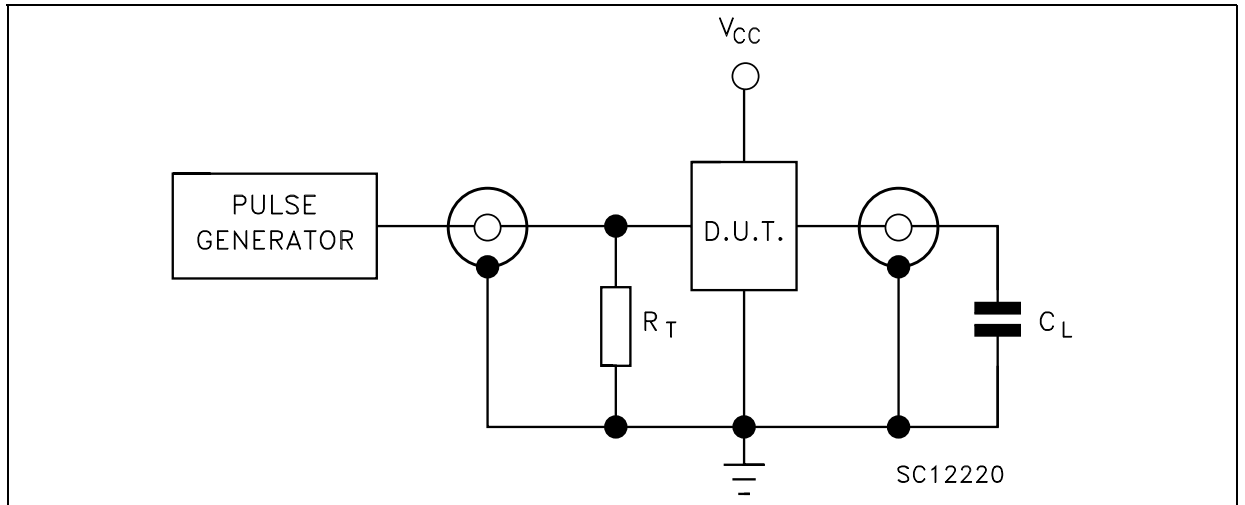
(\*) Voltage range is  $3.3\text{V} \pm 0.3\text{V}$ (\*\*) Voltage range is  $5.0\text{V} \pm 0.5\text{V}$ 

Table 8: Capacitive Characteristics

| Symbol   | Parameter                                    | Test Condition  |                         |  | Value                    |      |      |                             |      |                              | Unit |      |
|----------|--|-----------------|-------------------------|--|--------------------------|------|------|-----------------------------|------|------------------------------|------|------|
|          |  | $V_{CC}$<br>(V) |                         |  | $T_A = 25^\circ\text{C}$ |      |      | $-40$ to $85^\circ\text{C}$ |      | $-55$ to $125^\circ\text{C}$ |      |      |
|          |  |                 |                         |  | Min.                     | Typ. | Max. | Min.                        | Max. | Min.                         |      | Max. |
| $C_{IN}$ | Input Capacitance                            | 5.0             |                         |  |                          | 7    | 10   |                             | 10   |                              | 10   | pF   |
| $C_{PD}$ | Power Dissipation<br>Capacitance<br>(note 1) | 5.0             | $f_{IN} = 10\text{MHz}$ |  |                          | 25   |      |                             |      |                              |      | pF   |

1)  $C_{PD}$  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.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/2$  (per flip-flop)

Figure 4: Test Circuit



$C_L = 15/50\text{pF}$  or equivalent (includes jig and probe capacitance)  
 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

Figure 5: Waveform - Propagation Delays, Setup And Hold Times ( $f=1\text{MHz}$ ; 50% duty cycle)

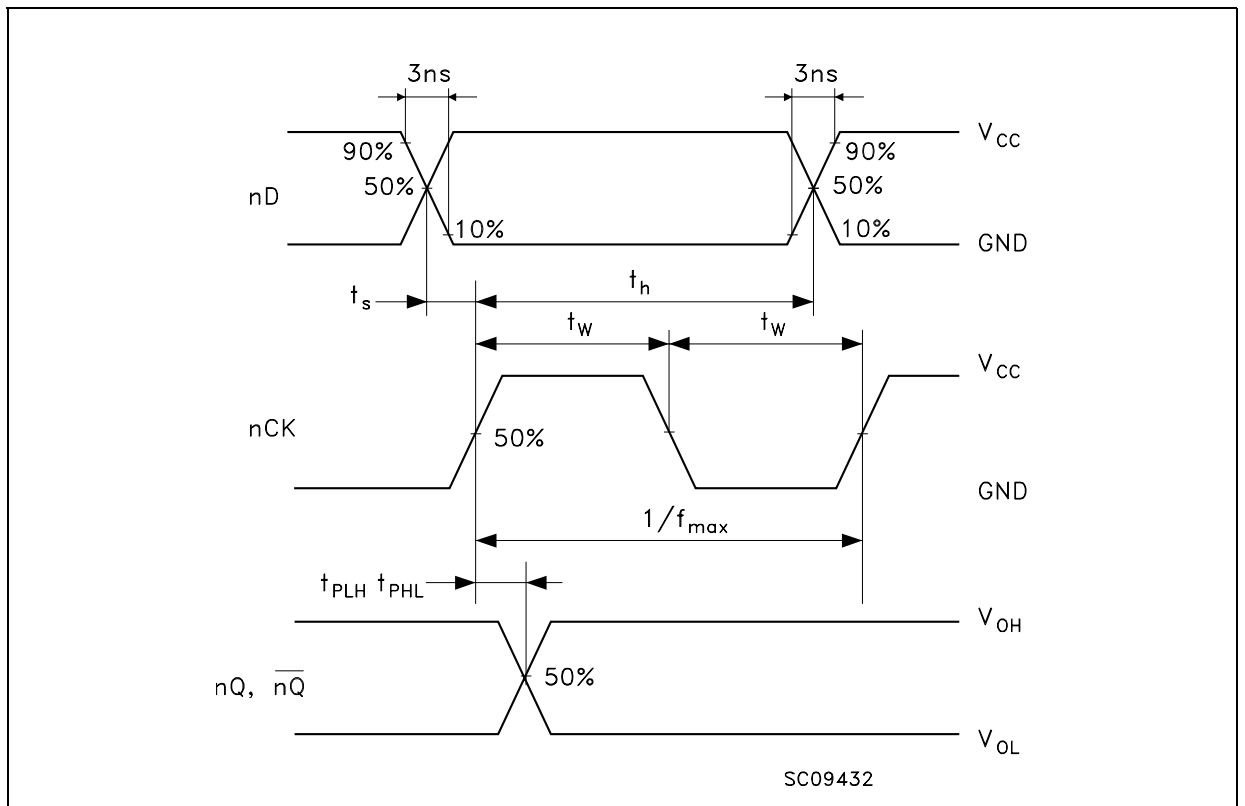


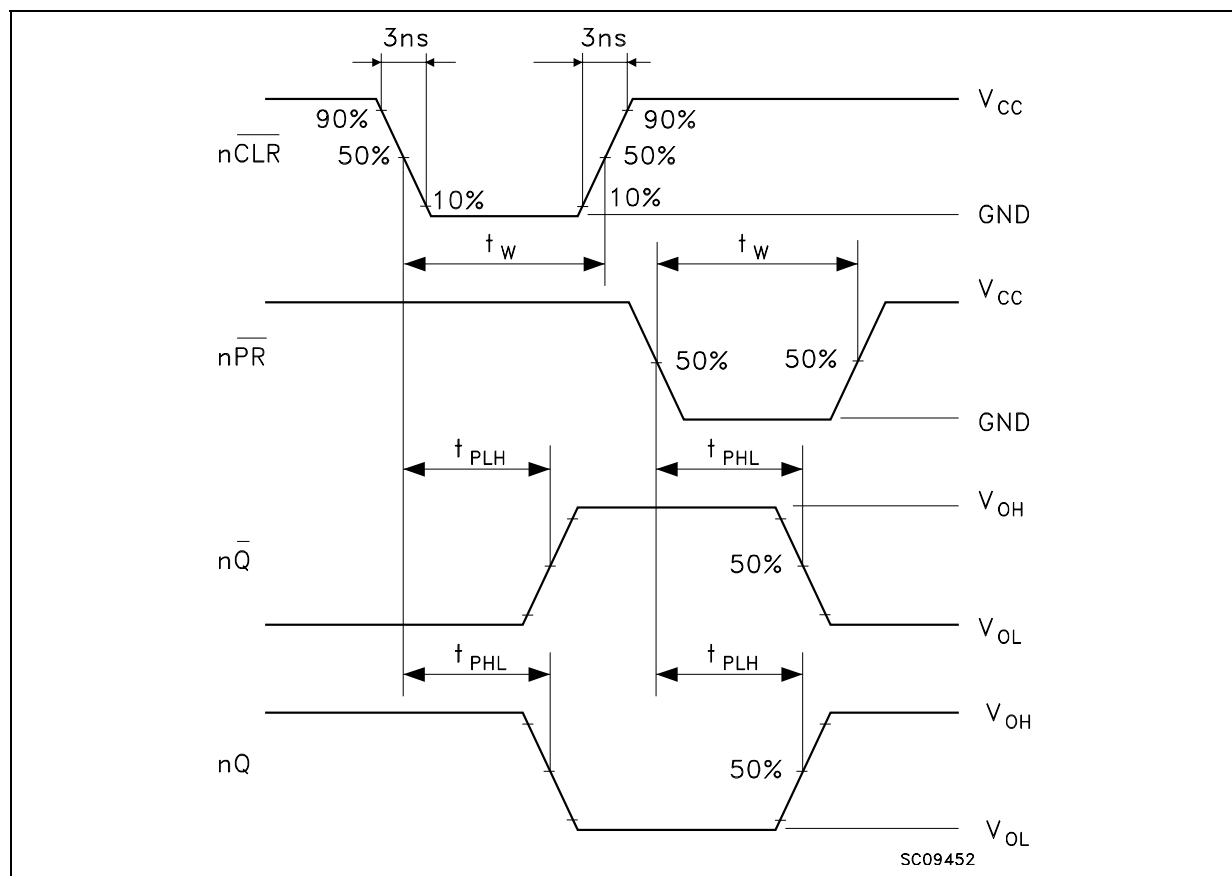
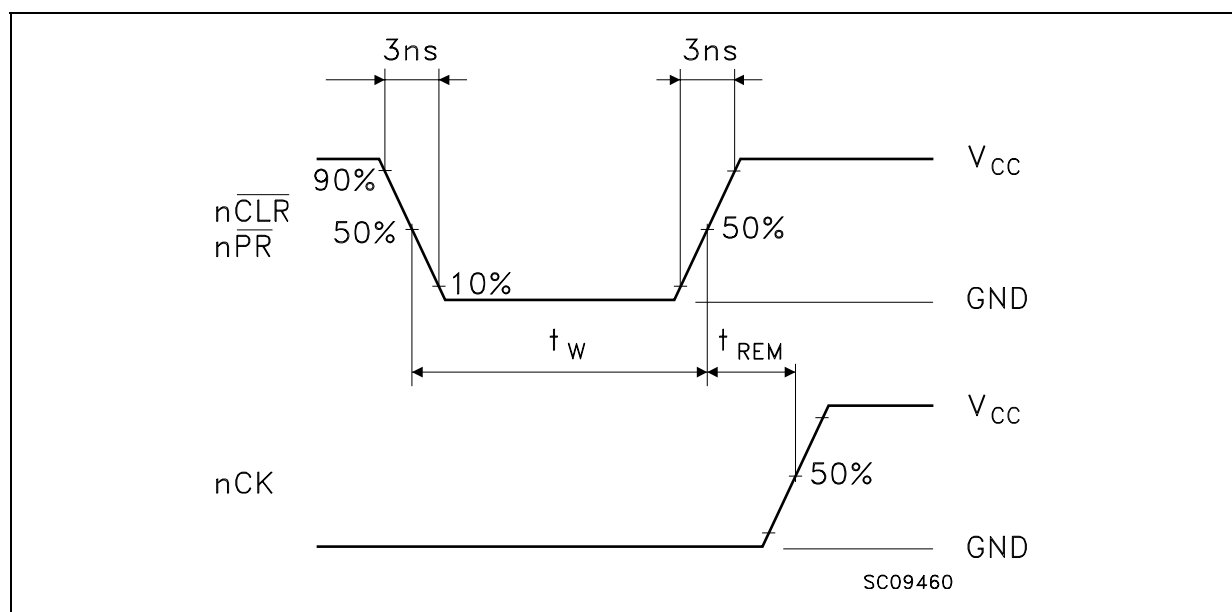
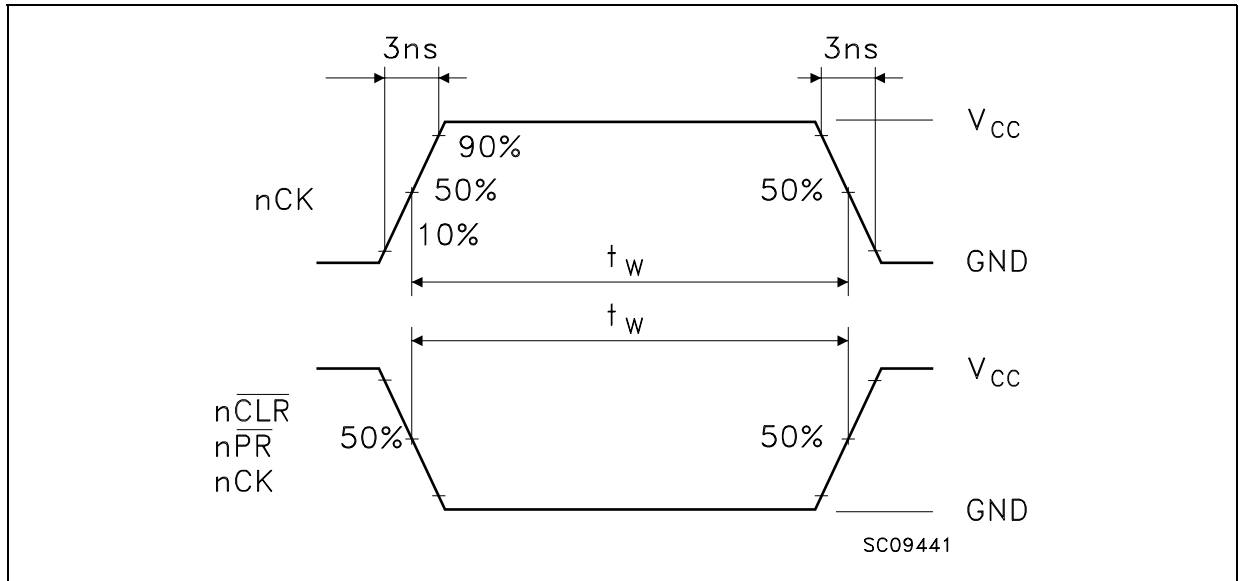
Figure 6: WAVEFORM 2: PROPAGATION DELAYS ( $f=1\text{MHz}$ ; 50% duty cycle)Figure 7: Waveform - Recovery Times ( $f=1\text{MHz}$ ; 50% duty cycle)

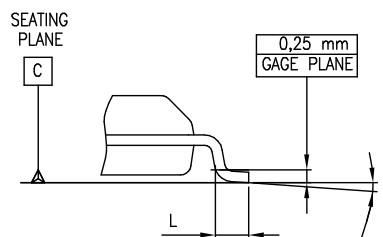
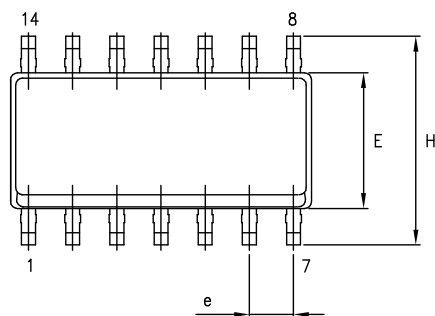
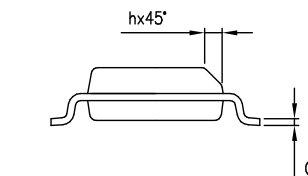
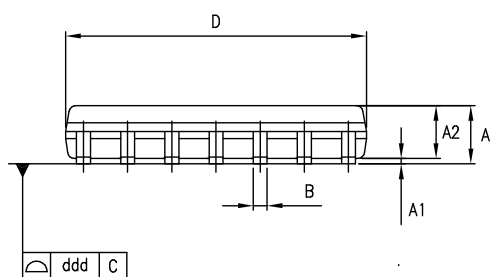
Figure 8: Waveform - Pulse Width





## SO-14 MECHANICAL DATA

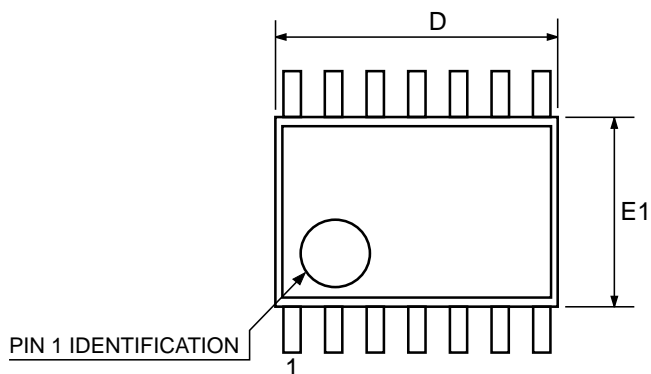
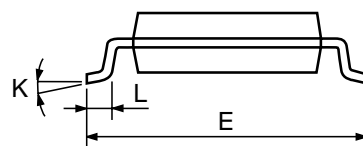
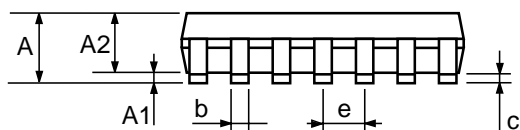
| DIM. | mm.  |      |       | inch  |       |       |
|------|------|------|-------|-------|-------|-------|
|      | MIN. | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 1.35 |      | 1.75  | 0.053 |       | 0.069 |
| A1   | 0.1  |      | 0.25  | 0.004 |       | 0.010 |
| A2   | 1.10 |      | 1.65  | 0.043 |       | 0.065 |
| B    | 0.33 |      | 0.51  | 0.013 |       | 0.020 |
| C    | 0.19 |      | 0.25  | 0.007 |       | 0.010 |
| D    | 8.55 |      | 8.75  | 0.337 |       | 0.344 |
| E    | 3.8  |      | 4.0   | 0.150 |       | 0.157 |
| e    |      | 1.27 |       |       | 0.050 |       |
| H    | 5.8  |      | 6.2   | 0.228 |       | 0.244 |
| h    | 0.25 |      | 0.50  | 0.010 |       | 0.020 |
| L    | 0.4  |      | 1.27  | 0.016 |       | 0.050 |
| k    | 0°   |      | 8°    | 0°    |       | 8°    |
| ddd  |      |      | 0.100 |       |       | 0.004 |



0016019D

## TSSOP14 MECHANICAL DATA

| DIM. | mm.  |          |      | inch  |            |        |
|------|------|----------|------|-------|------------|--------|
|      | MIN. | TYP      | MAX. | MIN.  | TYP.       | MAX.   |
| A    |      |          | 1.2  |       |            | 0.047  |
| A1   | 0.05 |          | 0.15 | 0.002 | 0.004      | 0.006  |
| A2   | 0.8  | 1        | 1.05 | 0.031 | 0.039      | 0.041  |
| b    | 0.19 |          | 0.30 | 0.007 |            | 0.012  |
| c    | 0.09 |          | 0.20 | 0.004 |            | 0.0089 |
| D    | 4.9  | 5        | 5.1  | 0.193 | 0.197      | 0.201  |
| E    | 6.2  | 6.4      | 6.6  | 0.244 | 0.252      | 0.260  |
| E1   | 4.3  | 4.4      | 4.48 | 0.169 | 0.173      | 0.176  |
| e    |      | 0.65 BSC |      |       | 0.0256 BSC |        |
| K    | 0°   |          | 8°   | 0°    |            | 8°     |
| L    | 0.45 | 0.60     | 0.75 | 0.018 | 0.024      | 0.030  |



0080337D

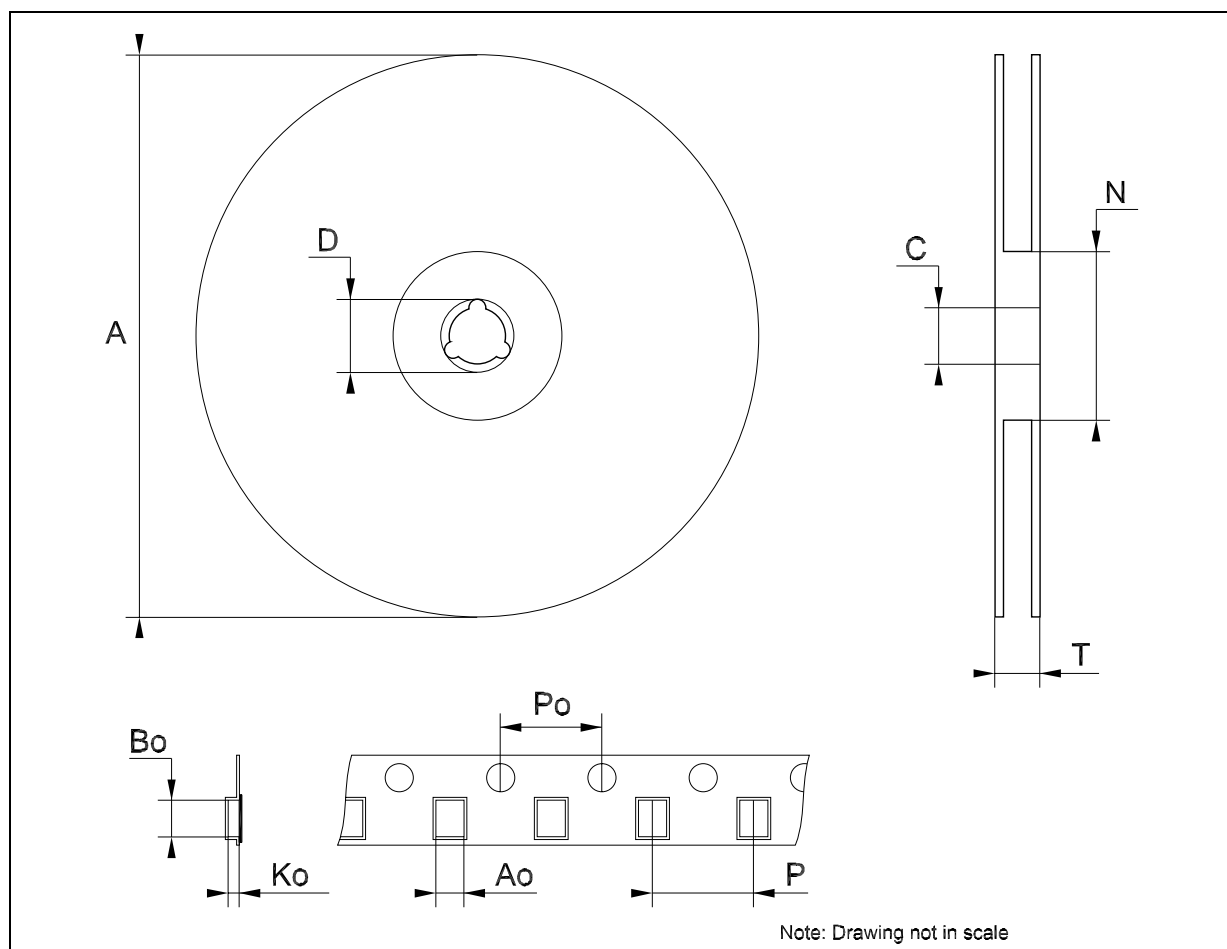
## Tape &amp; Reel SO-14 MECHANICAL DATA

| DIM. | mm.  |     |      | inch  |      |        |
|------|------|-----|------|-------|------|--------|
|      | MIN. | TYP | MAX. | MIN.  | TYP. | MAX.   |
| A    |      |     | 330  |       |      | 12.992 |
| C    | 12.8 |     | 13.2 | 0.504 |      | 0.519  |
| D    | 20.2 |     |      | 0.795 |      |        |
| N    | 60   |     |      | 2.362 |      |        |
| T    |      |     | 22.4 |       |      | 0.882  |
| Ao   | 6.4  |     | 6.6  | 0.252 |      | 0.260  |
| Bo   | 9    |     | 9.2  | 0.354 |      | 0.362  |
| Ko   | 2.1  |     | 2.3  | 0.082 |      | 0.090  |
| Po   | 3.9  |     | 4.1  | 0.153 |      | 0.161  |
| P    | 7.9  |     | 8.1  | 0.311 |      | 0.319  |



## Tape &amp; Reel TSSOP14 MECHANICAL DATA

| DIM. | mm.  |     |      | inch  |      |        |
|------|------|-----|------|-------|------|--------|
|      | MIN. | TYP | MAX. | MIN.  | TYP. | MAX.   |
| A    |      |     | 330  |       |      | 12.992 |
| C    | 12.8 |     | 13.2 | 0.504 |      | 0.519  |
| D    | 20.2 |     |      | 0.795 |      |        |
| N    | 60   |     |      | 2.362 |      |        |
| T    |      |     | 22.4 |       |      | 0.882  |
| Ao   | 6.7  |     | 6.9  | 0.264 |      | 0.272  |
| Bo   | 5.3  |     | 5.5  | 0.209 |      | 0.217  |
| Ko   | 1.6  |     | 1.8  | 0.063 |      | 0.071  |
| Po   | 3.9  |     | 4.1  | 0.153 |      | 0.161  |
| P    | 7.9  |     | 8.1  | 0.311 |      | 0.319  |



**Table 9: Revision History**

| Date        | Revision | Description of Changes         |
|-------------|----------|--------------------------------|
| 12-Nov-2004 | 4        | Order Codes Revision - pag. 1. |

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