

# TC74HCT74AP, TC74HCT74AF, TC74HCT74AFN

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

The TC74HCT74A is a high speed CMOS D FLIP FLOP fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

This drive may be used as a level converter for interfacing TTL or NMOS to High Speed CMOS. The inputs are compatible with TTL, NMOS and CMOS output voltage levels.

The signal level applied to the D INPUT is transferred to Q OUTPUT during the positive going transition of the CLOCK pulse.

$\overline{\text{CLEAR}}$  and  $\overline{\text{PRESET}}$  are independent of the CLOCK and are accomplished by setting the appropriate input to an "L" level. All inputs are equipped with protection circuits against static discharge or transient excess voltage.

### FEATURES:

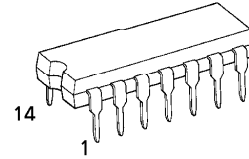
- High Speed..... $f_{\text{MAX}} = 53\text{MHz}$  (typ.)  
at  $V_{\text{CC}} = 5\text{V}$
- Low Power Dissipation..... $I_{\text{CC}} = 2\mu\text{A}$  (Max.) at  $T_a = 25^\circ\text{C}$
- Compatible with TTL outputs....  $V_{\text{IH}} = 2\text{V}$  (Min.)  
 $V_{\text{IL}} = 0.8\text{V}$  (Max.)
- Wide Interfacing ability.....LSTTL, NMOS, CMOS
- Output Drive Capability.....10 LSTTL Loads
- Symmetrical Output Impedance...  $|I_{\text{OH}}| = I_{\text{OL}} = 4\text{mA}$  (Min.)
- Balanced Propagation Delays.... $t_{\text{PLH}} \approx t_{\text{PHL}}$
- Pin and Function Compatible with 74LS74

### TRUTH TABLE

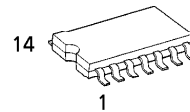
| INPUTS                  |                        |   |              | OUTPUTS      |                         | FUNCTION  |
|-------------------------|------------------------|---|--------------|--------------|-------------------------|-----------|
| $\overline{\text{CLR}}$ | $\overline{\text{PR}}$ | D | CK           | Q            | $\overline{\text{Q}}$   |           |
| L                       | H                      | X | X            | L            | H                       | CLR       |
| H                       | L                      | X | X            | H            | L                       | PRESET    |
| L                       | L                      | X | X            | H            | H                       | —         |
| H                       | H                      | L | $\uparrow$   | L            | H                       | —         |
| H                       | H                      | H | $\uparrow$   | H            | L                       | —         |
| H                       | H                      | X | $\downarrow$ | $\text{Q}_n$ | $\overline{\text{Q}}_n$ | NO CHANGE |

X : Don't Care

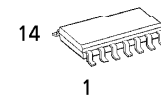
(Note) The JEDEC SOP (FN) is not available in Japan.



P (DIP14-P-300-2.54)  
Weight : 0.96g (Typ.)

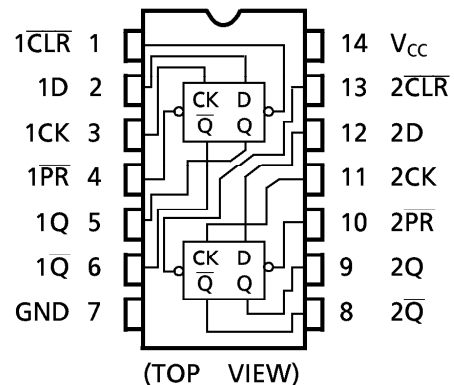


F (SOP14-P-300-1.27)  
Weight : 0.18g (Typ.)

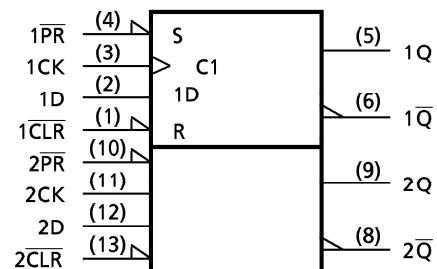


FN (SOL14-P-150-1.27)  
Weight : 0.12g (Typ.)

### PIN ASSIGNMENT



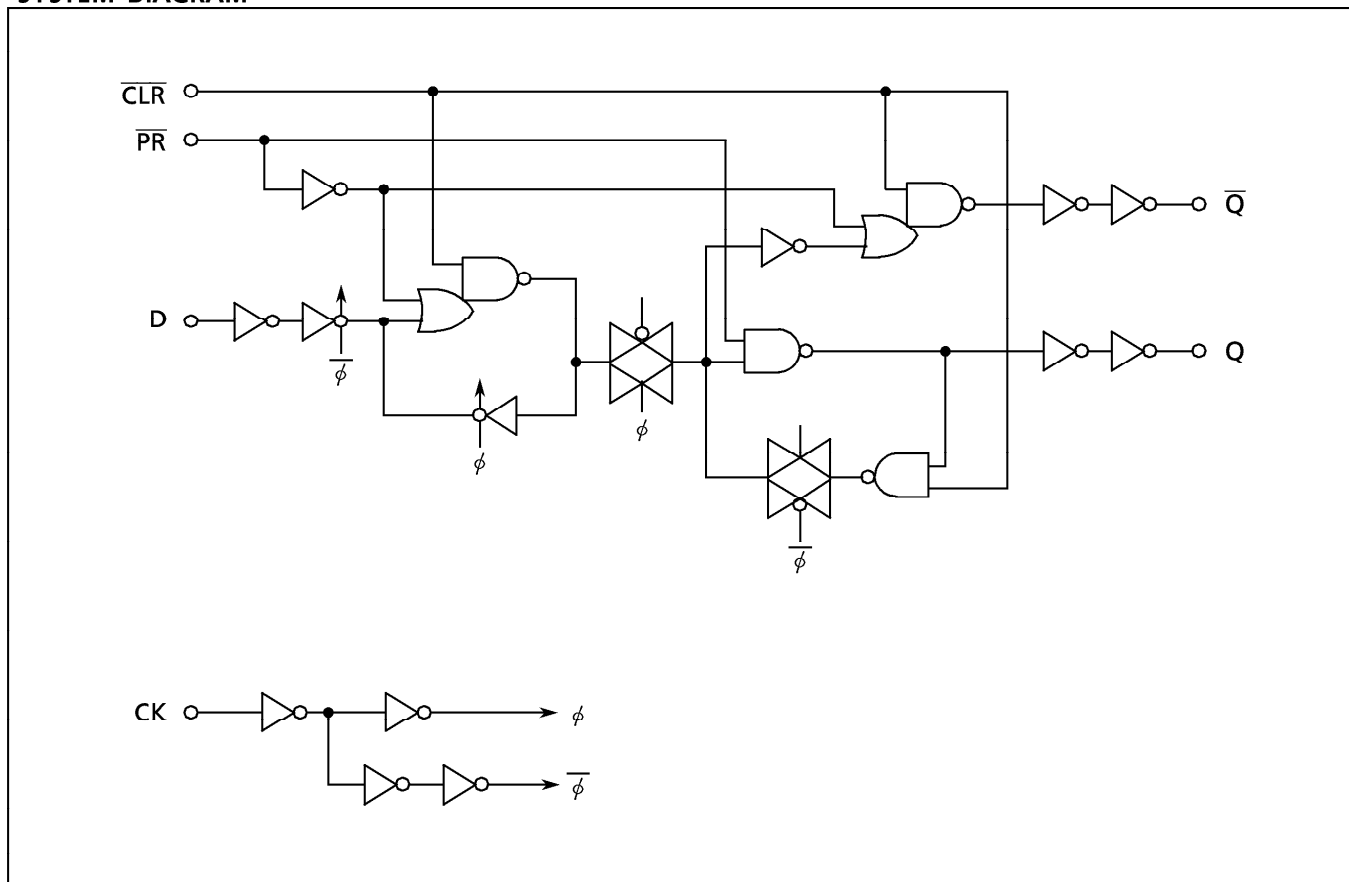
### IEC LOGIC SYMBOL



961001EBA2

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## SYSTEM DIAGRAM



961001EBA2'

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## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                    | SYMBOL    | VALUE                    | UNIT |
|------------------------------|-----------|--------------------------|------|
| Supply Voltage Range         | $V_{CC}$  | $-0.5 \sim 7$            | V    |
| DC Input Voltage             | $V_{IN}$  | $-0.5 \sim V_{CC} + 0.5$ | V    |
| DC Output Voltage            | $V_{OUT}$ | $-0.5 \sim V_{CC} + 0.5$ | V    |
| Input Diode Current          | $I_{IK}$  | $\pm 20$                 | mA   |
| Output Diode Current         | $I_{OK}$  | $\pm 20$                 | mA   |
| DC Output Current            | $I_{OUT}$ | $\pm 25$                 | mA   |
| DC $V_{CC}$ / Ground Current | $I_{CC}$  | $\pm 50$                 | mA   |
| Power Dissipation            | $P_D$     | 500 (DIP)* / 180 (SOP)   | mW   |
| Storage Temperature          | $T_{stg}$ | $-65 \sim 150$           | °C   |

\*500mW in the range of  $T_a = -40^\circ\text{C} \sim 65^\circ\text{C}$ . From  $T_a = 65^\circ\text{C}$  to  $85^\circ\text{C}$  a derating factor of  $-10\text{mW}/^\circ\text{C}$  shall be applied until 300mW.

## RECOMMENDED OPERATING CONDITIONS

| PARAMETER                | SYMBOL     | VALUE           | UNIT |
|--------------------------|------------|-----------------|------|
| Supply Voltage           | $V_{CC}$   | $4.5 \sim 5.5$  | V    |
| Input Voltage            | $V_{IN}$   | $0 \sim V_{CC}$ | V    |
| Output Voltage           | $V_{OUT}$  | $0 \sim V_{CC}$ | V    |
| Operating Temperature    | $T_{opr}$  | $-40 \sim 85$   | °C   |
| Input Rise and Fall Time | $t_r, t_f$ | $0 \sim 500$    | ns   |

## DC ELECTRICAL CHARACTERISTICS

| PARAMETER                   | SYMBOL   | TEST CONDITION                                                                            | $V_{CC}$<br>(V)                                                      | $T_a = 25^\circ\text{C}$ |      |           | $T_a = -40 \sim 85^\circ\text{C}$ |           | UNIT          |
|-----------------------------|----------|-------------------------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------|------|-----------|-----------------------------------|-----------|---------------|
|                             |          |                                                                                           |                                                                      | MIN.                     | TYP. | MAX.      | MIN.                              | MAX.      |               |
| High - Level Input Voltage  | $V_{IH}$ |                                                                                           | $4.5 \begin{smallmatrix} \text{ } \\ \text{ } \end{smallmatrix} 5.5$ | 2.0                      | —    | —         | 2.0                               | —         | V             |
| Low - Level Input Voltage   | $V_{IL}$ |                                                                                           | $4.5 \begin{smallmatrix} \text{ } \\ \text{ } \end{smallmatrix} 5.5$ | —                        | —    | 0.8       | —                                 | 0.8       | V             |
| High - Level Output Voltage | $V_{OH}$ | $V_{IN} = V_{IH} \text{ or } V_{IL}$                                                      | $I_{OH} = -20 \mu\text{A}$                                           | 4.5                      | 4.4  | 4.5       | —                                 | 4.4       | V             |
|                             |          |                                                                                           | $I_{OH} = -4 \text{ mA}$                                             | 4.5                      | 4.18 | 4.31      | —                                 | 4.13      |               |
| Low - Level Output Voltage  | $V_{OL}$ | $V_{IN} = V_{IH} \text{ or } V_{IL}$                                                      | $I_{OL} = 20 \mu\text{A}$                                            | 4.5                      | —    | 0.0       | 0.1                               | —         | V             |
|                             |          |                                                                                           | $I_{OL} = 4 \text{ mA}$                                              | 4.5                      | —    | 0.17      | 0.26                              | —         |               |
| Input Leakage Current       | $I_{IN}$ | $V_{IN} = V_{CC} \text{ or GND}$                                                          | 5.5                                                                  | —                        | —    | $\pm 0.1$ | —                                 | $\pm 1.0$ | $\mu\text{A}$ |
| Quiescent Supply Current    | $I_{CC}$ | $V_{IN} = V_{CC} \text{ or GND}$                                                          | 5.5                                                                  | —                        | —    | 2.0       | —                                 | 20.0      | mA            |
|                             | $I_C$    | PER INPUT: $V_{IN} = 0.5\text{V or } 2.4\text{V}$<br>OTHER INPUT: $V_{CC} \text{ or GND}$ | 5.5                                                                  | —                        | —    | 2.0       | —                                 | 2.9       |               |

TIMING REQUIREMENTS (Input  $t_r = t_f = 6\text{ns}$ )

| PARAMETER                         | SYMBOL     | TEST CONDITION | $V_{CC}(\text{V})$ | $T_a = 25^\circ\text{C}$ |       | $T_a = -40 \sim 85^\circ\text{C}$ | UNIT |
|-----------------------------------|------------|----------------|--------------------|--------------------------|-------|-----------------------------------|------|
|                                   |            |                |                    | TYP.                     | LIMIT | LIMIT                             |      |
| Minimum Pulse Width<br>(CK)       | $t_{W(L)}$ |                | 4.5                | —                        | 15    | 19                                | ns   |
|                                   | $t_{W(H)}$ |                | 5.5                | —                        | 14    | 16                                |      |
| Minimum Pulse Width<br>(CLR, PR)  | $t_{W(L)}$ |                | 4.5                | —                        | 15    | 19                                |      |
|                                   |            |                | 5.5                | —                        | 14    | 17                                |      |
| Minimum Set-up Time               | $t_s$      |                | 4.5                | —                        | 15    | 19                                |      |
|                                   |            |                | 5.5                | —                        | 14    | 17                                |      |
| Minimum Hold Time                 | $t_h$      |                | 4.5                | —                        | 0     | 0                                 |      |
|                                   |            |                | 5.5                | —                        | 0     | 0                                 |      |
| Minimum Removal Time<br>(CLR, PR) | $t_{rem}$  |                | 4.5                | —                        | 5     | 5                                 |      |
|                                   |            |                | 5.5                | —                        | 5     | 5                                 |      |
| Clock Frequency                   | $f$        |                | 4.5                | —                        | 27    | 22                                | MHz  |
|                                   |            |                | 5.5                | —                        | 30    | 24                                |      |

AC ELECTRICAL CHARACTERISTICS ( $C_L = 15\text{pF}$ ,  $V_{CC} = 5\text{V}$ ,  $T_a = 25^\circ\text{C}$ , Input  $t_r = t_f = 6\text{ns}$ )

| PARAMETER                                         | SYMBOL    | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|---------------------------------------------------|-----------|----------------|------|------|------|------|
| Output Transition Time                            | $t_{TLH}$ |                | —    | 6    | 12   | ns   |
|                                                   | $t_{THL}$ |                | —    | 6    | 12   |      |
| Propagation Delay Time<br>(CK—Q, $\bar{Q}$ )      | $t_{pLH}$ |                | —    | 17   | 28   |      |
|                                                   | $t_{pHL}$ |                | —    | 17   | 28   |      |
| Propagation Delay Time<br>(CLR, PR—Q, $\bar{Q}$ ) | $t_{pLH}$ |                | —    | 15   | 25   |      |
|                                                   | $t_{pHL}$ |                | —    | 15   | 25   |      |
| Maximum Clock Frequency                           | $f_{MAX}$ |                | 29   | 53   | —    | MHz  |

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

| PARAMETER                                         | SYMBOL    | TEST CONDITION | $V_{CC}(\text{V})$ | $T_a = 25^\circ\text{C}$ |      |      | $T_a = -40 \sim 85^\circ\text{C}$ |      | UNIT |
|---------------------------------------------------|-----------|----------------|--------------------|--------------------------|------|------|-----------------------------------|------|------|
|                                                   |           |                |                    | MIN.                     | TYP. | MAX. | MIN.                              | MAX. |      |
| Output Transition Time                            | $t_{TLH}$ |                | 4.5                | —                        | 8    | 15   | —                                 | 19   | ns   |
|                                                   | $t_{THL}$ |                | 5.5                | —                        | 7    | 13   | —                                 | 16   |      |
| Propagation Delay Time<br>(CK—Q, $\bar{Q}$ )      | $t_{pLH}$ |                | 4.5                | —                        | 21   | 33   | —                                 | 41   |      |
|                                                   | $t_{pHL}$ |                | 5.5                | —                        | 19   | 30   | —                                 | 37   |      |
| Propagation Delay Time<br>(CLR, PR—Q, $\bar{Q}$ ) | $t_{pLH}$ |                | 4.5                | —                        | 18   | 30   | —                                 | 38   |      |
|                                                   | $t_{pHL}$ |                | 5.5                | —                        | 15   | 27   | —                                 | 35   |      |
| Maximum Clock Frequency                           | $f_{MAX}$ |                | 4.5                | 27                       | 48   | —    | 22                                | —    | MHz  |
|                                                   |           |                | 5.5                | 30                       | 53   | —    | 24                                | —    |      |
| Input Capacitance                                 | $C_{IN}$  |                |                    | —                        | 5    | 10   | —                                 | 10   | pF   |
| Power Dissipation Capacitance                     | $C_{PD}$  | (1)            |                    | —                        | 32   | —    | —                                 | —    |      |

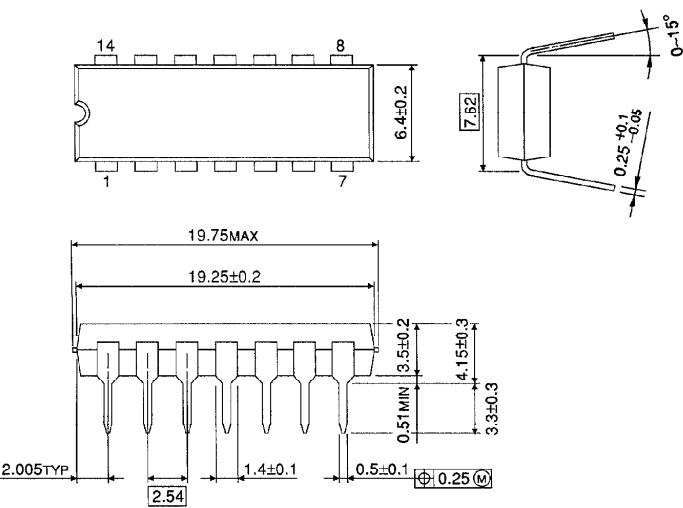
Note (1)  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2 \text{ (per F/F)}$$

DIP 14PIN OUTLINE DRAWING (DIP14-P-300-2.54)

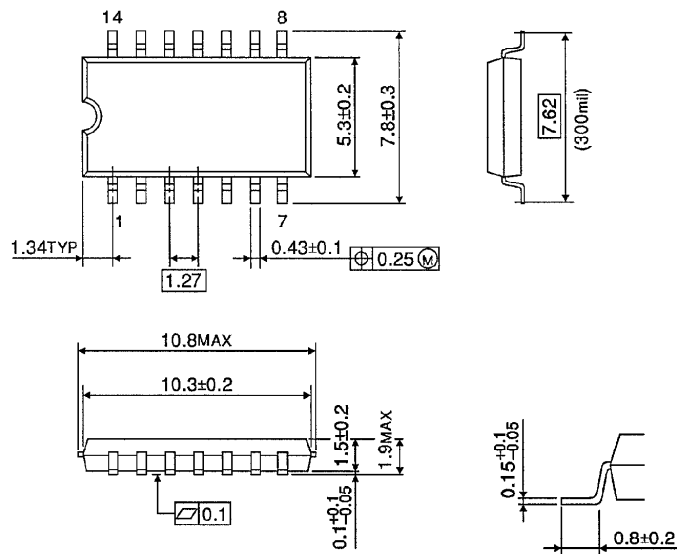
Unit in mm



Weight : 0.96g (Typ.)

SOP 14PIN (200mil BODY) OUTLINE DRAWING (SOP14-P-300-1.27)

Unit in mm

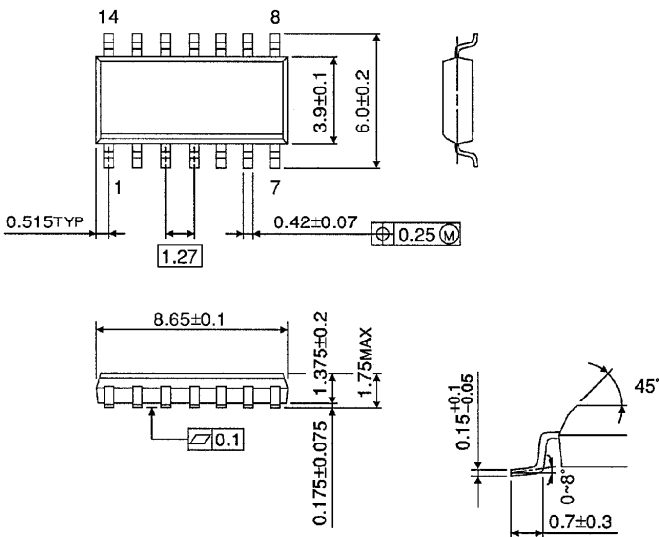


Weight : 0.18g (Typ.)

SOP 14PIN (150mil BODY) OUTLINE DRAWING (SOL14-P-150 -1.27)

Unit in mm

(Note) This package is not available in Japan.



Weight : 0.12g (Typ.)