

# **TC74VHC74F, TC74VHC74FN, TC74VHC74FS, TC74VHC74FT**

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

The TC74VHC74 is an advanced 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 Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

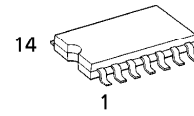
The signal level applied to the D INPUT is transferred to Q OUTPUT during the positive going transition of the CK pulse.

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

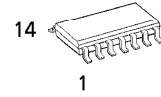
An input protection circuit ensures that 0 to 7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

### **FEATURES :**

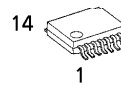
- High Speed ..... $f_{\text{MAX}} = 170\text{MHz}(\text{typ.})$   
at  $V_{\text{CC}} = 5\text{V}$
- Low Power Dissipation ..... $I_{\text{CC}} = 2\mu\text{A}(\text{Max.})$  at  $T_a = 25^\circ\text{C}$
- High Noise Immunity ..... $V_{\text{NIH}} = V_{\text{NIL}} = 28\% V_{\text{CC}} (\text{Min.})$
- Power Down Protection is provided on all inputs.
- Balanced Propagation Delays ... $t_{\text{PLH}} \approx t_{\text{PHL}}$
- Wide Operating Voltage Range... $V_{\text{CC}} (\text{opr}) = 2\text{V} \sim 5.5\text{V}$
- Pin and Function Compatible with 74ALS74



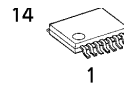
F (SOP14-P-300-1.27)  
Weight : 0.18g (TYP.)



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

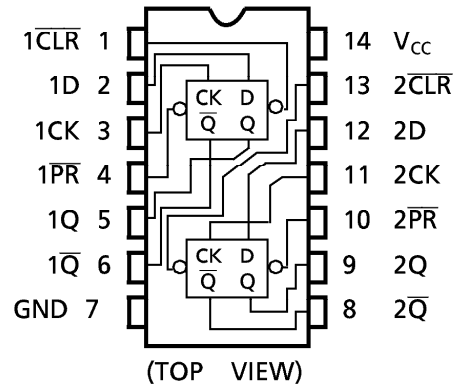


FS (SSOP14-P-225-0.65)  
Weight : 0.07g (TYP.)



FT (TSSOP14-P-0044-0.65)  
Weight : 0.06g (TYP.)

### **PIN ASSIGNMENT**

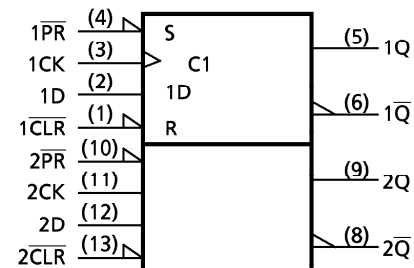


### **TRUTH TABLE**

| INPUTS                  |                        |   |              | OUTPUTS      |                         | FUNCTION  |
|-------------------------|------------------------|---|--------------|--------------|-------------------------|-----------|
| $\overline{\text{CLR}}$ | $\overline{\text{PR}}$ | D | CK           | Q            | $\overline{\text{Q}}$   |           |
| L                       | H                      | X | X            | L            | H                       | CLEAR     |
| 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

### **IEC LOGIC SYMBOL**



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## ABSOLUTE MAXIMUM RATINGS

| PARAMETER                   | SYMBOL    | VALUE                    | UNIT               |
|-----------------------------|-----------|--------------------------|--------------------|
| Supply Voltage Range        | $V_{CC}$  | $-0.5 \sim 7.0$          | V                  |
| DC Input Voltage            | $V_{IN}$  | $-0.5 \sim 7.0$          | V                  |
| DC Output Voltage           | $V_{OUT}$ | $-0.5 \sim V_{CC} + 0.5$ | V                  |
| Input Diode Current         | $I_{IK}$  | $-20$                    | 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           | $P_D$     | 180                      | mW                 |
| Storage Temperature         | $T_{stg}$ | $-65 \sim 150$           | $^{\circ}\text{C}$ |

## RECOMMENDED OPERATING CONDITIONS

| PARAMETER                | SYMBOL    | VALUE                                                                                           | UNIT               |
|--------------------------|-----------|-------------------------------------------------------------------------------------------------|--------------------|
| Supply Voltage           | $V_{CC}$  | $2.0 \sim 5.5$                                                                                  | V                  |
| Input Voltage            | $V_{IN}$  | $0 \sim 5.5$                                                                                    | V                  |
| Output Voltage           | $V_{OUT}$ | $0 \sim V_{CC}$                                                                                 | V                  |
| Operating Temperature    | $T_{opr}$ | $-40 \sim 85$                                                                                   | $^{\circ}\text{C}$ |
| Input Rise and Fall Time | $dt/dv$   | $0 \sim 100$ ( $V_{CC} = 3.3 \pm 0.3\text{V}$ )<br>$0 \sim 20$ ( $V_{CC} = 5 \pm 0.5\text{V}$ ) | ns/V               |

## 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  | $V_{IH}$ |                                      | 2.0<br>3.0~5.5             | 1.50<br>$V_{CC} \times 0.7$ | —<br>—            | —<br>—                      | 1.50<br>$V_{CC} \times 0.7$         | —<br>—                      | V             |
| Low - Level Input Voltage   | $V_{IL}$ |                                      | 2.0<br>3.0~5.5             | —<br>—                      | —<br>—            | 0.50<br>$V_{CC} \times 0.3$ | —<br>$V_{CC} \times 0.3$            | 0.50<br>$V_{CC} \times 0.3$ | V             |
| High - Level Output Voltage | $V_{OH}$ | $V_{IN} = V_{IH} \text{ or } V_{IL}$ | $I_{OH} = -50 \mu\text{A}$ | 2.0<br>3.0<br>4.5           | 1.9<br>2.9<br>4.4 | 2.0<br>3.0<br>4.5           | —<br>—<br>—                         | 1.9<br>2.9<br>4.4           | V             |
|                             |          |                                      | $I_{OH} = -4\text{mA}$     | 3.0                         | 2.58              | —                           | —                                   | 2.48                        |               |
|                             |          |                                      | $I_{OH} = -8\text{mA}$     | 4.5                         | 3.94              | —                           | —                                   | 3.80                        |               |
| Low - Level Output Voltage  | $V_{OL}$ | $V_{IN} = V_{IH} \text{ or } V_{IL}$ | $I_{OL} = 50 \mu\text{A}$  | 2.0<br>3.0<br>4.5           | —<br>—<br>—       | 0.0<br>0.0<br>0.1           | —<br>—<br>—                         | 0.1<br>0.1<br>0.1           | V             |
|                             |          |                                      | $I_{OL} = 4\text{mA}$      | 3.0                         | —                 | —                           | —                                   | 0.44                        |               |
|                             |          |                                      | $I_{OL} = 8\text{mA}$      | 4.5                         | —                 | —                           | —                                   | 0.44                        |               |
| Input Leakage Current       | $I_{IN}$ | $V_{IN} = 5.5\text{V or GND}$        | 0~5.5                      | —                           | —                 | $\pm 0.1$                   | —                                   | $\pm 1.0$                   | $\mu\text{A}$ |
| Quiescent Supply Current    | $I_{CC}$ | $V_{IN} = V_{CC} \text{ or GND}$     | 5.5                        | —                           | —                 | 2.0                         | —                                   | 20.0                        |               |

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TIMING REQUIREMENTS ( Input  $t_r = t_f = 3\text{ns}$  )

| PARAMETER                                                                    | SYMBOL           | TEST CONDITION | $V_{CC}$ (V)                   | $T_a = 25^\circ\text{C}$ | $T_a = -40 \sim 85^\circ\text{C}$ | UNIT |
|------------------------------------------------------------------------------|------------------|----------------|--------------------------------|--------------------------|-----------------------------------|------|
|                                                                              |                  |                |                                | LIMIT                    | LIMIT                             |      |
| Minimum Pulse Width<br>(CK)                                                  | $t_W$ (L)        |                | $3.3 \pm 0.3$                  | 6.0                      | 7.0                               | ns   |
|                                                                              | $t_W$ (H)        |                | $5.0 \pm 0.5$                  | 5.0                      | 5.0                               |      |
| Minimum Pulse Width<br>( $\overline{\text{CLR}}$ , $\overline{\text{PR}}$ )  | $t_W$ (L)        |                | $3.3 \pm 0.3$<br>$5.0 \pm 0.5$ | 6.0<br>5.0               | 7.0<br>5.0                        |      |
| Minimum Set - up Time                                                        | $t_s$            |                | $3.3 \pm 0.3$<br>$5.0 \pm 0.5$ | 6.0<br>5.0               | 7.0<br>5.0                        |      |
| Minimum Hold Time                                                            | $t_h$            |                | $3.3 \pm 0.3$<br>$5.0 \pm 0.5$ | 0.5<br>0.5               | 0.5<br>0.5                        |      |
| Minimum Removal Time<br>( $\overline{\text{CLR}}$ , $\overline{\text{PR}}$ ) | $t_{\text{rem}}$ |                | $3.3 \pm 0.3$<br>$5.0 \pm 0.5$ | 5.0<br>3.0               | 5.0<br>3.0                        |      |

AC ELECTRICAL CHARACTERISTICS ( Input  $t_r = t_f = 3\text{ns}$  )

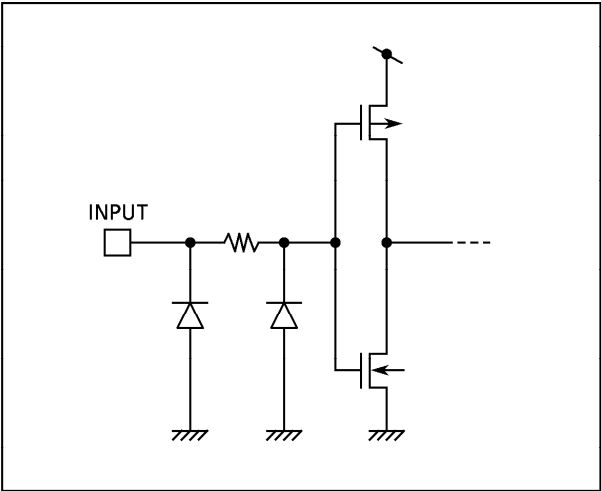
| PARAMETER                                                                                                 | SYMBOL                 | TEST CONDITION |         | $T_a = 25^\circ\text{C}$ |      |      | $T_a = -40 \sim 85^\circ\text{C}$ |      | UNIT |
|-----------------------------------------------------------------------------------------------------------|------------------------|----------------|---------|--------------------------|------|------|-----------------------------------|------|------|
|                                                                                                           |                        | $V_{CC}$ (V)   | CL (pF) | MIN.                     | TYP. | MAX. | MIN.                              | MAX. |      |
| Propagation Delay Time<br>(CK - Q, $\overline{\text{Q}}$ )                                                | $t_{pLH}$<br>$t_{pHL}$ | $3.3 \pm 0.3$  | 15      | —                        | 6.7  | 11.9 | 1.0                               | 14.0 | ns   |
|                                                                                                           |                        |                | 50      | —                        | 9.2  | 15.4 | 1.0                               | 17.5 |      |
|                                                                                                           |                        | $5.0 \pm 0.5$  | 15      | —                        | 4.6  | 7.3  | 1.0                               | 8.5  |      |
|                                                                                                           |                        |                | 50      | —                        | 6.1  | 9.3  | 1.0                               | 10.5 |      |
| Propagation Delay Time<br>( $\overline{\text{CLR}}$ , $\overline{\text{PR}}$ - Q, $\overline{\text{Q}}$ ) | $t_{pLH}$<br>$t_{pHL}$ | $3.3 \pm 0.3$  | 15      | —                        | 7.6  | 12.3 | 1.0                               | 14.5 |      |
|                                                                                                           |                        |                | 50      | —                        | 10.1 | 15.8 | 1.0                               | 18.0 |      |
|                                                                                                           |                        | $5.0 \pm 0.5$  | 15      | —                        | 4.8  | 7.7  | 1.0                               | 9.0  |      |
|                                                                                                           |                        |                | 50      | —                        | 6.3  | 9.7  | 1.0                               | 11.0 |      |
| Maximum Clock Frequency                                                                                   | $f_{\text{MAX}}$       | $3.3 \pm 0.3$  | 15      | 80                       | 125  | —    | 70                                | —    | MHZ  |
|                                                                                                           |                        |                | 50      | 50                       | 75   | —    | 45                                | —    |      |
|                                                                                                           |                        | $5.0 \pm 0.5$  | 15      | 130                      | 170  | —    | 110                               | —    |      |
|                                                                                                           |                        |                | 50      | 90                       | 115  | —    | 75                                | —    |      |
| Input Capacitance                                                                                         | $C_{IN}$               |                |         | —                        | 4    | 10   | —                                 | 10   | pF   |
| Power Dissipation Capacitance                                                                             | $C_{PD}$               | (Note 1)       |         | —                        | 25   | —    | —                                 | —    |      |

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 :

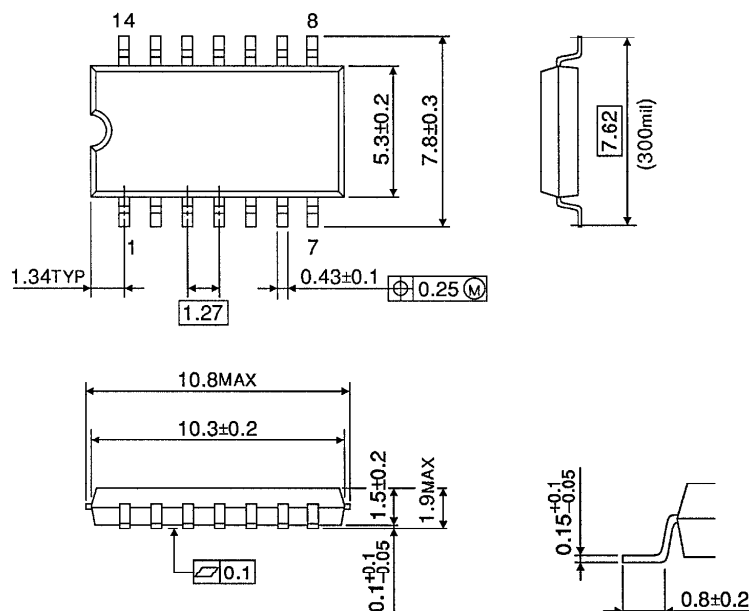
$$I_{CC(\text{opr.})} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2 \text{ (per F/F)}$$

INPUT EQUIVALENT CIRCUIT



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

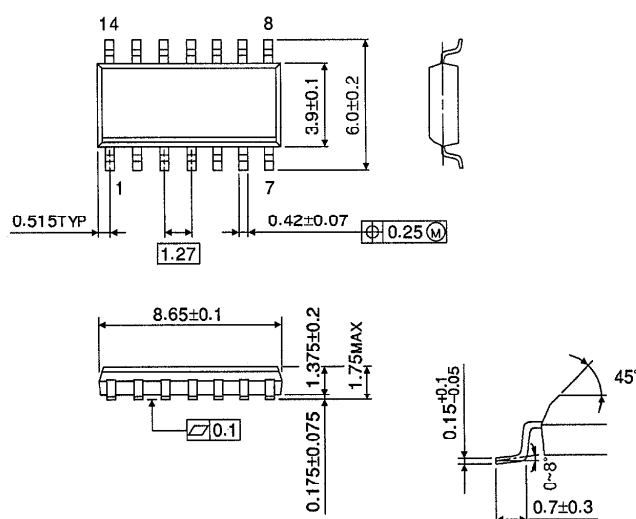
Unit in mm



Weight : 0.18g (TYP.)

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

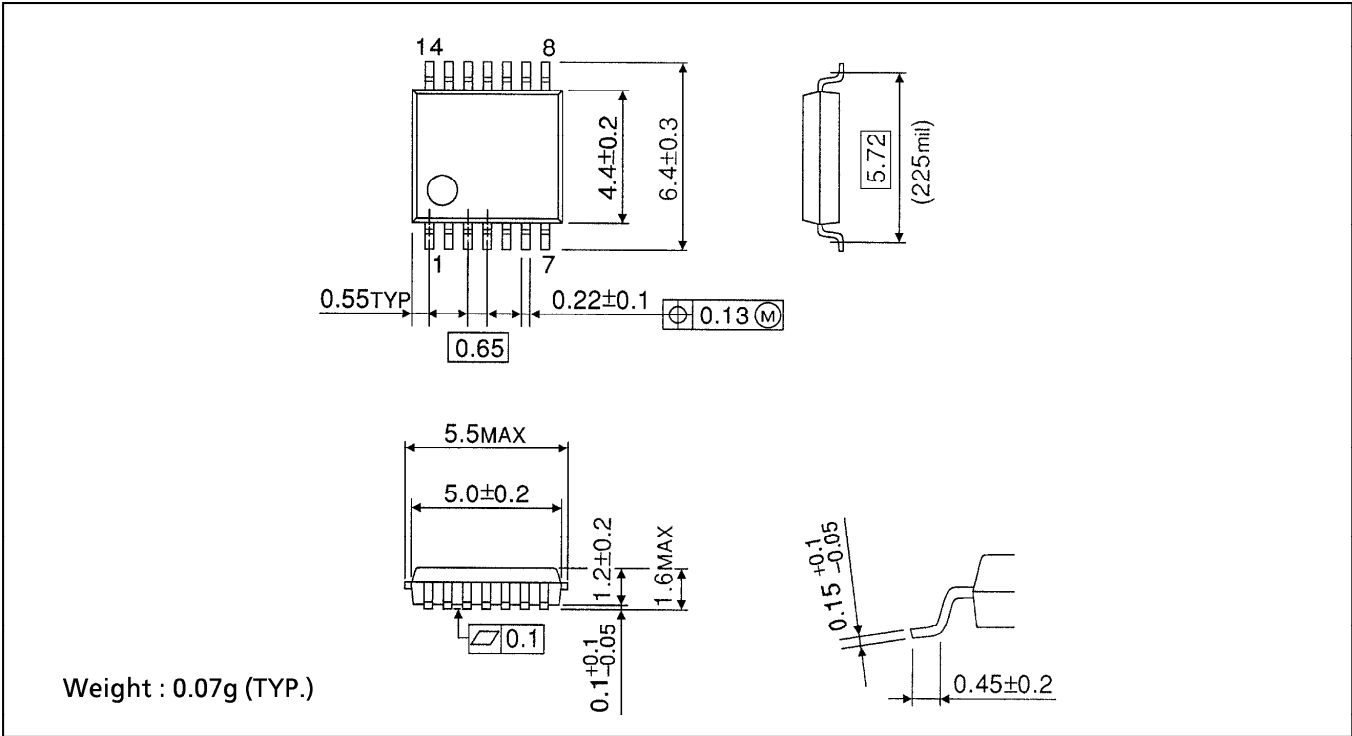
Unit in mm



Weight : 0.12g (TYP.)

SSOP 14PIN OUTLINE DRAWING (SSOP14-P-225-0.65)

Unit in mm



TSSOP 14PIN OUTLINE DRAWING (TSSOP14-P-0044-0.65)

Unit in mm

