

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

# TC7W74F, TC7W74FU, TC7W74FK

## D-TYPE FLIP FLOP WITH PRESET AND CLEAR

The TC7W74 is a high speed C<sup>2</sup>MOS 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 C<sup>2</sup>MOS low power dissipation.

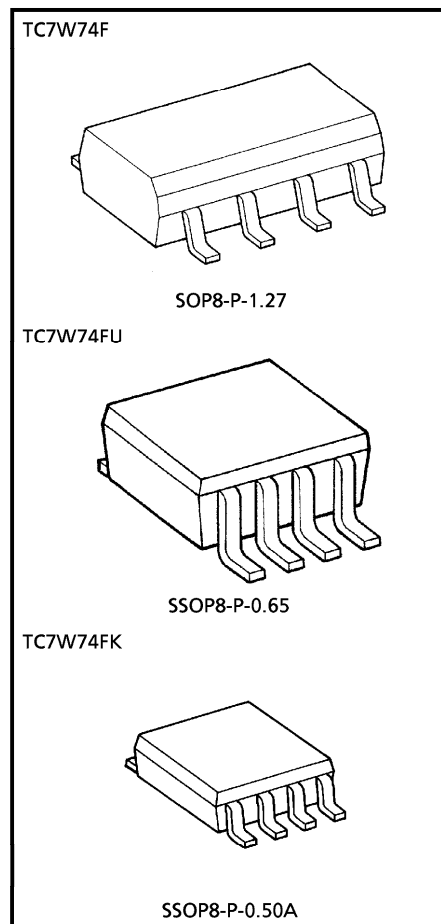
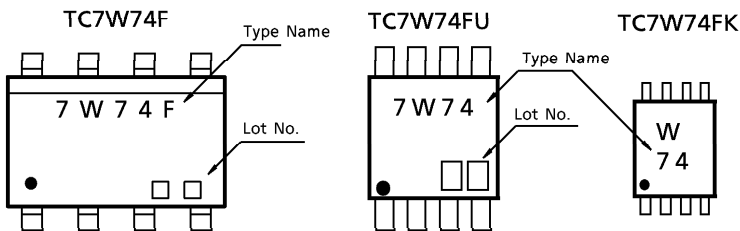
The signal level applied to the D INPUT is transferred to Q OUTPUT during the positive going transition of the CLOCK pulse CLEAR and PRESET are independent of the CLOCK and are accomplished by setting the appropriate input to an "L" level Input is equipped with protection circuits against static discharge or transient excess voltage.

Weight SOP8-P-1.27 : 0.05g (Typ.)  
 SSOP8-P-0.65 : 0.02g (Typ.)

### FEATURES

- High Speed .....  $f_{MAX} = 77\text{MHz}$  (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 .....  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (Min.)
- Output Drive Capability ..... 10 LSTTL Loads
- Symmetrical Output Impedance ...  $|I_{OH}| = I_{OL} = 4\text{mA}$  (Min.)
- Balanced Propagation Delays .....  $t_{pLH} \cong t_{pHL}$
- Wide Operating Voltage Range ...  $V_{CC}(\text{opr}) = 2 \sim 6\text{V}$

### MARKING



Weight  
 SOP8-P-1.27 : 0.05g (Typ.)  
 SSOP8-P-0.65 : 0.02g (Typ.)  
 SSOP8-P-0.50A : 0.01g (Typ.)

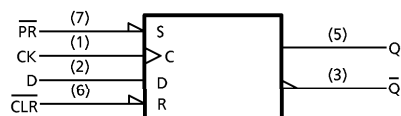
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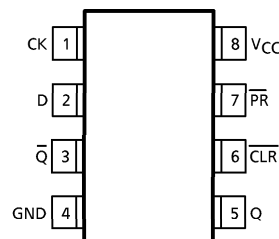
**MAXIMUM RATINGS** (Ta = 25°C)

| CHARACTERISTIC                     | SYMBOL           | RATING                    | UNIT |
|------------------------------------|------------------|---------------------------|------|
| Supply Voltage Range               | V <sub>CC</sub>  | -0.5~7                    | V    |
| DC Input Voltage                   | V <sub>IN</sub>  | -0.5~V <sub>CC</sub> +0.5 | V    |
| DC Output Voltage                  | V <sub>OUT</sub> | -0.5~V <sub>CC</sub> +0.5 | V    |
| Input Diode Current                | I <sub>IJK</sub> | ±20                       | mA   |
| Output Diode Current               | I <sub>OK</sub>  | ±20                       | mA   |
| DC Output Current                  | I <sub>OUT</sub> | ±25                       | mA   |
| DC V <sub>CC</sub> /Ground Current | I <sub>CC</sub>  | ±25                       | mA   |
| Power Dissipation                  | P <sub>D</sub>   | 300                       | mW   |
| Storage Temperature                | T <sub>stg</sub> | -65~150                   | °C   |
| Lead Temperature (10s)             | T <sub>L</sub>   | 260                       | °C   |

**LOGIC DIAGRAM**



**PIN ASSIGNMENT (TOP VIEW)**



**TRUTH TABLE**

| INPUTS |    |   |    | OUTPUTS        |                 | FUNCTION  |
|--------|----|---|----|----------------|-----------------|-----------|
| CLR    | PR | D | CK | Q              | Q̄              |           |
| L      | H  | x | x  | L              | H               | CLEAR     |
| H      | L  | x | x  | H              | L               | PRESET    |
| L      | L  | x | x  | H              | H               | —         |
| H      | H  | L | f  | L              | H               | —         |
| H      | H  | H | f  | H              | L               | —         |
| H      | H  | x | L  | Q <sub>n</sub> | Q̄ <sub>n</sub> | NO CHANGE |

x : Don't care

**RECOMMENDED OPERATING CONDITIONS**

| CHARACTERISTIC           | SYMBOL                          | RATING                          | UNIT |
|--------------------------|---------------------------------|---------------------------------|------|
| Supply Voltage           | V <sub>CC</sub>                 | 2~6                             | V    |
| Input Voltage            | V <sub>IN</sub>                 | 0~V <sub>CC</sub>               | V    |
| Output Voltage           | V <sub>OUT</sub>                | 0~V <sub>CC</sub>               | V    |
| Operating Temperature    | T <sub>opr</sub>                | -40~85                          | °C   |
| Input Rise and Fall Time | t <sub>r</sub> , t <sub>f</sub> | 0~1000 (V <sub>CC</sub> = 2.0V) | ns   |
|                          |                                 | 0~ 500 (V <sub>CC</sub> = 4.5V) |      |
|                          |                                 | 0~ 400 (V <sub>CC</sub> = 6.0V) |      |

## DC ELECTRICAL CHARACTERISTICS

| CHARACTERISTIC            | SYMBOL          | TEST CONDITION  |  | Ta = 25°C       |      |      | Ta = -40~85°C |      | UNIT |      |
|---------------------------|-----------------|---|--|-----------------|------|------|---------------|------|------|------|
|                           |                 |   |  | V <sub>CC</sub> | MIN. | TYP. | MAX.          | MIN. |      | MAX. |
| High-Level Input Voltage  | V <sub>IH</sub> | —   |  | 2.0             | 1.5  | —    | —             | 1.5  | —    | V    |
|                           |                 |   |  | 4.5             | 3.15 | —    | —             | 3.15 | —    |      |
|                           |                 |   |  | 6.0             | 4.2  | —    | —             | 4.2  | —    |      |
| Low-Level Input Voltage   | V <sub>IL</sub> | —   |  | 2.0             | —    | —    | 0.5           | —    | 0.5  | V    |
|                           |                 |   |  | 4.5             | —    | —    | 1.35          | —    | 1.35 |      |
|                           |                 |   |  | 6.0             | —    | —    | 1.8           | —    | 1.8  |      |
| High-Level Output Voltage | V <sub>OH</sub> | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub> | I <sub>OH</sub> = -20μA                          | 2.0             | 1.9  | 2.0  | —             | 1.9  | —    | V    |
|                           |                 |   |  | 4.5             | 4.4  | 4.5  | —             | 4.4  | —    |      |
|                           |                 |   |  | 6.0             | 5.9  | 6.0  | —             | 5.9  | —    |      |
| Low-Level Output Voltage  | V <sub>OL</sub> | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub> | I <sub>OL</sub> = 20μA                           | 2.0             | —    | 0.0  | 0.1           | —    | 0.1  | V    |
|                           |                 |   |  | 4.5             | —    | 0.0  | 0.1           | —    | 0.1  |      |
|                           |                 |   |  | 6.0             | —    | 0.0  | 0.1           | —    | 0.1  |      |
| Low-Level Output Voltage  | V <sub>OL</sub> | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub> | I <sub>OL</sub> = 4mA<br>I <sub>OL</sub> = 5.2mA | 4.5             | —    | 0.17 | 0.26          | —    | 0.33 | V    |
|                           |                 |   |  | 6.0             | —    | 0.18 | 0.26          | —    | 0.33 |      |
|                           |                 |   |  | 6.0             | —    | 0.18 | 0.26          | —    | 0.33 |      |
| Input Leakage Current     | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                |  | 6.0             | —    | —    | ±0.1          | —    | ±1.0 | μA   |
| Quiescent Supply Current  | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                |  | 6.0             | —    | —    | 2.0           | —    | 20.0 | μA   |

TIMING REQUIREMENTS (Input t<sub>r</sub> = t<sub>f</sub> = 6ns)

| PARAMETER                      | SYMBOL                                   | TEST CONDITION |  | Ta = 25°C       |      | Ta = -40~85°C | UNIT |       |
|--------------------------------|--|----------------|--|-----------------|------|---------------|------|-------|
|                                |  |                |  | V <sub>CC</sub> | TYP. | LIMIT         |      | LIMIT |
| Minimum Pulse Width (CLOCK)    | t <sub>W</sub> (L)<br>t <sub>W</sub> (H) | —              |  | 2.0             | —    | 75            | 95   | ns    |
|                                |  |                |  | 4.5             | —    | 15            | 19   |       |
|                                |  |                |  | 6.0             | —    | 13            | 16   |       |
| Minimum Pulse Width (CLR, PR)  | t <sub>W</sub> (L)                       | —              |  | 2.0             | —    | 75            | 95   |       |
|                                |  |                |  | 4.5             | —    | 15            | 19   |       |
|                                |  |                |  | 6.0             | —    | 13            | 16   |       |
| Minimum Set-up Time            | t <sub>s</sub>                           | —              |  | 2.0             | —    | 75            | 95   |       |
|                                |  |                |  | 4.5             | —    | 15            | 19   |       |
|                                |  |                |  | 6.0             | —    | 13            | 16   |       |
| Minimum Hold Time              | t <sub>h</sub>                           | —              |  | 2.0             | —    | 0             | 0    |       |
|                                |  |                |  | 4.5             | —    | 0             | 0    |       |
|                                |  |                |  | 6.0             | —    | 0             | 0    |       |
| Minimum Removal Time (CLR, PR) | t <sub>rem</sub>                         | —              |  | 2.0             | —    | 25            | 30   |       |
|                                |  |                |  | 4.5             | —    | 5             | 6    |       |
|                                |  |                |  | 6.0             | —    | 4             | 5    |       |
| Clock Frequency                | f  | —              |  | 2.0             | —    | 6             | 5    | MHz   |
|                                |  |                |  | 4.5             | —    | 31            | 25   |       |
|                                |  |                |  | 6.0             | —    | 36            | 29   |       |

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

| PARAMETER  | SYMBOL                 | TEST CONDITION | MIN. | TYP. | MAX. | UNIT |
|--|------------------------|----------------|------|------|------|------|
| Output Transition Time                                     | $t_{TLH}$<br>$t_{THL}$ | —              | —    | 6    | 12   | ns   |
| Propagation Delay Time (CLOCK-Q, Q)                        | $t_{pLH}$<br>$t_{pHL}$ | —              | —    | 13   | 26   |      |
| Propagation Delay Time (CLR, $\overline{\text{PR-Q}}$ , Q) | $t_{pLH}$<br>$t_{pHL}$ | —              | —    | 14   | 26   |      |
| Maximum Clock Frequency                                    | $f_{MAX}$              | —              | 36   | 77   | —    | MHz  |

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

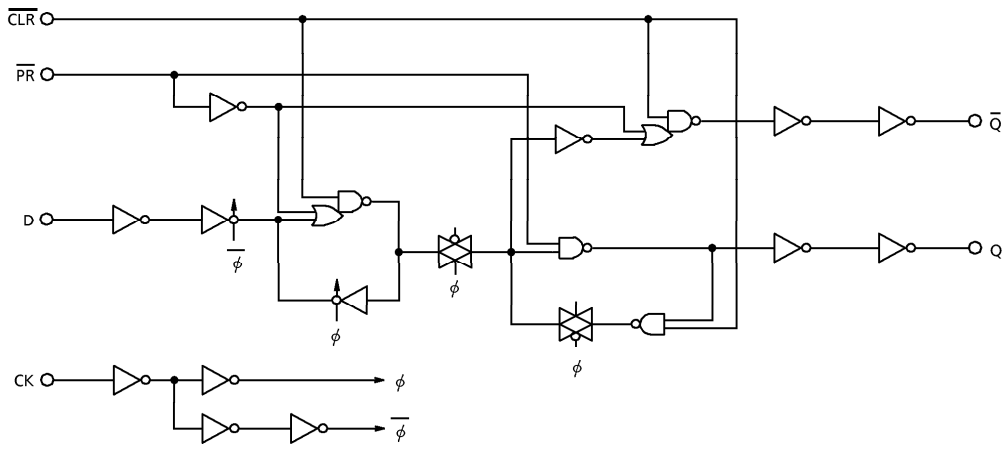
| PARAMETER  | SYMBOL                 | TEST CONDITION | $T_a = 25^\circ\text{C}$ |      |      | $T_a = -40 \sim 85^\circ\text{C}$ |      | UNIT |      |
|--|------------------------|----------------|--------------------------|------|------|-----------------------------------|------|------|------|
|  |                        |                | $V_{CC}$                 | MIN. | TYP. | MAX.                              | MIN. |      | MAX. |
| Output Transition Time   | $t_{TLH}$<br>$t_{THL}$ | —              | 2.0                      | —    | 30   | 75                                | —    | 95   | ns   |
|  |                        |                | 4.5                      | —    | 8    | 15                                | —    | 19   |      |
|  |                        |                | 6.0                      | —    | 7    | 13                                | —    | 16   |      |
| Propagation Delay Time (CLOCK-Q, $\overline{Q}$ )                        | $t_{pLH}$<br>$t_{pHL}$ | —              | 2.0                      | —    | 48   | 150                               | —    | 190  |      |
|  |                        |                | 4.5                      | —    | 16   | 30                                | —    | 38   |      |
|  |                        |                | 6.0                      | —    | 13   | 26                                | —    | 32   |      |
| Propagation Delay Time (CLR, $\overline{\text{PR-Q}}$ , $\overline{Q}$ ) | $t_{pLH}$<br>$t_{pHL}$ | —              | 2.0                      | —    | 51   | 150                               | —    | 190  |      |
|  |                        |                | 4.5                      | —    | 17   | 30                                | —    | 38   |      |
|  |                        |                | 6.0                      | —    | 15   | 26                                | —    | 32   |      |
| Maximum Clock Frequency  | $f_{MAX}$              | —              | 2.0                      | 6    | 21   | —                                 | 5    | —    | MHz  |
|  |                        |                | 4.5                      | 31   | 63   | —                                 | 25   | —    |      |
|  |                        |                | 6.0                      | 36   | 67   | —                                 | 29   | —    |      |
| Input Capacitance  | $C_{IN}$               | —              | —                        | 5    | 10   | —                                 | 10   | pF   |      |
| Power Dissipation Capacitance  | $C_{PD}$               | (Note 1)       | —                        | 34   | —    | —                                 | —    |      |      |

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

Average operating current can be obtained by the equation.

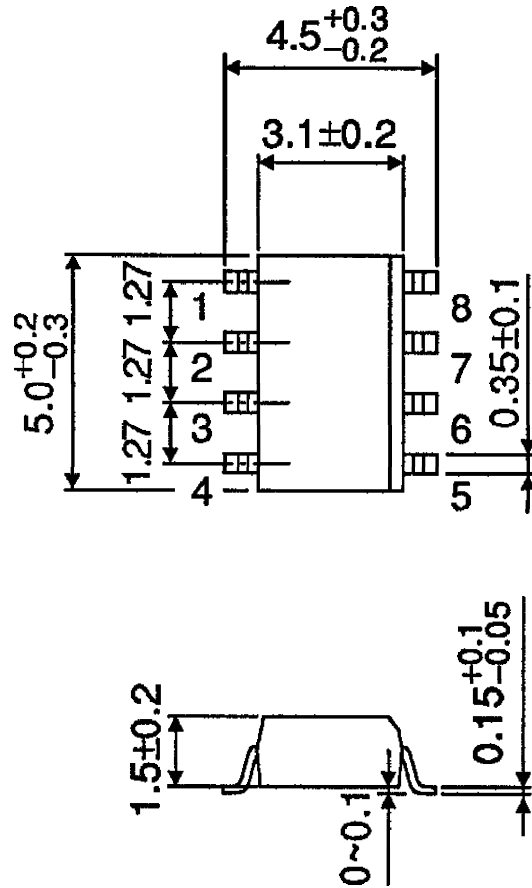
$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

SYSTEM DIAGRAM



OUTLINE DRAWING  
SOP8-P-1.27

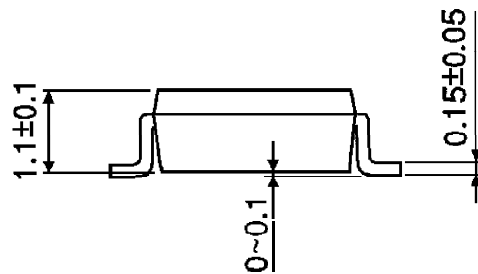
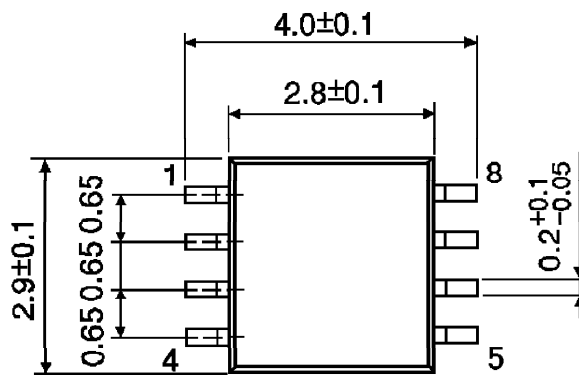
Unit : mm



Weight : 0.05g (Typ.)

**OUTLINE DRAWING**  
SSOP8-P-0.65

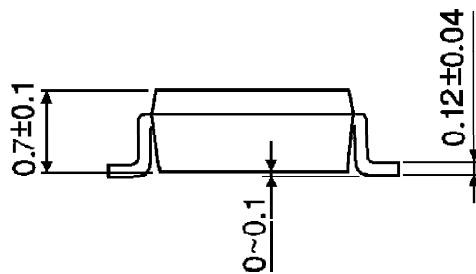
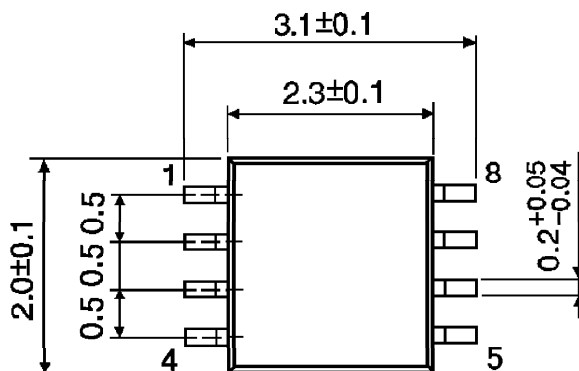
Unit : mm



Weight : 0.02g (Typ.)

OUTLINE DRAWING  
SSOP8-P-0.50A

Unit : mm



Weight : 0.01g (Typ.)