

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

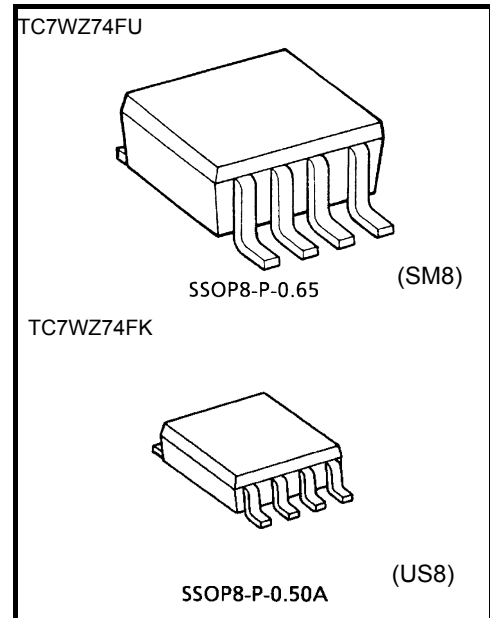
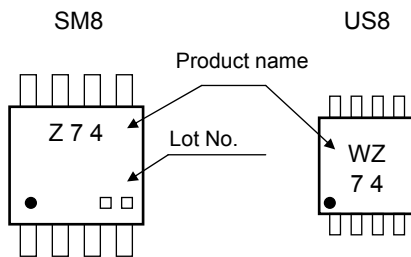
# TC7WZ74FU, TC7WZ74FK

## D-Type Flip Flop with Preset and Clear

### Features

- High output current:  $\pm 24$  mA (min) at  $V_{CC} = 3$  V
- Super high speed operation:  $t_{pd} = 2.8$  ns (typ.)  
at  $V_{CC} = 5$  V, 50 pF
- Operating voltage range:  $V_{CC(opr)} = 1.65$  to 5.5 V
- 5.5-V Tolerant inputs
- 5.5-V Power down protection outputs
- Matches the performance of TC74LCX series when operated at 3.3- V  $V_{CC}$

### Marking

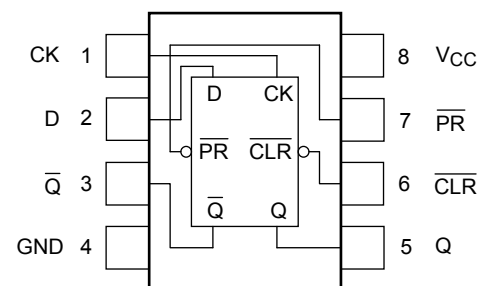


Weight  
 SSOP8-P-0.65 : 0.02 g (typ.)  
 SSOP8-P-0.50A : 0.01 g (typ.)

### Absolute Maximum Ratings (Ta = 25°C)

| Characteristics             | Symbol    | Rating                        | Unit |
|-----------------------------|-----------|-------------------------------|------|
| Supply voltage range        | $V_{CC}$  | -0.5 to 6                     | V    |
| DC input voltage            | $V_{IN}$  | -0.5 to 6                     | V    |
| DC output voltage           | $V_{OUT}$ | -0.5 to 6 (Note 1)            | V    |
|                             |           | -0.5 to $V_{CC}+0.5$ (Note 2) |      |
| Input diode current         | $I_{IK}$  | -20                           | mA   |
| Output diode current        | $I_{OK}$  | -20 (Note 3)                  | mA   |
| DC output current           | $I_{OUT}$ | $\pm 50$                      | mA   |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 50$                      | mA   |
| Power dissipation           | $P_D$     | 300 (SM8)<br>200 (US8)        | mW   |
| Storage temperature         | $T_{stg}$ | -65 to 150                    | °C   |
| Lead temperature (10s)      | $T_L$     | 260                           | °C   |

### Pin Assignment (top view)



Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/Derating Concept and Methods) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1:  $V_{CC} = 0$  V

Note 2: High or Low State. Do not exceed  $I_{OUT}$  of absolute maximum ratings.

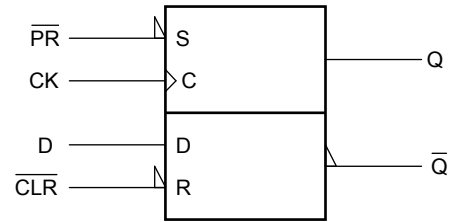
Note 3:  $V_{OUT} < GND$

## 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 | $\downarrow$ | Qn      | Qn                    | No Change |

X: Don't care

## IEC Logic Symbol



## Operating Ranges

| Characteristics          | Symbol    | Rating  | Unit |
|--------------------------|-----------|---|------|
| Supply voltage           | $V_{CC}$  | 1.65 to 5.5   | V    |
|                          |           | 1.5 to 5.5 (Note 4)   |      |
| Input voltage            | $V_{IN}$  | 0 to 5.5  | V    |
| Output voltage           | $V_{OUT}$ | 0 to 5.5 (Note 5)   | V    |
|                          |           | 0 to $V_{CC}$ (Note 6)  |      |
| Operating temperature    | $T_{opr}$ | -40 to 85   | °C   |
| Input rise and fall time | dt/dv     | 0 to 20 ( $V_{CC} = 1.80 \text{ V} \pm 0.15 \text{ V}$ ,<br>$2.5 \text{ V} \pm 0.2 \text{ V}$ ) | ns/V |
|                          |           | 0 to 10 ( $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ )  |      |
|                          |           | 0 to 5 ( $V_{CC} = 5.0 \text{ V} \pm 0.5 \text{ V}$ )   |      |

Note 4: Data retention only

Note 5:  $V_{CC} = 0 \text{ V}$

Note 6: High or low state

## Electrical Characteristics

### DC Characteristics

| Characteristics           |            | Symbol           | Test Condition  |                           | Ta = 25°C              |      |                        | Ta = -40 to 85°C       |                        | Unit |     |
|---------------------------|------------|------------------|---|---------------------------|------------------------|------|------------------------|------------------------|------------------------|------|-----|
|                           |            |                  |   |                           | V <sub>CC</sub> (V)    | Min  | Typ.                   | Max                    | Min                    |      | Max |
| Input voltage             | High level | V <sub>IH</sub>  | —   | 1.65 to 1.8               | V <sub>CC</sub> × 0.75 | —    | —                      | V <sub>CC</sub> × 0.75 | —                      | V    |     |
|                           |            |                  |   | 2.3 to 5.5                | V <sub>CC</sub> × 0.7  | —    | —                      | V <sub>CC</sub> × 0.7  | —                      |      |     |
|                           | Low level  | V <sub>IL</sub>  | —   | 1.65 to 1.8               | —                      | —    | V <sub>CC</sub> × 0.25 | —                      | V <sub>CC</sub> × 0.25 |      |     |
|                           |            |                  |   | 2.3 to 5.5                | —                      | —    | V <sub>CC</sub> × 0.3  | —                      | V <sub>CC</sub> × 0.3  |      |     |
| Output voltage            | High level | V <sub>OH</sub>  | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub> | I <sub>OH</sub> = -100 μA | 1.65                   | 1.55 | 1.65                   | —                      | 1.55                   | —    | V   |
|                           |            |                  |   |                           | 2.3                    | 2.2  | 2.3                    | —                      | 2.2                    | —    |     |
|                           |            |                  |   |                           | 3.0                    | 2.9  | 3.0                    | —                      | 2.9                    | —    |     |
|                           |            |                  |   |                           | 4.5                    | 4.4  | 4.5                    | —                      | 4.4                    | —    |     |
|                           |            |                  |   | I <sub>OH</sub> = -4 mA   | 1.65                   | 1.29 | 1.52                   | —                      | 1.29                   | —    |     |
|                           |            |                  |   |                           | 2.3                    | 1.9  | 2.15                   | —                      | 1.9                    | —    |     |
|                           |            |                  |   |                           | 3.0                    | 2.4  | 2.8                    | —                      | 2.4                    | —    |     |
|                           |            |                  |   |                           | 4.5                    | 3.8  | 4.2                    | —                      | 3.8                    | —    |     |
|                           | Low level  | V <sub>OL</sub>  | V <sub>IN</sub> = V <sub>IH</sub><br>or V <sub>IL</sub> | I <sub>OL</sub> = 100 μA  | 1.65                   | —    | 0                      | 0.1                    | —                      | 0.1  | V   |
|                           |            |                  |   |                           | 2.3                    | —    | 0                      | 0.1                    | —                      | 0.1  |     |
|                           |            |                  |   |                           | 3.0                    | —    | 0                      | 0.1                    | —                      | 0.1  |     |
|                           |            |                  |   |                           | 4.5                    | —    | 0                      | 0.1                    | —                      | 0.1  |     |
|                           |            |                  |   | I <sub>OL</sub> = 4 mA    | 1.65                   | —    | 0.08                   | 0.24                   | —                      | 0.24 |     |
|                           |            |                  |   |                           | 2.3                    | —    | 0.1                    | 0.3                    | —                      | 0.3  |     |
|                           |            |                  |   |                           | 3.0                    | —    | 0.15                   | 0.4                    | —                      | 0.4  |     |
|                           |            |                  |   |                           | 4.5                    | —    | 0.22                   | 0.55                   | —                      | 0.55 |     |
| I <sub>OL</sub> = 8 mA    | 1.65       | —                | 0.15  | 0.55                      | —                      | 0.55 |                        |                        |                        |      |     |
|                           | 2.3        | —                | 0.22  | 0.55                      | —                      | 0.55 |                        |                        |                        |      |     |
|                           | 3.0        | —                | 0.22  | 0.55                      | —                      | 0.55 |                        |                        |                        |      |     |
|                           | 4.5        | —                | 0.22  | 0.55                      | —                      | 0.55 |                        |                        |                        |      |     |
| Input leakage current     |            | I <sub>IN</sub>  | V <sub>IN</sub> = 5.5 V or GND                          | 0 to 5.5                  | —                      | —    | ±1                     | —                      | ±10                    | μA   |     |
| Power off leakage current |            | I <sub>OFF</sub> | V <sub>IN</sub> or V <sub>OUT</sub> = 5.5 V             | 0.0                       | —                      | —    | 1                      | —                      | 10                     | μA   |     |
| Quiescent supply current  |            | I <sub>CC</sub>  | V <sub>IN</sub> = 5.5 V or GND                          | 1.65 to 5.5               | —                      | —    | 1                      | —                      | 10                     | μA   |     |

## AC Characteristics (unless otherwise specified, Input: $t_r = t_f = 3$ ns)

| Characteristics  | Symbol   | Test Condition                                 | Ta = 25°C           |     |      | Ta = -40 to 85°C |     | Unit |     |
|--|--|--|---------------------|-----|------|------------------|-----|------|-----|
|  |  |  | V <sub>CC</sub> (V) | Min | Typ. | Max              | Min |      | Max |
| Maximum clock frequency  | f <sub>MAX</sub>                               | C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω | 1.80 ± 0.15         | 51  | —    | —                | 38  | —    | MHz |
|  |  |  | 2.5 ± 0.2           | 130 | —    | —                | 100 | —    |     |
|  |  |  | 3.3 ± 0.3           | 200 | —    | —                | 150 | —    |     |
|  |  |  | 5.0 ± 0.5           | 200 | —    | —                | 180 | —    |     |
| Propagation delay time<br>(CK-Q, $\bar{Q}$ )                         | t <sub>pLH</sub><br>t <sub>pHL</sub>           | C <sub>L</sub> = 15 pF, R <sub>L</sub> = 1 MΩ  | 1.80 ± 0.15         | 2.5 | 10.0 | 18.0             | 2.1 | 23.0 | ns  |
|  |  |  | 2.5 ± 0.2           | 2.0 | 4.9  | 7.5              | 1.7 | 9.0  |     |
|  |  |  | 3.3 ± 0.3           | 1.5 | 3.3  | 4.8              | 1.3 | 5.6  |     |
|  | C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω | 5.0 ± 0.5                                      | 1.0                 | 2.4 | 3.5  | 1.0              | 3.9 |      |     |
|  |  | 3.3 ± 0.3                                      | 2.0                 | 4.3 | 5.7  | 1.5              | 7.0 |      |     |
|  |  | 5.0 ± 0.5                                      | 1.5                 | 2.8 | 4.0  | 1.3              | 4.4 |      |     |
| Propagation delay time<br>( $\bar{CLR}$ , $\bar{PR}$ -Q, $\bar{Q}$ ) | t <sub>pLH</sub><br>t <sub>pHL</sub>           | C <sub>L</sub> = 15 pF, R <sub>L</sub> = 1 MΩ  | 1.80 ± 0.15         | 2.5 | 10.0 | 17.0             | 2.1 | 21.0 | ns  |
|  |  |  | 2.5 ± 0.2           | 2.0 | 5.0  | 7.3              | 1.7 | 8.8  |     |
|  |  |  | 3.3 ± 0.3           | 1.5 | 3.4  | 4.8              | 1.3 | 5.6  |     |
|  | C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω | 5.0 ± 0.5                                      | 1.5                 | 2.2 | 3.5  | 1.0              | 3.9 |      |     |
|  |  | 3.3 ± 0.3                                      | 2.0                 | 4.3 | 5.7  | 1.5              | 7.0 |      |     |
|  |  | 5.0 ± 0.5                                      | 1.0                 | 3.1 | 3.9  | 1.0              | 4.3 |      |     |
| Minimum setup time   | t <sub>s</sub>                                 | C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω | 2.5 ± 0.2           | 3.4 | —    | —                | 4.1 | —    | ns  |
|  |  |  | 3.3 ± 0.3           | 2.1 | —    | —                | 2.5 | —    |     |
|  |  |  | 5.0 ± 0.5           | 1.5 | —    | —                | 1.7 | —    |     |
| Minimum hold time  | t <sub>h</sub>                                 | C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω | 2.5 ± 0.2           | 2.4 | —    | —                | 2.9 | —    | ns  |
|  |  |  | 3.3 ± 0.3           | 1.4 | —    | —                | 1.5 | —    |     |
|  |  |  | 5.0 ± 0.5           | 1.0 | —    | —                | 1.1 | —    |     |
| Minimum pulse width<br>(CK)  | t <sub>w</sub> (L)<br>t <sub>w</sub> (H)       | C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω | 2.5 ± 0.2           | 3.0 | —    | —                | 3.6 | —    | ns  |
|  |  |  | 3.3 ± 0.3           | 3.0 | —    | —                | 3.3 | —    |     |
|  |  |  | 5.0 ± 0.5           | 3.0 | —    | —                | 3.2 | —    |     |
| Minimum pulse width<br>( $\bar{CLR}$ , $\bar{PR}$ )                  | t <sub>w</sub> (L)                             | C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω | 2.5 ± 0.2           | 3.0 | —    | —                | 3.6 | —    | ns  |
|  |  |  | 3.3 ± 0.3           | 3.0 | —    | —                | 3.3 | —    |     |
|  |  |  | 5.0 ± 0.5           | 3.0 | —    | —                | 3.2 | —    |     |
| Minimum removal time   | t <sub>rem</sub>                               | C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω | 2.5 ± 0.2           | 3.6 | —    | —                | 4.4 | —    | ns  |
|  |  |  | 3.3 ± 0.3           | 2.2 | —    | —                | 2.5 | —    |     |
|  |  |  | 5.0 ± 0.5           | 1.3 | —    | —                | 1.4 | —    |     |
| Input capacitance  | C <sub>IN</sub>                                | —  | 0 to 0.5            | —   | 3.0  | —                | —   | pF   |     |
| Output capacitance   | C <sub>OUT</sub>                               | —  | 0 to 0.5            | —   | 5.0  | —                | —   | pF   |     |
| Power dissipation<br>capacitance                                     | C <sub>PD</sub>                                | (Note 7)                                       | 3.3                 | —   | 30   | —                | —   | —    | pF  |
|  |  |  | 5.5                 | —   | 47   | —                | —   | —    |     |

Note 7: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

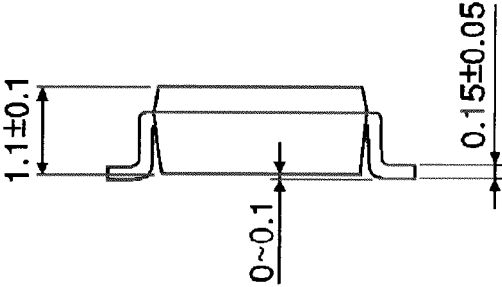
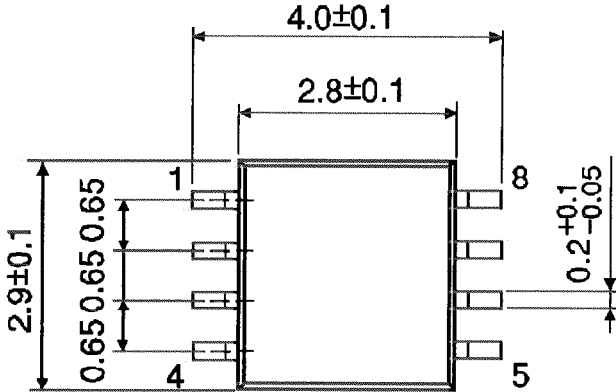
Average operating current can be obtained by the equation:

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

**Package Dimensions**

SSOP8-P-0.65

Unit : mm

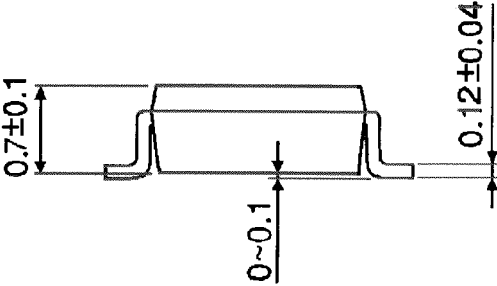
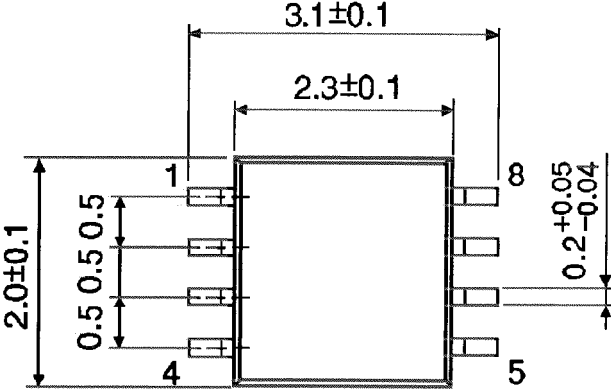


Weight: 0.02 g (typ.)

Package Dimensions

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

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