TOSHIBA CMOS Digital Integrated Circuit　Silicon Monolithic

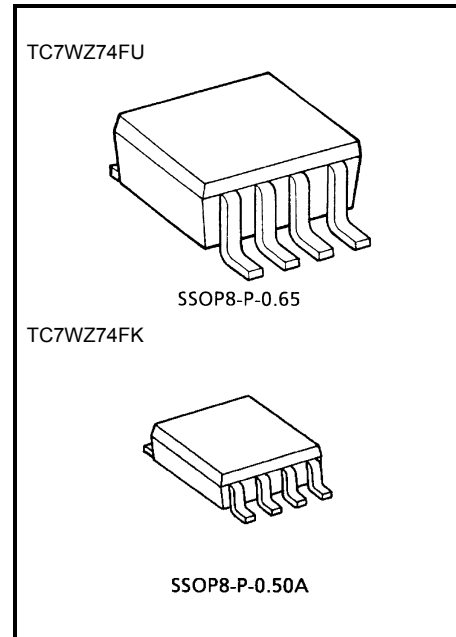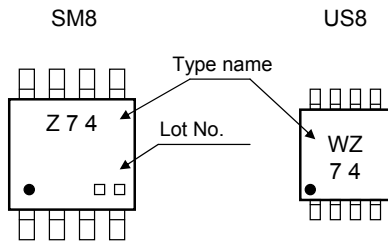# TC7WZ74FU,TC7WZ74FK

D-Type Flip Flop with Preset and Clear

## Features

- High output current: ±24 mA (min) at $V_{CC}$ = 3 V
- Propagation delay time: $t_{pd}$ = 2.8 ns (typ.) at $V_{CC}$ = 5 V, 50 pF
- Operating voltage range: $V_{CC\ (opr)}$ = 1.65~5.5 V
- 5.5-V Tolerant inputs
- 5.5-V Power down protection outputs
- Electrical characteristics when $V_{CC}$ = 3.3-V is the same as TC74LCX series

TC7WZ74FU


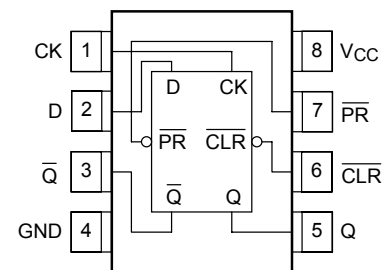
SSOP8-P-0.65

TC7WZ74FK



SSOP8-P-0.50A

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

## Marking

SM8　　　　　　　　　US8



Type name

Z 7 4

Lot No.

WZ
7 4

## Maximum Ratings (Ta = 25°C)

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

## Pin Assignment (top view)



| | | | | |
|---|---|---|---|---|
| CK | 1 | | 8 | $V_{CC}$ |
| D | 2 | | 7 | $\overline{PR}$ |
| $\overline{Q}$ | 3 | | 6 | $\overline{CLR}$ |
| GND | 4 | | 5 | Q |

(internal block labels: D, CK, $\overline{PR}$, $\overline{CLR}$, $\overline{Q}$, Q)

---

## Truth Table

| Inputs | | | | Outputs | | Function |
|---|---|---|---|---|---|---|
| $\overline{\text{CLR}}$ | $\overline{\text{PR}}$ | 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 | ↓ | Qn | $\overline{Q}$n | No Change |

X: Don't care

## Logic Diagram
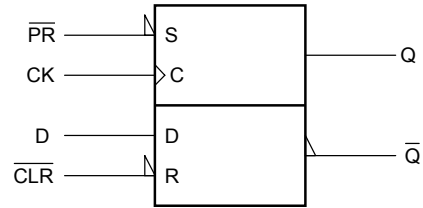


## Recommended Operating Conditions

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Supply voltage | $V_{CC}$ | 1.65~5.5 | V |
| | | 1.5~5.5 (Note 1) | |
| Input voltage | $V_{IN}$ | 0~5.5 | V |
| Output voltage | $V_{OUT}$ | 0~5.5 (Note 2) | V |
| | | 0~$V_{CC}$ (Note 3) | |
| Operating temperature | $T_{opr}$ | −40~85 | °C |
| Input rise and fall time | dt/dv | 0~20 ($V_{CC}$ = 1.8 V ± 0.15 V, 2.5 V ± 0.2 V) | ns/V |
| | | 0~10 ($V_{CC}$ = 3.3 V ± 0.3 V) | |
| | | 0~5 ($V_{CC}$ = 5.5 V ± 0.5 V) | |

Note 1: Data retention only

Note 2: $V_{CC}$ = 0 V

Note 3: High or low state

## Electrical Characteristics

## DC Characteristics

| Characteristics | | Symbol | Test Condition | | $V_{CC}$ (V) | Ta = 25°C | | | Ta = −40~85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Min | Typ. | Max | Min | Max | |
| Input voltage | High level | $V_{IH}$ | — | | 1.65~1.8 | $0.75 \times V_{CC}$ | — | — | $0.75 \times V_{CC}$ | — | V |
| | | | | | 2.3~5.5 | $0.7 \times V_{CC}$ | — | — | $0.7 \times V_{CC}$ | — | |
| | Low level | $V_{IL}$ | — | | 1.65~1.8 | — | — | $0.25 \times V_{CC}$ | — | $0.25 \times V_{CC}$ | |
| | | | | | 2.3~5.5 | — | — | $0.3 \times V_{CC}$ | — | $0.3 \times V_{CC}$ | |
| Output voltage | High level | $V_{OH}$ | $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OH} = -100\ \mu A$ | 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 | — | |
| | | | | $I_{OH} = -4\ mA$ | 1.65 | 1.29 | 1.52 | — | 1.29 | — | |
| | | | | $I_{OH} = -8\ mA$ | 2.3 | 1.9 | 2.15 | — | 1.9 | — | |
| | | | | $I_{OH} = -16\ mA$ | 3.0 | 2.4 | 2.8 | — | 2.4 | — | |
| | | | | $I_{OH} = -24\ mA$ | 3.0 | 2.3 | 2.68 | — | 2.3 | — | |
| | | | | $I_{OH} = -32\ mA$ | 4.5 | 3.8 | 4.2 | — | 3.8 | — | |
| | Low level | $V_{OL}$ | $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OL} = 100\ \mu A$ | 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 | |
| | | | | $I_{OL} = 4\ mA$ | 1.65 | — | 0.08 | 0.24 | — | 0.24 | |
| | | | | $I_{OL} = 8\ mA$ | 2.3 | — | 0.1 | 0.3 | — | 0.3 | |
| | | | | $I_{OL} = 16\ mA$ | 3.0 | — | 0.15 | 0.4 | — | 0.4 | |
| | | | | $I_{OL} = 24\ mA$ | 3.0 | — | 0.22 | 0.55 | — | 0.55 | |
| | | | | $I_{OL} = 32\ mA$ | 4.5 | — | 0.22 | 0.55 | — | 0.55 | |
| Input leakage current | | $I_{IN}$ | $V_{IN}$ = 5.5 V or GND | | 0~5.5 | — | — | ±1 | — | ±10 | μA |
| Power off leakage current | | $I_{OFF}$ | $V_{IN}$ or $V_{OUT}$ = 5.5 V | | 0.0 | — | — | 1 | — | 10 | μA |
| Quiescent supply current | | $I_{CC}$ | $V_{IN}$ = 5.5 V or GND | | 1.65~5.5 | — | — | 1 | — | 10 | μA |

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

| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | Ta = 25°C Min | Ta = 25°C Typ. | Ta = 25°C Max | Ta = −40~85°C Min | Ta = −40~85°C Max | Unit |
|---|---|---|---|---|---|---|---|---|---|
| Maximum clock frequency | $f_{MAX}$ | $C_L = 50$ pF, $R_L = 500\ \Omega$ | $1.8 \pm 0.15$ | 51 | — | — | 38 | — | MHz |
| | | | $2.5 \pm 0.2$ | 130 | — | — | 100 | — | |
| | | | $3.3 \pm 0.3$ | 200 | — | — | 150 | — | |
| | | | $5.0 \pm 0.5$ | 200 | — | — | 180 | — | |
| Propagation delay time (CK-Q, $\overline{Q}$) | $t_{pLH}$ $t_{pHL}$ | $C_L = 15$ pF, $R_L = 1$ MΩ | $1.8 \pm 0.15$ | 2.5 | 10.0 | 18.0 | 2.1 | 23.0 | ns |
| | | | $2.5 \pm 0.2$ | 2.0 | 4.9 | 7.5 | 1.7 | 9.0 | |
| | | | $3.3 \pm 0.3$ | 1.5 | 3.3 | 4.8 | 1.3 | 5.6 | |
| | | | $5.0 \pm 0.5$ | 1.0 | 2.4 | 3.5 | 1.0 | 3.9 | |
| | | $C_L = 50$ pF, $R_L = 500\ \Omega$ | $3.3 \pm 0.3$ | 2.0 | 4.3 | 5.7 | 1.5 | 7.0 | |
| | | | $5.0 \pm 0.5$ | 1.5 | 2.8 | 4.0 | 1.3 | 4.4 | |
| Propagation delay time ($\overline{CLR}$, $\overline{PR}$ -Q, $\overline{Q}$) | $t_{pLH}$ $t_{pHL}$ | $C_L = 15$ pF, $R_L = 1$ MΩ | $1.8 \pm 0.15$ | 2.5 | 10.0 | 17.0 | 2.1 | 21.0 | ns |
| | | | $2.5 \pm 0.2$ | 2.0 | 5.0 | 7.3 | 1.7 | 8.8 | |
| | | | $3.3 \pm 0.3$ | 1.5 | 3.4 | 4.8 | 1.3 | 5.6 | |
| | | | $5.0 \pm 0.5$ | 1.5 | 2.2 | 3.5 | 1.0 | 3.9 | |
| | | $C_L = 50$ pF, $R_L = 500\ \Omega$ | $3.3 \pm 0.3$ | 2.0 | 4.3 | 5.7 | 1.5 | 7.0 | |
| | | | $5.0 \pm 0.5$ | 1.0 | 3.1 | 3.9 | 1.0 | 4.3 | |
| Minimum setup time | $t_s$ | $C_L = 50$ pF, $R_L = 500\ \Omega$ | $2.5 \pm 0.2$ | 3.4 | — | — | 4.1 | — | ns |
| | | | $3.3 \pm 0.3$ | 2.1 | — | — | 2.5 | — | |
| | | | $5.0 \pm 0.5$ | 1.5 | — | — | 1.7 | — | |
| Minimum hold time | $t_h$ | $C_L = 50$ pF, $R_L = 500\ \Omega$ | $2.5 \pm 0.2$ | 2.4 | — | — | 2.9 | — | ns |
| | | | $3.3 \pm 0.3$ | 1.4 | — | — | 1.5 | — | |
| | | | $5.0 \pm 0.5$ | 1.0 | — | — | 1.1 | — | |
| Minimum pulse width (CK) | $t_W$ (L) $t_W$ (H) | $C_L = 50$ pF, $R_L = 500\ \Omega$ | $2.5 \pm 0.2$ | 3.0 | — | — | 3.6 | — | ns |
| | | | $3.3 \pm 0.3$ | 3.0 | — | — | 3.3 | — | |
| | | | $5.0 \pm 0.5$ | 3.0 | — | — | 3.2 | — | |
| Minimum pulse width ($\overline{CLR}$, $\overline{PR}$) | $t_W$ (L) | $C_L = 50$ pF, $R_L = 500\ \Omega$ | $2.5 \pm 0.2$ | 3.0 | — | — | 3.6 | — | ns |
| | | | $3.3 \pm 0.3$ | 3.0 | — | — | 3.3 | — | |
| | | | $5.0 \pm 0.5$ | 3.0 | — | — | 3.2 | — | |
| Minimum removal time | $t_{rem}$ | $C_L = 50$ pF, $R_L = 500\ \Omega$ | $2.5 \pm 0.2$ | 3.6 | — | — | 4.4 | — | ns |
| | | | $3.3 \pm 0.3$ | 2.2 | — | — | 2.5 | — | |
| | | | $5.0 \pm 0.5$ | 1.3 | — | — | 1.4 | — | |
| Input capacitance | $C_{IN}$ | — | 0~0.5 | — | 3.0 | — | — | — | pF |
| Output capacitance | $C_{OUT}$ | — | 0~0.5 | — | 5.0 | — | — | — | pF |
| Power dissipation capacitance | $C_{PD}$ | (Note 4) | 3.3 | — | 30 | — | — | — | pF |
| | | | 5.5 | — | 47 | — | — | — | |

Note 4:   $C_{PD}$ is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.
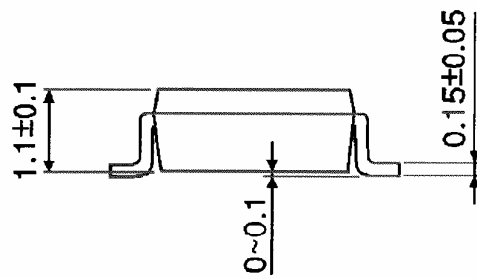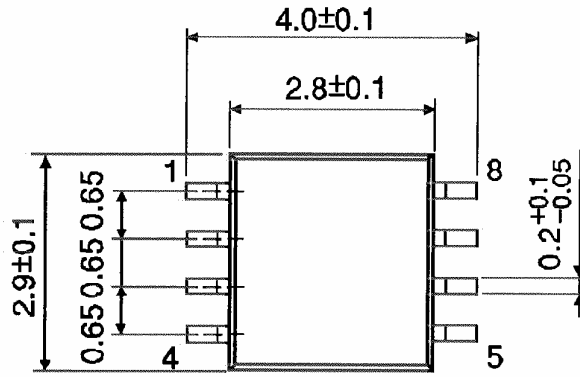Average operating current can be obtained by the equation:
$I_{CC\ (opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

**Package Dimensions**

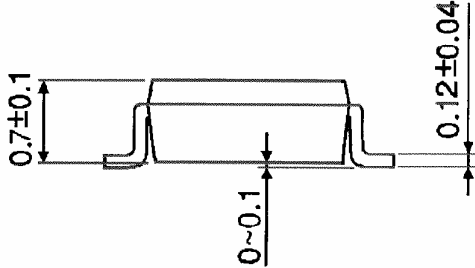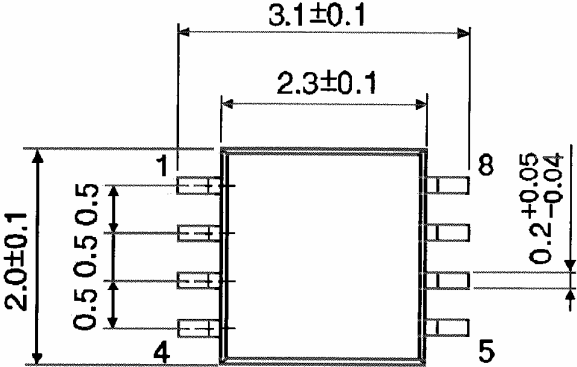SSOP8-P-0.65                                                    Unit : mm



Weight: 0.02 g (typ.)

## Package Dimensions

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

## RESTRICTIONS ON PRODUCT USE

030619EBA

The information contained herein is subject to change without notice.

The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of TOSHIBA or others.

TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..

The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.

The products described in this document are subject to the foreign exchange and foreign trade laws.

TOSHIBA products should not be embedded to the downstream products which are prohibited to be produced and sold, under any law and regulations.