

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

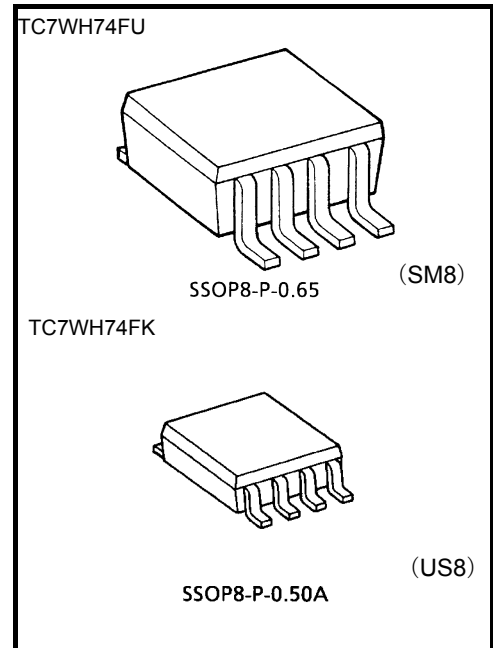
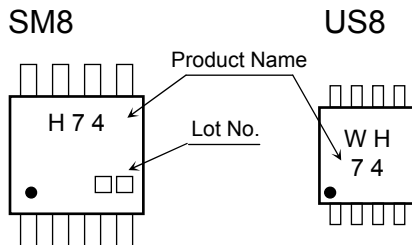
TC7WH74FU, TC7WH74FK

D-Type flip flop with preset and clear

Features

- High speed: $f_{MAX} = 170$ MHz (typ.) at $V_{CC} = 5V$
- Low power dissipation: $I_{CC} = 2\mu A$ (max) at $T_a = 25^\circ C$
- High noise immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (min)
- 5.5-V tolerant inputs
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC} = 2$ to $5.5V$

Marking

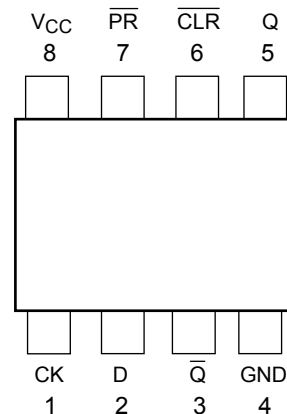


Weight
 SSOP8-P-0.65: 0.02 g (typ.)
 SSOP8-P-0.50A: 0.01 g (typ.)

Absolute Maximum Ratings (Ta = 25°C)

| Characteristics | Symbol | Rating | Unit |
|-----------------------------|-----------|------------------------|------------|
| Supply voltage | V_{CC} | -0.5 to 7.0 | V |
| DC input voltage | V_{IN} | -0.5 to 7.0 | V |
| DC output voltage | V_{OUT} | -0.5 to $V_{CC} + 0.5$ | V |
| Input diode current | I_{IK} | -20 | mA |
| Output diode current | I_{OK} | ± 20 (Note 1) | mA |
| DC output current | I_{OUT} | ± 25 | mA |
| DC V_{CC} /ground current | I_{CC} | ± 50 | mA |
| Power dissipation | P_D | 300 (SM8) | mW |
| | | 200 (US8) | |
| Storage temperature | T_{stg} | -65 to 150 | $^\circ C$ |
| Lead temperature (10 s) | T_L | 260 | $^\circ C$ |

Pin Assignment (top view)

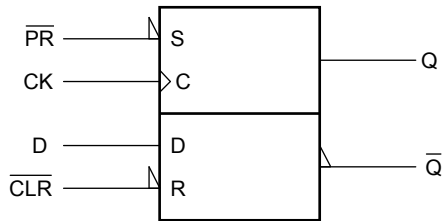


Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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: $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

IEC Logic Symbol



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 | ↑ | L | H | — |
| H | H | H | ↑ | H | L | — |
| H | H | X | ↓ | Q n | Q̄ n | No Change |

X: Don't care

Operating Range

| Characteristics | Symbol | Rating | Unit |
|--------------------------|-----------|--------------------------------------|------|
| Supply voltage | V_{CC} | 2.0 to 5.5 | V |
| Input voltage | V_{IN} | 0 to 5.5 | V |
| Output voltage | V_{OUT} | 0 to V_{CC} | V |
| Operating temperature | T_{opr} | -40 to 85 | °C |
| Input rise and fall time | dt/dv | 0 to 100 ($V_{CC} = 3.3 \pm 0.3$ V) | ns/V |
| | | 0 to 20 ($V_{CC} = 5.0 \pm 0.5$ V) | |

Electrical Characteristics

DC Characteristics

| Characteristics | Symbol | Test Condition | Ta = 25°C | | | Ta = -40 to 85°C | | Unit | | |
|---------------------------|-----------------|--|--------------------------|-----------------------|------|-----------------------|-----------------------|-----------------------|------|---|
| | | | V _{CC} (V) | Min | Typ. | Max | Min | | Max | |
| High-level input voltage | V _{IH} | — | 2.0 | 1.5 | — | — | 1.5 | — | V | |
| | | | 3.0 to 5.5 | V _{CC} × 0.7 | — | — | V _{CC} × 0.7 | — | | |
| Low-level input voltage | V _{IL} | — | 2.0 | — | — | 0.5 | — | 0.5 | V | |
| | | | 3.0 to 5.5 | — | — | V _{CC} × 0.3 | — | V _{CC} × 0.3 | | |
| High-level output voltage | V _{OH} | V _{IN} = V _{IH} or V _{IL} | I _{OH} = -50 μA | 2.0 | 1.9 | 2.0 | — | 1.9 | — | V |
| | | | | 3.0 | 2.9 | 3.0 | — | 2.9 | — | |
| | | | I _{OH} = -4 mA | 4.5 | 4.4 | 4.5 | — | 4.4 | — | |
| | | | | 3.0 | 2.58 | — | — | 2.48 | — | |
| Low-level output voltage | V _{OL} | V _{IN} = V _{IH} or V _{IL} | I _{OL} = 50 μA | 2.0 | — | 0.0 | 0.1 | — | 0.1 | V |
| | | | | 3.0 | — | 0.0 | 0.1 | — | 0.1 | |
| | | | I _{OL} = 4 mA | 4.5 | — | 0.0 | 0.1 | — | 0.1 | |
| | | | | 3.0 | — | — | 0.36 | — | 0.44 | |
| I _{OL} = 8 mA | 4.5 | — | — | 0.36 | — | 0.44 | | | | |
| | 3.0 | — | — | 0.36 | — | 0.44 | | | | |
| Input leakage current | I _{IN} | V _{IN} = 5.5 V or GND | 0 to 5.5 | — | — | ±0.1 | — | ±1.0 | μA | |
| Quiescent supply current | I _{CC} | V _{IN} = V _{CC} or GND | 5.5 | — | — | 2.0 | — | 20.0 | μA | |

TIMING REQUIREMENTS (unless otherwise specified, Input: t_r = t_f = 3 ns)

| Characteristics | Symbol | Test Condition | Ta = 25°C | | Ta = -40 to 85°C | | Unit |
|--|--|----------------|---------------------|-------|------------------|----|------|
| | | | V _{CC} (V) | Limit | Limit | | |
| Minimum pulse width (CK) | t _W (L) t _W (H) | — | 3.3 ± 0.3 | 6.0 | 7.0 | ns | |
| | | | 5.0 ± 0.5 | 5.0 | 5.0 | | |
| Minimum pulse width ($\overline{\text{CLR}}$, $\overline{\text{PR}}$) | t _W (L) | — | 3.3 ± 0.3 | 6.0 | 7.0 | ns | |
| | | | 5.0 ± 0.5 | 5.0 | 5.0 | | |
| Minimum setup time | t _s | — | 3.3 ± 0.3 | 6.0 | 7.0 | ns | |
| | | | 5.0 ± 0.5 | 5.0 | 5.0 | | |
| Minimum hold time | t _h | — | 3.3 ± 0.3 | 0.5 | 0.5 | ns | |
| | | | 5.0 ± 0.5 | 0.5 | 0.5 | | |
| Minimum removal time ($\overline{\text{CLR}}$, $\overline{\text{PR}}$) | t _{rem} | — | 3.3 ± 0.3 | 5.0 | 5.0 | ns | |
| | | | 5.0 ± 0.5 | 3.0 | 3.0 | | |

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

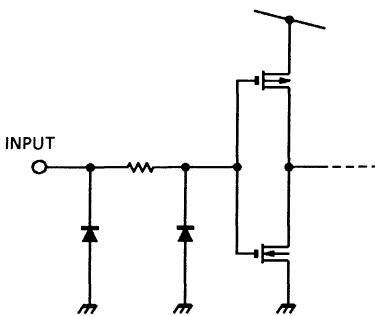
| Characteristics | Symbol | Test Condition | Ta = 25°C | | | Ta = -40~85°C | | Unit | | |
|--|------------------|----------------|---------------------|---------------------|-----|---------------|------|------|------|-----|
| | | | V _{CC} (V) | C _L (pF) | Min | Typ. | Max | | Min | Max |
| Propagation delay time (CK-Q, \bar{Q}) | t _{pLH} | | 3.3 ± 0.3 | 15 | — | 6.7 | 11.9 | 1.0 | 14.0 | ns |
| | | | | 50 | — | 9.2 | 15.4 | 1.0 | 17.5 | |
| | 5.0 ± 0.5 | | 15 | — | 4.6 | 7.3 | 1.0 | 8.5 | | |
| | | | 50 | — | 6.1 | 9.3 | 1.0 | 10.5 | | |
| Propagation delay time (\bar{CLR} , \bar{PR} -Q, \bar{Q}) | t _{pLH} | | 3.3 ± 0.3 | 15 | — | 7.6 | 12.3 | 1.0 | 14.5 | ns |
| | | | | 50 | — | 10.1 | 15.8 | 1.0 | 18.0 | |
| | 5.0 ± 0.5 | | 15 | — | 4.8 | 7.7 | 1.0 | 9.0 | | |
| | | | 50 | — | 6.3 | 9.7 | 1.0 | 11.0 | | |
| Maximum clock frequency | f _{MAX} | | 3.3 ± 0.3 | 15 | 80 | 125 | — | 70 | — | MHz |
| | | | | 50 | 50 | 75 | — | 45 | — | |
| | | | 5.0 ± 0.5 | 15 | 130 | 170 | — | 110 | — | |
| | | | | 50 | 90 | 115 | — | 75 | — | |
| Input capacitance | C _{IN} | | | — | 4 | 10 | — | 10 | pF | |
| Power dissipation capacitance | C _{PD} | (Note 2) | | | — | 22 | — | — | — | pF |

Note 2: 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:

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

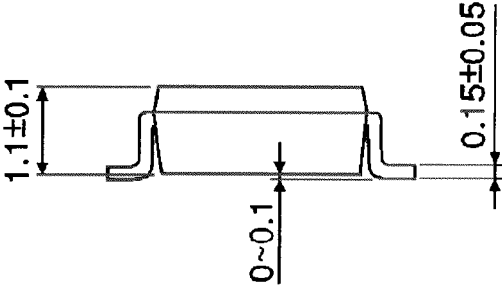
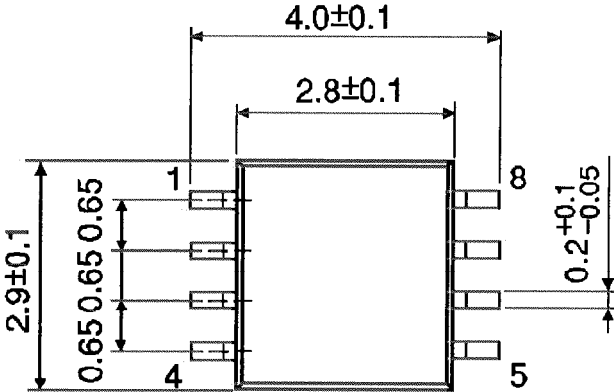
Input Equivalent Circuit



Package Dimensions

SSOP8-P-0.65

Unit : mm

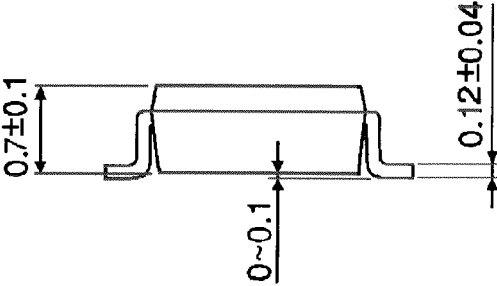
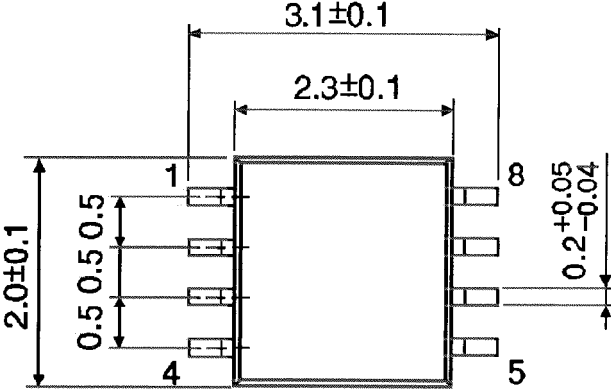


Mass: 0.02 g (typ.)

Package Dimensions

SSOP8-P-0.50A

Unit : mm



Mass: 0.01 g (typ.)

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