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TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7WH34FU,TC7WH34FK

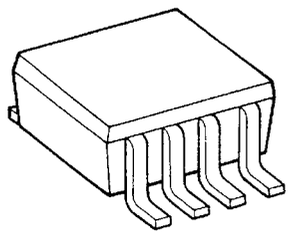
Triple Non-Inverter

The TC7WH34 is an advanced high speed CMOS Non-Inverter fabricated with silicon gate CMOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. The internal circuit is composed of 3 stages including buffer output, which provide high noise immunity and stable output. An input protection circuit ensures that 0 to 7 V can be applied to the input pins without regard to the supply voltage.

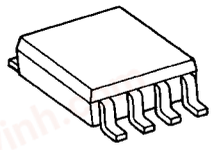
This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

TC7WH34FU



SSOP8-P-0.65

TC7WH34FK



SSOP8-P-0.50A

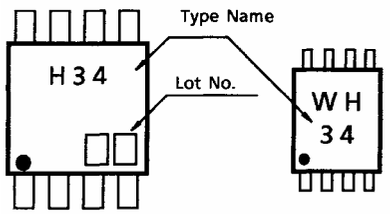
Weight
SSOP8-P-0.65: 0.02 g (typ.)
SSOP8-P-0.50A: 0.01 g (typ.)

## Features

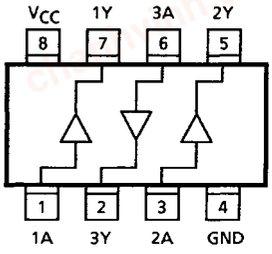
- High speed: $t_{pd}$ = 3.8 ns (typ.) at $V_{CC}$ = 5 V
- Low power dissipation: $I_{CC}$ = 2 μA (max) at Ta = 25°C
- High noise immunity: $V_{NIH} = V_{NIL}$ = 28% $V_{CC}$ (min)
- 5.5-V Tolerant inputs.
- Balanced propagation delays: $t_{pLH} \simeq t_{pHL}$
- Wide operating voltage range: $V_{CC}$ (opr) = 2~5.5 V

## Marking

**SM8** **US8**



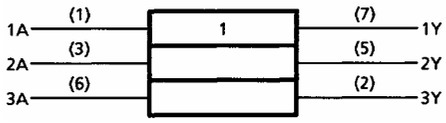

## Pin Assignment (top view)



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## Logic Diagram




## Truth Table

| A | Y |
|---|---|
| L | L |
| H | H |

## Maximum Ratings (Ta = 25°C)

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Supply voltage range | $V_{CC}$ | −0.5~7.0 | V |
| DC input voltage | $V_{IN}$ | −0.5~7.0 | V |
| DC output voltage | $V_{OUT}$ | −0.5~$V_{CC}$ + 0.5 | V |
| Input diode current | $I_{IK}$ | −20 | mA |
| Output diode current | $I_{OK}$ | ±20 | 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 | $T_{stg}$ | −65~150 | °C |
| Lead temperature (10 s) | $T_L$ | 260 | °C |

## Recommended Operating Conditions

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Supply voltage | $V_{CC}$ | 2.0~5.5 | V |
| Input voltage | $V_{IN}$ | 0~5.5 | V |
| Output voltage | $V_{OUT}$ | 0~$V_{CC}$ | V |
| Operating temperature | $T_{opr}$ | −40~85 | °C |
| Input rise and fall time | dt/dv | 0~100 ($V_{CC}$ = 3.3 ± 0.3 V) | ns/V |
| | | 0~20 ($V_{CC}$ = 5 ± 0.5 V) | |

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## Electrical Characteristics

### DC Characteristics

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| High-level input voltage | $V_{IH}$ | — | | 2.0 | 1.50 | — | — | 1.50 | — | V |
| | | | | 3.0~5.5 | $V_{CC}$ × 0.7 | — | — | $V_{CC}$ × 0.7 | — | |
| Low-level input voltage | $V_{IL}$ | — | | 2.0 | — | — | 0.50 | — | 0.50 | V |
| | | | | 3.0~5.5 | — | — | $V_{CC}$ × 0.3 | — | $V_{CC}$ × 0.3 | |
| High-level output voltage | $V_{OH}$ | $V_{IN}$ = $V_{IH}$ | $I_{OH}$ = −50 μA | 2.0 | 1.9 | 2.0 | — | 1.9 | — | V |
| | | | | 3.0 | 2.9 | 3.0 | — | 2.9 | — | |
| | | | | 4.5 | 4.4 | 4.5 | — | 4.4 | — | |
| | | | $I_{OH}$ = −4 mA | 3.0 | 2.58 | — | — | 2.48 | — | |
| | | | $I_{OH}$ = −8 mA | 4.5 | 3.94 | — | — | 3.80 | — | |
| Low-level output voltage | $V_{OL}$ | $V_{IN}$ = $V_{IL}$ | $I_{OL}$ = 50 μA | 2.0 | — | 0.0 | 0.1 | — | 0.1 | V |
| | | | | 3.0 | — | 0.0 | 0.1 | — | 0.1 | |
| | | | | 4.5 | — | 0.0 | 0.1 | — | 0.1 | |
| | | | $I_{OL}$ = 4 mA | 3.0 | — | — | 0.36 | — | 0.44 | |
| | | | $I_{OL}$ = 8 mA | 4.5 | — | — | 0.36 | — | 0.44 | |
| Input leakage current | $I_{IN}$ | $V_{IN}$ = 5.5 V or GND | | 0~5.5 | — | — | ±0.1 | — | ±1.0 | μA |
| Quiescent supply current | $I_{CC}$ | $V_{IN}$ = $V_{CC}$ or GND | | 5.5 | — | — | 2.0 | — | 20.0 | μA |

### AC Characteristics (input: $t_r = t_f = 3$ ns)

| Characteristics | Symbol | Test Condition | $V_{CC}$ (V) | $C_L$ (pF) | Ta = 25°C Min | Ta = 25°C Typ. | Ta = 25°C Max | Ta = −40~85°C Min | Ta = −40~85°C Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| Propagation delay time | $t_{pLH}$ $t_{pHL}$ | — | 3.3 ± 0.3 | 15 | — | 5.0 | 7.1 | 1.0 | 8.5 | ns |
| | | | | 50 | — | 7.5 | 10.6 | 1.0 | 12.0 | |
| | | | 5.0 ± 0.5 | 15 | — | 3.8 | 5.5 | 1.0 | 6.5 | |
| | | | | 50 | — | 5.3 | 7.5 | 1.0 | 8.5 | |
| Input capacitance | $C_{IN}$ | — | | | — | 4 | 10 | — | 10 | pF |
| Power dissipation capacitance | $C_{PD}$ | (Note) | | | — | 18 | — | — | — | pF |

Note: $C_{PD}$ 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:

$$I_{CC\ (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/3$$

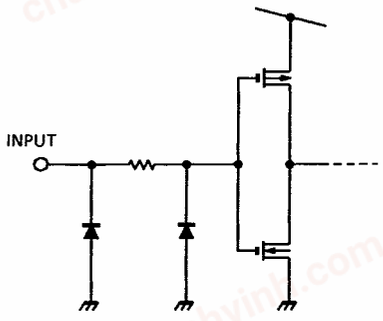
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## Noise Characteristics (Ta = 25°C, input: $t_r = t_f = 3$ ns)

| Characteristics | Symbol | Test Condition | | Typ. | Limit | Unit |
|---|---|---|---|---|---|---|
| | | | $V_{CC}$ (V) | | | |
| Quiet output maximum dynamic $V_{OL}$ | $V_{OLP}$ | $C_L$ = 50 pF | 5.0 | 0.3 | 0.8 | V |
| Quiet output minimum dynamic $V_{OL}$ | $V_{OLV}$ | $C_L$ = 50 pF | 5.0 | −0.3 | −0.8 | V |
| Minimum high level dynamic input voltage | $V_{IHD}$ | $C_L$ = 50 pF | 5.0 | — | 3.5 | V |
| Maximum low level dynamic input voltage | $V_{ILD}$ | $C_L$ = 50 pF | 5.0 | — | 1.5 | V |

## Input Equivalent Circuit

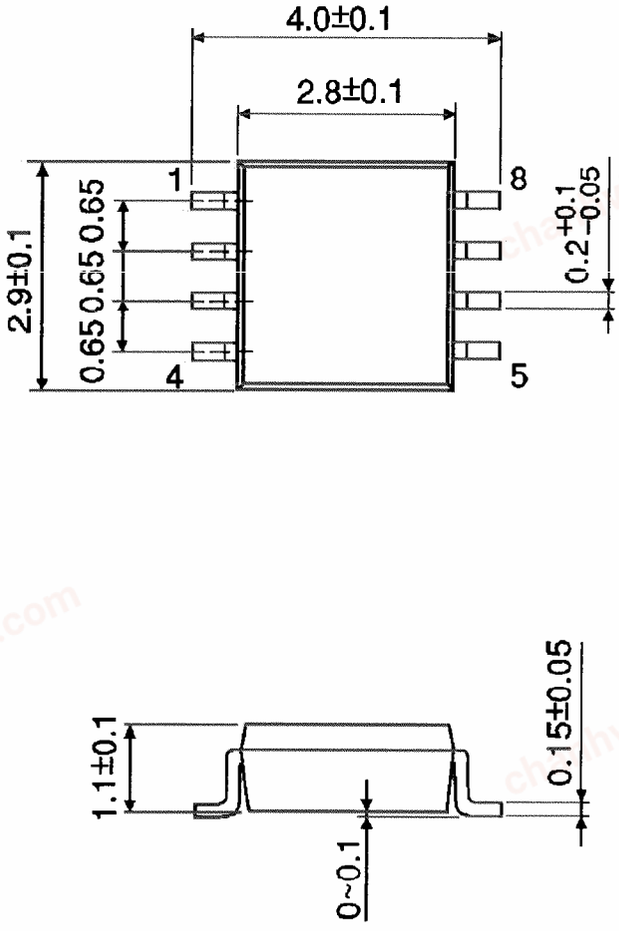


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## Package Dimensions

SSOP8-P-0.65 Unit : mm



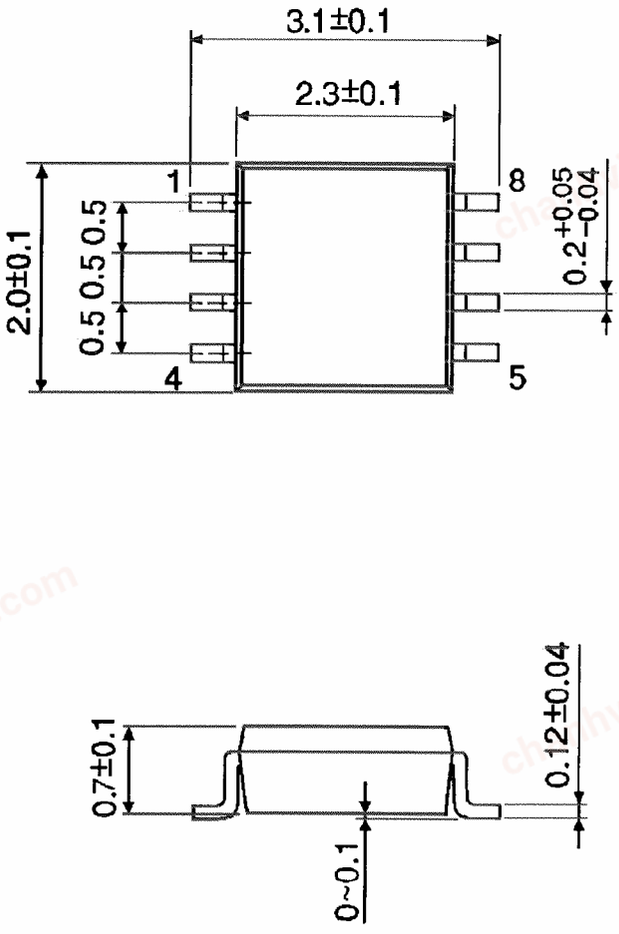

Weight: 0.02 g (typ.)

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## Package Dimensions

SSOP8-P-0.50A Unit : mm




Weight: 0.01 g (typ.)

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