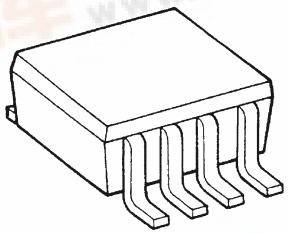
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7WH14FU,TC7WH14FK

## Triple Schmitt Inverter

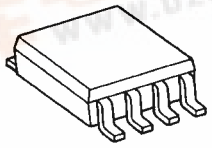
The TC7WH14 is an advanced high speed CMOS Schmitt Inverter fabricated with silicon gate CMOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. Pin configuration and function are the same as the TC7SH14 but the inputs have hysteresis and with its schmitt trigger function, the TC7WH14 can be used as a line receivers which will receive slow input signals. 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.

TC7WH14FU



SSOP8-P-0.65

TC7WH14FK



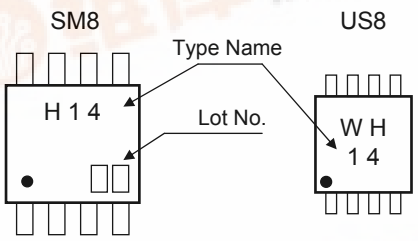
SSOP8-P-0.50A

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

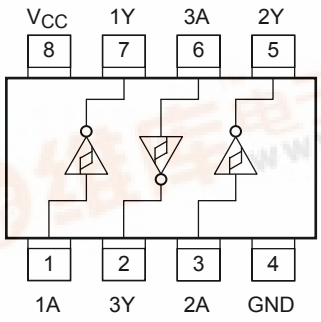
### Features

- High speed: $t_{pd}$ = 5.5 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




### Pin Assignment (top view)

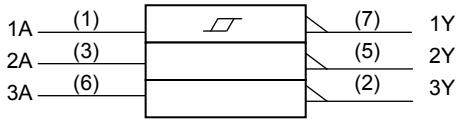


## Absolute Maximum Ratings (Ta = 25°C)

| 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 |

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).

## IEC Logic Symbol




## Truth Table

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

## Operating Ranges

| 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 |

## Electrical Characteristics

### DC Characteristics

| Characteristics | | Symbol | Test Condition | | Ta = 25°C | | | Ta = −40~85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $V_{CC}$ (V) | Min | Typ. | Max | Min | Max | |
| Input voltage | Positive threshold voltage | $V_P$ | — | 3.0 | — | — | 2.20 | — | 2.20 | V |
| | | | | 4.5 | — | — | 3.15 | — | 3.15 | |
| | | | | 5.5 | — | — | 3.85 | — | 3.85 | |
| | Negative threshold voltage | $V_N$ | — | 3.0 | 0.90 | — | — | 0.90 | — | |
| | | | | 4.5 | 1.35 | — | — | 1.35 | — | |
| | | | | 5.5 | 1.65 | — | — | 1.65 | — | |
| Hysteresis voltage | | $V_H$ | — | 3.0 | 0.30 | — | 1.20 | 0.30 | 1.20 | V |
| | | | | 4.5 | 0.40 | — | 1.40 | 0.40 | 1.40 | |
| | | | | 5.5 | 0.50 | — | 1.60 | 0.50 | 1.60 | |
| Output voltage | High level | $V_{OH}$ | $V_{IN}$ = $V_{IL}$ | $I_{OH}$ = −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 | $V_{OL}$ | $V_{IN}$ = $V_{IH}$ | $I_{OL}$ = 50 μA | 2.0 | — | 0 | 0.1 | — | 0.1 | |
| | | | | | 3.0 | — | 0 | 0.1 | — | 0.1 | |
| | | | | | 4.5 | — | 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 | | | Ta = 25°C | | | Ta = −40~85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{CC}$ (V) | $C_L$ (pF) | Min | Typ. | Max | Min | Max | |
| Propagation delay time | $t_{pLH}$ $t_{pHL}$ | — | 3.3 ± 0.3 | 15 | — | 8.3 | 12.8 | 1.0 | 15.0 | ns |
| | | | | 50 | — | 10.8 | 16.3 | 1.0 | 18.5 | |
| | | | 5.0 ± 0.5 | 15 | — | 5.5 | 8.6 | 1.0 | 10.0 | |
| | | | | 50 | — | 7.0 | 10.6 | 1.0 | 12.0 | |
| Input capacitance | $C_{IN}$ | — | | | — | 4 | 10 | — | 10 | — |
| Power dissipation capacitance | $C_{PD}$ | (Note) | | | — | 21 | — | — | — | — |

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

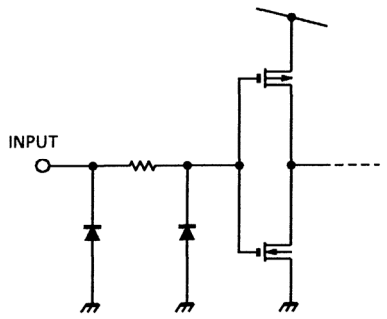
Average operating current can be obtained by the equation:

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

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

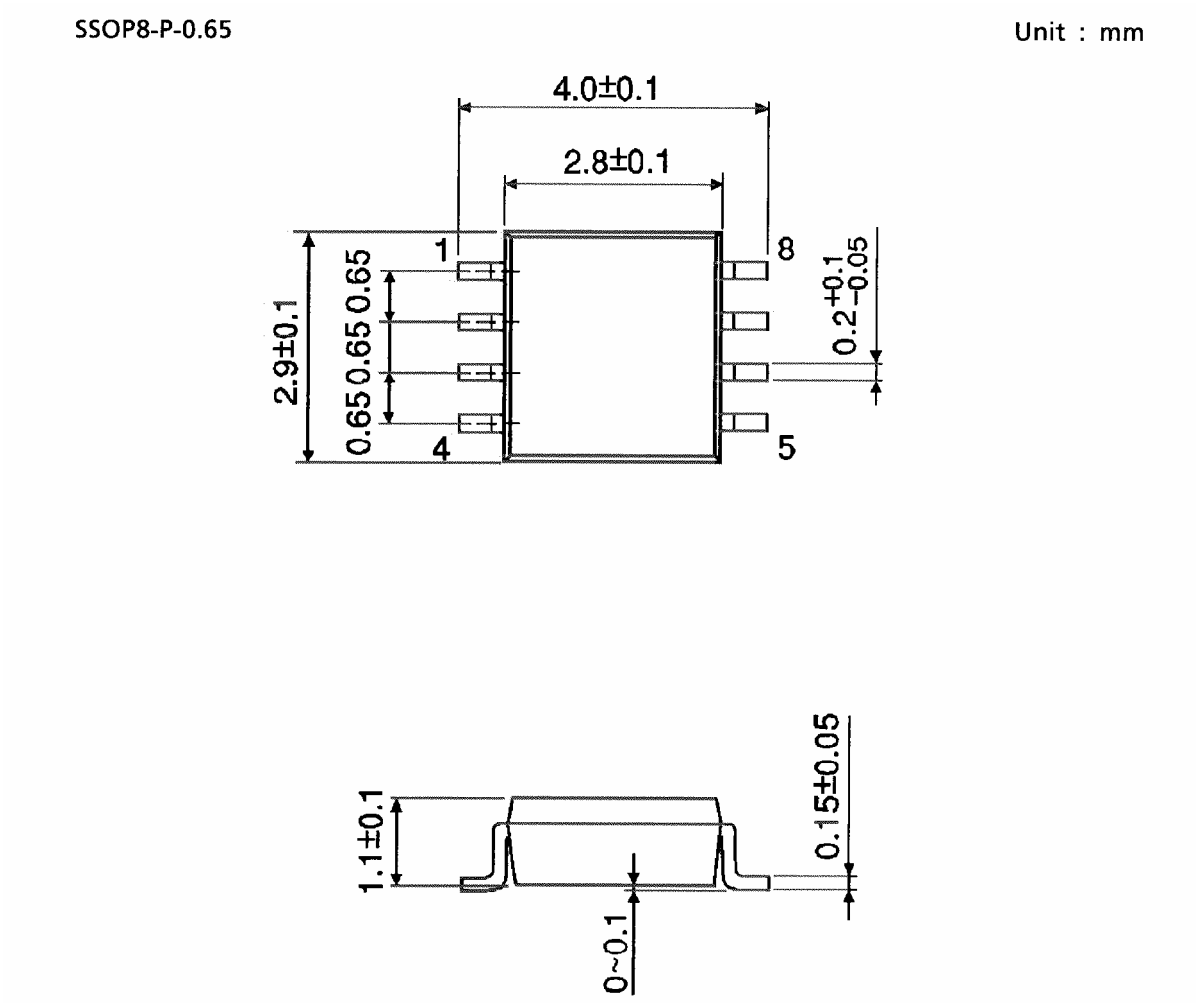
| Characteristics | Symbol | Test Condition | | Typ. | Limit | Unit |
|---|---|---|---|---|---|---|
| | | | $V_{CC}$ (V) | | | |
| Quiet output maximum dynamic $V_{OL}$ | $V_{OLP}$ | $C_L$ = 50 pF | 5.0 | 0.3 | 0.8 | V |
| Quiet output minimum dynamic $V_{OL}$ | $V_{OLV}$ | $C_L$ = 50 pF | 5.0 | −0.3 | −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



## Package Dimensions

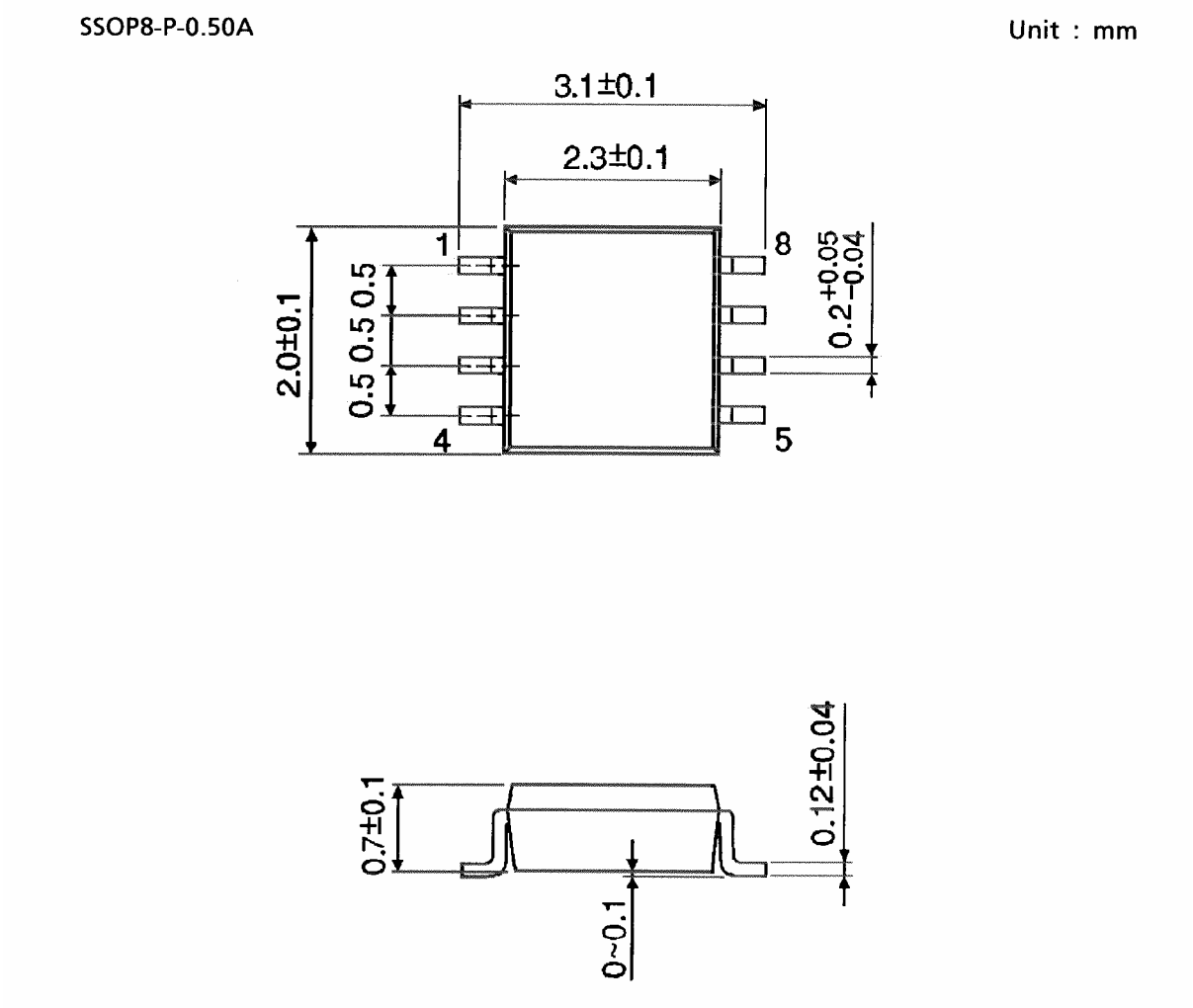
SSOP8-P-0.65 Unit : mm




Weight: 0.02 g (typ.)

**Package Dimensions**

SSOP8-P-0.50A Unit : mm




Weight: 0.01 g (typ.)

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20070701-EN GENERAL

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