

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7W14FU, TC7W14FK

## Schmitt Inverter

The TC7W14 is high speed C<sup>2</sup>MOS Schmitt Inverter fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the C<sup>2</sup>MOS low power dissipation.

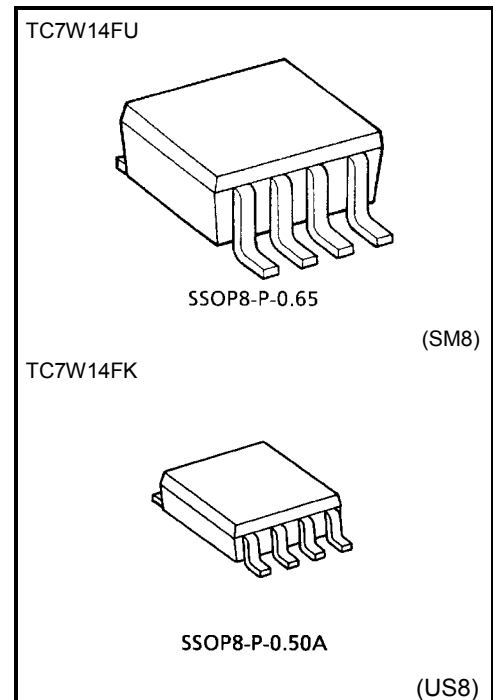
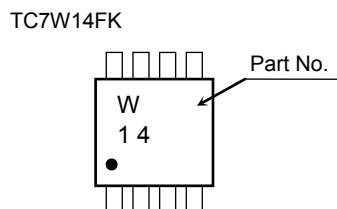
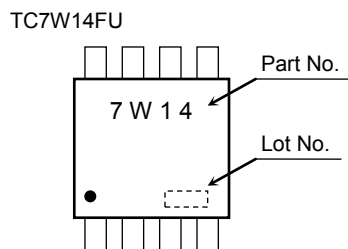
Pin configuration and function are the same as the TC7WU04 but the inputs have 25% V<sub>CC</sub> hysteresis and with its Schmitt trigger function, the TC7W14 can be used as a line receivers which will receive slow input signals.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

## Features

- High speed:  $t_{pd} = 11 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 1 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_H = 1.1 \text{ V}$  at  $V_{CC} = 5 \text{ V}$
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 4 \text{ mA (min)}$
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \text{ to } 6 \text{ V}$

## Marking



Weight

SSOP8-P-0.65: 0.02 g (typ.)

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

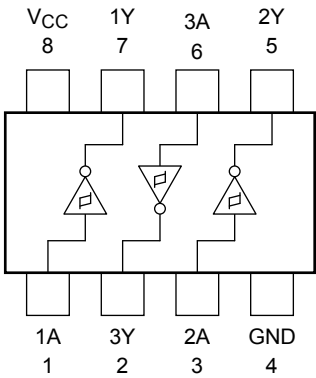
Start of commercial production  
1992-02

Absolute Maximum Ratings (Ta = 25°C)

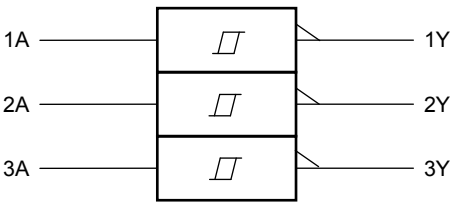
| Characteristics                    | Symbol           | Rating                        | Unit |
|------------------------------------|------------------|-------------------------------|------|
| Supply voltage range               | V <sub>CC</sub>  | −0.5 to 7                     | V    |
| DC input voltage                   | V <sub>IN</sub>  | −0.5 to V <sub>CC</sub> + 0.5 | V    |
| DC output voltage                  | V <sub>OUT</sub> | −0.5 to V <sub>CC</sub> + 0.5 | V    |
| Input diode current                | I <sub>IK</sub>  | ±20                           | mA   |
| Output diode current               | I <sub>OK</sub>  | ±20                           | mA   |
| DC output current                  | I <sub>OUT</sub> | ±25                           | mA   |
| DC V <sub>CC</sub> /ground current | I <sub>CC</sub>  | ±25                           | mA   |
| Power dissipation                  | P <sub>D</sub>   | 300 (SM8)                     | mW   |
|                                    |                  | 200 (US8)                     |      |
| Storage temperature range          | T <sub>stg</sub> | −65 to 150                    | °C   |
| Lead temperature (10 s)            | T <sub>L</sub>   | 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).

Pin Configuration (top view)



Logic Diagram



Truth Table

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

## Operating Ranges

| Characteristics             | Symbol    | Rating        | Unit |
|-----------------------------|-----------|---------------|------|
| Supply voltage              | $V_{CC}$  | 2 to 6        | V    |
| Input voltage               | $V_{IN}$  | 0 to $V_{CC}$ | V    |
| Output voltage              | $V_{OUT}$ | 0 to $V_{CC}$ | V    |
| Operating temperature range | $T_{opr}$ | -40 to 85     | °C   |

## Electrical Characteristics

## DC Electrical Characteristics

| Characteristics          |            | Symbol          | Test Condition                           |                          | Ta = 25°C           |      |      | Ta = -40 to 85°C |      | Unit |     |
|--------------------------|------------|-----------------|------------------------------------------|--------------------------|---------------------|------|------|------------------|------|------|-----|
|                          |            |                 |                                          |                          | V <sub>CC</sub> (V) | Min  | Typ. | Max              | Min  |      | Max |
| Threshold voltage        | High level | V <sub>P</sub>  | —                                        | 2.0                      | 1.0                 | 1.25 | 1.5  | 1.0              | 1.5  | V    |     |
|                          |            |                 |                                          | 4.5                      | 2.3                 | 2.7  | 3.15 | 2.3              | 3.15 |      |     |
|                          |            |                 |                                          | 6.0                      | 3.0                 | 3.5  | 4.2  | 3.0              | 4.2  |      |     |
|                          | Low level  | V <sub>N</sub>  | —                                        | 2.0                      | 0.3                 | 0.65 | 0.9  | 0.3              | 0.9  |      |     |
|                          |            |                 |                                          | 4.5                      | 1.13                | 1.6  | 2.0  | 1.13             | 2.0  |      |     |
|                          |            |                 |                                          | 6.0                      | 1.5                 | 2.3  | 2.6  | 1.5              | 2.6  |      |     |
| Hysteresis voltage       |            | V <sub>H</sub>  | —                                        | 2.0                      | 0.3                 | 0.6  | 1.0  | 0.3              | 1.0  | V    |     |
|                          |            |                 |                                          | 4.5                      | 0.6                 | 1.1  | 1.4  | 0.6              | 1.4  |      |     |
|                          |            |                 |                                          | 6.0                      | 0.8                 | 1.2  | 1.7  | 0.8              | 1.7  |      |     |
| Output voltage           | High level | V <sub>OH</sub> | V <sub>IN</sub> = V <sub>IL</sub>        | I <sub>OH</sub> = -20 μA | 2.0                 | 1.9  | 2.0  | —                | 1.9  | —    | V   |
|                          |            |                 |                                          |                          | 4.5                 | 4.4  | 4.5  | —                | 4.4  | —    |     |
|                          |            |                 |                                          |                          | 6.0                 | 5.9  | 6.0  | —                | 5.9  | —    |     |
|                          |            |                 |                                          | I <sub>OH</sub> = -4 mA  | 4.5                 | 4.18 | 4.31 | —                | 4.13 | —    |     |
|                          |            |                 |                                          |                          | 6.0                 | 5.68 | 5.80 | —                | 5.63 | —    |     |
|                          | Low level  | V <sub>OL</sub> | V <sub>IN</sub> = V <sub>IH</sub>        | I <sub>OL</sub> = 20 μA  | 2.0                 | —    | 0    | 0.1              | —    | 0.1  |     |
|                          |            |                 |                                          |                          | 4.5                 | —    | 0    | 0.1              | —    | 0.1  |     |
|                          |            |                 |                                          |                          | 6.0                 | —    | 0    | 0.1              | —    | 0.1  |     |
|                          |            |                 |                                          | I <sub>OL</sub> = 4 mA   | 4.5                 | —    | 0.17 | 0.26             | —    | 0.33 |     |
|                          |            |                 |                                          |                          | 6.0                 | —    | 0.18 | 0.26             | —    | 0.33 |     |
| Input leakage current    |            | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND | 6.0                      | —                   | —    | ±0.1 | —                | ±1.0 | μA   |     |
| Quiescent supply current |            | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND | 6.0                      | —                   | —    | 1.0  | —                | 10.0 | μA   |     |

**AC Electrical Characteristics ( $C_L = 15 \text{ pF}$ ,  $V_{CC} = 5 \text{ V}$ ,  $T_a = 25^\circ\text{C}$ )**

| Characteristics        | Symbol                 | Test Condition | $T_a = 25^\circ\text{C}$ |      |     | Unit |
|------------------------|------------------------|----------------|--------------------------|------|-----|------|
|                        |                        |                | Min                      | Typ. | Max |      |
| Output transition time | $t_{TLH}$<br>$t_{THL}$ | —              | —                        | 4    | 8   | ns   |
| Propagation delay time | $t_{pLH}$<br>$t_{pHL}$ | —              | —                        | 11   | 21  | ns   |

**AC Electrical Characteristics ( $C_L = 50 \text{ pF}$ , input  $t_r = t_f = 6 \text{ ns}$ )**

| Characteristics               | Symbol                 | Test Condition | $V_{CC} \text{ (V)}$ | $T_a = 25^\circ\text{C}$ |      |     | $T_a = -40$<br>to $85^\circ\text{C}$ |     | Unit |
|-------------------------------|------------------------|----------------|----------------------|--------------------------|------|-----|--------------------------------------|-----|------|
|                               |                        |                |                      | Min                      | Typ. | Max | Min                                  | Max |      |
| Output transition time        | $t_{TLH}$<br>$t_{THL}$ | —              | 2.0                  | —                        | 30   | 75  | —                                    | 95  | ns   |
|                               |                        |                | 4.5                  | —                        | 8    | 15  | —                                    | 19  |      |
|                               |                        |                | 6.0                  | —                        | 7    | 13  | —                                    | 16  |      |
| Propagation delay time        | $t_{pLH}$<br>$t_{pHL}$ | —              | 2.0                  | —                        | 42   | 125 | —                                    | 155 | ns   |
|                               |                        |                | 4.5                  | —                        | 14   | 25  | —                                    | 31  |      |
|                               |                        |                | 6.0                  | —                        | 12   | 21  | —                                    | 26  |      |
| Input capacitance             | $C_{IN}$               | —              | —                    | —                        | 5    | 10  | —                                    | 10  | pF   |
| Power dissipation capacitance | $C_{PD}$               | (Note)         | —                    | —                        | 28   | —   | —                                    | —   | pF   |

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

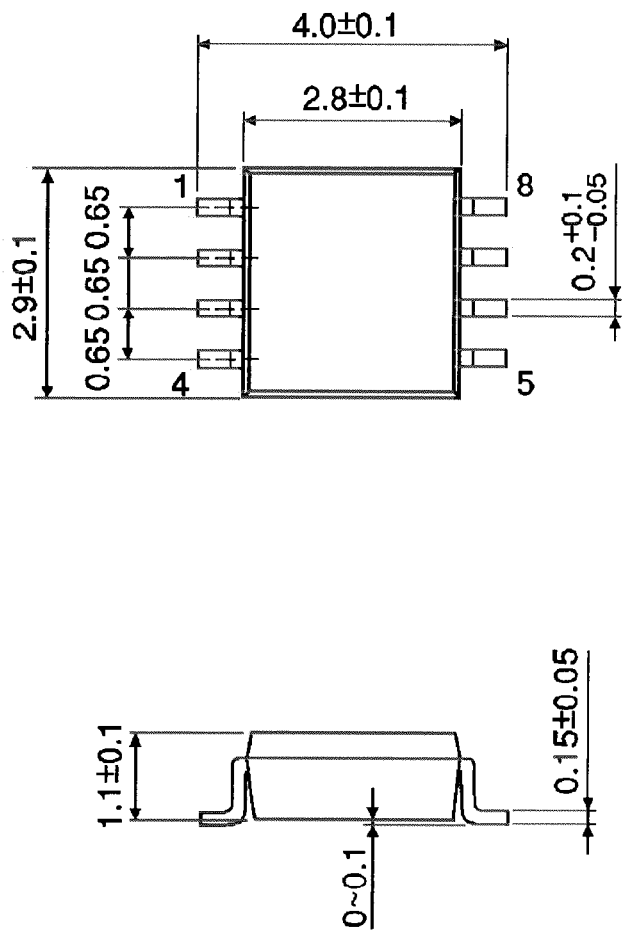
Average operating current can be obtained by the equation hereunder.

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

Package Dimensions

SSOP8-P-0.65

Unit : mm

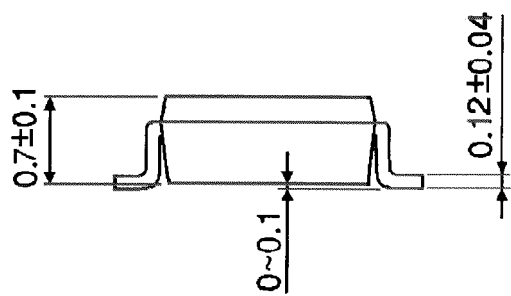
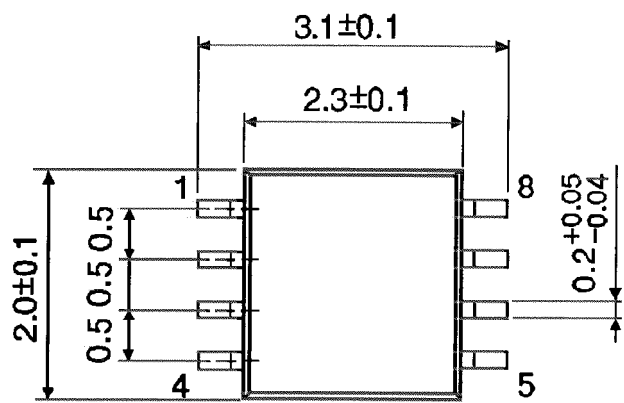


Weight: 0.02 g (typ.)

Package Dimensions

SSOP8-P-0.50A

Unit : mm



Weight: 0.01 g (typ.)

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