

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7S14F, TC7S14FU

## Schmitt Inverter

The TC7S14 is a high speed C<sup>2</sup>MOS Schmitt Inverter fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves a 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 TC7SU04F but input have 25% V<sub>CC</sub> hysteresis and with its schmitt trigger function, the TC7S14F can be used as line receivers which will receive slow input signal.

Input is equipped with protection circuits against static discharge or transient excess voltage.

Output currents are 1/2 compared to TC74HC series models.

### Features

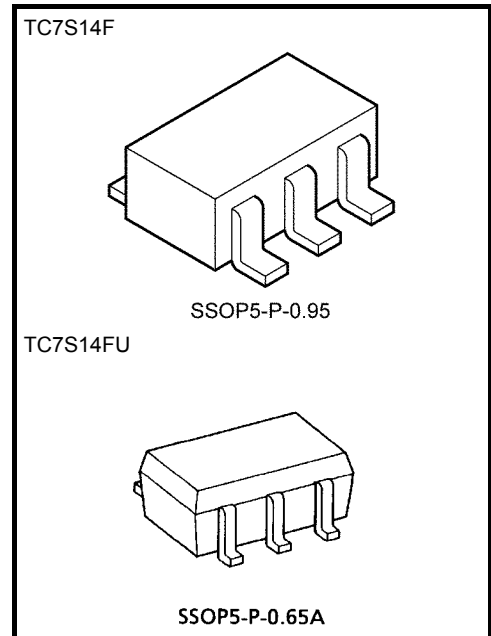
- High speed:  $t_{pd} = 11 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 1 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_H = 1.1 \text{ V}$  at  $V_{CC} = 5 \text{ V}$
- Output drive capability: 5 LSTTL loads
- Symmetrical output impedance: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

### 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> | ±12.5                         | mA   |
| DC V <sub>CC</sub> /ground current | I <sub>CC</sub>  | ±25                           | mA   |
| Power dissipation                  | P <sub>D</sub>   | 200                           | mW   |
| 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.

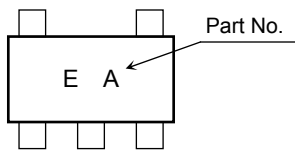
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).



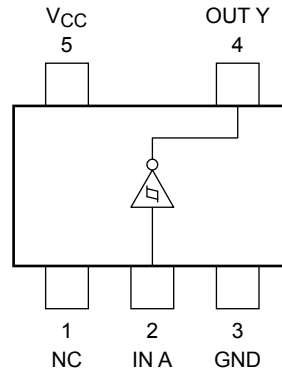
Weight  
 SSOP5-P-0.95: 0.016 g (typ.)  
 SSOP5-P-0.65A: 0.006 g (typ.)

Start of commercial production  
 1991-06

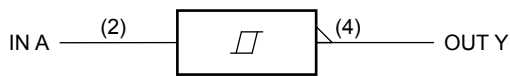
**Marking**



**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        | Positive   | 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  |      |   |
|                          | Negative   | 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> = -2 mA  | 4.5  | 4.18 | 4.31             | —    | 4.13 | —    |   |
|                          |            |                 |  |                          | 6.0  | 5.68 | 5.80             | —    | 5.63 | —    |   |
|                          |            |                 |  |                          | 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> = 2 mA   | 4.5  | —    | 0.17             | 0.26 | —    | 0.33 |   |
|                          |            |                 |  |                          | 6.0  | —    | 0.18             | 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   |   |

Note: Output currents are 1/2 compared to TC74HC series models.

### AC Electrical Characteristics (C<sub>L</sub> = 15 pF, V<sub>CC</sub> = 5 V, Ta = 25°C)

| Characteristics        | Symbol                               | Test Condition | Ta = 25°C |      |     | Unit |
|------------------------|--------------------------------------|----------------|-----------|------|-----|------|
|                        |                                      |                | Min       | Typ. | Max |      |
| Output transition time | t <sub>TLH</sub><br>t <sub>THL</sub> | —              | —         | 4    | 8   | ns   |
| Propagation delay time | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | —         | 11   | 21  | ns   |

**AC Electrical Characteristics (C<sub>L</sub> = 50 pF, input t<sub>r</sub> = t<sub>f</sub> = 6 ns)**

| Characteristics               | Symbol                               | Test Condition | Ta = 25°C           |     |      | Ta = -40 to 85°C |     | Unit |     |
|-------------------------------|--------------------------------------|----------------|---------------------|-----|------|------------------|-----|------|-----|
|                               |                                      |                | V <sub>CC</sub> (V) | Min | Typ. | Max              | Min |      | Max |
| Output transition time        | t <sub>TLH</sub><br>t <sub>THL</sub> | —              | 2.0                 | —   | 50   | 125              | —   | 145  | ns  |
|                               |                                      |                | 4.5                 | —   | 14   | 25               | —   | 30   |     |
|                               |                                      |                | 6.0                 | —   | 12   | 21               | —   | 24   |     |
| Propagation delay time        | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 2.0                 | —   | 48   | 100              | —   | 235  | ns  |
|                               |                                      |                | 4.5                 | —   | 12   | 20               | —   | 48   |     |
|                               |                                      |                | 6.0                 | —   | 9    | 17               | —   | 40   |     |
| Input capacitance             | C <sub>IN</sub>                      | —              | —                   | 5   | 10   | —                | 10  | pF   |     |
| Power dissipation capacitance | C <sub>PD</sub>                      | (Note)         | —                   | 28  | —    | —                | —   | pF   |     |

Note: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

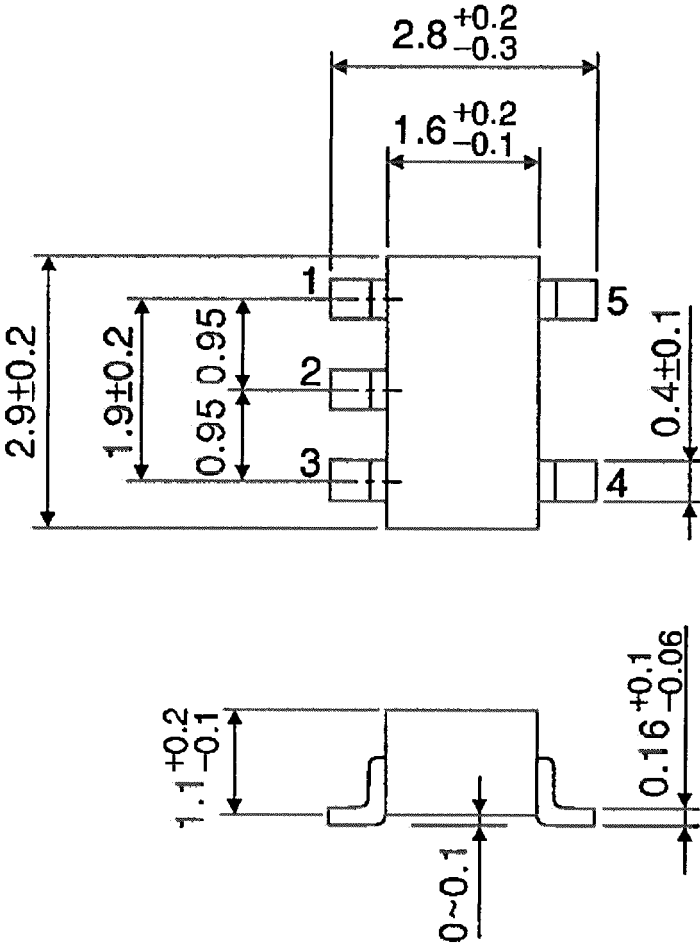
Average operating current can be obtained by the equation:

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

Package Dimensions

SSOP5-P-0.95

Unit : mm

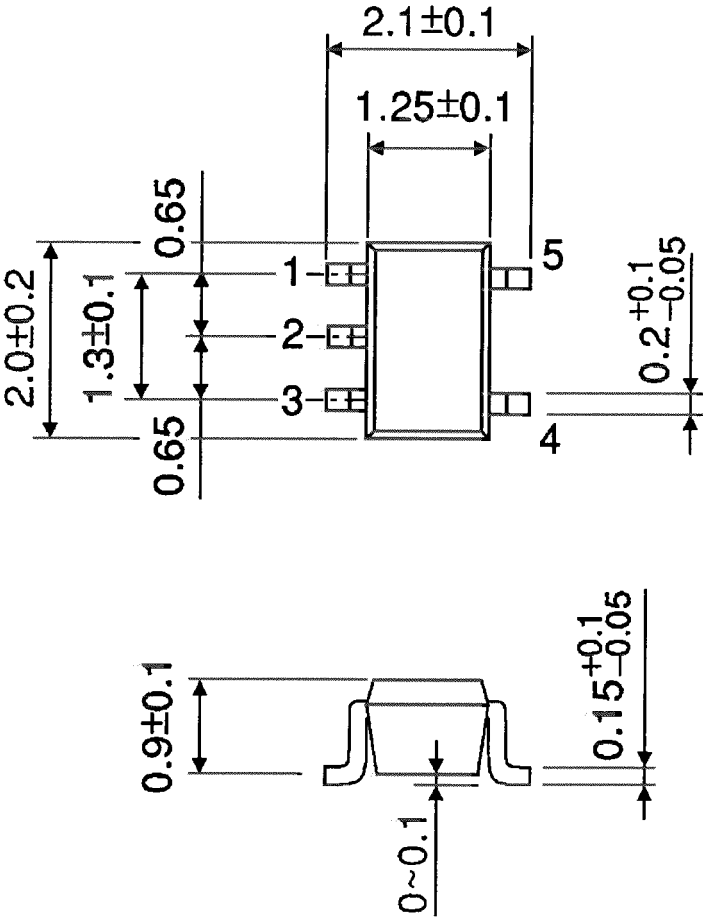


Weight: 0.016 g (typ.)

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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