

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

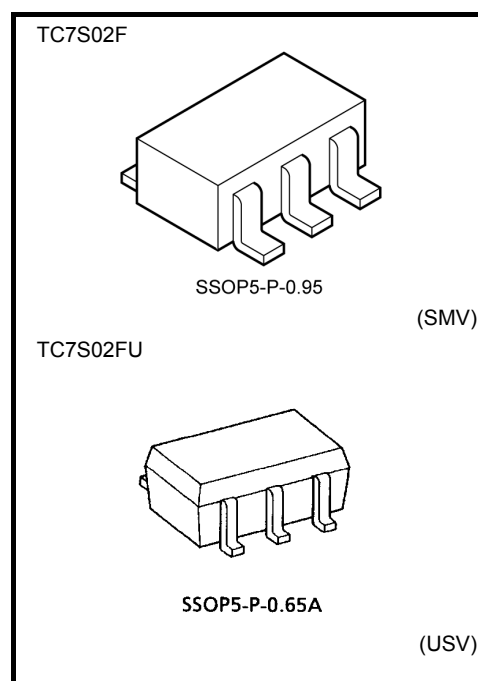
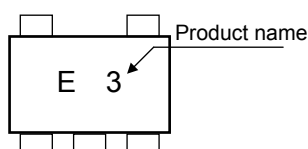
## TC7S02F, TC7S02FU

### 2-Input NOR Gate

#### Features

- High Speed :  $t_{pd} = 7\text{ ns (typ.)}$  at  $V_{CC} = 5\text{ V}$
- Low power dissipation :  $I_{CC} = 1\text{ }\mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity :  $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (min)
- Output drive capability : 5 LSTTL Loads
- Symmetrical Output Impedance :  $|I_{OH}| = I_{OL} = 2\text{ mA (min)}$
- Balanced propagation delays :  $t_{pLH} \doteq t_{pHL}$
- Wide operating voltage range :  $V_{CC} = 2\text{ to }6\text{ V}$

#### Marking

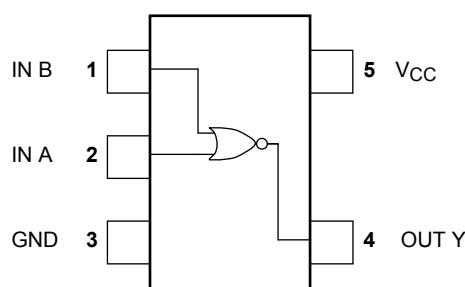


Weight  
SSOP5-P-0.95 : 0.016 g (typ.)  
SSOP5-P-0.65A : 0.006 g (typ.)

#### Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

| Characteristics             | Symbol    | Rating                 | Unit             |
|-----------------------------|-----------|------------------------|------------------|
| Supply voltage              | $V_{CC}$  | -0.5 to 7.0            | V                |
| DC input voltage            | $V_{IN}$  | -0.5 to $V_{CC} + 0.5$ | V                |
| DC output voltage           | $V_{OUT}$ | -0.5 to $V_{CC} + 0.5$ | V                |
| Input diode current         | $I_{IK}$  | $\pm 20$               | mA               |
| Output diode current        | $I_{OK}$  | $\pm 20$               | mA               |
| DC output current           | $I_{OUT}$ | $\pm 12.5$             | mA               |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 25$               | mA               |
| Power dissipation           | $P_D$     | 200                    | mW               |
| Storage temperature         | $T_{stg}$ | -65 to 150             | $^\circ\text{C}$ |
| Lead temperature (10 s)     | $T_L$     | 260                    | $^\circ\text{C}$ |

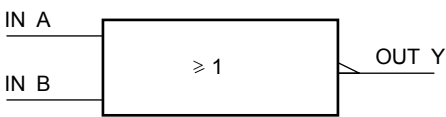
#### Pin Assignment (top view)



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).

IEC Logic Symbol



Truth Table

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

Operating Ranges

| Characteristics          | Symbol     | Rating                                | Unit |
|--------------------------|------------|---------------------------------------|------|
| Supply voltage           | $V_{CC}$   | 2.0 to 6.0                            | V    |
| Input voltage            | $V_{IN}$   | 0 to $V_{CC}$                         | V    |
| Output voltage           | $V_{OUT}$  | 0 to $V_{CC}$                         | V    |
| Operating temperature    | $T_{opr}$  | -40 to 85                             | °C   |
| Input rise and fall time | $t_r, t_f$ | 0 to 1000 ( $V_{CC} = 2.0\text{ V}$ ) | ns   |
|                          |            | 0 to 500 ( $V_{CC} = 4.5\text{ V}$ )  |      |
|                          |            | 0 to 400 ( $V_{CC} = 6.0\text{ V}$ )  |      |

**Electrical Characteristics**
**DC Characteristics**

| Characteristics           | Symbol          | Test Condition                                       |                           | Ta = 25°C           |      |      | Ta = -40 to 85°C |      | Unit |
|---------------------------|-----------------|------------------------------------------------------|---------------------------|---------------------|------|------|------------------|------|------|
|                           |                 |                                                      |                           | V <sub>CC</sub> (V) | Min  | Typ. | Max              | Min. |      |
| High-level input voltage  | V <sub>IH</sub> | —                                                    |                           | 2.0                 | 1.5  | —    | —                | 1.5  | V    |
|                           |                 |                                                      |                           | 4.5                 | 3.15 | —    | —                | 3.15 |      |
|                           |                 |                                                      |                           | 6.0                 | 4.2  | —    | —                | 4.2  |      |
| Low-level input voltage   | V <sub>IL</sub> | —                                                    |                           | 2.0                 | —    | —    | 0.5              | —    | V    |
|                           |                 |                                                      |                           | 4.5                 | —    | —    | 1.35             | —    |      |
|                           |                 |                                                      |                           | 6.0                 | —    | —    | 1.8              | —    |      |
| High-level output voltage | 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 |      |
|                           |                 |                                                      | I <sub>OH</sub> = -2.6 mA | 6.0                 | 5.68 | 5.80 | —                | 5.63 |      |
| Low-level output voltage  | V <sub>OL</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OL</sub> = 20 µA   | 2.0                 | —    | 0.0  | 0.1              | —    | V    |
|                           |                 |                                                      |                           | 4.5                 | —    | 0.0  | 0.1              | —    |      |
|                           |                 |                                                      |                           | 6.0                 | —    | 0.0  | 0.1              | —    |      |
|                           |                 |                                                      | I <sub>OL</sub> = 2 mA    | 4.5                 | —    | 0.17 | 0.26             | —    |      |
|                           |                 |                                                      | I <sub>OL</sub> = 2.6 mA  | 6.0                 | —    | 0.18 | 0.26             | —    |      |
| Input leakage current     | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND             |                           | 6.0                 | —    | —    | ±0.1             | —    | µA   |
| Quiescent supply current  | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND             |                           | 6.0                 | —    | —    | 1.0              | —    | µA   |

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

## AC Characteristics ( $C_L = 15\text{pF}$ , $V_{CC} = 5\text{V}$ , Input: $t_r = t_f = 6\text{ ns}$ )

| Characteristics        | Symbol                 | Test Condition | Ta = 25°C |      |      | Unit |
|------------------------|------------------------|----------------|-----------|------|------|------|
|                        |                        |                | Min.      | Typ. | Max. |      |
| Output transition time | $t_{TLH}$<br>$t_{THL}$ | —              | —         | 5    | 10   | ns   |
| Propagation delay time | $t_{pLH}$<br>$t_{pLH}$ | —              | —         | 7    | 15   | ns   |

## AC Characteristics ( $C_L = 50\text{pF}$ , Input: $t_r = t_f = 6\text{ ns}$ )

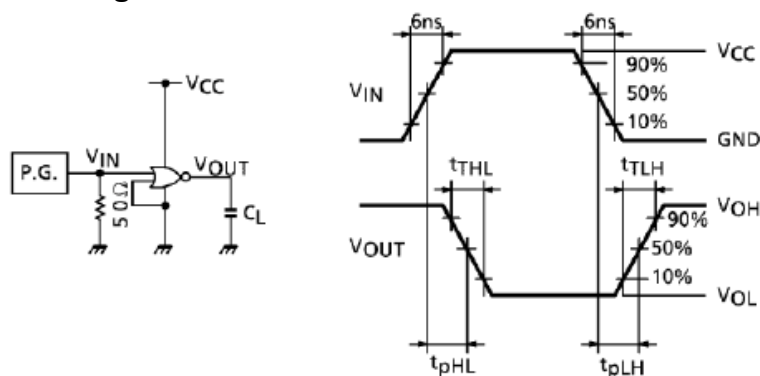
| Characteristics               | Symbol                               | Test Condition | Ta = 25°C           |     |      |     | Ta = −40 to 85°C |      | Unit |
|-------------------------------|--------------------------------------|----------------|---------------------|-----|------|-----|------------------|------|------|
|                               |                                      |                | 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 | —                | 155  | ns   |
|                               |                                      |                | 4.5                 | —   | 14   | 25  | —                | 31   |      |
|                               |                                      |                | 6.0                 | —   | 12   | 21  | —                | 26   |      |
| Propagation delay time        | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 2.0                 | —   | 48   | 100 | —                | 125  | ns   |
|                               |                                      |                | 4.5                 | —   | 12   | 20  | —                | 25   |      |
|                               |                                      |                | 6.0                 | —   | 9    | 17  | —                | 21   |      |
| Input capacitance             | C <sub>IN</sub>                      | —              |                     | —   | 5    | 10  | —                | 10   | pF   |
| Power dissipation capacitance | C <sub>PD</sub>                      | (Note 1)       |                     | —   | 10   | —   | —                | —    | pF   |

Note 1: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

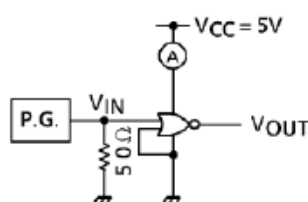
Average operating current can be obtained by the equation:

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

## Switching Characteristics Test Circuit



## I<sub>CC (opr.)</sub> Test Circuit

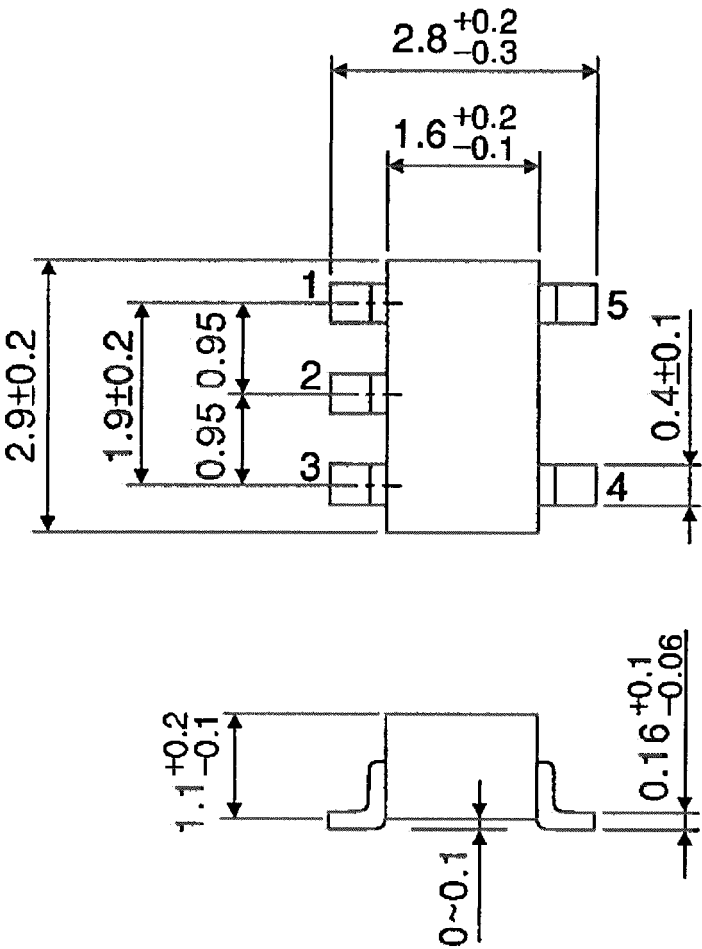


Input waveform is the same as that in case of switching characteristics test.

Package Dimensions

SSOP5-P-0.95

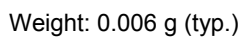
Unit : mm



Weight: 0.016 g (typ.)

## SSOP5-P-0.65A

Unit : mm



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