

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

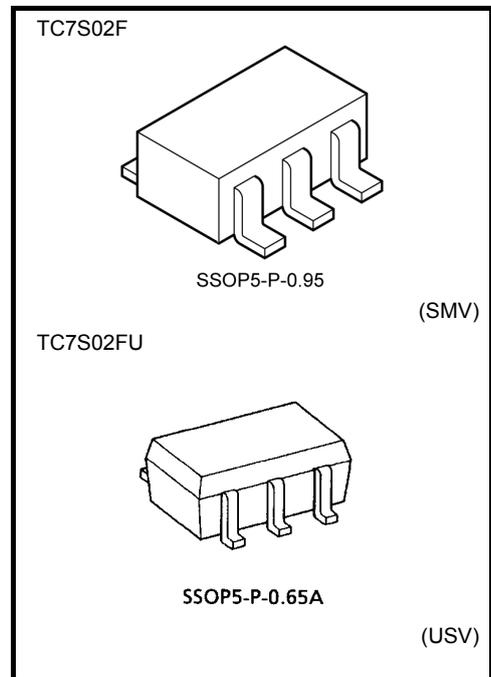
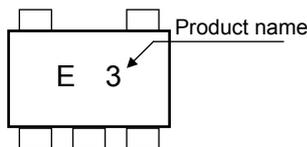
TC7S02F, TC7S02FU

2-Input NOR Gate

Features

- High Speed : $t_{pd} = 7\text{ns}$ (typ.) at $V_{CC} = 5\text{V}$
- Low power dissipation : $I_{CC} = 1\ \mu\text{A}$ (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 : $t_{pLH} \cong t_{pHL}$
- Wide operating voltage range : $V_{CC} = 2\text{ to }6\text{V}$

Marking

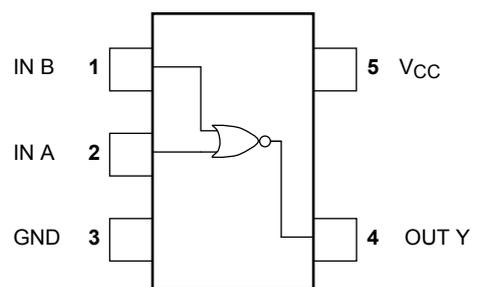


Weight
 SSOP5-P-0.95 : 0.016 g (typ.)
 SSOP5-P-0.65A : 0.006 g (typ.)

Absolute Maximum Ratings (Ta = 25°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} | ± 20 | mA |
| Output diode current | I_{OK} | ± 20 | mA |
| DC output current | I_{OUT} | ± 12.5 | mA |
| DC V_{CC} /ground current | I_{CC} | ± 25 | mA |
| Power dissipation | P_D | 200 | mW |
| Storage temperature | T_{stg} | -65 to 150 | °C |
| Lead temperature (10 s) | T_L | 260 | °C |

Pin Assignment (top view)

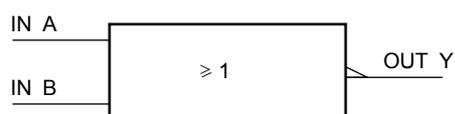


Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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).

Start of commercial production
 1987-08

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 _{CC} (V) | Min | Typ. | Max | Min | | Max |
| High-level input voltage | V _{IH} | — | | 2.0 | 1.5 | — | — | 1.5 | — | V |
| | | | | 4.5 | 3.15 | — | — | 3.15 | — | |
| | | | | 6.0 | 4.2 | — | — | 4.2 | — | |
| Low-level input voltage | V _{IL} | — | | 2.0 | — | — | 0.5 | — | 0.5 | |
| | | | | 4.5 | — | — | 1.35 | — | 1.35 | |
| | | | | 6.0 | — | — | 1.8 | — | 1.8 | |
| High-level output voltage | V _{OH} | V _{IN} = V _{IL} | I _{OH} = -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 _{OH} = -2 mA | 4.5 | 4.18 | 4.31 | — | 4.13 | — | |
| 6.0 | 5.68 | 5.80 | | — | 5.63 | — | | | | |
| Low-level output voltage | V _{OL} | V _{IN} = V _{IH} or V _{IL} | I _{OL} = 20 μA | 2.0 | — | 0.0 | 0.1 | — | 0.1 | |
| | | | | 4.5 | — | 0.0 | 0.1 | — | 0.1 | |
| | | | 6.0 | — | 0.0 | 0.1 | — | 0.1 | | |
| | | | I _{OL} = 2 mA | 4.5 | — | 0.17 | 0.26 | — | 0.33 | |
| 6.0 | — | 0.18 | | 0.26 | — | 0.33 | | | | |
| Input leakage current | I _{IN} | V _{IN} = V _{CC} or GND | | 6.0 | — | — | ±0.1 | — | ±1.0 | μA |
| Quiescent supply current | I _{CC} | V _{IN} = V _{CC} or GND | | 6.0 | — | — | 1.0 | — | 10.0 | μA |

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

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

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

AC Characteristics (C_L = 50pF, Input: t_r = t_f = 6 ns)

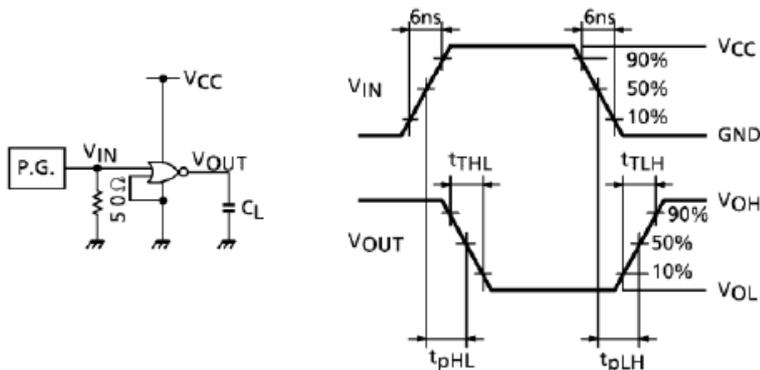
| Characteristics | Symbol | Test Condition | V _{CC} (V) | Ta = 25°C | | | Ta = -40 to 85°C | | Unit |
|-------------------------------|--------------------------------------|----------------|---------------------|-----------|------|-----|------------------|-----|------|
| | | | | Min | Typ. | Max | Min | Max | |
| Output transition time | t _{TLH} t _{THL} | — | 2.0 | — | 50 | 125 | — | 155 | ns |
| | | | 4.5 | — | 14 | 25 | — | 31 | |
| | | | 6.0 | — | 12 | 21 | — | 26 | |
| Propagation delay time | t _{pLH} t _{pHL} | — | 2.0 | — | 48 | 100 | — | 125 | ns |
| | | | 4.5 | — | 12 | 20 | — | 25 | |
| | | | 6.0 | — | 9 | 17 | — | 21 | |
| Input capacitance | C _{IN} | — | — | 5 | 10 | — | 10 | pF | |
| Power dissipation capacitance | C _{PD} | (Note 1) | — | 10 | — | — | — | pF | |

Note 1: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

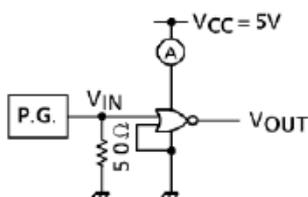
Average operating current can be obtained by the equation:

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

Switching Characteristics Test Circuit



I_{CC (opr.)} Test Circuit

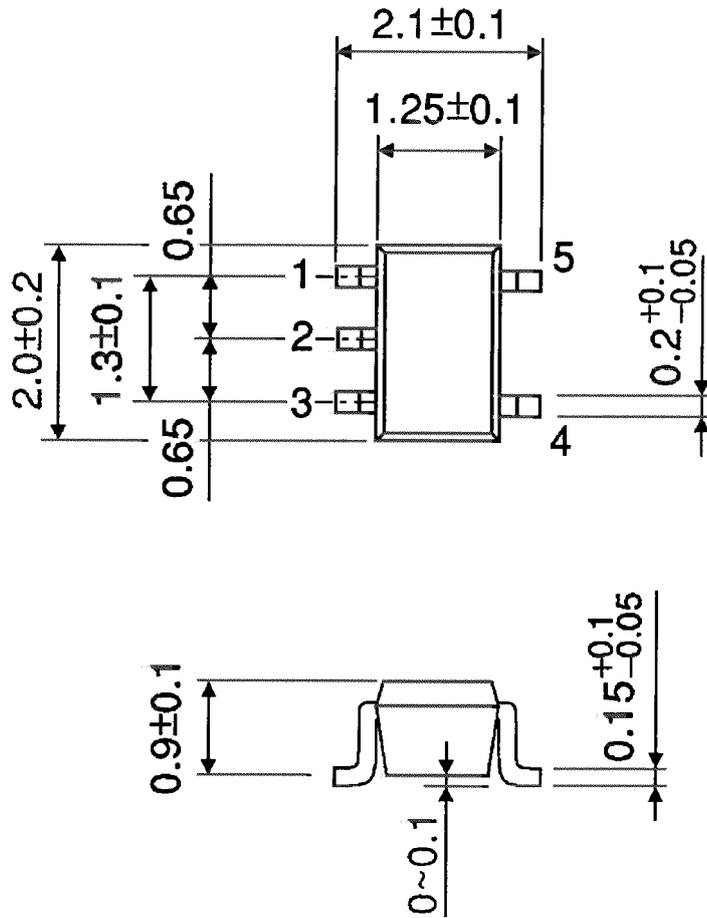


Input waveform is the same as that in case of switching characteristics test.

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 0.006 g (typ.)

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