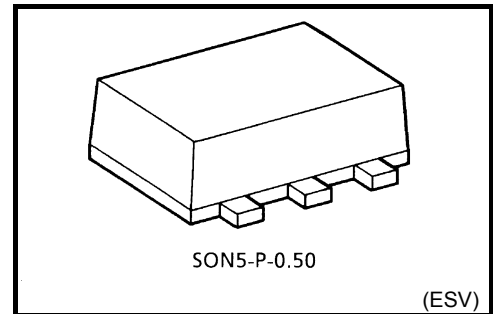


TC7SG02FE

2-Input NOR Gate

Features

- High output current : ± 8 mA (min) at $V_{CC} = 3.0$ V
- Super high speed operation : $t_{pd} = 2.4$ ns (typ.)
at $V_{CC} = 3.3$ V, 15pF
- Operating voltage range : $V_{CC} = 0.9$ to 3.6 V
- 5.5-V tolerant inputs
- 3.6-V power down protection output

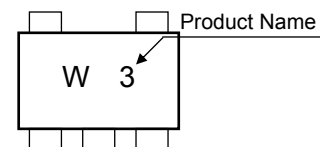


Weight: 0.003 g (typ.)

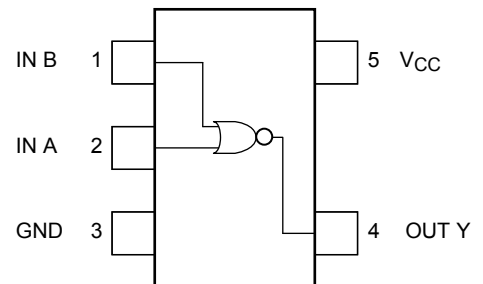
Absolute Maximum Ratings (Ta = 25°C)

| Characteristics | Symbol | Rating | Unit |
|-----------------------------|-----------|---------------------------------|------|
| Supply voltage | V_{CC} | -0.5 to 4.6 | V |
| DC input voltage | V_{IN} | -0.5 to 7.0 | V |
| DC output voltage | V_{OUT} | -0.5 to 4.6 (Note 1) | V |
| | | -0.5 to $V_{CC} + 0.5$ (Note 2) | |
| Input diode current | I_{IK} | -20 | mA |
| Output diode current | I_{OK} | -20 (Note 3) | mA |
| DC output current | I_{OUT} | ± 25 | mA |
| DC V_{CC} /ground current | I_{CC} | ± 50 | mA |
| Power dissipation | P_D | 150 | mW |
| Storage temperature | T_{stg} | -65 to 150 | °C |

Marking



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.).

Note 1: $V_{CC} = 0V$

Note 2: High or Low state. Do not exceed I_{OUT} of absolute maximum ratings.

Note 3: $V_{OUT} < GND$

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} | 0.9 to 3.6 | V |
| Input voltage | V_{IN} | 0 to 5.5 | V |
| Output voltage | V_{OUT} | 0 to 3.6 (Note 4) | V |
| | | 0 to V_{CC} (Note 5) | |
| Output Current | I_{OH}/I_{OL} | ± 8.0 (Note 6) | mA |
| | | ± 4.0 (Note 7) | |
| | | ± 3.0 (Note 8) | |
| | | ± 1.7 (Note 9) | |
| | | ± 0.3 (Note 10) | |
| | | ± 0.02 (Note 11) | |
| Operating temperature | T_{opr} | -40 to 85 | °C |
| Input rise and fall time | dt/dv | 0 to 10 (Note 12) | ns/V |

Note 4: $V_{CC} = 0V$

Note 5: High or Low state.

Note 6: $V_{CC} = 3.0$ to 3.6 V

Note 7: $V_{CC} = 2.3$ to 2.7 V

Note 8: $V_{CC} = 1.65$ to 1.95 V

Note 9: $V_{CC} = 1.4$ to 1.6 V

Note 10: $V_{CC} = 1.1$ to 1.3 V

Note 11: $V_{CC} = 0.9$ V

Note 12: $V_{IN} = 0.8$ to 2.0 V, $V_{CC} = 3.0$ 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} | — | 0.9 | V _{CC} | — | — | V _{CC} | — | V | |
| | | | 1.1 to 1.3 | V _{CC} × 0.7 | — | — | V _{CC} × 0.7 | — | | |
| | | | 1.4 to 1.6 | V _{CC} × 0.65 | — | — | V _{CC} × 0.65 | — | | |
| | | | 1.65 to 1.95 | V _{CC} × 0.65 | — | — | V _{CC} × 0.65 | — | | |
| | | | 2.3 to 2.7 | 1.7 | — | — | 1.7 | — | | |
| | | | 3.0 to 3.6 | 2.0 | — | — | 2.0 | — | | |
| Low-level input voltage | V _{IL} | — | 0.9 | — | — | GND | — | GND | V | |
| | | | 1.1 to 1.3 | — | — | V _{CC} × 0.3 | — | V _{CC} × 0.3 | | |
| | | | 1.4 to 1.6 | — | — | V _{CC} × 0.35 | — | V _{CC} × 0.35 | | |
| | | | 1.65 to 1.95 | — | — | V _{CC} × 0.35 | — | V _{CC} × 0.35 | | |
| | | | 2.3 to 2.7 | — | — | 0.7 | — | 0.7 | | |
| | | | 3.0 to 3.6 | — | — | 0.8 | — | 0.8 | | |
| High-level output voltage | V _{OH} | V _{IN} = V _{IL} | I _{OH} = -0.02 mA | 0.9 | 0.75 | — | — | 0.75 | — | V |
| | | | I _{OH} = -0.3 mA | 1.1 to 1.3 | V _{CC} × 0.75 | — | — | V _{CC} × 0.75 | — | |
| | | | I _{OH} = -1.7 mA | 1.4 to 1.6 | V _{CC} × 0.75 | — | — | V _{CC} × 0.75 | — | |
| | | | I _{OH} = -3.0 mA | 1.65 to 1.95 | V _{CC} - 0.45 | — | — | V _{CC} - 0.45 | — | |
| | | | I _{OH} = -4.0 mA | 2.3 to 2.7 | 2.0 | — | — | 2.0 | — | |
| | | | I _{OH} = -8.0 mA | 3.0 to 3.6 | 2.48 | — | — | 2.48 | — | |
| Low-level output voltage | V _{OL} | V _{IN} = V _{IH} or V _{IL} | I _{OL} = 0.02 mA | 0.9 | — | — | 0.1 | — | 0.1 | V |
| | | | I _{OL} = 0.3 mA | 1.1 to 1.3 | — | — | V _{CC} × 0.25 | — | V _{CC} × 0.25 | |
| | | | I _{OL} = 1.7 mA | 1.4 to 1.6 | — | — | V _{CC} × 0.25 | — | V _{CC} × 0.25 | |
| | | | I _{OL} = 3.0 mA | 1.65 to 1.95 | — | — | 0.45 | — | 0.45 | |
| | | | I _{OL} = 4.0 mA | 2.3 to 2.7 | — | — | 0.4 | — | 0.4 | |
| | | | I _{OL} = 8.0 mA | 3.0 to 3.6 | — | — | 0.4 | — | 0.4 | |
| Input leakage current | I _{IN} | V _{IN} = 0 to 5.5V | 0 to 3.6 | — | — | ±0.1 | — | ±1.0 | μA | |
| Power off leakage current | I _{OFF} | V _{IN} = 0 to 5.5V V _{OUT} = 0 to 3.6V | 0 | — | — | 1.0 | — | 10.0 | μA | |
| Quiescent supply current | I _{CC} | V _{IN} = V _{CC} or GND | 3.6 | — | — | 1.0 | — | 10.0 | μA | |

AC Characteristics (unless otherwise specified, Input: $t_r = t_f = 3$ ns)

| Characteristics | Symbol | Test Condition | Ta = 25°C | | | Ta = -40 to 85°C | | Unit | |
|-------------------------------|------------------------|--|---------------------|-----|------|------------------|-----|------|-----|
| | | | V _{CC} (V) | Min | Typ. | Max | Min | | Max |
| Propagation delay time | t_{pLH} t_{pHL} | $C_L = 10$ pF, $R_L = 1$ M Ω | 0.9 | — | 17.0 | — | — | — | ns |
| | | | 1.1 to 1.3 | — | 8.8 | 18.4 | 1.0 | 34.2 | |
| | | | 1.4 to 1.6 | — | 5.0 | 8.5 | 1.0 | 10.0 | |
| | | | 1.65 to 1.95 | — | 3.8 | 6.2 | 1.0 | 6.7 | |
| | | | 2.3 to 2.7 | — | 2.7 | 3.9 | 1.0 | 4.4 | |
| | | | 3.0 to 3.6 | — | 2.1 | 3.1 | 1.0 | 3.7 | |
| | | $C_L = 15$ pF, $R_L = 1$ M Ω | 0.9 | — | 20.7 | — | — | — | |
| | | | 1.1 to 1.3 | — | 10.6 | 21.5 | 1.0 | 37.2 | |
| | | | 1.4 to 1.6 | — | 5.9 | 9.3 | 1.0 | 11.2 | |
| | | | 1.65 to 1.95 | — | 4.5 | 6.9 | 1.0 | 7.1 | |
| | | | 2.3 to 2.7 | — | 3.0 | 4.4 | 1.0 | 5.0 | |
| | | | 3.0 to 3.6 | — | 2.4 | 3.4 | 1.0 | 3.9 | |
| | | $C_L = 30$ pF, $R_L = 1$ M Ω | 0.9 | — | 29.6 | — | — | — | |
| | | | 1.1 to 1.3 | — | 14.8 | 29.6 | 1.0 | 56.0 | |
| | | | 1.4 to 1.6 | — | 8.0 | 13.1 | 1.0 | 15.9 | |
| | | | 1.65 to 1.95 | — | 6.0 | 9.2 | 1.0 | 9.6 | |
| | | | 2.3 to 2.7 | — | 3.9 | 5.7 | 1.0 | 6.1 | |
| | | | 3.0 to 3.6 | — | 3.0 | 4.4 | 1.0 | 4.8 | |
| Input capacitance | C _{IN} | — | 3.6 | — | 3 | — | — | pF | |
| Power dissipation capacitance | C _{PD} | (Note 13) | 0.9 to 3.6 | — | 6 | — | — | — | pF |

Note 13: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

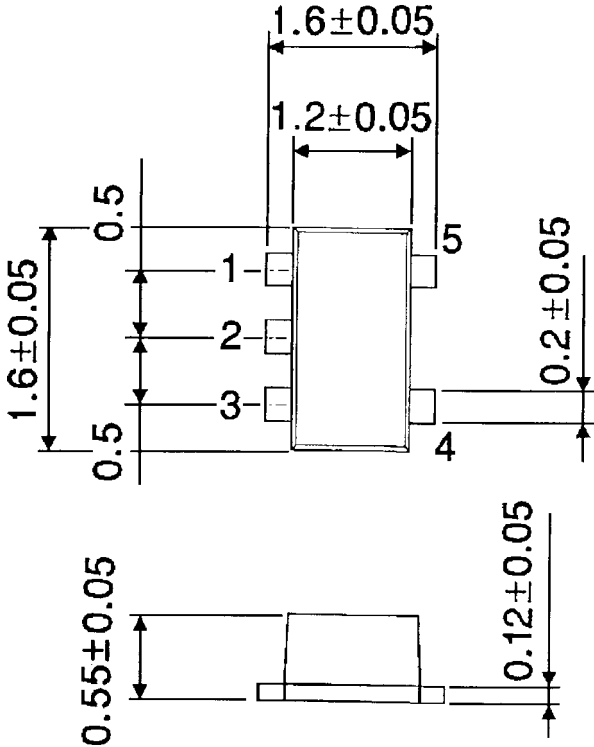
Average operating current can be obtained by the equation:

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

Package Dimensions

SON5-P-0.50

Unit : mm



Weight: 0.003 g (typ.)

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