

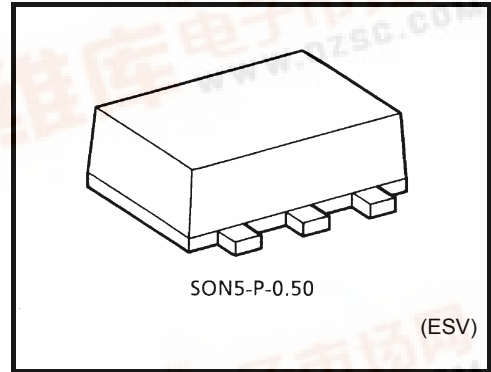
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7SG04FE

Inverter

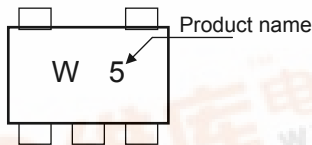
Features

- High-level output current: $I_{OH}/I_{OL} = \pm 8 \text{ mA}$ (min) at $V_{CC} = 3.0 \text{ V}$
- High-speed operation: $t_{pd} = 2.3 \text{ ns}$ (typ.) at $V_{CC} = 3.3 \text{ V}, 15\text{pF}$
- Operating voltage range: $V_{CC} = 0.9\sim 3.6 \text{ V}$
- 5.5-V tolerant input.
- 3.6-V power down protection output.

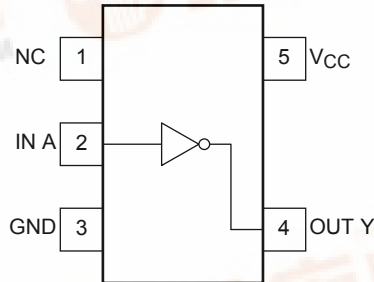


Weight: 0.003 g (typ.)

Marking



Pin Assignment (top view)



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

| Characteristics | Symbol | Value | Unit |
|-----------------------------|-----------|-------------------------------|------------------|
| Power supply voltage | V_{CC} | -0.5~4.6 | V |
| DC input voltage | V_{IN} | -0.5~7.0 | V |
| DC output voltage | V_{OUT} | -0.5~4.6 (Note 1) | V |
| | | -0.5~ $V_{CC} + 0.5$ (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} | -65~150 | $^\circ\text{C}$ |

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).

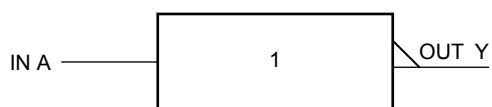
Note 1: $V_{CC} = 0\text{V}$

Note 2: High or Low State. I_{OUT} absolute maximum rating must be observed.

Note 3: $V_{OUT} < \text{GND}$



IEC Logic Symbol



Truth Table

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

Operating Ranges

| Characteristics | Symbol | Value | Unit |
|--------------------------|-----------------|----------------------|-------------|
| Power supply voltage | V_{CC} | 0.9~3.6 | V |
| Input voltage | V_{IN} | 0~5.5 | V |
| Output voltage | V_{OUT} | 0~3.6 (Note 4) | V |
| | | 0~ 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} | -40~85 | $^{\circ}C$ |
| Input rise and fall time | dt/dV | 0~10 (Note 12) | ns/V |

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

Note 5: High or Low state.

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

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

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

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

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

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

Note 12: $V_{IN} = 0.8\sim 2.0 V, V_{CC} = 3.0 V$

DC Electrical Characteristics

| Characteristics | Symbol | Test Condition | Ta = 25°C | | | Ta = -40~85°C | | Unit | | |
|---------------------------|------------------|-------------------------------------------------------|----------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|---|
| | | | V _{CC} (V) | Min | Typ. | Max | Min | | Max | |
| High-level input voltage | V _{IH} | — | 0.9 | V _{CC} | — | — | V _{CC} | — | V | |
| | | | 1.1~1.3 | V _{CC} × 0.7 | — | — | V _{CC} × 0.7 | — | | |
| | | | 1.4~1.6 | V _{CC} × 0.65 | — | — | V _{CC} × 0.65 | — | | |
| | | | 1.65~1.95 | V _{CC} × 0.65 | — | — | V _{CC} × 0.65 | — | | |
| | | | 2.3~2.7 | 1.7 | — | — | 1.7 | — | | |
| | | | 3.0~3.6 | 2.0 | — | — | 2.0 | — | | |
| Low-level input voltage | V _{IL} | — | 0.9 | — | — | GND | — | GND | V | |
| | | | 1.1~1.3 | — | — | V _{CC} × 0.3 | — | V _{CC} × 0.3 | | |
| | | | 1.4~1.6 | — | — | V _{CC} × 0.35 | — | V _{CC} × 0.35 | | |
| | | | 1.65~1.95 | — | — | V _{CC} × 0.35 | — | V _{CC} × 0.35 | | |
| | | | 2.3~2.7 | — | — | 0.7 | — | 0.7 | | |
| | | | 3.0~3.6 | — | — | 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 | 1.1~1.3 | V _{CC} × 0.75 | — | — | V _{CC} × 0.75 | — | |
| | | | I _{OH} = -1.7 mA | 1.4~1.6 | V _{CC} × 0.75 | — | — | V _{CC} × 0.75 | — | |
| | | | I _{OH} = -3.0 mA | 1.65~1.95 | V _{CC} - 0.45 | — | — | V _{CC} - 0.45 | — | |
| | | | I _{OH} = -4.0 mA | 2.3~2.7 | 2.0 | — | — | 2.0 | — | |
| | | | I _{OH} = -8.0 mA | 3.0~3.6 | 2.48 | — | — | 2.48 | — | |
| Low-level output voltage | V _{OL} | V _{IN} = V _{IH} | I _{OL} = 0.02 mA | 0.9 | — | — | 0.1 | — | 0.1 | V |
| | | | I _{OL} = 0.3 mA | 1.1~1.3 | — | — | V _{CC} × 0.25 | — | V _{CC} × 0.25 | |
| | | | I _{OL} = 1.7 mA | 1.4~1.6 | — | — | V _{CC} × 0.25 | — | V _{CC} × 0.25 | |
| | | | I _{OL} = 3.0 mA | 1.65~1.95 | — | — | 0.45 | — | 0.45 | |
| | | | I _{OL} = 4.0 mA | 2.3~2.7 | — | — | 0.4 | — | 0.4 | |
| | | | I _{OL} = 8.0 mA | 3.0~3.6 | — | — | 0.4 | — | 0.4 | |
| Input leakage current | I _{IN} | V _{IN} = 0~5.5V | 0~3.6 | — | — | ±0.1 | — | ±1.0 | μA | |
| Power off leakage current | I _{OFF} | V _{IN} = 0~5.5V V _{OUT} = 0~3.6V | 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 Electrical Characteristics (input $t_r = t_f = 3$ ns)

| Characteristics | Symbol | Test Condition | Ta = 25°C | | | Ta = -40~85°C | | Unit | |
|-------------------------------|--------------------------------------|--------------------------------------------------|---------------------|-----|------|---------------|-----|------|------|
| | | | V _{CC} (V) | Min | Typ. | Max | Min | | Max |
| Propagation delay time | t _{PLH} t _{PHL} | C _L = 10 pF, R _L = 1 MΩ | 0.9 | — | 18.6 | — | — | ns | |
| | | | 1.1~1.3 | — | 8.7 | 18.4 | 1.0 | | 34.2 |
| | | | 1.4~1.6 | — | 4.9 | 8.5 | 1.0 | | 10.0 |
| | | | 1.65~1.95 | — | 3.8 | 6.2 | 1.0 | | 6.7 |
| | | | 2.3~2.7 | — | 2.6 | 3.9 | 1.0 | | 4.4 |
| | | | 3.0~3.6 | — | 2.1 | 3.1 | 1.0 | | 3.7 |
| | | C _L = 15 pF, R _L = 1 MΩ | 0.9 | — | 21.0 | — | — | | — |
| | | | 1.1~1.3 | — | 9.8 | 21.5 | 1.0 | | 37.1 |
| | | | 1.4~1.6 | — | 5.4 | 9.3 | 1.0 | | 11.2 |
| | | | 1.65~1.95 | — | 4.2 | 6.9 | 1.0 | | 7.1 |
| | | | 2.3~2.7 | — | 2.8 | 4.4 | 1.0 | | 5.0 |
| | | | 3.0~3.6 | — | 2.3 | 3.4 | 1.0 | | 3.9 |
| | | C _L = 30 pF, R _L = 1 MΩ | 0.9 | — | 31.2 | — | — | | — |
| | | | 1.1~1.3 | — | 13.8 | 29.6 | 1.0 | | 56.0 |
| | | | 1.4~1.6 | — | 7.4 | 13.1 | 1.0 | | 15.9 |
| | | | 1.65~1.95 | — | 5.6 | 9.2 | 1.0 | | 9.6 |
| | | | 2.3~2.7 | — | 3.7 | 5.7 | 1.0 | | 6.1 |
| | | | 3.0~3.6 | — | 2.9 | 4.4 | 1.0 | | 4.8 |
| Input capacitance | C _{IN} | — | 3.6 | — | 3 | — | — | pF | |
| Power dissipation capacitance | C _{PD} | (Note 13) | 0.9~3.6 | — | 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.

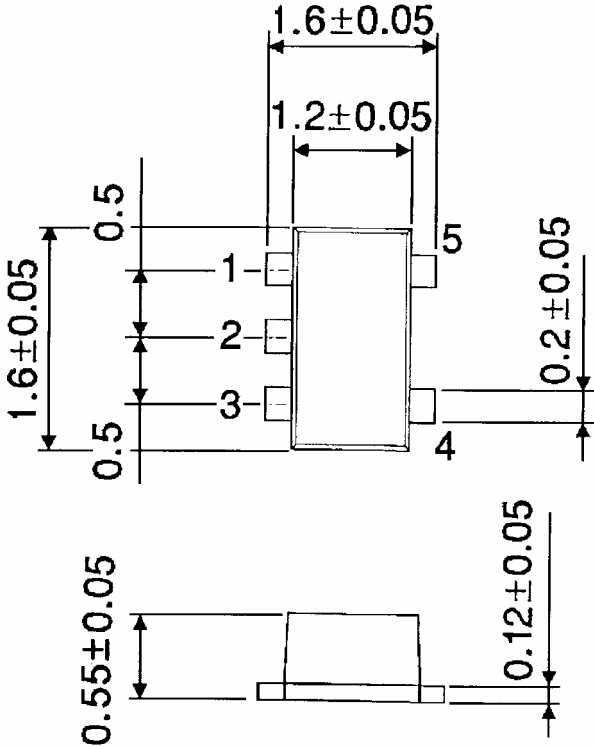
Average operating current can be obtained by the equation:

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

Package Dimensions

SON5-P-0.50

Unit : mm



Weight: 0.003 g (typ.)

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20070701-EN GENERAL

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