

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

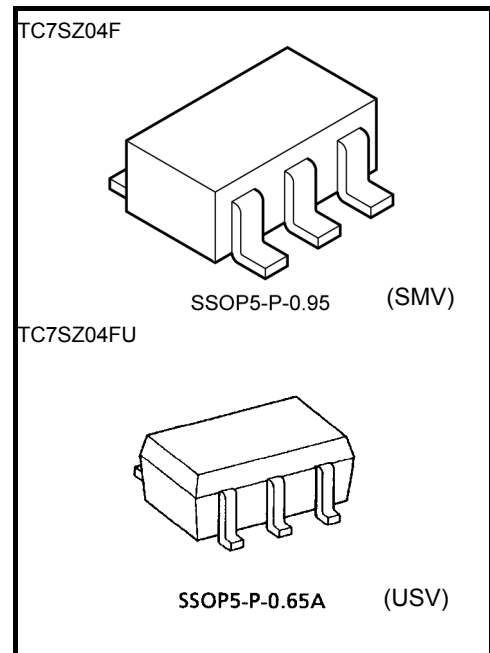
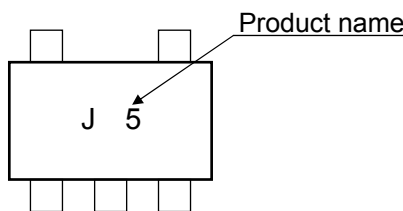
TC7SZ04F, TC7SZ04FU

Inverter

Features

- High output current : ± 24 mA (min) at $V_{CC} = 3$ V
- Super high speed operation : $t_{pd} = 2.4$ ns (typ.)
at $V_{CC} = 5$ V, $C_L = 50$ pF
- Operation voltage range : $V_{CC} = 1.8$ to 5.5 V
- 5.5-V tolerant input
- 5.5-V power down protection output
- Matches the performance of TC74LCX series when operated at 3.3- V V_{CC}

Marking

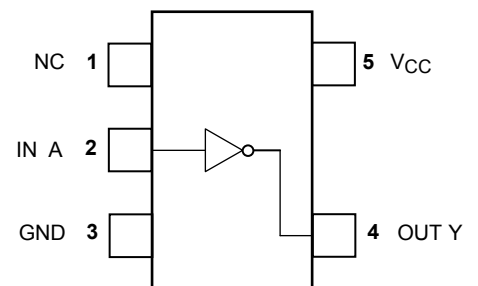


Weight
 SSOP5-P-0.95 : 16.0 mg (typ.)
 SSOP5-P-0.65A: 6.0 mg (typ.)

Absolute Maximum Ratings (Ta = 25°C)

| Characteristics | Symbol | Rating | Unit |
|-----------------------------|-----------|---------------------------------|------|
| Supply voltage | V_{CC} | -0.5 to 6 | V |
| DC input voltage | V_{IN} | -0.5 to 6 | V |
| DC output voltage | V_{OUT} | -0.5 to 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} | ± 50 | mA |
| DC V_{CC} /ground current | I_{CC} | ± 50 | 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.

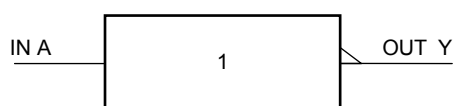
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

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

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 | Y |
| L | H |
| H | L |

Operating Ranges

| Characteristics | Symbol | Rating | Unit |
|--------------------------|-----------|--|------|
| Supply voltage | V_{CC} | 1.8 to 5.5 | V |
| | | 1.5 to 5.5 (Note 4) | |
| Input voltage | V_{IN} | 0 to 5.5 | V |
| Output voltage | V_{OUT} | 0 to 5.5 (Note 5) | V |
| | | 0 to V_{CC} (Note 6) | |
| Operating temperature | T_{opr} | -40 to 85 | °C |
| Input rise and fall time | dt/dv | 0 to 20 ($V_{CC} = 1.8\text{ V}, 2.5\text{ V} \pm 0.2\text{ V}$) | ns/V |
| | | 0 to 10 ($V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$) | |
| | | 0 to 5 ($V_{CC} = 5.0\text{ V} \pm 0.5\text{ V}$) | |

Note 4: Data retention only

Note 5: $V_{CC} = 0\text{ V}$

Note 6: High or Low state

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} | — | 1.8 | V _{CC} × 0.88 | — | — | V _{CC} × 0.88 | — | V | | |
| | | | 2.3 to 5.5 | V _{CC} × 0.75 | — | — | V _{CC} × 0.75 | — | | | |
| Low-level input voltage | V _{IL} | — | 1.8 | — | — | V _{CC} × 0.12 | — | V _{CC} × 0.12 | V | | |
| | | | 2.3 to 5.5 | — | — | V _{CC} × 0.25 | — | V _{CC} × 0.25 | | | |
| High-level output voltage | V _{OH} | V _{IN} = V _{IL} | I _{OH} = -100 μA | 1.8 | 1.7 | 1.8 | — | 1.7 | — | V | |
| | | | | 2.3 | 2.2 | 2.3 | — | 2.2 | — | | |
| | | | | 3.0 | 2.9 | 3.0 | — | 2.9 | — | | |
| | | | | 4.5 | 4.4 | 4.5 | — | 4.4 | — | | |
| | | | | I _{OH} = -8 mA | 2.3 | 1.9 | 2.15 | — | 1.9 | | — |
| | | | | I _{OH} = -16 mA | 3.0 | 2.4 | 2.8 | — | 2.4 | | — |
| | | | | I _{OH} = -24 mA | 3.0 | 2.3 | 2.68 | — | 2.3 | | — |
| I _{OH} = -32 mA | 4.5 | 3.8 | 4.2 | — | 3.8 | — | | | | | |
| Low-level output voltage | V _{OL} | V _{IN} = V _{IH} | I _{OL} = 100 μA | 1.8 | — | 0 | 0.1 | — | 0.1 | V | |
| | | | | 2.3 | — | 0 | 0.1 | — | 0.1 | | |
| | | | | 3.0 | — | 0 | 0.1 | — | 0.1 | | |
| | | | | 4.5 | — | 0 | 0.1 | — | 0.1 | | |
| | | | | I _{OL} = 8 mA | 2.3 | — | 0.1 | 0.3 | — | | 0.3 |
| | | | | I _{OL} = 16 mA | 3.0 | — | 0.15 | 0.4 | — | | 0.4 |
| | | | | I _{OL} = 24 mA | 3.0 | — | 0.22 | 0.55 | — | | 0.55 |
| I _{OL} = 32 mA | 4.5 | — | 0.22 | 0.55 | — | 0.55 | | | | | |
| Input leakage current | I _{IN} | V _{IN} = 5.5 V or GND | 0 to 5.5 | — | — | ±1 | — | ±10 | μA | | |
| Power off leakage current | I _{OFF} | V _{IN} or V _{OUT} = 5.5 V | 0.0 | — | — | 1 | — | 10 | μA | | |
| Quiescent supply current | I _{CC} | V _{IN} = V _{CC} or GND | 5.5 | — | — | 2 | — | 20 | 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} | C _L = 15 pF, R _L = 1 MΩ | 1.8 | 2.0 | 4.4 | 9.5 | 2.0 | 10.0 | ns |
| | | | 2.5 ± 0.2 | 0.8 | 2.9 | 6.5 | 0.8 | 7.0 | |
| | t _{pHL} | | 3.3 ± 0.3 | 0.5 | 2.1 | 4.5 | 0.5 | 4.7 | |
| | 5.0 ± 0.5 | | 0.5 | 1.8 | 3.9 | 0.5 | 4.1 | | |
| | C _L = 50 pF, R _L = 500 Ω | | 3.3 ± 0.3 | 1.5 | 2.9 | 5.0 | 1.5 | 5.2 | |
| | | | 5.0 ± 0.5 | 0.8 | 2.4 | 4.3 | 0.8 | 4.5 | |
| Input capacitance | C _{IN} | — | 0 to 5.5 | — | 4 | — | — | pF | |
| Power dissipation capacitance | C _{PD} | (Note 7) | 3.3 | — | 20 | — | — | — | pF |
| | | | 5.5 | — | 26 | — | — | — | |

Note 7: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

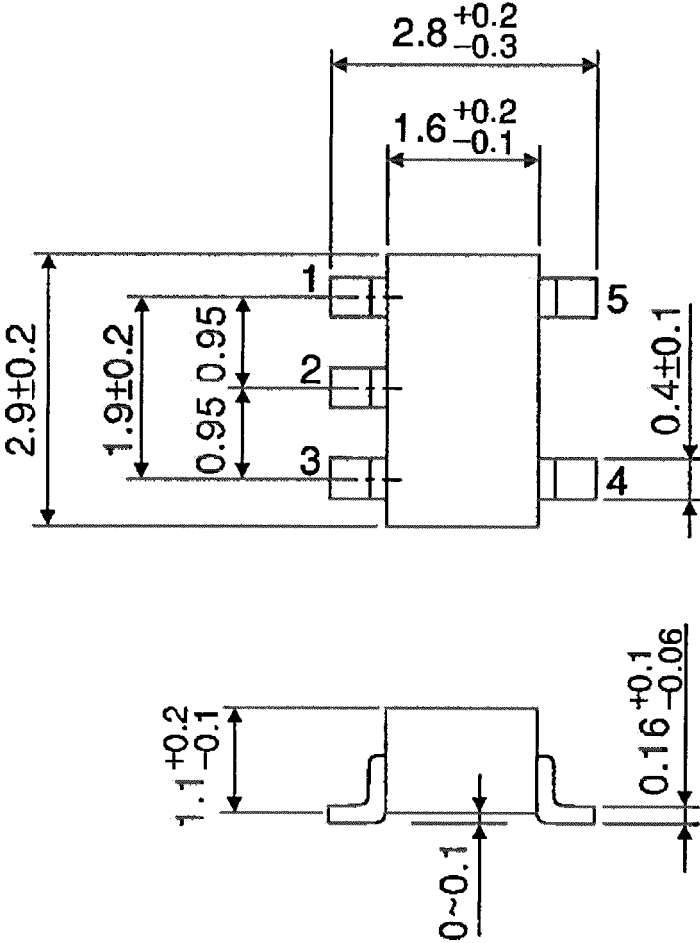
Average operating current can be obtained by the equation:

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

Package Dimensions

SSOP5-P-0.95

Unit : mm

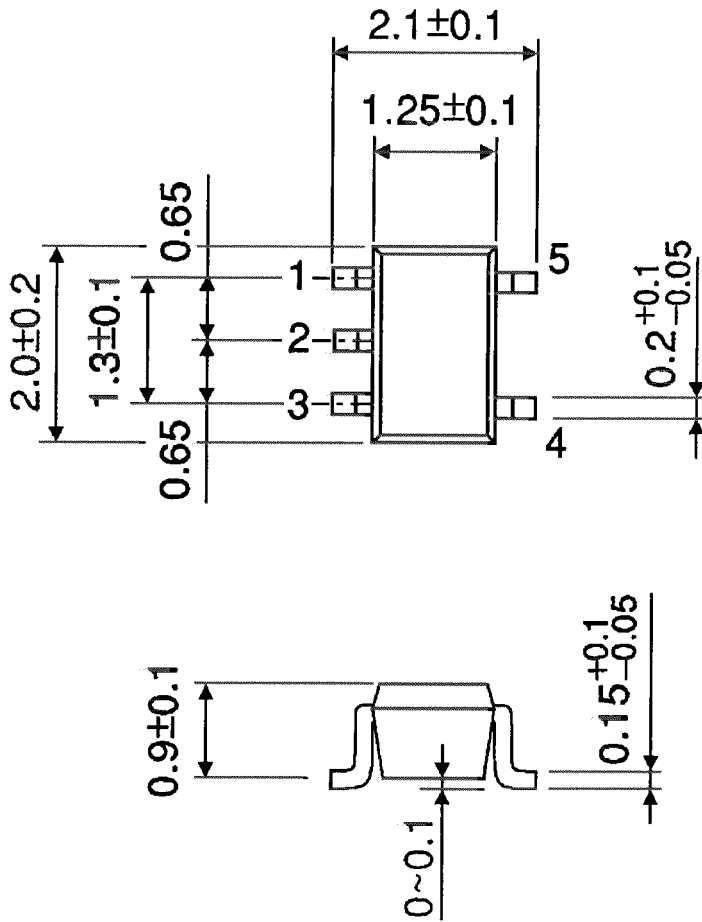


Weight: 16.0 mg (typ.)

Package Dimensions

SSOP5-P-0.65A

Unit : mm



Weight: 6.0 mg (typ.)

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