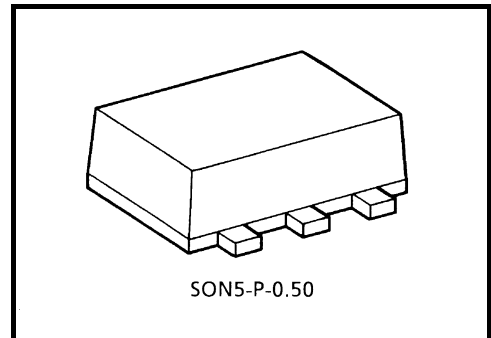


# TC7SZ04AFE

## Inverter

### Features

- High output drive:  $\pm 24$  mA (typ.)  
@ $V_{CC} = 3$  V
- Super high speed operation:  $t_{PD} 2.4$  ns (typ.)  
@ $V_{CC} = 5$  V, 50 pF
- Operation voltage range:  $V_{CC (opr)} = 1.8\sim 5.5$  V
- Supply voltage data retention:  $V_{CC} = 1.5\sim 5.5$  V
- Latch-up performance:  $\pm 500$  mA
- ESD performance: Human body model  $> \pm 2000$  V  
Machine model  $> \pm 200$  V
- Power down protection is provided on all inputs.
- Matches the performance of TC74LCX series when operated at 3.3 V  $V_{CC}$
- Input rise and fall time ( $t_r$ ,  $t_f$ ) (recommended operation condition)  
@ $V_{CC} = 1.8$  V, 2.5 V  $\pm 0.2$  V: 0~20 ns/V  
@ $V_{CC} = 3.3$  V  $\pm 0.3$  V: 0~10 ns/V  
@ $V_{CC} = 5.5$  V  $\pm 0.5$  V: 0~5 ns/V



Weight: 0.003 g (typ.)

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

| Characteristics             | Symbol    | Rating               | Unit             |
|-----------------------------|-----------|----------------------|------------------|
| Supply voltage range        | $V_{CC}$  | -0.5~6               | V                |
| DC input voltage            | $V_{IN}$  | -0.5~6               | V                |
| DC output voltage           | $V_{OUT}$ | -0.5~ $V_{CC} + 0.5$ | V                |
| Input diode current         | $I_{IK}$  | $\pm 20$             | mA               |
| Output diode current        | $I_{OK}$  | $\pm 20$             | mA               |
| DC output current           | $I_{OUT}$ | $\pm 50$             | mA               |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 50$             | mA               |
| Power dissipation           | $P_D$     | 150                  | mW               |
| Storage temperature         | $T_{stg}$ | -65~150              | $^\circ\text{C}$ |
| Lead temperature (10 s)     | $T_L$     | 260                  | $^\circ\text{C}$ |

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).

## Operating Ranges

| Characteristics          | Symbol           | Rating  | Unit |
|--------------------------|------------------|---|------|
| Supply voltage           | V <sub>CC</sub>  | 1.8~5.5                                       | V    |
|                          |                  | 1.5~5.5 (Note 1)                              |      |
| Input voltage            | V <sub>IN</sub>  | 0~5.5   | V    |
| Output voltage           | V <sub>OUT</sub> | 0~V <sub>CC</sub>                             | V    |
| Operating temperature    | T <sub>opr</sub> | -40~85  | °C   |
| Input rise and fall time | dt/dv            | 0~20 (V <sub>CC</sub> = 1.8 V, 2.5 V ± 0.2 V) | ns/V |
|                          |                  | 0~10 (V <sub>CC</sub> = 3.3 V ± 0.3 V)        |      |
|                          |                  | 0~5 (V <sub>CC</sub> = 5.5 V ± 0.5 V)         |      |

Note 1: Data retention only.

## Electrical Characteristics

### DC Characteristics

| Characteristics           | Symbol          | Test Circuit | Test Condition                           | Ta = 25°C                 |                          |      | Ta = -40~85°C          |                        | Unit                   |     |   |      |
|---------------------------|-----------------|--------------|--|---------------------------|--------------------------|------|------------------------|------------------------|------------------------|-----|---|------|
|                           |                 |              |  | V <sub>CC</sub> (V)       | Min                      | Typ. | Max                    | Min                    |                        | Max |   |      |
| High-level input voltage  | V <sub>IH</sub> | —            | —  | 1.8                       | 0.75 × V <sub>CC</sub>   | —    | —                      | 0.75 × V <sub>CC</sub> | —                      | V   |   |      |
|                           |                 |              |  | 2.3-5.5                   | 0.7 × V <sub>CC</sub>    | —    | —                      | 0.7 × V <sub>CC</sub>  | —                      |     |   |      |
| Low-level input voltage   | V <sub>IL</sub> | —            | —  | 1.8                       | —                        | —    | 0.25 × V <sub>CC</sub> | —                      | 0.25 × V <sub>CC</sub> | V   |   |      |
|                           |                 |              |  | 2.3-5.5                   | —                        | —    | 0.3 × V <sub>CC</sub>  | —                      | 0.3 × V <sub>CC</sub>  |     |   |      |
| High-level output voltage | V <sub>OH</sub> | —            | V <sub>IN</sub> = V <sub>IL</sub>        | I <sub>OH</sub> = -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 <sub>OH</sub> = -8 mA  | 2.3  | 1.9                    | 2.15                   | —                      | 1.9 |   | —    |
|                           |                 |              |  |                           | I <sub>OH</sub> = -16 mA | 3.0  | 2.4                    | 2.8                    | —                      | 2.4 |   | —    |
|                           |                 |              |  |                           | I <sub>OH</sub> = -24 mA | 3.0  | 2.3                    | 2.68                   | —                      | 2.3 |   | —    |
| I <sub>OH</sub> = -32 mA  | 4.5             | 3.8          | 4.2                                      | —                         | 3.8                      | —    |                        |                        |                        |     |   |      |
| Low-level output voltage  | V <sub>OL</sub> | —            | V <sub>IN</sub> = V <sub>IH</sub>        | I <sub>OL</sub> = 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 <sub>OL</sub> = 8 mA   | 2.3  | —                      | 0.1                    | 0.3                    | —   |   | 0.3  |
|                           |                 |              |  |                           | I <sub>OL</sub> = 16 mA  | 3.0  | —                      | 0.15                   | 0.4                    | —   |   | 0.4  |
|                           |                 |              |  |                           | I <sub>OL</sub> = 24 mA  | 3.0  | —                      | 0.22                   | 0.55                   | —   |   | 0.55 |
| I <sub>OL</sub> = 32 mA   | 4.5             | —            | 0.22                                     | 0.55                      | —                        | 0.55 |                        |                        |                        |     |   |      |
| Input leakage current     | I <sub>IN</sub> | —            | V <sub>IN</sub> = 5.5 V or GND           | 0-5.5                     | —                        | —    | ±1                     | —                      | ±10                    | μA  |   |      |
| Quiescent supply current  | I <sub>CC</sub> | —            | V <sub>IN</sub> = V <sub>CC</sub> or GND | 5.5                       | —                        | —    | 2                      | —                      | 20                     | μA  |   |      |

### AC Characteristics (input: $t_r = t_f = 3 \text{ ns}$ )

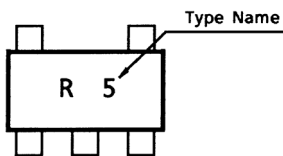
| Characteristics               | Symbol           | Test Circuit | Test Condition                                   | Ta = 25°C           |   |           | Ta = -40~85°C |     | Unit |     |     |     |
|-------------------------------|------------------|--------------|--|---------------------|---|-----------|---------------|-----|------|-----|-----|-----|
|                               |                  |              |  | V <sub>CC</sub> (V) | Min   | Typ.      | Max           | Min |      | Max |     |     |
| Propagation delay time        | t <sub>PLH</sub> | —            | C <sub>L</sub> = 15 pF,<br>R <sub>L</sub> = 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 <sub>PHL</sub> |              |  | 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 <sub>L</sub> = 50 pF,<br>R <sub>L</sub> = 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 <sub>IN</sub>  | —            | —  | 0-5.5               | —   | 4         | —             | —   | pF   |     |     |     |
| Power dissipation capacitance | C <sub>PD</sub>  | —            | (Note)   | 3.3                 | —   | 21        | —             | —   | —    | pF  |     |     |
|                               |                  |              |  | 5.5                 | —   | 34        | —             | —   | —    |     |     |     |

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

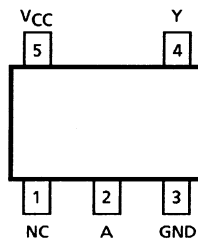
Average operating current can be obtained by the equation.

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

### Marking



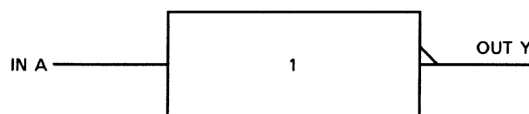
### Pin Assignment (top view)



### Truth Table

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

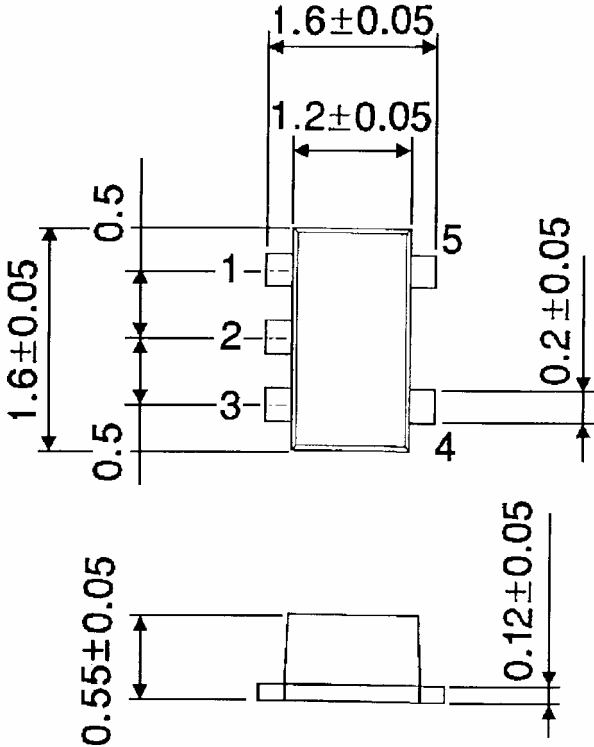
### Logic Diagram



**Package Dimensions**

SON5-P-0.50

Unit : mm



Weight: 0.003 g (typ.)

**RESTRICTIONS ON PRODUCT USE**

20070701-EN GENERAL

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