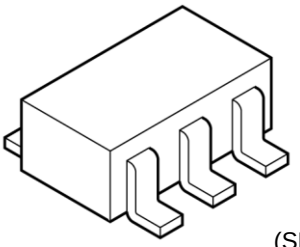
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7SZ125F

Bus Buffer with 3-State Output

## Features

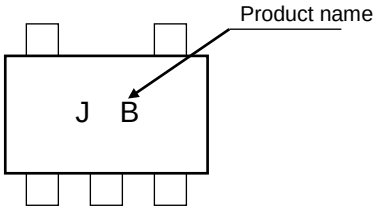
- High output current: ±24 mA (min) at $V_{CC}$ = 3 V
- Super high speed operation: $t_{pd}$ 2.6 ns (typ.) at $V_{CC}$ = 5 V, 50 pF
- Operation voltage range: $V_{CC}$ = 1.8 to 5.5 V
- 5.5-V tolerant inputs
- 5.5-V power down protection output
- Matches the performance of TC74LCX series when operated at 3.3 V $V_{CC}$



SSOP5-P-0.95 (SMV)

Weight: 0.016 g (typ.)

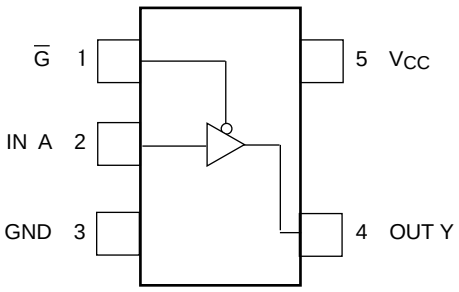
## Marking




## 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).

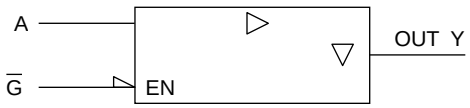
Note 1: $V_{CC}$ = 0 V or high impedance condition.

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

Note 3: $V_{OUT}$ < GND

Start of commercial production
1998-08

## IEC Logic Symbol




## Truth Table

| Input | | Output |
|---|---|---|
| A | $\overline{G}$ | Y |
| X | H | Z |
| L | L | L |
| H | L | H |

X: Don't Care
Z: High Impedance

## 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 V, 2.5 V ± 0.2 V) | ns/V |
| | | 0 to 10 ($V_{CC}$ = 3.3 V ± 0.3 V) | |
| | | 0 to 5 ($V_{CC}$ = 5.0 V ± 0.5 V) | |

Note 4: Data retention only

Note 5: $V_{CC}$ = 0 V or high impedance condition

Note 6: High or Low state

## Electrical Characteristics

## DC Characteristics

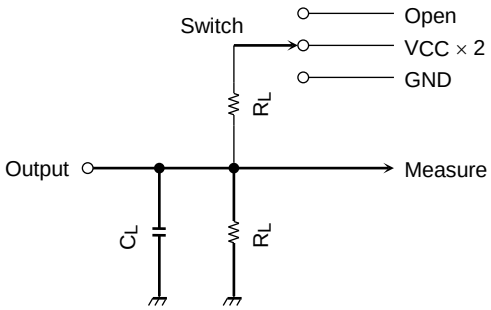
| Characteristics | | Symbol | Test Condition | | Ta = 25°C | | | Ta = −40 to 85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $V_{CC}$ (V) | Min | Typ. | Max | Min | Max | |
| Input voltage | High level | $V_{IH}$ | — | 1.8 | $V_{CC}$ ×0.88 | — | — | $V_{CC}$ ×0.88 | — | V |
| | | | | 2.3 to 5.5 | $V_{CC}$ ×0.75 | — | — | $V_{CC}$ ×0.75 | — | |
| | Low level | $V_{IL}$ | — | 1.8 | — | — | $V_{CC}$ ×0.12 | — | $V_{CC}$ ×0.12 | |
| | | | | 2.3 to 5.5 | — | — | $V_{CC}$ ×0.25 | — | $V_{CC}$ ×0.25 | |
| Output voltage | High level | $V_{OH}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$ | $I_{OH}$ = −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 | $V_{OL}$ | $V_{IN}$ = $V_{IL}$ | $I_{OL}$ = 100 μA | 1.8 | — | 0 | 0.1 | — | 0.1 | |
| | | | | | 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 |
| 3-state output off-state leakage current | | $I_{OZ}$ | $V_{IN}$ = $V_{IH}$ or $V_{IL}$<br>$V_{OUT}$ = 0 to 5.5 V | | 1.8 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 | $t_{pLH}$ $t_{pHL}$ | $C_L$ = 15 pF, $R_L$ = 1 MΩ (Figure 1 ) | 1.8 | 2.0 | 5.3 | 11.0 | 2.0 | 11.5 | ns |
| | | | 2.5 ± 0.2 | 0.8 | 3.4 | 7.5 | 0.8 | 8.0 | |
| | | | 3.3 ± 0.3 | 0.5 | 2.5 | 5.2 | 0.5 | 5.5 | |
| | | | 5.0 ± 0.5 | 0.5 | 2.1 | 4.5 | 0.5 | 4.8 | |
| | | $C_L$ = 50 pF, $R_L$ = 500 Ω (Figure 1 ) | 3.3 ± 0.3 | 1.5 | 3.2 | 5.7 | 1.5 | 6.0 | |
| | | | 5.0 ± 0.5 | 0.8 | 2.6 | 5.0 | 0.8 | 5.3 | |
| Output enable time | $t_{pZL}$ $t_{pZH}$ | $C_L$ = 50 pF, $R_L$ = 500 Ω (Figure 1 ) | 1.8 | 2.0 | 7.0 | 12.5 | 2.0 | 13.0 | ns |
| | | | 2.5 ± 0.2 | 1.5 | 4.6 | 8.5 | 1.5 | 9.0 | |
| | | | 3.3 ± 0.3 | 1.5 | 3.5 | 6.2 | 1.5 | 6.5 | |
| | | | 5.0 ± 0.5 | 0.8 | 2.8 | 5.5 | 0.8 | 5.8 | |
| Output disable time | $t_{pLZ}$ $t_{pHZ}$ | $C_L$ = 50 pF, $R_L$ = 500 Ω (Figure 1 ) | 1.8 | 2.0 | 5.4 | 11.0 | 2.0 | 12.0 | ns |
| | | | 2.5 ± 0.2 | 1.5 | 3.5 | 8.0 | 1.5 | 8.5 | |
| | | | 3.3 ± 0.3 | 1.0 | 2.8 | 5.7 | 1.0 | 6.0 | |
| | | | 5.0 ± 0.5 | 0.5 | 2.1 | 4.7 | 0.5 | 5.0 | |
| Input capacitance | $C_{IN}$ | — | 0 to 5.5 | — | 4 | — | — | — | pF |
| Power dissipation capacitance | $C_{PD}$ | (Note 7) | 3.3 | — | 17 | — | — | — | pF |
| | | | 5.5 | — | 24 | — | — | — | |

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

## AC Characteristics Measurement Circuit

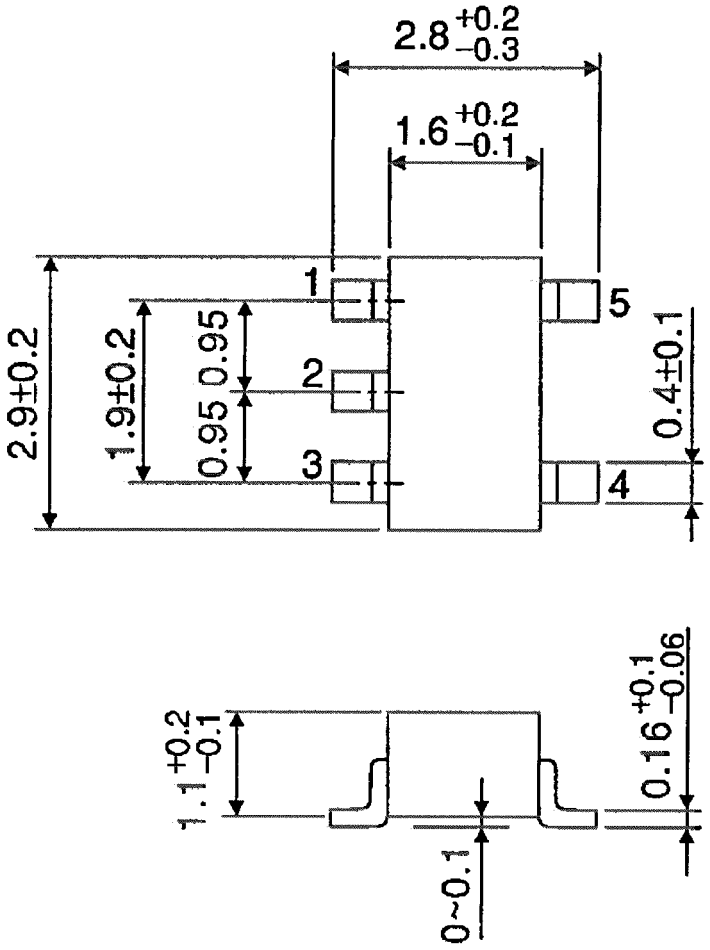



| Characteristics | Switch |
|---|---|
| $t_{pLH}$, $t_{pHL}$ | Open |
| $t_{pLZ}$, $t_{pZL}$ | $V_{CC}$ × 2 |
| $t_{pHZ}$, $t_{pZH}$ | GND |

**Figure 1**

## Package Dimensions

**SSOP5-P-0.95** **Unit: mm**




Weight: 0.016 g (typ.)

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