Preliminary TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

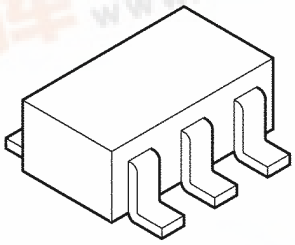
# TC7SZ14F,TC7SZ14FU

Schmitt Inverter

## Features

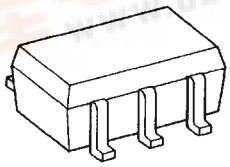
- High output drive: ±24 mA (min) @$V_{CC}$ = 3 V
- High speed: $t_{pd}$ = 3.7 ns (typ.) @$V_{CC}$ = 5 V, 50 pF
- Wide operating voltage range: $V_{CC\ (opr)}$ = 1.65 to 5.5 V
- High latch-up immunity: Higher than or equal to ±500 mA
- High ESD : Higher than or equal to ±200 V (JEITA)
  : Higher than or equal to ±2000 V (MIL)
- Power-down protection is provided on all inputs and outputs.
- Matches the performance of TC74LCX Series when operated at 3.3 V

TC7SZ14F



SSOP5-P-0.95 (SMV)

TC7SZ14FU



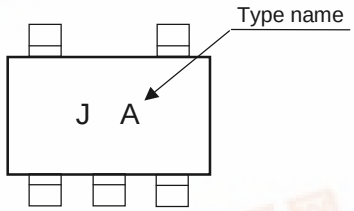
SSOP5-P-0.65A (USV)

Weight:
SSOP5-P-0.95 : 0.016 g (typ.)
SSOP5-P-0.65A : 0.006 g (typ.)

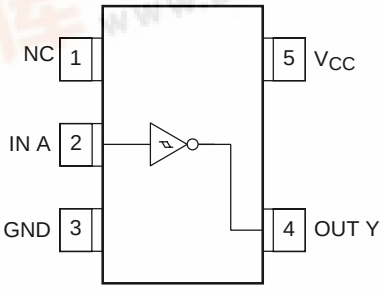
## Maximum Ratings (Ta = 25°C)

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Supply voltage range | $V_{CC}$ | −0.5 to 6 | V |
| DC input voltage | $V_{IN}$ | −0.5 to 6 | V |
| DC output voltage | $V_{OUT}$ | −0.5 to 6 | V |
| Input diode current | $I_{IK}$ | −20 | mA |
| Output diode current | $I_{OK}$ | −20 | 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 |

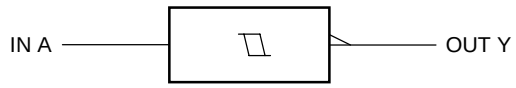
## Marking




## Pin Assignment (top view)



## Logic Diagram




## Truth Table

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

## Recommended Operating Conditions

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Supply voltage | $V_{CC}$ | 1.65 to 5.5 | V |
| | | 1.5 to 5.5 (Note 1) | |
| Input voltage | $V_{IN}$ | 0 to 5.5 | V |
| Output voltage | $V_{OUT}$ | 0 to 5.5 (Note 2) | V |
| | | 0 to $V_{CC}$ (Note 3) | |
| Operating temperature | $T_{opr}$ | −40 to 85 | °C |

Note 1: Date retention only

Note 2: $V_{CC}$ = 0 V

Note 3: High or Low State

## Electrical Characteristics

## DC Electrical Characteristics

| Characteristics | Symbol | Test Condition | | Ta = 25°C | | | Ta = −40~85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{CC}$ (V) | Min | Typ. | Max | Min | Max | |
| Positive threshold voltage | $V_P$ | — | 1.65 | 0.6 | 1.0 | 1.4 | 0.65 | 1.4 | V |
| | | | 1.8 | 0.7 | 1.1 | 1.5 | 0.7 | 1.5 | |
| | | | 2.3 | 1.0 | 1.4 | 1.8 | 1.0 | 1.8 | |
| | | | 3.0 | 1.3 | 1.75 | 2.2 | 1.3 | 2.2 | |
| | | | 4.5 | 1.9 | 2.45 | 3.1 | 1.9 | 3.1 | |
| | | | 5.5 | 2.2 | 2.9 | 3.6 | 2.2 | 3.6 | |
| Negative threshold voltage | $V_N$ | — | 1.65 | 0.2 | 0.5 | 0.8 | 0.2 | 0.8 | |
| | | | 1.8 | 0.25 | 0.55 | 0.9 | 0.25 | 0.9 | |
| | | | 2.3 | 0.40 | 0.75 | 1.15 | 0.40 | 1.15 | |
| | | | 3.0 | 0.6 | 1.0 | 1.5 | 0.6 | 1.5 | |
| | | | 4.5 | 1.0 | 1.43 | 2.0 | 1.0 | 2.0 | |
| | | | 5.5 | 1.2 | 1.70 | 2.4 | 1.2 | 2.4 | |
| Hysteresis voltage | $V_H$ | — | 1.65 | 0.1 | 0.48 | 0.9 | 0.1 | 1.0 | V |
| | | | 1.8 | 0.15 | 0.54 | 1.0 | 0.15 | 1.0 | |
| | | | 2.3 | 0.25 | 0.65 | 1.1 | 0.25 | 1.1 | |
| | | | 3.0 | 0.4 | 0.77 | 1.2 | 0.4 | 1.2 | |
| | | | 4.5 | 0.6 | 1.01 | 1.5 | 0.6 | 1.5 | |
| | | | 5.5 | 0.7 | 1.18 | 1.7 | 0.7 | 1.7 | |

| Characteristics | Symbol | Test Condition | | | Ta = 25°C | | | Ta = −40~85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $V_{CC}$ (V) | Min | Typ. | Max | Min | Max | |
| High-level output voltage | $V_{OH}$ | $V_{IN}$ = $V_{IL}$ | $I_{OH}$ = −100 μA | 1.65 | 1.55 | 1.65 | — | 1.55 | — | V |
| | | | | 1.8 | 1.7 | 1.8 | — | 1.7 | — | |
| | | | | 2.3 | 2.2 | 2.3 | — | 2.2 | — | |
| | | | | 3.0 | 2.9 | 3.0 | — | 2.9 | — | |
| | | | | 4.5 | 4.4 | 4.5 | — | 4.4 | — | |
| | | | $I_{OH}$ = −4 mA | 1.65 | 1.29 | 1.52 | — | 1.29 | — | |
| | | | $I_{OH}$ = −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 | 1.65 | — | 0 | 0.1 | — | 0.1 | |
| | | | | 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 | |
| | | | $I_{OL}$ = 4 mA | 1.65 | — | 0.08 | 0.24 | — | 0.24 | |
| | | | $I_{OL}$ = 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 | | 0~5.5 | — | — | ±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 | $I_{CC}$ | $V_{IN}$ = 5.5 V or GND | | 1.65~5.5 | — | — | 1 | — | 10 | μA |

## AC Electrical Characteristics (Unless otherwise specified Input: $t_r = t_f = 3$ ns)

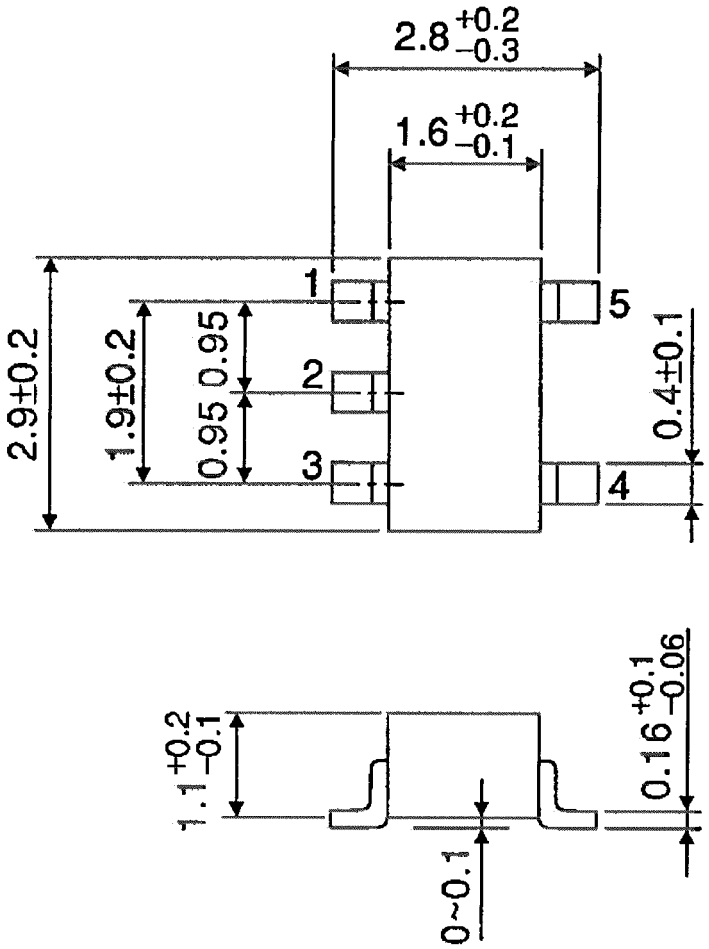
| Characteristics | Symbol | Test Condition | | Ta = 25°C | | | Ta = −40~85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{CC}$ (V) | Min | Typ. | Max | Min | Max | |
| Propagation delay time | $t_{pLH}$ $t_{pHL}$ | $C_L$ = 15 pF, $R_L$ = 1 MΩ | 1.65 | 2.0 | 9.1 | 15.0 | 2.0 | 15.6 | ns |
| | | | 1.8 | 2.0 | 7.6 | 12.5 | 2.0 | 13 | |
| | | | 2.5 ± 0.2 | 1.0 | 5.0 | 9.0 | 1.0 | 9.5 | |
| | | | 3.3 ± 0.3 | 1.0 | 3.7 | 6.3 | 1.0 | 6.5 | |
| | | | 5.0 ± 0.5 | 0.5 | 3.1 | 5.2 | 0.5 | 5.5 | |
| | | $C_L$ = 50 pF, $R_L$ = 500 Ω | 3.3 ± 0.3 | 1.5 | 4.4 | 7.2 | 1.5 | 7.5 | |
| | | | 5.0 ± 0.5 | 0.5 | 3.7 | 5.9 | 0.8 | 6.2 | |
| Input capacitance | $C_{IN}$ | — | | — | — | — | — | — | pF |
| Power dissipation capacitance | $C_{PD}$ | (Note 4) | | — | — | — | — | — | pF |

Note 4: CPD 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**

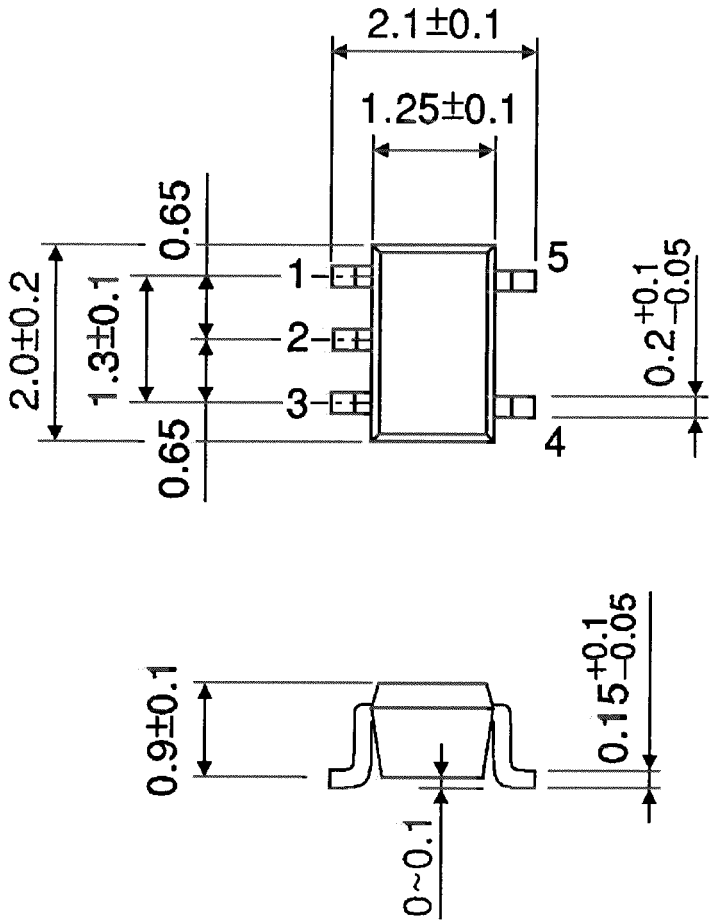
SSOP5-P-0.95 Unit : mm




Weight: 0.016 g (typ.)

**Package Dimensions**

SSOP5-P-0.65A Unit : mm




Weight: 0.006 g (typ.)

## RESTRICTIONS ON PRODUCT USE

000707EBA

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer’s own risk.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.