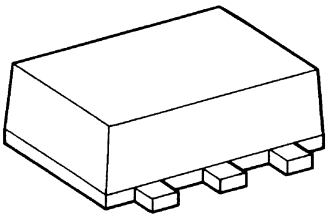
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7SHU04FS

**INVERTER (Un-Buffer)**

## Features

High speed: $t_{pd}$ = 3.5 ns (typ.) at $V_{CC}$ = 5 V
Low power dissipation: $I_{CC}$ = 2 μA (max) at Ta = 25°C
High noise immunity: $V_{NIH} = V_{NIL}$ = 10% $V_{CC}$ (min)
5.5V tolerant input.
Wide operating voltage range: $V_{CC}$ (opr) = 2~5.5 V

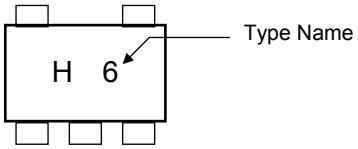


SON5-P-0.35

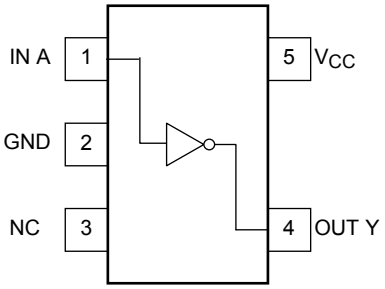
(fSV)

Weight : 0.001 g (Typ.)

## Marking (top view)




## ・Pin Assignment



## Absolute Maximum Ratings (Ta = 25°C)

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Supply voltage range | $V_{CC}$ | −0.5~7.0 | V |
| DC input voltage | $V_{IN}$ | −0.5~7.0 | V |
| DC output voltage | $V_{OUT}$ | −0.5~$V_{CC}$ + 0.5 | V |
| Input diode current | $I_{IK}$ | −20 | mA |
| Output diode current | $I_{OK}$ | ±20 | mA |
| DC output current | $I_{OUT}$ | ±25 | mA |
| DC $V_{CC}$/ground current | $I_{CC}$ | ±50 | mA |
| Power dissipation | $P_D$ | 50 | mW |
| Storage temperature | $T_{stg}$ | −65~150 | °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).

## Logic Diagram


## Truth Table

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

## Operating Ranges

| Characteristics | Symbol | Rating | Unit |
|---|---|---|---|
| Supply voltage | $V_{CC}$ | 2.0~5.5 | V |
| Input voltage | $V_{IN}$ | 0~5.5 | V |
| Output voltage | $V_{OUT}$ | 0~$V_{CC}$ | V |
| Operating temperature | $T_{opr}$ | −40~85 | °C |

## Electrical Characteristics

### DC Characteristics

| Characteristics | Symbol | Test Condition | | $V_{CC}$ (V) | Ta = 25°C Min | Ta = 25°C Typ. | Ta = 25°C Max | Ta = −40~85°C Min | Ta = −40~85°C Max | Unit |
|---|---|---|---|---|---|---|---|---|---|---|
| High-level input voltage | $V_{IH}$ | — | | 2.0 | 1.70 | — | — | 1.70 | — | V |
| | | | | 3.0~5.5 | $V_{CC}$ × 0.8 | — | — | $V_{CC}$ × 0.8 | — | |
| Low-level input voltage | $V_{IL}$ | — | | 2.0 | — | — | 0.30 | — | 0.30 | V |
| | | | | 3.0~5.5 | — | — | $V_{CC}$ × 0.2 | — | $V_{CC}$ × 0.2 | |
| High-level output voltage | $V_{OH}$ | $V_{IN}$ = $V_{IL}$ | $I_{OH}$ = −50 μA | 2.0 | 1.8 | 2.0 | — | 1.8 | — | V |
| | | | | 3.0 | 2.7 | 3.0 | — | 2.7 | — | |
| | | | | 4.5 | 4.0 | 4.5 | — | 4.0 | — | |
| | | $V_{IN}$ =GND | $I_{OH}$ = −4 mA | 3.0 | 2.58 | — | — | 2.48 | — | |
| | | | $I_{OH}$ = −8 mA | 4.5 | 3.94 | — | — | 3.80 | — | |
| Low-level output voltage | $V_{OL}$ | $V_{IN}$ = $V_{IH}$ | $I_{OL}$ = 50 μA | 2.0 | — | 0.0 | 0.2 | — | 0.2 | V |
| | | | | 3.0 | — | 0.0 | 0.3 | — | 0.3 | |
| | | | | 4.5 | — | 0.0 | 0.5 | — | 0.5 | |
| | | $V_{IN}$ =$V_{CC}$ | $I_{OL}$ = 4 mA | 3.0 | — | — | 0.36 | — | 0.44 | |
| | | | $I_{OL}$ = 8 mA | 4.5 | — | — | 0.36 | — | 0.44 | |
| Input leakage current | $I_{IN}$ | $V_{IN}$ = 5.5 V or GND | | 0~5.5 | — | — | ±0.1 | — | ±1.0 | μA |
| Quiescent supply current | $I_{CC}$ | $V_{IN}$ = $V_{CC}$ or GND | | 5.5 | — | — | 2.0 | — | 20.0 | μA |

**AC Characteristics (Input: $t_r = t_f = 3$ ns)**

| Characteristics | Symbol | Test Circuit | Test Condition | | | Ta = 25°C | | | Ta = −40~85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $V_{CC}$ (V) | $C_L$ (pF) | Min | Typ. | Max | Min | Max | |
| Propagation delay time | $t_{pLH}$ $t_{pHL}$ | — | — | 3.3 ± 0.3 | 15 | — | 5.0 | 8.9 | 1.0 | 10.5 | ns |
| | | | | | 50 | — | 7.5 | 11.4 | 1.0 | 13.0 | |
| | | | | 5.0 ± 0.5 | 15 | — | 3.5 | 5.5 | 1.0 | 6.5 | |
| | | | | | 50 | — | 5.0 | 7.0 | 1.0 | 8.0 | |
| Input capacitance | $C_{IN}$ | — | — | | | — | 5 | 10 | — | 10 | pF |
| Power dissipation capacitance | $C_{PD}$ | — | (Note) | | | — | 6 | — | — | — | pF |

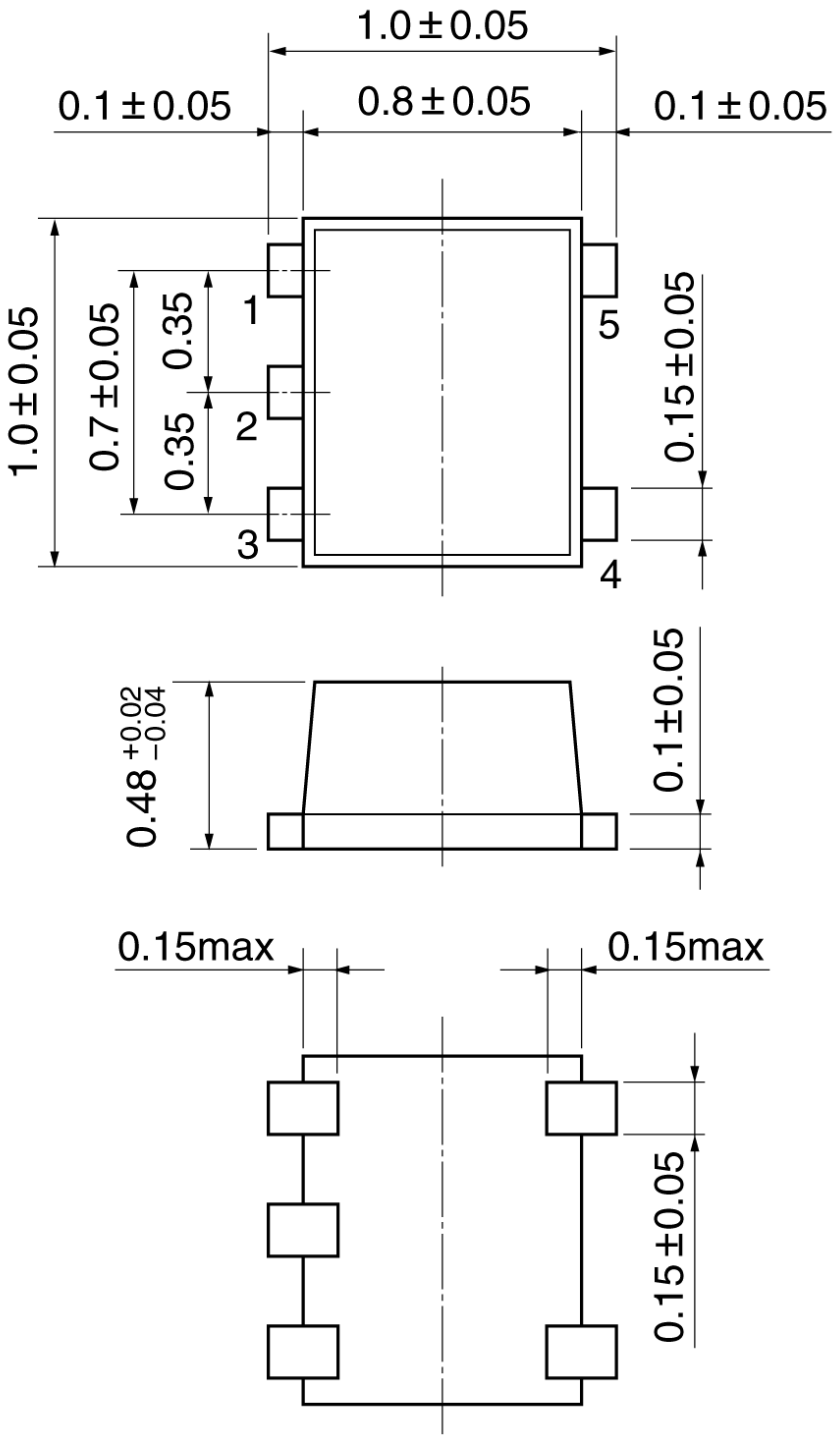
Note: $C_{PD}$ is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

## Package Dimensions

**SON5-P-0.35** **Unit:mm**




Weight: 0.001 g (typ.)

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20070701-EN GENERAL

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