

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74HCU04AP, TC74HCU04AF, TC74HCU04AFT

### Hex Inverter

The TC74HCU04A is a high speed CMOS INVERTER fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

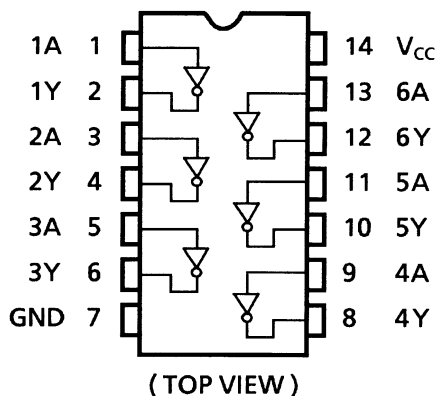
Since the internal circuit is composed of a single stage inverter, it can be used in analog applications such as crystal oscillators.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

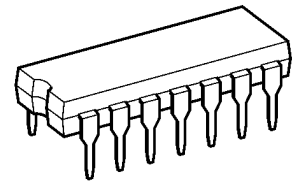
### Features

- High speed:  $t_{pd} = 4 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 1 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIH} = 10\% V_{CC} \text{ (min)}$
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 4 \text{ mA (min)}$
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS04

### Pin Assignment

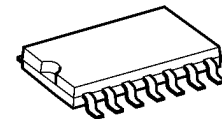


TC74HCU04AP



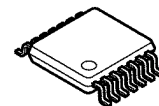
DIP14-P-300-2.54

TC74HCU04AF



SOP14-P-300-1.27A

TC74HCU04AFT



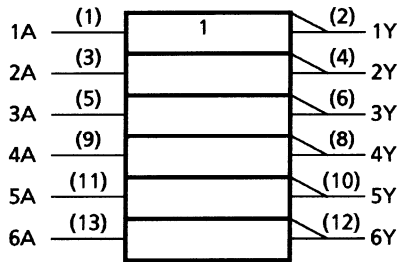
TSSOP14-P-0044-0.65A

### Weight

|                      |                 |
|----------------------|-----------------|
| DIP14-P-300-2.54     | : 0.96 g (typ.) |
| SOP14-P-300-1.27A    | : 0.18 g (typ.) |
| TSSOP14-P-0044-0.65A | : 0.06 g (typ.) |

Start of commercial production  
1986-10

## IEC Logic Symbol



## Truth Table

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

## Absolute Maximum Ratings (Note 1)

| Characteristics             | Symbol    | Rating                             | Unit |
|-----------------------------|-----------|------------------------------------|------|
| Supply voltage range        | $V_{CC}$  | -0.5 to 7                          | V    |
| DC input voltage            | $V_{IN}$  | -0.5 to $V_{CC} + 0.5$             | V    |
| DC output voltage           | $V_{OUT}$ | -0.5 to $V_{CC} + 0.5$             | V    |
| Input diode current         | $I_{IK}$  | $\pm 20$                           | mA   |
| Output diode current        | $I_{OK}$  | $\pm 20$                           | mA   |
| DC output current           | $I_{OUT}$ | $\pm 25$                           | mA   |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 50$                           | mA   |
| Power dissipation           | $P_D$     | 500 (DIP) (Note 2)/180 (SOP/TSSOP) | mW   |
| Storage temperature         | $T_{stg}$ | -65 to 150                         | °C   |

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

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 2: 500 mW in the range of  $T_a = -40$  to  $65^\circ\text{C}$ . From  $T_a = 65$  to  $85^\circ\text{C}$  a derating factor of  $-10 \text{ mW}/^\circ\text{C}$  shall be applied until 300 mW.

## Operating Ranges (Note)

| Characteristics       | Symbol    | Rating        | Unit |
|-----------------------|-----------|---------------|------|
| Supply voltage        | $V_{CC}$  | 2 to 6        | V    |
| Input voltage         | $V_{IN}$  | 0 to $V_{CC}$ | V    |
| Output voltage        | $V_{OUT}$ | 0 to $V_{CC}$ | V    |
| Operating temperature | $T_{opr}$ | -40 to 85     | °C   |

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

## DC Characteristics

| Characteristics           | Symbol          | Test Condition                           |                                                      | Ta = 25°C           |                   |             | Ta =<br>−40 to 85°C |                   | Unit              |     |
|---------------------------|-----------------|------------------------------------------|------------------------------------------------------|---------------------|-------------------|-------------|---------------------|-------------------|-------------------|-----|
|                           |                 |                                          |                                                      | V <sub>CC</sub> (V) | Min               | Typ.        | Max                 | Min               |                   | Max |
| High-level input voltage  | V <sub>IH</sub> | —                                        |                                                      | 2.0<br>4.5<br>6.0   | 1.7<br>3.6<br>4.8 | —<br>—<br>— | —<br>—<br>—         | 1.7<br>3.6<br>4.8 | —<br>—<br>—       | V   |
| Low-level input voltage   | V <sub>IL</sub> | —                                        |                                                      | 2.0<br>4.5<br>6.0   | —<br>—<br>—       | —<br>—<br>— | 0.3<br>0.9<br>1.2   | —<br>—<br>—       | 0.3<br>0.9<br>1.2 | V   |
| High-level output voltage | V <sub>OH</sub> | V <sub>IN</sub> = V <sub>IL</sub>        | I <sub>OH</sub> = −20 μA                             | 2.0                 | 1.8               | 2.0         | —                   | 1.9               | —                 | V   |
|                           |                 |                                          |                                                      | 4.5                 | 4.0               | 4.5         | —                   | 4.0               | —                 |     |
|                           |                 |                                          |                                                      | 6.0                 | 5.5               | 5.9         | —                   | 5.5               | —                 |     |
|                           |                 | V <sub>IN</sub> = GND                    | I <sub>OH</sub> = −4 mA<br>I <sub>OH</sub> = −5.2 mA | 4.5                 | 4.18              | 4.31        | —                   | 4.13              | —                 |     |
| 6.0                       | 5.68            |                                          |                                                      | 5.80                | —                 | 5.63        | —                   |                   |                   |     |
| Low-level output voltage  | V <sub>OL</sub> | V <sub>IN</sub> = V <sub>IH</sub>        | I <sub>OL</sub> = 20 μA                              | 2.0                 | —                 | 0.0         | 0.2                 | —                 | 0.2               | V   |
|                           |                 |                                          |                                                      | 4.5                 | —                 | 0.0         | 0.5                 | —                 | 0.5               |     |
|                           |                 |                                          |                                                      | 6.0                 | —                 | 0.1         | 0.5                 | —                 | 0.5               |     |
|                           |                 | V <sub>IN</sub> = V <sub>CC</sub>        | I <sub>OL</sub> = 4 mA<br>I <sub>OL</sub> = 5.2 mA   | 4.5                 | —                 | 0.17        | 0.26                | —                 | 0.33              |     |
| 6.0                       | —               |                                          |                                                      | 0.18                | 0.26              | —           | 0.33                |                   |                   |     |
| Input leakage current     | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND |                                                      | 6.0                 | —                 | —           | ±0.1                | —                 | ±1.0              | μA  |
| Quiescent supply current  | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND |                                                      | 6.0                 | —                 | —           | 1.0                 | —                 | 10.0              | μA  |

AC Characteristics (C<sub>L</sub> = 15 pF, V<sub>CC</sub> = 5 V, Ta = 25°C, input: t<sub>r</sub> = t<sub>f</sub> = 6 ns)

| Characteristics        | Symbol           | Test Condition | Min | Typ. | Max | Unit |
|------------------------|------------------|----------------|-----|------|-----|------|
| Output transition time | t <sub>TLH</sub> | —              | —   | 4    | 8   | ns   |
|                        | t <sub>THL</sub> |                |     |      |     |      |
| Propagation delay time | t <sub>pLH</sub> | —              | —   | 4    | 8   | ns   |
|                        | t <sub>pHL</sub> |                |     |      |     |      |

## AC Characteristics ( $C_L = 50 \text{ pF}$ , input: $t_r = t_f = 6 \text{ ns}$ )

| Characteristics               | Symbol                               | Test Condition | Ta = 25°C           |     |      | Ta = -40 to 85°C |     | Unit |
|-------------------------------|--------------------------------------|----------------|---------------------|-----|------|------------------|-----|------|
|                               |                                      |                | V <sub>CC</sub> (V) | Min | Typ. | Max              | Min | Max  |
| Output transition time        | t <sub>TLH</sub><br>t <sub>THL</sub> | —              | 2.0                 | —   | 30   | 75               | —   | 95   |
|                               |                                      |                | 4.5                 | —   | 8    | 15               | —   | 19   |
|                               |                                      |                | 6.0                 | —   | 7    | 13               | —   | 16   |
| Propagation delay time        | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 2.0                 | —   | 18   | 60               | —   | 75   |
|                               |                                      |                | 4.5                 | —   | 6    | 12               | —   | 15   |
|                               |                                      |                | 6.0                 | —   | 5    | 10               | —   | 13   |
| Input capacitance             | C <sub>IN</sub>                      | —              | —                   | —   | 9    | 15               | —   | 15   |
| Power dissipation capacitance | C <sub>PD</sub><br>(Note)            | —              | —                   | —   | 13   | —                | —   | —    |

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.

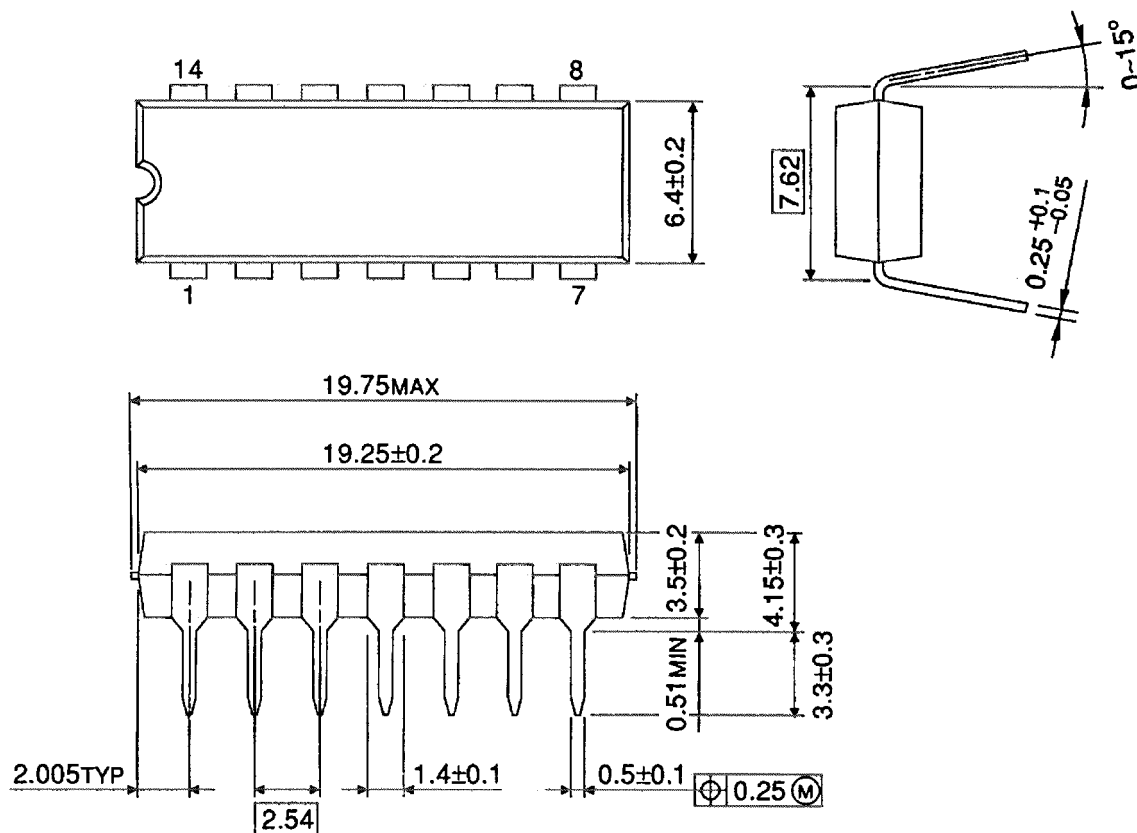
Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/6 \text{ (per gate)}$$

## Package Dimensions

DIP14-P-300-2.54

Unit : mm

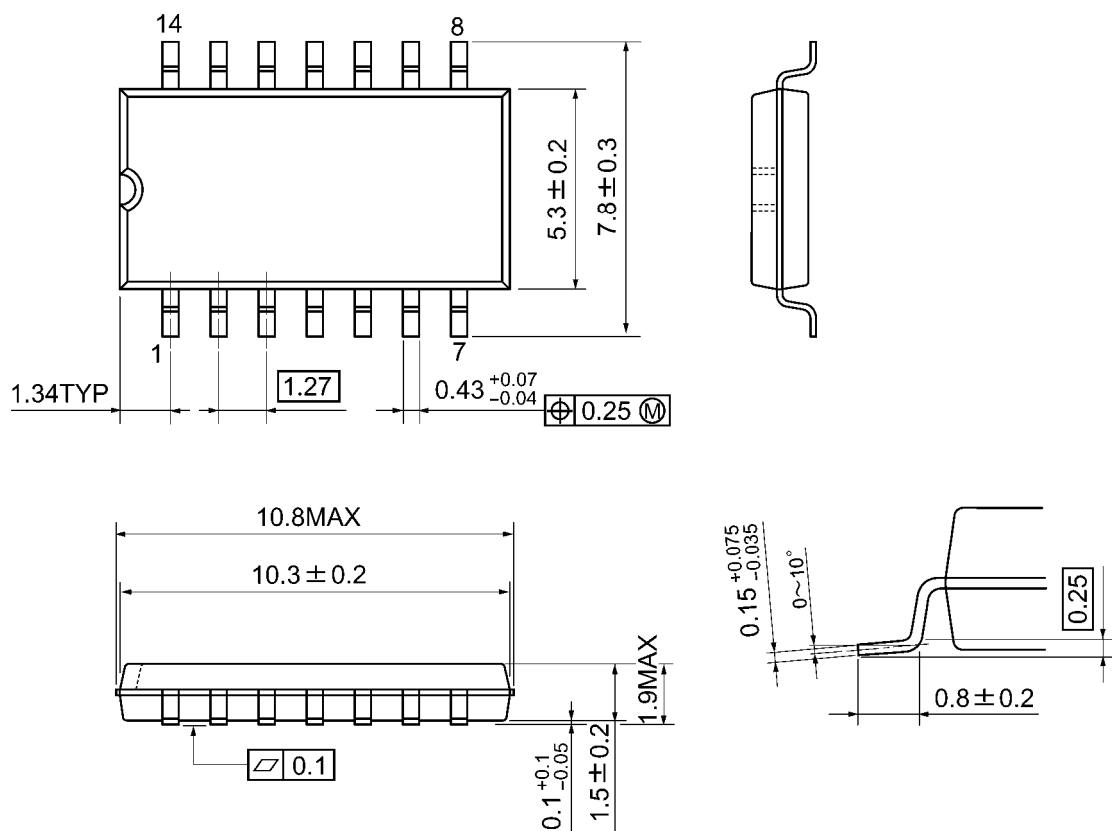


Weight: 0.96 g (typ.)

## Package Dimensions

SOP14-P-300-1.27A

Unit: mm

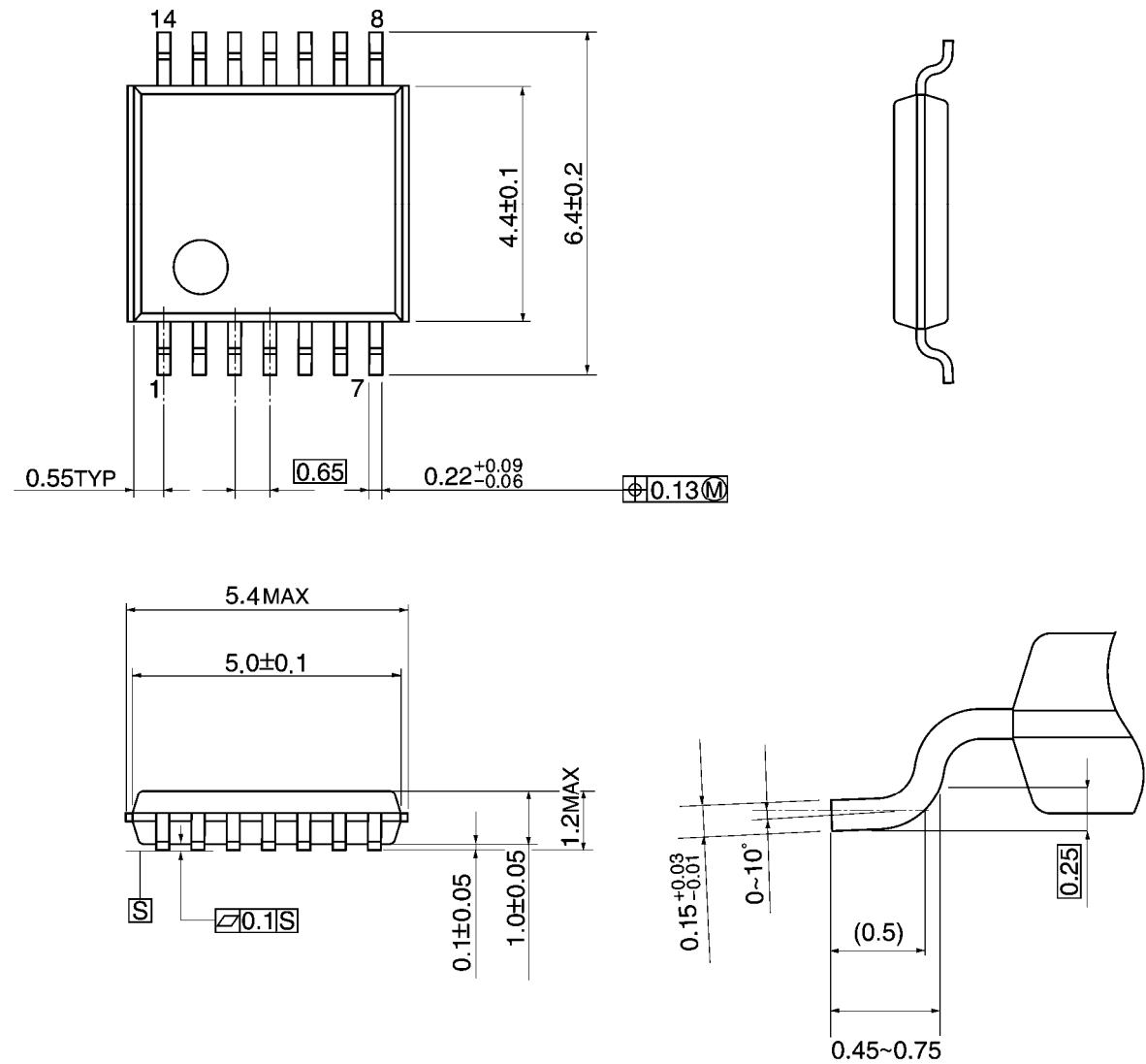


Weight: 0.18 g (typ.)

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

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